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Indigenous Resilience and Indigenous Knowledge Systems in the context of Climate Change

Edited by

Huei-Min Tsai, Yih-Ren Lin and Mucahid Mustafa Bayrak

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About the Editors

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Editorial

Indigenous Resilience to Disasters in Taiwan and Beyond

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1. Introduction

The world is undergoing rapid environmental change. Different perspectives must be used to understand change and to respond to environmental disasters brought about by climate change and other driving forces. Many national and international agencies have been exploring the use of Indigenous and local knowledge as a source of resilience and adaptation in the face of rapid change. This Special Issue is a follow-up to a conference organized in Taipei in December 2019 to explore two interrelated themes: “Climate Change and Food Security: Indigenous Knowledge-based Responses and Actions” and “Climate Change and Post-Disaster Resilience in Indigenous Communities—10 Years after Typhoon Morakot”. This Special Issue includes selected papers from the Taipei December 2019 conference and contributed papers.

The overall goals of the Special Issue are to (1) discuss the international experience with Indigenous resilience and knowledge systems; (2) bring together what is known about Indigenous and local knowledge for adaptation to climate change and for disaster management, as relevant to Taiwan; and (3) generate a conversation among scholars, Indigenous peoples, and policy-making agencies to move the agenda forward.

This introductory paper starts with two sections on basic concepts and the logic behind them—the state of the art in the international literature. The next section discusses why Taiwan poses unique and interesting problems, and what special issues Taiwan is concerned with. The following section is a review of existing scholarship in Taiwan about these issues and gaps in knowledge. Taiwan is very experienced in disaster risk reduction, disaster management, and post-disaster recovery and re-settlement. Other areas, such as Indigenous resilience (the ways in which cultural factors such as knowledge and learning, along with the broader political ecology, determine how local and Indigenous people understand, deal with and adapt to environmental change), remain to be developed. The penultimate section deals with the policy implications of these findings and the way ahead. Specifically, we discuss the prospects toward adaptive governance using Indigenous knowledge and resilience. The final section introduces the papers in the Special Issue.

2. Climate Change, Disaster Risk Reduction, Indigenous Resilience

Recent discussions of climate change assume that there is a need for adaptation. This was not so until fairly recently. Under the 1992 UN Framework Convention on Climate Change and the 1997 Kyoto Protocol, the policy focus on climate change was mitigation, with the idea that climate change could be reduced in severity by such measures as reducing greenhouse gases. Adaptation was not widely discussed, and considered an undesirable policy focus in that it might undermine mitigation. Only after about 2010, after it became



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clear that mitigation was not working, and the Kyoto Protocol formally expired in 2012, the concept of adaptation came into the foreground.

Thus, we are past the point of preventing climate change, so it is time to adapt. This requires being ready to respond to events that occur occasionally and unpredictably, such as typhoons. Unpredictable events, by their very nature, pose a difficult problem for governance. Some measures are possible, such as earthquake-proof building codes. However, it cannot be known beforehand when and where a typhoon might strike or its magnitude. Therefore, it is nearly impossible to typhoon-proof an entire island such as Taiwan.

We are in an unusual new era in which human activities have started to cause major changes in the earth's ecosystems and biogeochemical cycles—we are in the Anthropocene [1]. According to the last two IPCC reports, climate change very likely means a statistical increase in the frequency and strength of typhoons in the Pacific and hurricanes in the Atlantic [2]. However, typhoons are not the only consequence of climate change, and climate change is not the only kind of global environmental change. Rapid global environmental change requires governance for disaster risk reduction (DRR), and new and creative responses to maintain flexible policy options in the face of unpredictable disaster events.

With more frequent and more intense disasters, DRR evolved as an approach generally adopted by disaster risk management professionals to make “our communities safer and more resilient to disasters” (p. 1) [3]. DRR is generally aimed at identifying, assessing and reducing the causal and/or underlying risk factors of environmental disasters [4]. Indigenous communities hold a unique position in DRR discourse in that they are often thought to be more vulnerable than non-Indigenous groups. Yet they also hold local and traditional knowledge that enables an understanding of hazards and disasters, and confers adaptive capacity [5,6].

To explore what we can learn from local and traditional knowledge, we discuss the concept of resilience and its significance for environmental change in the context of risks and hazards. Resilience is the ability to deal with change successfully [7]. Since 2010 or so, resilience has become a central concept in sustainability science because it is probably the most commonly used theory of change in social-ecological systems, that is, the integrated system of people and environment considered together. Resilience may be formally defined as the “capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity and feedbacks” [8]. It is the capacity of a system (such as a community together with the land and resources on which it depends) to deal with disturbances, such as floods and typhoons, so as to retain its essential structures and functions. Resilient systems have the ability to absorb shocks and stresses, to self-organize, and to learn and adapt.

A resilient social-ecological system may have a high diversity of landscapes, native species, and crop species and varieties, as well as a diversity of economic opportunities and livelihood options for its inhabitants [9]. The knowledge and understanding behind such diversity and options provide a built-in ability to buffer change and/or to adapt to change [10]. Peoples' knowledge of their environment is an important consideration in buffering or adapting to change. For example, Indigenous knowledge can supplement science by providing grounded information and understanding of the actual impacts of climate change and adaptation possibilities [11].

Resilience is important for dealing with disaster-shocks for three reasons. First, resilience as a theory or organizing framework is interdisciplinary and avoids the artificial disciplinary divide between the study of people and the study of the biophysical environment. It helps evaluate hazards holistically when the integrated social-ecological system is used as the unit of analysis. For example, if a typhoon results in a landslide in an area used by an Indigenous community, the unit of analysis is the Indigenous community together with its land and resource base, including the area that has suffered the landslide. It is not only the people in the community, nor is it only the land.

Second, resilience puts the emphasis on the ability of the system to deal with a disaster-shock. There are multiple ways in which a response may occur. A relatively small disturbance typically triggers short-term or coping responses. However, if the coping capacity is exceeded, then there are incremental changes—an adaptive response. If both coping and adapting capacities are exceeded, the response is no longer incremental but transformative, such as in a resettlement situation following a typhoon. The system no longer retains its identity; in this case, it has been transformed from a rural to an urban social-ecological system. Absorptive capacity, adaptive capacity, and transformative capacity may be considered as the three components of social-ecological resilience [7].

Third, resilience is forward-looking and helps explore policy options for dealing with uncertainty and change. Because it deals with the dynamics of response, resilience helps explore policy options for dealing with future uncertainty and change. Resilience-building is an effective way to deal with social-ecological change characterized by future surprises and unknowable risks. It can be accomplished by actively developing and engaging the capacity to deal with change, for example, by improving social learning from past disaster-shocks and looking for “windows of opportunity” to affect policy change [9]. Resilience provides a way for thinking about policies for the future, an important consideration in a world characterized by rapid change.

The concept of resilience to disasters takes on special importance in an era of rapid change. One of the ideas explored in the Taipei December 2019 conference was the promising approach of building resilience based on Indigenous and local knowledge [12]. However, much of the IPCC literature makes little mention of Indigenous peoples, much less Indigenous knowledge. Salick and Ross [13] commented that the IPCC [14] treated Indigenous peoples only as helpless victims of environmental change that is beyond their control. This view of Indigenous peoples as passive victims is not consistent with the experience. For example, in the Canadian Arctic, the Inuit were adapting to climate change as early as the late 1990s [15]. Much has been documented since then throughout the world on local responses to climate change [11]. However, Indigenous and local knowledge seem to be still undervalued and largely unrecognized by the IPCC [16].

What is the source of Indigenous resilience, and how do Indigenous peoples do it? It is largely a question of survival. Left to their own devices, Indigenous and local rural peoples have developed the knowledge and experience to deal with disaster-shocks. We use this term to refer to unexpected and catastrophic impacts stemming from nature-triggered extreme environmental events, such as earthquakes, typhoons, hurricanes, cyclones, and floods. Disaster-shocks are typically extreme events that surpass the usual technological, socioeconomic and cultural thresholds [17,18]. Typically, they are events that oral cultures are well equipped to remember.

Thus, the use of social memory is one of the ways in which Indigenous peoples deal with these disaster-shocks. Indigenous and local rural peoples retain a memory of once-in-a-generation events and often develop protocols to deal with them. Some of these protocols were described as early as the 1930s in some Pacific islands by the anthropologist Raymond Firth [19]. Thus, a major mechanism to develop local responses to disasters seems to be social learning: the deliberation of individuals and groups to share experiences for collaborative problem-solving [20,21].

Building resilience based on Indigenous knowledge, social memory and social learning is still only a part of the story. Ford et al. [6] reviewed Indigenous resilience to environmental change, and emphasized the importance of the interconnected roles of place, agency, institutions, and collective action, in addition to Indigenous knowledge and learning. In this Special Issue, we explore Indigenous resilience: the ways in which local and cultural factors, along with the broader political ecology, determine how Indigenous people understand, cope with and adapt to climate change related events and other disaster-shocks.

3. Learning from Indigenous and Local Knowledge

After discussing disaster risk reduction, resilience and specifically Indigenous resilience, we focus on one of the major factors: how local and Indigenous knowledge can help build resilience. Indigenous knowledge is not only important for its own sake; it can also lead to mutual learning involving Indigenous peoples, researchers, and policy-makers. Such social learning involves networks of actors, including Indigenous knowledge-holders, and can facilitate adaptive governance to deal with rapid environmental change. This is a subject we return to in the next-to-last section of this paper.

Traditional ecological knowledge (TEK) has been defined as “a cumulative body of knowledge, practice and belief, evolving by adaptive processes, and handed down through generations by cultural transmission” [22]. The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) uses the same definition but calls it Indigenous and local knowledge (ILK) [23]. Indigenous knowledge (IK) may be more broadly defined as local knowledge held by Indigenous peoples or local knowledge unique to a given culture or society. These terms (TEK, ILK, IK) are often used interchangeably. Local knowledge usually refers to knowledge that is rooted in place but not time-tested through multiple generations [22].

Indigenous knowledge is time-tested wisdom. It is important for the knowledge-holders themselves and their communities, for cultural, educational, economic, and political reasons. However, it is also important as a part of the common heritage of humankind. Here, we discuss it in terms of dealing with hazards and disaster-shocks, but it has been used for a wide variety of purposes from conservation to development planning (Table 1). Indigenous and local knowledge can help build resilience in three ways: increasing the range of available knowledge; providing the basis for adaptations; and enabling social learning.

Table 1. Practical significance of Indigenous and local knowledge (traditional ecological knowledge (TEK)/Indigenous and local knowledge (ILK)/Indigenous knowledge (IK)) as common heritage of humankind. More details in Berkes [22].

-
- It is an important source of biological, pharmacological or medical knowledge
 - It is an important source of ecological insights, for example, on species interactions and ecosystem dynamics
 - It can inform natural resource management strategies
 - It can be important for networks of protected areas by contributing community-conserved areas, such as sacred sites
 - It provides scale-specific understandings (local knowledge) for biodiversity conservation
 - It can be a source of input, including knowledge, preferences and values, for development planning
 - It can be used in environmental monitoring and assessment
 - It can inform climate change adaptation
 - It is important for dealing with hazards and disaster-shocks
 - It has been a source of wisdom that informs environmental ethics
-

First, Indigenous knowledge increases the range of knowledge available to solve problems. It is important for Indigenous and local peoples themselves, but it is also important to help address global problems. Many of these global issues require the use of different perspectives to understand the full range of their impacts, as in the case of climate change [11]. Indigenous knowledge is important for the co-production of knowledge, defined as the collaborative process of bringing a plurality of knowledge sources and types together to address a problem [24].

The multiple evidence base approach [25] brings together natural science, social science, transdisciplinary science, local knowledge, and Indigenous knowledge. The approach creates the potential for co-producing knowledge, enriching knowledge for insights and

for better understanding, and bridging knowledge systems to make links between multiple epistemologies. This approach has been used by IPBES [23] among others.

Second, Indigenous knowledge is a source of adaptive capacity, as it has the potential to provide the raw material for adaptations in the face of environmental change. Peoples' knowledge and practices are the basis for adaptations, and adaptive capacity is part of resilience. Knowledge provides options and flexibility for dealing with change. For example, the 9000 ha Potato Park in Peru holds some 1300 varieties and cultivars, and helps conserve crop genetic diversity for the world. It is a Biocultural Heritage site, located at the center of origin and diversity of potato in the Andean highlands. It is administered and managed by the local Quechua Indigenous people. The amazing diversity of varieties, adapted to different environmental variables in diverse habitats, is crucial as a source of genes needed for global food security in the face of climate change (summarized in Berkes [26]).

Another example comes from the Bolivian Andes, where Indigenous knowledge helps understand climate variability and change. Indigenous people maintain age-old adaptations for unpredictable environmental change. For example, they cultivate crops in discontinuous plots at different altitudes and different faces (aspects) of slopes. They diversify their holdings so that at least some of the fields produce successfully in a given year. Indigenous peoples note local and regional variations in climate change effects: violent rains, erosion and hail damage to crops in the highlands, but drought and unpredictable rain in the valleys. These differences in the local spatial scale do not show up in scientific climate change models [27].

Third, Indigenous knowledge can help build resilience, not only for Indigenous communities but society as a whole, when collaborative networks include researchers and policy-makers. For example, in Canada, regional and national policies have benefited from Indigenous knowledge and experience in two areas of environmental change: Arctic ecosystem contamination and climate change impacts and adaptations [28]. The co-production of knowledge and collaboration through mechanisms such as natural resource co-management lead to mutual learning at multiple levels of governance from local to national. The beginnings of co-management in Taiwan between the government and some Indigenous groups with regard to wildlife and forest management are very important in this regard.

Collaborative networks facilitate social learning, and social learning is key to learning-by-doing, also known as adaptive management and, more broadly, as adaptive governance. Many countries have typically practiced top-down management, with no history of user participation and community–government collaboration. In such cases, collaborative networks may take years before they become functional. Joint problem-solving and learning-as-participation are good ways to start collaboration to build trust among the parties.

Indigenous knowledge is essential for monitoring disaster-shocks and understanding environmental change because it provides on-the-ground information. However, Indigenous knowledge has to be used with caution because it has a cultural context—it is a body of knowledge, practice and belief. This is one of the reasons why scientists and governments sometimes dismiss Indigenous knowledge. Another reason is the politics of knowledge: there will always be power differences between Indigenous knowledge and government science. The key to knowledge co-production is to respect the integrity of each way of knowing, and in particular, not using Indigenous knowledge outside its cultural context. Knowledge systems can be used in parallel and can be “bridged” [25,29]. That is, they can be used together respectfully without mixing them or trying to test one against the other.

To summarize, lessons from the international literature indicate that Indigenous knowledge is useful in understanding environmental change. For example, local knowledge shows fine-scale differences in climate change impacts (e.g., valleys vs. highlands in Bolivia), whereas global and regional climate change models are simply too coarse to show this. Indigenous knowledge and local practice often indicate existing adaptations to

climate variability, and potential new adaptations made possible by experimentation and adaptation. In both the Peru and Bolivia examples, local knowledge drives adaptations that keep options open, hence providing resilience. These cases are not unique. Savo et al. [11] discovered and reviewed 1017 studies of local observations of climate change impacts and adaptations throughout the world. The surprisingly large number of cases indicates that local observations and knowledge are now part of the international effort to understand and deal with environmental change.

4. Taiwan: Unique Lessons and Considerations

Taiwan is a unique environment in which to explore Indigenous resilience to disasters. Consisting of the main island and some 121 others, Taiwan is a democratic regime in East Asia, rich in both biological and cultural diversity [30,31]. Taiwan's topography enables an unusual diversity of ecosystems from mountain tops to the seashore. Only 142 km wide, the main island contains over 200 peaks over 3000 m, the highest reaching nearly 4000 m. Set along the "Ring of Fire" and marking the border between two tectonic plates, Taiwan is often plagued by quakes and landslides.

Due to its location in the Pacific Rim and its mountainous topography, Taiwan is increasingly affected by typhoons and related disasters, such as floods, landslides and debris flows. High and steep mountains are erosion-prone; rivers can turn into torrents running the short distance from the upper slopes to the sea. That makes mountain communities and infrastructure such as roads difficult to maintain. The rapid flow of water from the mountains is hard to control, and necessitates building reservoirs to meet water needs.

Taiwan has a complex colonial history. Since the 17th century, the Spanish, Dutch, Chinese, Japanese and others have come to trade with or colonize Taiwan. The multiple colonial history has meant ever-changing governing policies of the colonists impacting the population and the environment in various ways. To put this into the framework of nature–culture interactions, Taiwan is relatively small but very complex. One spectacular advantage of this is that one can visit very different social-ecological systems on a one-day trip!

Taiwan and its offshore islands are home to 16 officially recognized Indigenous groups ("yuan-chu-min-zu"; 原住民族) as well as other local or unofficially recognized groups (Figure 1). Taiwan is a settler society like the United States, Canada and Australia. The Indigenous peoples are Austronesian in general, and they were living on Taiwan long before the mass immigration of Han Chinese from southern China began in the 17th century. The plains and fertile lands have been occupied by the Han Chinese. In the process of modernization, most of the plains area has become urbanized. Indigenous communities occupy the mountainous interior and the rugged eastern coast. Indigenous peoples in Taiwan accounted for 573,086 people in 2020 (2.4% of the island's total population), of whom 287,789 lived in Indigenous tribal communities [32].

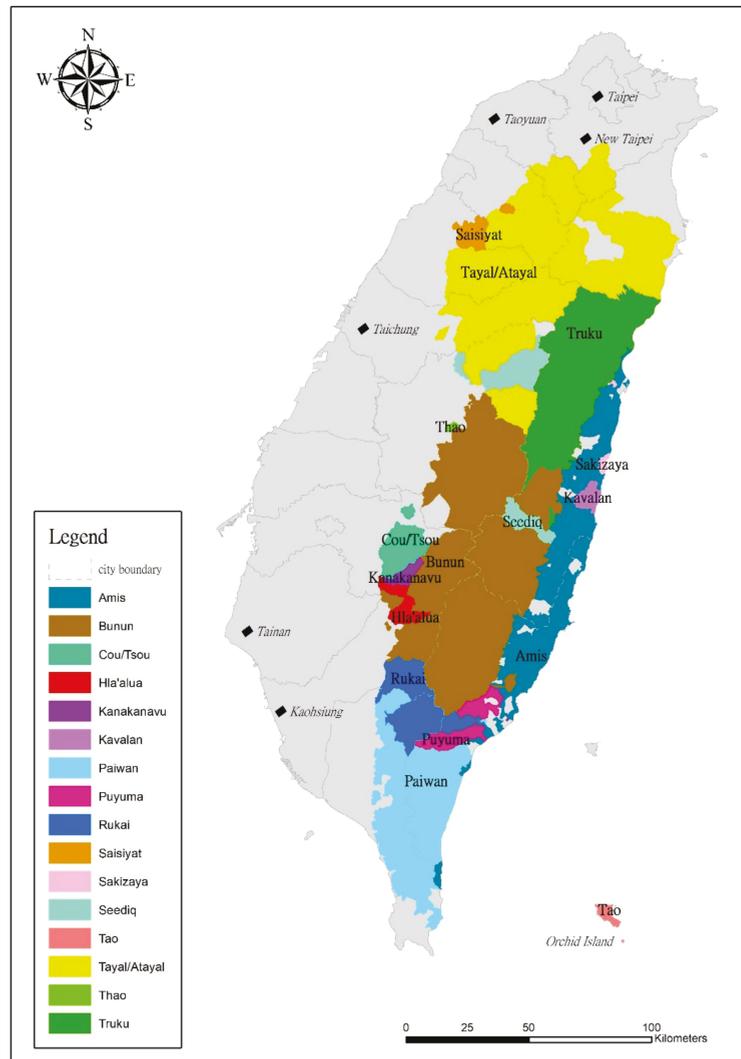


Figure 1. Map of Indigenous territories in Taiwan (prepared by Hsu, Y.Y. and Bayrak, M.M., National Taiwan Normal University, based on Dept. of Household Registration [33]).

The 16 official Indigenous groups all have their distinctive languages and cultures. The land and biodiversity of Taiwan are understood and used in the traditional ways of these groups, such as through naming, material practices, social institutions and worldviews. Assuming that each tribe has a unique understanding of Taiwan's biodiversity, Taiwan has at least 16 different sets of biodiversity through the lens of its Indigenous languages. This constitutes a very rich treasure of biocultural diversity, not just biological diversity or cultural diversity per se [26,34]. The most diverse and rich ecosystems of the island are maintained as national reserves, many of them home to Indigenous peoples who have knowledge and understandings of these areas better than others. Indigenous cultures have wisdom accumulated from interacting with their lands and changing environments. However, at the same time, Indigenous peoples have been treated as a threat to national

reserves and biodiversity. These are important issues for resilience studies, and Taiwan has a lot to offer.

Partly due to geography, but also due to colonial legacy and political economy, Taiwan's Indigenous peoples are disproportionately affected by climate change and other disasters. Bayrak et al. (in this Special Issue) found that of all recorded instances of extreme climate-related events between 2006 and 2020 (which are related to, but not necessarily caused, by climate change), 43% occurred or directly impacted Indigenous communities [35]. Typhoon Morakot in 2009 had perhaps the most profound impact on Indigenous and rural communities in Taiwan in recent history. Typhoon Morakot caused 699 deaths, destroyed 1766 houses and displaced 4500 residents [36]. The responses from the government, civil society organizations and Indigenous communities themselves during and after Morakot included disaster relief, resettlement, and recovery, and became a focus of studies after 2009 [37].

Politically, Taiwan's Indigenous peoples have been gaining political legitimacy, recognition, and the ability to revive their customs and languages. However, centuries of colonization, assimilation, and modernization have left deep and profoundly negative impacts. There are many land use and nature conservation-related conflicts between Indigenous peoples and government agencies, private stakeholders, and even among Indigenous communities themselves [38–42].

The recognition of Indigenous knowledge and the consideration of Indigenous resilience in Taiwan are closely intertwined with democratization processes in this young and independent political regime. Particularly important for Indigenous peoples is the name rectification in the constitutional amendment of 1991. Since then, "yuan-chu-min" (原住民, Indigenous people) has become the formal title to replace "mountain people", or even worse, the discriminatory and offensive title, "fan-jen" (蕃人, barbarian).

Changes have not come easy. Waves of social movements, including those on Indigenous peoples' rights, made a great effort to promote Indigenous peoples and discourses related to their oppressed situation, consistent with international norms. Article 26 (2) of the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) contemplates the rights of Indigenous peoples to own, use, develop and control their lands, territories and resources.

In 2000, another major leap for Indigenous people's rights was achieved through the "New Partnership Policy" adopted by the then new President of Taiwan. The President promised to respect traditional customary law and facilitate the co-management of natural resources and the recognition of land rights [43]. Subsequently, the "Indigenous Basic Law" was enacted in 2005. Indigenous peoples' issues have become significant in the political agenda and in election campaigns. In 2016, the transitional justice issue that closely embodies Taiwan's democratic process appeared on the agenda. This then led to the formal Presidential apology to Indigenous peoples in the same year.

Overall, the role of Indigenous peoples has been promoted in Taiwan's civil society at significant speed since about 1990. The democratization of Taiwan has brought forth Indigenous voices. The social dimension of resilience studies pays particular attention to democratic participation, mutual learning, networking and local knowledge. It seems interesting that the struggle history of Indigenous peoples and decolonizing processes parallel the growth of democratic processes in Taiwan.

In this context, multiple hazards and environmental threats have created new opportunities for society to reorganize disaster management to include Indigenous concerns. This led to a new collaborative learning environment involving science, government, and local community. The new partnerships were made possible through legislative support, institutional transition and multilevel disaster governance [37,44,45], providing the context for making sense of Taiwan's experience with disasters.

5. Dealing with Disaster-Shocks: The Taiwan Experience

Since the devastating effects of Typhoon Herb in 1996, Typhoon Mindulle in 2004 and Typhoon Morakot in 2009, Taiwanese academia assumed a leadership role in disaster management, DRR and post-disaster recovery among Indigenous communities. We arrived at this conclusion after having analyzed 111 peer-reviewed studies on Indigenous peoples, climate change and resilience since Typhoon Morakot (see also Bayrak et al. in this Special Issue). We found that 76 of these (68.5%) have dealt with one of the four stages of disaster management or DRR, ranging from risk perception to post-disaster recovery. Most of these studies were written in the context of Typhoon Morakot (Table 2).

Table 2. Number of publications in Taiwan since 2009 on climate change, resilience, disaster resilience and indigenous peoples, in peer-reviewed publications indexed in Scopus or Airiti Library.

Subject/Purpose	International (Mostly English)	Domestic (Mostly Chinese)	Total
Disaster management	26	50	76
Indigenous culture	17	22	39
Indigenous knowledge and wisdom	11	16	27
Community development	20	6	26
Housing and architecture	5	12	17
Indigenous health	8	7	15
Indigenous tourism	7	4	11
Traditional agriculture	6	2	8
Climate justice	4	4	8
Adaptive governance	4	0	4
Indigenous education	0	1	1

There are many lessons to be learned from Taiwan. The Taiwanese government shifted a significant amount of funding towards research projects on Indigenous peoples and DRR, resulting in a substantial number of studies, encompassing a variety of views and perspectives. For example, Wang et al. [46] employed a community resilience model to discover the drivers of successful post-disaster recovery. These drivers were: effective use and coordination of community resources, private-public sector partnership building, and positive values among community members (such as a sense of mutual help, sharing of social and economic assets, and autonomy). Other studies on Taiwan's post-disaster response [47–49] showed that some cases of DRR have been culturally inappropriate.

For example, after Typhoon Morakot, several historically rival Indigenous groups were resettled in the same villages. Reconstructed villages were often planned without the necessary input from the new residents [47,50]. Additionally, insufficient attention was given to the farming and livelihood practices of the resettled groups. Indigenous households were unable to resell their homes or return to their old farming and hunting grounds [48,50]. Based on these criticisms, Taiban et al. [49] concluded that post-disaster policies for Indigenous communities should be land-based and culturally appropriate in order to enhance community resilience in a post-disaster setting.

Studies on Taiwan have adopted various resilience or vulnerability approaches, such as community resilience [46,49], social and cultural vulnerability [36] and livelihood vulnerability [51]. However, these approaches have not always been embedded in a particular Indigenous context. Power relations are part of that context. One of the more promising approaches in the literature has been procedural vulnerability. Procedural vulnerability arises “from people’s (and peoples’) relationships to power rather than environment, and the ways that power is exercised” (p. 309) [52]. Historical vulnerabilities and power relations have shaped contemporary disaster management among Taiwan’s Indigenous peoples, and therefore also their resilience to environmental change.

Indigenous knowledge and wisdom (including TEK, ILK and IK) has been another important theme or approach in the literature (24%). Some studies have linked knowledge to DRR or climate change adaptation. Examples include studies on traditional farming

methods [53,54], Indigenous ecological knowledge and disaster management [55], and traditional knowledge and risk perceptions [56]. Lin and Chang [57] argue that local knowledge plays a substantive role in disaster risk management. They introduce a new type of knowledge, which they define as involuted disaster knowledge, which integrates Indigenous knowledge with scientific knowledge. Significantly, many studies on Indigenous knowledge and wisdom have been written, either as first author or co-author, by Taiwanese Indigenous peoples themselves (i.e., [54–56,58–60]).

Among the analyzed publications, four studies addressed themes of adaptive governance and management [57,61–63]. Tai developed a framework on adaptive governance aimed to be deliberative, multi-layered, just, networked and participatory [61]. Lin and Chang [57] called for an inclusive form of disaster governance that fits “into local contexts and have the capacity to solve community problems” (p. 8). As Taiwanese Indigenous peoples are actively asserting their political rights to restore their customary territories, new modes of adaptive governance are needed to govern and manage these territories. Studies on adaptive governance in the context of land and resources, as well as in disaster management, are therefore crucial.

Social learning is widely acknowledged in the analyzed studies as being important for strengthening social-ecological resilience, community resilience [46], post-disaster recovery [49], knowledge creation [57], and adaptive governance [61]. A study of Yen and Chen [53] involved a series of workshops, which served as social learning platforms for local Tayal farmers to exchange knowledge on sustainable agriculture and agricultural adaptation. As pointed out by Gerlak et al. [64], many studies, in Taiwan and internationally, lack a clear conceptualization and operationalization of (social) learning. Empirically, it has also not been clear how social learning has shaped Indigenous resilience and adaptive governance in Taiwan.

Typhoon Morakot was a “focusing event”, defined as “a sudden, exceptional experience that, because of how it leads to harm or exposes the prospect for great devastation, is perceived as the impetus for policy change” (p. 983) [65]. The disastrous consequences of Morakot led to policy change, which enabled a substantial amount of government funding to be channeled towards Indigenous community resettlement, post-disaster recovery, academic research, and DRR [36,49]. As the impact of Morakot was disproportionately severe for Taiwan’s Indigenous communities [36], many studies consequently shifted attention to Indigenous-related issues.

While this shift is important, future studies could more explicitly focus on the role of social learning in shaping Indigenous resilience and adaptive governance. This could be carried out at multiple levels from local to national, as well as over time, i.e., longitudinal or ex-post approaches. The scholarship in Taiwan on Indigenous peoples, climate change impacts, and disaster risk reduction is strong. While there is an increasing amount of studies on Indigenous knowledge [55,66–71] and community resilience, more work is warranted on social learning and adaptive governance in the context of environmental change.

6. Towards Adaptive Governance with Indigenous Resilience

Acknowledging the right of Indigenous peoples as self-determining entities that can define their own means of shaping the future, how do we foster Indigenous aspirations for dealing with disasters? This is a question of governance. Indigenous knowledge helps people to understand environmental change and respond to it. It is a major factor in building Indigenous resilience and in facilitating adaptive governance. Although Indigenous knowledge and participation have contributed to the response to disaster-shocks in Taiwan, the concept of Indigenous resilience [6] remains to be developed, as indicated by the literature review in the previous section. The present section deals with the policy implications of these findings and the way ahead. Specifically, we discuss the prospects toward adaptive governance using Indigenous knowledge and learning.

Perhaps the major lesson from the literature is the importance of building capacity for learning and adapting (i.e., the resilience approach) for adaptive governance. Approaching

disaster risk reduction through social learning can build resilience in the face of rapid change and unpredictable events. This, we argue, is a key requirement for disaster preparedness, given the context of global change, uncertainty and the suddenness of most disaster-shocks. Learning-based adaptive governance has a better record in dealing with surprises than conventional management, which embodies assumptions of predictability and controllability [6,12,72].

Dealing with unpredictable events, such as extreme weather events, is a very difficult task for governments. Using Indigenous knowledge to build resilience and adopting a learning approach can help deal with unpredictability. The term adaptive governance captures this flexible, integrated, holistic form of governance. Governance is considered the broader arena in which institutions operate; it is used here as a more inclusive term than management. Adaptive governance is governance that incorporates social learning to improve outcomes in an iterative way; in our case, from one disaster-risk reduction and recovery case to the next [57].

Adaptive governance is a research framework for analyzing social, institutional, economic and ecological aspects of governance for building resilience. It is an outgrowth of the search for modes of managing uncertainty and complexity [73]. Adaptive governance is based on learning-by-doing, and builds on social learning and experience. In contrast to individual learning, social learning is learning at the level of groups, including institutions. Adaptive governance is an ongoing process. As Pahl-Wostl and Hare [74] put it, it “is not a search for the optimal solution to one problem but an ongoing learning and negotiation process where a high priority is given to questions of communication, perspective sharing, and the development of adaptive group strategies for problem solving” (p. 193).

The key to adaptive governance is social learning and the co-production of knowledge: the art of combining different kinds of knowledge to solve problems [24]. Local and Indigenous knowledge can create opportunities for problem-solving through local collective action and self-organization, assisted by government science. Intermediary organizations, such as universities and non-governmental organizations, help perceive and assess disaster-shocks, and respond and adapt to them. Learning-by-doing can be made more effective by (1) co-management, the sharing of power and responsibility for making decisions; (2) participatory research involving local people and scientists/managers working together; and (3) capacity development (capacity-building) to improve the ability to deal with problems.

Co-management is important for setting the stage. Participatory research is effective for social learning and also results in trust-building, especially important in situations in which there is no previous experience of working together. Capacity development helps cooperation and communication, for example, by sharing technical vocabulary and concepts. It also helps to tackle problems at increasingly greater scales, starting with small problems and moving onto larger ones. Essential ingredients of adaptive governance include linkages at multiple levels, allowing two-way communication from local to national. Co-management and participatory research can give rise to problem-solving networks, sometime called learning communities, which are informal groups of people who collaboratively apply their knowledge. These measures have the potential to facilitate knowledge co-production for mutual learning.

To recap, resilience-building, social learning with Indigenous knowledge and science, and adaptive governance are significant for the ability to respond to risks and hazards. They help the ability to respond to climate change impacts and other disaster-shocks. Funding and encouragement of disaster-response studies in Taiwan are extremely important in this regard. Indigenous resilience shows promise to be effective in dealing with unpredictable events. Useful Indigenous knowledge exists, for example, in the area of water management in Taiwan [62]. Intermediary organizations such as universities have an important role to play as partners in bridging different kinds of knowledge; developing capacity; assisting with communication; supporting local institutions; and fostering social learning.

Emphasis on social learning, with ongoing adjustments in governance, makes adaptive governance dynamic. This calls for a willingness to experiment with innovative policies and practice in the face of uncertainty [72]. The active engagement of local people, including Indigenous peoples, through democratic participation is crucially important. Multiple voices are needed to generate innovative practices and governance options [75]. Indigenous resilience, driven and controlled by local communities, and characterized by place-based knowledge, social learning, collective action and empowerment, is an essential part of the way ahead in dealing with disaster-shocks.

7. Introduction to the Papers of the Special Issue

This Special Issue brings together several papers on Taiwan and international case studies on local and Indigenous resilience to environmental change (see Appendix A for the full list of papers). We identify five (overlapping) themes: (1) Indigenous resilience and knowledge systems; (2) Social learning and adaptive governance; (3) DRR and disaster management; (4) International case studies; and (5) Academic and policy dialogues towards a new policy agenda on Indigenous resilience.

In terms of Indigenous resilience and knowledge systems, authors have focused on local marine-area management among coastal Amis communities (Futuru C.L. **Tsai**), seeing Indigenous resilience through a foodscape lens in the face of global climate change among Tayal communities (Yih-Ren **Lin** et al.), and building Indigenous resilience after Typhoon Soudelor (Su-Hsin **Lee** and Yin-Jen **Chen**). Studies in this Special Issue show how Indigenous resilience should be better situated within broader livelihood strategies, social-ecological dynamics, and Indigenous worldviews and knowledge systems. Authors such as Yih-Ren **Lin** et al. and Yayut Yishiuan **Chen** highlight the importance of decolonizing knowledge and Indigenous counter-stories of resilience and sustainability. This would serve to understand how Taiwan's Indigenous peoples cope with, adapt to, and transform negative impacts of climatic and other environmental stressors and shocks. More than "giving voice" to Indigenous people, it is imperative to understand and listen to Indigenous narratives and knowledges towards creating resilient social-ecological systems which can cope with broader social, environmental and climate-related challenges.

The second theme is social learning and adaptive capacity. Futuru C.L. **Tsai**, Yayut Yishiuan **Chen** and Yih-Ren **Lin** et al. show in great detail how Indigenous communities engage in social learning, and how this is linked to community-building, agriculture and food systems, local ecosystem management, traditional institutions, and worldviews and belief systems. Yayut Yishiuan **Chen** understands resilience from Tayal's "ontological understandings of their place in the world" (p. 2), which requires a completely new paradigm and mindset towards Indigenous resilience. The paper by Joyce Hsiu-yen **Yeh** et al. further shows how the transformation and innovation of Indigenous cultural heritage provide Taiwanese Indigenous peoples additional possibilities to create culturally appropriate development interventions, which can help them to cope better with the challenges of contemporary society and environmental change.

Futuru C.L. **Tsai** and Hsing-Sheng **Tai** discuss the adaptive governance of Indigenous communities. Both studies highlight in detail the struggles that communities face with top-down government planning. While participatory governance regimes are starting to emerge (such as community-based natural-resource management), Hsing-Sheng **Tai** concludes that social-ecological resilience in Taiwan has "focused on ecological resilience and the well-being of Han society" (p. 16). If so, this is problematic as there is a growing awareness among many policy-makers and scholars in Taiwan that Indigenous communities are disproportionately affected by typhoons and other disaster shocks (Mucahid Mustafa **Bayrak** et al.) and their needs require attention too.

Regarding the third theme, DRR and disaster management, Mucahid Mustafa **Bayrak** et al. have effectively shown in their bibliometric analysis and literature review that Taiwan has assumed a leadership position in this field. Two papers stand out which deal with this theme: the papers of Pei-Shan Sonia **Lin** and Wei-Cheng **Lin**, and Su-Hsin **Lee** and

Yin-Jen **Chen**. The former focusses on post-disaster recovery among Tsou communities after Typhoon Morakot, whereas the latter highlights the coping strategies during and after typhoon Soudelor among Tayal communities. The cultural dimensions related to how Indigenous peoples cope with climate disasters should play a more prominent position in DRR and post-disaster recovery efforts according to both studies. Pei-Shan Sonia **Lin** and Wei-Cheng **Lin** state: “shared culture positively influences cohesion within an ethnic group, allowing communities affected by disasters to jointly strengthen, preserve, and sustain their identity” (p. 13).

The fourth theme of this Special Issue is related to international cases. The study of Gerard A. **Persoon** and Tessa **Minter** shows how four Indigenous communities in Indonesia and the Philippines have reacted to external development interventions and how climate change impacted their ways of life. This study is particularly valuable as many parallels could be drawn between Taiwan’s Indigenous peoples and the Indigenous peoples of insular Southeast Asia. The papers by Ephias **Mugari** et al. and Muhamad Khoiru **Zaki** et al. both employ quantitative methods. The former identified the underlying drivers influencing Indigenous climate change response in Botswana, whereas the latter focused on how local and Indigenous knowledge systems helped communities cope with changing weather events and droughts in Indonesia. Two additional papers focus on Pacific Island states. Jan **van der Ploeg** et al. include a discourse analysis on the “sinking islands” narrative, and argue that this narrative detracts attention and resources from more urgent environmental and development problems. The paper by Janne **von Seggern** employed a meta-ethnographic approach in order to analyze studies focusing on local and Indigenous climate change adaptation and mitigation strategies in selected South Pacific Island States.

The fifth and last theme is about generating a conversation among scholars, Indigenous peoples, and policy-makers to move the agenda forward. All papers have policy implications, but the two papers by Gregory A. **Cajete** and Richard **Howitt**, both keynote addresses at the December 2019 conference, provide particularly important policy considerations towards a new agenda on Indigenous resilience to environmental change.

Richard **Howitt** argues that Indigenous vulnerability and resilience need to be understood in the messy contexts of lived experience: “policy, science and practice all need to develop a much more sophisticated literacy in the scale politics of responding to the risk landscapes that Indigenous groups negotiate” (p. 2). Researchers need to engage with the knowledges, ontologies and experiences of Indigenous peoples meaningfully, considering their specific histories, geographies and impacts of colonialization: “Climate risks render Indigenous groups more vulnerable, not because of their indigeneity, but because their lives are so often marked by intergenerational legacies and the newly created scars of colonialism” (p. 11). Hence, decolonizing people and places is part of the approach to nurture Indigenous self-determination in rethinking the geopolitics of Indigenous resilience.

Gregory A. **Cajete**, an Indigenous scholar himself, articulates some foundational considerations toward a framework for thinking about Indigenous community-building and development, as illustrated with Taiwan examples by Joyce Hsiu-yen **Yeh** et al. Directly addressing Indigenous peoples, he argues that Indigenous science is not subordinate to western science: “we have ancient systems of extended family, clan, and tribal relationships that we can mobilize in positive ways to implement sustainable changes in our economies” (p. 10). These Indigenous ways of sustainability could be translated into the present through Indigenous community-building and science curricula development toward culturally responsive models—models that strengthen Indigenous societies and develop capacity for new forms of economic development, self-determination, and ways of dealing with adversity, including disasters.

The engaged scholarship of this Special Issue encourages the readers of Sustainability and other scholars to critically reflect upon the various insights and lessons learnt on Indigenous resilience in the context of Taiwan and beyond. The recognition of Indigenous issues in Taiwan is closely intertwined with democratization processes. The emergence of

Indigenous voices, Indigenous knowledge, and the consideration of Indigenous resilience to environmental change are not apolitical processes, but rather related to democratization by direct participation. The engagement of more scholars and practitioners with comprehensive studies and applications of Indigenous resilience is needed. In doing so, we hope that Taiwan's Indigenous peoples, as well as all other Indigenous peoples, are at the forefront of this new paradigm shift.

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Appendix A

Table A1. List of papers belonging to the Special Issue (ordered according to Section 7's themes).

No.	Full Bibliography
1	Tsai, F. Shuttling between Land and Sea: Contemporary Practices among Amis Spearfishing Men as a Foundation for Local Marine-Area Management. <i>Sustainability</i> 2020 , <i>12</i> (18), 7770; https://doi.org/10.3390/su12187770
2	Lin, Y.; Tomi, P.; Huang, H.; Lin, C.; Chen, Y. Situating Indigenous Resilience: Climate Change and Tayal's "Millet Ark" Action in Taiwan. <i>Sustainability</i> 2020 , <i>12</i> (24), 10676; https://doi.org/10.3390/su122410676
3	Lee, S.; Chen, Y. Indigenous Knowledge and Endogenous Actions for Building Tribal Resilience after Typhoon Soudelor in Northern Taiwan. <i>Sustainability</i> 2021 , <i>13</i> (2), 506; https://doi.org/10.3390/su13020506
4	Chen, Y. Decolonizing Methodologies, Situated Resilience, and Country: Insights from Tayal Country, Taiwan. <i>Sustainability</i> 2020 , <i>12</i> (22), 9751; https://doi.org/10.3390/su12229751
5	Yeh, J.H.-y.; Lin, S.-c.; Lai, S.-c.; Huang, Y.-h.; Yi-fong, C.; Lee, Y.-t.; Berkes, F. Taiwanese Indigenous Cultural Heritage and Revitalization: Community Practices and Local Development. <i>Sustainability</i> 2021 , <i>13</i> (4), 1799; https://doi.org/10.3390/su13041799
6	Tai, H. Resilience for Whom? A Case Study of Taiwan Indigenous People's Struggle in the Pursuit of Social-Ecological Resilience. <i>Sustainability</i> 2020 , <i>12</i> (18), 7472; https://doi.org/10.3390/su12187472
7	Bayrak, M.; Hsu, Y.; Hung, L.; Tsai, H.; 'e vayayana, t. Global Climate Change and Indigenous Peoples in Taiwan: A Critical Bibliometric Analysis and Review. <i>Sustainability</i> 2021 , <i>13</i> (1), 29; https://doi.org/10.3390/su13010029
8	Lin, P.; Lin, W. Rebuilding Relocated Tribal Communities Better via Culture: Livelihood and Social Resilience for Disaster Risk Reduction. <i>Sustainability</i> 2020 , <i>12</i> (11), 4538; https://doi.org/10.3390/su12114538

Table A1. Cont.

No.	Full Bibliography
9	Persoon, G.; Minter, T. Knowledge and Practices of Indigenous Peoples in the Context of Resource Management in Relation to Climate Change in Southeast Asia. <i>Sustainability</i> 2020 , <i>12</i> (19), 7983; https://doi.org/10.3390/su12197983
10	Mugari, E.; Masundire, H.; Bolaane, M. Adapting to Climate Change in Semi-Arid Rural Areas: A Case of the Limpopo Basin Part of Botswana. <i>Sustainability</i> 2020 , <i>12</i> (20), 8292; https://doi.org/10.3390/su12208292
11	Zaki, M.; Noda, K.; Ito, K.; Komariah, K.; Sumani, S.; Senge, M. Adaptation to Extreme Hydrological Events by Javanese Society through Local Knowledge. <i>Sustainability</i> 2020 , <i>12</i> (24), 10373; https://doi.org/10.3390/su122410373
12	van der Ploeg, J.; Sukulu, M.; Govan, H.; Minter, T.; Eriksson, H. Sinking Islands, Drowned Logic; Climate Change and Community-Based Adaptation Discourses in Solomon Islands. <i>Sustainability</i> 2020 , <i>12</i> (17), 7225; https://doi.org/10.3390/su12177225
13	von Seggern, J. Understandings, Practices and Human-Environment Relationships—A Meta-Ethnographic Analysis of Local and Indigenous Climate Change Adaptation and Mitigation Strategies in Selected Pacific Island States. <i>Sustainability</i> 2021 , <i>13</i> (1), 11; https://doi.org/10.3390/su13010011
14	Howitt, R. Decolonizing People, Place and Country: Nurturing Resilience across Time and Space. <i>Sustainability</i> 2020 , <i>12</i> (15), 5882; https://doi.org/10.3390/su12155882
15	Cajete, G. Indigenous Science, Climate Change, and Indigenous Community Building: A Framework of Foundational Perspectives for Indigenous Community Resilience and Revitalization. <i>Sustainability</i> 2020 , <i>12</i> (22), 9569; https://doi.org/10.3390/su12229569

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Article

Shuttling between Land and Sea: Contemporary Practices among Amis Spearfishing Men as a Foundation for Local Marine-Area Management

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Abstract: This paper explores how the Amis people on the east coast of Taiwan who practice freediving spearfishing manage the local marine area. Among the coastal Amis people, freediving spearfishing is not only a way of life but is also closely related to ritual ceremonies. Amis spearfishing men are knowledgeable of the near-shore sea and coast, and the practice of spearfishing collectively cultivates their ability to deal with both public affairs and human relations in the community. However, the Taiwanese government regards spearfishing guns as weapons and restricts them. Furthermore, the assumption that spearfishing destroys the coral ecosystem and fishery resources means that the practice is often demonized or increasingly restrained. In this paper, I argue that local marine Traditional Ecological Knowledge (TEK) among Amis spearfishing men can be the foundation for local marine conservation under the concept of community-based natural-resource management (CBNRM), involving both the local Amis community and the government, in spite of both parties still having their own issues to overcome.

Keywords: A'tolan; Amis people; freediving spearfishing; CBNRM; TEK; Taiwan

1. Introduction

Spearfishing with a harpoon is an ancient skill that can be traced back to more than 5000 years ago [1] (p. 6). Among the Amis people, one of Taiwan's indigenous peoples, the earliest documentation of harpoon spearfishing was in 1803; it was described by Japanese sailors who accidentally drifted to Cawi' village on the east coast of Taiwan and stayed there for four years [2] (p. 24). It is difficult to trace the earliest freediving spearfishing among Amis people, but it is possible that it started during the Japanese colonial period, when rubber and glass were introduced into Amis areas. In the Amis language, the spearfishing gun is called a pacin or cinko, which originates from the Japanese word pacinko, which means slingshot [3] (p. 4).

For the Amis people on the east coast of Taiwan, freediving spearfishing is not only a means of subsistence but is related to their society and culture. Furthermore, Amis freediving spearfishing requires complex knowledge of the nearshore sea, including the currents, fish species, marine landscapes, and related stories, which, together, can be regarded as Traditional Ecological Knowledge (TEK). The local marine TEK of the Amis freediving spearfishers regards the interactions between local Amis society and the sea, which is the foundation of the social-ecological system of indigenous resilience. In other words, the relationship between the local Amis society and the sea is, to a certain extent, interdependent, and problems on either side will also affect the other. Hence, in terms of the Amis spearfishing men's TEK about the local nearshore sea and coast, it can be a critical resource for local marine management.

However, the Taiwanese government treats spearfishing guns as weapons, and each spearfishing gun must be registered in the local police system. For this reason, Amis spearfishing men usually go

spearfishing in a low-key manner in order to avoid law enforcement by the coast guards. However, neither the regulations nor the coast guards are sufficient to enforce the reef-fishing regulations in Taiwan. Therefore, the Fishery Agency of Council of Agriculture, Executive Yuan, introduced a preliminary notice to commence a period of public comment for drafting “Regulations of Spear Gun on Harvesting Aquatic Animals in No-take Zones” in 2017 to prohibit spearfishing based on the aim of protecting the reef ecosystem. Although the regulation allows indigenous peoples to go spearfishing according to indigenous customs in the area, the regulation is still controversial and a cause of debate. Firstly, those indigenous people living outside the indigenous jurisdictions will not be allowed to go spearfishing. Secondly, some Han Taiwanese think it is unfair that only indigenous peoples benefit from spearfishing, which could potentially cause ethnic conflict between indigenous people and the Han Taiwanese. Finally, it is not logical for the Fishery Agency to ban spearfishing based on the discourse of protecting the reef ecosystem, when it excludes the reef ecosystems from indigenous areas. In sum, the Fishery Agency does not have sufficient evidence proving that spearfishing could cause damage to the reef ecosystem. It is, therefore, argued that they do not enforce rational regulations on marine-resource conservation.

It is bound to fail with a top-down (government-controlled) strategy according to the draft regulation as above; one of the critical issues is the neglect of local TEK and the management of local natural resources, accordingly, by local communities. In terms of community-based natural-resource management (CBNRM), especially in indigenous areas, not only the TEK holders, as the local experts, but also the autonomy of indigenous groups is one of the key points for managing the natural resource. In this paper, I argue that local marine TEK among Amis spearfishing men can be the foundation for local marine conservation, following the concept of community-based natural-resource management (CBNRM) that is based on the sovereignty of the indigenous groups and transforming it into a co-management project between the local Amis community and the government.

2. TEK as the Foundation for CBNRM

In Taiwan, most local marine resources are governed by the government—the Fishery Agency—except for some local fishery conservation areas. To date, there is only one local-management fishery-conservation area in indigenous regions (the Fushan Fishery Conservation Area, Taitung County, Taiwan). However, the settler Han Taiwanese community manages the conservation area instead of the indigenous people, so the conservation organization has many conflicts with the local indigenous people, especially during the annual ocean ritual the local Amis people practice. In short, the Fishery Agency still practices a top-down strategy for governing marine areas. Below, I will discuss the governmentality of natural resources from the government and the context of understanding the local TEK in the face of conflicts between the government and the local communities. Furthermore, I describe how TEK can be the foundation of CBNRM, and the main associated challenges are highlighted.

2.1. Governmentality

Top-down governmentality is a traditional strategy for governing a nation state, focusing on the techniques and relationalities of the rules of the government [4,5]. Therefore, the procedure of the implementation and dissemination of policy by the bureaucratic administration is key [6]. Hence, the government usually imagines the local place based on a simple classification and quantification methodology to govern the natural resources without local knowledge [7]. In other words, the local environmental knowledge system has usually been regarded as nonrational for managing and exploiting natural resources such that the local knowledge holders are considered as non-specialists or non-technical experts in local natural-resource management systems [8].

Secondly, bureaucracy, in one way, distracts from local historical meanings and the cultural context of local natural resources and, in another sense, relocates them into a different context, which is usually defined by the urban experience of managing the natural resources [9]. Furthermore,

the bureaucracy often relies on a certain expert system as the bridge between the state and locality to produce professional knowledge, which usually does not match local understandings of ecosystems [9].

From another perspective, governmentality cannot be regarded merely by the government but also by the local actors. Actor-network theory (ANT) implies that governance should be regarded in terms of the interaction between the government and the local actors [10]. The local actors would also represent the agency to interpret the guidance from the state and redefine it for the locality [11].

In short, the government usually neglects the local knowledge of a place, adopting a “rational” methodology to manage and exploit natural resources. Local actors do not readily accept one-way governance from the government; rather, they try to negotiate it. It is important to present the local knowledge as a “rational” system for managing local natural resources. There needs to be a discussion of what constitutes “rational”, as there is a disconnect between government policy and local knowledge systems. Therefore, traditional ecological knowledge (TEK) becomes the way to negotiate with the government.

2.2. TEK as the Agency of Natural-Resource Management

Studies on TEK have been based on conflicts between local communities and the government, including the expert systems that the governments relied on [9]. Studies on TEK have been the focus since the 1980s due to local communities facing numerous conflicts with the rational methodology of “modern” environmental conservation, which is derived from Western scientific ideology [12].

TEK, local knowledge (LK), and indigenous environmental knowledge (IK), although somewhat different from each other, all address knowledge that was previously neglected by so-called “Western” science. These three types of knowledge focus more on the relationships of communities with the local environment and natural resources. For example, Posey argues that indigenous environmental knowledge is compatible with Western science; furthermore, it is also important to discuss the cultural rights of indigenous communities in the context of governance [13]. The first studies on indigenous environmental knowledge mostly focused on the “tradition” perspective and how traditional knowledge can be in opposition to science. In other words, earlier research on indigenous environmental knowledge also neglected its dynamics. Therefore, some scholars noticed that indigenous environmental knowledge is locally adaptive [14,15]. I define IK as a subset of TEK, which refers to a local knowledge system that is interactive with the local environment and is embedded in the context of local rituals, social interactions, social organizations, and daily practices.

In terms of the characteristics described above, we could identify TEK as an adaptive complex system of knowledge, practices, and belief, which is developed by an adaptive process in the local community with cultural practices, including the following dimensions: knowledge of local natural resources, a management system, social organization, and the context of local beliefs and worldviews [16].

2.3. CBNRM as a Way of Self-Development

As mentioned above, the top-down governance of environmental management has caused many conflicts in local communities, and TEK has been a focus in understanding local natural-resource management. Based on this approach, TEK can be the foundation of a management system. Therefore, community-based natural-resource management (CBNRM) can be an alternative form of governance of the local environment.

CBNRM requires the participation of local and indigenous groups with local knowledge as local (non-technical) experts from within the community. In the meantime, the principles of CBNRM can be summarized as follows. Firstly, benefit to the local population should be the priority; secondly, the TEK of the local community can be integrated into a formal management system; and thirdly, by connecting the issues on environmental destruction and social equality, non-governmental organizations (NGOs) could also bring in the social-justice issue of minority groups’ treatment in the historical process as a way to get them involved [17] (pp. 1–3).

Although CBNRM seems to solve the problem of governance failures, there are still problems that need to be tackled. First, most NGOs and the government focus on international conservation trends that they want to introduce but repress local knowledge or ignore the local political situation [18]. In other words, the government usually misunderstands the relationship between local TEK holders and external support, relying on external ecological specialists to manage the local natural resources; this means the local community or institute is ignored.

For the indigenous community, CBNRM also implies sovereignty based on the right of the indigenous peoples to govern their own environment. The new CBNRM approach emphasizes the resilience of place, state-local partnerships, subsidiarity, institutionalism, self-determination, accountability, the security of tenure/rights, and sovereignty [19]. The new trend of CBNRM stresses the local institution instead of the community; subjectivity is a weapon to force the state to be a partner in managing the environment. However, it would be romanticizing to regard the local place as a functional institution or assume the state will be effective at managing it [20]. Therefore, a local environmental management system should include local institutions, the government, related scholars, and NGOs, all of which need to cross disciplines as partners to start institutional learning and form adaptive co-management systems [20,21]. In sum, CBNRM could be successful with a dynamic process involving different participants and partnerships based on local places.

TEK is one of the core elements of CBNRM, and the sovereignty of the indigenous community is also key to CBNRM in indigenous regions. For the A'tolan tribe (belonging to the Amis) to manage the marine area locally, TEK and its relationships with institutions (social organizations of the community) need to be clarified. Freediving spearfishing men among the A'tolan Amis are the most knowledgeable holders of TEK of the marine area, which includes knowledge on currents, waves, underwater landscapes, fish species, coral-reef ecosystems, etc. Furthermore, the marine TEK can be classified into four categories: knowledge of the local marine area, the management system, the social organization, and the context of the local beliefs and worldview [16].

3. TEK among Amis Freediving Spearfishing Men

A'tolan (Dulan) is a village located in Taitung County on the southeast coast of Taiwan; it was originally inhabited by indigenous Amis people, but today, they make up only half of the total population of the village. For the Amis, the community can be understood on two different levels: one is the administrative village including all the residents in the village and its governing institutions, mostly created by the Taiwanese government, and the other is mostly based on the relationships among the local indigenous people—*niyaro'* (tribe) in the Amis language. The following descriptions are based on the notion of *niyaro'*. A'tolan is a coastal community, and the marine area is very important to local Amis culture. Gathering food from the tidal flats and ocean fishing are closely connected to Amis society and culture, and the people possess comprehensive marine knowledge. Generally speaking, the gathering activities at the intertidal zone, called "lakelaw", are mostly practiced by women and involve picking up edible seaweeds and shellfish. Sometimes, men also catch crabs or other edible marine life. As for fishing, the Amis have three traditions. They are *mitilu* (gill net), *tafukul* (throwing net), and *micinko/mipacin* (spearfishing) [3] (p. 2). All three kinds of fishing require substantial knowledge of the local marine life. The environmental understanding of both the intertidal zone among Amis women and the inshore open water among Amis men are fundamental to understanding the broader marine context of natural-resource management. In this paper, I focus on the freediving spearfishing men as one of the key TEK holders to start the discussion of local marine management, due to the other TEK practices needing further research in Taiwan. Since the Japanese colonial period, freediving spearfishing has been a popular and important fishing method, especially for men aged 25 to 50.

I am going to briefly describe the local marine TEK that is practiced by A'tolan Amis spearfishing men based on the four TEK categories described above [16].

3.1. Knowledge of the Local Marine Area

Local marine knowledge is comprehensive compared to the government's, ocean scientists', and environmental NGOs' data, which is parallel to some desertification research showing that external expert knowledge is based on questionable evidence and that it has been privileged over local knowledge primarily for political, economic, and administrative reasons that do not take indigenous ecological knowledge into account [22]. For example, after a reef-check project carried out by the NGO the Taiwan Environmental Information Association from 2010 to 2013, they announced that many fish species were disappearing from the Taitung area (where A'tolan is located) or, at least, that there were no data on them [23]. However, local Amis spearfishing men have a different understanding of the situation. The reason for the different perspectives is the different methods used to recognize fish species. The NGO performs the reef check only once a year and takes only one day for it; although they use a scientific method to collect the data, their knowledge simply cannot compare with that of the local spearfishing men who dive daily as long as the conditions are good enough. Therefore, local Amis spearfishing men are familiar with the local marine area and have developed marine knowledge that the scientists or the NGOs cannot match due to discrepancies in scientific methodologies, the inadequate temporal scales that frame scientific observations, and the dismissal of the regular observations by generations of local indigenous resource users. This could be compared to Hobson's conclusion in the Canadian Arctic, where the absence of scientists from winter environments limited observational data across seasons [24].

Local marine knowledge among A'tolan Amis spearfishing men can be briefly described as follows.

3.1.1. Fish and Other Edible Marine Life

The names of reef fish are an important index in fishing culture among the A'tolan Amis. The fish species that are frequently speared are listed in Appendix A, Table A1.

Among the reef fish in Appendix A, Table A1, there are some features that make the local knowledge different from general biological knowledge:

1. Cu'in (surgeon fish), fice'ki (gray rudderfish), sulita (octopus), and kung (pufferfish) are the favorite fish among the A'tolan Amis for consumption, especially cu'in—it has a particularly fishy smell that most Han Taiwanese people do not like, but the A'tolan Amis elders like it very much due to the gentle texture. Cu'in always follow parrotfish (pihoku'ay); therefore, the parrotfish has become the index fish in the reef ecosystem, which is different from the scientific approach.
2. The fish preferred by A'tolan Amis can generally be classified into two types, based either on the morphology or habitual behaviors of the fish or on the naming system, which is totally different from the scientific way.

3.1.2. Traditional Marine Territory as a Complex System

Taiwan is the state governed by the Han Taiwanese settlers. The indigenous peoples of Taiwan only account for slightly more than 2% of the total population of Taiwan. In the colonial history, indigenous peoples lost most of the traditional land-tenure rights. The authority formally signed "A New Partnership Between the Indigenous Peoples and the Government of Taiwan" in 2002, signed by the president and representatives of the indigenous peoples. Since that year, the government and academia have jointly initiated survey projects for the traditional territories of indigenous peoples. Since then, the authority has gradually developed a legal framework in the traditional territories of indigenous peoples. However, it focuses merely on lands and excludes private lands from indigenous traditional territories. There is only one indigenous region of the indigenous peoples that has been recognized by the government from 2002 to 2020, and most of the rest of the traditional indigenous territories still cannot be legally recognized by the state.

Since 2000, due to many large-scale tourism-development projects led by the government or consortia on the east coast of Taiwan, there have been conflicts with the local indigenous peoples [25].

The A'tolan Amis did not follow the legal regulation established by the authority but proclaimed their traditional territory by their own cognition on 28 February 2017, which not only includes the land territory but also the marine area (see Figure 1 for the traditional marine area). A'tolan is the first indigenous community to proclaim the traditional marine territory in Taiwan. The traditional marine territory has been identified since 2003 and has been modified several times by the A'tolan Amis. Based on the map in Figure 1, we can see that the coastal naming system is much more complex than the governmental administration's naming system. The names on the map mostly reflect social memory and geographical or marine features (for example, the current). However, the administration's naming system is much simpler, mostly following the administration villages such as Jialulan, Fushan, Dulan, Xingchang, Xinglung, Lungchang, etc. (see Appendix A, Table A2).



Figure 1. A'tolan Amis' traditional marine territory, italics are Chinese or Japanese names. (source: Google Maps at <https://reurl.cc/b5N8V6>) [26] (pp. 27–28).

1. According to the map in Figure 1, the closer to the village, the more complicated the names for coastal areas; away from the village center, the names for the marine area are fewer and simpler.

2. Traditional names are based on different historical events, geographical features, knowledge of the inshore sea, and the nearshore terrestrial ecology [26] (pp. 26–34); once Japanese and Mandarin were introduced, some of the coastal names were changed into Chinese or Japanese. For example, Dulanbi is named in Chinese and means the nose of A'tolan, named after the geographical characteristic of protruding headland, yet A'tolan Amis have at least four names in the place of Dulanbi, which are Pacifalan (the place for locating boats), Patekodan (different currents crash here), Cifanaway (there is a hollow landscape), and Cingohonan (named after a person whose name was Ngohon who drowned here) (see Figure 2). Simply naming this protruding headland as Dulanbi in Chinese reflects the A'tolan Amis's historical memory and environmental knowledge in this area of injury and exploitation. On the contrary, reading these four traditional names of the landscapes in Dulanbi as a "political text" not only represents the knowledge of the coastal environment of the Amis people in A'tolan but is also an important foundation for decolonization [27].
3. Each coastal place could have different fish species; some places' waves are rough with strong currents, and some specific fish would come to the spot. Different fish would be away from the reef holes at certain different times during the day. Some fish would be rare in certain seasons, etc. Each spot has its own story and details about fish.



Figure 2. The currents and underwater landscapes around Dulanbi (source: based on Google Maps).

Furthermore, each spearfishing man has his favorite and least-favorite spots; the favorite one would be a "secret base", mostly because the spearfishing man had caught some big game in this area. As for the least-favorite spots, these would mostly be such because they are associated with bad memories, e.g., someone they were close to drowned there.

3.1.3. Underwater Landscapes and Currents

A'tolan Amis spearfishing men are very familiar with the currents and the underwater landscapes, so they can judge where and when to go freediving spearfishing and for what kind of fish. For example, the Dulanbi area is a very important fishing area for the A'tolan Amis; according to different seasons and different tides, the currents and underwater landscapes change, as Figure 2 shows.

Therefore, spearfishing men know which spots have plenty of certain fish, which season would be best to dive in, and where it is dangerous for those who are not strong divers. There are many rocks

above the water in the marine area of A'tolan, which corresponds to stories about people who drowned nearby because they were greedy and caught too many fish.

3.1.4. Reef Landscapes above the Water and Traditional Stories

Most of the reef rocks appearing above the water are named after certain events, e.g., someone drowning near the rock. For example, Cionecan near Patekodan is a reef rock that appeared above the water; Onec is the name of someone who drowned near the rock. Onec was greedy and took many baskets to carry the fish, but they were too heavy to bring back to land and Onec drowned there. The name of the landscape is a part of the management system for the marine resources in A'tolan Amis society. This will be further elaborated on in the next section.

3.1.5. The Ocean Is Understood with Reference to the Land

The A'tolan Amis have developed a knowledge system in which they observe the relationships between the ocean and land by daily fishing or gathering. First, some fish are named after land animals due to their behavior or appearance (see Appendix A, Table A1). Secondly, senior spearfishing men can tell if underwater visibility is good based on the cloud on the mountains. If it is cloudy up in the mountains behind the village, then it might be murky underwater. Third, the A'tolan Amis always say:

Kamaro'ay a riyal, awa'ay ko fali. (No wind when the sea is sitting down.)

This old saying of the A'tolan Amis means that when there is low tide, there is no wind at all. The A'tolan Amis observe and subtly develop their knowledge of the environment. A final piece of common knowledge among the A'tolan Amis for trying to identify whether the conditions are good or not for spearfishing is the question "where is the wind coming from?". Generally speaking, when the wind is coming from the south, the waves are not good for diving because it could be very rough and fish will not leave the reef caves. However, when the wind is coming from the north, it is a good time for fishing and the waves are smoother.

3.1.6. Water Temperature and Environmental Change

By diving, spearfishers sense subtle changes in the ocean, especially temperature conditions. In general, the water temperature in the A'tolan marine area is 25 to 26 °C. However, at the beginning of 2016, there was a cold snap; it even snowed in the Taipei area. However, the sea temperature in that period was warmer than before. At that time, some spearfishing men were already predicting that a large typhoon would hit. In the end, there were three severe typhoons that hit Taiwan, including Typhoons Nepartak, Meranti, and Megi. Especially, Typhoon Nepartak, with record-breaking strong wind, caused a very serious disaster in the Taitung area in July 2016. At the beginning of 2017, spearfishers sensed that the sea temperature was lower but the land temperature was higher than in the previous year, although they did not use any scientific measuring tools or methods.

The TEK system of A'tolan Amis spearfishers is very complicated and full of details about the local marine area that policymakers, scientists, and environmental NGOs cannot understand without daily practice of diving in the local marine area.

3.2. The Management System

There are persistent governance institutions of the A'tolan Amis that influence local marine-resource management; however, the region is also facing new challenges, such as climate change, tourism development, and chemical pollution from agriculture. In terms of daily practices among A'tolan Amis spearfishing men, they involve informal institutions in which Amis governance is adapting and reshaping customary governance institutions.

3.2.1. Sustainable Fishing and Natural Restrictions

As mentioned above, the marine area is affected by different seasons and wind conditions. In certain places, it would be difficult to dive due to the monsoon coming from the northeast from November to the following February. This is the windy season in A'tolan, and some locations face the wind, so the waves would be very rough to dive into. Furthermore, when the wind comes from the east, the ocean is usually murky, which prevents people from diving, especially in the periods of April to May and October to November, when the seasons are in transition in A'tolan; during that period, the visibility is not good enough to dive.

Another restriction is natural disasters. Typhoons are the issue that would limit spearfishing or other fishing activities. The most damaging typhoon to date in the Taitung area was Typhoon Morakot in 2009, which caused a lot of driftwood to float on the ocean for several months, stopping sunshine from reaching the coral reef, and then, the wood crashed into the coral. Therefore, the coral reef was destroyed by the typhoon, and the reef fish have decreased since then.

3.2.2. Sustainable Fishing by Memory and Taboo

As mentioned above, there are stories about how greedy men drowned in the sea, and nearby reefs are named after people who died around there. Therefore, this forms an ideology in which people cannot be too greedy in taking foods from the sea. Secondly, there is a sacred coastal place named Pacifalan that A'tolan Amis people believe is the mythic place of the ancestors landing from overseas. However, the government had planned a tourism project to build up a resort on the sacred site, which is also an important fishing ground for A'tolan Amis people. The conflict between the A'tolan Amis and the authorities lasted about 10 years from 2001, and the government finally stopped the development project in 2011 [28] (pp. 97–103).

As for the taboos related to fishing among A'tolan Amis, firstly, it is not allowed to eat fish or to fish when harvesting rice, and men who have had sex the night before are not allowed to dive in the sea for fishing. Secondly, there is a dangerous inshore sea with strong rip currents that the A'tolan Amis call "the hungry ocean" limiting the number of people who are qualified to dive locally. Finally, A'tolan Amis usually do not spear sea turtles because they are the subject of a certain taboo. A'tolan Amis people believe that turtle shells are ritual objects related to the rain. The shamans of the Amis people used tortoise shells to pray for rain after a long period of drought, but if too many turtle shells were kept at home, they could cause a calamitous flood. Therefore, sea turtles have the sanctity associated with water.

3.2.3. Sustainable Fishing by the Sense of Traditional Territory

In the past, the A'tolan Amis would not claim ownership of the traditional marine territory in order to exclude others. However, a sense of protecting the sea has been emerging recently due to the decrease in marine resources. For example, a middle-aged man who came from the other township staying in A'tolan's traditional marine area was trying to poison lobsters; he was found by a local Amis spearfishing man, and a violent argument ensued. The Amis spearfishing man asked him to leave the territory of the A'tolan Amis. Therefore, although the A'tolan Amis think that the ocean belongs to everyone, this does not mean that others can destroy the marine ecology with impunity. In terms of the sense of traditional territory, the A'tolan Amis will start watching out and caring for marine resources. Other examples have also recently been happening. Firstly, in recent years, A'tolan Amis people have found that the parrotfish in the traditional marine area have been decreasing. In order to protect the parrotfish, the leaders in the age organization who are also experienced freediving spearfishers have banned spearing the parrotfish at night since 2017. Secondly, the new leader (kakita'an in the Amis language) of the A'tolan tribe in 2020 also realized the ecological changes in the traditional marine area, and began to plan to consult the tribal members to discuss how to protect the sea.

These customary norms and those adapting and reshaping customary governance institutions for managing local marine areas are not formally regulated among the A'tolan Amis, so there needs to be organizations in the community that will support the initiative.

3.3. The Social Organization

The age organization of males is an important social structure in Amis society; men are distinguished by age; with every 5 years, a new age set is established. Each age set will be given a collective name by the leader and the elderly according to the major events that occurred during their adulthood, and the females follow their husbands' age to become members of the specific age set (see Table 1) [29] (pp. 33–39). The age organization of males in A'tolan is based on the niyaro' level and is a system for taking care of community affairs, including public ceremonies and rituals. The age organization in A'tolan is still functional not only in terms of the rituals or ceremonies in the village but also the public affairs, including marine management. It is obvious that freediving spearfishing is a way to connect each individual into one integrated team (or age set) to take responsibility for the public affairs in a niyaro'. When the age set reaches the Mihiningay stage, it is time to prepare to take over the responsibility of public affairs, which happens at the Mikumoday stage. During the Mihiningay stage, the members go spearfishing together to cultivate tacit understanding. It is a training system that organizes the Amis as a team to manage public affairs, including marine management.

Table 1. The structure of the age organization of males in A'tolan (2016–2010) [29] (pp. 31–32).

Categories	General Name for Age Grade	Name and Responsibility	Age Set	
Malitengay People who are near the ancestors	Tu'as The elders	Ladihif The elders who rest in the cave	Lahetai Lamindai Laxinpip Lakimon Lakinma	
		Las'fi The elders who rest in the gathering house	Latiko Lakocung	
	Matatapalay or Mi'ienengay Middle-aged men	Tukal Main pillar of the house	Lajingko	
		Tapal Learning how to be tukal	Lakensec	
		Culal Germinating	Laencu	
		Romrom Look out for fire	Lakancin	
		Mikumoday The manager of the village	Lakayakay	
		Mihiningay	Mihiningay (Miodi'ay) Watching and learning	Lakanca
	Malikoday Dancing people	Kaph Youth	Sakakaay no Kaph The big brothers among youth	Lacinsi
			Saka tosa no Kaph The second big brother	Laliwil
Saka toro no Kaph The third big brother			Ladatong	
Safafaay no Kaph The youngest youth			Lakutang	
Pakarongay The boys who serve the others			Pakarongay	

3.4. The Belief Context of the Sea

The rituals related to the sea in Amis society are ocean rituals and pakelang (a ceremony in which Amis go fishing and eat fish on the coast to transfer the sacred into daily life for coastal Amis), for which each coastal Amis tribe has different words (mikesi', misace'po (which means ocean ritual in Makuta'ay village), pafafoy (which means ocean ritual in Torik village), etc.). Both ocean rituals and pakelang play a critical role in the social and cultural life of Amis. In A'tolan, mikesi' is on the last day of the annual ritual: all the males except Ladihif and Las'fi go to the coast to catch fish; women are not allowed to participate in the ritual. As for pakelang, coastal Amis get together in the coastal area to catch and cook fish at the close of a social or cultural event, e.g., a wedding, funeral, etc.

The A'tolan Amis believes that two mythical ancestors came from the ocean, so when they perform rituals and ceremonies by the coast, they call upon those two ancestors to protect the people and pray to them for fish. The two ancestors are Leping (male) and Dongi (female). Some spearfishing men in A'tolan also call upon the ancestors' names when praying for safe diving and a rich catch of fish.

In other words, the ocean is not only a social space but also a cultural landscape for the A'tolan Amis.

3.5. TEK in Crisis

According to the brief introduction to local marine TEK based on the categories identified by Berkes, Colding, and Folke [15], many recent studies imply that either the indigenous TEK per se is significant [30,31] or it is also effective for sustainable environmental management in collaboration with modern scientific knowledge and technology [32–34]. TEK among A'tolan Amis freediving spearfishing men could provide the basis for managing the local marine area. However, it is too romantically depicted. There are still changes happening in the environment, so TEK needs to evolve to be relevant to contemporary environmental issues. The most serious problem, for now, is the decrease in fish species in the A'tolan traditional marine area. The main reasons for this, in the understanding of the local spearfishing men, include typhoon impacts (especially Typhoon Morakot in 2009), too many commercial fishing boats using trawl and gill nets illegally, some people leaving their gill nets underwater, too many chemical insecticides being used in agriculture and flowing into the sea following rain, etc.

Typhoons and climate change are the most serious problems for the marine area of the A'tolan area from the perspective of spearfishing men. Although spearfishing men have been aware of slight changes in the water temperature for the past few years, Typhoon Nepartak, in July 2016, confirmed that the weather is changing. Typhoon Morakot, in 2009, caused very serious problems; the elders of the A'tolan Amis said that they had never experienced a typhoon that caused so much damage, especially to the coral-reef system in Taitung. In fact, in the TEK of the A'tolan Amis, typhoons are not always devastating. In their past experience, typhoons from the Pacific Ocean hit Taiwan basically every summer; sometimes, typhoons clean up the sand deposited on the bottom of inshore sea and give coral reefs a chance to regenerate. However, the typhoon phenomenon in the past few years has exceeded the understanding of the A'tolan Amis. Some typhoons are particularly violent such as Morakot in 2009 and Nepartak in 2016. From 2019 to August 2020, no typhoon even hit Taiwan. This phenomenon is beyond the past experience of A'tolan Amis, and the people can only guess it may be evidence of climate change.

Developing sustainable natural-resource management in the local marine area will need to rely on the contributions of both government agencies, ocean scientists, and environmental NGOs and Amis spear fishers—with each of these parties recognizing the strengths and limitations of the others.

4. The Dilemma of Marine Management

For the past three decades, studies on CBNRM have focused on the idea and practice of co-management between the government and local community. There have been many discussions and studies on forest management focusing on co-management between the indigenous community and

the government, in the form of the Forestry Bureau in Taiwan [35–38]. However, it is ironic that Taiwan is an island state, yet the government concerns itself with fisheries more than with managing marine resources and attempts to use a top-down strategy to control marine resources. The government, which takes charge of the ocean natural resources, needs to think about how to manage them efficiently alongside the local community, and vice versa. The following section describes the dilemma of marine management from the point of view of both the government and the A'tolan.

4.1. Inadequate Management from the State

There was no ocean-resource management department in the Taiwanese government before 2018; the Fishery Agency (FA) took charge of this responsibility. A new governmental agency, the Ocean Conservation Administration (OCA), was established on 28 April in 2018, which is a suborganization of Ocean Affairs Council, which is also a new department in the central government of Taiwan. Compared with the Forestry Bureau (FB), not only are the FA and OCA both very small units but also their divisions of responsibilities are divided such that FA takes charge in commercial fishing and OCA takes charge in conservation of ocean. It is difficult to integrate marine-resource management when the responsible governmental agencies are separated in different departments. Furthermore, there is little understanding of the marine TEK of indigenous peoples, not only in government but also in academia. Generally speaking, coastal fishery management relies on laws and regulations made by those who do not understand local TEK, and the coast guard cannot execute the laws or regulations efficiently due to not having enough TEK training and manpower.

As for local marine-area management, current fishing law prohibits using bottom-trawl nets within three nautical miles of the shore; however, it is difficult for the coast guard to enforce this law because it has neither the suitable equipment nor enough manpower. For coral-reef resources, there are no monitoring data for setting reasonable regulations for local marine-area management.

Today, the government has no regulations managing noncommercial fishing, such as hook fishing or spearfishing. NGOs have noticed a decrease in fish in coral reefs in Taiwan and proposed a prohibition on spearfishing within 12 nautical miles of the shore on 14 March 2017. This regulation caused much debate among spearfishing men, environmental NGOs, marine biologists, and fisherman communities. The regulation was followed by a public forum on 25 June 2017 in Taipei to make the final decision on whether the state would ban spearfishing in Taiwan.

According to the draft of the regulation prohibiting spearfishing, the main purpose is to protect the coral ecology and reef-fish system in Taiwan. Ironically, indigenous peoples who spear in the indigenous area are the exception to this regulation, which implies two things: one, it is illogical to exclude the indigenous area from marine-resource management according to the draft spearfishing regulation, and two, it is unrealistic to expect that indigenous people can manage the local marine area without any external support.

The regulation regarding spearfishing has caused many arguments among the spearfishing communities; most think spearfishing is the most sustainable method. However, there is also an idea that even spearfishing needs regulating to manage the marine resources. The most critical problem, for now, is that the government does not have any reliable data with which to monitor coral-reef marine life, so they cannot issue reasonable management regulations.

In the end, the government has not enforced the law of prohibiting spearfishing at all; debates are still going on in Taiwan. There is still a lack of rational regulations for managing freediving spearfishing.

Based on CBNRM theories, getting the local community to be involved in the management system is one of the keys to successful management. However, the local community should not have to shoulder the whole responsibility for managing local natural resources, even though local TEK is more complicated than a general understanding of the local environment.

4.2. TEK and Local Marine Management

TEK is not a static knowledge system but interacts with the environment to be an evolving process of knowledge. TEK on the local marine area in A'tolan can be learned from spearfishing men. However, there are still some issues that need to be surmounted. The challenges among the A'tolan Amis are as follows.

4.2.1. Climate Disasters and Crises of Reef Fish

As mentioned above, recent typhoon impacts have been becoming more critical and unpredictable as well as more intense. Typhoon Morakot caused major damage to the coral-reef ecosystem; fish populations have not recovered to what they were before. This is a major problem for Amis spearfishing men in A'tolan.

Furthermore, the other impact from the land is in the form of development projects, both for tourism and for agriculture. The growth of tourism brings more people, which implies that more wastewater goes into the sea without any water treatment. As for agriculture, chemical pesticides also flow into the sea. These problems cannot be managed by the local community alone; they require investigation, data collection, and a large budget to improve infrastructure.

4.2.2. Fishing as a Way of Survival

Most of the discourse describing freediving spearfishing regards it as a sustainable way to catch fish due to indigenous people only taking what they need at the time. Traditionally, most young Amis could spearfish on their own and did not need to buy fish. However, it cannot be denied that some of the spearfishing men make a living from spearfishing. They sell most of the fish to those whose young family members are not at home but working in the cities. In A'tolan, there is only one old spearfishing man who relies on selling fish to the villagers. This elder will sometimes spear small fish to sell. However, it seems insensitive to ask him not to spear a certain small fish because he is considered a master of spearfishing and is an elder, and according to custom, younger people need to respect their elders.

However, the younger generation is more easily managed because the age organization in A'tolan is still functional. As long as the mikumoday and the kakita'an (traditional leader) identify certain fish, sizes, seasons, conservation areas, etc., most of the younger generation will follow the rules. As for outsiders who come to the traditional marine territory, it will not be possible to enforce the regulations because the niyaro' has no authority or manpower to stop them, especially from hook fishing.

4.2.3. Political Rights: Sovereignty

The government does not understand the use of local TEK in managing marine areas and also does not have enough equipment or manpower to enforce the regulations, so it is not effective to manage local marine areas via top-down governance. CBNRM can be a solution to managing local natural resources, but the local community (institute) has no authority either. As Brad Coombes mentioned, an indigenous community has a sense of self-determination to defend their own environment, although internal ambivalence leads to an institutional process representing the indigeneity [19]. In other words, CBNRM in an indigenous community must be connected with the self-autonomy of the indigenous people.

Other examples of indigenous sovereignty as the key to CBNRM can be found in Hawaii. On Moloka'i, there is an indigenous community that manages its own marine area based on the local custom of consulting nature. Local indigenous communities have been forming a management system for marine areas based on some specific individuals learning local TEK, including environmental knowledge, beliefs, and the worldview to not only manage the marine area but also to teach others the TEK. This example has influenced many other Hawaiian communities and schools [39]. Therefore, there are more and more studies focusing on exploring indigenous ocean knowledge, which is utilized

in marine management [40,41]. Furthermore, there are some cases stressing the relationship between marine management and Hawaii's indigenous sovereignty [42,43].

In terms of Moloka'i's case, the customary sea tenure is one of the key issues of indigenous sovereignty. The legal framework of customary sea tenure is based on local TEK, which is not only recognized by the governmental authorities but also respected by the dominant society. In other words, the practices of TEK help to establish and legitimize local sea tenure [44] (p.19). Furthermore, the recognition and reinforcement of customary sea tenure and indigenous institutions for managing local marine resources "offer the best prospect for reconnecting fractured jurisdictional domains, and for bringing about social equity, environmental protection, and self-determined regional development" [45]. Therefore, customary marine tenure systems have a better chance of success in the management of local marine resources, and governments must strengthen them to enable them to play their role in sustainable marine-resource management [46]. In sum, due to the self-determination movement in the indigenous community, there is a chance to utilize TEK in locally managing a marine area, although the community must define the unity (community) and identify the key individuals as a team (institution) to proceed with CBNRM.

In A'tolan, the age organization has been representing the niyaro' since the 1990s. It is confusing that there are three different levels taking care of the public affairs in the community, including the administration village, Community Development Association, and Cultural Association of A'tolan Amis representing niyaro'. The Cultural Association of A'tolan Amis is based on the age organization. The Cultural Association of A'tolan Amis has a plan to have the A'tolan Amis develop fishing regulations by themselves. It would take a long time to form a system for managing the local marine area without any support from the government, ocean biologists, or even NGO volunteers. Therefore, the right to autonomy of the indigenous community is important for confirming the authority of the management and obtaining support from external resources.

5. Conclusions

How to manage natural resources sustainably has been a long-term discussion, not only in terms of theories but also at a practical level. Traditional Ecological Knowledge has been one of the core elements in managing local natural resources, which is also one of the foundations of local social-ecological resilience. Community-based natural-resource management (CBNRM) focuses on both TEK and the local community's participation in the managing system. Recently, in indigenous areas, CBNRM has further stressed the indigeneity of self-determination and the diversity of local political interactions in the indigenous community. CBNRM needs all the parties who participate in the natural-resource management to work adaptively as part of a co-management system.

In A'tolan, Amis freediving spearfishing men have comprehensive TEK about the local marine area, which is different from the scientific perspective. A'tolan Amis have also noticed that marine resources are decreasing. However, this is barely recognized in the management plan for A'tolan marine resources, either by the government or by the community. Even if the A'tolan Amis will be in charge of protecting the local marine area, some difficulties still need to be solved. For one thing, the government needs to understand that local marine TEK is not only related to the indigenous resilience of the social-ecological system but also the key to managing local natural resources and could provide many details about the local environment such as monitoring data for scientists and NGOs. The government also needs to support the community as it comes to agreement, and sometimes, social and cultural issues are among the keys to executing natural-resource management sustainably.

On the other hand, the indigenous community needs self-determination and autonomy as it raises environmental awareness, especially about how climate change and development projects would affect local marine resources. It is necessary to cooperate with external experts in demanding sovereignty, treasuring those who have TEK and teaching it to the next generation. Scientists and NGOs also need to learn to respect local TEK and to work with local TEK knowledge-holders and the informal cultural and community institutions that support them. In this way, scientists and NGOs might become more

effective in overcoming the misunderstanding and mistrust between the government and the local community, and become advocates for the importance of local TEK in managing and monitoring marine resources.

The co-management of forests between the government and the local indigenous community is becoming common in Taiwan at present. Ironically, though, there is a lack of discussion about co-management in marine areas. Freediving spearfishing requires knowledge of marine life and the environment. If the government wants to manage marine areas successfully, TEK from those underwater hunters can be a first step in adaptive learning for a local community or institute.

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Appendix A

Table A1. Fish that the A’tolan Amis spear frequently.

No.	Photo	Amis Name (Meaning)
1		Cu’in (upside-down betel nut)
2		Lilid (grasshopper)
3		Fice’ki

Table A1. Cont.

No.	Photo	Amis Name (Meaning)
4		Fice'ki
5		Kokok (chicken)
6		Pihoku'ay (greed for eating)
7		Sulita
8		Kung (owl)

Table A1. Cont.

No.	Photo	Amis Name (Meaning)
9		Kahungto'ay (pipe fish)
10		Lilateng (vegetable)
11		Mitilidan niliwa/salisin ira (chief of fish, shaman)
12		Lihok
13		Matopa'ay a Lihok (stupid Liohk)
14		Fafoy (wild pig)

Table A1. Cont.

No.	Photo	Amis Name (Meaning)
15		Lukedaw (tiger/leopard)
16		Sinapukay
17		Fati'alus
18		Afal
19		Kalapu'ay
20		Skal

Table A2. Traditional and contemporary coastal names in the A'tolan marine territory (from north to south).

No.	Traditional Name	Meaning	Contemporary Name	Meaning
1	Kanifangal		Longchang	Based on the administration village.
2	Kilacay			
3	Kalamuyud		Xinglong	Based on the administration village.
4	Kafafedin			
5	Kafiki		Yangqiao	Based on a bridge.
6	Pa'anifon		Xingchang	Based on the administration village.
7	Cinemnemay	Spring water; there is no water, so this name is an irony.		
8	Katangtang	The place for cooking.	Northern Kayakay	Based on the reference name in the south.
9	Cikayakay	The reef as a bridge.	Kayakay	The same as the traditional name.
10	Sukoan			
11	Kanapunungan			
12	Cingohonan	Named after a person who was drowned here.	Banshao	Banshao means military watch house.
13	Cifanaway	There is a hollow landscape.	Wali	The east point of A'tolan.
14	Patekodan	Different currents crash here.	Wali	
15	Pacifalan	The place for locating boats.	Dulanbi or Bazang	Contemporary name for the landscape, Bazang, borrowed from Hokeness, the cement block.
16	Cisiya'an			
17	Kanalatip	The waves push the land to the west.		
18	Kunkunlan	A place for youth talking.	Zilaishuichang	Water station.
19	Cilikesan	With many mosquitos.	Duqiao	Based on the bridge.
20	Ci'ataian	The land is shaped like a liver.	Northern Jiamuzi	The southern place as the reference.
21	Kamod	Plenty of fish that could be caught by hand.	Jiamuzi	Transformed from Kamod.
22	Afidayan		Jiamuzi pailion	Modern landscape.
23	Da'ado'ay	A creek runs into another creek.	Qianniaoqiao	Based on the bridge.
24	Kanalisalian	The river for washing illness.	The northern pavilion of the Xinglangang	Modern landscape, the harbor.
25	Nakai		The back of Meinung	The back of Meinung's house.
26	Fafikian		The southern pavilion of the Xinglangan	Modern landscape, the harbor.
27	Kanalesip		The 151k tree	The landscape.
28	Funto'an	Many young men wore loincloth.	Yuchang (fishing ground)	Plenty of fish in the Fushan conservation area.
29	Fudafudak	The ocean was shining.	Tsitong	Based on the administration village.
30	Kilam		Changjiang (long rivier)	Based on the underwater landscape.
31	Kalulu'an		Jiukongchi	Landscape.
32	Satefalan	A place for landing airplanes.	Jialulan	Based on the administration village.

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Article

Situating Indigenous Resilience: Climate Change and Tayal's "Millet Ark" Action in Taiwan

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Abstract: Whereas indigenous people are on the frontlines of global environmental challenges such as climate change, biodiversity loss, and numerous other forms of critical planetary deterioration, the indigenous experiences, responses, and cultural practices have been underestimated in the mainstream frameworks of environmental studies. This paper aims to articulate a meaningful response to recent calls to indigenous and local knowledge on food as a source of resilience in the face of global climate change. By retrieving the values and practices indigenous people of Taiwan, specifically Tayal women, associate with human and non-human ecologies, our collaborative work with the indigenous community explores indigenous resilience and its relevance to indigenous cultural knowledge and global environmental concerns. Pivoting on the "Millet Ark" action, a Tayal conservation initiative of the bio-cultural diversity of millets, this study revolves around issues of how Tayal communities adapt to the climate change, how to reclaim their voice, heritage, knowledge, place, and land through food, and how to narrate indigenous "counter-stories" of resilience and sustainability. The cultural narrative of "Millet Ark" investigates indigenous way of preserving millet bio-cultural diversity and restoring the land and community heritage, inquiring into how Tayal people are adaptive and resilient to change and therefore sustainable through the cultural and social life of millets.

Keywords: climate action; resilience; bio-cultural diversity; millet varieties; adaptation; sustainability; indigenous and local knowledge; indigenous food sovereignty

1. Introduction

It is commonly believed that the mitigation of the climate change impact needs to "think globally and act locally". The phrase is popular in international environmental movements since the 1980s that urges a common thinking of us living on the same planet and demands different allied actions from the local communities across the world to protect the earth. It indicates a common future of ours, in which we seek solidarity. While the global has been understood through many different languages and cultures, it is oftentimes perceived as the index of a hegemonic epistemology, for, unfortunately, these different forms of knowledge are not strong enough to contest with the dominant form of Western science. The global thinking based on scientific understanding often indicates a unitary voice that suppresses other forms of understanding the world. This paper argues for an alternative way of thinking based on indigenous knowledge without losing sight of facing the global crisis. It centralizes

the role of indigeneity so as to challenge Euro-American/Western epistemological privilege and evoke the planet as a resilient and sustainable home for all sentient beings.

Indigenous resilience is a way of thinking. Social-ecological resilience theorists study institutions, systems, and individuals so that they can understand how they withstand, or why they succumb to, significant disruption. Resilience is regarded as the capacity of a system to absorb disturbance without flipping into a qualitatively different state [1]. It is a normative concept and yet “the efforts to define it must be situated in the context of contested and evolving human interests and the uncertainties of human interaction” [2] (p. 5). This kind of reasoning with a critical focus on “situatedness” entails indigenous perspectives of understanding resilience. Knowledge that is “situated” acknowledges social, cultural, and historical rootedness to specific locations, places, and life practices [3]. It evokes an important aspect of indigeneity (for further discussion on the topic, see [4]), which allows the original inhabitants of a place to make truth claims to practices, thoughts, science, logic and reason, verified by accumulated experience with their traditional lands, communities and transactions with the environment. Indigenous people are active participants, rather than passive observers, of the Earth processes. A thorough engagement with the concept of resilience from indigenous perspectives may lead to recognition of new dimensions of “ecosystemic processes that contribute to human flourishing” [5]. We approach resilience from indigenous perspectives as a dynamic process of cultural and ecological adaptation and transformation in the face of global climate change, crucial to not merely the survival but thriving and flourishing of human and non-human species [6].

This paper aims to articulate a meaningful response to recent calls to indigenous and local knowledge on food as a source of resilience in the face of global climate change. By retrieving the values and practices indigenous people of Taiwan, specifically Tayal women, associated with human and non-human ecologies, our collaborative work with the indigenous community explores indigenous resilience and its relevance to indigenous cultural knowledge and global environmental concerns. Pivoting on the “Millet Ark” action, a Tayal conservation initiative of the bio-cultural diversity of millets, this study revolves around issues of how Tayal communities adapt to the climate change, how to reclaim their voice, heritage, knowledge, place, and land through food, and how to narrate indigenous “counter-stories” of resilience and sustainability.

The paper is divided into four parts: (1) “introduction,” in which we acknowledge indigenous and international grassroots voices and review relevant literature; (2) “methodology,” which lays bare the significance of “walking” and “narrating”/“narrative” as methods, using the storytelling tradition of Tayal people as its backbone; (3) “the cultural narrative of “Millet Ark,” which investigates indigenous foodscape and adaptation strategy as they are embedded in Tayal migratory history; shifting, fire-fallow and intercropping cultivation in the millet culture; the bio-cultural diversity of millets in the context of Tayal livelihood; and the Tayal women’s position and their connection to the land.; (4) “conclusion,” which prioritizes the indigenous knowledge as an essential part of contemporary discussions of resilience and reflects on the implications, limitations of the work, and further development of the research.

Acknowledging Tayal People’s Food Culture—A Review of Literature

Tayal people’s food culture reveals the depth of their understandings and knowledge about the local ecosystem and living places. This locally situated knowledge is, however, marginalized by the global capitalism as well as modern scientific knowledge under the proceeding of the Anthropocene. The traditional millet growing accompanied by multi-species cropping, shifting agriculture, rich knowledge of related rituals has powerfully demonstrated the people’s interdependence with nature and its advantage in living with the environment. Meanwhile, the tendency of monoculture cultivation, standardization, and mass production of agriculture has encountered unprecedented challenges due to the impact of global warming. It is high time that the world starts to reflect upon a new reappraisal of the value of indigenous ecological agro-knowledge.

The issue of traditional knowledge of agrobiodiversity is important, not only for Taiwan, but internationally. Berkes et al. argue that “traditional knowledge represents a summation of millennia of ecological adaptation of human groups to their diverse environments” [7] (p. 269). Indigenous peoples have observed and survived the changes in their environment for thousands of years. In indigenous foodscape is embodied “a capital of knowledge that contains not only the simpler, ‘Is this good to eat?’ type of information, but also the codified essential information on how to respond to changes in the environment” [7] (p. 281). Similarly, Zimmerer et al. emphasize “the value of locally sourced agrobiodiversity” [8] (p. 6). Along these lines of thinking, our research aims to retrieve the value of Tayal community in Taiwan as a model of “locally sourced agrobiodiversity” in response to global climate crises. Recent work such as “The Effect of Cultural Practices and Perceptions on Global Climate Change Response Among Indigenous Peoples” by Bayrak et al. examines how Tayal people have been affected by climate-related disasters and argues that their ways of responding to climate crisis should be incorporated comprehensively into global adaptation and mitigation policy in the face of climate change (see [9]). Nonetheless, little has been mentioned regarding the significance of the creation of a foodscape built on the relationship between indigenous people and the plants they cultivate for food. Our paper illustrates what is at stake when the relationship between indigenous people and the “first foods” they gather and cultivate is put at risk or interrupted due to the impact of global climate crisis (For a growing movement of foodways, human rights, and environmental justice, which is called the “local foods”, “food justice”, or “food sovereignty movement”, see [10]). Our research focuses exclusively on a unique initiative of the “Millet Ark,” on which we have collaborated with Tayal farmers and practitioners. It is grounded in connectivity and encounter rather than in division and separation between academia and the indigenous. The indigenous is the subject of self-articulation, self-reliance, and self-affirmation rather than that of research and scholarship. It illustrates the co-agency, co-organization, and mutual aid/support of researchers and indigenous people in solidarity.

Traditionally, Tayal people regard their surrounding environment as their food reservoir and know how to use it. Forests and rivers are regarded as part of their foodscape rather than scenic sites of national parks. Employing the concept of foodscape, we aim to explore places and spaces where Tayal people acquire food, prepare food, talk about food, and gather knowledge and meaning from food. First developed in the field of geography and later extended in sociology and anthropology, this concept furthermore directs us to investigate the institutional arrangements, cultural practices, and discourses that mediate indigenous people’s relationship with food [11] (p. 16). Climate change as it takes place across the globe brings about warning messages to urge us to reflect upon ancient ecological wisdom like Tayal’s food-based knowledges. Hsinya Huang notes elsewhere that national recognition of 16 Indigenous groups, the Tayal included, “marked a milestone in Taiwanese history” and provided “consistent and progressive formulation and execution of indigenous policies and coordinated planning for...the wellness of aboriginal peoples;” however, much remains to be done and indigenous groups continue to work “for self-reliance and self-affirmation” [12] (p. 165) (see also [10]).

Indeed, foodscape, which the Tayal call “nature’s refrigerator” in an intimate way, is a dynamic social and historical process of foodways, most relevant to Tayal people’s self-reliance, self-affirmation, and self-articulation. It embodies the people’s seeking, producing, competing, or sharing, and surviving upon the food in the places they have walked. The principles and mechanism of resilience can be best explored and apprehended from this dynamic process. Biggs et al. disclose the principles as to how to build resilience through maintaining diversity, managing connectivity, fostering complex adaptive system thinking, etc. [13]. In this paper, an attempt is made to explore Tayal foodscape as a source of resilience by examining these principles.

This paper draws on seven years (2013–2020) of research and field investigation on the traditional territory of Tayal people as well as on over a decade of collaboration between academics and Taiwanese indigenous writers, farmers, and practitioners, which has contributed to the development of a school of cultural study that links Taiwanese indigenous studies to global frameworks of native science and

aboriginal cultures. As members of Asia-Pacific Observatory the Humanities for the Environment (hfe) network (<http://hfe-asiapacific-observatory.nsysu.edu.tw/>), we work with colleagues from other 8 Observatories across the globe to identify and explore how humanities contribute to solve global, social, and environmental challenges in the Anthropocene. In this paper, the indigenous concepts of resilience, foodscape and sacred geography, household and well-being, subsistence tradition and bio-cultural diversity, etc. are conveyed in the form of narrative scholarship as our way of striking a balance between discursive formation and field practices. There are competing historical and cultural narratives deeply embedded in the landscape that indigenous people created. By including Tayal stories and words to best communicate their relationship with the land and local places, we aim to speak to the fullness of indigenous experiences and practices in their home place.

2. Methodology

To probe into indigenous ways of “observing, discussing, and making sense,” our study employs experiential methodology, specifically walking and storytelling, to engage in affective, place-based, and rhythmic aspects of indigenous knowledge. By experiential methodology, we mean to underscore the dynamic and meaning-creating process, in which humans interact with the world, or things, in our case, the Tayal millet foodscape. In a sense, humans are not only shaped by the environment and foodscape, but also have the power to mold the world. Experiential methodology recognizes that, in different relationships, we as humans make sense and create meanings through constant interactions and processes of perceiving, understanding, reasoning, imagining, and so on [14]. In such a process of co-belonging between humankind and the environment (foodscape), we become sensitive to perceive and to be concerned—a capacity to make ourselves sensitive that precedes all distinctions among the instruments of science, humanities, arts, theology, etc [15].

2.1. Walking (Transect Walks)

As field investigations and empirical research are pivotal in this study, we use walking as a mode of inquiry beyond the logics of symbolic representation. It is a form of engagement in the tangible, immediate, and evolving perception of local places, through which our scholarship transcends the confines of archival and office space and “seek ways to examine vital, sensory, material, and ephemeral intensities” of places [16] (p. 2). Tim Ingold in his renowned volume, *The Life of Lines*, analogizes individuals as lines, and as individuals walk along the surface of the ground, “they thread their lines through the world rather than across its outer surface. And their knowledge . . . is not built up but grows along the paths they tread” [17] (p. 47). Walking comprises a set of connected bodily performances, including observing, remembering, listening, touching, feeling, becoming sensitive and sensible, etc. It is through these performances, along the way, that our knowledge of Tayal foodways and foodscape is forged [18] (p. 5). This is how we understand indigenous knowledge as the indigenous communities accumulate ways of adapting and responding to changes along the path of their migration. In *Being Alive*, Ingold suggests that “all inhabitants are students and all students inhabitants—our task is not to take stock of its contents but to follow what is going on” [19] (p. 14). Walking as a method is not about collecting “contents” but about “following” the indigenous path of everyday life process and “becoming” indigenous inhabitants ourselves. When working with Tayal farmers, we recognize that we are all students in a learning process, and thus our responsibility lies not so much in documenting any static content of knowledge as in tracking closely an unending path of learning. Walking enables an ongoing process of embodied learning.

In fact, the original inhabitants of our island walk/migrate; as they walk, they thread their lines through the world rather than across its outer surface. Their knowledge, as Ingold puts out, is “not built up but grows along the paths they tread” [17] (p. 45). The Tayal community, like other Taiwanese indigenous groups, migrates. In Tayal tradition, migration is a communal activity, and more importantly, it is a way of coping with and responding to environmental changes. Throughout thousands of years in history, Tayal people have accumulated knowledge and experiences

of change and their adaptation has been embedded in their culture as well as everyday life practices. Whether the causes of migration were natural (floods, earthquakes, plagues, etc.) or human-made (wars, population booms, land shortages, etc.), Tayal ancestors had to take responsive actions in their migratory process. This process includes acknowledging a survival crisis, forming a consensus to leave the original location, sending people to scout ahead, and confirming the livability of the new land. Tayal migratory process has been well studied with participation from indigenous members and the result is an award-winning documentary film, titled *Once Upon a Time (Thousand Years of the Tayal)* [20].

Tayal people migrate and develop “situated knowledge” of their place. In our research, we feel the compelling necessity of “walking” their place as a method and in so doing, acknowledging ethico-political responsibility toward the land, which requires both reflexive thinking and communal engagement. We conceive our work through mediation and bodily affect as we “walk” through the land of the indigenous people. In “walking,” we endeavor “to observe which is not to objectify; it is to attend to persons and things, to learn from them, and to follow in precept and practice” [17] (p. 157). It is as such that we define the indigenous land “not as a two-dimensional segment of a map but as *something on which an entity depends for its subsistence*” [15] (p. 263).

2.2. Storytelling

Walking, as Tim Ingold et al. put it, is much like talking, and both are quintessential features of what we take to be a human form of life [18] (p. 1). Our scholarly journey is a long walk of seven years with indigenous farmers and practitioners, which entails pensive thinking, conversations, and telling of stories. Indeed, there is a strong oral tradition in indigenous culture. Instead of writing, indigenous people tell stories and pass on their heritage from mouth to mouth. The oral art of story-telling challenges the authority of writing culture and thus, in effect, Euro-Sino-centric understanding of language and representation. Through the never-ending stories, transformed with each retelling, indigenous people rely on the oral ritual to reclaim the lost heritage of their community. In each of the walking workshops, Pagung Tomi opens her story/song with a telling of her ancestors’ migratory history in her native language. Each of the tellings becomes not just a repetition of the tale, but a metamorphosis of a past lost, in a present lived, and a future foreseen. Each story gives rise to a strategic disclosure and each enhances self-empowerment and self-creation. Story becomes her testimony which embodies significant cultural and political repercussions. This testimony has involved a potency to communicate odds and gains, risk and management, scarcity and their struggle for survival. When the story flew into her ears from her forebear, it made a picture in her mind she could never forget. As migratory people, history/memory is embodied in the land and traced with stories, with the presence of ancestors and spirits. Pagung’s stories testify indigenous presence in this land and delineate how indigenous people adapt and respond to the changes and crises and become resilient. We stress the value of story-telling in a time of danger and crises such as global warming; as Walter Benjamin has put it, the people of this land strive “to seize hold of a memory as it flashes up at a moment of danger” [21].

3. The Cultural Narrative of “Millet Ark”

This paper focuses on the narrative of recovering millet in Taiwan indigenous cultural context, through which to find inspiration about adaptive mechanism in the face of climate change. It has to be told through the global-local interaction events concerning sustainability under the impact of climate change. The “Millet Ark” initiative involved by the authors exemplifies a social practice of collaboration between some indigenous people and academia. It starts from an international invitation but is based on a sincere support for local thinking. In 2013, Frederik van Oudenhoven, a Netherland environmental NGO organizer and a book-prize winner [22], got in touch with us through the International Society of Ethnobiology’s secretary, Natasha Duarte. He was asked to establish a grassroots taskforce in response to climate change and in order to do so, he invited mountain-dwelling indigenous farmers from different countries to gather and discuss how climate change affected their environment as well as

find a solution based on their local knowledges. This concept is founded on the presumption that the residents of the high mountains would sense the impact of climate change more acutely than those in the modern urban settings. This is also why some of them become victims and are known as “climate refugees,” for example, due to the accelerated effect of melting snow in mountains of the Himalayas or Tibet. Moreover, these indigenous farmers that reside long-term in the mountains must be able to react to the ever-changing natural environment, so they might have accumulated some local knowledge and created a culture around adapting to changes. This is what then we participate in the INMIP (International Network of Mountain Indigenous Peoples) [23], a global grassroots network organization founded on this kind of dialogue and cooperation. We anticipate the creation of a positive and proactive grassroots force and the discovery of a way to contribute as a collective voice from indigenous peoples on the climate change issue.

In the spring of 2014, this grassroots network concept finally came to life. Yih-Ren Lin and Pagung Tomi, two of our authors, as well as a few members of Taiwan’s indigenous people, including Apuu Kaaviana from the Kanakanavu tribe, and Atung Yupas and Yapit Tali, who are both from the Tayal tribe, were invited to Bhutan to meet with mountain farmers from nine other countries and participate in a walking workshop. This process and outcome were later broadcasted by Taiwan’s indigenous television network [24]. The walking workshop took us into the actual landscapes of the indigenous people in Bhutan, and the climate change issue was the main point of discussions. As we walked and talked, we pulled together different experiences and opened up an opportunity for mutually beneficial sharing among the different indigenous peoples. During the five-day event, we came up with a formal and public declaration on our stance regarding climate change [25]. Our representatives and the International Institute for Environment and Development (IIED) then presented it at the international conference on climate change. In addition, our agenda this time also took us to the 14th International Society of Ethnobiology conference held in Bhutan. More importantly, as an indigenous woman from the remote mountain area in Taiwan, this was Pagung’s first time to hear, through a friend’s translation, the various farmers from around the globe and share their experiences dealing with climate change. She was moved and inspired, especially in terms of protecting traditional crops. This event later made her think about what she could do from her own cultural point of view.

In 2016, the group of Taiwanese representatives, inspired by the spirit of walking workshop, launched an “International Indigenous Ecological Farmers Alliance Conference” in Taiwan, as a response to the Bhutan Declaration, through collaboration with the International Society of Ethnobiology. All the countries that attended the conference created the farmers’ declaration together after the walking workshop. Then Taiwan’s representatives, Apuu Kaaviana and Yih-Ren Lin, brought it up during the Democratic Progressive Party’s Central Standing Committee meeting as a reminder to the elected party of the indigenous small farmers’ agricultural policy, as well as their determination to respond to the climate crisis together. As one of the indigenous representatives, Pagung decided to revert back to the traditional millet cultivation in her village, Tbahu. In addition to the eco-farmers conference, her action is also influenced by the following 2017 INMIP walking workshop in Peru, where indigenous farmers shared their experiences as they toured the world heritage site “Potato Park”, which shows the indigenous contribution of their local knowledge in conserving rich varieties of potatoes.

According to Pagung, millet is the shared traditional crop of the Taiwanese indigenous peoples, and thus there is a deeply-rooted connection between the cultural history and local knowledge of the indigenous groups. Millet demonstrates not only biological diversity but also cultural and linguistic diversity. In other words, millet is not just millet itself. It has to be connected to the land the people belong to. Therefore, the key issue is the operation of the millet field and related knowledge which includes the millet’s resilience regarding water supply, soil fertility and slope restriction. The fact that Taiwan is a subtropical pacific island no less with natural disasters such as typhoons and earthquakes presages the high probability of indigenous peoples’ migration activities and forms their dynamic settlement livings. Thus, the natural and social process of how the millet field is produced has to be dealt with seriously. As we engage ourselves with the social practices of millet field restoration, the whole

traditional livelihood of the Tayal people begins to unfold itself. This livelihood illustrates how the indigenous people’s traditional migration, environmental change and the basic food demand have converged to the millet field operation, which we consider to be foodscape production. The following are our observations and findings from the social practices and process of the “Millet Ark” initiative, including (1) Tayal foodscape and hidden adaptation strategy in their migratory history; (2) shifting, fire-fallow and intercropping cultivation in the millet culture; (3) the bio-cultural diversity of millets in the context of Tayal livelihood; (4) the Tayal women’s position and their connection to the land.

3.1. Tayal Foodscape and Hidden Adaptation Strategy in Their Migratory History

We start our millet story from Tayal’s traditional migratory phenomenon. Our purpose is to understand the relationship between traditional food production and the ever-changing living environment. To the Tayal, migration is a common and communal activity, and more importantly, it is very possibly a result of lacking food supplies under the impact of climate change. In this paper, we learned from the Tayal elders about their migratory routes for the past four hundred years. Figure 1 shows the route, which is a GIS (Geographic Information System) map guided by the past elder Masa Tohui. We drew the map mainly based on the contents of Tayal’s special ancient singing called “Imuhuw.” It is the Tayal’s unique way of telling their cultural stories. For an academic purpose of understanding “Imuhuw,” different aspects of translation are needed, which include the recording of ancient singing itself, transcribing it into Tayal language, the translating activities to other languages such as Chinese and English, and finally the collaborative interpretation amongst the authors. The outcome is mainly presented in the form of GIS map, which is to be viewed side by side with the singing passages and the accompanied interpretation. This is a way of deeper understanding about Tayal’s indigenous knowledge. Moreover, “Imuhuw” also contains the information about Tayal spatial memory, ecological observations of their living environment, adaptive strategies, and historical migratory social action responding to the environmental change. In a sense, the migratory routes and their mapping embody Tayal people’s foodscape, in which the landscape such as forests, rivers, millet cultivation lands, and households is perceived as the container of food production. It also illustrates how the changing environments affect Tayal people’s livelihood. Migration is a strategy of adapting to the changes.

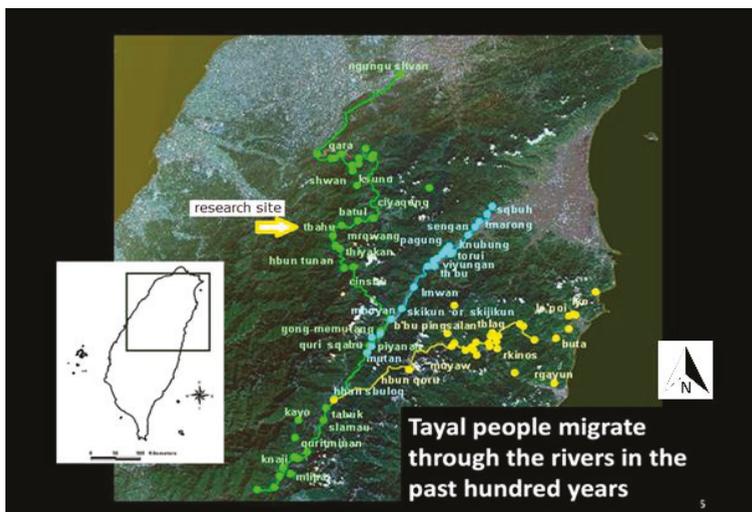


Figure 1. The migration route, traditional territory, important places, and villages of Tayal people (map guided by the past elder Masa Tohui, drawn by Huei Chung Hsiao).

Traditional singing of “Imuhuw” is the best oral record of Tayal migratory history. It is Tayal people’s narrative of their life, past, present, and future. The singing unfolds a deep culture of how the people respond to changes, which strongly links to their social institution. Tayal is a big tribe in Taiwan. It is divided into several subgroups with distinctive linguistic differences. Each sub-group called “llyung” (literally, the group of one river basin) has their own singing which contains the migratory history of the group. In her fieldwork, Pagung heard the singing from elder Yupas Pusing, recorded and translated it collaboratively with Atung Yupas and Watan Kahat. Her village Tbahu belongs to the Mknazi sub-group of Tayal people. Seeking the supplies of food is always the central concern of the migration, which is made explicit in the following passages from “Imuhuw”:

Pin’ara ke nqu bnkis na Tayal lkotas ta lkmButa, lkmYaboh, lkmAyan

(A reminder from lkmButa, lkmYaboh, lkmAyan, the three great ancestors of the Tayal people)

laqi! maha ni si ta kaki squ qbuli na bnkis ta qani lga, musa ta pskyutan qu hwinuk ta la. mosa ta yan nqu qara na maqaw pqqolan nqu llaqi ta kinbahan la, mosa si psqquli mita wagiq la. nanu yasa qu usa ru usa hmkangiy kzikan mamu balung, usa hmkangiy ‘san mamu matuk tnga na pazyeh, teta musa mbhuyaw pslabang mqyanux squ tgyzumuw na rhzyal qu laqi mamu kinbahan, teta simu minblaq mita squ sinnyaxan na wagi, mtasaw na qsya. yan na ‘ali bzinuq mbhuyaw.

(Children! If we keep on guarding our original homeland, we may starve and become thin. Descendants! Perhaps we may even fight over mountain peppercorn just to fill our bellies, and sigh to the skies. Thus, you must rise up, and seek hunting grounds that you can weave through, fertile land that you can plow. Let future generations flourish on bountiful land, accompanied by sunshine and clear rivers, and grow as quickly as a flying arrow).

This passage suggests the impact of environmental change that causes shortage of food. Planning to migrate seems to be an alternative for the survival and thriving of the group. It also shows that the decision is made in a thoughtful way and with courage. Apparently, unlike the modern compulsory relocation project determined by the government, Tayal people have the free will to carefully choose where they are going to stay and they do it with sophisticated preparation.

Furthermore, Tayal people migrate in solidarity and recognize themselves as oneness despite the coming split due to migration, as the next passage indicates:

qutux lozi ga, laqi! usa ru usa blaq pgwayaw squ son mamu mtasaw nqu llyung, laxi usa mkkkiy nqu qlcing, laxi usa pqeway na pakaw. kya qu qmayat squ tluqiy, ini ga blaq balay pgwayaw qu tunux na bubu, teta simu minblaq mbhuyaw.

(Also, children! Find a heart as clear as water, do not become cold and indifferent to each other. Do not cut off contact using thorns and fences. If there is someone you like, choose wisely and determine the bloodline, so you may thrive and grow in strength).

Some other “Imuhuw” passages show the Mknazi’s migratory routes over the past four hundred years (Figure 2). They identify Quri Sqabu, Papak Waqa, and Hbun Tunan as significant landmarks and as integral to the Tayal territory. In the Tayal creation story, “Pinsbkan” is their ancestral home, meaning “birthplace of the rock cracks”. It is a metaphor for all the future generations moving north along the rivers and mountain ridges, expanding their territory, finding fertile lands, and dividing into various subgroups. In this paper, we focus on how one of the subgroups Tbahu village’s ancestors migrated to the group’s current place as well as their geographical knowledge related to the environment. Figure 2 maps the Mknazi migratory route of Pagung’s ancestor, lkmButa, from the Tayal origin place, as it is recollected from the traditional singing of Imuhuw as follows:

rasun lkmButa mkura sa quri Sqabu

(Chief lkmButa led his people toward the mountain saddle, Sqabu)

mbyaq squ son mha hbun na Mhebung
(go downward to the so-called rivers' confluence, Mhebung)
Tqzing
(the first village name from the three ancestor brothers' split point)
usa ru usa mbyaq squ hbun Tunan
(continue to go downward to the rivers' confluence, Tunan)
hbun Pehwan
(the rivers' confluence, Pehwan)
hbun Bilaq
(the rivers' confluence, Bilaq)
hbun Gogan
(the rivers' confluence, Gogan)
ru usa squ son mha llyung Mstranan
(continue to go to the riverbasin of Mstranan)
ru llyung Mstngtung
(go to the riverbasin of Mstngtung)

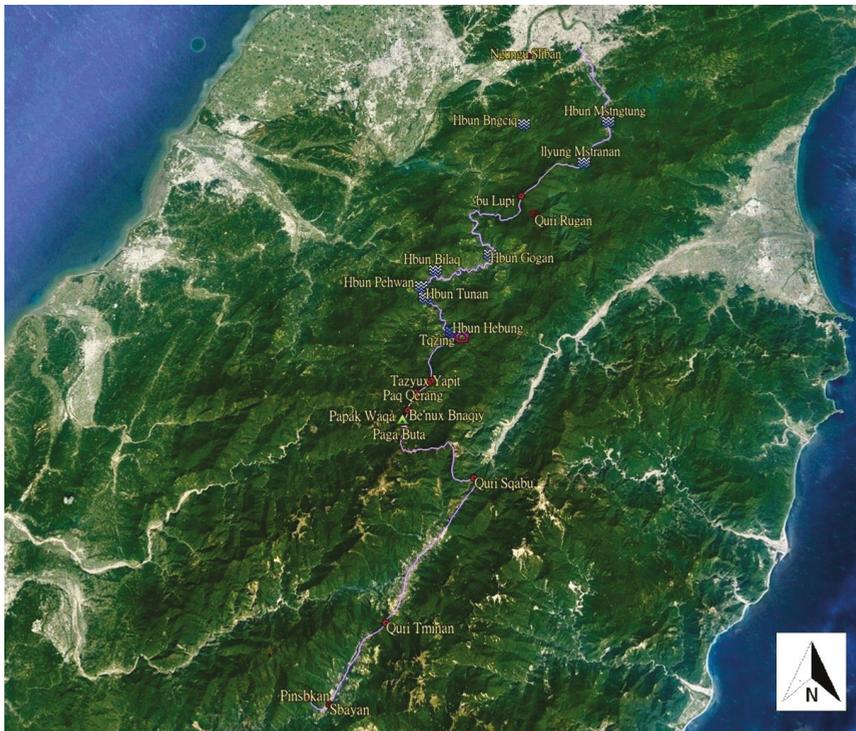


Figure 2. The main Mknazi migratory route of Pagung's great ancestor, Ikmbuta from the Tayal origin place (GIS map by Pagung Tomi).

Chief Ikmbuta is one of the three ancestral brothers and the direct ancestor of Pagung's villagers. In Tayal vocabulary, quri and hbun respectively mean the mountain saddle and the rivers' confluence. Both are the key landmarks for the Tayal to navigate the mountains. Hundreds of small place names describe their ecological observations along their migratory route. The observations embedded in the place names are evidence of their knowledge regarding how to adapt to the changing environment.

This knowledge is vital to their safety and food supplies. Examples abound as shown in Figure 3 and Table 1.

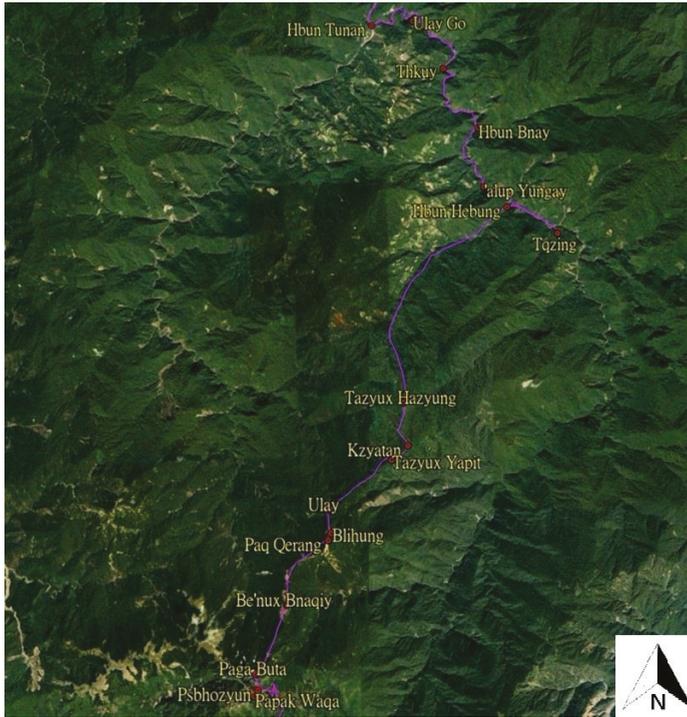


Figure 3. Some Tayal place names of ecological and geomorphological significance on the migratory route (GIS map by Pagung Tomi).

Table 1. The geomorphological and ecological knowledge as it is embodied in the place names of “Imuhuw”.

Migratory Order from South to North	Tayal Place Names	Geomorphological or Ecological Characteristics
1	Psbhuzyun	a windy and cold place; when passing through one must hold on and crouch low; the wind is strong enough to blow down small rocks, so Tayal people must past through quickly, sometimes hand in hand.
2	Papak Waqa	the sacred mountain of northern Tayal people
3	Paga Buta	the ancestor IkmButa’s storage shelf
4	Be’nux Bnaqiy	a sandy flat place on the mountain top
5	Blihung	a door-like cliff
6	Paq Qerang	qerang means red bean or ice storms; there is often freezing rain here, which is visible to the eye; it’s a very beautiful place.
7	Ulay	hot spring
8	Tazyux Yapit	yapit means flying squirrel; tazyux is a place to rest; this means a place where many flying squirrels like to rest.
9	Kzyatan	clothes getting wet because of thick mist

Table 1. Cont.

Migratory Order from South to North	Tayal Place Names	Geomorphological or Ecological Characteristics
10	Tazyux Hazyung	a rest place with many pine trees
11	Hbun Hebung	hebung means yellow color because of the autumn leaves of maple trees; hbun means rivers confluence
12	Tqzing	The first established village after IkmButa left Quri Sqabu
13	alup Yungay	a place with many Wild papaya
14	Hbun Bnay	bnay means little wild orange; hbun means rivers confluence
15	Thkuy	a place with a sharp turn
16	Ulay Go	a place with many green pigeons drinking and eating
17	Hbun Tunan	tunan means weaving; hbun means rivers confluence
18	Hbun Bilaq	bilaq means gravel; hbun means rivers confluence

Moreover, any migratory action is a careful collective plan that includes many preparations in advance, such as the probing of possible residential sites and their land condition for future food sources. In “Imuhuw,” as the phrase “so-called” implies that the route had been well explored by the heralds before the group set out on their journey. The Tayal remember their ancestral migration through “Imuhuw,” which tells stories of not merely survival but flourishing of the indigenous groups. As diverse, healthy, and sustainable food and cultivation systems provide needs of present and future generations, the Tayal continue to thrive and flourish. It is worth noting that without aid of modern technology, the Tayal ancestors have retained their ecological and geographical knowledge through singing their “Imuhuw”. The reason for the migration is very much connected to the impact of environmental change. How to survive on a harsh migratory journey was strongly connected to the millet culture, as examined in the following sections.

3.2. Shifting, Fire-Fallow, and Intercropping Cultivation in the Millet Culture

Tayal people have a myth (Figure 4) about shooting the sun; this story is evidently the people’s response to climate change in natural history, which also has to do with millets. Legend says that a long time ago, two suns appeared in the sky and caused a great drought. The Tayal chose brave warriors to carry infants on their back and go where the sun was. During the long journey, the children grew up and finally shot down one of the suns to restore life to the earth. Throughout the long journey, each warrior kept a tiny tube in his earlobe, and inside the tube were millet grains. Millets were to be sowed on their path, so that the warriors could find their way home and meanwhile secured enough food for their travels. The elders often repeat this story, as if to tell us that climate change is not a modern occurrence.

Millet plays an important role in the Tayal migratory epic. According to the elders, traditional millet cultivation has three important ecological secrets: first, fire-fallow cultivation; second, shifting cultivation; and third, intercropping. Millet is a drought-tolerant crop so it does not need a complex irrigation system, and it is often grown on uneven lands and steep hills (Figure 5). The changes to agriculture due to limitations of the topography show Tayal people’s adaptability to mountain life.



Figure 4. A wall painting about the myth of “Shooting the Sun” in Cinsbu Church. (Photo by Yih-Ren Lin).



Figure 5. A sketch of traditional millet field on a mountain slope (Sketch by Wen-Chi Liao).

The Tayal practice fire-fallow cultivation because they do not separate forestry from agriculture as modern land management would. When the Tayal ancestors first arrived in a new location, they would clear up trees and weeds, and then burned them. Next, they would mix ashes with the dirt and use them as a kind of natural fertilizer and start to farm. In the fire-fallow process, they used fire very delicately. Determining wind direction and when to ignite the fires are skills necessary for fire-fallowing; otherwise it could lead to devastating forest fires. Through this farming method, the Tayal could artificially turn their woods into fields and, more interestingly, recover their fields into woods.

This use of land brings us to a discussion on shifting cultivation. Realizing how long-term farming would make the land less fertile and make it hard for the millets to grow, the Tayal practiced shifting cultivation. Unlike modern agriculture where farmers keep adding fertilizer, the Tayal ancestors chose to let their land rest. Letting the land rest is a special feature of the millet’s shifting cultivation. Moreover, while they let the land rest, the Tayal grow Makino bamboo (Figure 6), which they call “luma” or they grow Formosan alder (*Alnus formosana* Makino), “iboh”. The Tayal people are very dependent on Makino bamboo; bamboo shoots are a source of food, and bamboo stem is used for construction. As for alder trees, they are a heliotropic plant that form symbiotic relationships with

the rhizobium that grows in its roots. Rhizobium has the ability to fix nitrogen into the soil, so once they burn the alder after a few years, the land retains the nitrogen rich soil. Thus, through implementing shifting and fire-fallow cultivation, the Tayal people have created a complex adaptive ecosystem. They are a part of nature, and not apart from it. This could be what the North American Chief Seattle truly meant when he said that man belongs to the earth.

Intercropping is still another special feature of the millet fields. Instead of saying that the millet is the only crop, you might say that it is the flagship crop behind the creation of the Tayal homeland. Traditionally, besides the millet, in a millet field there are also sweet potatoes, taros, corns, pigeon peas and other different crops. Other grains and beans are grown amongst the millets, creating a nutritious diet for the Tayal, which contains protein-rich beans as well as starch (Figure 7). Furthermore, these crops also attract animals like birds, mice, and wild boars. The Tayal set traps for the animals in the fields, adding a new source for animal protein. The elders told us that in the past, millet was very rare and had to be carefully protected. One night, the person guarding the millet field heard a clanking sound and thought it was a thief. But upon listening carefully, he found that the noise was coming from beneath the ground and it was the sound of the sweet potato roots expanding. These roots created crevices and space in the soil, allowing the millet to sprout. The story of sweet potatoes helping the millet grow was a touching tale of ecological symbiosis to our ears. The concept of an ecological network has already long been passed down in the indigenous culture. According to the Pacific Island indigenous myth, peas, corn, and cassava are three sisters. Cassava loosens the soil underground to let Corn grow vertically upwards, and Peas can grow along the cornstalk, creating an interdependent/intercropping ecosystem. The intercropping tradition convey strong ecological significance while the Green Revolution of modern agriculture endorses mass production of a single crop, going against the balance of nature.



Figure 6. Resting millet field covered by the vegetation of Makino Bamboo.

In short, fire-fallow, shifting, and intercropping cultivation in the Tayal millet culture formulate a harmonious union of farming and the ecological system. This is most likely a result of long-term evolution and adaptation. Even more noteworthy is that this kind of codependency and mutual support is especially important under the context of climate change. As a major staple food, millets facilitate and shape the dynamic development of Tayal's traditional territory, in which the responsive strategies to climate change reside.

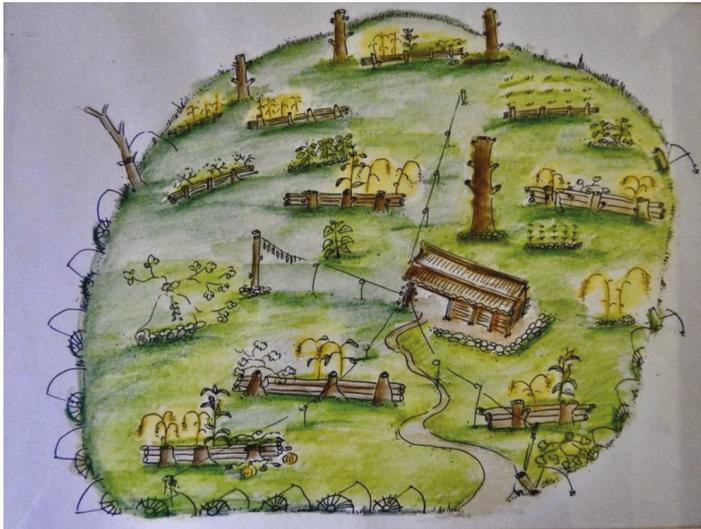


Figure 7. A traditional mix-cropping millet field and the traps for animals (Sketch by Wen-Chi Liao).

3.3. The Bio-Cultural Diversity of Millets in the Context of Tayal People

When Pagung began to grow millets at home in 2016, she had little experience and received many skeptical eyes from the villagers. The village Tbahu like many other indigenous villages in Taiwan has gone under the influence of market economy which means farmers got used to growing cash crops. Tbahu is a famous and an important site for growing tomatoes to supply the urban area like Taipei, the capital. Few villagers would recognize the value of growing back the traditional crop, millet, because they do not find it worthwhile in terms of income. Traditionally, millet is their staple food, but the cultivation habit has been replaced by rice paddy since Japanese colonized Taiwan in 1895, in order for the government to fix them in one single location and prevent them from migrating. Therefore, this village has abandoned millet growing for quite a long time. Under such circumstances, Pagung's millet dream was hard to realize; nonetheless, she managed to find millet seeds collected by researchers from other Tayal territories and preserved in the government's seed bank. She also found a piece of land and began to grow them.

She received little attention until one day an old woman visited her millet field. Pagung was surprised by her appearance and asked her why she was here. The old woman started to tell stories about millet, reminding her of many childhood memories. She began to tell Pagung knowledge related to millet including the long-lost vocabulary about the names of different millets, rituals, and agricultural practices to take care of the millet field. Pagung started to interview the elders in the village, including her own father, and recorded their knowledge about millet. Table 2. Ethno-classification of millets known by Tbahu villagers shows the vocabulary of millet varieties.

Seven different varieties of millets have been identified, each carrying an indigenous name, based on their colors and other characteristics. Indigenous peoples preserve them by growing and caring them in their environment and everyday practices rather than in the seed bank as the main-stream bio-science does. In this in situ way, language and culture of the millet accompany the biological diversity. Pagung witnessed the whole process of recovering Tayal millets in the past 5 years, at different stages of growing millet, for example, clearing the field by slashing and burning, seeding, weeding, thinning, bird-repelling, and harvesting. Pagung's people start to plant the seeds by observing the blossoming of mountain cherry trees around February but the phenology is now seriously challenged by the climate change. Moreover, while slashing and burning practices used

to be regarded by colonial Japanese experts as out-of-date agriculture, they recovered sophisticated knowledge through their practices, which we will explain later in the migratory section. Rituals at different stages represent indigenous people's relationship with the land and more broadly their cosmology. Knowledge related to naming, resources usage technology and skills, social institution, spirituality, belief, and worldview are richly embodied through Pagung's long-term social practice by growing millet. The cultural and social life surrounding millet would not be possible if millet seeds were only preserved in the low-temperature refrigerator under the scientific project of a seed bank for biological diversity.

Table 2. Ethno-classification of millets known by Tbahu villagers.

Characteristics	Tayal Name	nmyun	ntosa	nbukil	nqara	nzyungay	nbaqu	npepay
Stickiness	yes			V	V	V	V	V
	no	V	V					
Grain colors	yellow	V		V	V	V		
	red							V
	black						V	
	brown		V					
	Long hairy				V			
Millet spike appearance	Short hairy	V			V	V	V	V
	Not hairy		V					
	Single fork tail				V			
	Double fork tail					V		
	Sharp point tail							V
	Round point tail	V			V		V	
Spike length	Tightly packed grains		V					
	Less than 15 cm		V		V			
	Longer than 25 cm	V		V		V	V	V

Pagung's initiative of recovering millets has gained support from a small grant of Ministry of Culture as well as collaboration from the universities. Over the years, one plot of land has grown up to ten plots and become a significant landscape of millets in the village. Attracted by the landscape, more villagers came to serve as volunteers, especially the older women. They revealed stories about millets. Story-telling then becomes a common way of life when there are significant rituals held for millets such as seeding or harvesting. These stories include villagers' collective memory and knowledge related to millets. It also constitutes and reconnects the relations of the villagers to their traditions surrounding the land and their ancestors.

3.4. The Tayal Women's Position and Their Connection to the Land

Millet culture is rapidly disappearing under policies that encourage the modernization and grounding of Taiwan's indigenous peoples. In losing traditional cultivation culture, the biggest problem is the loss of the connection to the land and adaptability to environmental changes. When we joined the INMIP's walking workshop seven years ago, we gradually felt the importance of the grassroots force and traditional ecological knowledge to the climate change response. Thus, we started the "Millet Ark" Initiative. This movement was started by Pagung in her own village, Tbahu, and is a preservation initiative regarding the bio-cultural diversity of millets.

Taiwan has over a hundred kinds of millets. Moreover, different villages have different traditional uses of millets. Millets can be steamed, made into congee or cakes, used for marinating meat or making wine; each village has their own methods. Pagung's village has not grown millets in over thirty years,

mostly because the need for modern currency caused them to switch to cash crops. The traditional phrases, rituals and skills and social practices related to millets all disappeared when they ceased to grow them. The preservation of millets means physically growing them on their fields, not resorting to any scientific methods including freezing seeds. Upon return from Bhutan in 2014, our team has been focusing on bringing back millet cultivation, especially in Pagung's village. Pagung remembered that the seeds of different varieties were gathered from various Tayal village locations and stored by the government. So, the first step was to get these seeds back and find land in the village to plant the millets. Thus, the millets grew from one field to over ten different fields over the past years. The number of participants increases from one person into an entire group of indigenous cultivators.

Continuous support came from the elderly women. They were the first villagers to approach the millet field, and they were the ones who started to share their memories of millet growing with Pagung. They shared many words related to millet, including the names of different millet types, the words for different stages of cultivation, songs, rituals for sowing, harvesting, and storing, as well as millet-related stories. The participation and memories of these women added a lot of cultural and social meaning to our "Millet Ark" initiative. Traditionally, the Tayal's patriarchal society demands women to be less vocal in public, but this does not mean that they are not proactive in the society. The millet preservation movement not only let us realize that women have an active role in the millet cultivation process, but also that a lot of the ecological knowledge is demonstrated in their everyday practices. Table 2 discloses a part of this knowledge. More significantly, the efforts of the women have expanded the field of millets from one piece of land to a landscape of traditional food production (See Figure 8).



Figure 8. The restoration of millet foodscape by "Millet Ark" Initiative; (The yellowish part is millet field. Photo by Pagung Tomi).

The millet landscape is a soothing place, for it recalls the elderly women's cultural memories, which include many past feelings that were erased by modernization. Through physical labor and contact to the culturally-meaningful millet, the process brings forth an intimate connection between the individual and community, between people and the earth, and between people and the spiritual presence. This landscape is not "no human being's wilderness." On the contrary, the labor and participation of the people enriches the land with an emotional connection, adding to the meaning of "Tayal country." "Tayal country" basically refers to the socio-ecological system created through the Tayal people's interactions with nature. In this there are not just material but also biological and societal ecological services. This is the force that made the women willing to approach the millet field and gain a kind of healing. We have participated in Tbahu village's sowing, harvesting, and storing

process and simultaneously felt a kind of harmonious rhythm. The healing and affective impact of this millet initiative can never be overestimated. Unlike cultivating cash crops, millets bring smiles, laughter, and rest. This is because it is not done for monetary gain and these women forge a sense of community and a bond of common livelihood through the childhood memories that they rediscover and share. They plant step by step on a terrace field, and the sowing work is finished quickly (Figure 9). As a consequence, the mothers went to rest in the shade, and someone started to hum traditional tunes of rimuy-rimuy-rimuy-so and voices soon joined to make a chorus. This is a soothing scene, in which re-growing the millet balances out the stress of work and distance between people and the earth caused by the logic of a capitalist market. Traditionally, millet growing is accompanied with the rhythm of seasonal change, the ecological interaction of the land, soils, and non-human species, the collaborative work across the age and gender of all family members, and the rituals to connect humans with nature as a whole. In our millet narratives, women take the lead to restore knowledge about millets and by extension, usher the community into the sustainable and resilient future through the present action of “Millet Ark”.



Figure 9. T'bahu women working in the millet field (Photo by Yih-Ren Lin).

The millet story comes to a symbolic performance when a food rights panel based on this millet initiative was presented in the 2019 annual meeting of the American Studies Association in Honolulu, Hawaii. The panel titled “Building Caring Solidarity Economies: Food Sovereignty, Community Solar, and Gastronomies of Place” conveyed indigenous perspectives in building caring “solidarity economies” around food and energy systems, with Pagung being the primary voice of indigenous vision and wisdom [26]. As a Tayal conservation initiative, the “Millet Ark” features indigenous self-determination and place-making and brings to life the traditional foodscape which would otherwise be consigned into oblivion.

The international conference is not merely an intellectual event but a long walk, which will be continued. This walk is about indigenous knowledge and its relevance to climate change, from the ancient to the contemporary. Our local efforts of almost seven years had a chance to be presented internationally (Figure 10). The purpose of sharing our story was to explain one thing, which is a variation of the average conservationist’s slogan, “Think Globally, Act Locally.” Our movement emphasizes that “Think Locally, Act Globally” is just as important. Global and local conservation efforts are mutually dialectical, and localized thinking shows the importance of traditional ecological knowledge. Our seven years of practical work has reaffirmed the value of

the ancient knowledge accumulated by Taiwanese indigenous peoples in regards to the current global crisis. In the face of environmental changes, people must adapt and learn in accordance with nature. Our initiative delivers not merely the biological or cultural characteristics of the millets, but how millet growing entails an understanding of the environment.



Figure 10. Pagung used Tayal language to illustrate the Millet Ark Initiative and was accompanied with the English translation by Yih-Ren Lin and Chia-hua Lin in the ASA meeting. (Photo by Hsinya Huang).

In Taiwan, millets are the flagship species of the Tayal people’s traditional crops. Tayal elder and practitioner Pagung’s experience exemplifies how the indigenous people in the trans-Pacific context forge practices that invoke the concepts of traditional knowledge, native science, resilience, and foodscape. In one of the walking workshops later held in the mountainous Tayal villages, Pagung sang, in indigenous words, a song about the migratory journey of her Tayal ancestors, a group of whom walked across the sacred mountains of Papak Waqa and settled in Mknazi as “those who come first.” It is in this historical process of migration and settlement that Tayal people develop ways of knowing and understanding the complex Austronesian world of islands, mountains, waters, and food, which the later settlers from the Chinese continent began to appreciate only recently. This knowledge involves land management, relationship between human and non-human beings, foodways, ceremonies and rituals, belief and practices, as well as the connection between the place and seasonal forces in their everyday life, which provide an intellectual stimulus to this paper.

4. Conclusions

This paper illustrates Tayal’s millet field operation as their foodscape, in which indigenous resilience principles reside. Some of these principles coincide with those explicated in the work of Biggs et al. [13]. Firstly, the Tayal millet foodscape sustains bio- and cultural diversity of the Tayal community. Millets have vanished for over three decades in Pagung’s village. However, the action of

Millet Ark Initiative has significantly recovered the varieties of millets used by the villagers in the past. Not only are the biological varieties recovered, including the varieties of millet crops (intra-species) and of mixing crops in the millet field (inter-species), so is the traditional millet vocabulary, which signifies cultural and linguistic diversity of the Tayal.

Secondly, the millet foodscape manages connectivity. Tayal's historical migration should not be regarded as a simple act of moving in space. The shifting agriculture of millets and the grand migration, remembered through the singing of "Imuhuw", are both responses to the environmental change. In such a manner, humans are connected to the changing environment and react to it. The migratory movement also means more connections to other non-human species that include bamboo, alder, new lands, and places. All these are involved and linked in a wider sense of Tayal ecological world.

Thirdly, the millet foodscape monitors feedbacks. The shifting agriculture closely linked with millets growing involves feedback process of crops (millet and other mixing crops)-fallow-bamboo-(or alder)-crops in connectivity. This process has to be combined with the active human agency of slashing and burning the bamboo (or alder) for increasing the nutrients of the soil. In this way, Tayal's millets growing does not need the chemical fertilizers but use the ecological services in the environment as the Tayal are keen on responding to feedbacks from the environment.

Fourthly, the millet foodscape fosters complex adaptive systems thinking. The historical migratory routes and experiences embody many incidents of trial-and-error to establish an adaptive system for Tayal's survival. The thinking behind these efforts include the navigation skills, food foraging, ecological observations about finding safe residential sites and the social institutions related to solidarity. Finally, it expands participation into a widening circle of associations. In the past seven years, the members of Millet Ark Initiative have connected global network action of climate change to the local context and provided local knowledge and thinking in return. The global-local interaction has been significantly increased through the women's practices led by Pagung. In view that women's voice has largely been silenced in traditional Tayal society, the Initiative has not only broadened the participation on the international level but also crossed over gender boundary.

There are other boundaries to transcend including that between the human and non-human. The indigenous ways we convey through our narrative embodies an entangled world of human and non-human beings, a "meshwork", which in effect creates "new possibilities for the flourishing of life along diverse lines" [27] (p. 320). Indigenous ways are different from knowledge of Western science as they are "conservation-oriented practices of ecosystem, which tend to be grounded in their humans-as-part-of-nature worldview," a wider community of beings that includes animals, plants, rivers and rocks [7] (p. 273). The interactions and interchanges between the human and non-human species shape the Tayal home/land into a "nourishing terrain of indigenous sovereignty," to borrow Deborah Bird Rose words, which heals and takes care, providing "nourishment for body, mind and spirit; heart's ease" [28] (p. 7). Indigenous land is recalled with an affective force that affirms the land not merely as a shared heritage of belonging but as a material base where indigenous survival and flourishing are made possible. Rose calls for renewed attention to "situated connectivities that bind us into multi-species communities" [29].

This study applies storytelling to make sense of what we hear, observe, participate in, and experience in the field and in so doing, to recuperate indigenous resilience and climate action. Our methodology, however, is not without limitation. As we cannot but translate indigenous stories/singing into English, we become sensitive to and aware of what is then lost in translation. Not only concepts but words are translated into Chinese first and then English, both dominate languages that are often those of oppression and repression. They are oppressive and repressive in the sense that for indigenous people, dominant languages are "the enemy's languages" [30]. Not until they are "reinvented," would they not communicate indigenous values, vision, and experiences to the fullness.

In fact, translation can be a double-edged sword—"a tool for counter-hegemonic practices of communication and a tool of oppression, always giving minority languages a modicum of

'value' in the market of linguistic exchanges," as Marina Sitrin puts it brilliantly [31]. In telling the stories, Pagung retains her native language while a part of her stories is carried out in Chinese. In our English writing, therefore, we do not translate words; instead, we translate ideas. Some of the indigenous words, heavily charged with cultural and historical meanings, do not have simple equivalents in English. An "untranslatable" word alerts us to the unique cultural dynamics of an "othered" world, whose tradition has been repressed by the mainstream culture.

The aspect of untranslatability is powerful precisely because it cuts through or orients toward an alternative worldview, which is different from the commonsensical mainstream. Ideas and praxes of resistance are, however, translatable. We translate ideas in English writing in the form of stories/narratives to reach out to those who are already building a common symbolic system of understanding. Some of the translations are intentionally left at what would appear slightly imperfect. We keep an indigenous word of cultural or historical significance intact and when this happens, we explicate it in our narrative in the hope to best communicate it. There are passages intermingling English with a rhythmic indigenous language filled with oral story-telling markers. Drawing upon indigenous orality, Pagung recovers the lost memory of her home-base as she recounts migration. The indigenous words in this paper represent both the "route" of the migration and the "root" of migratory people. Consequently, our paper presents the process of telling and listening. By that sensory experience, we also trace a process of becoming sensitive to the place and people from which we are speaking to facilitate transformed relationships with indigenous land, water, and ecology.

The untranslatability is thus powerful as a form of resistance and storytelling is apt for situated knowledge of indigenous community and in its telling and retelling, opens a co-working space where transdisciplinary scholarship and indigenous place-based thought mingle. Knowledge which is situated is much more realistic than knowledge from nowhere, as Ingold points out [19]. Our responsibility is to the future when we endeavor to find ways to cope with a changing world [32].

As scholars from different disciplines at work with indigenous communities, we find interdisciplinary telling of stories as meshwork useful. Informed by Tim Ingold's use of "meshwork" as a metaphor for how life is lived along lines of becoming: emergent, indeterminate, contingent, historical, narrative, the use of "meshwork" to make transdisciplinary research encounters more attuned to difference [27]. The idea of "meshwork" conveys the open-endedness of transdisciplinary research where subject positions are not conceived in advance of a research encounter, but rather "erupt in the interstices of research methods, objectives and desired outcomes" [27] (p.315).

We aim to further and expand our work by calling for a meshwork approach in transdisciplinarity to identify multiple pathways toward alternative futures. Such an approach visualizes individuals as lines of not "being" but "becoming"; thus Nicole Klenk suggests:

As lines of becoming, research practices and knowledges are always already entangled in knots with other lines of becoming. We need to learn to be attuned to the histories and trajectories of the lines of becoming we cross, and learn to tell their stories. Meshwork is about becoming skillful in recognizing entanglements, and through attunement to stories, in creating new possibilities for the flourishing of life along diverse lines [27] (p. 320).

This approach, in Klenk's language, "encourages us to become skilled at being with others and witnessing their personal experiences" by learning to "tell their stories" [27] (p. 318). We view our collaboration with the indigenous community as "composed of individual paths with histories and trajectories, which are best characterized and become known as stories" [27] (p. 317). In a sense, we recognize that "knowledge grows and becomes integrated through storytelling" [27] (p. 317). We learn from the stories we are given, and now endeavor to learn to tell the stories of our encounters. In this interdisciplinary, place-based praxis of meshwork, to borrow words from environmental justice scholar and activist Julie Sze, "it is precisely now that imagination and action become essential" [33] (p. 1).

Consequently, we move beyond anthropocentric thoughts to side with those who study contact zones where lines separating nature from culture have disappeared or blurred, where encounters between *Homo sapiens* and other beings generate mutual ecologies, anticipating the emergence of

the “alterworlds” of other living beings. In this way, our narratives reflect what Stacy Alaimo describes as corporeal ethics, where “ethical action arises, then, from the recognition of one’s specific location within a wider, more-than-human kinship network” [34] (p. 30). We appreciate thinking and acting for the construction of dialogues, affinities, and collective action with a view to social and planetary transformation. Our meshwork evokes solidarity networks from global alliances to local/indigenous identification, to actions and practices battling environmental deterioration, which is part and parcel of our responsibilities and of our country’s resilience and power.

Huway bnakis Tayal ru huway utux krahuw. (Thanks to the Tayal ancestors and the Supreme Spirit).

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Article

Indigenous Knowledge and Endogenous Actions for Building Tribal Resilience after Typhoon Soudelor in Northern Taiwan

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Abstract: Indigenous peoples often face significant vulnerabilities to climate risks, yet the capacity of a social-ecological system (SES) to resilience is abstracted from indigenous and local knowledge. This research explored how the Tayal people in the Wulai tribes located in typhoon disaster areas along Nanshi River used indigenous knowledge as tribal resilience. It applied empirical analysis from secondary data on disaster relief and in-depth interviews, demonstrating how indigenous people's endogenous actions helped during post-disaster reconstructing. With the intertwined concepts of indigenous knowledge, SESs, and tribes' cooperation, the result presented the endogenous actions for tribal resilience. In addition, indigenous knowledge is instigated by the Qutux Niqan of mutual assistance and symbiosis among the Wulai tribes, and there is a need to build joint cooperation through local residence, indigenous people living outside of their tribes, and religious or social groups. The findings of tribal resilience after a typhoon disaster of co-production in the Wulai, Lahaw, and Fushan tribes include the importance of historical context, how indigenous people turn to their local knowledge rather than just only participating in disaster relief, and how they produce indigenous tourism for indigenous knowledge inheritance. The paper contributes to contemporary tribal resilience research as well as cooperation actions among tribes through indigenous knowledge, all of which exhibit social, nature, and economy resilience from their own indigenous knowledge to address the possibility of governance and disaster adaptation.

Keywords: resilience; social-ecological system; indigenous knowledge; Tayal people in Taiwan



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1. Introduction

Most indigenous people living in geographically high-risk areas suffer vulnerabilities to the risks of climate change [1]. Rainfall patterns have suddenly changed, while the climate change has increased the frequency and scale of rainfall-induced landslides. A typhoon is one of Taiwan's most hazardous disasters in Taiwan and causes considerable loss of life and property [2–6]. Its extremely torrential rainfall causes floods, landslides, and mudslides in indigenous tribes' regions, especially economically over-developed areas. After disasters occur, people adopt the thinking of recuperation and land conservation, yet the capacity of a social-ecological system (SES) to resilience is derived from indigenous knowledge, which is increasingly gaining international attention as a way to combat climate change [1]. By focusing on indigenous and local knowledge, one can broaden the level of knowledge existing within tribes that are impacted by environmental hazards.

Climate events contribute to the occurrence of disasters, and the combination of environmental hazard and vulnerability exposes indigenous tribes to potentially dangerous settings [7]. UNESCO (United Nations Educational, Scientific and Cultural Organization) [8] has acknowledged the importance of indigenous knowledge, and land resource management practices should engage traditional wisdom from them. One may disengage from environmental hazards by recognizing, and promoting traditional knowledge (TK)

coping mechanisms, which can also build the capacity of recovering relief in an indigenous area [9]. This paper emphasizes on indigenous knowledge and proposes its important significance at affording the practice of SES for providing disaster relief. In August 2015, Typhoon Soudelor dropped total accumulated rainfall of nearly 800 mm and caused over 100 landslide collapses in the Wulai area of northern Taiwan. Espeso-Molinero and Pastor-Alfonso argued that “each socio-ecosystem will have its own ways of developing resilience and so a specific in-depth study of each case is required” [10] (p. 657). The aim of this study is to explore the processes, the resilience after typhoon disaster, and interaction during post-disaster reconstruction through indigenous knowledge (IK) of the Wulai tribes in Northern Taiwan.

According to the Indigenous Peoples Basic Law [11], a tribe refers to a group of indigenous persons who form a community by living together in specific areas of the indigenous peoples’ regions and follow traditional norms with the approval of the central indigenous authority. The Tayal tribes are small-scale communities based on mutualism in Taiwan. The social actions during disaster relief initiated within the Wulai tribes (endogenous) are automatically instigated by themselves, instead of outsiders or local government (exogenous). Endogenous actions based on the Tayal gaga (social regulations and cultures) and Qutux Niqan (sharing groups) of IK make up their traditional culture. The Wulai tribes launched the Qutux Niqan to maintain people’s lives, tribal social functions, and more importantly tribal cooperation, food resilience, social resilience, and indigenous tourism preparedness under the Tayal gaga for resilience. There are also interconnections between IK and other aspects, including environmental management, social values, and beliefs. IK is dynamic and adapted in a disaster from indigenous holistic worldviews.

To explore tribal resilience-building actions, this research used in-depth interviews from post-disaster reconstructing cases in three tribes (Wulai, Lahaw, and Fushan), populated along Nanshi River, in response to natural hazards and endogenous actions by the indigenous peoples. We illustrate the impacts of Social-Ecological Systems (SESs) on endogenous actions of IK after a typhoon in the Wulai area. The research problematic issues are as follows. (1) How did the Tayal people initiate co-operative endogenous actions under indigenous knowledge? (2) What is the social resilience in post-disaster reconstruction? (3) What is the food resilience in post-disaster reconstruction? (4) What economic recovery actions were adapted after disaster? To answer these questions, this paper categorizes these actions during the post-disaster into a broader level of endogenous (launched from within the tribes) actions of Tayal IK in the Wulai tribes where they subsist, develop, and build inter-ethnic relations based on the nature and environment.

2. IK, SESs, and Tribal Resilience

Environmental and anthropogenic factors affect indigenous societies through increasing disaster risks [12,13]. Resilience is “the capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feed backs” [14] (p. 4). The most important mission is to develop sound social and cultural values with the traditional way of life in order to realize community development toward more sustainability and less waste in the contemporary world [12].

Many researchers have assessed those communities or tribes that have embraced indigenous knowledge have managed to save lives and property, and utilized disaster risks analysis to complement and expand scientific knowledge on reducing vulnerability [15–19]. In many discussions about the indigenous knowledge system, concepts and definitions are often used interchangeably, such as indigenous knowledge (IK), traditional knowledge (TK), local knowledge (LK), and traditional ecological knowledge (TEK). Indigenous knowledge is the unique knowledge confined to a particular culture or society that has evolved all the time [20–25]. It is not just a kind of knowledge, but also the practical experience and skills of indigenous life. In the 1960s, there was an “Anti-Mainstream” movement in Western developed research on “Oriental,” “original,” and “local” cultural knowledge [21]. Thus, this kind of knowledge is available and working in local tribes. IK is often regarded as

static, simple, and primitive [22,23]. While in many instances the term TEK is used, “IK is broader than ecological knowledge and better reflects the holistic worldviews that often underpin IK systems” [24,26]. Indigenous spirituality, man-land relationship, and the managing of resources are included in IK and presented in tribal members’ regulations and cultures. In many cases, exploiting IK can mitigate and reduce disaster risks. We therefore use the term IK in discussing the related research, except when citing literature that specifically uses other terms.

Resilience in ecology was first applied to the ability of a stable state to return to its usual environmental standard after degradation and overdevelopment [27]. When used in tribes, it can be the reconstruction paradigms of responses to disaster damage and vulnerability. The Tayal people are able to deal with hazards through the gaga (work together, sharing together) of IK. Resilience concerns environmental, economic, and social dimensions [28] that are relevant to IK and closely interact in social systems and the ecosystem [29] in a tribal society. Therefore, reconstruction actions should be established that are based on the concerns of IK and organized according to their needs and resilience within a tribe.

By reviewing much of the recent papers on IK, the useful cultural knowledge and social knowledge have been seen by many as an alternative way of providing disaster relief, reconstructing, and reducing disaster risks. Rapid environmental changes and potential environmental disasters have been caused by the development of foreign colonization and capitalization in the Wulai area. Howitt [30] proposed to consider more about the resilience, vulnerability, and adaptation of tribes’ geopolitics under climate change and indigenous historical colonization. Building a resilient society requires a dynamic process in SESs thought [31–34]. Thus, tribal resilience needs to build upon the environmental, economic, and social aspects, which are the core concepts of social-ecological systems (SESs).

The development and strategic improvement in the ecological environment indeed reinforce the ability to adapt to environmental changes through the diversity of the participants in reorganizing [35–38]. The less resilient the system is, the lower is the capacity to sustain humans’ well-being in the face of complexity and change. Olsson et al. [39] argue that adaptability among actors is needed to reinforce and sustain the desired social-ecological state and to make it resilient to future change and unpredictable events. Moreover, Olsson et al. [39] found adaptive governance is the approach to rising community self-management abilities and endogenous development on an economy. These can be done by important leaders who organize and transit in the processes [40].

SESs are inherently complex, but no one theoretical perspective is sufficient to analyze all feasible situations. McGinnis and Ostrom (2014) proposed a revised “social-ecosystem framework” that has gradually been spread internationally for empirical research applications [41–45]. Research pointed out that the local knowledge of SESs generated from local cultural and historical experiences has an important ability to adapt to the impact of disasters or climate change [46–48]. However, some scholars questioned SESs. For example, Colding and Barthel [49] reviewed the SESs literature spanning two decades and pointed out that many papers had an unclear definition of SESs and concept of “society.” Therefore, researchers have also focused on what and how the Tayal society exhibit cooperation and social resilience during disaster relief.

3. Research Method

3.1. Research Area

The research site has been struck by many typhoons and is a part of the Wulai indigenous tribes in northern Taiwan. The Wulai District of New Taipei City is an indigenous tourism scenic attraction and very near Taipei City, the metropolitan capital of Taiwan. In 2016, it had a population of 6187, covering 321 square kilometers. There are four tribes here and it is one of the earliest indigenous townships that Taiwan developed for tourism since the 1950s. The geographical landscape terrain features of Wulai are such as canyons, river valleys, cliffs, waterfalls, mountains, and rivers. Indigenous people comprise the main

population, although more Han people presently inhabit this area. Hot springs, cable cars, forests, cherry blossoms, rhododendrons, ferns, Tayal culture, and a miniature train are tourist resources. The richly natural and cultural environment makes Wulai a famous place for sightseeing and leisure [50].

The use of hot springs (only for police and faculty) in the Wulai area can be traced back to the period when Japan governed Taiwan around the end of the 19th century [51]. After Japan withdrew following World War II, more and more households used water pumps to extract hot spring water. During that period, areas near the train station were filled with souvenir shops and hawkers taking photos for tourists, packing the area with people. Ever since the gondola opened in the Wulai area in 1967, tourists have been taking the train to Wulai to see the waterfall, and tourism business activities have flourished. With the popularity of mass tourism in the 1980s, waterfall viewing and the gondola tours brought a lot of tourists from Taipei's metropolitan area [52].

In the late 20th century, as citizens of the capital invaded the mountain area, the Tayal people were forced to leave their hometown. Riyueguang and Julong Mountain Villa introduced hot spring water to Chungchi, 2 km away from the river, and the Ogawa Yuen hotel on Wulai Street (Wulai tribe) introduced Japanese professional hot spring equipment. In the 1990s, the government began promoting hot spring tourism and building infrastructure and facilities in the Wulai area, which showed that government promotion of tourism policies encouraged Wulai to use its hot spring resources to increase tourism income, which achieved a solution for regional development. The hot spring hotel industry brought the economies of Wulai and Chungchi more closely integrated with the tourism industry. Tourism activities that already were the livelihood of the local people also brought forth many tourism impacts. A lot of luxury hot spring hotels flourished in the Wulai area in the 2000s.

In Wulai District, the Wulai, Lahaw, and Fushan tribes are located in the upstream, midstream, and downstream of Nanshi River, as shown in Figure 1. The Wulai tribe is the closest to downtown Taipei City in the Nanshi River basin, which has led to compressed space and rapid tourism industry flows. The capitalism and crowds of people from urban areas have all been influential in altering the original state of the Wulai tribe. With the advent of capitalism and consumption, the indigenous people have come to realize they must share their tribal space with tourists and display items that visitors like to see in order to earn money especially in the Wulai tribe. This conclusion resonates with what Edensor advocated that tourism is a process consisting of unseen behavioral patterns and actual space reconstruction. Embedded in the host-visitor context, this process has enhanced the influence of mainstream tourism on indigenous areas. This is deemed as a consumptive phenomenon of indigenous commodification; hence, the area is split into front-stage and back-stage spaces, as suggested by Goffman [53]. The front-stage space (Wulai tribe) is where the hosts (indigenous people) meet consumers; whereas the back-stage space (Lahaw and Fushan tribes) is the area where indigenous people live. In other words, the lent-out area is in the downstream part of the Nanshi River basin, which the tourists can easily approach via transportation, while the back-stage area is around the midstream and upstream of the Nanshi River basin where IK and cultures are better preserved.

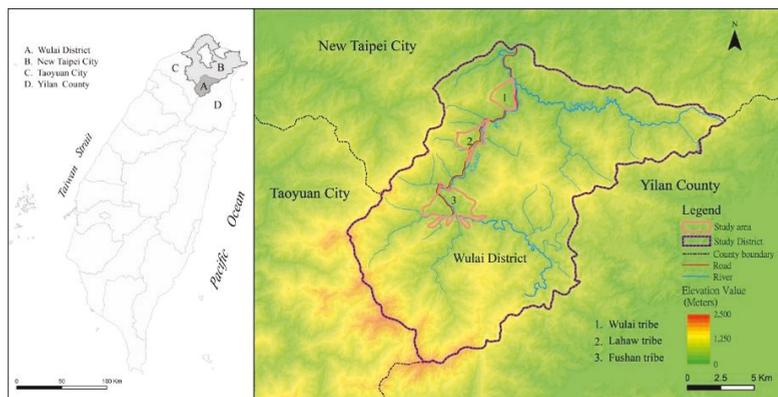


Figure 1. The location of Wulai, Lahaw, and Fushan tribes in New Taipei City.

3.2. Conceptual Framework

Secondary data collection was from a comprehensive review of literature using publications from scientific articles, papers, and reports after the tribes' areas were severely damaged, and contained findings from one year of observations in the three-year Ministry of Science and Technology project "Changes of Indigenous Livelihood, Place Bonding and the Social Space Model of Subjectivity (2014–2016)" [54]. According to the disaster prevention plan data [55], recent events in the area were mainly sloping disasters caused by Typhoon Sula in 2012 and Typhoon Soudelor in 2015, each of which had accumulated rainfall of 577 mm/day and 710 mm/day, respectively. The rivers in the Wulai area subsequently soared, moving higher than the embankments and bridges and causing many roads to be cut off. Although it is found that the distribution of landslides is approximately consistent with downhill in the Wulai area, indigenous tribes are generally impacted by environmental processes both non-anthropogenically and anthropogenically at all spatial scales.

During Typhoon Soudelor, the heavy rains in the Wulai area caused the Wusha River to soar and the streams and sands rushed over the bridge deck. The Dana Resort Farm located in the upper reaches of the Wushaxi Bridge was completely destroyed in this mudslide, and a total of 14 houses were impacted or buried by mud and rock. The rushing flow of water caused many collapses along the banks of the bridge, and mud and sand flooded into the hot springs hall and parking lot. Beside the waterfall park, a thick layer collapsed in the soil and rock interface, causing damage to a household that was almost buried. The collapse of earth and boulders caused traffic disruption to Huanshan Road. The lower slope of Route 9 collapsed, resulting in a 70-m roadbed gap. The collapse of the back slope of Wulai School caused the collapse of the school playground. Damages impacted the Wulai tribe (front-stage) and also disrupted roads to the Lahaw and Fushan tribes (back-stage). Given the severe damaged, 2000 Wulai residents were evacuated. About 1100 residents were reluctant to leave their homes, but the food shortage problem was affecting those trapped without any connection to the outside world.

Tribal resilience in providing disaster relief in a social ecological system after Typhoon Soudelor often has synergies with several elements of adaptive capacity operating at different scales. The Wulai tribes returned to their original self-sufficiency life when their water, electricity, roads, and communications were all interrupted due to the damage of landslides.

The above dimensions practiced within SESs for providing disaster relief in the interview context were identified into four significant general categories: cooperation, food resilience, social resilience, and indigenous tourism preparedness. For the Wulai tribes, SESs may make use of the disaster as a chance to transform into a more sustainable state. In

particular, IK continues to play a major part in the formation of many of these action sectors. By Tayal IK providing disaster relief, the indigenous people organized themselves with their traditional values and regulations and explored various paths in their reconstruction processes of environmental, social, and economic dimensions. These endogenous actions highlight the role of life sustaining (food), economy, and social resilience, and also show how IK reinforces the Wulai tribes' connectedness and collectiveness. It is this collective the gaga that the Tayal people draw upon to help cope with the social ecological system and offensive and defensive alliances that affect tribal society. They encompass the main strategy for which the Tayal people in the Nanshi River basin reduced disaster risks based on their traditional knowledge. The conceptual framework is shown in Figure 2.

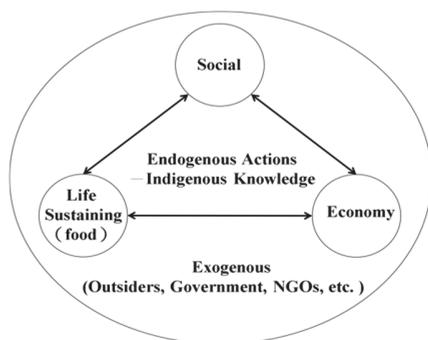


Figure 2. The endogenous reconstructing works in SESs for tribal resilience based on IK.

3.3. Data Collection

The methodological parts of this study were drawn from both primary and secondary sources. According to a comprehensive review after the tribes' areas were severely damaged, the disaster was caused during Typhoon Soudelor, which could be put into three categories that occurred to the Wulai tribes: collapse, mudslides, and flood [56]. The collapse area mainly happened to the Lahaw and Fushan tribes; the area of the flood was mainly located near the riverside of Nanshi River, as well as the area near the Wulai tribe and the main street (business street). The road linking the Wulai tribes to the main part of the transportation system was completely washed-out, dropping precipitously to the riverbed far below. Wulai suffered the most damage by the typhoon, with landslides cutting off the district's only road access to Taipei, as shown in Figure 3.

The project, Establishing Resilient Tribe for Climate Change: the Empowering Action Plan in Lahaw, Wulai, New Taipei City (2016.4–12) [57], of the Soil and Water Conservation Bureau showed that even though the typhoon damaged the areas of the original tribes seriously, the indigenous people stayed their own land tightly. Reconstructing their tribes in their own familiar and damaged hometown made them turn to take actions from the Tayal gaga of IK, especially for the disaster relief relationship between the different groups.

After the secondary data collection that helps present and analyze the reconstruction after disaster, we then process in-depth interviews obtaining qualitative information regarding the Tayal people who used IK and their endogenous actions and procedures. The key informant interviews took place in the Wulai, Lahaw, and Fushan tribes along Nanshi River. Interviews were guided by a series of open-ended questions about the disaster relief practice, involving environmental, social, and livelihood actions and the interaction under SESs. There were seven formal interviews, and in order to understand the long-term tribal resilience in SESs, we interviewed at least one time every year to the following interviewee individually from 2018 to 2019. Tribal elders, ward councilor (once), school teachers, and tourism industry staffs were the interview subjects. We use the triangulation approach to verify, corroborate, and enhance the credibility and trustworthiness or validity of the collected data.



Figure 3. The landslides cutting off the Wulai district’s only road access to downtown. Photo: Taipei Times from EPA/New Taipei city fire department [58].

The primary method of a qualitative study is for researchers to employ in-depth interviews, allowing respondents to provide a narrative to present their subjective meanings and motivations [59]. Each interview lasted about 1–2 h. The text was then analyzed and compared and analyzed with secondary data in the Wulai area. The combination of secondary data collection and primary data from in-depth interviews focuses on examining the research questions in SESs for tribal resilience of what actions the indigenous people took for long-term rebuilding of their homeland after the disaster.

Based on secondary data collection, we conducted in-depth interviews from the following dimensions: (1) How did the Tayal people face the damaged environment and reconstruct their homeland after the disaster? (2) In the beginning, who called and led the disaster relief in the tribes? (3) From the shortage of food, water, and electricity supplied, how did the Tayal people maintain basic life necessities? (4) What are the livelihood and long-term economy of tribal resilience in the context of local knowledge after the disaster? Based on the endogenous-exogenous reconstructing framework, the interaction of IK between endogenous and exogenous actions in providing disaster relief of the investigation could be conceptualized in the following matrix (see Table 1). The endogenous and exogenous actions and sources are presented in terms of social resilience, life sustaining, and indigenous tourism preparedness. The arrow direction indicates the contents in the column were excited from another.

Table 1. The endogenous-exogenous and tribal resilience in the Wulai tribes.

Indigenous knowledge	Social Resilience	Nature Resilience (Life Sustaining/Food Resilience)	Economy Resilience (Indigenous Tourism Preparedness)
Endogenous actions and sources	Tayal gaga (social regulations and cultures): elders, hunting groups, young generation, Tayal women, etc.	1. Finding the source of river water 2. Preserve food in traditional style 3. Turn to hunting 4. The Qutux Niqan	1. Gathering together and inherit hunting culture 2. Sharing the hunting indigenous knowledge (IK) and culture with the tourists
Exogenous actions and sources	1. Tribes’ churches 2. Organizations 3. Tribal people who live outside 4. Local authority	1. Tribal people who live outside carrying supplies and food back to their tribes on foot 2. Go through the local authority to connect with the Tayal people for transporting supplies back to the Wulai tribes	Go through the local authority and government to promote Wulai indigenous tourism

4. Results and Discussion

4.1. Cooperation under the Gaga: Indigenous Knowledge and Social Regulations

Indigenous peoples' land ethics toward the environment and natural resources as well as their traditional knowledge and competence such as ecological wisdom are based on their life experiences on food collection, fishing and hunting, and farming. The important characteristics of life cover the psychological demand of tribal people's interaction and sharing of collective work, work exchange, as well as food and information sharing with time and space arrangements of social life in order to maintain their material and social lives. The tribes are small-scale communities based on mutualism. They cultivate and hunt in the spacious mountain valleys and rivers. The mountain areas are their common properties and offer a form of man-land connection. Indigenous peoples' land development and management are based on their tribes with rights and public ownership of subjectivity. The villages possess land ownership, whereas individual are entitled to land use.

Endogenous actions from Tayal IK illustrate dynamic, cumulative, living social capital that could enhance the ability of the tribal society to cope with environmental change [60]. Tayal people have their own gaga (social regulations and cultures) with the functions of social control and mutualism (work and sharing together). The indigenous peoples have an intimate connection to the land. Different clans and ethnical groups share their cultures, languages, living models, and life development in the tribe, yet they attack together and defend against external invasion. During the seasons of cultivation, harvest, and hunting, they help each other and communalize into a solid tribal society (community with a common destiny). The tribes in the Wulai area combine different clans that cooperate with each other. Traditional Tayal social organizations are divided into clan, hunting, ancestral worship, sacrifice, mutual groups, and elders' meetings, with members of them often overlapping. The gaga of IK not only connect the Tayal people, but also are the keys for a modern indigenous society to reconstruct traditional values and spur endogenous actions for tribal resilience.

Indigenous peoples in Taiwan follow a traditional social organization based mainly on the clan system, especially the Tayal people who share resources and manage land by obeying the gaga of IK. The Qutux Niqan of IK was proposed from Tayal people. A member of the Fushan tribe said, "We called out to our relatives to deliver the food for the Wulai tribe (front-stage), and they carried what we needed during the disaster." Tribes' elders were also the chiefs of village. They were commanders who assigned various disaster relief affairs with their local knowledge. For example, because of the Tayal concept of hunting space, the elders and hunters have mastered the characteristics of the river basin and thus helped local people in how to walk along the river back to tribes, however, this is more difficult than usual without IK. "I have walked along the Nanshi River with the elders when I was a little boy. That is the collective memory of IK in my Fushan tribe (Respondent D)." Thus, Tayal people have a set of abilities in how to adapt themselves in the physical environment (e.g., finding the source of river water) and to gather and hunt successfully. In SES, IK provides the needed support or antecedent basis for the mechanism of long-term interaction with mountains and forests as well as inter-ethnic relations. That is why experienced hunters and elders are better equipped to organize different groups and collect food in the mountain, especially during a disaster.

During the food shortage transition period after the typhoon disaster, Tayal people used alternative nature routes for carrying supplies and food back to their tribes on foot. They walked along the Nanshi River basin and supplied the food from Xindian District of New Taipei City to the Wulai tribe and then transported it further to the Lahaw and Fushan tribes. Tayal people also responded to shortage conditions by adjusting their lives back to hunting, harvesting different species, and fishing with harpoons. "When we hunt after a typhoon disaster, the Tayal hunter taught us the rituals of the mountain and of ancestor worship, telling us the importance of revering, respecting, and thanking the mountains for our lives (Respondent F)." The indigenous people undertook social-ecological resilience to overcome seasonal variability and climate changes through processing the harvests and

using the resources provided within IK [61]. After the typhoon (Soudelor), Tayal people from different tribes gathered together and cooperated through the *gaga* belonging to IK. In this situation, IK is the cause of endogenous action whilst sharing groups (*Qutux Niqan*) and with other social organizations to strengthen the endogenous actions and form a set of strategies for sustainable use of natural resources [62] and disaster risk reduction benefit from the accumulation of IK.

4.2. Social Resilience

The elderly class is those who actually execute the *Qutux Niqan* of mutual assistance and symbiosis among the Wulai tribes. They can call for different groups to influence the internal social system as well as all attitudes and behaviors. Women's groups, youth organizations, hunters, and the elderly exert social resilience and endogenous actions during disasters. Through the *Qutux Niqan*, the tribes devised of labor. Women are responsible for the meals of the tribes, and some are responsible for food distribution, cooking, washing dishes, environmental organization, etc. As noted by Respondent B: "The *Qutux Niqan* is our traditional culture of IK, and we often share food with our relatives, friends, and tribal members in front of our house." Another important group is young people. During the period of providing disaster relief in Wulai, young people showed a lot of physical hard work in operating machines for rebuilding and removing soil and rocks that fell on the roads, whereas those who lived in the urban area set up supply teams to carry supplies back to the tribes on foot. Most important of all, the hunters who have IK were able to provide enough meat, fish, and other proteins by hunting to the local people (e.g., the hunter catch fish through the traditional method, as shown in Figure 4).



Figure 4. The hunter set up fish trap baskets in the stream to catch fish.

The Tayal people were also in contact with the tribes' churches and other social groups, requesting for supplies, such as the Presbyterian Church in Taiwan. The caring group was composed of pastors who visited the Lahaw and Fushan tribes in order to help meet their needs. Therefore, tribal social resilience was built in a joint cooperation through local people, indigenous people living elsewhere, and religious or social groups.

4.3. Food Resilience

The forest's resources are dependable and help the tribes live long and prosper. Fundamentally, indigenous peoples depend on forests for their livelihoods and food security [63]. Using drying, smoking, or salting meat of IK, the Tayal people preserve food carefully in case they cannot hunt during a natural disaster. The fish property rights of the river were decided under negotiation between the different tribal leaders based on traditional regulation. Under their agreement, they can achieve the goal of protecting fish ecosystems by fishing in different seasons and sections [64].

After the typhoon, the Tayal people salted the meat downtown and then carried it back to the Wulai tribes. Indigenous populations in the back-stage space (Lahaw and Fushan tribes) have a wide variety of ways to collect and preserve food. They also share

the storing and preserving of food with other residents during disaster relief. Nowadays, this knowledge of ensuring food availability during an environmental event is preserved in the back-stage space by the Tayal IK, even though modernization has encroached upon indigenous tribes. They also use water from mountain creeks through their local knowledge of the environment. Enhancing the ability of communities to mitigate disaster risks and coping when disasters strike do not increase dependency on external assistance, but rather help support tribes' self-sufficiency through endogenous measures [9].

4.4. Indigenous Tourism Preparedness

Indigenous knowledge inheritance from ancestors over the centuries helps current-day tribal members cope with environmental hazards and to face natural disasters. Governments increasingly recognize that the reduction of disaster risks forms the foundation for successful sustainable development. However, IK has only begun to be applied to environmental and social validation practices in the ecosystem for sustainable development in the late 20th and early 21st centuries [65–68].

The impacts of climate change on tourism destinations are mostly from damage to the physical environment in mountainous areas. After years of disasters, the Wulai indigenous people are aware of over-development due to economic growth. Moreover, as tourism has developed at an industrial scale and become profit-oriented, it has begun to exert a negative impact on indigenous peoples' traditional cultures and values and impeded the development of indigenous tribes. Today, the Tayal people's lifestyle has changed, as there is a gradual loss of their IK. General employment restricts them from practicing traditional skills, and formal education limits how they teach the next generation. They have thus begun to ask themselves how their traditional cultures and natural environment can be maintained.

The Wulai and Fushan tribes started to promote eco-cultural tourism, including a hunter school and learning about IK inheritance to help spread the Tayal traditional life and mountain-related culture and to identify with the Tayal's worldview and cultural spirit. Hunting culture and knowledge are the main subjects of indigenous life. The Tayal hunters' archery and hunting skills are inherited via hunting culture and IK. They realize that indigenously co-existing with mountains and forests is the most important value to develop tourism themselves after tourism industry over-developed and the disaster. In indigenous tourism contexts, the tribal socio-cultural fabric economy could enhance the resilience to cope with disasters and crises. The local people see indigenous tourism as a strategy to inherit and continue their IK. "I taught the hunting skills to the tribal members in order to perform them for the tourists. By doing these, the young generation have the motivation to learn hunting (Respondent C)" (as shown in Figure 5). Based on this ethnic consciousness, the Tayal people have spontaneously, actively, and collectively established organizations to operate a hunter school and IK inheritance groups that regard indigenous tribes as the subject instead of the object.

The Tayal people want to inherit and extend the spirit, value, and living system of IK and put it into practice in indigenous tourism. The hunters can encounter tourists and outsiders by the indigenous cultural courses offered, especially in the Fushan and Wulai tribes. They are aware of the limitations of family or the informal education of IK in tribes and thus take a relatively positive view toward such economic livelihood to cope with this situation. Economic recovery needs to link together humanitarian needs, environment restoration, and the rebuilding of new social networks and livelihoods [69], which must be drawn from the function and influence of resilience [70]. Hunters teach the indigenous and local knowledge and are attracting some young Tayal people to join them. Indigenous tourism concerning preparedness knowledge and skills is based on their IK and is constantly being updated with new approaches and information that meet the environment and climate challenges.



Figure 5. The hunter taught the young generation how to take bows and arrows.

5. Conclusion: Endogenous Actions in Tribal Resilience

This research presents the endogenous actions built up from inside an indigenous tribal society after Typhoon Soudelor and contributes to a deeper understanding of tribal resilience. In particular, we consider how three tribes in the Wulai area of northern Taiwan utilize IK in disaster relief efforts. For the social-ecosystem framework, the Tayal people undertook actions in disaster relief, used natural resources, and developed indigenous tourism preparedness, demonstrating their environmental, social, and food resilience. Tribal resilience reveals the importance of Tayal gaga and the cooperation among indigenous tribes in the Nanshi River basin. A reconstruction of the endogenous actions by the Wulai tribes shows how they met communal objectives. However, cooperation still exists with (exogenous) outsiders to ensure that IK forms an integrated approach to the river basin's social-economic strategy as a whole, including coordination with the tribes' churches and other social groups. Furthermore, the concept of tribal resilience has been explored in the roll-out of the Qutux Niqan of Tayal IK, which reveals the critical role of partnerships at all levels of Tayal elders, hunters, women, and other stakeholders.

IK in the social ecological system illustrates how endogenous actions can build resilience in the Wulai tribes, despite political, economic, and modern societal disturbances. This current study and other SES papers have underscored the importance of social and economic resilience in identifying the broad spectrum of local indigenous values. We find that endogenous social mobilization deriving from Tayal gaga (social regulations and cultures) is the key factor initiating communalization and also at the core of reconstructing. The social approach to build tribal resilience is highly dominated by the Tayal people, and IK is used to gather and work together, meaning it is an endogenous form that requires the cooperation of the tribes through the gaga. The collaboration between endogenous and exogenous actions works well due to recognition of IK in tribal society. The Tayal IK is acknowledged by the different values and identities of groups co-existing in the Nanshi River basin. For example, when assigning the work of carrying food back to the tribe or hunting, the elders taught young tribal members, churches, and other social groups what steps to take. The Tayal people and their partnerships mobilize resources from a variety of sources to function together and jointly cooperate in providing disaster relief. Co-working between outsiders and insiders can motivate and enhance indigenous people's inherent social resilience. This can subsequently help promote sustainable development and build an internal mechanism in their communities, while also better understanding the needs and priorities of external support.

Indigenous tourism preparedness is a planning process that is central to cultural and social themes that have emerged in SESs around local knowledge-specifically, how IK directly enriches indigenous tourism, and whether local efforts can contribute to minimizing

emerging risks. We offer some evidence that indigenous tourism supported through IK indeed works well [71–73], and that indigenous people in recent years also wish to raise the younger generations' understanding of Tayal IK through indigenous tourism preparedness.

Natural hazards have severely impacted indigenous areas in Taiwan. The reorganization phases of the endogenous actions demonstrate how tribal resilience has built up through IK. The findings of this study also emphasize the importance of social resilience and food resilience of the Qutux Niqan during supply shortages that occur following a disaster. By focusing on disaster relief of the Wulai tribes after Typhoon Soudelor, this research offers another approach for endogenous actions with a collective orientation toward following IK and experiencing the sharing together of resources with other tribes during reconstruction. In Taiwan, climate change hazards have brought forth the need to set up support social capital entry points, including the practice actions of IK (e.g., hunting, finding the source of river water collectively during a disaster, cooperation with neighboring members under gaga, sharing food, building a livelihood of IK after environmental change, etc.).

Future research can conduct more case studies to investigate how indigenous people use their IK to build resilience, because many valuable things can be learned from endogenous actions for reconstruction after a natural disaster. Tribal resilience can enhance current disaster relief knowledge and provide more guidance to local governments and social organizations such as NGOs and practitioners. Many studies and international climate change reports [74,75] have identified the importance of IK in reducing socio-economic vulnerabilities to disaster as well as how to deal with environmental and other hazards that trigger them. This research contributes to the growing body of IK literature at resilience to climate change. To strengthen resilience, indigenous tribes must prepare for and recover quickly from environmental hazards by sharing their cultural awareness and skills of IK through indigenous tourism. Specifically, analyzing endogenous actions in disaster relief via SESs allows one to verify and acknowledge the resilience, based upon enhanced IK engagement by indigenous peoples at disaster risk reduction. The end result can better leverage as well as help create more resilient tribes that are able to achieve disaster management and sustainable development.

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Article

Decolonizing Methodologies, Situated Resilience, and Country: Insights from *Tayal* Country, Taiwan

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Abstract: This paper addresses the methodological challenges of working with Indigenous peoples in the Anthropocene. Drawing from the author's geographical fieldwork with *Tayal* people, one of sixteen nationally recognized Indigenous groups in Taiwan, it argues that ontological shift is required in the dominant ways of thinking about resilience research. After reviewing a well-adopted Australian custom called 'Acknowledgement of Country', the paper addresses the concept of Indigenizing methodology and mobilizing the concepts of 'Country' and 'situated resilience' in *Tayal* settings. Finally, the paper proposes methodological principles for better engaging Indigenous knowledge in a more-than-human world on an ethical and constructive basis, as well as its implications for resilience research.

Keywords: decolonizing methodologies; Acknowledgement of Country; Taiwan; Indigenous geographies; *Tayal* people; situated resilience

1. Introduction

With rising awareness of climate change, there are increasing scholarly and governmental focuses on Indigenous and local communities' knowledges as sources for resilience [1–3]. While this long-overdue recognition is important, academic and institutional players in climate change adaptation and policy research too easily assume privilege and discretion belongs only to them and is not available to marginalized Indigenous groups. It is, perhaps, unsurprising that methodological approaches to reflect and respond to ethical engagement with Indigenous peoples are not well developed in scholarly research [4]. How to ethically involve Indigenous peoples, and even acknowledge Indigenous peoples' leadership in research demands more actions from governments and academia. Much more careful, respectful and humble attention is required if academic, policy and development practice is to address the significant capacity deficits [5] in academic and institutional settings. This paper is based on geographical and ethnographic research methods and personal experiences over the course of time as an academic while I engage with literatures in an Indigenous context (for interviewees list please see the Appendix A). Research methods adopted include participatory observation, in-depth interview and mental mapping. Drawing on geographical fieldwork with Indigenous *Tayal* people in northern Taiwan, this paper argues that understanding human-environmental relationships, natural disaster, adaptive responses and societal resilience through engagement with *Tayal* ontologies provides valuable guidance in developing decolonizing methodologies for climate change adaptation research and policy development. The *Tayal* people are an Indigenous group with a population of 92,306 as of April 2020 [6] who dwell in mountainous area, northern Taiwan (the total Taiwanese population is 23,829,964 as of October 2020). They are one of the sixteen Indigenous groups recognized by the national government in the Republic of China (ROC) in Taiwan. This paper reflects on engagement with *Tayal* people, and it mobilizes three key concepts—Country, ontological pluralism and situated

resilience—as a foundation for responding to the need to think outside the conventional frameworks of already-colonized thinking that privileges state, academic and global institutional thinking over local and Indigenous understandings of current circumstances. Through critical reflections, this paper aims to provide methodological principles that will better engage Indigenous peoples in resilience research and policy.

1.1. The Concept ‘Country’

As previous research shows in the *Tayal* settings, governing water resources is not about exercising sole ownership over a natural resource, but about governing human and non-human agencies in a more-than-human world [7]. In this paper, I explore *Tayal* ontological understandings of their place in the world, and its implications for resilience research. Further, this paper proposes methodological principles for engaging Indigenous knowledge in a more-than human world on an ethical and constructive basis.

The idea of ‘Country’ as a way of characterizing the relationships between Indigenous groups and their territories and the wider world is a central concept in this paper. The concept is drawn from Aboriginal Australians’ usage of an English term. In Aboriginal Australian settings, the term Country implies a very different meaning from general English usage to refer to either a nation-state or to a rural setting. Country is “an Aboriginal English term that encompasses particular areas as they co-become—shape and enable each other—in human and more-than-human relations of response and responsibility” (p. 24) [8]. The concept comprises complex ideas about relationships and connections. It simultaneously encompasses “territorial affiliation, a social identification and cosmological orientation” (p. 370) [9]. Learnt from her working experience with Australian Aboriginal peoples, Rose [10] develops the concept of Country as a “nourishing terrain”. In her words she notes: “Country is a place that gives and receives life. Not just imagined or represented, it is lived in and lived with” (p. 7). To further elaborate, Rose [10] explains that Australian Aboriginal peoples do not perceive their Country as a nature/culture dualism. On the contrary, “Country in Aboriginal English is not only a common noun but also a proper noun. People talk about country in the same way that they would talk about a person: they speak to country, sing to country, visit country, worry about country, feel sorry for country, and long for country” (p. 7).

1.2. Ontological Pluralism

Recognizing ‘Country’ and setting it is central to understanding the challenges of resilience science. It implies a centrality for a more-than-human ontology. It demands de-privileging any human-centric understanding and practices of natural resource management and opens up a space to recognizing plural and non-linear relationships between people and environment. ‘Country’ encompasses human and non-human agencies in a more-than-human world [11]. If one’s starting point is acceptance that western science has a self-evident advantage over all other forms of knowledge, this requires quite a fundamental rethinking of humans’ place in the world. Acknowledging Aboriginal Australians’ connections to and custodianship of their Country ultimately requires acceptance of the need to recognize ontological pluralist understandings of nature and has implications for how to pursue sustainability.

Ontology, understood as a branch of metaphysics, is the science of being, embracing such issues as the nature of existence and the categorical structure of reality [12]. That is, ontology is about being, existence and knowing in the Cosmos. Ontology is the foundation of how humans know themselves and the Cosmos. While ontology is clearly defined in many philosophy and social theory texts [12,13], the implication for understanding and for claiming its power is rarely understood in the common discourses of climate change and disaster management. Howitt and Suchet-Pearson [14] advocate that ontological pluralism should be recognized in contested cultural landscapes [14,15]. They [14] argue “academic discourse typically represents its knowledge as detached, objective and universal”. They propose engaging with “alternative ontologies-diverse ways of knowing,

being-in-place and related to complex, often contested cultural landscapes at various scales” (p. 557) as their alternative to relying on an inadequate singular, homogenous and dominant ontological discourse.

For Howitt and Suchet-Pearson, ontological pluralism goes beyond Euro-centric philosophies as the foundation for being-in or knowing the world. They argue that diverse ways of knowing the world are extremely important for reframing dominant forms of natural resource governance. Culture shapes the way people know the world, and the way people locate themselves in relationship with the Cosmos [16–18]. To decenter the dominant human-centric ontology, which assumes a hierarchical order between human/non-human, Suchet-Pearson and her research partners raise the idea of a ‘relational ontology’ [16,19]. They elaborate it as “a relational ontology of connection means understanding all beings and things as inherently connected. Neither one’s identity, actions or ethics can be understood in isolation from other research partners, family members, other people, or the natural world. Rather, humans, animals, plants, winds, rocks, spirits, songs, sunsets and water, indeed all things, are connected together in a web of kinship and responsibility” (p. 1076) [19].

1.3. Situated Resilience

In climate change adaption discourses, resilience has a long history [20–26]. I advocate the notion of ‘situated resilience’ in this paper. It emphasizes the specific temporal-spatial context in which the concept and practice of resilience are generated, defined and exercised. It alters the conventional thinking that resilience strategies are universally applicable and propose that resilience strategies are responsible for and ethically engaging a specific temporal-spatial context. The notion of ‘situated resilience’ requires a careful tackling on ontological politics. It is useful to visit the discussion on relational ontology proposed by the work of the Bawaka Collective (e.g., Lloyd K [19] and Bawaka collectives [16,27]). The relational ontology not only de-centers human-centric privilege in the creation and evaluation of knowledge, but also profoundly asserts the need to recognize that multiplicity resides within the concept of ontology. This in turn implies that the concepts mobilized to engage with relationality on more-than-human systems must also be carefully contextualized and situated.

The deployment of resilience is neither self-evident nor universally applicable and there are multiple versions of resilience being mobilized in contemporary discourses [28]. Scholars reflect on Indigenous ontologies to argue the importance of situating resilience in a specific temporal-spatial context. Fisher [29] reviews how ‘resilience’ has been deployed and applied in fundamentally different ways in two research-focused settings. She argues that the notion of resilience is not a modern invention, and that in Aotearoa/New Zealand, Maori ontologies influence how resilience is enacted and that “entanglements that arise when worlds collide” (p. 34) provide a catalyst for change as Maori “assert their rights to different ways of knowing and being and as the differentiated effects of resilience interventions are made apparent” (p. 35).

The Bawaka Collective [8] maintain that “ontological politics must be sited” (p. 24), and that the ontological politics of resilience not only can be learned from place, more importantly, it is of place. They maintain that the resilience demonstrated by Indigenous peoples in their more-than-human settings is always to be understood as situated. There is a deep sense of place in this notion of resilience. From this perspective, there is no universalized, abstract notion of resilience because resilience is inherently situated in a relational web of connections across time and space. They also demonstrate for Indigenous Yolngu people in Australia, weather is not a ‘natural’ phenomena that is separated from ‘culture’ and call for an “embodied, emotional, affective experience” (p. 297) on weather and climate [30]. The importance of local scale practice has been widely acknowledged in resilience science [26,31].

So, resilience strategies are not, and cannot be universally applicable. On the contrary, it is important to acknowledge that engaging with the ontological politics of resilience requires engagements with those whose situation has given rise to the resilience (or lack of resilience) that is at issue. In other words, given that recognition of ontological pluralism demands the recognition that situated resilience of Indigenous groups is embedded in the geographical, historical, cultural and political context in which

people are entangled, researchers, policy-makers and advocates alike must develop methodological approaches that respond respectfully, humbly and patiently to context.

2. Acknowledgement of Country—Acknowledging Context

2.1. Acknowledging Indigenous Context

As Howitt [32] recognizes, in Australian Indigenous settings, a ‘Welcome to Country’ is a custom among many Aboriginal groups to assess the bona fides of visitors and ensure their safe passage in Country. That custom is now extended to include Traditional Owners giving a welcome to non-Indigenous groups at the start of a speech or an event. Arising from the growth of the reconciliation process there is also an increasingly common use of an ‘Acknowledgement of Country’, which can be used by anyone—Indigenous and non-Indigenous—to acknowledge the Traditional Owners of the land at the start of a speech or event [33]. Acknowledgment rituals are structured as affirming recognition of the entitlement and belonging of Indigenous persons or groups to a place, typically by an outsider. While the Acknowledgment is a matter of appreciation, or a declaration made to ensure validity, the Welcome has a classic host–guest structure. A host is normally someone who has an entitlement or belonging within a domain to which the guest is admitted. The host is to be respected but is also morally bound to extend hospitality to the guests. An Acknowledgment may be made by someone without direct address to those understood to be acknowledged, and without reciprocation; a Welcome frames both parties as participants of the event (Merlan [34] p. 298). There is no doubt that some elements of Welcome (such as smoking and dance) have long been in use among groups of Indigenous Australians, but most Australians realize that both ritual forms have become part of public protocol in the recent past. The two rituals started coming into public use during the 1990s, as a form of recognition during the reconciliation decade (see Merlan [34] pp. 299–302).

As a Taiwanese visitor to Australia, the Acknowledgement of Country for me, is very much about acknowledging connections—the connections that encompass people-to-environment, people-to-people and people-to-Cosmos relations [35,36]. This paper addresses the methodological challenges of working with Indigenous peoples by starting with a positionality of recognizing and acknowledging *Tayal* custodianship of Country. Therefore, I would like to acknowledge *Tayal* people and their Country and offer my appreciation of the opportunity to work with and learn from them, and acknowledge the entitlement that accompanies Indigenous *Tayal* peoples’ belonging to place and aim to emplace the following discussion in the specific context where knowledge are generated.

2.2. Mobilizing Resilience in *Tayal* ‘Country’

Applying the Australian Aboriginal notion of Country in the Taiwanese setting, Hsu, Howitt and Chi [9] felt there was an opportunity to “inspire a novel and constructive approach to questions regarding Indigenous experiences of disaster relief and reconstruction in Taiwan” (p. 371). They go on to argue that First Nations’ social, political and environmental histories shape their resilience and capacity to recover from disruption. In disaster recovery, they say, the idea of Country helps to understand how effective and culturally appropriate recovery activity will “consider the social dimensions of community (people-people), the cultural and spiritual dimensions of identity and community (people-cosmos) and the socio-ecological dimensions of community well-being in terms of livelihood, history and values (people-environment)” (p. 374).

In *Tayal* domains, however, the complex histories of colonization, dispossession and displacement have produced a range of institutional arrangements that claim to exercise power over *Tayal* people, *Tayal* environments and *Tayal* lives [37]. Despite this, many aspects of *Tayal* spiritual life, self-determination and governance persist in relationships guided by the philosophy of *Gaga* [38] and the processes of managing *Tayal* resources for survival [39,40] and shape the ways in which *Tayal* communities respond to changing circumstances in their lives. Developing a research methodology to understand and support local resilience has required significant entangling with *Tayal* people, language, culture and

history and developing a strong sense of belonging within *Tayal* communities and places. While some elements of my own experience have been intensely personal, there are many aspects of the work that offer methodological lessons with wider application. The work of listening to and learning from *Tayal* mentors, rather than assuming that *Tayal* experience and understanding is simply data to be collected and analyzed using already-colonizing tools, for example, has required recognition of the ontological foundation of their experiences of resisting, responding and asserting their custodianship of their Country despite Settler State's consistent ignorance, hostility and denial that *Tayal* autonomy could pre-date and persist beyond the creation of the state. In particular, in the *Tayal* context, it has been through engaging with stories of connection, place and belonging and *Imuhuw* (migration history chanting) that I have come to understand that the notions of climate change and disaster management that have been normalized in mainstream international and domestic discourse are themselves colonizing in their impact and erase the insights and opportunities created within *Tayal*-centric discourses (see also [41,42] for parallel examples elsewhere in Taiwan).

That is, understanding and supporting *Tayal* resilience in *Tayal* Country requires a methodology that recognizes the ontological politics of resilience, acknowledges the ontological priority of Country and context in *Tayal* settings, and engages with resilience as situated rather than as some sort of universal abstraction disconnected from people, place and context.

3. Decolonizing and Indigenizing Methodologies—Towards a *Tayal*-Centric Framing

3.1. Framing Methodological Challenges

Linda Tuhiwai Smith's landmark book *Decolonizing methodologies: Research and Indigenous peoples* [4] profoundly affected Indigenous studies. The fashion of postcolonialism, in Smith's words, has become a strategy for re-inscribing or re-authorizing the privileges of non-Indigenous academics because the field of 'post-colonial' discourse "has been defined in ways which can still leave out Indigenous peoples, our ways of knowing and our current concerns" (p. 25). Referring to Smith's words, Sikes [43] argues that the applicability and meaning of the 'post' prefix, and particularly when it is hyphenated, is problematic. Not only does 'post' suggest a temporal linearity and a definite in-the-pastness which some (ex)colonized peoples may not experience or perceive, it perpetuates the 'othering' and emphasizes oppositions and binaries. A central task of projects of decolonization is, and should be, to go beyond such reductive polarizations (pp. 350–351).

The publication *Decolonizing methodologies* marked an important milestone for research with Indigenous peoples. However, it also requires careful consideration when responding to this framework and adapting it for use in different Indigenous settings. As noted by Smith herself [4], even the term 'Indigenous' is problematic in that it appears to collectivize many distinct populations whose experiences under colonialism and imperialism have been vastly different (p. 6). Rather than distinguishing and binarizing Indigenous people versus settlers, Mlcek [44] argues that decolonizing methodologies are about making the connections. The storytelling process both resists and intervenes to cocoon the individual in a state of protective and strengthening sustainability. The telling of personal stories is a powerful way to talk about life experiences within a socio-cultural context, especially when they relate to being "on the borders" [44] (pp. 85, 88). *Decolonizing methodologies* challenges researchers to think deeply of their own colonial and cultural contexts and provokes a nascent research paradigm embedded in specific cultural settings. However, Leslie [45] found that the label 'decolonizing' is not suitable in her own *Kamilaroi* cultural context. To avoid conflating a specific Indigenous context into a colonized/de-colonizing binary, through reflective thinking in *Kamilaroi* language, Leslie [45] developed her own *Wingangay* methodology. The root '*winanga*' is translated as 'hear' and the verb for *winanga*, *Wingangay* goes beyond just hearing. In Leslie's *Kamilaroi* culture, like many oral cultures, "the ear is seen as the instrument or seat of intelligence and perception, therefore *winangay* goes beyond just hearing." (p. 203). This approach shifts the relationship between the privileged researcher and

their research subjects away from one of colonizing knowledge whereby knowledge is something to be possessed by the researcher and reframes the research relationship in very different ways.

3.2. *Tayal* People's Ontological Understanding of 'Country'

The above issues prompted me to think deeply about how to frame resilience studies. Decolonizing methodologies introduced me to the idea of framing a research methodology with Indigenous peoples, but it also reminded me that 'Indigenous' is a problematic label, which might conflate diverse experiences of colonized peoples. Indigenous research methodologies should be embedded in a specific context, rather than just adopting a generic decolonizing methodological paradigm without being aware of the context. Thus, I frame this paper as radical contextualism, an idea recently introduced to geography [36]. Extending from this methodological framing here, I address the *Tayal* people's ontological understanding of 'Country'.

In April 2012, a surprising incident occurred on *Tayal* Country. Police caught a *Tayal* person from *Smangus* community 'unlawfully' logging cypress in the traditional territories, which had been categorized as State forest, of another *Tayal* community: *Pyanan* community. On one hand, the Taiwanese State argued the man's action was illegal because according to the ROC legislation, all timber in State-owned forest are State property. Hence, the accused man had stolen State property. On the other hand, *Tayal* people felt the man's action in this case was customarily illegal because the suspect had violated *Tayal Gaga* (the Law in *Tayal* ontology). In *Tayal Gaga*, violating the *Gaga* (Law) of boundaries is the most severe transgression. *Tayal* people have very rigid *Gaga* (Law) of boundaries regarding rivers, hunting grounds and cultivating fields. Respecting the boundary and never moving across it without permission is fundamental in *Tayal* ontology. This incident especially stirred *Tayal* people in the *Pyanan* community to anger because it was a *Tayal* person who had encroached their territory, not an outsider. In order to settle the anger and amend the relationship between the communities, the two communities decided to hold a *Sbalay* (Reconciliation) ceremony in *Quri Sqabu*, one of the vital bifurcated places during *Tayal* people's epic migration [46]. They chose *Quri Sqabu* as the ceremony venue because it was where *Tayal* ancestors had agreed to ally with each other before they separated into different watersheds and built their communities. In their oral history *Imuhuw* chanting, when a *Tayal* ancestor *Kbuta* led *Tayal* people migrated to *Quri Sqabu*, he said to his people they would separate from here, and exhorted his people to follow rivers and build their communities (see also [7]):

You shall not turn your back on each other. When boys turn mature, be prudential of blood relation [to avoid incest taboos]. If you hear of a well-educated girl, you shall ask elders to propose in proper ways. Then your children shall thrive as well as bamboo shoots. (Zheng [46] ch.4 p.9 (my translation))

The *Pyanan* community and the *Smangus* community performed a *Sbalay* (Reconciliation) ceremony not only for amending relations, but also for proclaiming their sovereignty over their Country and re-strengthening the *Tayal* alliance. Thus, this ceremony was also a *Phaban* (Alliance) ceremony (see: [47]). The *Sbalay* (Reconciliation) ceremony was held on 4 May 2012 at *Quri Sqabu* near the *Pyanan* community. I arrived at the *Pyanan* community on 3 May 2012. I was visiting the *Pyanan* community as a postgraduate student and was about to commence my fieldwork in the community. That night, elders from *Tayal* Country gathered together at the *Pyanan* Presbyterian Church. A map was drawn to denote the *Tayal* Country (Figure 1). This map was used in the *Sbalay* (Reconciliation)/*Phaban* (Alliance) ceremony the next day (Figure 2).

This map is titled 'the traditional territory of *Tayal* people' (the green words on the top). This map represents *Tayal* Country. Each river in *Tayal* Country is drawn in blue lines with the *Tayal* name labelled in blue and the Mandarin name labelled in purple. Each river represents a watershed and a clan of *Tayal* people. For instance, *llyung Tmail* is the name of river *Tmali* and the name of the clan living inside the watershed of river *Tmali*. The location of *Quri*

Sqabu is marked in the red circle, and the presented point the elder is pointing at is the sacred mountain *Papak waqa*. The small figure in the right bottom corner indicates the area of *Tayal* Country in Taiwan (the red bordered area) and indicates other Indigenous peoples in the island (the yellow bordered area). (Photo taken on 3 May 2012 at the *Pyanan* Presbyterian Church. Credit: Huei-Chung Hsiao. Reproduced with permission)



Figure 1. A map of *Tayal* County prepared for the *Sbalay* (Reconciliation)/*Phaban* (Alliance) ceremony.



Figure 2. The *Sbalay* (Reconciliation)/*Phaban* (Alliance) ceremony. (Photo taken on 4 May 2012 at *Quri Sqabu*. Credit: Huei-Chung Hsiao. Reproduced with permission).

The ceremony began with an introduction and included following programs:

- *Pramu minqyanux* (Sacrifice and purification): Killing a pig as the sacrifice
- *Smrlhuw qyunam Tayal* (Proclaiming *Tayal* traditional territory)
- *Lmuhuw msgail kwas* (Migration history chanting)
- *Pinhaban qyunam Tayal* (Alliance): each *Tayal* clan sent a representative to proclaim the alliance by dipping some pig blood on the map.
- *Pmumu pinhaban ke* (Vow to ally)
- *Qwas sinrhgan ke* (Exhortation from elders)
- *Pzimuw pngsa'* (Prayer for thanksgiving)
- *Mqwas sinramat* (*Tayal* hymns)

The *Sbalay* (Reconciliation)/*Phaban* (Alliance) ceremony profoundly shaped my methodological framing. I can still recall the memory vividly. It altered my understanding of 'Taiwan'. I was born and raised in a Han family, the descendants of Chinese settlers. Having faith in the State for me was something normalized in my daily life. Yet, in that ceremony, *Tayal* people requested apologies from the State for sabotaging *Tayal* forest regulations and rejected State policy that they saw as fallacious [48]. In the ceremony the territory was presented, the vow was made, and the alliance was strengthened. 'It was and always will be their Country' I thought. I had a strong feeling that they were/are governing their Country in *Tayal* ways. Given the suspect has been arrested by the ROC police force, *Tayal* people decided to settle according to the *Tayal Gaga* (the Law). The reconciliation process in *Tayal* ontology is about re-connecting and strengthening ongoing relations. There was a strong connection of time and space in that ceremony. Choosing where the *Tayal* ancestors had bifurcated during their epic migration as the ceremony venue connected the past of *Tayal* people to their present, as well as connecting to an allied and reconciled future. Representatives from every watershed vowed to work together in the program of alliance, connecting *Tayal* places across Country into a congregation. The notion of *Tayal* Country is more than a bounded area. Rather, it encompasses connections across time and space between *Tayal* people, place and *Gaga*.

Attending the *Sbalay* (Reconciliation)/*Phaban* (Alliance) ceremony in 2012 altered my understanding of *Tayal* Country utterly. It made me realize *Tayal* people governed and continue to govern their Country in their own ways, despite persistent colonial interventions. *Tayal* people are always retaining and renewing their connections to their Country and each other. *Tayal* connections to Country are built on relations with rivers, mountain and people co-existing in the Country. In order to emplace this paper in the ways *Tayal* people see, think and do, it is important to explore the ways in which the *Tayal*-centric approach to questions of belonging, connection and Country. It also requires a profound rethinking of Indigenous peoples' connections to space, time and place.

4. Recognizing Relational Webs in *Tayal* Country

In the wake of transitional justice in the Taiwanese national polity see [38], recognizing the conceptual framework of ontological pluralism [14,15] in Taiwanese contested cultural landscapes sets the ground for later discussion. Inspired by the Australian Aboriginal protocol of an 'Acknowledgement of Country', my research responds to the methodological challenges of contextualizing this paper in a specific-temporal-and-spatial scale and cultural-and-geographical-appropriate context.

Acknowledging *Tayal* people's custodianship of Country is the entry point to establishing that a *Tayal* ontology of place must inevitably shape research about *Tayal* places. In Taiwan, the complex histories of colonization failed to accommodate *Tayal* people and *Tayal* Country as already encompassed by *Tayal* ontology, law (*Gaga*) and responsibilities has seen much scholarly research framed in ways that privilege colonial and colonizing values. As Rose (1999) recognizes, even well-intentioned research risks being caught in the web she characterizes as "deep colonizing". Recent Indigenous and other scholarship in Australia [49], Aotearoa New Zealand [50] and North America [51] and more broadly in the emerging field of Indigenous geographies [52,53] offer timely and contextualized advice on how to reconceptualize research methodology in Indigenous settings. The challenge of radical contextualism, however, is to move beyond some sort of generic and abstracted Indigenous frame to the particularities of a specifically *Tayal* frame for this research.

In their work on "being-together-in-place", Johnson and Larsen [54] offer some valuable insights into the challenges of building a *Tayal*-centric methodology for this research, but their work does not refer to *Tayal* Country and culture. Rather it draws on work in New Zealand and North America. Similarly, the powerful insights of the Bawaka Country research collective [16,27] provide valuable guidance and suggestions, but is not *Tayal*-specific. The key challenge is to take the reader into the relational web of *Tayal* Country and its people, to move beyond acknowledgement and towards engagement.

I have sought to follow a path to Country that sits comfortably in and is able to be challenged and transformed by my *Tayal* guides, mentors and teachers. In other words, my methodology has developed as *Tayal*-centric-drawing on guidance and insights from wider scholarly debates about Decolonizing methodology and Indigenous geographies, but always coming home to *Tayal* Country, *Tayal* advisors for review, affirmation and approval. My personal journey has immersed me in *Tayal* social relations, taken me into my *Tayal* family, and held me accountable in *Tayal* customary discourses. This is a continuing journey, and one that I hope will allow me to nurture research that moves from being *Tayal*-centric to being *Tayal* controlled, governed and driven. But in explaining the *Tayal*-centric methods developed and applied in this research, let me first take the reader on some of my journey into that relation web of people, mountains and rivers in *Tayal* Country.

4.1. Rivers, Mountains and Peoples: A Relational Web

From January 2018 to February 2018, I intensively visited a *Tayal* pastor recently retired from the Presbyterian Church. Pastor Sanguis is a pioneer and social activist from the 1980s. He is one of the people I have come to admire since I started working with *Tayal* people in 2009. I was lucky enough to interview him at some length. I wanted to interview him because of a figure he drew for another scholar's doctoral dissertation to explain the ontology of *Tayal* People (p. 157) [55]. As elaborated in

but nothing happened. Then the public threw an elder into the water, but still nothing happened. The public confirmed there must have been offenders among them. They did a thorough investigation and found out that a brother and sister committed incest. The public threw them into the water and this time, the deluge subsided. [57] (p. 34; my translation)

The triangle in the middle of Figures 4 and 5 indicates *Papak Waqa* (scared mountain). Locating *Papak Waqa* as the coordinate starting point, each curve indicates a river along which *Tayal* people have built communities and reside. As can see at Figures 4 and 5, each river diffuses from *Papak Waqa* and brings a *Papak Waqa*-centric Country into being. However, not every river physically originates from *Papak Waqa* (the scared mountain). For instance, those rivers with a cross mark on them do not originate from *Papak Waqa* (the scared mountain). Moreover, it is clear that Figure 4 is more simplified than Figure 5. The reason is that Teru hesitates to over-generalize the ‘name’ of rivers in *Tayal* Country:

When they were naming the rivers, they named it section by section. Because people from downstream could not go over border. You know we have the sense of territory, *qes* (border). Even though we all belong *Tayal* people. For example, I am *Kanzi* clan. I would not go over to *Mrqwang* clan’s territory. If you across the border, then you *hmiriq Gaga* (against customary law). (Teru from *Kanzi* people, fieldwork interview on 7 January 2018 at Hengshan Township)

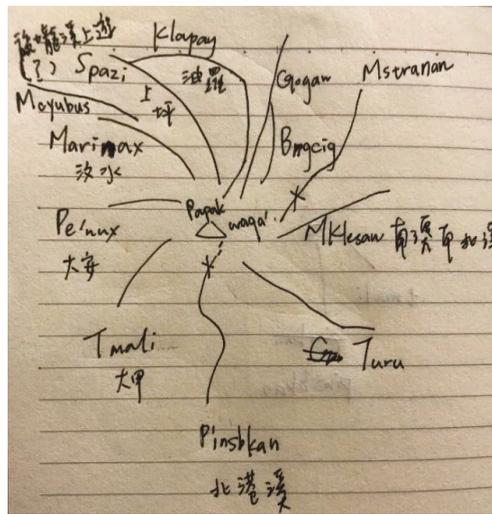


Figure 4. *Papak waqa*-centric Rivers reproduced by Hsiao.

For *Tayal* people, the rivers and tributaries provide the pathways by which the ancestors migrated and built a series of settlements (Kuan, 2009: 141). When Pastor Sangus redrew the figure for me (Figure 6), he said:

Tayal society is a society without writing system. Moreover, we do not have the concept of ‘ocean’. We do not have ‘ocean’ in our creation myth. Only mountains and rivers in our creation myth . . . For instance, in our creation myth, it was *Papak Waqa* (the scared mountain) saved our life . . . Our migration is about mountains and rivers. We emphasize mountains and rivers . . . a very important point is that when speaking of our sense of space, because we do not have writing system, we use myth and *lmuhuw* (oral history) to deliver (our sense of space). Either we use chanting or description to record our ancestral migration pathway along rivers. (Pastor Sangus, fieldwork interview on 8 January 2018 at Chutung Township)

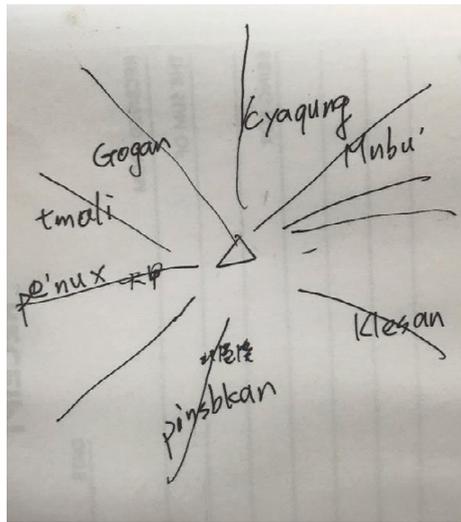


Figure 5. Papak waqa-centric Rivers reproduced by Teru.

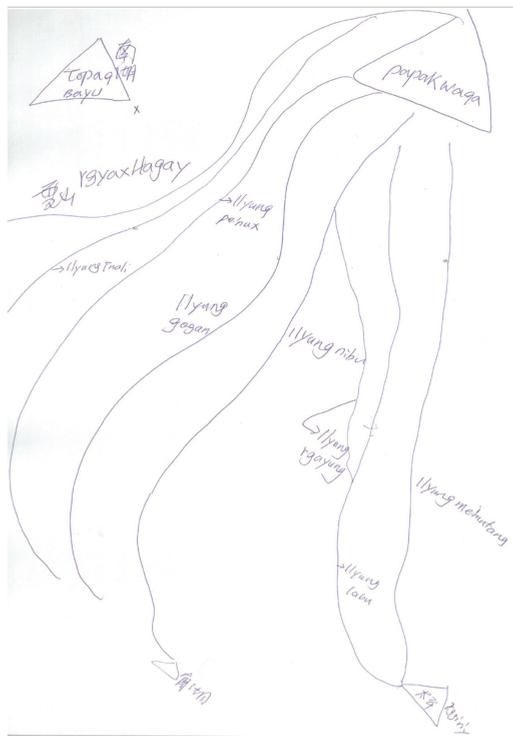


Figure 6. Papak waqa-centric Rivers drawn by Pastor Sangus.

Rivers and mountains are decisive in *Tayal* ontology. In *Tayal* language there is a term '*qluw llyung*'. Interpreting the term directly, '*qluw*' means relatives and '*llyung*' means river, so '*qluw llyung*' mean

'relatives along the river'. Through migrations, *Tayal* people started to settle down and progressively develop settlements within watersheds. Settlements within the same watershed form a military alliance to defend enemies and use the term '*qluw llyung*' to refer community members who live within the same watershed. Not only rivers have been used to metaphorize social relations in *Tayal* society, but also mountains. When proposing a marriage in *Tayal* society, the groom-to-be is required to give his future brother-in-law '*pintrgyax*'. The term '*pintrgyax*' comes from the word root '*trgyax*', mountain ridge and the term '*trgyax*' comes from the word '*rgyax*', mountain. '*Pintrgyax*', normally is a pig, could be interpreted as the greeting gift the groom-to-be gives to his future brother-in-law when proposing marriage to the bride-to-be's family. Using '*trgyax* (mountain ridge)' as the word root implies marriage is merging two families and building relations, just like crossing mountain ridges.

The other thing Pastor Sangus noted is the sense of 'orientation' in *Tayal* ontology: "Most importantly, other people may believe they came from lowland and migrated to highland. However, for *Tayal* people, our concept is that we migrate from highland; from mountain" [fieldwork interview on 5 January 2018 at Chutung Township]. Teru also mentioned this feature during her interview:

I used to say to Pastor Sangus that: "our ancestors were really clever. It seems like they saw things from highest point. They saw the world and saw the future. Then they slowly walked down (. . .)." So I said to Pastor Sangus: "Our *Tayal* people's environment really starts from *Papak Waqa* (scared mountain) . . . when we perceive regions, we perceived it from watersheds instead of administrative districts, such like how many clans dwelled in that watershed. We do not perceive our environment by where can cement roads reach. We perceive our environment by *llyung* (river). People from same *llyung* (river) are belong to that *llyung* (river)". (Teru from *Kanzi* people, fieldwork interview 2 February 2018 at *Tbahu* community)

Rivers, mountains and people weave *Tayal* Country into being and constitute *Tayal* ontological understandings of beings. For *Tayal* ontology, every being is connected within a relational web constituted by rivers, mountains and peoples. For me, it is pivotal to establish *Tayal* ontology when coping with disaster management and climate change as it challenges the predominant paradigm.

4.2. Reframing Ontologically Pluralist Readings of Situated Resilience

Recognizing and acknowledging *Tayal* Country under Pastor Sangus' mentoring completely altered my way of seeing things. It opened up a *Tayal*-centric perspective as well as a *Tayal*-centric framing of research. It also facilitates emplacing this paper more powerfully in *Tayal* Country: as Howitt [36] argues: "Context matters—the historical, geographical, social, and cultural context in which social geographers undertake research fundamentally shapes what we come to know and how we come to represent it to our various audiences" (p. 142). By applying this 'radical contextualist' lens, a *Tayal*-centric positionality not only acknowledges *Tayal* people's custodianship to their Country but also shapes a way of doing the research that gives that custodianship primacy in shaping knowledge.

Under conditions of climate change, developing resilient strategies has emerged as a central concern for both academic and public policy discourses. However, as argued by Howitt [32] in this special issue, Indigenous peoples are "easily classified as either dangerously vulnerable or inherently resilient to climate risks" (p. 1 of 16). Such over-simplified images of Indigenous peoples ignore the diverse contexts of Indigenous peoples. Indigenous peoples may share the common experience of being colonized. Yet, the historical, geographical, cultural, social and political contexts of that experience differ from place to place. Thinking that there is a universal or singular solution, a panacea, to global climate challenges to be derived from a universal or singular Indigenous perspective would be an illusion. Rather, the insight to be drawn from *Tayal* Country is that responding to climate change in the contemporary era requires listening to and on Country. It demands listening attentively to people's stories of connection and belonging. It also demands listening humbly to Country—listening to

what Country can teach us as a society, rather than assuming a self-privileging-human-centric position or a universalized conclusion relevant regardless of context.

5. Methodological Principles toward Resilient *Tayal* Futures

Three methodological principles are conceptualized from the above discussion to better engage with local knowledge and Indigenous peoples.

1. Decentralize top-down governance

As Australian Aboriginal concept 'Country' has been introduced in this paper, I argue that it is vital to recognize Indigenous peoples' connections to Countries and acknowledge that their custodianship always was and always will be nurturing their Country. To achieve this, it demands that researchers and government agencies rethink privileged top-down governance mentality. A top-down governance system favors universal and generalized solution for a resilient future and rejects contextualizing environmental issues in a specific-temporal-and-spatial scale and cultural-and-geographical-appropriate context. It projects a singular imagination of a resilient future. However, paying attention to local impact and listening to local responses will situate the notion and practice of resilience in a context. As I mentioned in Section One, the concept of 'situated resilience' provokes a radical recognition of place, where the knowledge is generated, maintained and practiced. It is the importance of place in knowledge systems making the impossibility of having a universally applicable climate change strategy. Acknowledging Indigenous peoples' custodianship and hearing local stories of connections will enlighten a very different pathway toward resilient governance.

2. Deauthorize expert-centric narrative

It is important to rethink how Indigenous peoples' knowledge and custodianship of their Countries have been omitted, marginalized and deauthorized by settler states' discursive constructions. In the *Tayal* people's context, their custodianship of Country has been ignored and their knowledge of their Country has been overlooked. It is critical for settler states and Western-science-trained experts to treat, think and view Indigenous peoples as intellectually equivalent partners, not as subordinate subjects or innocent victims. Sharing and valuing cross-cultural knowledge to each other does not devalue one or both. On the contrary, it demonstrates a great reciprocity that would bridge different knowledge systems. Only by justly valuing all stakeholders' knowledge can the partnership be bonded and the mutual trust can be built. To mitigate climate change and manage natural disaster, sharing cross-cultural knowledge will not solely enrich different knowledge systems' understanding to each other. More importantly, it will provide a strong sense of sharing obligation to all stakeholders as their knowledge are equally weighted.

3. Decolonize taken-for-granted ontological understanding

Nature is never natural. The constructed dichotomy of 'nature/culture' has been subjected to critical examinations across disciplines (for instance, see [58–62]). Drawing from the *Tayal* experience, I maintain that in *Tayal* ontology, nature is never separated from human society. In *Tayal* ontology, nature, the mountains and rivers, is not only the environment on which their livelihoods depend. It is their identity, their sense of belonging and their Country. For *Tayal* people, environmental issues, including climate change and natural disasters, are not separate events from their culture. It is their Country. *Tayal* ways of seeing, thinking and doing are fundamentally built on and shaped by their mountains and rivers. Mountains and rivers are not just non-human agencies for *Tayal* people. It is a significant agency in their more-than-human ontology. To achieve resilience environmental governance, it is necessary to recognize and respect ontology pluralism in the contested cultural landscape, a lesson not only for the Taiwanese government, but also for other settlers' states.

6. Conclusions

Three key notions mobilize this paper: Country, ontological pluralism and situated resilience. This paper starts with how acknowledging *Tayal* Country would shift the taken-for-granted research paradigm of resilience study. Then this paper argues that it is pivotal to recognize ontological pluralism in contested cultural landscapes, such as Taiwan. It deprivileges a conventional framework that deems resilience strategy to be universally applicable. This paper demands a careful rethinking and argues that resilience strategies, on the contrary, are embedded in a specific-temporal-and-spatial scale and cultural-and-geographical-appropriate context. Developing methodological principles to listen to and learn from local resilience requires immersing researchers in the local context. This paper draws from my own experience of working with *Tayal* mentors. Through in-depth and long-term fieldwork, I came to understand that for *Tayal* people, stories of connection, place and belonging and *Imuhuw* (migration history chanting) all play critical roles in their more-than-human ontology. *Tayal* people's custodianship of their Country is persistent and resistant despite colonial interventions. There is no way to truly understand *Tayal* resilience without acknowledging their custodianship of Country. In order to achieve so, it is critical to develop methodological principles. Three methodological principles were abstracted from my own experience of working with *Tayal* people: (1) Decentralize top-down governance; (2) Deauthorize expert-centric narrative; (3) Decolonize taken-for-granted ontological understanding.

As mentioned earlier, the insight to be drawn from *Tayal* Country is that responding to climate change in the contemporary era requires listening to and on Country. Implementing existing methodology on Indigenous peoples would be duplicating the settler-sanctioned research paradigm, which has been forcibly imposed on Indigenous peoples during colonial/imperial periods. The three methodological principles developed in this paper are hoping to provide a guidance for interested researchers and practitioners to ethically engage Indigenous resilience. In the Taiwanese settings, I argue that understanding the value of local governance, seeing Indigenous peoples as research partners rather than subordinated participants and learning to recognize the ontological politics of resilience are critical to achieving resilient *Tayal* futures.

However, the three methodological principles are not the panacea to the global climate crisis. I have emphasized in Section Three that Indigenous people are not a homogenous group, nor are they a conflated imagination that served as the opposite categorization against 'settler'. Indigenous peoples' cultures are diverse. It is important to acknowledge the multiplicity and complexity of connections. This paper conceptualizes and argues three methodological principles that I have learnt from ethical engagements with my *Tayal* informants. I hope these three principles can be utilized as a foundation for framing resilience science research in the Anthropocene. Engaging culturally diverse Indigenous groups to climate change adaptation is never easy. It involves careful listening to the Indigenous people, their connections to their Countries. It also involves fundamental de-learning on taken-for-granted understanding for disaster and climate. It requires a humble and respectful re-learning on what Indigenous people can offer to us, not solely as small communities but also as a whole human society. It needs determination to take actions to be responsible for ethical engagement. It is requisite to have a deep commitment on framing resilience science in not only centered on ethical engagements but also to frame studies in the ethical way. This requires an attentive rethinking on framing the Indigenous research participants not just as objects, but as active audience for the research itself.

Before concluding this paper, I would like to acknowledge *Tayal* Country. *Tayal* people and their Country have profoundly taught me a different way to view the world. People are not disconnected from the environment in *Tayal* ontology. On the contrary, rivers, mountains and people co-weave into existence in *Tayal* Country. This concept of weaving into existence is such a prominent component in *Tayal* philosophy and ontology. It is pivotal to adopt the culturally appropriate methodological principles in order to provide resilience plans for *Tayal* people when it comes to climate change. This will open up the possibility to improve Taiwanese government's responses to both Indigenous

rights and climate change in the Anthropocene by acknowledging *Tayal* people's custodianship to their Country, and it will also offer more resilient futures to *Tayal* people and the Taiwanese society.

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Appendix A

Table A1. Interviewees for In-depth interviews.

Name (Pseudonym)	Interviews Date	Gender	Occupation	Age	Ethnic Group	Rationale of Selection	Interview Themes
Sangus	2018.1.5 2018.1.8 2018.1.31	Male	Retired minister	60~	<i>Tayal</i>	Sangus is a retired minister of the Presbyterian Church. He has participated in the Indigenous social movements since 1990s. He is devoted to <i>Tayal</i> cultural preservation, <i>revitalization</i> and promotion. He has expertise in <i>Tayal</i> customary chanting, a form of oral history recording <i>Tayal</i> people's migration.	<ul style="list-style-type: none"> • Mapping of <i>Tayal</i> traditional territory • <i>Tayal</i> history and culture • Indigenous polity and identity
Teru	2018.1.7 2018.2.2	Female	Cultural worker and farmer	50~	<i>Tayal</i>	Teru is a dedicated cultural worker. She applies government projects to work on <i>Tayal</i> culture preservation, revitalization and promotion. She also grows customary crops and commercial crops.	<ul style="list-style-type: none"> • Mapping of <i>Tayal</i> traditional territory • <i>Tayal</i> history and culture • Experience of running a <i>Tayal</i> local business

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Article

Taiwanese Indigenous Cultural Heritage and Revitalization: Community Practices and Local Development

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Abstract: The continuing interest and progress in indigenous communities and local economies based on traditional, cultural, and ecological knowledge contributes to indigenous resilience. Here we report on an ongoing collaborative project investigating the process of renewal of cultural heritage through strengthening the roots of indigenous cultural traditions of knowledge and practice, and the changing concepts of tradition. The project investigates the various mechanisms for conserving indigenous culture: How the heritage of indigenous culture is reconstructed; how this heritage is related to the social frame and practice of everyday life; how power intervention affects the contestation of heritage; and in the context of heritage contestation, how cultural heritage turns into economic capital in the tourism economy of the community. The project explores the process of cultural heritagization of indigenous traditional knowledge through six individual projects in the areas of food and edible heritage, ethnic revival, weaving, solidarity economy, cultural ecotourism, and indigenous agro-products. In addition, the project examines the establishment of a constructive dialogue between the “traditional future”, cultural heritage literature and local practice in the interest of the consolidation of alternative development.

Keywords: Taiwanese indigenous studies; cultural heritage; heritagization; ecotourism; indigenous food culture; weaving; solidarity economy; alternative development

1. Introduction

Cultural heritage is a cornerstone of local and indigenous identity. The heritagization process is based on place and local culture characterized by traditions, according to some scholars, in order to promote cultural identity and to establish political control over the acculturation process [1]. The concept of heritagization has often been used in relation to cultural tourism. However, it has also been used in other cultural areas, such as music, in discussing how lived culture can be transformed into heritage to be safeguarded [2]. Here we use the concept to refer to the renewal of cultural heritage by strengthening and promoting the roots of indigenous traditions of knowledge and practice (which are themselves changing), towards social and economic development options that are culturally appropriate. Many indigenous societies around the world are involved in various kinds of cultural renewal efforts, identified by terms such as revival, revitalization, and restoration.

In Hawaii, for example, scholars have called it cultural renaissance [3] and biocultural restoration [4].

Indigenous peoples in Taiwan face a double problem. The first one is that development, especially culturally appropriate development, is a priority. However, as with other indigenous peoples of the world, achieving such development is a challenge. Indigenous communities often seem destined to play the roles scripted by others. In some scripts, they are heroic people resisting development; in others, they are the victims of progress [5]. Part of the dynamic is that culture is never static but changing all the time. Traditional practices are modified and enriched by outside technologies and knowledge, resulting in cultural adjustments and changes in the local economy. A promising development strategy is to deal with these changes from a position of strength based on the “roots” of cultural heritage. Such renewal of cultural heritage may shape and control the development process, conferring a kind of indigenous resilience. “Opting in” to the regional, national, and global economy makes more sense than resisting development, and often involves local cultural roots and social enterprises [6]. Such social enterprises are based on an economic model that provides for broad goals—economic, social, cultural, and political—providing multiple benefits such as self-determination, cultural revitalization, capacity development, as well as employment and cash income [7,8].

The second problem is that Taiwan has a disaster-prone geography. In addition to frequent earthquakes, Taiwan is increasingly vulnerable to typhoons, in part due to climate change. In particular, the Typhoon Morakot of 2009 resulted in a spate of studies dealing with disaster risk reduction and post-disaster recovery over the past decade (see the introduction paper to this Special Issue). These natural disasters, combined with colonial administration policies to relocate traditional communities, have resulted in social disasters from institutional violence and injustice. Much of Taiwanese indigenous peoples’ community revitalization efforts can be characterized as a reaction to the colonial legacy of an unjust past. However, the “native point of view” from indigenous livelihood and its related historical trajectory has been absent in the conventional framework of cultural heritage studies. Note that indigenous peoples only obtained name rectification in 1994 from the condescending term of “mountain compatriots/barbarians.” Such exoticizing and othering views meant that the indigenous peoples were usually presented as objects or cultural specimens, rather than as subjects in their own right. The six projects in this paper are examples of contemporary efforts to connect indigenous subjects and the idea of “traditional futures”. With a future that remembers cultural meaning from the past, these projects reflect on an alternative economy against neoliberal forces of governmentality, and make cultural heritage a living tradition.

Taiwan’s 16 officially recognized indigenous tribes with a total population of nearly 400,000 are considered to be the northernmost representatives of Austronesian culture. Geographically, the majority of Taiwan’s indigenous tribes are located in the mountainous interior, on the east coast, and offshore on Orchid Island. In response to the environmental devastation from natural disasters, cultural heritage development has emerged as an important economic diversification strategy. Indigenous cultural festivals, food, ecotourism, historical commemorations, and performances are all seen as effective means of attracting tourists to reach goals of economic diversification. Indigenous peoples are aware of the popularity of their attractive and distinctive cultural and natural resources and heritage. They use these as resources in exhibitions and performances to reconnect and recall the significance of local places and regions. However, what do we mean by cultural heritage in the context of sustainable development?

This paper focuses on how heritage for development is negotiated through various processes. It demonstrates that revitalization is dynamic, diverse, and sometimes contested, and always socially and culturally embedded. As a research focus, this integrated project involves connecting various indigenous communities (Figure 1) that are transforming cultural heritage into local economic forms that draw upon traditional knowledge and practice. The project also seeks the origins of these developments from a wider political and

economic perspective. Community practices and local development involve negotiation between communities and external agents of change. Clifford [9,10] points out that the revival of tradition involves the pragmatic selection and critical reconfiguration of “roots”. Is the renewal of cultural heritage necessary to connect to the capitalist market? What are the best mechanisms for facilitating the conservation and appreciation of indigenous culture toward development? As Cajete [11] puts it, “Western notions of development and its paradigm of ‘progress’ with little regard for social, cultural, and ecological consequences is an extension of colonialism”. Many indigenous peoples throughout the world have been searching for alternatives, “new paradigms of ‘development’ . . . more in line with [indigenous] cultural and spiritual ethos.”. Our paper is part of the search for an “Indigenized conceptual framework of sustainable community development” toward revitalization and renewal [11].

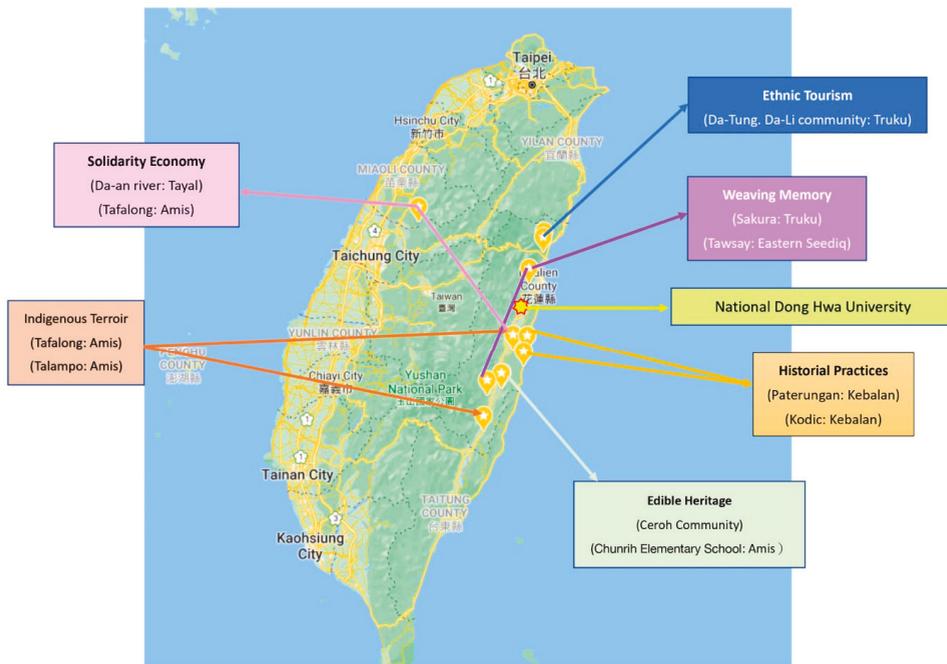


Figure 1. Map of Taiwan and locations of six research project sites.

To treat traditions as historical practices does not simply mean to return to the past. Rather, it means seeking origin stories for social transformation. Through prosperous ecotourism, indigenous culture and local knowledge are re-packaged as intangible cultural heritage and successfully create vernacular characters. These vernacular characters contain a potential path toward local subsistence economy and alternative tourism and other development. Within a development framework of indigenous community practices and local economies, the project attempts to rethink the meaning and value of indigenous agriculture and food sovereignty, legends and ceremonies, traditional artisanal techniques, community kitchens, and ecotourism. This not only strengthens the building of diverse cultural heritage, but also leads to consolidated constructions of indigenous identity. The project engages two important alternative historical perspectives. The first is Clifford’s [9] “traditional future” in which “returns” are used to re-examine and respond to diverse contemporary social development landscape and indigenous community development. The second is when “tradition” is instead viewed as an “historical practice”. This requires

paying attention to the links between physical memories and artisanal techniques and to the importance of cultural heritagization in local economic resistance strategies and indigenous community participation models. This second alternative, tradition as historical practice, is the perspective examined here.

Within the processes of globalization and neoliberalism, contemporary indigenous peoples have emphasized ethnic, cultural, and subjective representation in cultural revitalization. In Taiwan, as elsewhere in the indigenous world, more and more indigenous people are choosing to return to their communities to rediscover, acquire, and collect traditional cultural heritage. Moreover, through the activation and re-implementation of the practice of cultural heritage, as well as negotiations and collaborations with and resistance against mainstream social recognition and economic markets, new survival strategies and directions have emerged. Examples include ecotourism, ethnic handicraft markets, re-cultivation of farmland by indigenous people with the return of small farmers to their communities, repatriation of ethnic artifacts by museums, performance and exhibition of legends and ceremonies, and promotion of indigenous food culture.

The aim of this research is to investigate how indigenous people transform their traditional knowledge and create the possibility of livelihood and lifestyle renewal. The process of returning to and transforming local knowledge involves three dimensions of relations—relations to nature, object, and spirit. Taiwan's indigenous cultures were deeply rooted in these three dimensions (nature, object, and spirit) that need to be accounted for in the renewal of cultural heritage. Community practices provide the cultural mechanism to accomplish this, as shown in Figure 2. The six cases complement one another by dealing with nature (food, land, and ecology), object (weaving craft and fermentation products), and spirit (cultural revival).

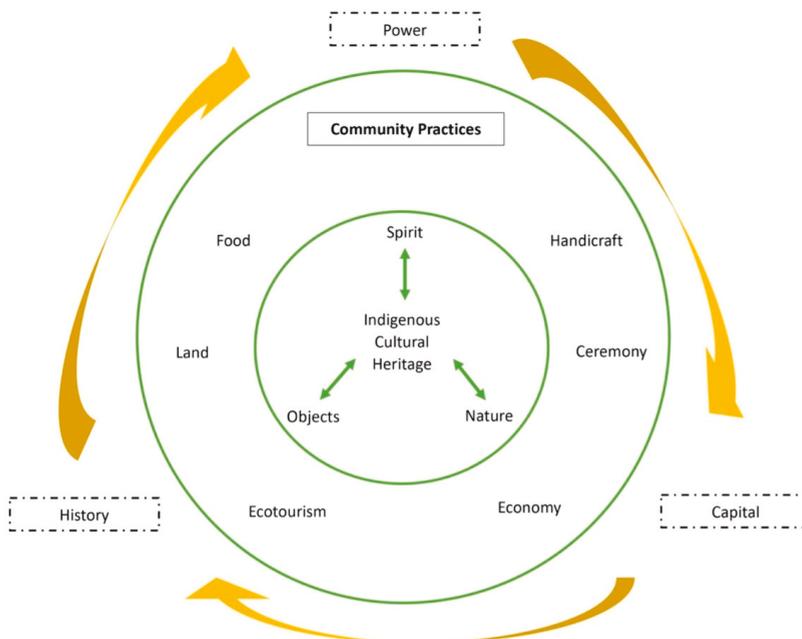


Figure 2. How the six cases fit together: Cultural mechanisms are provided by indigenous community practices and local development in the renewal of indigenous cultural heritage.

However, indigenous communities face contestation from external forces, and they are compelled to negotiate with the state or settler colonialism, which holds power, capital, and history. The process of struggle is engaged at the community level where cultural revitalization and local development come into focus (Figure 2). The six cases are dealing organically with the forces to create an upward spiral for indigenous cultural heritage involving land, economy, ceremony, food, handcraft, and ecotourism. Thus, the cases highlight cultural identity and ethnic subjectivity, the capability of indigenous communities to cope with social change, and the agency to rebuild transformative tradition.

The transformation and innovation of indigenous cultural heritage provide indigenous peoples with more possibilities for cultural identification and development, offering an understanding of how to engage, transform, and represent different forms of cultural heritage in the face of changing contemporary society. This paper seeks to probe these different developments through six interrelated case studies within a research approach that involves assessing the management and revitalization of cultural and natural resources as they merge with socio-cultural explorations of local knowledge and development practices. By approaching heritage from a socio-cultural perspective and applying theories of globalization and representation, the project examines how heritage is constructed, interpreted, and represented in indigenous Taiwan.

We argue that an empirically grounded understanding of how indigenous heritage is (re)produced through the mediation of unequal power relations, and how processes of alternative paradigms of development [11] is a prerequisite for any serious attempt to instigate dialogue that would allow all stakeholders to benefit from sustainable development initiatives. The major goal of the paper is to show that cultural revitalization is a significant context for understanding social, cultural, economic, and political action in indigenous communities. Building upon earlier research by the authors, the paper analyzes several patterns of development and uses case studies to illustrate the arguments.

2. Study Approaches and Methods

This research applied the approaches of post-colonial theories and methods, with special attention to cultural sensitivity in the research process [12]. We consulted, negotiated, and dialoged with people and scholars from indigenous communities. In order to highlight the subjectivity and diversity of indigenous heritage, we focused on continuous listening to local voices, ongoing negotiation of positionality, and proceeding reflection on equal relationship with communities and people. To capture a range of types of cultural heritage, six cases were undertaken. The cases dealt with different communities and different resources, offering a range of development experiences and alternatives.

As summarized in Table 1, multiple qualitative methods were used in the project. Fieldwork, participant observation, participatory action research, visual analysis of indigenous weaving craftworks, and in-depth interviews were carried out over a 3-year period. The project explored what cultural heritage means to indigenous peoples and their communities, and what forms of representation and developments arise within these practices. Indigenous heritage is seen as an embodied practice, so the paper addresses the negotiated character of knowledge production with reference to the knowledge interfaces between local communities and external agents of change who have their own practices and discourses.

Table 1. Research methods for the six cases.

Case Title, Period of Research, Research Site	Research Methods and Methodologies
<p>Joyce Hsiu-yen Yeh's project:</p> <ul style="list-style-type: none"> Indigenous Food Power 2016–2019 <p>NDHU-Naional Dong Hwa University Millet Farm, Ceroh Amis Community and, Chunrih Elementary School</p>	<ol style="list-style-type: none"> Participatory Action Research with National Dong Hwa University students, Ceroh Amis community people, and Chunrih Elementary School students to rebuild local food system and indigenous food culture biodiversity In-depth interviews and informal conversions with key informants engaged in the projects Focus group with indigenous elders and university students, and elementary school students who participated in growing millet and Formosa quinoa
<p>Shu-chuan Lai's project:</p> <ul style="list-style-type: none"> Cultural Revival of the Kebalan Tribe 2018–2019 <p>Paterongan and Kodic (Kebalan)</p>	<ol style="list-style-type: none"> Conducting oral history interviews with the elderly from the Paterongan and Kodic tribes Participant observation involving representative sea rituals and harvesting ceremonies Observing and recording the development of Paterongan and Kodic crafts (banana silk weaving, wood carving, and bamboo weaving)
<p>Shu-chuan Lai's project</p> <ul style="list-style-type: none"> We are Weaving the Different Stories 2017–2019 <p>Shanli (also known as Tawsay) and Shueiyuan (also known as Sakura)</p>	<ol style="list-style-type: none"> Participant observation with the following organizations and activities: Community development association, weaving-related festival, weaving workshops, and craft fair. In-depth interviews with (a) women who are weaving, their family and life history, experiences of weaving and (b) officers working in local organizations related to weaving such as township government, churches, the association of community development, and schools.
<p>Ying-hao Huang's project:</p> <ul style="list-style-type: none"> Solidarity Economy in the Tribes 2017–2019 <p>Da-an River (Tayal) and Tafalong (Amis)</p>	<ol style="list-style-type: none"> In-depth interviews: Interviewing the group members of Ina Kitchen and the social workers involved the project. Focus groups to collect the history and the collective experience of the Ina Kitchen. Participant observation: Visiting and making observation in the tribal village (Da-an River and Tafalong) and taking part in the activities of the Ina Kitchen.
<p>Chen Yi-fong's project:</p> <ul style="list-style-type: none"> Cultural Heritage, Identity Politics and Alternative Development 2016–2020 <p>Da-Tung and Da-Li communities in the vicinity of the Taroko National Park</p>	<ol style="list-style-type: none"> Participant observation: Participating in ethnic tourism guided by local operators to observe the interactions between indigenous tour operators and tourists; observing how indigenous people demonstrate knowledge about the environment to earn the respect of tourists. In-depth interviews with indigenous tour operators to understand how they initiate ethnic- and eco-tourism, and how they reinforce cultural identity by performing their cultural heritage during the process of tourism activities.
<p>Yi-tze Lee's project:</p> <ul style="list-style-type: none"> From Indigenous Flavor to the Making of Local Terroir 2015–2017 <p>Two Amis communities, Talampo (daylily) and Tafalong (rice)</p>	<ol style="list-style-type: none"> Participant observation: Staying in the villages for six months and participating in life events of local farmers; learning how local flavor and food preparation is done. Snowball sampling interviews: (a) learning the commodity chains; (b) how the flavor of fermented foods was negotiated between Han factory and Amis farmers; and (c) learning about the home-returning of local farmers

3. Taiwanese Indigenous Cultural Heritage and Revitalization: Six Case Studies

3.1. Indigenous Food Power: Participatory Action Research on Indigenous Agriculture and Edible Heritage

The ongoing project, “Farm to Table”, uses participatory action research (PAR) methodology to reinforce community-university partnerships. Yeh has been working with college students to grow Taiwanese traditional indigenous crops such as millet and Formosa quinoa on NDHU campus since 2012. The NDHU Millet Farm is not only the first farm in Taiwan to develop indigenous farming knowledge and food culture in a university setting, but this farm also connects food, culture, and community to create a cultural landscape where indigenous elders and students are working and learning together to pass on their cultural heritage [13]. At the same time, Yeh and her student team—food, agriculture, tourism, and sustainability (FATS) are working with the local Amis Ceroh community and the elementary school to cultivate their own millet farm so “lost” traditional foods could be brought back to the table.

The farming process has helped students to develop skills in working with community, discover indigenous values, cultures, traditions, and heritage [14]. The project aims to engage with the Amis Ceroh indigenous community in Hualien and its elementary school’s agriculture and food education. Yeh stresses the importance of using cultural knowledge, culinary traditions, and agricultural resources to develop indigenous peoples’ ability to exercise and implement empowering opportunity to promote their food heritage and sharing economy. Encouraging meaningful participation by all parties, she jointly explores how agriculture and food turn into edible heritage and become multiple resources for local economic development and education. The initiative emphasizes indigenous peoples’ capacity for adaptability, resilience, and restoration of traditional agriculture and food use, as well as food production in response to changing conditions.

Food is commodity and culture too. For indigenous peoples, food can be the basis of a collective social movement to make culturally appropriate foods visible, and exercise indigenous heritage. The project considers the ways in which edible heritage is identified, experienced, and brought into the present. It also examines the role of tourists as consumers of edible heritage. By engaging in PAR processes, the local people and students articulate and examine how their knowledge is produced, reproduced, and experienced. Out of those articulations, locals and student groups jointly implement action plans that address issues salient to them. Edible heritage matters because indigenous peoples’ right to agriculture and food is inseparable from their rights to land, territories, natural resources, culture, and self-determination. Yeh argues that the community-campus food projects can begin as “incubators”, pioneering new nodes in an alternative food chain for the local region. At the same time, experiential learning in indigenous agriculture and foodways deepens connections to place, integrates values beyond those embedded in conventional food system, and fosters new ethical choices, both for the cultural industry and for community participants.

3.2. Cultural Revival of the Kebaran Tribe—Heritage and Re-Creation in Historical Practice

This research explores how Kebaran Tribe continues to practice its culture and rituals in the context of modern society. The development of intangible culture is manifested in the accumulation and the transmission of memories. Traditional beliefs, regardless of origin, have a dual nature. They are collective traditions or memories, but they are also concepts or customs derived from the understanding of the present [15]. Memories may be translated into an idea or symbol, and acquire a meaning, becoming an element in the system of social ideas. This is why tradition and current ideas can coexist [15].

The ethnic group revival movement of the Kebaran Tribe started following the “Fakong Night” performance at a sarcophagus exhibition in 1987. For nearly 30 years, certain cultural traditions, such as myths, ritual activities, songs and dances, tribal language learning, banana silk cloth, traditional skills, food, and clothing, have been restored or created. In addition, ethnic totems such as *gasup*, *saur*, and others have also been created, displaying

the spirit and cultural values unique to the tribe and drawing recognition for the local tribal people. In the first year of the project, the most representative sea rituals and harvesting ceremonies were explored. When the contemporary social environment underwent change, people of Paterongan and Kodoc took into account historical memory and traditional customs. They sought from within solutions and ways of holding events, such as the regeneration of new and old sea ritual sites and hosting events through traditional cross-ethnic *mipaliu* (mutual aid and trade). They engaged in spontaneous operations, formed alliances, and represented meanings.

In the transmission of rituals or making of products with ethnic characteristics, the Kebalan Tribe's cultural and social response can be found in that the tribe chose to use meaningful space and historical memory as the starting points for identity, thus reorganizing culture for the contemporary era. The new practices allowed memory "appear" to the present. As for the distinctive cultural products integrated into myths (legends) and historical memory, these products were endowed with images that could be recognized by the public as being characteristics of Kebalan Tribe. Our research found that the adapted rituals or commodities emerged out of the interaction between the Tribe and the larger society.

The study was intended to develop specific implementation models to serve as examples for other ethnic groups. These models demonstrated flexibility, as they strategically used traditional methods to achieve cultural heritage. During the 30-year revival process, vanishing cultures on the brink of extinction revived crafts (e.g., banana silk weaving, wood carving, and bamboo weaving), rituals, and agriculture and fishery practices. Studies and analyses showed how contemporary adaptations and reorganization were integrated into the myths of the tribe, how historical memory generated characteristic products for economic development, and how these actions strengthened tribal identity, and enabled the tribal communities to become a "living traditional culture".

3.3. *We Are Weaving the Different Stories: The Reconstruction and Contestation of Weaving Memories for Pan-Facil Tatto Groups*

With the development of weaving craft by the Pan-Facil Tattoo groups (Pan-Tayal), following the activation of the ethnic revival and cultural economy movements, weaving workshops were conducted, one after another, in many indigenous communities. However, these weaving workshops now barely survive due to inadequate marketing strategies. Is the renewal of cultural heritage necessary to connect to the capital market? What is the best mechanism for the conservation of weaving culture? There are two cases, Shanli (also known as Tawsay) and Shueiyuan (also known as Sakura) villages, where weaving culture continues within the household. The motivation to weave is to recall the memories of mothers' or grandmothers' weaving experiences, and to prepare dowry for daughters or granddaughters. In Shanli the "ramie festival" is held every few years in order to strengthen ethnic identity. In the festival, the action of making thread by *ramie* (a traditional fiber crop) and weaving is demonstrated. Narratives and songs concerning migration experiences are presented. Many villagers who have left their home villages to work in cities come back to participate in the festival, and memories of the weaving and migration history strengthen their ethnic identity.

In Shanli, weaving enables a continuous learning network from generation to generation in the community. Life memories such as *waya* beliefs (religious belief), marriage customs, the norm of gift exchange, and the sharing stories of textile patterns, sustain the motivation and vital energy to continue weaving. In Shueiyuan, some middle-aged women form companionships in learning groups in which they weave together daily and share the memories of their mothers and grandmothers. These learning groups even attract women from other villages, transforming weaving from household labor into a community-wide activity of cultural expression and market trade. With the development of tourism, they also share their weaving experiences and memories with tourists.

People in Shanli and Shueiyuan move between tradition and future by revitalizing and re-practicing weaving culture, thus making transformative survival of heritage possible.

Weaving memories are reconstructed and become the source of cultural capital needed for tourism. Through the cases of Shanli and Shueiyuan, it is shown that the social memory of weaving is important in the conservation of the weaving culture, and it further enhances the cultural capital of the local economy. Formation of cultural capital is empowering, as it indicates “micro-resistance” to mainstream society, and shifts the position of women from the margin to the center.

This study has investigated the different mechanisms that conserve the weaving culture in these two cases. It has examined how the social memory of weaving is reconstructed; how the memory of weaving experience is related to the social relations and practice of everyday life; how political intervention affects the contestation of memories; and regarding memory contestation, how social memory turns into cultural capital deployed in stimulating the tourism economy. The project has studied how the community competes, cooperates, and negotiates with mainstream travel agents in terms of cultural interpretation and economic benefits.

3.4. Solidarity Economy in the Tribes: The Da-an River Tribal Kitchen as a Starting Point to Explore

Social work in indigenous tribal communities is only a small part of the service that the State provides, but it also often functions as a tool of social control by the State apparatus. How could the implementation of social work avoid the imposition of mainstream values on indigenous peoples, or become an accessory to the State’s assimilation and control powers, given that it is privileged with an abundance of resources? These have long been crucial questions for indigenous social workers. If social work is a matter of social reform, then economic autonomy, free from the constraints of corporations and government, is of crucial importance. The possibilities of social reform in Taiwan have been significantly restrained due to dual repression by professionalism and neoliberalism. When the commodification of public service becomes the norm, the implementation of social work turns more and more bureaucratic and becomes rigidly standardized. In light of that, it becomes critical how indigenous peoples, who are often economically marginalized due to neoliberalism and globalization, can develop means of progressive resistance.

The term “solidarity economy” refers to a grassroots form of cooperative economics to connect thousands of local alternatives together to create large-scale, viable, and creative networks of resistance to the profit-over-all-else economy. Solidarity economy is an economic form which seeks to improve the quality of life of a region or community on the basis of solidarity, often through local business and not-for-profit endeavors. It also refers to a set of strategies aimed at the abolition of capitalism and the oppressive social relations that it supports and encourages. Instead of prioritizing competition and profits, these economies place human needs and relationships at the center [16,17]. Solidarity economy is a way to resist the colonizing power of the individualistic, competitive, and exploitative economies. Indigenous solidarity economy may be one promising route for indigenous peoples and a way to think about indigenous social work.

Da-an River Tribal Community Work Station began as a social work station that developed tribal industries [18]. Upon realizing the exploitative nature of capitalist markets, it adjusted its goal to work towards a solidarity economy. When indigenous peoples enter the global capitalist system, economic development of tribal communities becomes fragile as external forces take control. The issue is not only to let the tribal community flourish economically but also to resolve the fundamental problem of feelings of economic inferiority. This project has attempted to extend the field of research on the Tribal Kitchen at the Da-an River tribal community to the Ina Kitchen of Tafalong tribe in Hualien, and to continue examining the reality of social work in indigenous communities. It focuses on the process and challenges in developing tribal industries as people gain experience in a solidarity economy. It then compares the Da-an River experience with several communities in Hualien that are currently developing or have the potential to move towards a solidarity economy, in an attempt to discuss and analyze the solidarity economy as an alternative to existing models of tribal community development.

3.5. Cultural Heritage, Identity Politics and Alternative Development: Study on the Changes of Indigenous Ecotourism in the Taroko Area

Tourism activities based on indigenous traditional ecological knowledge continue to grow in Taiwan. This research has investigated the process of cultural heritagization and changing concepts of tradition. It also has sought the social origins of these changes within wider political and economic structures. Clifford [9,10] points out that the revival of tradition involves pragmatic selection and the critical reconfiguration of “roots”. To treat traditions as historical practices does not simply mean to return to the past, but involves the origins of social transformation. Through prosperous ecotourism, indigenous culture and local knowledge are re-packaged as intangible cultural heritage, and may successfully create vernacular characters containing a potential path toward local subsistence economy and alternative development.

The research focuses on ethnic ecotourism in the Taroko (both Taroko and Truku refer to the same group and their area in eastern Taiwan. Taroko is usually used as a place name, as in the official spelling of the nearby Taroko National Park. Truku is more often used as the name of the people) area, a long-term study site for the researcher. Serial changes have been occurring over the past two years. Firstly, the financial assistance from the government to develop ecotourism induced further capital investment by private ecotourism operators and involved larger interests. Secondly, the new ruling by the Democratic Progressive Party-DPP government called for a transitional justice policy involving the legalization of hunting rights and instituting natural resource co-management between the state and indigenous peoples. Lastly, the long-term major project informant/participant in the Taroko area was elected to the township council, in addition to his relatively overlooked earlier position as the head of the local indigenous association. Through the process of studying heritagization of indigenous traditional knowledge in the development of ethnic tourism, particularly ecotourism, the project aimed at establishing a constructive dialogue between “traditional future,” cultural heritage literature, and local practice for the consolidation of alternative development.

The local conduct of ethnic- and eco-tourism in Da-Tung and Da-Li communities has opened up an opportunity for Truku people to perform and reconstruct their cultural heritage. To comprehend and interpret the local environment as a way to revitalize traditional knowledge, is to transform cultural heritage into a living tradition. Both the tourism operation and the degree of heritage commodification are under indigenous control, resulting in a kind of solidarity economy among the communities involved. As such, indigenous peoples can take advantage of the development of ethnic tourism to revitalize traditional knowledge, an exemplary demonstration of the traditional future. However, there are growing concerns and challenges. First, the operating scale and the profit rate of ethnic- and/or eco-tourism is not sufficient to support a family. Second, there is tension between different families operating ecotourism, because the distribution of public (communal) resources might endanger solidarity cultivated during the past few years.

3.6. From Indigenous Flavor to the Making of Local Terroir: A Study of the Taste of Processes in Indigenous Agro-Products and the Function of a Local Fermentation Workshop

This project considers three kinds of indigenous fermentation-based sauces, flavors, and products: “red rice *koji*” which is a kind of fungus (used in making *anka*, a type of miso paste), “daylily fermented paste”, and fermented “millet wine”. Based on these products, the project discusses the interaction and formation of a multi-species production chain, indigenous flavors, local terroir, and ethnically embodied memories. The project aims to present research on two indigenous agricultural communities and their cooperative fermentation workshops producing indigenous flavors in Eastern Taiwan. These unique indigenous flavors are referred to here as the local terroir, the characteristic taste and flavor imparted to a product by the environment in which it is produced. Based on the historical trajectory of local workshop development, as well as the recent promotion of indigenous taste, this project explores the transition of fermented agro-product manufacture from family operations to community networks and finally to large-scale tourism factories.

Reflection on the industrialization of fermentation processes reveals translation work in producing indigenous flavors and its relationship to the construction of local cultural identity.

How does the industrial-scale production process reproduce the “terroir” of indigenous materials and climate, as well as the local memory of original taste? This is the main focus of this project. The production chain of indigenous flavors relies on the interaction among three fields: Collection of indigenous agro-materials, the fermentation technology used, and the promotion of consumption of traditional flavors. The concept of a “boundary object” [19] is a key to the project, since these indigenous products help start a dialogue between indigenous and non-indigenous peoples. Another key idea, multispecies ethnography (with fungi, millet, daylily flavors, and involving indigenous farmers and fermentation craftsman) helps shed light on extensive relations involving indigenous taste and terroir.

In the end, this project aims to discuss and critically trace the transition from a local agriculture-based production chain to an outside-oriented industrial-scale production network. It documents the conversion of production to serve the Han Chinese market, while trying to retain indigenous control. It reveals how local terroir based on indigenous landscape, special ways of planting and harvesting, and ancestral tales, are combined with a branded logo for consumption by non-indigenous visitors. While unfriendly policies have created difficulties for organic certification, local efforts and traditional knowledge help to promote indigenous agricultural sovereignty. The investment of indigenous labor turns an unfavorable work environment into meaningful products. Organic farming is not a feminized mode of production that reflects “women’s work” as wage labor considered low in social class. Rather, it is a corporeal revelation of the relationship between body and work: A demonstration of symbolic capital in the form of embodied experiences. Local terroir is regained through actively promoted local taste via fermentation workshops and story-making in empowered co-op tourism.

4. Discussion

The six cases illustrate alternative forms of development that aim to give priority to social, cultural, and ecological aspects of sustainable community development. They are fundamentally different from the Western paradigm of development and “progress” which are an extension of colonialism and which prioritize profits above all. The cases in this paper document how indigenous peoples are transforming cultural heritage into local economic forms that draw upon traditional knowledge and practice. This is the heritagization process we discuss in this paper—renewal of cultural heritage by strengthening and promoting the roots of indigenous traditions of knowledge and practice towards culturally appropriate social and economic development options. Cultural revitalization is an essential part of heritagization, and the context for understanding social, cultural, economic, and political action in indigenous communities.

We have argued that heritage needs to be understood in the broadest of terms to encompass not only past traditions but also contemporary conditions. The paper deals with the historical and contemporary conditions of Taiwanese indigenous peoples, and it also looks to the future. The six cases provide an accounting of the continuity of indigenous peoples, their cultures and their development. This is shown by the research themes addressed by this paper:

1. From cultural heritage, such as agriculture, food culture, weaving, tourism and ethnic education, legends, rites, and ceremonies, we explored the current status of indigenous community heritagization in Taiwan.
2. We elucidated indigenous cultural heritage and its reproduction, as well as its dynamic translatability.
3. Based on aspects of food and farming, artisanal technologies, and tourism, we have treated the content and meaning of local indigenous peoples’ views of the historical

practices of cultural heritagization, interpretive process, and transformation of skills and techniques involving cultural innovation.

4. We provided an understanding of how cultural heritagization becomes the basis for identification and the foundation for indigenous community development in the presentation of “indigenous power.”
5. As we have discovered indigenous subjective practices and connotations, we are building up research on Taiwan’s indigenous cultural heritagization as a reference for “mobile workshops” for proposing possible deliberation methods for implementing practices at the local level.

The paper takes a significant step in providing a greater appreciation of the diversity of Taiwan’s indigenous peoples, and possibilities of cultural revitalization. The inclusion of several tribes and multiple communities in the study helps document a rich experience. This is important because each case involves different conditions, challenges and opportunities. Reducing the study to fewer cases would have missed this richness and would have lowered the quality of the paper and the strength of its findings. However, the heritagization and development experience captured here, focusing as it does mainly on the east coast (Figure 1) is only a small part of the diversity and complexity of indigenous Taiwan. Therefore, we call for more empirical work that makes indigenous peoples and their communities the central vantage point to illustrate indigenous views and to provide a better understanding of the indigenous experience.

In examining and reflecting on indigenous concepts from cultural production to practice and participation, the paper provides Taiwanese perspectives on the renewal of indigenous cultural heritage, the generation of options in response to development needs, and the implications of cultural heritagization. The case studies show that culturally appropriate development is possible and feasible in a number of areas, from cultural tourism to millet wine production. Many of the cases involve social enterprises, as part of a solidarity economy. The cases do not follow the utilitarian economic development models based on profit. Rather, they aim to provide multiple benefits such as self-determination, cultural identity and pride, empowerment, and revitalization. Social enterprises are a good fit for indigenous economic development, as they help to establish control and manage local affairs [20]. They strengthen cultural relationships such as food-sharing [8], as in tribal kitchens. These enterprises and projects are important for controlling the direction of development, and thus they have the potential to contribute to indigenous resilience.

Importantly, these projects provide development options, based on the “roots” of cultural heritage, for indigenous communities impacted by the Typhoon Morakot of 2009 and other environmental disasters. Maintaining a diversity of options is important because it provides flexibility and opens up the opportunity to learn from a diversity of development “experiments”. Such a resilience-building strategy is significant in the face of Taiwan’s disaster-prone geography, and the likely increase in the frequency and strength of typhoon events in the coming years. Thus, this paper is focused on the historical and contemporary conditions of Taiwanese indigenous cultures, but it also looks toward a resilient future.

The six cases deal with a diversity of indigenous peoples, communities, cultures, and development possibilities. Based on the results of these sub-projects, reported at various stages [13,14,18,21–23], we continue to delve into indigenous cultural heritage as our overarching research area. In doing so, we connect indigenous communities and make use of multiple research perspectives related to Taiwan’s indigenous cultural heritage and relevant practical experience. The “six-sided prism” interpretative analysis (Figure 3) is used to show the path from analysis of cultural heritage to development. The prism summarizes how multiple projects are engaged with the research themes. Based on our findings, the three pie-charts indicate the main areas of tension and dynamics between global/national level market forces and local struggles for sustainability, for example, neo-liberalism vs. solidarity economy.

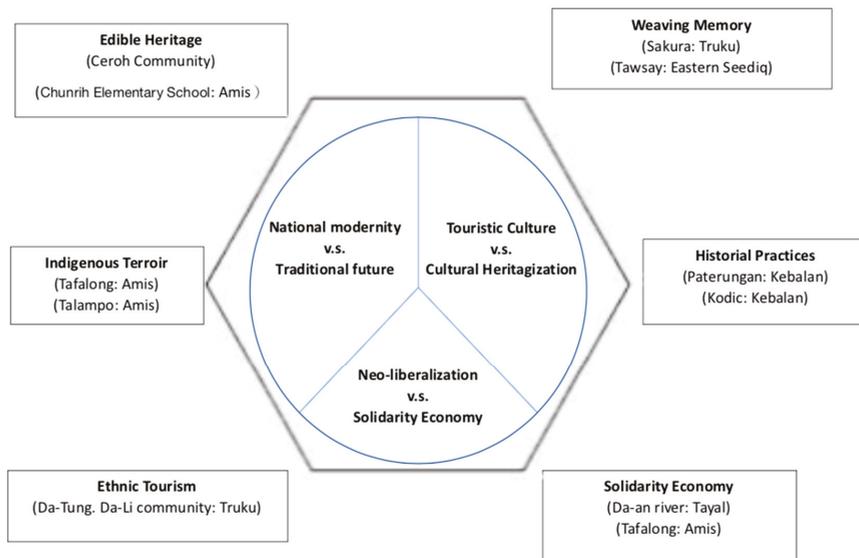


Figure 3. Relationship diagram of the key concepts and issues of “heritagization” of indigenous community practices and the local economy.

There is no one model for alternative development. Based on the situation and the current state of various indigenous communities, multiple possibilities are explored in the face of globalization. Moreover, indigenous community esthetics and the new vision of indigenous cultural heritage are presented through local agriculture, weaving and other artisanal techniques, ethnic cuisine, history, ceremonies, the establishment of collective participation and local cohesiveness, as well as the maintenance of cultural heritage. Each involves issues worthy of attention. The research team not only focuses the discussion and analysis on the themes and issues of the various sub-projects, but also through common networks of practice.

Together these six cases emphasize the connectivity and divergence of communities in different regions of Taiwan. Case studies and observations of situations are used to explore how heritage can be transformed into local industries that drive indigenous community tourism and sustainable development strategies. As well, the cases reflect on the cooperative relationships within and between indigenous communities in different areas, and political, economic, and social organizations. In these relationships we highlight issues related to the building of cultural heritagization involving dialectical relationships and derivative commercialization and industrialization. For example, solidarity economy is a critique of conventional economies that prioritize competition and profits above all. Instead, solidarity economy places human needs and relationships at the center, and is therefore similar to the Latin America-based international movement, *buenvivir* (“good living” in Spanish) [24].

From Clifford’s alternative views of history [9,10], thought is given to cultural heritagization as the action core of indigenous community practices and local economies. Six key areas (food heritage, historical practices, weaving-related memories, ethnic tourism, solidarity economy, and indigenous terroir) are the issues of concern for the six collaborating researchers. From Taiwan’s indigenous subjective concepts, the application of this integrated research project is used to explain how “the rich and glorious knowledge of the past” is inlaid in “modern times”. Through selection mechanisms, namely the different concepts and directions of the sub-projects, we elaborate on the idea that cultural heritage is the concrete presentation of history, artisanal techniques, knowledge, values, internal

logic, and cultural practices. Taking this a step further, we place emphasis on the necessary activation of indigenous traditional cultural heritage in the rebuilding of connections with the land and for indigenous community “life projects” [5] and local development mechanisms to take root.

Moreover, the food consumed and the clothing worn in daily life involve the most basic cycles of food, artisanal techniques, and ecology. Through the integration of local economy and mainstream markets, traditional knowledge (history) again becomes part of the practice and experience of market mechanisms, through experimentation to form cultural affirmations and economic flows. “Cultural heritage” is the greatest asset that contemporary indigenous people possess, something precious left behind by the past generations that has once again been proven to possess contemporary value, and has not been washed away in the torrent of time. Moreover, indigenous groups are building empowerment mechanisms and reviving cultural kinetic energy. This paper takes a significant step toward providing a greater appreciation of the diversity and possibilities of cultural heritage of Taiwanese indigenous communities and peoples.

In this way, the relationship between “the past” and “contemporary practice” forms a positive and dynamic cycle. Figure 4 provides a detailed expression of the integration of practices, approaches, and six key areas. The cultural past is not simply the cultural future. The “roots” of indigenous cultural heritage provide a diversity of cultural elements to select from. In our study, we selected the six areas shown in the figure, but there are of course many others. These selected areas become the engine for local economic development, leading to new social, cultural, political, and environmental benefits, for example, the cultural capital needed for the tourism economy. They also lead to practices that sustain these various benefits, leading to renewed and reconstructed cultural heritage.

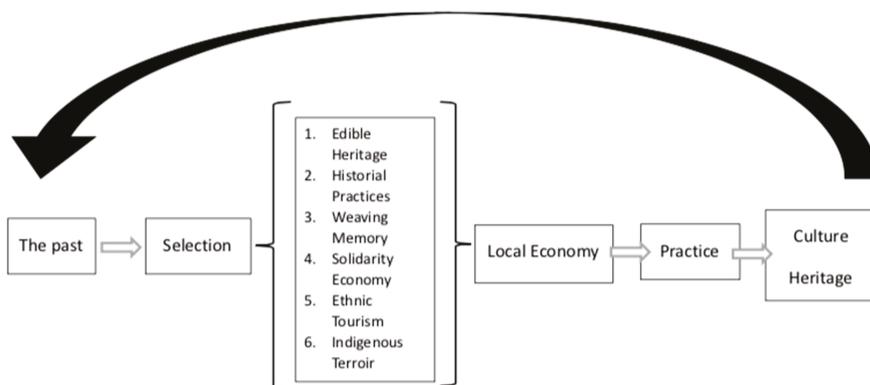


Figure 4. Integrated project practices and approaches (adapted from [25] (p.93)).

5. Conclusions

Our attempt, through the study of cultural revitalization, to understand changes related to indigenous heritage leading to social, cultural, economic, and political action, has many practical and theoretical implications. The expected academic and practical benefits of this project may be summarized as follows:

1. Deepening of the identification of different generations with farming village culture and the land, and strengthening of efforts to grow traditionally used plants and to provide relevant farming education.
2. Promotion of farming education practices and agricultural revival of food assets based on indigenous culture.
3. Through conservation and revival of weaving skills as well as memory, the indigenous traditional knowledge and cultural heritage will continue and be innovated in living

cultures. Moreover, these practices can be transformed into the cultural, symbolic and economic capitals for local industry.

4. Clarification of the rebuilding and seeking of multiple cultural mechanisms for indigenous cultural heritage under a contemporary capitalist framework.
5. By viewing intangible knowledge as cultural heritage, the definition of cultural heritage is expanded. In addition, in the process of heritagization, the recognition of traditional knowledge related to forest ecology becomes important.
6. With the integration of tourism and ecology, ecological knowledge is restored and revived. Reproduction of relationships of indigenous social and cultural traditions are promoted in multiple forms in dialogues with the mainstream society.
7. We contemplate the active and strategic use of traditional practices, such as (*mipaliu*, helping one another, exchange of labor) to preserve cultural characteristics and to pass on heritage.
8. When culture undergoes contemporary adaptation and recombination, understanding can be created about how to incorporate characteristics of indigenous legends and historical memory into products, and how to adapt to industrialization, such that the meaning of the new era is presented as “living traditional culture”.

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Article

Resilience for Whom? A Case Study of Taiwan Indigenous People's Struggle in the Pursuit of Social-Ecological Resilience

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Abstract: While the notion of social-ecological system resilience is widely accepted and applied, the issue of “resilience for whom” is clearly ignored. This phenomenon has also occurred in Taiwan. This article explores the roots of, and a possible solution to, this issue through a case study in the context of Taiwan’s indigenous peoples. The Danungdafu area, the focal social-ecological system, was studied. Qualitative research methods and an action-oriented research approach were employed. For a long period, the central government shaped the political, economic, social, institutional, and ecological contexts; dominated resilience discourses and determined the problem-framing and problem-solving agenda; defined the scale and levels at which social-ecological system governance issues were addressed; and determined the knowledge system used to define and solve problems. After 2011, a new participatory governance regime emerged. Multiple stakeholders, including indigenous communities, began to contribute to resilience discourses and influenced governance and trade-offs among differing governance goals. However, under the established structures dominated by Han people, indigenous views, rights, and well-being continue to be ignored. Affirmative action is required to recognize and safeguard indigenous rights. A practical institutional pathway is available to facilitate the transformation from “resilience for mainstream society” to “resilience for indigenous people” in indigenous territories.

Keywords: indigenous people; resilience; social-ecological system; Taiwan

1. Introduction

In the context of global changes, the influence of resilience thinking has expanded rapidly over the past two decades. Academia, governments, civil society, and even the private sector have embraced the notion of social-ecological system resilience and have applied it to a wide range of sustainability issues [1]. Resilience here is defined as “the capacity of a social-ecological system to absorb a spectrum of shocks or perturbations and to sustain and develop its fundamental function, structure, identity, and feedbacks through either recovery or reorganization in a new context” [2]. As this definition demonstrates, from the origin of the concept, social systems and ecosystems have been regarded as an inseparable and closely interacting system [1,3]. Because of the nature of the social system and the need to distinguish which system states are desirable or undesirable when undergoing adaptation and transformation, resilience is an inherently value-laden concept [1,4]. Similar to the concept of sustainability, resilience concerns the well-being of human society at different levels [5,6]. It must therefore address related social issues, including value judgments, power, political and social processes, distribution, inequality, collective action, and human agency. Thus, resilience should address the following core questions: resilience of what to what? and resilience for whom? [1,7,8].

As a core issue of resilience, the issue of “resilience for whom” should be addressed explicitly, especially in relation to disadvantaged and marginalized groups in the social system (see, for example, [9]). Numerous scholars, however, have stated that the extent to which this issue has been addressed in resilience research remains far from adequate [10–14]. More precisely, deficiencies are reflected in several interrelated subtopics.

Power is a key issue in the resilience and governance of social-ecological systems. Unequal power relations between different social groups are often the root cause of environmental and resilience problems, and the deterioration of the environment and resilience often worsens inequalities in distributions of power [10]. Power directly involves politics. Power inequality not only involves contemporary political and social processes but can often be traced back to the colonial period and the period of state-building [11]. Power and politics shape politically advantaged and disadvantaged groups and ethnic, class, economic, cultural, and gender boundaries and affect the capacity of groups to respond to disturbances. Generally, the groups most vulnerable to disturbances are also the most politically powerless [11]. Not only does inequality cause low resilience in certain groups, it also reduces the possibility of rebuilding resilience [13]. This means that power, politics, and ethical considerations are, among others, the main driving factors affecting the resilience of social-ecological systems. They should be deliberately included in any analysis rather than be intentionally or unintentionally ignored [8].

Considering power, politics, value judgments, and ethical aspects, a number of major issues emerge when people attempt to address the question “resilience for whom” in a specific case: (1) Who and what drivers shape unequal political, economic, social, institutional, and ecological contexts [15,16]; (2) Who dominates resilience discourses and determines problem-framing and problem-solving agendas [10,17]; (3) Who defines the scale and levels at which social-ecological system governance issues are addressed [10]; (4) Who determines the knowledge system used to define and solve problems [10]; (5) Who are the major agents of the governance process, who exerts influences on governance and why [18,19]; (6) Who decides trade-offs among conflicting resilience governance goals [10]; and (7) Whose rights should be actively recognized and safeguarded, and what measures can people take to improve this process of recognizing and protecting rights [13,20–22].

Compared with international trends, Taiwan has recognized and applied the concept of social-ecological system resilience relatively late. Only about 10 years have passed since it became popular. Even so, the concept of resilience has already been used in numerous fields. Taking Taiwan’s central governmental sectors as an example, the Ministry of Science and Technology recently completed a disaster prevention policy proposal titled “Resilient Cities under Extreme Disasters” [23]. The Council of Agriculture has moved toward resilient agriculture [24], and the Taiwan Forestry Research Institute of the Council of Agriculture has called for pursuing resilient urban forests [25]. The Ministry of the Interior has promoted the concept of resilient communities [26]. Also, the Ministry of Economic Affairs made “Resilient Water Resources Management” one of its major policies [27]. These examples suggest that the concept of resilience has penetrated main public policy fields and exerted a significant influence on policy discourses. However, although nearly all sectors of Taiwanese society have quickly embraced resilience notions, many profound theoretical and practical issues have emerged. As the review in the previous paragraphs argues, the “resilience for whom” issue is a critical topic that is rarely addressed. Similar phenomena can be seen in Taiwan, and a greater degree of attention is urgently needed to correct deficiencies that may have occurred at the level of theoretical understanding as well as policy discourse and implementation.

This article aims, through a case study in the context of Taiwan indigenous peoples, to explore the “resilience for whom” issue. It argues that so far, discourses and practices related to resilience in real cases in Taiwan have mainly focused on ecological resilience and the well-being of mainstream society, whereas the views, rights, and well-being of indigenous peoples are largely ignored or at least underestimated. These phenomena are deeply rooted in the political, economic, institutional, social, and cultural structures dominated by the mainstream Han society. I argue that, in Taiwan’s pursuit of social-ecological resilience, this is a major deficiency that cannot be ignored. Proactive measures are

required to correct this unacceptable injustice. Despite seemingly insurmountable obstacles, this article also suggests possible institutional pathways that could help solve the problem of resilience for whom in the context of Taiwan.

The article is organized as follows. After explaining the significance of the research background, research questions, and purpose of the work in the first section, the article briefly introduces the background of the studied case in the second section. Section 3 describes the research methodology used. In Section 4, various subtopics in the issue of resilience for whom are analyzed according to the sequence of the case’s evolution. The major findings of the case study are discussed in Section 5. The final section summarizes the conclusions. Based on the real circumstances of Taiwan presented in this case, this article also proposes possible institutional approaches to improve the problem-solving process.

2. Case Background

The focal social-ecological system studied in this paper is the Danungdafu Area (hereinafter referred to as DFA), Hualien County, Taiwan. The ecosystem included in the focal system is the Danungdafu plain forests, located in the middle of the East Rift Valley (23° 36’ N, 121° 24’ E), with the East Coastal Mountain Range in the east and the Central Mountain Range in the west, and with a total area of 1250 hectares. The social system encompasses the villages that are adjacent to, and have a close relationship with, the plain forests area, including indigenous communities (Tafalong, Fata’an, Fahol, Okakay, Sado) and communities where Han people, making up the majority of the population, and indigenous people live together (Daho, Fuhsing, Fuyuan, Galiwan; see Figure 1).



Figure 1. Danungdafu Area (DFA). The area enclosed by the red border is Danungdafu Forest Park. Red dots represent indigenous communities (Tafalong, Fata’an, Fahol, Okakay, Sado), and yellow dots represent Han–indigenous communities (Daho, Fuhsing, Fuyuan, Galiwan), where Han people comprise the majority of the population.

The DFA case is a particularly complex but representative case for the issue of the land and natural resource rights of indigenous peoples in Taiwan. Considering indigenous land and natural resource rights, the Western plains of Taiwan are currently mainly used by Han people with private land rights. Therefore, in terms of political reality, making these plains the main target of indigenous peoples’ land movement is difficult. The central mountainous region, where mainly indigenous settlements

are located and most lands are designated as protected areas or state-owned forests, is generally considered to be, with less controversy, traditional territories of indigenous peoples. Issues in the Eastern plain region, especially the Eastern Rift Valley region, pose the greatest challenge. This was the final area taken by Han settlers and the modern state regime; many Han people moved to this area only at the end of the nineteenth century [28]. Today, eastern Taiwan remains the region with the highest proportion of indigenous people. In the Eastern Rift Valley area, numerous indigenous villages and Han-dominated communities are present. Over the past 100 years, the state nationalized a large proportion of lands in the area, lands which were once the traditional territories of indigenous peoples, and a considerable portion of the lands became private property in the process of privatization. These realities pose major challenges to the political claims of the indigenous “Return Our Land” movement and to the implementation of the Indigenous Historical Justice and Transitional Justice Policy that started in the first term of the current president, Tsai Ing-Wen, in 2016 [29].

3. Methodology

This study is part of an integrated research project titled “Social-Ecological System Resilience in Central Eastern Rift Valley: The Role of Danungdalu Forestation Area.” It is based mainly on the research work of the governance subproject; the project as a whole covers numerous aspects of natural and social sciences. The goals of the integrated project are to study the resilience dynamics of a specific social-ecological system and to promote resilience-oriented governance based on the research findings. More specifically, the research team (hereafter referred to as the NDHU Team) followed the Resilience Assessment Framework suggested by the Resilience Alliance. It includes five main iterative and reflexive stages [30], as follows:

- Describing the system
- Understanding system dynamics
- Probing system interactions
- Evaluating system governance
- Acting on the assessment

The Resilience Assessment Framework is applied to the DFA case; this research integrates iterative feedback processes, from building a knowledge base to taking appropriate actions, and is therefore a form of action-oriented research. Governance issues should also be studied, including formal institutions and informal norms, multiple interests and value judgments, human organizations, social networks and interpersonal interactions, collective actions, and social movements. All these issues have social, economic, political, and ecological contexts. To study the complex interaction of the various contexts and factors mentioned, qualitative research methods including in-depth interviewing, participatory observation, and focus group meetings were employed. The research was conducted from August 2013 to April 2020.

4. The Case Study

4.1. Political, Social, Economic, Institutional, and Ecological Contexts

Before the end of the nineteenth century, the DFA was the traditional territory of Amis people [31,32]. Amis people engaged in slash-and-burn farming and hunting to maintain their livelihoods. After 1895, the Japanese government’s policy of nationalizing all “ownerless” land completely changed the fate of Taiwan’s indigenous peoples [33]. In the 1910s, the Japanese state entered and ruled the DFA. The state nationalized indigenous peoples’ land and used it for commercial sugar cane plantations at the expense of indigenous people. Amis people who lived there were expelled, causing them to be displaced to marginal areas of the East Coastal Mountain Range and the Central Mountain Range. The evictions led to the disintegration of indigenous communities. Furthermore, these marginal lands are generally

vulnerable to natural disasters and have low land productivity, leading to the prevailing economic and social predicament of indigenous people that continues today [32,34].

After the 1910s, DFA land and surrounding communities were transformed from a social-ecological system with high biological and livelihood diversity to farmland growing a single commercial crop that largely depended on the international trade-oriented sugar economy. Because sugar production required intensive manpower, Han people began to settle in the area in large numbers, forming mixed settlements of Han-indigenous communities, which greatly changed the population composition of the area. Changes in the population composition also profoundly affected the attributes of the social system, including today's actors and collective actions related to governance.

After the Second World War, the Taiwanese government took full control of Japanese land and industrial assets in Taiwan and followed the same policy of state ownership of land. The de jure public land in the DFA was received by the state-owned Taiwan Sugar Company (hereafter referred to as TSC) established in 1946 [35]. Therefore, the DFA maintained the sugar-based social and economic structure that originated during Japanese rule, with a similar central government-led governance system. In the 1980s, the international price of sugar dropped significantly and domestic production costs rose sharply, and the industry began to shrink. In 1995, Taiwan applied to join the World Trade Organization, and for this reason it removed some protection measures for the sugar industry. Sugar production finally ceased in 2002 [35], and DFA land was temporarily idle.

DFA land soon faced changes from the implementation of government policies. To cope with the impact of Taiwan's World Trade Organization membership on domestic agriculture, the Council of Agriculture has promoted the "Plain Land Afforestation Project" since 2002 to subsidize the afforestation of agricultural land. Other arguments promoting plain land afforestation include increasing the forest coverage of the plains, enhancing carbon sequestration, improving environmental quality and aesthetics, conserving biodiversity, and enhancing the potential for timber self-sufficiency [36]. DFA land thus rapidly changed from idle farmland to an afforestation area. In 2011, under the guidance of government policies, the DFA afforestation area was designated the "DFA Forest Park," one of the three largest plain forest parks in Taiwan. The main policy objectives were to provide ecosystem services and promote tourism. The Forestry Bureau of the central government is responsible for the management of the forest park, although the public enterprise TSC continues to own the land and forest property rights. Thus, central government policy over the past 100 years has determined the current characteristics of the DFA social-ecological system and the fundamental structure of its governance.

4.2. Problem Framing, Discourses, and Scale Issues

From the early 2000s to the early 2010s, with the growth of the forest and the opening and operation of the forest park, stakeholders with different positions developed conflicting views on the park. As the official managing authority of the park, the Forest Bureau has always looked at management issues from a national perspective. In the management plan of the DFA forest park, the Hualien Branch of the bureau clearly stated the following objectives: enhancing carbon sequestration, improving environmental quality and aesthetics, conserving biodiversity, promoting ecotourism, environmental education, and local development, and conserving Amis culture [37]. These goals relate mainly to the provision of national-level public goods and regional common-pool resources. The main target beneficiaries of these ecosystem services are the general public of the country. Local residents may also benefit from these services, and local development is indeed listed as a major goal, but, in fact, this is at most only a side effect of the real motivation for designating a forest park, namely environmental conservation. Notably, in the problem framing and policy discourse of the management plan, no particular consideration was given to the historical context of the land grab and the costs that local residents had to bear, especially in terms of indigenous rights.

As one of few large forests in otherwise over-developed plain areas, the DFA park's potential role in biodiversity conservation also attracted the attention of academics and environmental nongovernmental organizations (NGOs). In addition to helping to conserve rare species in the plains, the main focus

of discussion is whether the DFA is a potential ecological corridor between the protected national forests of the Central and the East Coastal mountain ranges. Some researchers have studied the topic. Individual academics and NGOs have also presented proposals for an ecological corridor; they have advocated enhancing the protection of DFA forests and minimizing human use. As the major government authority in charge of nature conservation, the Forestry Bureau has expressed a high level of interest in the idea of an ecological corridor. Researchers have since determined that the DFA has indeed begun to function as an ecological corridor [38,39]. The Forestry Bureau launched a national ecological network plan in 2018 that treated the DFA forest as a critical corridor in eastern Taiwan.

The Forestry Bureau, some scholars, and environmental NGOs consider DFA governance issues mainly from environmental perspectives; by contrast, the TSC and local communities are primarily concerned about economic utilization and local livelihoods. TSC is a government-owned enterprise that legally owns the land and forests of the DFA forest park. It essentially expects and strives to reap economic benefits through a more intensive use of land and forest resources. However, it must also follow the government's current conservation-oriented policy.

Indigenous communities are primarily concerned with the ownership of land and natural resources rights. Their main political appeal to the state regarding DFA land is that the state should return the land to them and let them decide autonomously how to use the land. Most indigenous residents advocate agricultural use, tourism development, and land use types based on indigenous culture, like ethnic botanical gardens that can provide opportunities for daily edible plant collection and possible tourism sightseeing spots [40]. According to the land ethics of the indigenous people, they have generally agreed that land use should take environmental perspectives into consideration. The point, however, is that local indigenous communities should have autonomy in deciding how to balance livelihoods, cultural revitalization, and conservation perspectives.

In addition to villages whose populations are mainly indigenous, multiple communities near the DFA mostly comprise Han people, including descendants of past sugar industry workers and a small number of new residents who moved here from urban West Taiwan. These Han-dominant communities have no special claim on land rights issues, and they also respect the status quo of national land ownership and forest park policy. Their main expectation is that given the economic and social issues prevailing in rural areas, the forest park may bring more economic and employment opportunities to local communities through deliberate planning and improved management. Most local Han people have consciously avoided talking about indigenous peoples' land rights. They are, in private, generally not sympathetic to indigenous claims, but they are reluctant to publicly express their true thoughts for political reasons. Some people in these communities, especially new residents -who pursued a better natural environment and the younger generation of residents with urban work experience, express strong environment-friendly values. This group of people therefore emphasizes the ecological conservation function of the forest park and is happy to see the park play a larger role in conservation. They also generally look forward to the development of conservation-based economic activities such as ecotourism.

4.3. Development of Governance Network after 2011

On May 21, 2011, the forest park officially opened. Then-President Ma Ying-Jeou presided over the opening ceremony. A number of indigenous people protested fiercely during the ceremony and made the political claim "Return Our Land." This was the first time that the DFA case had attracted national attention. This protest, as well as the political and social changes in Taiwan behind the incident, including the indigenous movement, had a profound impact on the governance of the DFA. Many indigenous people began to challenge the existing land tenure arrangement and governance regime. However, the reality is that with these seemingly insurmountable structural barriers, real progress after the protest was sluggish. The Forestry Bureau did attempt to start a dialogue with indigenous communities after the protest, with the motivation of reducing tension.

However, due to their enormous differences in views and because of long-accumulated conflicts and mistrust, the dialogue between the two parties ended again in conflict.

Research by the NDHU Team highlighted the characteristics of the governance regime of the DFA in the early 2010s. Overall, governance of the DFA was characterized as (1) nonparticipatory and nondeliberative; (2) monocentric, with a two-tier structure of dominant state and weak communities; (3) unjust, with upward accountability; and (4) loose governance networks [41]. The issue of injustice affects all local communities, but, undoubtedly, the most affected are indigenous communities. These characteristics can explain the serious defects of the governance regime at the time, including indigenous and local knowledge not being included in the governance process and a lack of consideration of social and cultural diversity. Another serious problem involves scale mismatch: the state-dominated governance regime views issues from a national perspective, whereas local communities view issues from their own perspective; DFA governance issues cannot be addressed at adequate governance levels based on the nature of the issues [41].

Even if the existing governance regime is far from ideal, the uninterrupted indigenous movement and changes in the Forestry Bureau have led to the possibility of gradual change. The indigenous movement has forced the Forestry Bureau to start considering indigenous people's views, at least in specific cases such as the DFA. Furthermore, influenced by international trends in conservation, the Forestry Bureau has begun to adopt measures that include more local views and encourage local involvement. For example, community forestry policy is a typical approach that has been widely applied since 2002 [42]. The same situation applied to the DFA after 2011. Specifically, with the DFA, changes were also prompted by action-oriented academic research initiatives. As described in the previous paragraph, the researchers identified flaws in the existing governance regime. The NDHU Team accordingly launched a series of action-oriented initiatives. The basic goal was to collaborate with all types of stakeholders and proactively pursue a better governance mode. This new mode should be superior to the previous governance regime for the following governance attributes: participation, deliberation, justice, accountability, diverse knowledge base, and scale match.

Throughout the 2010s, under the influence of various factors mentioned in the previous paragraph and with the involvement of diverse actors, DFA's governance network structure underwent significant changes. In this section, the interaction of actors and the subsequent development of the governance network are analyzed. Four stages of network development emerged.

4.3.1. Governance Network in 2011

In 2011, a very loose network structure between the institutions and actors involved in governance existed. The Hualien Branch of the Forestry Bureau (HBFB) was in charge of the management of the forest park, and the TSC owned (and continues to own) the land and forest rights. Due to community forestry and other government-driven projects, Han-dominant community organizations began to emerge, operate, and interact with the HBFB. For the indigenous communities, only one actor who had been fighting for land rights for a long time participated, and he had a tense confrontation with the two government authorities, the HBFB and TSC. Most of the other tribe members refused to interact with the authorities. In addition, two research teams conducted research separately, without close coordination or cooperation. At that time, the researchers' work largely focused on natural science investigations, and governance issues were not examined, particularly the issue of land ownership. Academia did not interact with these indigenous peoples. Loose interaction relationships existed among the researchers, HBFB, TSC, and Han-dominant community organizations. Figure 2 presents the interaction of actors and the governance network during this period.

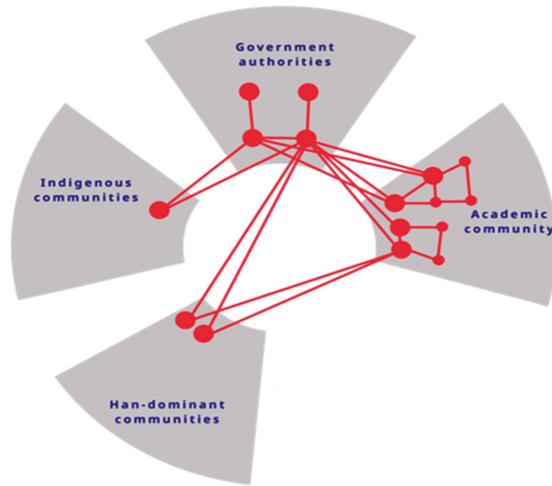


Figure 2. Governance network in 2011. Large dots represent major, active actors, and small dots represent actors with secondary significance. Lines between points represent interactive relationships.

4.3.2. Governance Network between 2012 and 2013

The indigenous protest in 2011 and change in the attitude of the Forestry Bureau toward local participation prompted it to begin to test very limited local community participation measures. From 2011 to 2013, the HBFB began to strengthen its interaction with indigenous communities. However, due to long-term disputes over land ownership and the resulting mistrust, most tribe members remained reluctant to communicate directly with the HBFB. Only one major actor continued to negotiate the land tenure issue, and other tribe members did not directly participate in forest park governance issues. The HBFB continued to promote community forestry projects in the DFA and sought to integrate the capacities of various communities to promote ecotourism. Because the Han-dominant communities generally welcomed this new community-based policy, interaction between Han-dominant community organizations and the HBFB began to intensify. In the academic sector, the NDHU Team began to conduct research projects and gradually strengthened the interaction with government authorities, Han-dominant community organizations, and indigenous communities. Because the NDHU team's research included governance issues of all major stakeholders, contact between the research team and indigenous people actors was initiated to gain a deeper understanding of the views of indigenous people. However, due to long-accumulated alienation, the interaction between the indigenous people and other stakeholders was relatively weak. Between the indigenous and Han-dominant community organizations, the previous isolation was maintained, and no substantive communication occurred between the two communities. The actor interaction and governance network during this period is presented by Figure 3.

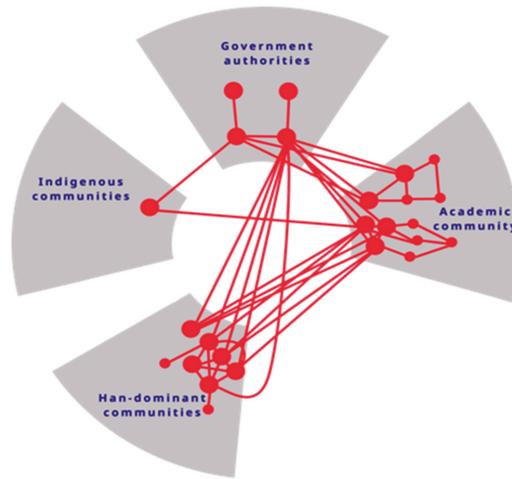


Figure 3. Governance network: 2012–2013.

4.3.3. Governance Network between 2014 and 2015

The period from 2014 to 2015 was critical for the development of the governance network. On the one hand, the HBFB developed a volunteer interpreter group in local communities. These volunteers proved to be a key social group actively participating in governance. On the other hand, the NDHU Team started to promote citizen science in 2014. People joining volunteer and citizen science groups gradually merged into a subnetwork. The citizen science network aimed primarily to fill gaps in natural science research in academia with local knowledge, through input from local volunteers. Citizen scientists, under the guidance of scholars, regularly monitored birds and amphibians in the DFA area and reported the results to academics and the HBFB. The evolving citizen science network, due to the roots of its origin, developed a close collaborative relationship with the HBFB, community organizations, and academia.

At the same time, the indigenous community network began to emerge. In 2012, the Hualien County Government set up a tribal affairs assembly mechanism for indigenous communities, and tribal chiefs met regularly to discuss tribal affairs. Two of the chiefs began to address DFA-related issues when they chaired meetings. Through regular meetings, their discussions increasingly reached consensus. Among the most crucial consensuses reached was that DFA land was the traditional territory of Amis people. This represents the fundamental “bottom line” for DFA governance from the indigenous perspective. Because of fundamental differences regarding land tenure claims, the indigenous network did not formally interact with other subnetworks. However, due to the involvement of one tribal chief in the citizen science network during this period, the interaction between indigenous communities, the citizen science network, and academia, although still very limited, began to develop. The overall situation of the actor interaction and governance network during this period is presented using Figure 4.

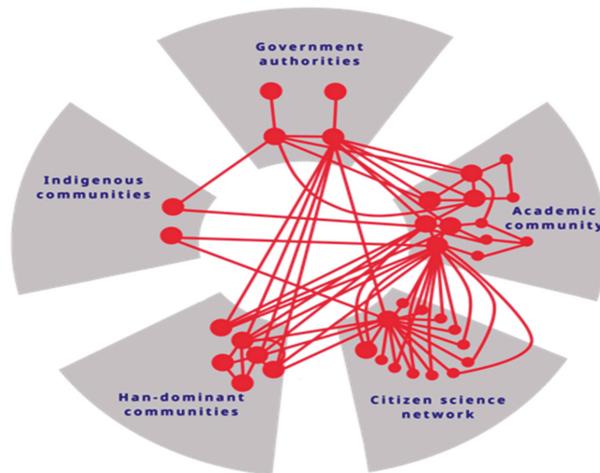


Figure 4. Governance network: 2014–2015.

4.3.4. Governance Network after 2016

Since 2016, due to the central government's Indigenous Historical Justice and Transitional Justice Policy, the Forestry Bureau has clearly revised its policy and has become more open to indigenous issues regarding natural resource use and co-management. In the DFA case, the HBFB accelerated its effort toward establishing a more inclusive governance mechanism and seeking to include primary stakeholders. This effort, based on the perspective of resilience-oriented governance, is also supported and pursued by the NDHU Team. An obvious major challenge was that the indigenous communities refused to engage in dialogue and cooperation with the existing state management regime. This led to the absence of indigenous representation in the governance network. The attitude of the indigenous communities is understandable, considering their extremely negative experiences of oppression by the state. The boycott can also continue to highlight the indigenous land and natural resource rights issues that Taiwan society generally ignores. However, this strategy is also a two-sided sword for the indigenous communities themselves. Continuing to be absent from the governance process actually means the absence of opportunities for the indigenous people's perspective to be considered, leading to the continued dominance of land use governance by mainstream social groups. Indigenous communities also lost an opportunity to foster their own governance capacity. The trend of large numbers of young indigenous people moving to urban areas has exacerbated these concerns. From a longer-term perspective, indigenous people must prepare their capacity in advance of the possible enactment of the Indigenous Autonomy Act.

To address this dilemma, the NDHU Team, as a change facilitator, took initiatives to discuss it with the tribal network. Based on long-term internal dialogues of tribal leaders and the bridging role of academia, the NDHU Team was able to host a series of discussions. The tribal network, after thorough consideration, agreed to join the meetings of the DFA governance platform, under the premise that the indigenous party insisted on its land ownership claim. The internal consensus of the tribal chiefs is that they can talk with other parties on improving DFA governance, while the land rights issue can, and should, be addressed in a stepwise manner. After 2017, stakeholders representing the public sector, indigenous communities, Han community organizations, citizen scientists, and academia regularly held governance platform meetings to discuss governance issues from both scientific and local knowledge perspectives. This platform integrates various stakeholders at different governance levels and facilitates cross-scale and cross-level interactions.

Compared with the network structure prior to 2016, interactions among the multiple groups of stakeholders are now closer and more frequent, including interactions between indigenous communities and other stakeholders. Two new types of stakeholders also emerged. One is a network for a national protected areas plan, and the other is the ecotourism platform. Both these subnetworks are results of the Forestry Bureau's efforts, and the common purpose is to incorporate the DFA into the national network of protected areas while promoting ecotourism. Figure 5 presents the interaction of actors and governance network after 2016.

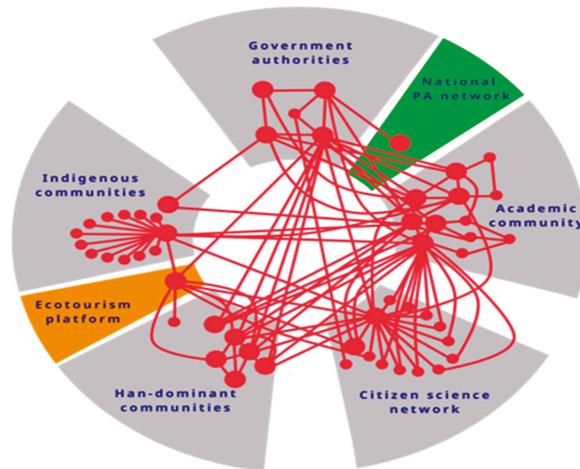


Figure 5. Governance network after 2016.

4.4. Current Governance Outcome

The main achievement of the governance platform to date has been the successful proposal of a new land use plan for the DFA forest park. In accordance with recent scientific research findings, all parties have agreed to designate the central part of the park as an ecological corridor connecting protected areas in the Central Mountain Range and the East Coastal Mountain Range. The area outside the corridor is to be used primarily for more intensive economic purposes, both consumptive and nonconsumptive, for example, tourism and agroforestry (see Figure 6). This latest blueprint is the result of a sophisticated compromise. The designation of the ecological corridor reflects the call of the proconservation parties, including the Forestry Bureau, citizen scientists, a majority of the Han community organizations, and most researchers. Promoting ecotourism is in line with the policy objectives of the Forestry Bureau and the interests of local communities, both Han and indigenous. The intensification of agricultural use mainly aims to meet the needs of the TSC and indigenous communities. This consensus is based on both scientific findings and local knowledge of land use practice. It also considers the preferences and needs of multiple stakeholders in the social system. On the whole, all parties have made compromises, and each has received some recognition of their concerns.

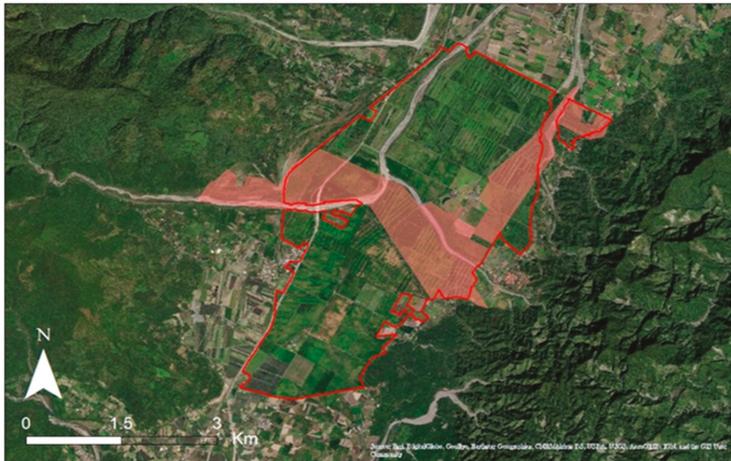


Figure 6. Future land use planning for the DFA forest park. The pink area represents the location of the planned ecological corridor. Source: I-Ming Chen (modified by the author).

Regarding the governance process, the following practices enabled a consensus to be reached. First, years of academic research allowed the discussion to proceed on a solid foundation. Hotspots of wildlife distribution, the economic and social needs of local communities, and differences in the perspectives of different ethnic groups were identified through research. Second, research findings and local knowledge supported stakeholder understanding of the basic information required for decision-making through governance platform meetings. Moreover, with the deliberate effort of major parties, the governance platform meeting included all key types of stakeholders; thus, key opinions could be considered. In the end, the opinions expressed in the governance meeting were fed back to the research team to assist them in revising the preliminary planning concept and making the revised blueprint acceptable to the stakeholders of the governance platform meeting. More precisely, compared with the previous governance model, the governance platform adopted was more participatory, deliberative, and knowledge-based. These characteristics facilitated the formation of a consensus among the stakeholders.

5. Discussion

Based on the case study, the main subtopics of the issue “resilience for whom” are discussed in this section as follows:

- Who and what drivers shape unequal political, economic, social, institutional, and ecological contexts;
- Who dominates resilience discourses and determines the problem-framing and problem-solving agenda;
- Who defines the scale and levels at which social-ecological system governance issues are addressed;
- Who determines the knowledge system used to define and solve problems;
- Who are the major agents of the governance process, who exerts influence on governance, and why; and
- Who decides the trade-offs among conflicting resilience governance goals.

5.1. Who and What Drivers Shape Unequal Political, Economic, Social, Institutional, and Ecological Contexts

The entry and rule of the modern state regime is the origin of the drastic transformation of the DFA social-ecological system. Indigenous land was nationalized by the state and subsequently used for the production of agricultural commodities for international trade. After Taiwan lost its international

economic competitiveness in the cane sugar industry, the environmental conservation of DFA land was then conducted. Whether due to economic motivations or environmental considerations, the dominant political power of the modern state regime has fundamentally shaped land tenure, economic use patterns, social and demographic structures, governance institutions, and ecosystems. From the perspective of ethnic groups, dominant ethnic groups drive the modern state regime. In the era of Japanese rule, the dominant ethnic group was Japanese. In the current Taiwanese state, Han people dominate political power. Obviously, DFA's land tenure, economic utilization, and governance institutions reflect the interests of dominant ethnic groups.

5.2. Who Dominates Resilience Discourses and Determines the Problem-Framing and Problem-Solving Agenda; Who Determines the Knowledge System Used to Define and Solve Problems

After the afforestation in the early 2000s, the Forestry Bureau took control of the management of the DFA forest. For forest policy, the central government considers environmental conservation the first priority, supplemented by policy objectives of nonconsumptive uses such as ecotourism. This is also an era in which attention to climate change has been initiated, as well as to carbon sequestration and resilience. In this context, the DFA forest is regarded as a tool for Taiwan to pursue international greenhouse gas regulation goals and enhance ecological resilience. Therefore, the central government has dominated the entire policy discourse pertaining to DFA land use. In addition, along with government policies, mainstream Taiwanese society also has a strong voice, hoping to reserve the DFA forest for conservation purposes. Conservationists, civil society organizations, most scholars, and active actors in Han communities involved in DFA governance support the government's conservation-oriented policy. In this discourse, national-scale ecological resilience and its potential benefits to Taiwanese society as a whole are arguably the central consideration.

Certainly, with the pressure brought by the indigenous movement and the policy revision of the Forestry Bureau itself, official and civil society mainstream discourses have also begun to adjust. Typical discourse emphasizes the need to take into account the public interests of the country (such as ecological resilience) as well as local concerns like livelihoods. Including local perspectives, this change has both sincere and hypocritical elements. It is happy to highlight the benefits that ecological resilience will bring to the locality, but at the same time it usually avoids discussing costs to local communities in the pursuit of this goal—especially the price paid by indigenous people. In such a power and discourse structure, DFA governance has mainly relied on (especially in the past) scientific and expert knowledge systems. Local knowledge, and especially indigenous knowledge systems, has long been excluded and ignored. This situation was not partially corrected until the emergence of the new governance platform.

5.3. Who Defines the Scale and Levels at Which Social-ecological System Governance Issues are Addressed

Before 2000, the DFA region was regarded by the central government as a base to support national economic development, given the fact that the sugar industry was once one of Taiwan's main sources of foreign exchange income. This history has had both negative and positive socio-economic effects on various local communities, but these were incidental effects and not the focus of policy considerations. After 2000, the DFA was mandated by the central government and mainstream society to support national ecosystem resilience goals. This has also brought benefits and hidden costs to local communities, but again, these are incidental effects rather than the focus of the policy. From focusing on economic development to highlighting the social-ecological system's resilience, Taiwanese society has indeed undergone significant changes. However, what has not changed is that the DFA continues to be treated as a place that should support the country's overall goals. As for the fate of the DFA itself as a local social-ecological system, it is optional, according to policy needs.

After 2011, the pressure of the indigenous movement, policy changes within the Forestry Bureau, and the efforts of some academics have jointly contributed to the emergence of a new governance platform. This marked a milestone in revising previous national-scale viewpoints and an attempt to sincerely reconcile national- and local-scale views. Different groups of stakeholders

have gradually joined the governance network, for different reasons. Han community organizations hope to develop ecotourism, whereas citizen scientists are motivated by conservation. The ecotourism platform developed later is basically a subnetwork derived from the first two. The three subnetworks, with experienced and active members of civil society, joined the governance network and collaborate with the public sector and academia. These actors are mostly wealthier, well-educated, and have sufficient work experience in an urban area. Their vision for the DFA is basically consistent with that of the public sector, and they are also familiar with how the public sector, civil society, and academia operate, so they can collaborate with other stakeholders relatively smoothly and play active and significant roles in the governance network. Their views, mixed with local and national scales, and actions therefore affect the governance process to a considerable extent.

5.4. Who are the Major Agents of the Governance Process, Who Exerts Influence on Governance, and Who Decides the Trade-offs among Conflicting Resilience Governance Goals

The Forestry Bureau continues to control the management authority of the forest park. This means that, without the support of the Forestry Bureau, major independent governance decisions cannot actually be made. Therefore, issues like the degree of local participation, agenda setting, the applied knowledge system, and the trade-offs between the main governance goals are carefully controlled by the Forestry Bureau. With the policy objectives of the central government, the Forestry Bureau adheres to the environmental conservation role of the DFA forest. On the premise of completing this task, it can adopt flexible measures, to some extent, regarding other goals, such as improving local livelihoods. Concurrently, academia serves as a producer of DFA-related academic knowledge and plays the role of a bridge among stakeholder groups and a facilitator of the governance platform. Academia has assisted in fostering several subnetworks such as citizen science and community organizations. Academia, as a bridge, has also critically contributed to the participation of indigenous communities in governance.

Due to negative historical experiences and the resulting mistrust of the state regime and mainstream society, indigenous communities joined the governance network relatively late, after choosing a long-term boycott position. Their joining added two key perspectives to the governance process. First, it let more people (some of whom for the first time) realize indigenous land issues and the social and economic costs suffered by indigenous peoples due to land deprivation. Second, it brought indigenous knowledge into governance decisions, especially cultural traditions that may balance land use and ecological conservation, as well as long-term on-site knowledge. Indigenous, scientific, and local knowledges provided by other subnetworks finally contributed to the redesign of DFA land use planning. That said, this remarkable progress does not mean that the participation of indigenous people was smooth. In fact, the process is filled with obstacles. Members of mainstream society still generally hold a suspicious attitude toward indigenous knowledge. Language barriers and culture gaps make it more difficult for tribal members to express their views in formal meetings and/or in informal dialogues. The migration of young people has resulted in tribes lacking active actors and a new generation of leaders. The impact of these obstacles was evident throughout the development of the governance network. At present, the governance network remains dominated by nonindigenous stakeholders in the number of active actors, network connectivity, and interaction frequency. Indigenous actors played a relatively marginal role.

A practical example can also be used to illustrate the challenges faced by indigenous people in governance. Indigenous representatives strongly advised that DFA land be more intensively used to provide economic and employment opportunities for surrounding indigenous communities, and this recommendation was accepted. Frankly, the reason this proposal was accepted was because the land owner, TSC, strongly supported the proposal to increase its economic revenues. Without strong support from other powerful stakeholders, a purely indigenous proposal would not be so readily accepted in a final determination. Another indigenous proposal was treated completely differently. Indigenous representatives have proposed that a piece of land be allocated to establish an ethnic food forest, because Amis people are known for their unique plant knowledge and plant utilization

culture. However, most participants were obviously more interested in the ecological corridor than the ethnic food forest. This proposal ultimately received little response. This reflects the reality that ecological conservation remains more central to the governance process than the revitalization of indigenous culture.

6. Conclusions and Policy Recommendation

The DFA case is arguably representative of the complicated history that Taiwan has experienced with regard to indigenous land issues and the fact that indigenous people were and remain oppressed. Under the colonial regime and rise of the modern state, DFA land was snatched and registered as owned by the state. To meet the national development goals of different periods, this land was assigned with varying policy tasks. In the era of economic development, the land was used to produce commercial agricultural products of high economic value. In today's era, emphasizing global environmental changes, the land was converted into forests to enhance ecological resilience and to serve as support for the resilience of the national social-ecological system. Whether the focus is on the well-being of social systems or ecological resilience, the needs of indigenous people were dismissed by mainstream society's dominant powers.

This study determined that, for a long period, the central government determined "resilience for whom." The central government shaped the political, economic, social, institutional, and ecological contexts; they dominated resilience discourses and determined the problem-framing and problem-solving agenda; they defined the scale and levels at which social-ecological system governance issues were to be addressed; and they determined the knowledge system used to define and solve problems. This situation has changed, somewhat. The current DFA governance institution has begun to incorporate the views of multiple stakeholders, and, to a limited extent, allow more governance power to these stakeholders. More active, mostly local actors are participating in the governance process. These new participants have begun to contribute their views on resilience discourses and have exerted influences on governance and trade-offs among differing governance goals. This is certainly meaningful progress that can help people achieve a finer balance between national and local perspectives. Findings of this article demonstrated, however, that under the established political, economic, institutional, social, and cultural structures, dominated by Han people, the current participatory governance regime primarily reflects the power, views, and interests of Han society. On the whole, the governance of the DFA can be said to have changed from the "resilience for the public" mode to the "resilience for both the public and local people" mode. Regardless of the mode, though, the main beneficiaries are Han people, not indigenous people. In fact, indigenous people almost always pay a disproportionate price in decision-making. Final questions arise: whose rights should be actively recognized and safeguarded, and what measures can the people take to improve the process of rights recognition and protection?

For the indigenous communities in the DFA, under the established structure, the pursuit of their own social-ecological system resilience is long and extremely difficult. Both in an era of economic development and an era of highlighted social-ecological systems, this struggle is the same. The emergence and goodwill of the participatory governance model does help indigenous people express their views and substantially influence the governance process and outcomes, but it is far from sufficient to address the roots of the "resilience for mainstream society" phenomenon: the established land ownership and subsequent governance authority. Obviously, affirmative action is sorely needed to effectively recognize and safeguard indigenous autonomy.

Redefining land ownership and returning land rights to indigenous people is undoubtedly a highly challenging political issue in Taiwanese society, in which Han people make up 97% of the population. A nationwide, systematic solution relies on the Indigenous Land and Ocean Act under discussion in parliament. However, due to the complexity of the issue, the passage of this bill is likely remote and far from certain. Before taking that step, people could consider other institutional pathways. A practical example, the case of Molisaka, near the DFA, might be a model worth considering. Molisaka is a traditional territory of the indigenous Truku people that was too classified as state-owned land and

managed by the Forestry Bureau. After years of academic investigation, this land was confirmed by the Indigenous Historical Justice and Transitional Justice Committee appointed by the Presidential Office to be indigenous [43]. Administrative procedures for returning land are in progress. A governance committee has also been formally established, with more than half of its representatives indigenous. This article suggests that the DFA case follows the same approach. A formal land history survey through an official proposal of the Indigenous Historical Justice and Transitional Justice Committee can be conducted, and after confirming the historical facts of the territory, the legal and administrative procedures for land return can be initiated. This may open a new era of “resilience for indigenous people” in traditional indigenous territories as early as possible.

Emphasizing “resilience for indigenous people” is of significant importance not only to indigenous people but also for the DFA region and the overall social-ecological system resilience of Taiwan. For years, when discussing social-ecological resilience in Taiwanese society, people have focused on ecological resilience and the well-being of Han society. This deficiency should be corrected. From a positive perspective, following synthesis of the comprehensive review by Chapin et al. [44], I suggest that “resilience for indigenous people” helps improve the social-ecological resilience of individual regions and of Taiwan as a whole. It enhances the capacity of crucial segments of society, particularly that of vulnerable groups, to adapt to adverse impacts. It sustains cultural diversity and helps maintain a diversity of options that could be crucial to social-ecological resilience. Social cohesion, trust, networking, and communication among various groups can be fostered to adapt governance that realizes sustainable solutions. All these will contribute to the transformation of all of society into a more resilient social-ecological system.

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Article

Global Climate Change and Indigenous Peoples in Taiwan: A Critical Bibliometric Analysis and Review

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Abstract: In recent years, the subject of Indigenous peoples and global climate change adaptation has become a rapidly growing area of international study. Despite this trend, Taiwan, home to many Indigenous communities, has received relatively little attention. To date, no comprehensive review of the literature on Taiwan's Indigenous peoples and global climate change has been conducted. Therefore, this article presents a bibliometric analysis and literature review of both domestic and international studies on Taiwan's Indigenous peoples in relation to resilience, climate change, and climate shocks in the 10-year period after Typhoon Morakot (2009). We identified 111 domestic and international peer-reviewed articles and analyzed their presentation of the current state of knowledge, geographical and temporal characteristics, and Indigenous representation. Most studies were discovered to focus on post-disaster recovery, particularly within the context of Typhoon Morakot, as well as Indigenous cultures, ecological wisdom, and community development. This study also discovered relatively few studies investigating how traditional ecological knowledge systems can be integrated into climate change adaptation. Most studies also adopted a somewhat narrow focus on Indigenous resilience. Large-scale quantitative and longitudinal studies are found to be in their infancy. We observed a geographical skewness among the studies in favor of southern Taiwan and relatively limited engagement with contemporary studies on Indigenous peoples and climate change. We furthermore determined a large overlap between the destruction path of Morakot and study sites in the articles. Indigenous scholars have managed to find a voice among domestic and international outlets, and an increasing number of scholars have argued for more culturally sensitive approaches to post-disaster recovery and disaster management in Taiwan.



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Keywords: Taiwan; indigenous peoples; resilience; global climate change; bibliometric analysis; Typhoon Morakot

1. Introduction

The world's Indigenous peoples represent less than 5% of the global population, yet they currently manage or have rights over numerous ecosystems, ranging from the Arctic to the tropical rain forests of Borneo [1]. As the current and projected consequences of global climate change and environmental change come under greater scrutiny, academics have noted that the world's Indigenous peoples bear little responsibility (if any) for the forecast consequences [2]. This is the reason for the rapidly growing trend in studies on Indigenous peoples, resilience, and global climate change [1,3–6]. Such studies have explored how Indigenous peoples' knowledge systems, institutions, worldviews, conservation practices, and local perceptions could be of benefit or be integrated into climate change adaptation

and mitigation programs. These studies have had many aims, including exploring Indigenous alternatives for sustainable ecosystem management [7], understanding Indigenous peoples' perceptions of climate change [4], and Indigenous peoples finding representation in global climate change debates and negotiations [8]. Research has been conducted on various levels. Microlevel studies have often focused on particular Indigenous communities, traditional ecological knowledge (TEK) systems, climate resilience and livelihood adaptations, and local perceptions of climate change [9–12]. Mesolevel studies tend to investigate Indigenous conservation practices and land management on a regional or cross-country level [13–16]. Lastly, macrolevel studies have either performed a global analysis of previous studies [4,6,17] or adopted a global approach to Indigenous peoples' research and global climate or environmental change [1,8].

Within the context of the growing trend in research on Indigenous peoples and global climate change, we now consider Taiwan, which is home to 16 officially recognized Indigenous groups as well as other locally or unofficially recognized groups (Figure 1; Appendix A). Taiwan's Indigenous peoples (Táiwān yuán zhù mínzú) accounted for 573,086 people in 2020 (2.4% of the island's total population), of whom 287,789 lived in an Indigenous community [18]. Taiwan's Indigenous peoples are Austronesian, and some communities have been able to conserve their culture, customs, traditional livelihoods, and practices despite centuries of colonialization, assimilation, and suppression [19–21].

Global climate change poses a considerable challenge for Taiwan. Since the 1990s, there has been a growing awareness of the impacts of climate change on the nation. This started with the devastating effects of Typhoon Herb in 1996 (73 fatal, 463 non-fatal casualties) and Typhoon Nari in 2001 (104 fatal, 265 non-fatal casualties). Climate change is expected to increase temperatures and heatwave frequency throughout the country. Rainy seasons will bring more precipitation, whereas dry seasons will become drier, and typhoons and associated extreme rainfall events are expected to increase in intensity, although not necessarily in frequency [22,23]. Due to its location in the Asia-Pacific, Taiwan regularly experiences climate events that have a negative impact. Of the 384 recorded instances of extreme climate events that had a negative impact on Taiwan between 2006 and 2020, 43.2% occurred or directly impacted Indigenous communities [24]. Taiwan's Indigenous peoples are therefore disproportionately exposed to the negative effects of climate events [22,25,26]. Typhoon Morakot, which struck central and southern Taiwan in August 2009, is perhaps most exemplary of the destructive effects of climate change on Indigenous and rural communities to date [27]. The typhoon killed 699 people, destroyed 1766 houses, and displaced 4500 residents [28,29]. After this national tragedy, numerous studies were undertaken to investigate the effect of climate change on Taiwan's Indigenous peoples, and relevant articles have been published through both domestic and international publishing outlets.

An international conference entitled "Climate Change, Indigenous Resilience, and Local Knowledge Systems: Cross-Time and Cross-Boundary Perspectives" was organized by the Research Institute for the Humanities and Social Sciences and took place in December 2019 in Taipei City. This conference explored the state of knowledge on climate change and Indigenous resilience in Taiwan 10 years after Typhoon Morakot. One critical issue raised during this conference was the underrepresentation of studies from Taiwan in the international literature. Whether this was due to a lack of Taiwanese studies or Taiwan being largely overlooked by international scholars is unclear. Therefore, the primary aim of this study was to assess the state of knowledge of Indigenous peoples and climate change in Taiwan since Typhoon Morakot. This was achieved through bibliometric analysis and a literature review of articles published in both domestic and international peer-reviewed academic journals and books over the past 10 years.

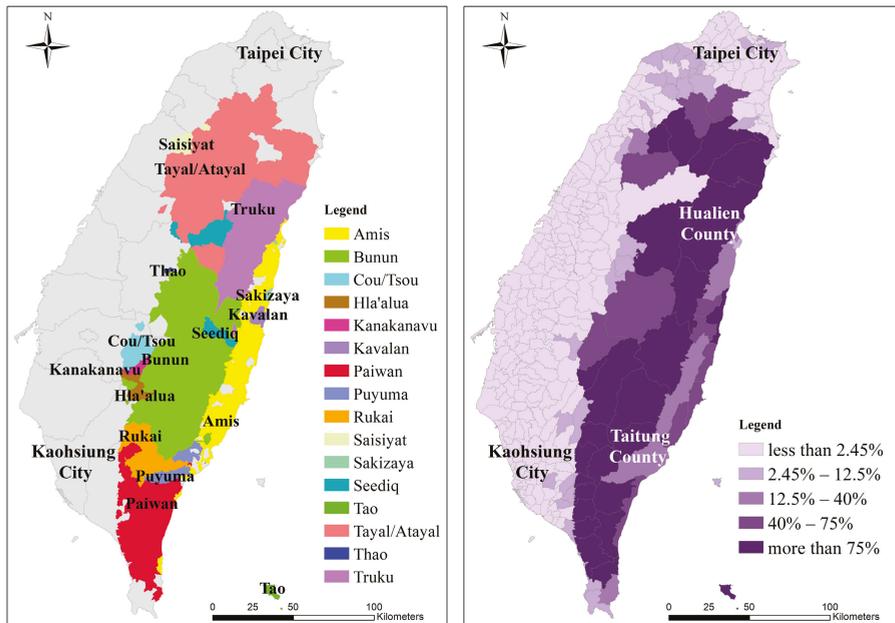


Figure 1. (a) Distribution of recognized Indigenous areas in Taiwan (data from: [18]) and (b) the percentage of Indigenous population in Taiwan on district/township level (data from: [30]).

2. Research Questions and Methods

The aims of this study could be subdivided into five research questions: (1) what trends, themes, and topics can be found among domestic and international studies, and what differences can be observed; (2) what is the geographical distribution of the studies in Taiwan, and which Indigenous groups have been selected; (3) what are the temporal characteristics of the studies (ranging from risk perception to post-disaster recovery); (4) to what extent are Indigenous Taiwanese voices represented in such academic articles; (5) what knowledge gaps and potential research directions can be identified.

We performed bibliometric analysis (employing similar methods as: [6,31,32]) using the databases of Scopus and Airiti Library. Several Taiwanese journals are not indexed in Scopus, which was why Airiti Library was selected for finding Chinese-language articles. The time frame of our research was from January 2010 until April 2020. This date was chosen as we started a special issue on the same theme [33], and this would thus heavily influence our bibliometric analysis. We used Boolean search strings, shown in Table 1, to identify articles that referred to climate change, Indigenous peoples, disaster, or resilience in their titles, abstracts, or keywords. Climate change could also refer to climate hazards or disasters, climatic change, or climate variability. When we searched for international articles, we also employed Taiwan as a keyword to geographically restrict our search results. Additionally, we employed a snowball method in our literature review, examining the references of all identified studies to find other relevant studies. In addition to the inclusion criteria above, this project concerned itself with only peer-reviewed studies.

Table 1. Search terms for the bibliometric analysis.

Audience & Database	Search Terms (Climate Change and Indigenous Resilience Focus)				
International Scopus	“Taiwan”	AND	“Indigenous” or “Indigenous people” or “aboriginal”	AND	“disaster” or “climate” or “hazard” or “local knowledge” or “resilience”
Domestic Airiti Library			“Indigenous people” (原住民, Yuán zhùmín) or “tribe” (部落, Bùluò)	AND	“disaster” (災害, zāihài) or “disaster” (災難, zāinàn) or “climate change” (氣候變遷, qìhòu biànciān) or “resilience” (韌性, rèn xìng) or “disaster” (災, zāi)
Inclusion criteria	1.	climate change and Indigenous resilience focus			
	2.	2010 January -2020 April			
	3.	Keywords AND Title AND Abstract			

All studies that did not focus (this could range from being the main focus to being relevant to the topics) on climate change (or climate disasters), resilience, or Indigenous peoples were excluded from our constructed database. It is important to take into account that Indigenous peoples in Taiwan also face other negative (environmental) events such as earthquakes, land subsidence, or tsunamis. Therefore, this study does not consider all disasters. At the same time, it is important to note that Indigenous resilience could be applied to all stressors and shocks [34]. Furthermore, climate events and disasters could be considered to be climate change-related but cannot always be proven to be caused by global climate change.

After identifying the relevant articles for the literature review, a dataset in Microsoft Excel was created in which the articles were categorized on the basis of the year of publication, language, type of disaster, the ethnicity of the studied group, the ethnicity of the authors, themes of the study, phase in disaster management, and geographical distribution among other items. Data were analyzed using Microsoft Excel and Power BI [35]. The relevance of the data was assured by conducting a literature review to better understand the trends and themes among the articles in our database, and geographic information system techniques combined with secondary data were employed to identify the geographical distribution and knowledge gaps of the studies. Power BI was employed to visualize and analyze the papers, themes, and topics, and an interface was designed enabling the user to interact with and analyze the data themselves (Appendix B).

3. Results and Discussion

In total, we discovered 111 articles, 50 of which were indexed in Scopus (labeled as international articles) and 61 in Airiti Library (domestic articles; Figure 2; Appendix C). Each year saw an increase in the number of articles, and the number of domestic and international articles peaked in 2012 and 2016, respectively. The international articles were published in *Sustainability* (Switzerland; n = 4), *Natural Hazards* (n = 2), and other journals ranging from *Land Use Policy* (n = 1) to *International Psychogeriatrics* (n = 1). Most of the journals were either related to disaster management (e.g., the *International Journal of Disaster Risk Reduction*) or sustainability sciences (e.g., *Sustainability Science*). The domestic studies were published in the *Journal of Slope and Hazard Prevention* (n = 6), *Taiwan: A Radical Quarterly in Social Studies* (n = 5), the *Journal of Natural and Human Environment of Indigenous Peoples* (n = 4), and the *Journal of the Taiwan Indigenous Studies Association* (n = 4). Other domestic articles were published in various social and natural science journals. At least four of the Taiwanese journals specifically focus on Indigenous peoples; in addition to those aforementioned, these included the *Taiwan Indigenous Studies Review* and *Taiwan Journal of Indigenous Studies*.



Figure 2. Number of articles by year (frequency, left; cumulative count, right).

3.1. Trends, Themes, and Topics

The studies in our database were categorized into at least one of the following 10 themes and topics: disaster management; Indigenous culture (including cultural practices, traditions, institutions, and worldviews); ecological wisdom; community development; housing and sustainable architecture; Indigenous health; Indigenous tourism; sustainable agriculture; climate justice; and education (Figure 3).

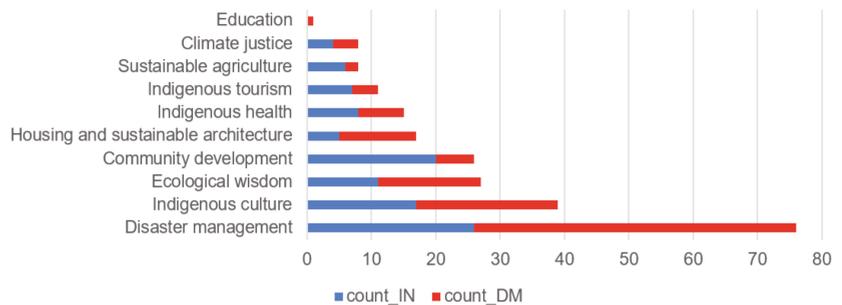


Figure 3. Themes and topics of the articles (frequency; multiple options possible). Note: count_IN = international articles, count_DM = domestic articles.

After Typhoon Morakot, there was a surge in studies on the impact of the typhoon on Indigenous peoples as well as the post-disaster recovery efforts (Table 2), especially in the years 2012 and 2016, as then most projects would come to an end and results were consequently presented. These studies focused on issues ranging from lessons learned from relocation and resettlement policies [36] to cultural issues in post-disaster reconstruction [28]. Cultural issues (the second most common theme) were considered to be crucial in both domestic and international studies. Some of these articles are critical of the Taiwanese government’s response after Typhoon Morakot. After Morakot, many Indigenous communities in southern Taiwan were relocated to or resettled in new locations. Many scholars

argued that these government policies were insensitive toward Indigenous cultures and historical vulnerabilities [29,37–40]. Various Indigenous groups were relocated together; pre-existing villages to which Indigenous groups were resettled were not accustomed to Indigenous cultures; numerous households were ineligible for governmental housing; and resettled families were unable to continue their farming activities or sell their newly acquired homes [37,41–43].

Table 2. Type of climate disaster investigated in the articles (frequency; multiple options possible; count_IN = international articles, count_DM = domestic articles).

Type of Disaster	Count_IN	Count_DM	Total
Typhoon Morakot	25	31	56
Debris flow/landslide/rockfall (rainfall induced)	2	13	15
Typhoon	1	8	9
Heavy rain	0	3	3
Land subsidence	0	1	1
Wind	0	1	1
General	23	21	44

Other studies focused on climatic stressors and shocks: other typhoons besides Morakot; debris flow, landslides, or rock falls as a result of heavy rain; and more general aspects of climate change such as droughts, flooding, and climate variability (Table 2). Some studies created climate resilience or vulnerability indices for urban [44] or rural [25] settings. Several studies focused on the ecological wisdom of Indigenous peoples, including TEK systems [45–47], agroforestry and conservation practices [48–50], the roles of traditional institutions in conservation [51], traditional housing and settlement patterns [52], and traditional knowledge and risk perception [53]. Even though many studies acknowledged the importance of TEK systems, only a few focused on how TEK could be integrated into climate change adaptation [54–56]. The majority of the studies were published in domestic journals. Notably, Kuan [54] presented a detailed case study on the TEK systems of the Atayal/Tayal people and contemporary disaster management in a watershed area. Wang [56] specifically focused on the perceptions of climate change of the Tayal people and how their TEK systems could support households to identify climate change adaptation options. Lin et al. [52] investigated how Indigenous Tao (or Yami) people employed their ecological wisdom by choosing the appropriate settlement location and housing architecture for coping with strong winds on Lanyu (Orchid) Island.

Other major topics and themes included community development (26 articles), housing and sustainable architecture (17 articles), and Indigenous health (15 articles). In terms of community development, some studies referred to either cultural and social vulnerability [28] or procedural vulnerability [38]. The procedural vulnerability concerns the relationships people have with power rather than with the environment [38]. Relocation after a climate disaster, for example, has often been labeled as a double disaster in Taiwan because it shifts Indigenous peoples from one vulnerable situation into another that may be worse [39]. In the health sciences, scholars focused on mental health, posttraumatic stress disorder, and depression among Indigenous peoples after Typhoon Morakot and other climate disasters [57,58]. Chen et al. [59], for example, reported that Indigenous peoples tended to show stronger mental recovery from Typhoon Morakot than Han people (the ethnic majority in Taiwan) due to their higher adaptability to cope with a changing environment and climate. Findings from health science studies thus indicate that research on mental resilience could complement studies on Indigenous peoples' resilience when faced with climate change [60,61].

Indigenous tourism (11 articles) is currently a trending topic among the literature on Indigenous peoples and climate change. A growing amount of research is focusing on how Indigenous tourism contributes to Indigenous resilience against climate disasters [62,63] or contribute to community development [51,64]. Scholars often perceived a relationship

groups and reflecting gradual changes and stressors in general. A notable exception has been Lanyu/Orchid Island, home to the Tao people. Relevant studies [46,52] specifically focused on this island due to the assumed resilience of the Tao people to negative climate events.

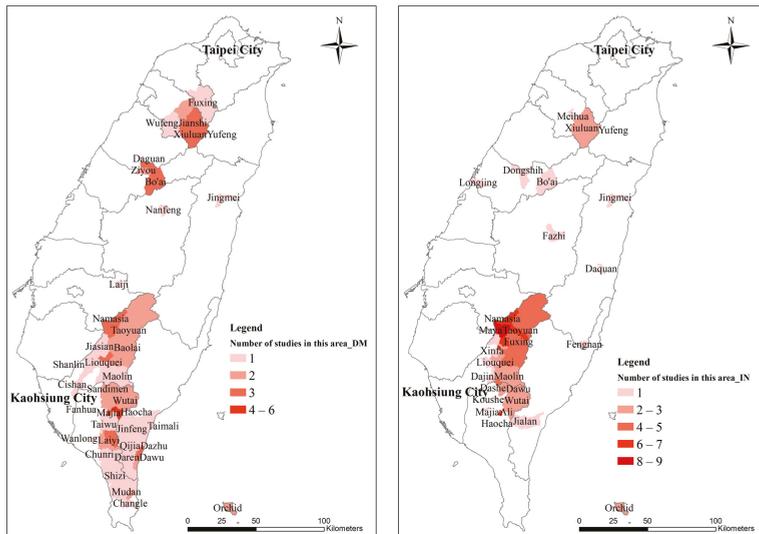


Figure 5. Geographical distribution of (a) domestic and (b) international articles at village/town/district level. Note: if studies were conducted in multiple research sites, all sites are shown on the map. Studies that did not refer to a specific research site were excluded.

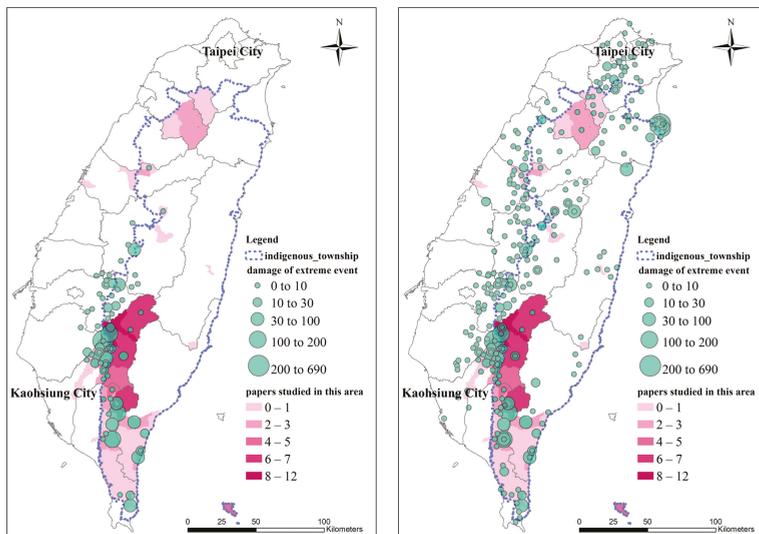


Figure 6. Geographical distribution of (a) all articles and damage caused by Typhoon Morakot in 2009 and (b) all articles and damage caused by extreme climate events on the national level from 2006 till 2020 (data from: [24]). Note: damage refers to a cumulative score of deceased and injured people and severely damaged or destroyed houses as a result of extreme climate events, such as typhoons, rainfall-induced debris flows, or heavy rainfall.

Another reason for the uneven geographical distribution among the included studies is the relationship between university locations and site access. Some universities in southern Taiwan (National Ping Tung University, National Sun-Yat Sen University, National Cheng Kung University, and I-Shou University in particular) have extremely active research centers or colleges dedicated to Indigenous studies. Researchers from these universities have produced numerous studies, with articles published both domestically and internationally. This was partly the result of government policy to allocate substantive research funding to southern universities in Taiwan to study the impacts of Typhoon Morakot instead of allocating it to their northern counterparts. In Taipei City, researchers from National Chengchi University and National Taiwan University have taken the lead in conducting studies on Indigenous peoples and those living in north-central Taiwan in particular. According to our database, Wulai, an Indigenous Tayal district in New Taipei City, interestingly received very little attention from Taipei-based scholars over the past 10 years. This is remarkable because Wulai was severely affected by Typhoon Soudelor in 2015 [70], and the district is close to Taipei City. Wulai district has been relatively well prepared for typhoons [70], which partly explains why it has not been a focus in the analyzed articles.

We also searched for the individual Indigenous groups in the relevant studies and identified 13 groups in total (Figure 7): 12 officially recognized groups and one locally recognized group (Taivoan). The Rukai and Paiwan peoples were the most studied with 29 (26.1%) and 28 (25.2%) articles, respectively. These Indigenous groups were most heavily affected by Morakot and government relocation policies [29,39], so it should therefore not come as a surprise that they were the most investigated. The third and fourth most studied groups were the Tayal (17 articles; 15.3%) and the Bunun (14 articles; 12.6%) respectively. Many articles on the Tayal focused on either their agricultural or hunting practice or their TEK systems [45,54,71]. The east coast's Amis people—Taiwan's largest Indigenous group, which accounts for 213,958 people [72]—are underrepresented with only three articles. The Saisiyat, Thao, Sakizaya, and Kavalan peoples were not mentioned in any of the articles, and 21.8% of all articles failed to mention a specific Indigenous group. This is most likely because the authors assumed their readers would know which groups were involved in their study based on the location of the study site or because the authors did not consider this to be relevant information. Some authors also had problems understanding the differences between the terms Indigenous, aboriginal, tribe, and ethnic minority. In one article [58], the aforementioned words were used interchangeably; it was stated that (t)he Indigenous people are the ethnic minority group [sic] in Taiwan (p.12). Hsu [37], in her insightful study on Taiwan's imagined geographies and identities, discusses in great detail the political implications and issues related to the classification and recognition of Taiwan's Indigenous peoples. This is reflected in how some articles (often from outside the social sciences) identify or acknowledge the relevant Indigenous groups. Additionally, the process of translating Chinese terms into the English language could have caused some confusion among scholars [37].

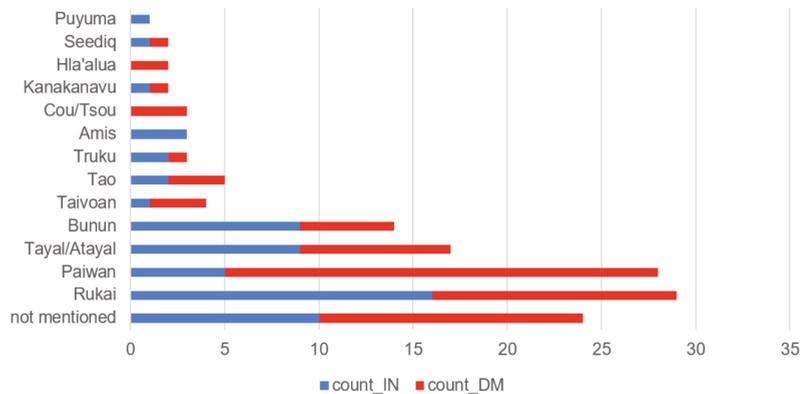


Figure 7. Indigenous peoples mentioned in the research articles (frequency; multiple options possible).

3.3. Temporal Characteristics

For disaster management literature analysis, we divided all articles into four categories reflecting the temporal characteristics of the disaster phase being investigated: risk perception, disaster risk reduction (DRR), in-season coping strategies, and post-disaster recovery (Figure 8). These categories refer to the temporal orientations of the studies and correspond to the four stages of disaster management (mitigation, preparedness, response, and recovery, respectively). Each phase reflects how climate change affects Indigenous livelihoods and adaptation strategies. Post-disaster recovery was the focus of most articles (76 in total; 68.5%), whereas DRR was the second most reported, risk perception third, and in-season coping strategies last. With the exception of one article [59], the articles in our database did not focus on all four phases of disaster management.

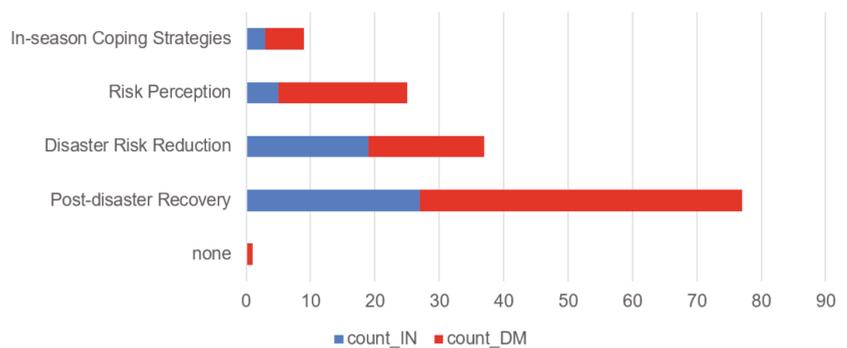


Figure 8. Phase of disaster management (frequency; multiple options possible).

In the previous section, we mention that the majority of studies focused on post-disaster recovery or the post-disaster setting. Many articles shared the lessons learned from Taiwan after Typhoon Morakot in a variety of contexts, ranging from the highly descriptive or technical [36] to the very critical [65]. Generally, Taiwan's approach to disaster management is somewhat top-down [39]. This is why numerous scholars have argued for more culturally appropriate post-disaster recovery strategies within Indigenous contexts [28,42,43]. Few studies adopted a longitudinal approach [73], and follow-up studies were rare. Many studies also lacked a clear baseline, but this is somewhat understandable given the unpredictable nature of climate hazards.

Although many of the studies could be considered to have investigated the DRR or risk perception phases, few studies elucidated how TEK could play a role in both perceiving and preparing for climate disasters and climate change more generally [48,53,54,71]. Roder et al. [53] included a relatively small section on traditional knowledge and risk perception in a Bunun community in their article, whereas Ba et al. [48] investigated the Rukai's traditional farming methods for coping with disasters and achieving sustainable development. Another insightful study, conducted in an Indigenous community in the mountains of Taichung county, revealed that local Tayal households could identify disaster risks by detecting changes in local terrain, hydrology, flora, and fauna [71]. However, the lack of relevant studies indicates that more studies on TEK in relation to disaster management should be conducted.

Only nine studies (8.1%) shed light on in-season coping strategies. For instance, a study conducted in (Indigenous) mountainous villages in Kaohsiung City revealed that 86.2% of the households did not receive any formal early disaster warning of the onset of debris flows during Typhoon Morakot [74]. These households solely relied on their intrinsic senses and Indigenous knowledge before and during the disaster. An article published in the *Fooyin Journal of Health Sciences* revealed the power struggles between Indigenous peoples and governmental medical personnel during Typhoon Morakot and its direct aftermath. These struggles were caused by mainstream societal misperceptions of the inferiority and vulnerability of Indigenous peoples in Taiwan [75]. However, Indigenous experiences and strategies during climate shocks and stressors generally remain underinvestigated.

3.4. Indigenous Authors and Voice

Various scholars increasingly agree that Indigenous voices deserve a more prominent role in the Conference of the Parties (COP) meetings, Intergovernmental Panel on Climate Change (IPCC) reports, and academic studies [8,31]. Taiwan, which is internationally unrecognized by the vast majority of the world's nations, is perhaps not active in COP meetings, but numerous academic studies have been written by Indigenous scholars. At least 22.9% (14 studies) of domestic articles were either written or co-written by Indigenous authors. For international articles, this percentage was at least 12.0% (six studies in total). We identified Indigenous scholars by their names or their ethnicity being otherwise mentioned in the main text. These Indigenous scholars self-identified as Rukai, Paiwan, Puyuma, Tayal, Seediq, Tao, Sakizaya, Amis, and Tsou/Cou. They either wrote the articles as a single author or together with other Taiwanese, Indigenous, or foreign scholars. In terms of diversity among the Indigenous authors, nine groups are represented, meaning that seven groups (e.g., the Bunun) are not represented. In total, seven non-Taiwanese scholars contributed to studies on Taiwan's Indigenous peoples and climate change; two of these studies were co-written by Indigenous scholars. Given that Indigenous peoples only make up 2.4% of Taiwan's total population, Taiwan's Indigenous scholars can be concluded to have found a voice in academia, especially in articles published in domestic outlets (Appendix C). It is hoped that more domestic research can be translated into English for an international audience because many articles written by Indigenous scholars contain very detailed ethnographies on local TEK systems [47,54,55].

3.5. Future Research Directions and Knowledge Gaps

The final research question concerns what kind of knowledge gaps or future research directions can be identified among the literature on Indigenous peoples, resilience, and climate change in Taiwan. In terms of knowledge gaps, a geographical skewness was identified, with southern Taiwan receiving substantially more attention than Taiwan's east coast. This can be partly attributed to Typhoon Morakot and the relatively low impact it had on Taiwan's east coast. Government-led projects to studying Typhoon Morakot and associated funding channels also contributed to this skewness. This ties in with the types of climate hazards studied currently. Many scholars focus on climate shocks, as can be seen in the large overlap of Morakot's destruction path and the study sites of the selected

articles (Figure 6a; Appendix D). More studies must be conducted on climate stressors affecting Indigenous farmers and smallholders, how Indigenous peoples cope with climate variability, and how Indigenous peoples experience, perceive, and cope with global climate change. These stressor studies would help improve the east coast's Indigenous population's representation in future studies. This relates to a broader issue regarding the multiple impacts of climate change on Indigenous peoples in Taiwan. These could be direct (such as shocks), gradual (such as stressors), or indirect impacts, such as effects of climate change response by government agencies on Indigenous peoples. Highlighting the latter, Taiwan's quest for renewable or non-fossil fuel energy has led to new land grabs and disputes on traditional territories and rights of Indigenous peoples on Taiwan's east coast [76,77]. These multiple impacts, however, have not been comprehensively discussed by the articles in this bibliometric study.

In terms of the Indigenous peoples considered in the relevant studies, there are relatively few articles focusing on the Amis among other groups. The Amis are renowned for their TEK systems and local marine area management [20], and several questions remain regarding how climate change affects their traditional livelihoods and resilience. Future research could also adopt a longer timeframe, such as from 1990–2020, as studies prior to Typhoon Morakot could shed more light on communities that have received less attention, such as Indigenous communities on Taiwan's east coast.

We also discovered that relatively few studies have investigated how TEK systems can be integrated into climate change adaptation and disaster management. There is a valid concern that translating Indigenous languages into Chinese and then into English is difficult. Furthermore, some Indigenous elderly people are more fluent in Japanese than Chinese as a result of colonialization, and translation errors could also occur for this reason. Much information could be lost, and it, therefore, makes sense that these types of articles are published in Chinese in domestic outlets. Additionally, many (unpublished) masters theses—often indexed in Airiti Library—as well as grey literature on TEK have not been translated into academic articles yet. Nonetheless, the international community remains somewhat unexposed to the TEK systems of Taiwan's Indigenous peoples. This is probably another major reason why international literature has not covered Taiwan (e.g., [6]). In terms of methodological trends, many studies have adopted a qualitative approach, performing microlevel case studies. Although qualitative approaches provide rich data, they could be complemented with larger-scale quantitative surveys on the regional or national level. Comparative and longitudinal studies are also lacking. What are, for example, the long-term implications of climate-induced relocation? How does climate change create environmental mobility among Indigenous households? These questions require a more critical exploration of the relationship between Taiwan's Indigenous peoples, Indigenous resilience, and climate change. Perspectives in political ecology, for example, have been proven to be very valuable [78], but no study in our database adopted this approach. Future studies also need to adopt more multi-, cross-, and trans-disciplinary research methods. Studies on Indigenous peoples and climate change have been conducted from multiple academic disciplines, ranging from health sciences to DRR studies, and from ethnographic research to natural sciences. The next wave of Indigenous peoples' research should take advantage of these multiple disciplines by adopting more holistic approaches to the global climate change response of Indigenous peoples.

Indigenous resilience is also a dimension that deserves more attention in future studies. The concept of resilience consists of three dimensions: absorptive, adaptive, and transformative capacity, which correspond to coping, adaptation, and transformation respectively [79–82]. Most studies focused on coping or adaptation strategies [44,48,73], but no studies were found which analyzed the transformative capacity of Indigenous peoples to climate change. This consequently led to a somewhat narrow understanding of the concept of resilience. This is a research gap that should be addressed more comprehensively among studies on Indigenous peoples and climate change, both within the context of Taiwan and beyond.

It is crucial to mention why the lessons learned from Taiwan are important for other countries in the Asia-Pacific that are home to Indigenous peoples. Although Taiwan lacks international recognition, it is one of the few countries in Asia that officially recognizes its Indigenous peoples [19]. Taiwan is also a liberal democracy, and therefore the development path of Taiwan, being a newly developed country, can provide vital lessons for other countries in Asia that are home to Indigenous peoples, such as Vietnam, Cambodia, and Myanmar. It is hoped this study will prompt the international audience to engage more intensively with the literature on Indigenous peoples, resilience, and climate change in Taiwan. This study is the first of its kind for Taiwan's literature and is a humble beginning, but hopefully, the first step to give Taiwan's Indigenous peoples greater importance on the international stage.

Lastly, it is recommended that other studies conduct similar bibliometric analyses in countries home to the world's Indigenous peoples. The methodology employed in this study can be used to provide more insightful analyses embedded in national contexts to understand our current state of knowledge of how the world's Indigenous peoples cope and are resilient to global climate change.

4. Conclusions

This study analyzed 111 articles published in peer-reviewed domestic and international journals or books and concerning Indigenous peoples, resilience, and global climate change in Taiwan in the 10-year period after Typhoon Morakot. Most of the articles focused on disaster management, with a particular focus on post-disaster recovery, Indigenous cultures, ecological wisdom, and community development. Most studies were conducted within the context of and in relation to Typhoon Morakot, and more focus was given to climate shocks than climate stressors. There was also a somewhat narrow understanding of the concept of Indigenous resilience. Among the articles, we found a geographical skewness in favor of southern Taiwan, with Taiwan's eastern coast receiving relatively little attention. The geographical skewness could be partially attributed to the destruction path of Morakot, which overlapped considerably with the geographic locations of the included studies, and governmental research funding channels. The Amis, Taiwan's largest Indigenous group, were also largely overlooked. In terms of post-disaster recovery, most scholars argue for a more culturally sensitive approach that fits the needs and livelihoods of Indigenous peoples. Longitudinal studies and those focusing on all four phases of disaster management remain in their infancy. This also accounts for the small number of studies on TEK systems and climate change adaptation. Indigenous scholars have been very active in publishing their research, but most of their articles have been published in domestic outlets. Taiwan-based scholars should thus engage more with contemporary studies and global debates on the roles of Indigenous peoples in global climate change adaptation and mitigation. Taiwan is a case study and can provide the globe with an understanding of how Indigenous peoples can become more resilient to the negative effects of global climate change.

Author Contributions: All authors (M.M.B., Y.-Y.H., L.-S.H., H.-M.T. and t'ev.) contributed to the study conception and design. Material preparation, data collection and analysis were performed by M.M.B. and Y.-Y.H. The first draft of the manuscript was written by M.M.B., Y.-Y.H., and L.-S.H. All authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Table A1. Indigenous population in Taiwan in 2020.

Tribe	Indigenous Population	People in Indigenous Community
Atayal/Tayal	92,306	47,531
Saisiyat	6743	2194
Rukai	13,498	8032
Bunun	59655	29,454
Hla'alua	418	1982
Kanakanavu	367	1018
Tsou/Cou	6709	3252
Thao	818	294
Seediq	10,485	8592
Truku	32,435	21,466
Amis	213,958	96,098
Sakizaya	992	1389
Kavalan	1503	373
Puyuma	14,573	7346
Paiwan	103,032	54,568
Tao	4692	4196
Not-recognized	10,902	—
Total	573,086	287,789

Source: Ministry of the Interior [72] and Council of Indigenous Peoples [18].

Appendix B

Sustainability and Climate Change of Taiwan Indigenous People

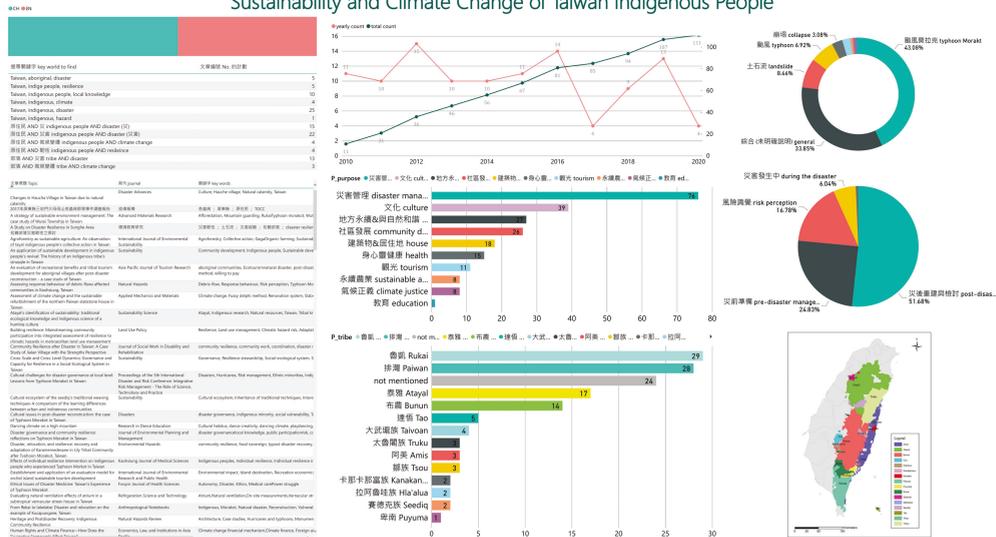


Figure A1. Screenshot of the Power BI analysis. Note: For the online version, see: <https://bit.ly/3gyBW3b>.

Appendix C

Table A1. List of all articles *.

Code IN = International (Scopus) DM = Domestic (Airiti Library)	Full Bibliography:
DM01	Chang A-S (2010) Dense Forest in the Past, but Few and Far between Nowadays the Dialogues between Aborigines Traditional Mountain Experiences and Recent Mountain Development of Southern Region in Taiwan. <i>Taiwan: A Radical Quarterly in Social Studies</i> 78: 327–353. https://doi.org/10.29816/TARQSS.201006.0009
DM02	Chang W-C, Lin Y-S (2012) The Psychological Phenomenology of Natural Disaster Survivors: Cases from Typhoon Morakot. <i>The Journal of Kaohsiung Behavioral Sciences</i> 3:95–124. https://doi.org/10.29854/TJKBS.201205.0004
DM03	Chen C-F (2019) Regenerating “Home” between Auvinni Kadreseng’s Writing of Storm Damage and the Construction of Social Resilience. <i>Chung Wai Literary</i> 48:169–194. https://doi.org/10.6637/CWLQ.201909_48(3).0005
DM04	Chen C-N, Yeh Y-L (2010) Recovery Evaluation of Hillslope Disaster in Mountain Tribes. <i>Journal of Taiwan Agricultural Engineering</i> 56:61–70. https://doi.org/10.29974/JTAE.201003.0005
DM05	Chen P-S, Li C-P, Tseng Y-L, Chuang H-H (2013) The study of disaster prevention social capital to construct innovative strategy in rural area—a case study of landslide disaster (in Chinese). <i>Agricultural Extension Anthology</i> 58: 89–122
DM06	Chen S-T, Hsu C-L, Kuo J-M, et al. (2011) Review on Disaster Preparedness and Response of Laiyi Township as Nanmadol Typhoon Period. <i>Journal of Slopeland Hazard Prevention</i> 10:37–48. https://doi.org/10.29995/JSHR.201112.0004
DM07	Chen T-C, Lin Y-S, Hsu W-Y (2013) An Exploration of the Differences between Aborigines and Han in Their Coping Styles and Adaptation Strategies After Surviving Typhoon Morakot. <i>Formosa Journal of Mental Health</i> 26:249–278. https://doi.org/10.30074/FJMH.201306_26(2).0003
DM08	Chen W-L (2012) Reconstruction of Ka’aluwan Village after the Typhoon Morakot: A Case Study on Disaster of Anthropology. <i>Chinese Journal of Applied Anthropology</i> 1:157–173. https://doi.org/10.6290/CJAA.2012.0101.07
DM09	Chen Y-J (2011) A Community-Based Study on the Model of the Life Rehabilitation in the Aboriginal Disaster Areas. <i>Cha Nan Annual Bulletin</i> 37: 516–525. https://doi.org/10.29539/CNABH.201112.0019
DM10	Chen Y-L (2010) Subjectification, Movement, and Tribe Re-establishment in Indigenous Area of Southern Taiwan after Morakot Flood. <i>Taiwan: A Radical Quarterly in Social Studies</i> 78: 403–435. https://doi.org/10.29816/TARQSS.201006.0012
DM11	Chern J-C (2019a) Reconstruction after Typhoon Morakot: Achievements and Reflection on Its 10th Anniversary (I)—Prologue & Infrastructure Built for Disaster Prevention and Sustainability. <i>Civil and Hydraulic Engineering</i> 46:4–13. https://doi.org/10.6653/MoCICHE.201906_46(3).0001
DM12	Chern J-C (2019b) Reconstruction after Typhoon Morakot: Achievements and Reflection on Its 10th Anniversary (II)—Building a Colorful Sustainable Community. <i>Civil and Hydraulic Engineering</i> 46:14–30. https://doi.org/10.6653/MoCICHE.201906_46(3).0002
DM13	Chien H-F, Wang Y-C, Li H-C, et al. (2018) 2017年屏東縣三地門大母山恙蟲病群聚事件調查報告[2017 Investigative Report for cluster infection of Scrub Typhus at Mt.Damumu in Sandimen Township, Pingtung County] (in Chinese). <i>Taiwan Epidemiology Bulletin</i> 34:115–118. https://doi.org/10.6524/EB.201804_34(7).0001

Table A1. Cont.

Code IN = International (Scopus) DM = Domestic (Airiti Library)	Full Bibliography:
DM14	Chien W-M (2011) 莫拉克風災對荖濃溪、楠梓仙溪流域原住民族群遷徙與文化變遷的影響與因應 [The impact and adaptation to the Indigenous groups' migration and culture change of Laonung river and Nanzixian river drainage basin by Typhoon Morakot] (in Chinese). <i>Kaohsiung Historiography</i> 1:6–27
DM15	Chiu FYL (2011) On Understanding Man-made Catastrophes and Re-generating Communal Capacities. <i>Taiwan: A Radical Quarterly in Social Studies</i> 85:317–352. https://doi.org/10.29816/TARQSS.201112.0008
DM16	Chuang P-F (2012) The Reconstruction and Healing Work after Typhoon Morakot. <i>Journal of natural and human environment of Indigenous peoples</i> . 3:55–75 https://doi.org/10.29875/JNHEIP.201206.0003
DM17	Chung M-C, Tan C-H, Wang G-S, et al. (2010) Case Study of Ji-Lou Landslide Triggered by Typhoon Morakot. <i>Journal of Chinese Soil and Water Conservation</i> 41:333–342. https://doi.org/10.29417/JCSWC.201012_41(4).0005
DM18	Dong X-H (2012) 莫拉克颱風嘉蘭村災後家園重建與社會文化的復振 [Post disaster reconstruction and cultural and social recovery of kaaluwan village after Typhoon Morakot] (in Chinese). <i>Journal of natural and human environment of Indigenous peoples</i> 3: 77–98. https://doi.org/10.29875/JNHEIP.201206.0004
DM19	Du Chang M-C (2014) Indigenous Natural Resources Policy. <i>Journal of The Taiwan Indigenous Studies Association</i> 4:63–78
DM20	Gadeljeman V, Taiban S (2019) Construction of Culture Space in Indigenous Community after Disaster: The Case Study of Three Permanent Housing Bases in Pingtung. <i>Policy and Personnel Management</i> 10:109–138. https://doi.org/10.29944/PPM.201906_10(1).0004
DM21	Hou Y-K, Liang B-K (2010) Tourism and Local Development of Indigenous Regions: A Case Study of Laiji Tribe of the Tsou People. <i>Taiwan Journal of Indigenous Studies</i> 3:105–148. https://doi.org/10.29910/TJIS.201003.0004
DM22	Hsia Y-J, Lin P-R (2011) Aborigine and Natural Resources Management: A Theoretical Framework for Co-management. <i>Taiwan Journal of Indigenous Studies</i> 4:39–66. https://doi.org/10.29910/TJIS.201103.0002
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* Note: we present this bibliography in English according to the English titles provided by the authors themselves. In case there were only Chinese titles available, we translated them ourselves but we also provided the original titles in Chinese. It is also important to mention that not all articles had DOI numbers, and therefore we only included them if they were available. Codes in bold have been (co-)written by Indigenous authors.

Appendix D

Geographical distribution of all articles and damage of Typhoon Morakot in 2009 and damage of extreme climate events on a national level from 2006 till 2020 in Taiwan.

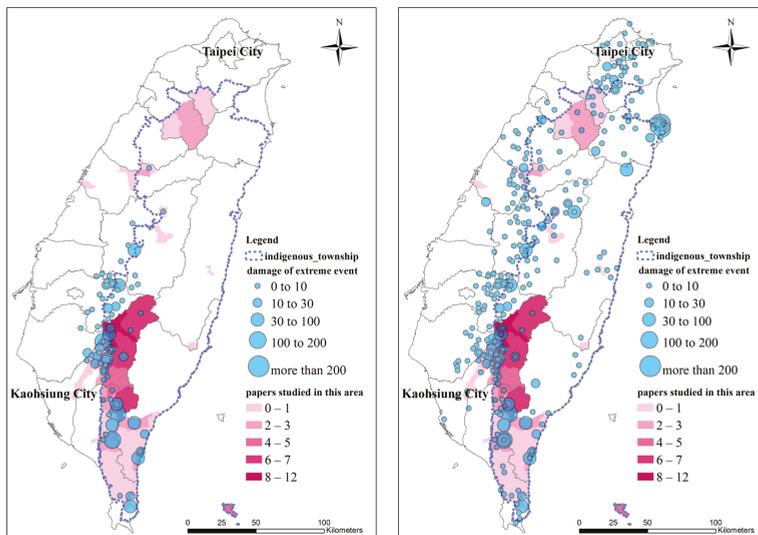


Figure A2. Cumulative housing damage from typhoon Morakot (a) and of all extreme climate events (b) in Taiwan (data from: [24]).

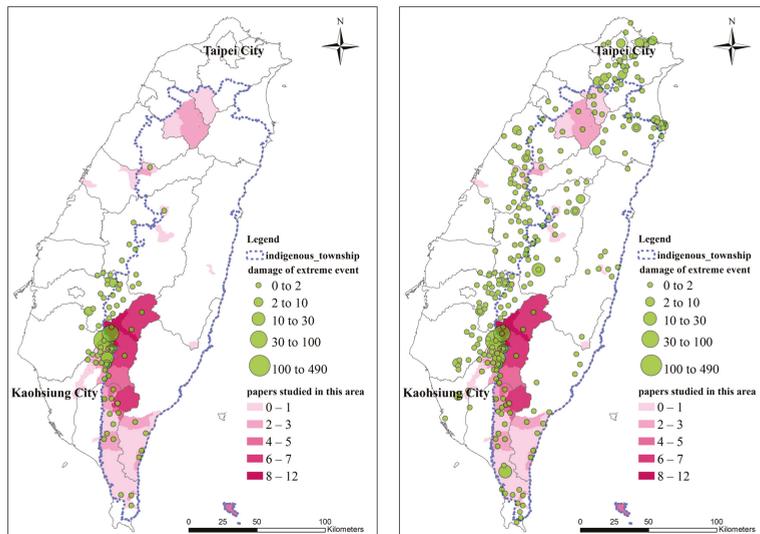


Figure A3. Cumulative score of deceased and injured victims of typhoon Morakot (a) and of all extreme climate events (b) in Taiwan (data from: [24]).

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Article

Rebuilding Relocated Tribal Communities Better via Culture: Livelihood and Social Resilience for Disaster Risk Reduction

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Abstract: Building back better is the goal of post-disaster recovery. However, most of the extant literature focuses on hardware reconstruction and there is a lack of attention on the social aspect of recovery. This study aims to understand the role of culture in the recovery process of relocating indigenous communities through tourism livelihood. A Tsou indigenous settlement, relocated after the 2009 Typhoon Morakot in Taiwan, was used as a case study. Field data were collected through participant observations in tourism and community activities as well as semi-structured interviews over a period of 15 months. The study found that appealing to a relocated tribe's culture, not their land, as their community's foundation could reduce conflicts within the community and increase social resilience. Indigenous culture-based tourism could serve as an important source of livelihood for such tribes, supporting long-term development. This study highlights community-based cultural tourism as a post-disaster livelihood revival approach which is beneficial for a resilient recovery. Culture could reduce disaster risk through a transformation to a livelihood source and further become the base of community resilience. Instead of promoting detached culture preservation, this study argues that a livelihood-relevant culturally innovative transformation could create a win-win situation for both post-disaster community recovery and culture inheritance.

Keywords: relocation; post-disaster recovery; cultural tourism; build back better; community-based tourism

1. Introduction

The Sendai Framework for Disaster Risk Reduction 2015–2030 emphasizes that advanced preparation in the recovery phase is an opportunity for a community to build back better (BBB) [1]. Recently, recovery and reconstruction research has increased [2], and most of the literature points out that BBB is a final goal to be realized for reducing disaster risk worldwide. However, most extant post-disaster recovery literature focuses on the hardware of reconstruction—such as housing, site selection, and land use planning—thus lack focus on the social dimensions of a recovering community, such as livelihood and culture revival [3–5].

When Typhoon Morakot struck Taiwan in 2009, it had a serious impact on the country's central, southern, and eastern parts. The Ali Mountain (in Chinese Mandarin, Alishan) area had 2854 mm of rainfall within 72 hours, exceeding Taiwan's average six-month rainfall. The heavy rain brought landslides in mountain areas and flooding in lowland areas, damaging 1764 homes, causing the death of 699 people [6]. After the disaster, in order to reconstruct as fast as possible and promptly settle the affected persons, the government adopted non-governmental organizations' suggestion to skip the temporary housing stage, and instead provided free permanent housing as its main post-disaster

recovery policy. However, a relocation strategy made in such a short time could change society in terms of human–land relations and cause further cultural conflicts and livelihood problems [7,8].

The Zhulu tribal community (*Poftonga Veoveo*) is a relocated permanent housing community situated on the main traffic route uphill to the Ali Mountain, where the impacted indigenous Tsou people, belonging to eight tribes, have resided since 2012. Although they share the same indigenous Tsou culture, the displacement caused these migrants considerable anxiety about their lives. The Zhulu people began using “culture” as the core of their livelihood development, particularly through the form of tourism. The indigenous Tsou culture was utilized not only to unite people from the eight original tribes, but also as a means to develop a resilient livelihood, leading the community to build back better lives than before.

This research explores how culture could act as the source of social resilience by activating the relocated people through community-based tourism. Furthermore, it examines in what sense cultural tourism could innovatively increase the community’s resilience via a sustainable livelihood. This study focuses on the social aspect of post-disaster relocation, where communities were moved to low-risk locations but faced social challenges. Social resilience was used as a lens to understand culture’s role in post-disaster livelihood recovery for building a relocated community back better.

This paper consists of five sections. First, we review published research on post-disaster social resilience and community’s cultural tourism to fit this research into the broader literature. We then describe the background of the case study, followed by the research methods. The results are presented based on fieldwork, comprising three subsections describing the dynamic process of rooting culture in a relocated site, transforming culture to livelihood, and brewing resilience through community-based cultural tourism. The discussion particularly focuses on the catalysis of cultural tourism to turn a resettled community into a resilient identity. We argue that the concretization of culture could cohere internal divergence and further condense into resilience for facing external disturbances.

2. Concepts from Literature

2.1. Community’s Social Resilience for Post-Disaster Recovery

The United Nations Office for Disaster Risk Reduction (UNDRR) has been keenly accepted the BBB as a priority action in recovery and reconstruction strategy worldwide. Clinton conducted research following the 2004 Indian Ocean tsunami and proposed the BBB concept with ten supporting claims [9]. Other research affirmed his viewpoint [10,11] based on studies in Aceh and Sri Lanka. Among them, Fan noted that politics have a significant influence on the success of BBB in terms of international humanitarian aid between countries and domestic collaboration among different parties [12]. Based on previous publications, Mannakkara and Wilkinson proposed an analytical framework to evaluate whether post-disaster recovery is now better than before and has been used to evaluate different types of recovery worldwide [13–15]. After some revision, in 2019, Mannakkara et al. proposed a framework comprised of three main aspects—disaster risk reduction (DRR), community recovery, and effective implementation—to evaluate recovery situations [16]. In the community recovery aspect, social, psychological, and economic factors were the keys for a community to recover from disaster and sustain a resilient situation.

Therefore, besides referring to indices to determine whether a community is recovering satisfactorily or not, a deep understanding of a community’s social cohesion should be undertaken for a more comprehensive understanding of its rehabilitation [17]. The UNDRR emphasizes that although restoring physical infrastructure is important for reconstruction, revitalizing the community’s societal systems is necessary to meet the standards of BBB [18]. This illustrates that the effects of DRR on the social fabric of a community is key to deeply understanding the context of recovery processes [19]. Social resilience was proposed by Adger to describe a community’s ability to cope with external stress and disturbance, including social, political, and environmental change [20]. It shows the ability of different social units (such as a person, organization, or community) to sustain, adapt, absorb, and

respond to environmental and social threats [21]. Social resilience emphasizes “response” and explores the new opportunities arising from it [22]. This is similar to the ideas of renewal and learning in the reorganization phase of the “adaptive renewal cycle of development” model [23].

Among the various types of recovery, relocation and replacement is the type that influences the people and changes the community the most, resulting in relocated individuals depending on culture as their recovery source. Thus, rather than simply following scientific opinion and government strategy, it is critical to listen to the relocated community’s needs and concerns [24]. Recovery is a challenging issue because it requires not only new buildings and infrastructure but also new social networks and livelihoods [25,26], which act as both the root causes and results of resilience.

Relocated people often encounter huge challenges in adapting lifestyle and culture into the new setting [8]. This could be because of the public sectors’ disregarded and oversimplified replacement strategy, as well as the results of the missing linkage between culture, land, and people [4,8]. Cultural influence on disaster risk reduction could also be seen in local and scientific knowledge integration [5]. From Taiban, Lin, and Ko’s case study in Taiwan, traditional crops and cultivation turned out to be the source of resilience for the indigenous community’s recovery process [8]. Furthermore, cultural value was rediscovered and brought indirect income for the community. However, there is still a lack of discourse on how livelihood acts as a practical reason for post-disaster culture revival and inheritance.

2.2. Cultural Tourism as Livelihood for Relocated Communities

Culture, one of the core and fundamental elements for resilience, has importance for the community [27,28], especially in the post-disaster recovery process [29]. Culture can be defined as the customs, beliefs, way of life, and social structure of a particular group [30]; it also refers to the attitudes that people in a group share [31]. Saja et al. collected research about social resilience and found culture to be one of its five critical aspects [32]. While culture is documented as key to social resilience, which plays a role in building a disaster-impacted community back better, past research has lacked a clear understanding of how exactly culture can increase social resilience for post-disaster communities. Moreover, issues such as “how culture is impacted by disaster” and “how can culture become the motive for social reorganization” are seldom discussed in the disaster management literature.

Although relocation could reduce disaster risk by moving away from a risky location, it can have a huge impact on the relocated groups’ cultural, social, and political aspects [33]. However, in most countries’ experience, including the post-2009 Morakot recovery in Taiwan, most minority victims are overlooked by the majority culture. Thus, their cultural inheritance is threatened by the path of recovery in relocated areas [8]. VanLandingham argued that culture can explain why some communities could build back better than others [34]. However, each culture and ethnic group has its niche in society, which gives it power and social capital. In post-disaster recovery strategies, mainstream culture often uses its own viewpoint to assess the value of other cultures [24,35].

The worldview of indigenous people is rooted in human-land, human-nature, and human relationships. Land and natural resources closely interact with their daily lives and are the foundation of their culture [36]. Once an indigenous tribe is relocated, its members immediately face a series of conflicts due to their “uprooting.” Lin and Lin listed the social and cultural challenges with which indigenous people have to deal after disasters [7]. These include a disconnect with their original lives, the disturbance of their social structure based on tribal tradition, the inability to adapt to a job market based on capitalism, permanent housing that does not match their previous lifestyle, and policies that are inconsistent with indigenous social context. These cultural issues gradually emerge when victims move into the permanent houses and start to recover their lives with new livelihoods and lifestyles.

Indigenous culture has unique characteristics which are nearly universally considered as exotic by developed and metropolitan populations. Cultural tourism can thus be an attractive way for a tribal community to earn a sustainable livelihood. Through ethnic tourism, people can experience culture that is “real” but different from ones’ past experience [37]. It is “selling the imagination of

heterotopia” that forms the “tourist gaze” in such activities [38,39]. This kind of exploitative selling of culture and stereotypes could be a serious problem for ethnic tourism. A relocated indigenous tribal community combines exoticism with the fear of disaster and the hope of recovery, which could be an attraction to tourists. Tsou and Ni further argued that tourists seeking “primitive” indigenous culture in a vulnerable community will somehow reshape the culture, for the sake of sustaining residents’ livelihood [40].

On the other hand, tourists amazed by the culture presented by the residents could help in raising indigenous peoples’ self-identification and foster their self-exploration for further positive development. Community-based cultural tourism, therefore, has several different and fundamental roles—to protect and to innovatively transform culture both for the group’s self-identification and source of livelihood—in building indigenous community stronger and more resilient [3,41]. Furthermore, community-based tourism in an indigenous community could not only absorb external disturbances but could also reinforce cultural revitalization that together breeds resilience in the community [42].

3. Case Study

3.1. Macro-Context of Taiwan and the Tsou Tribes

Taiwan is a mountainous island located in the western Pacific. Its total area of 36,000 square kilometers holds a population of 23 million residents, of which roughly 2% are indigenous. Taiwan’s location is prone to earthquakes and typhoons, and its high terrain with steep slopes is at high risk for rainfall-triggered landslides. The 2009 Typhoon Morakot hit the island and caused serious damage in the mountainous areas. After the disaster, the government established the “Special act for the post-disaster reconstruction of Typhoon Morakot” (abolished on 29 August 2014) to guide post-disaster recovery and reconstruction work, with the guidelines of providing free permanent houses for victims as soon as possible [6]. The homeland reconstruction plan’s top priority was to keep “away from disaster risk but stay in the same village”; the second priority was to “move away from the village but stay in the same township”; and the last choice was “to collectively relocate to an appropriate location nearest to the original township” [6].

The Alishan Township, located in southern Taiwan, was one of the most seriously impacted areas. It is home to the indigenous Tsou tribes, with a population of around 6700 divided into eight tribes (traditional settlement units) within seven villages (modern administration boundary) (Figure 1). Traditionally, Tsou society is formed based on family identity, organized with a big tribe (*hosa*) and a small tribe (*denohiu*). Culturally, big tribes were the earliest formed residential units, which are the political, religious, and economic core of the Tsou community. The small tribes are divisions originating in agriculture activities. There are two big tribes (also called the mother tribe)—the *Tapangu* (Dabang) tribe and the *Tfuya* (Tefuye) tribe—which act as the two main, traditional cores of the other small tribes. The importance of *hosa* can be seen in Tsou culture. For example, the annual “war and unity festival” (*mayasvi*) held by the *hosa* is the reunion ceremony to gather small subordinate tribes to the mother tribe. Similarly, the most important public space—*kuba*, a space for adult male gatherings—can only be situated in a big tribe.

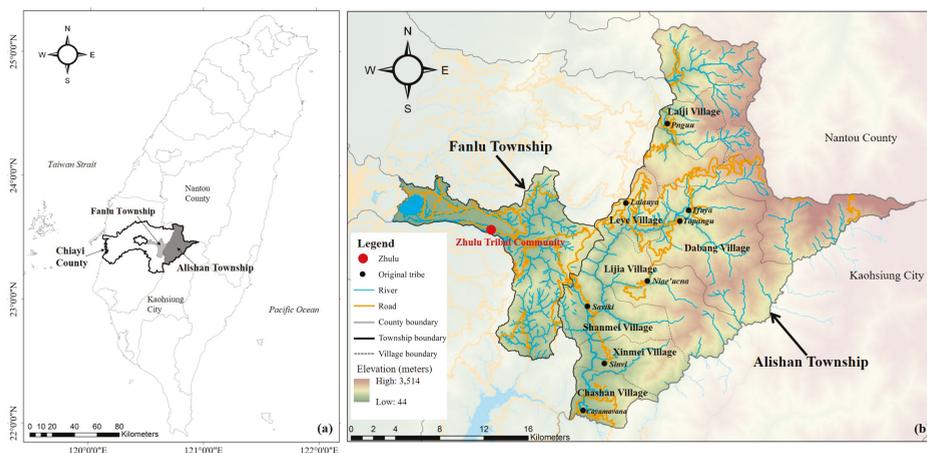


Figure 1. Location of study site: (a) the Alishan township and Fanlu Township, Chiayi County; (b) the eight Tsou tribes (located within seven villages) in Ali Mountain and the relocated Zhulu community.

3.2. The Zhulu Tribal Community (*Poftonga Veveo*)

The Zhulu tribal community (hereafter abbreviated as the “tribe” or the “Zhulu”, as this is how they refer to themselves) residents are from the eight tribes (within seven villages under the modern administrative boundary) of Ali Mountain within the administrative boundary of Alishan Township—Dabang, Tefuye (is delimited in the Dabang villages’ administrative area), Laiji (Figure 2), Leye, Lijia, Shanmei, Xinmei, Chashan. Ninety percent of the residents are Tsou indigenous people and were victims of the Morakot disaster. The impacted people were relocated in permanent housing sites away from their original homes, including the Zhulu—about 20 kilometers away from their homeland in Alishan township (Figure 1). Zhulu is within the administrative boundary of Fanlu Township, Chiayi County. About 80 households currently live in the Zhulu tribe, which is located on the main route (Provincial Highway 18) of the famous Alishan National Scenic Area (ANSA), next to the Chukuo tourist center. Zhulu is a typical relocated site under the governmental-driven permanent housing policy in Taiwan. In addition, the Tsou indigenous population is one of the small ethnic groups; therefore, the culture could have a chance to be rooted out if the relocation policy does not treat the recovery issue well. In addition, among the relocation sites that accommodate Tsou people, the Zhulu community is the one that resides in the most households and covers the largest area.

The Tsou’s ancestors used to hunt sika deer in this area, hence the tribal name “Zhu-lu”, which means “chasing deer” in Mandarin. Tsou ancestors also used deerskin and deer horn to exchange goods with other ethnic groups. Thus, this resettlement area uses sika deer as the cultural image to represent the Tsou as well as the new-settled tribal community (field note P02). The Zhulu is one of the permanent housing areas built by the Red Cross Society of Taiwan. Construction began in November 2011 and finished in December 2012, with 156 houses built in total.

Before being impacted by the 2009 Morakot, the Tsou tribes were naturally spread around Alishan based on the family and tribal unit. However, the Zhulu was an artificially formed settlement that accommodated those seriously impacted Tsou people after the typhoon Morakot. It was planned to house the impacted Tsou people, no matter their original tribes or family. The master plan is based on census household registration under the modern demographical management to allocate house size. Within the Zhulu residential area, people did not naturally gather to form a neighborhood via tribal or family relationships; people drew lots to decide the location of their new house inside the community.

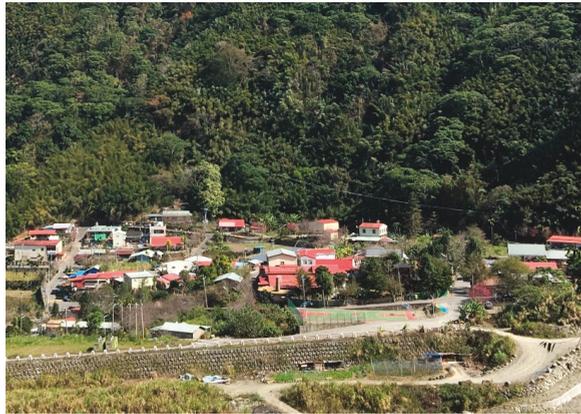


Figure 2. Pnguu (Laiji) tribe in Ali mountain.

The residential space is divided into three areas: permanent housing, a cultural art museum, and the tribal market (Figure 3). There is a public activity center and three churches in the permanent housing area. Also, a few residents gathered together to develop the “Zhulu tribal artistic village” by remodeling a garage into a Tsou-art-character workshop. This aims at sustaining residents’ livelihoods through running culturally characteristic artistic shops in their homes. This was motivated in part by the halting of construction on the planned cultural art museum due to problems between the local government and the contractor (the estimated finish date is May 2021). The *yokeoasu* tribal market skirts the settlement and opened once the residents moved in. Zhulu people could rent stalls to sell goods and food to earn income. The market also acts as a space for cultural dissemination, staging traditional Tsou dance performances on the weekends to introduce the tribes’ origins, Tsou culture, and Tsou greetings to tourists.



Figure 3. Environmental arrangement in the Zhulu tribal community.

Tourists visit Zhulu mainly in the Tsou dance performance times (one session in the morning and one in the afternoon) on weekends or holidays. Therefore, most of the tourists’ visiting area is limited to the *yokeoasu* tribal market, as tourists can shop, eat and drink, and enjoy performances in the area. Although the “Zhulu tribal artistic village” in the permanent housing area is only a three-minute walk from the tribal market, few tourists go into the artistic village, mainly because tourists have limited access to information about it; in addition, those characteristic Tsou art workshops are scattered over the huge area, so people need to spend time to explore and walk. Quite a lot of the tourists that visit

Zhulu are members of group tours to ANSA. ANSA is one of the most popular tourist attractions in Taiwan; thus, Zhulu, which is located on the main entrance to ANSA, has become a sort of a 'stop-by service area' for those group tourists. For those individual tourists, except for the tribal market on the outskirts of the Zhulu community, they tend to have more interest and sufficient time to walk along the street and visit the entire community, such as the churches, the *kuba* model, and the Tsou-art-character workshops. In addition, tourists can experience Tsou culture through tourism activities such as feeding young sika deer, learning traditional Tsou hunters' archery, making millet mochi (sticky rice cake) and aiyu jelly (made from the seeds of a kind of fig plant), and taste traditional Tsou cuisine.

The Zhulu community established two community activism organizations in 2013: the Zhulu Community Development Association (ZCDA) and the Limited Liability Chiayi County Indigenous Zhulu Community Cooperative (ZCC). The ZCDA's membership consists of all residents and it delegates the charge of community development, while the ZCC organizes tribal tourism, including the operation of the tribal market. The ZCC's economic income is used for community development, which means the two organizations support each other. Furthermore, the government also supports and funds various projects to help with post-disaster development, including cultural inheritance, employment, and tribal empowerment [43] (Table 1).

Table 1. Government funded post-disaster development projects in Zhulu.

Project Name	Funding Sector	Project Goals	Implementation Period
Cultural seed cultivate project (phase Two)	Ministry of culture	Facilitate employment in situ and promote cultural reconstruction	2013
Morakot reconstruction area community empowerment sustainable development project	Ministry of Interior	Building the community's capacity for self-recovery and reconstruction	January 2013 to August 2014
Multiple Employment Promotion Program	Ministry of Labor	Through the partnership between public and private sectors to facilitate local development and reduce unemployment	Start from 2013
Morakot post-disaster reconstruction Yao-Dong project: Industry development Project in indigenous people's permanent house sites	Morakot Post-Disaster Reconstruction Council, Executive Yuan	Developing relocated communities' sustainable development of livelihood, especially focus on industry, employment, culture, and lifestyle.	February 2013 to June 2014
Morakot Post-Disaster relocated tribes' reuse and traditional-cultural landscape reproduce project	Council of Indigenous Peoples, Executive Yuan	Activating relocated tribes' original living place and traditional-cultural landscape to protect and manage culture.	March 2013 to December 2014
Chiayi County gold medal community empowerment project	Chiayi County government	Provide resources and expertise to keep younger generations in Chiayi and encourage innovations to solve communities' predicament.	April to December 2017

Although the tribespeople relocated to Zhulu eight years ago, little academic research has been conducted on the site. Most of the published works that mentioned Zhulu focused on the cross-site comparison of reconstruction hardware issues such as relocation site planning and residential satisfaction. For the social issue of recovery in Zhulu, Chang used Zhulu as a case to conduct research

on place attachment and identity [44]. He concluded that although people have adapted to the living space and environment in Zhulu, the sense of belonging has not yet fully formed. Therefore, the Zhulu people autonomously use cultural decoration to transform the house into a “permanent” home. As the Zhulu people are aware of the importance of cultural continuity, they thus start to bestow culture to this new place, hoping to gradually turn their new houses into homes.

4. Methods

To understand how cultural tourism could act as people’s livelihood, brewing social resilience in the relocated community, this study applied in-depth semi-structured interviews and participant observations during fieldwork from December 2017 to March 2019. Interviews allowed us to understand people’s perception, thoughts, and experiences on culture from an internal angle. At the same time, participant observations provided an external viewpoint to understand what kind of cultural messages were passed from the Zhulu to outsiders via tourism activities.

Interviews were conducted in person, following an interview guide (see Appendix A) for consistency, with flexibility across interviews. The interview guide was developed based on concepts excerpt from the literature on social resilience, cultural tourism, and post-disaster recovery. The interviewed residents were asked detailed questions on the community status quo and development, local livelihood structure and the tourism situation, cultural transformation and merging with recovery work, Morakot typhoon’s impact, and the reconstruction process. We also asked interviewees from the public sector questions on post-disaster recovery strategy, tourism promotion objectives in Zhulu, and the relation between cultural revival, post-disaster recovery, and local industrial strategies. Questions to tourists were mainly about their tourist behaviors. The researchers conducted interviews according to each circumstance and could change the order of questions, adding questions within the research objectives that we found important or were in the interviewee’s interest.

All interviews were audio-recorded with the participants’ oral permission. We used purposive sampling, by which several residents, who sell cultural goods in Zhulu, were interviewed first. These persons were then asked to recommend others who might be suitable and willing to be interviewed. Then, snowball sampling was used to identify others until the participants offered no new information relating to the study’s purpose. The interviewed residents are all currently living in Zhulu, including community organizations’ leaders and members, and residents who have promoted or are promoting tourism. The interviewees’ representation was not based on the sampled size, but rather because they were appropriate and informative in responding to the research topic. All participants were informed of the study’s research aims and its ethical considerations before they agreed to be interviewed. The interviews lasted, on average, from 45 to 120 minutes, were conducted in Chinese Mandarin, and were carried out in places where interviewees were comfortable to talk, such as their homes. Table 2 provides basic descriptions of the 25 interviewees with coded identification numbers to protect their privacy. The interviews were transcribed for narrative analyses and discourse analyses.

Participant observation sessions were conducted to observe Zhulu residents’ daily lives and their tourism activities. Through the observation, we were able to understand how they weave Tsou culture into tourism to revive their post-disaster livelihood and how they use culture to attract tourists. Although the researchers are Han, we had no difficulties interacting with the Tsou people because there has been strong interaction between Tsou and Han over hundreds of years [45] (the Alishan National Scenic Area, with an administrative boundary that covers the entire Tsou living area, was formally established in 2001).

Participant observation took place in the tribal market, tribal artistic village, permanent houses, and activity center on occasions such as guided tours, Tsou traditional dance, the culture sharing festival, culture and health station courses for the tribal elders, Zhulu tribe culture co-learning courses for children, and lunar new year tourist activities (Figure 4). Informal interviews were held during the observations. When the researchers participated in activities that were not open to the public, such as courses for residents, they introduced themselves and requested permission before participating

and asking questions (informal interviews). While participating in activities open to the public, such as festivals, the researchers did not reveal their identity unless informal interviews were conducted (when researchers verbally revealed the research topic to obtain people’s consent). Observational data were recorded in many forms, including written field notes, photos, and videos. Field notes were made extensively during fieldwork to record what was seen and heard.

Table 2. Classification and characteristics of interviewees.

Interviewee Attributes (see Appendix B for Details)	Identity Code
<i>Zhulu residents</i>	<i>R (Number of interviewees = 11)</i>
Operates culturally characteristic artistic shops or stalls in the tribal market	R01, R02, R08
Member of the community cooperative	R03(employee), R05 (Member), R07(Cadre)
Others	R04, R06, R09, R10, R11 (member of the Chiayi county Parliament)
<i>Governmental officials</i>	<i>G (Number of interviewees = 6)</i>
Central government	G01 and G02 (Morakot Post-Disaster Reconstruction Council), G03 (Alishan National Scenic Area Administration)
Local government	G04 and G05 (Chiayi county government), G06(Alishan Township Office)
<i>External organization members</i>	<i>E (Number of interviewees = 2)</i>
Non-governmental organization employee	E01 (The Red Cross Society)
Local government’s reconstruction collaboration team	E02
<i>Tourists</i>	<i>T (Number of interviewees = 6)</i>
Total	25



Figure 4. Participant observation: (left) aboriginal dance activity; (right) culture and health station courses.

This research involved 13 participant observations with coded identification numbers from P01 to P13. Although both researchers were not indigenous Tsou, most Tsou people have extensive interaction with the Han Chinese, use Chinese Mandarin as their main language of communication, and interact with tourists who are mainly Han Chinese. Thus, the researchers’ Han ethnicity did not have any impact on the collection of data.

All interviews were subsequently transcribed. Field notes, interview transcriptions, and secondary data (like published reports, statistics, and maps) were cross-referenced during analysis. Editing analysis

was used to develop categories and then crystallize concepts for interpretation. Text, narrative, and discourse analyses were used during the process [46].

The research limitations were mainly in the data. First, post-disaster recovery is a continuous process. The researchers conducted fieldwork from 2017 to 2019 and thus could not get first-hand data on events before 2017. Second, both the disaster and the relocation happened more than five years ago; some interviewees might have vague memories about past events. To limit the bias caused by these limitations, we used mixed methods to collect data, including interviews and observation, as well as collecting second-hand data from multiple sources to triangulate the obtained first-hand data.

5. Results

5.1. Rooting Culture in the Relocated Site

The Zhulu tribe’s association with deer serves to connect the new land to their history and to sustain Tsou culture, and so the tribe has begun deer restoration. “This place used to be a sika deer hunting ground. What we are doing now is restoration, we will be able to see sika deer in the future” (Interviewee R01, 2018). There are many sika deer-shaped artwork decorations in the tribe, and the entire tribe is full of elements relating to sika deer (field note P03, 2018). Not only does this act as a cohesive force for the eight tribes within the community after the disaster, but it also increases tourist attraction. “Let tourists spend time getting close to the deer and learning the culture of the Tsou people. Otherwise, it would be so boring just to visit the market” (Interviewee R07, 2018). Taking culture as the core of tourism can better highlight the characteristics of Zhulu, and this is the key to develop the new community in a sustainable manner (Table 3). “If you want tourism to be different from others, you need a cultural connection. We don’t rear deer for the sake of rearing, but for culture reasons” (Interviewee R08, 2019).

Table 3. Concepts, features, and resilience brewed by community-based cultural tourism in Zhulu.

	Concepts	Features	Resilience
<p>Strong</p>  <p>Stronger</p>	From community to tribal community	<ol style="list-style-type: none"> 1. The 9th Tsou tribe in Alishan 2. Traditional buildings 3. culture co-learning classroom 	<ol style="list-style-type: none"> 1. Tribal consensus 2. Coherence 3. Culture inherent
	Culture as tourism’s root	<ol style="list-style-type: none"> 1. Sika deer 2. Tsou’s style archery 3. Social media 	<ol style="list-style-type: none"> 1. Indigenous Tsou culture 2. Access to resource 3. Social capital
	Innovative transformation for recovery	<ol style="list-style-type: none"> 1. Zhulu Tribe Cultural Sharing Festival 2. Ceremony 3. Night feast 	<ol style="list-style-type: none"> 1. Innovation 2. Transformation 3. Social network

Besides deer, the *kuba* architectural concept of Tsou culture was integrated into the design of the Zhulu tribe’s permanent houses, with the roof designed as a dome. With subsidies from the central government, the outer walls of the permanent houses are decorated with the traditional Tsou totems, representing different stories from Tsou culture. “The decoration of the permanent house is a way to use our ingenuity to bring cultural images from the mountain and plant it here in the new home” (Interviewee G02, 2019). Structures symbolizing the culture of Tsou hunters, such as hunting shelters (*hufu*) and traditional homes (*Emoo*), were built in public spaces. These buildings help extend the indigenous culture from the tribes on the Ali Mountain to the newly built permanent housing

community and transform Zhulu, in its post-disaster state, into an off-site reconstructed tribe that integrates the eight tribes.

Zhulu residents commemorate their relocation into this permanent housing estate as a festival. They celebrate the “Zhulu Tribe Cultural Sharing Festival and Promotion of the Cultural Tourism Industry”, or “Sharing Festival” for short, and invite government officials, legislators, indigenous tribe leaders and tribespeople every year to commemorate their experience and perpetuate their culture (field note P05, 2018). They strive to make Zhulu the “9th tribe” of the Alishan Township, using culture as the nutrient for the rebirth of the new tribe (Interviewee R02, 2018). This name, “9th tribe,” represents the ancestral connection between the new settlement and the indigenous hometown, through the building up of Zhulu’s social resilience with culture (Table 3). It thereby reduces the tribespeople’s separation fear and anxiety induced by off-site reconstruction and migration.

However, although cultural heritage is important, culture can also include certain social taboos beyond collective life and memory. For example, the local government agencies and non-governmental organizations involved in aiding the reconstruction built the *kuba*—which most embodies the Tsou cultural image—in the Zhulu tribe, as a physical representation of Tsou culture on the new site. This move runs counter to the Tsou cultural tradition that only *hosa* can have *kuba*. “Our Tsou seniors are all very against it, how can *kuba* be built in Zhulu?” (Interviewee G04, 2019). Although the original intention of building *kuba* in the Zhulu tribe was to allow the off-site reconstructed new settlements to be more connected to the indigenous culture in various ways, culture still has its traditions (Table 3). The term *kuba*, therefore, has gradually faded away to be replaced with “pavilion.”

5.2. Transforming Culture to Foster Post-Disaster Livelihood

After the Morakot typhoon disaster, the government prioritized tourism when implementing the industrial plan of the permanent housing base. The Zhulu tribe permanent housing area combines indigenous culture with an excellent geographical location, as it is en-route to the ANSA, and occupies a midpoint between urban and scenic areas. These factors, coupled with the tourism and marketing experience of some of the tribespeople, enabled the Zhulu tribe to gradually develop their tourism industry.

However, the promotion of the tourism industry requires the cooperation of many parties, including the input of resources by the government, the cohesion of the tribespeople, and the degree of acceptance of the created tourism environment among tourists. Thus, there are many challenges facing the promotion of the tourism industry. “It’s not easy to be a businessman. The Tsou indigenous people . . . are all hunters” (Interviewee G01, 2019). The collaboration team that cooperated with the local government to reconstruct the Zhulu estate found that some tribespeople generally have low interest in business and marketing courses. They, therefore, encounter many issues of adjustment, abandonment, disputes, and personnel turnover in the process of promoting tourism (Interviewee E02, 2019). In addition, the delay in the completion of the Zhulu cultural tourism art museum was another reason for the tribespeople’s delay in promoting tourism. “After the construction stopped in the first year, some people felt that they had no choice but to return [to the indigenous tribe on the mountain] to work” (Interviewee R01, 2018). This museum was originally planned to be a space for tribespeople to carry out cultural performance activities, but until 2019, its construction was still suspended and remained unfinished. This has caused tribespeople to express negativity toward Zhulu’s tourism development and to leave Zhulu in search of other jobs. “Do you think we can wait for it for so many years? Actually, we already don’t have much hope in it” (Interviewee G06, 2019).

Even so, there were still some tribespeople who tried hard to encourage residents to join them in developing the tribe’s cultural tourism industry on their own. Although they did not have the cultural art museum, they decorated the tribal market in the Tsou pavilion thatched cottage style instead. “Initially, tents were used. Only after four years does it gain this current appearance of the Tsou image, created with thatch. Everyone has toiled away to support it in the past two years” (Interviewee R08, 2019). They also planned the building of specialty stores to form the tribal art village in the

permanent housing area. Together with sightseeing guided tours of the tribal market and permanent housing area, the specialty stores allow visiting tourists to enter the community and have even more cultural experiences besides spending time in the market (field notes P03, P12, and P13). However, the actual operation of the tribal art village was not as smooth as originally planned. For example, many tribespeople only used the space as a parking space for their own vehicles, ignoring the common goal of the tribal art village. "After everything was built, some people haven't even put out anything, not knowing what they should do" (Interviewee R01, 2018). This phenomenon has partially weakened the harmony of the tribe, as well as the opportunity for the recovery of their post-disaster livelihood.

Even while traditional culture is used as the core of tourism development, it is difficult to avoid the impact of a capitalistic market. For example, products sold in the tribal market are mostly packaged and sold in plastic bags or lunch boxes, due to cost and convenience considerations, while natural materials presenting the traditional culture, such bamboo leaves, wood, stones, and bamboo, are seldom used. Furthermore, the tourists' imagination of the experience and culture of the indigenous people and disaster migration is inconsistent with that presented while sightseeing in the Zhulu tribe (Interviewee T03, 2018). There were even tourists who felt that they could not feel the "tribal flavor" due to the steel construction framework of the permanent houses. "A bit out of my expectations, their buildings are too modern" (Interviewee T01, 2018). Mainstream society's imagination of indigeneity remains at "primitive life," and space is still needed for mutual communication and understanding between mainstream society and the tribespeople. In particular, communication is necessary regarding their new post-disaster vitality and their attempts to integrate traditional culture and modern art.

5.3. Breeding Social Resilience through Cultural Tourism

In order to highlight their culture and promote tourism, the tribespeople of Zhulu are participating more actively in tribal public affairs and learning together (field notes P08 and P09). This phenomenon can promote growth in resilience. It not only allows for post-disaster recovery but also allows the tribe to be more resilient to disasters than before, due to its increased social resilience. The innovative transformation of culture into a tourism industry is the key to reorganization, emphasized by the "adaptive renewal cycle of development." During reorganization after the collapse of a system, any innovation, learning, and transformation will prompt renewal in the system. "We need to slowly develop our own Tsou culture, an alternative kind" (Interviewee G01, 2019). In the Zhulu tribe, culture, as a post-disaster source of livelihood, needs to go through innovation and transformation in tourism development to bring about the new regime. After the germination of the tourism industry in the off-site reconstruction, there needs to be a gradual input of external resources, including subsidies from local government agencies or professional assistance from non-governmental organizations. For example, the "Sharing Festival" not only works to strengthen the network between the Zhulu residents and the Ali Mountain tribal tribespeople, but also allows local government agencies, local representatives, and legislators to pay more attention to the Zhulu (field note P05, P06, P07) (Table 3). "Indigenous people like sharing. Such a feeling of sharing invited our family who still live in the mountain to come and eat with us. This is cohesion" (Interviewee R08, 2018). This also allows the Zhulu tribe to connect to local and central governmental units, and even makes the tribe become the target of visits by foreign post-disaster reconstruction experts and academics. This increases the capacity of the Zhulu tribe to obtain resources, echoing the importance of the political factor, as mentioned in Fan [8].

Although the Zhulu tribe is an off-site reconstruction "out of nothing" after a disaster, the relocated tribespeople have continued to build and expand the tribe's social network for recovery and living. For example, the Zhulu tribe cultural-health station, a government-supported program to help take care of those in need, extends indigenous culture and tradition through caring for the elderly (field note P09, P10). Another example is the Zhulu community development association, which increased the tribespeople's opportunities for participation in public affairs, and also established the ZCC, seeking external funding and opportunities to promote the internal development of the tribe. In addition, the

“culture co-learning classroom” passes on the Tsou culture to the next generation, preventing children from having their cultural roots destroyed as a result of reduced contact with traditional culture due to being away from the tribal environment (field note P11). The co-learning courses can help parents pass on the Tsao spirit to the next generation and have them attach greater importance to culture (Table 3). “The kids will come to the co-learning classroom, and correspondingly it shows that these parents care about our culture” (Interviewee R08, 2018). The establishment of this social capital has strengthened the tribe’s social resilience, and, in the future, will continue to assist in the stability of the Zhulu tribal art village to attain BBB.

The tribe’s external social network is an important element in building the tribe’s internal social resilience. In the process of developing cultural tourism in the Zhulu tribe, the tribe’s cooperation with the ANSA management office is an important source. In recent years, the sika deer restoration and traditional archery activities developed by the Zhulu tribe were results of a joint effort with the ANSA management office to develop cultural tourism (field note P12, 2018). These activities provide tourists with first-hand experience, so as to gain the pleasure of sightseeing on the one hand, and to experience Tsou culture and enhance each other’s gains from tourist activities on the other (Table 3). “The ANSA management office hopes that we live here, and for the industry to also be here. So it funds for building our tourism capacity like the archery field and the sika deer restoration field” (Interviewee R03, 2018). Therefore, the indigenous cultural tourism developed in the Zhulu tribe can be segmented from the market of the neighboring “Yuyupas Tsou cultural tribe park,” which has been developed over a long period (Interviewee E02, 2019). While increasing the source of the tribespeople’s livelihoods, it has also strengthened the tribe’s resilience and improved their development prospects.

6. Discussion and Conclusions

This research aims to explore culture’s role as the source of social resilience through community-based tourism, and to understand how cultural tourism could innovatively increase the community’s resilience via sustainable livelihood. Based on the existing literature on building back better as a common goal for post-disaster recovery, this study found that culture could reduce disaster risk through its transformation into a livelihood source and would be internalized as community resilience. Using indigenous culture to create a sustainable livelihood is a win–win situation for communities. Cultural tourism not only increases cohesion among subgroups of people in the community and empowers the community, but also establishes livelihood sources and further forms sustainability [47,48]. These are the elements of social resilience that reduce disaster risk. In Zhulu, residents’ high participation rate and the well-functioning community organization show most residents’ high acceptance of using community-based tourism to retain culture.

The question of livelihoods is key to the feasibility of households affected by disasters returning to their daily lives. The Zhulu, who had previously engaged in agriculture, now lack land in their relocation site. Those who had worked in their mountainous homeland also had their livelihood affected due to the great distance from their place of work. Under economic pressure as well as the government’s promotion of capitalism, the tribe has turned to the community-based tourism as a driving force in post-disaster recovery—making use of cultural tourism in particular to pass on their culture while economically sustaining their livelihoods. Promotion of the tourism industry has indeed benefited the tribe, motivating the injection of government funding, accelerating the recovery of the tribe, and improving its social and cultural resilience. Resilience developed from cultural tourism has not only deepened the Zhulu people’s identity in the new community and the new land, but also rooted the people to the place via livelihoods that connect them to their prior memories. This has formed the basis for BBB for the Zhulu people.

This study found that shared culture positively influences cohesion within an ethnic group, allowing communities affected by disasters to jointly strengthen, preserve, and sustain their identity. Through searching for their history, the tribe’s connection to their culture was recovered, and they were able to further extend this connection to their new land, thereby minimizing the factors impacting

off-site reconstruction [34]. However, the impacts of off-site reconstruction on social systems are still unavoidable. This study found that the utilization of run-of-the-mill living quarters and the accommodating representations of indigenous culture that tourism demands have rapidly modernized relocated communities. However, traditional living habits have also changed with their inhabitants; it could be concluded that culture is dynamic, evolving with time, space, and, most importantly, people. This may represent the possibility for off-site reconstructed indigenous settlements to strengthen their social resilience as they change as a people.

This study has found that culture is as important as economic rehabilitation in disaster-resistant recovery. It serves as a force to gather tribe members, to stabilize social networks, and to enhance resistance to external disturbances [34]. Indigenous culture can also be transformed into a post-disaster economy through community-based tourism, obtaining social resources, and opportunities to participate in public affairs. This transition could be depicted by a multi-level perspective on transitions [49] explaining the dynamic path of intertwined culture, tourism, and livelihood (Figure 5).

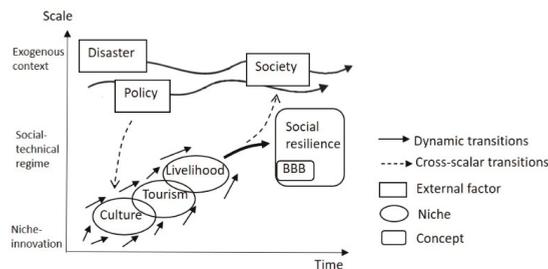


Figure 5. Multi-scale transitions of community-based cultural tourism for post-disaster resilience. Source: Modified from Geels and Schot [49].

From this study, we can see that culture can generate social resilience, and serve as a supporting point for various aspects of post-disaster recovery. In addition to “merely” reducing the risk of encountering future disasters by moving away from the original disaster risk area, the effect of off-site reconstruction on the worldviews of the indigenous people should be understood, ways to build social resilience in new areas through culture should be explored, and livelihoods should be stabilized through the development of local industries. Government strategy on post-disaster recovery, therefore, should merge scientific suggestions on replacement with relocated communities’ concerns regarding their harmonic development to avoid potential failures in relocation projects. Recovery is a challenging issue because it requires not only new buildings and infrastructure but also new social networks and livelihoods. This will transform the off-site reconstructed community into a tribal community with a cultural identity so that it will be resilient in facing future disturbances.

Future research could delve into the minorities among the relocated indigenous people, as they would be vulnerable subgroups of the underprivileged in society. Although culture could be the ‘stake’ for them to convert to a better regime during post-disaster recovery, it would only be valid when people are capable of becoming the ‘stakeholder’. Therefore, the relationship between social capital, resource access, and community-based cultural tourism is an area for more study. For practical recommendations, we suggest that governmental-driven relocation should more comprehensively consider local industry and livelihood, as these are the foundation of the relocated community’s long-term resilience. Providing a well-planned spatial area as well as supporting resources both benefit the empowerment of the people. Finally, we suggest building awareness of disaster risk to reduce exposure to hazards, strengthening social networks to enhance external mutual aid, and increasing cultural identity to cohere internal resilience. Doing so will reduce disaster risk in all aspects of people’s lives.

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Abbreviations

BBB	Build back better
UNDRR	The United Nations Office for Disaster Risk Reduction
DRR	Disaster risk reduction
ANSA	Alishan National Scenic Area
ZCDA	The Zhulu Community Development Association
ZCC	The Limited Liability Chiayi County Indigenous Zhulu Community Cooperative

Appendix A

Table A1. Interview Guide.

Dimensions	Sub-Aspect	Interview Questions
Interviewee’s background	Before relocation	<ol style="list-style-type: none"> Which tribe do you belong to? How long have you lived in the original tribes before been relocated? What are your main livelihood activities?
	After relocation	<ol style="list-style-type: none"> Why did you accept the relocation plan to Zhulu? What is your main livelihood to make a living now? How many households from your tribe move into Zhulu? Their location in Zhulu?
Social resilience	Community lives	<ol style="list-style-type: none"> Which community organization do you belong to? Why? What is the aim of public activity in the community? For daily life in permanent housing, is there any common consensus among residents?
	Local industry and tourism development	<ol style="list-style-type: none"> What is the main local industry promoted by the community? Why? What are the tourism activities in Zhulu? Do you own a stall in the tribal market or an artistic village workshop? Why? What is your goal? How could the tribal market and the artistic village workshop benefit each other and the community? What is the Tsou culture’s benefit in developing tourism?

Table A1. Cont.

Dimensions	Sub-aspect	Interview questions
Post-disaster reconstruction strategy	Cultural representation	<ol style="list-style-type: none"> 1. What is culture's function and role in the recovery and reconstruction process? 2. How do you/the Zhulu transmit culture to tourists? 3. Is replacement an influential factor for culture? Why? 4. How does Zhulu's tourism development contribute to Tsou cultural inheritance and revival?
	The resident	<ol style="list-style-type: none"> 1. What is the impact of Morakot on your life? 2. What are your thoughts on Zhulu's recovery situation? 3. What does the annual "sharing festival" mean to you? 4. In what sense does culture tourism nourish a relocated community's resilience?
	Public sector	<ol style="list-style-type: none"> 1. What is the government's goal in promoting Zhulu's tourism industry? 2. Why does the public sector decide to offer resources for a relocated community's recovery? 3. How does the public sector niche the Zhulu in the blueprint of indigenous culture innovative preservation and community resilience development?

Appendix B

Table A2. Interviewees' Demographic information.

Interviewee Attributes	Zhulu Residents	Governmental Officials	External Organization Members	Tourists
Number of interviewees	11	6	2	6
Age	20–40	3	1	2
	40–60	6	4	4
	60–above	2	1	0
Gender	Male	6	5	2
	Female	5	1	4
Ethnicity	Tsou	6	4	0
	Han, but marry to Tsou	3	0	0
	Han	2	2	2

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Article

Knowledge and Practices of Indigenous Peoples in the Context of Resource Management in Relation to Climate Change in Southeast Asia

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Abstract: In this article, we document how four indigenous peoples in insular Southeast Asia (Indonesia and the Philippines) have reacted to external interventions and discuss to what extent climate change has been a factor in the adjustment of their way of life. All groups share a similar environment, that is tropical low land rainforest. However, their traditional modes of exploitation of this environment vary, which can be ascribed to specific geographical and cultural characteristics. In recent years, these indigenous peoples have faced encroachment of their lands through logging and mining activities and the arrival of migrants looking for arable lands. They have developed various ways to cope with the changing conditions, ranging from efforts to retreat into the remaining rainforest to increased resource extraction and losing a long-term interest in the sustainability of their home territory. The younger generation seems to take a different stand towards their future in relation to their natural environment and the way of life of their ancestors. Though there can be no doubt about climate change in the context of insular Southeast Asia, this change is difficult to differentiate from the cumulative environmental impacts brought about by other forms of anthropogenic change, notably forest degradation. Examples that will be discussed in this article are the Agta of Northeastern Luzon in the Philippines, and the Orang Rimba, the Mentawaians, and the Ngaju Dayak in Indonesia.

Keywords: indigenous peoples; Southeast Asia; aggravation of climate change impact; climatic change discourse; local and indigenous knowledge systems

1. Introduction: Indigenous Peoples in Tropical Lowland Rainforests in Southeast Asia

Southeast Asia is home to a large diversity of indigenous peoples in a wide range of environmental conditions. Though they are often grouped together in terms of their socio-political status as relatively weak and marginal communities within the present nation-states, there are many ways to differentiate between them on the basis of modes of livelihoods, or specific cultural, religious, or linguistic characteristics [1,2]. Here, we focus on four of these groups in order to discuss the present-day challenges that they face as a result of climatic changes, in addition to the impacts of other types of environmental changes brought about by human interventions.

In this article, we discuss some of the practices and the related knowledge about the natural environment and its resources of four indigenous groups in insular Southeast Asia, namely the Agta in the Philippines, and the Orang Rimba, Mentawai, and Ngaju Dayak in Indonesia. We focus on the way these peoples have reacted to external interventions in their home territories and discuss to what extent climate change has been a major factor in the need for adjustment of their way of life. All groups share a similar environment, that is tropical lowland rainforest, with or without a coastal zone. However, their traditional modes of exploitation of this environment have differed substantially,

which can partly be ascribed to its specific characteristics at various locations as well as to the cultural characteristics of these ethnic groups.

The majority of the indigenous peoples in Southeast Asia practice some form of shifting agriculture in either lowland, hilly, or even mountainous environments. Within this group, there are big differences in terms of crops cultivated, and specific methods of practicing this form of land use [3]. In some cases, they also combine shifting agriculture with permanent agriculture, for instance for the cultivation of particular fruit trees or cash crops. There are also relatively small groups of hunter-gatherers to be found in the region's lowland rainforests. Their numbers and densities are always low. To a large extent they hunt, fish, and collect a wide range of products for their own subsistence, but all of them are also involved in the harvesting of non-timber forest products (NTFPs) for commercial purposes and exchange with traders. As hunting and gathering alone usually no longer provide a sufficient basis for their living, most of these groups also engage in small-scale agriculture (usually shifting cultivation), as well as casual labor [4].

Practices of shifting cultivation have often been described in negative terms. Colonial and national government officials in many countries considered this form of using forest resources as being wasteful and inefficient [5]. Policies were formulated to turn these forest cultivators into permanent agriculturalists. A recent volume in a series of books on shifting cultivation, edited by Malcolm Cairns [6], about Shifting Cultivation Policies, which provides numerous case studies from a wide range of countries, proves this point again. However, scientists of various disciplines, inspired by the monumental work of Conklin [7], have looked into these practices in closer detail and they have reached a different conclusion. They consider the shifting cultivation practiced by many forest-based indigenous communities as being a highly efficient and sustainable way of using available resources, which does not harm forest resources in the long run. In contrast, there are clear indications that small-scale shifting cultivation can positively affect forest biodiversity. This is evident, for instance, from the high number of useful plants and animals that are the result of selective cultivation and breeding [8]. On the other hand, there are also examples in which indigenous communities have overexploited particular plants or animals often because of their commercial value for external markets. An interesting case is how the demand for agarwood (also known as eaglewood or *gaharu*) has brought some *Aquilaria* species, that produce this valuable product to the point of extinction in many forested areas in Southeast Asia [9].

In addition, there is now widespread recognition of the extensive indigenous knowledge about forest ecosystems, including its diversity of plants and animals, soil types, and fertility. The attention for and interest in such knowledge systems has increased very much in recent decades. In fact, various branches of ethno-science, like ethno-ecology, ethno-botany, and ethno-zoology have developed. Of particular interest is also the knowledge and use of medicinal plants by indigenous peoples, which has turned out to be of great value for the development of a wide range of medicines [10]. In addition to this extensive ecological knowledge, many indigenous communities hold knowledge or memories about specific natural hazards, like earthquakes, volcano eruptions, or tsunamis, and this knowledge tends to be passed on to next generations through narratives and oral traditions [11].

In contrast, knowledge about various aspects of climatic conditions and climate change among forest dwelling communities in Southeast Asia appears to be less elaborate, apart from the interpretation of particular indicators of relatively short-term future weather conditions [12,13]. Beyond the experience of extended drought or excessive rainfall, there are few references in indigenous knowledge systems about awareness of long-term variability in temperature or rainfall. This relative absence of knowledge of gradual climatic changes may in itself not be surprising as, especially in the wet tropics, such changes are usually only noticeable on the basis of systematic records kept over extended periods of time. In case these changes become more extreme, like the frequency and intensity of tropical storms, floods, or mudslides, local awareness of them will likely increase.

In other climate zones, where the climatic changes are more evident or pronounced, local knowledge on such changes appears to be more elaborate. Moreover, perceptions of such change by local and

indigenous communities have turned out to be quite consistent with studies of climate change based on data collected through the use of instruments. Savo et al. [14] provide an interesting meta-analysis of climate changes observed by hundreds of subsistence-oriented communities from around the globe. This study confirms once more the relevance of traditional ecological knowledge in studying ecosystems including the impact that changes of whatever kind have on the environment and their livelihoods.

Approach and Methods

The case studies are based on fieldwork by the authors over an extended period of time, while three PhD students, who are supervised by the authors, have conducted fieldwork more recently. Their work is referenced in the case-studies. The aim of the case studies is to look closer at the combined and often cumulative impact of climate change and other environmental changes as a result of logging activities and other types of resource use.

The description of these case studies is based on ethnographic fieldwork by the authors in the context of various research projects, and their involvement as researchers or consultants in a number of conservation and/or development projects. Fieldwork among the Agta was conducted by the second author for a total of 9 months spread out between 2002 until 2005, which was continued with short, yearly field visits until 2014. Fieldwork among the Orang Rimba was done by the first author in July–August in 1983, from August until December 1985, during short visits of one to three weeks in 1988, 2000, and 2005, and during a joint visit by both authors in 2013. The fieldwork on Siberut was done by the first author from September 1979 until January 1982, from December 1984 until July 1985, and during shorter visits of one to four weeks in 1986, 1988, 1994, 2002, 2004, 2009, and 2013. Fieldwork among the Ngaju Dayak was done by the first author in September–October 2002, May–June 2004, November 2004, June 2005, and July 2011.

The long-term insights presented in this article are derived from this ethnographic fieldwork. The methods used during these fieldwork periods are a combination of participant observation, qualitative interviews, and structured interviews with local informants from the indigenous peoples that we describe, as well as interviews with field officials, missionaries, representatives of NGOs, staff of logging and mining corporations, and development workers. Secondary sources, including company reports, and data from local government offices were also part of this knowledge base. Insights from these primary and secondary sources have been used in combination with the relevant scientific literature.

2. Climatic Change in Southeast Asia

Over the past two decades numerous reports, including those of the International Panel of Climate Change (IPCC), have been published about climatic change in Southeast Asia [15]. The information contained in these reports has also been used to produce Global Climate Model (GCM) outputs in order to be able to assess the impact of climatic change and to suggest options for adaptation measures. In general, the literature about Southeast Asia shows a high level of agreement on observed climate change and its impacts. Of course, there is also substantial variation within the region given the size of the area and the prevailing climatic conditions. It is not the purpose of this article to discuss the wealth of available data in detail, but here we highlight the main trends and projections for the region [16–18].

Differences in rainfall patterns and the occurrence of typhoons predated the present-day climatic changes. In large parts of Southeast Asia, the climate extremes which have been known for a long time, such as El Niño and La Niña, are likely to increase in scope and frequency, leading to higher risks of extended periods of drought as well as heavy rains and therefore floods. Increase in surface temperature has already exceeded 1 °C during the 20th century and is expected to further increase depending on future developments. Making general statements about changes in annual precipitation is difficult, as there are substantial differences between and even within countries. In Indonesia for instance, some areas have experienced an increase in rainfall in recent years, while in others it has reduced. This change has not been homogeneous. In the future, the Philippines will most likely be hit

by a larger number of typhoons, which might also increase in relative strength, bringing increased amounts of rainfall [19,20].

The impacts of climate change are felt in various sectors. Agricultural productivity is severely influenced by the longer dry seasons caused by El Niño. Increasing sea water temperatures are likely to affect aquaculture along the coasts of the Philippines, Vietnam, and Indonesia. The extensive periods without rainfall are likely to increase the risk of forest fires. This is particularly problematic in the peat land forests of Borneo and Sumatra, large parts of which have recently been drained for establishing commercial plantations, contributing also to biodiversity loss. Heavier and excessive rainfall, on the other hand, may lead to floods, thereby destroying both agricultural land as well as settlements and infrastructure, notably roads and bridges. Human health will be impacted as well: vector borne diseases such as malaria, and dengue fever will be spreading as a result of stagnant water. Availability of drinking water will become a problem during drought periods. Particularly low-lying areas close to the coast may suffer from inundation and salt water intrusion, which will then also threaten agriculture and drinking water facilities. This may be aggravated by sea level rise, predictions for which vary across the region, but which is already threatening parts of Vietnam and Indonesia. Coral reefs will be affected by the rise in temperature [17,19,20].

Many of these phenomena are well-known by now and they have become subject to various policy measures. Examples are the ban on the use of fire as an instrument in forest management or in the process of conversion to other types of land use (to avoid wild fires), the rehabilitation of degraded peat swamp forests (to avoid further drainage) and the reduction of conversion of mangrove forests into shrimp ponds (to avoid coastal erosion and coral bleaching) [17]. A range of management and financial instruments have been designed to cope with these problems, including the Clear Development Mechanisms (CDM), which provide financial means for taking positive environmental action. This includes compensation for not doing particular things, as is the case for REDD+ (Reducing Emission from Deforestation and Forest Degradation, with the addition of biodiversity). This program compensates owners or managers of a forest area for abstaining from logging, or for the additional costs arising from biodiversity conservation [21].

REDD+ has been criticized for its lack of efficacy, which stems from challenges regarding the governance of these schemes and the complex web of agencies, right claimers and other stakeholders involved. In some cases, large scale land acquisitions and efforts to protect the ecosystem through REDD+ strategies may even compete for the same area [21]. Another important point of criticism relates to the additional impacts that these schemes have on indigenous communities' well-being. These impacts are most directly felt with respect to the landscapes, and the plant and animal life on which their livelihood is based. The REDD+ program serves as one of the most important examples of how climate change mitigation measures often limit local and indigenous communities' access to natural resources. Limitations also tend to include prohibitions on shifting agriculture. As a result, food procurement has to change, which often has far-reaching social consequences, including changes in division of labor within communities and households. Knowledge and skills that were essential for traditional tasks, may become less important under such conditions [22–24]. Such experiences should form the basis for reconsidering the way REDD+ projects are being implemented as well as the impact such projects have on local livelihoods [25].

The indigenous peoples inhabiting the tropical lowland forests of Southeast Asia have been faced with large scale changes over the last few decades, of which the ongoing process of climate change is only one. Though some areas were already converted into plantations for cash crops like rubber and palm oil in the first decades of the 20th century, it was mainly in the 1970s and 1980s that the scale on which activities like logging, mining, and conversion took place and became much larger. In combination with more powerful technology (chainsaws, bulldozers, and skidders), the construction of roads facilitated the extraction of other resources like coal, iron ore or minerals. These road networks also facilitated the arrival of people in search of arable land in areas that were often considered as being 'empty land' [8,26]. As a result of these activities, the landscape of the tropical lowland forests of

Southeast Asia has been described as a mosaic of land use types, in addition to the traditional forms of land use by the indigenous population [27]. When zooming in on individual countries, or even regions within countries, the overall picture of the forests of Southeast Asia is one of massive forest degradation or even deforestation and conversion to plantations. The FAO/UNEP's annual publication on the State of the World's Forests clearly shows this overall trend for regions and countries like the Philippines, Indonesia, Malaysia, Vietnam, and Cambodia [28]. Numerous and more detailed individual country studies confirm this trend. Though there is also a gradual increase in the number of protected areas, as national parks or areas with another conservation status, the contrast with their adjacent areas is getting more and more obvious in terms of the type and quality of the vegetation cover and biodiversity. Increasingly such protected areas become 'islands' without 'bridges', corridors, or connections with other conservation areas [29–31].

Compared to climate change, the impact of the large-scale forest degradation and conversion on the living conditions of the indigenous peoples is, without doubt, much more strongly felt. While the effects of climate change come gradually and may in some cases be hardly noticed by forest-dwelling communities, forest operations carried out by logging and mining companies usually have a more immediate impact with far-reaching long-term consequences. Importantly, in many cases the effects of such operations may aggravate the impact of climate change. For example, the construction of logging roads and the removal of trees results in an open canopy, which intensifies the drying of debris of the logging operations along such roads and on the forest floor during El Niño periods. Forest fires may spread more easily under such conditions, while a lowland tropical rainforest with a closed canopy and without direct sunlight on the forest floor will hardly be susceptible to rapidly spreading forest fire [29].

In the recent scientific and popular literature, as well as in the national and international policy discourse, one can easily get the impression that climate change is by far the most important cause behind the present-day problems faced by all kinds of communities across the region. However, in real life situations, the impacts of forest operations by logging, mining, and agricultural companies, are much more clearly and urgently felt. Moreover, there can be no doubt that deforestation and forest degradation generate vulnerabilities that aggravate the (future) impacts of climate change. These various impacts are thus cumulative and mutually reinforcing.

3. Indigenous Peoples, and the Cumulative Impact of Climate Change and Forest Operations

In this section, we will present the four case studies of indigenous forest dwelling communities in the Philippines and Indonesia who have experienced large scale changes in their environment, while at the same time their territories are also subject to climate change. The examples are the Agta of Northeastern Luzon in the Philippines, and the Orang Rimba, the Mentawaians, and the Ngaju Dayak in Indonesia (see Figure 1).

3.1. The Agta of Northeast Luzon (the Philippines)

The first case that we discuss concerns the Agta (sometimes referred to as Dumagat), an indigenous population of about 10,000 people consisting of 16 linguistic groups [32]. They live in small, scattered, kin-based groups along coasts and rivers in Northeast Luzon (the Philippines). Contemporary Agta trace much of their ancestry with the Australasian peoples that first populated the archipelago, somewhere between 30 and possibly 60–70 thousand years ago [33,34]. Although they have increasingly intermarried with and partly assimilated into the Austronesian farming populations that have settled in their vicinity over the past 5000 years [35,36], part of the Agta population maintains a distinct cultural identity, social organization, and livelihood system (see Figure 2).



Figure 1. Map of Southeast Asia with the locations of the four case studies.



Figure 2. Map of Northeastern Luzon (Philippines), indicating the home territory of the Agta and the boundary of the Northern Sierra Madre Natural Park.

This is despite tremendous pressures on their natural and social environment that have arisen particularly since the 1950s. While Agta and non-Agta are thought to have maintained relatively symbiotic barter relations for hundreds of years, from the mid-20th century the demography of the hitherto sparsely populated region drastically changed [37]. Large-scale and long-term logging and mining operations caused massive deforestation. These operations drew thousands of laborers, many of whom permanently settled at the logging frontier and developed farmland in previously forested areas [30]. Consequently, the Agta became a small minority in a heavily degraded environment [38]. Their situation was aggravated by the impact of armed conflict between the Philippine National Army and communist insurgents, who used the remaining forest as their hiding place [39,40]. Over the past decade, Agta groups inhabiting the coastal areas have been displaced by tourism and infrastructural development [41,42].

The impacts of these developments have in some areas led the Agta to become a new impoverished underclass of landless peasants who live on the margins of towns and villages [37]. Others retreated further into the remaining forest or stayed put on isolated coastal strips. In the remotest areas, an estimated 2000 Agta continue to live in hamlets of several closely related nuclear households away from roads, towns, and villages. They live on a combination of fishing, hunting, small-scale swidden cultivation, and the collection of forest and marine products for consumption and exchange with farmers and traders. These include a variety of freshwater and saltwater fish, crayfish and shells, game (notably deer, wild pig, macaque, monitor lizard, bats, and a range of birds [43], edible and medicinal plants [44], timber, and non-timber forest products such as honey and rattan. In addition, for almost all groups casual labor on farms, and in logging and mining concessions form an important source of income for at least a few months each year [45].

The tropical ecosystems that sustain the Agta include reefs, mangroves, lowland dipterocarp rain forests, rivers, and streams. This environment has always been heavily influenced by seasonal fluctuations in rainfall and temperature. The dry season runs roughly from February through June and comes with mean temperatures ranging from 27–29 °C and a (usually mild) wind blowing from the southwest. The wet season dominates the rest of the year, and comes with temperatures of roughly 24–26 °C and average monthly rainfall ranging from 400–900 mm. The peak of this season (June–December) is also known as the ‘typhoon season’. In an average year, twenty typhoons, or tropical storms, affect the Philippines, of which around eight or nine make landfall [46]. Usually coming from the southeastern direction [47], these massive tropical weather systems land on the coastal strip that flanks the Northern Sierra Madre Mountain Range, which runs in a north-south direction.

The Agta’s livelihood and mobility strategies have evolved to respond to these fluctuations and have different emphases in the wet and dry seasons. For instance, fishing in rivers and on reefs is primarily done during the hot, dry season, when waters are calm and clear. As spear fishing is the predominant technique used, visibility is crucial. This is also the season in which mobility is highest: several nuclear families may group together in temporary shelters on a beach or riverbed, from where they fish for a few consecutive days before returning to the more permanent hamlet or moving on to the next fishing site. The dry season also marks the peak in collection of most fruits and honey, which requires lengthy trips into the forest. During the wet season, mobility decreases and nuclear families come together in larger, more permanent settlements. Housing then ranges from open huts with a lifted bamboo floor and palm thatched-roofs, to two room houses with timber walling and corrugated iron roofs [48]. Fishing is hampered by rough seas and rivers, colder water temperatures, and poor visibility. Depending on the group’s location and individual preferences, hunting, swidden cultivation, and casual labor become more important (see Figure 3).

However, these strategies to navigate seasonal fluctuations are compromised by changing environmental conditions. Even in the remotest areas, the integrity of coastal and forest ecosystems has been undermined by the combined effects of deforestation, population pressure and resource depletion. Apart from the direct ecological impacts of logging and subsequent land conversion on tree cover and wildlife abundance, the influx of company laborers has meant additional pressure on

fish and game. As a result, the Agta's fishing and hunting success has dwindled up to the point that some Agta groups have given up on hunting [40], while fishing has become extremely unrewarding, especially in upriver 'logging hotspots' [45].



Figure 3. Agta getting ready for a typhoon, Maconacon, Philippines. Based on earlier experiences, the Agta know where and how to hide for serious storms while minimizing the risk for human safety and material damage© Minter, November 2004).

Unsustainable logging practices further undermine the forest's important role in water regulation [49]. With heavily eroded riverbanks, blocked watercourses, and denuded hillsides, the forest is no longer able to absorb the amount of water that it used to. This results in flashfloods and mudslides both in upstream areas and in the densely populated downstream plains. This situation persists despite the designation of the Northern Sierra Madre Natural Park as a protected area in 1997. Due to weak environmental governance and law enforcement, overharvesting of timber and non-timber forest products has continued [50]. The recent and contested construction of a road across the protected area is expected to further aggravate this situation [42].

This reduced protective function of forests is arguably among the foremost concerns in relation to climate change for the Agta and for Northeastern Luzon as a whole. The main known impact of climate change to be seen in the region is a further increase of the already existing seasonal fluctuations. Specifically, an increase in rainfall during the wet season, and a decrease in rainfall during the dry season is expected, as well as an increase in the occurrence of natural hazards like typhoons, floods, and landslides [46,47]. Longitudinal data on tropical storms since the 1950s show, that there has already been an increase in the highest category typhoons [51].

Typhoons have always been part of life in Northeast Luzon and several observations can be made that hint at the Agta's relatively favorable adaptations towards this harsh climate. This should however not be misunderstood to suggest their being 'typhoon resilient' under new conditions of climate change. Certainly, the earlier mentioned diversity of their livelihood package in itself serves as a way to spread risk, including the risks brought about by extreme weather. Also, while Agta minimally engage in agriculture, the few crops that they do grow are usually typhoon-resistant root crops such as sweet potato and cassava, rather than the vulnerable cash crops yellow corn and rice that

dominate the region. Marginal as the Agta's fields may seem, being spread out in multiple locations they do serve as an important source of 'famine food', while requiring minimal maintenance [40,52].

With respect to Agta's strategies to seek protection during typhoons, little information is available to establish their effectiveness. We know that these strategies include digging shelters under big, previously fallen trees, hiding in caves, closing open huts with woven palm fronds, and constructing specific 'typhoon houses'. These are built very low to the ground, in an open space away from rivers and coasts, and provide shelter for several nuclear families. Agta living closer to villages and towns sometimes seek safety in designated evacuation centers, like churches and schools [48].

Interestingly, as part of various post-typhoon relief aid programs, and especially following typhoon Juan in 2010 (international name 'Megi'), local authorities have actively encouraged Agta in coastal areas to move land inward and build 'permanent houses' (i.e., houses with concrete hollow-block or timber walls and tin roofs). While a few individuals and families have responded positively, many are ambivalent towards these housing schemes. Some claim they never received the construction materials that were meant for them; others say they are not interested in them anyway because they prefer to continue living where and how they have always lived. Among their hesitations is the fact that the schemes result in houses that may be slightly sturdier than the Agta's usual houses, but that they are certainly not typhoon-proof. This results in additional dangers from wild-flying tin roofs during typhoons as well as a lot of costly repair work afterwards [48].

Most importantly, these material interventions only serve to mitigate impacts without addressing the underlying problem. The highest numbers of deaths do not arise from the storm itself, but from floods, mudslides, and landslides that occur during and after the associated heavy downpours [53]. With forests being severely reduced in size and quality, their protective function has diminished [47]. Thus, the focus on technical aspects of typhoon mitigation distracts attention from the root-causes of the arising disasters: decades of unsustainable forest management.

3.2. The Orang Rimba of Jambi, Central Sumatra (Indonesia)

The Orang Rimba, formerly also known as the Kubu or the Anak Dalam, traditionally occupied the lowland forests of the central part of Sumatra. They were hunters and gatherers with only limited contacts with the outside world, which mainly consisted of the Malay people, who were living in scattered settlements along the banks of the major rivers. Since the early reports on the Orang Rimba, they have always been described as living in extremely poor conditions. Many Dutch colonial administrators as well as early ethnographers believed that they were on their way to either complete assimilation into the Malay society or they would go extinct in the near future. They made their living through hunting animals like monkeys, wild pigs, and deer and by collecting a variety of wild tubers and forest fruits. Through a system of 'silent trade' they were exchanging some forest products like rattan and honey for tobacco, iron ware, and cloth [54,55]. They were living in small bands. Their huts consisted of lean-to's or very small houses with a somewhat elevated floor. The Orang Rimba in general moved within a particular part of watershed of one of the major rivers in the area. On the basis of their intimate knowledge of such an area they could making a living from the available resources [56,57] (see Figure 4).

Since the beginning of the so-called New Order of President Suharto (1966–1997) large areas of the lowland forests were granted as concessions for logging companies. Sometimes the areas were designated as production forests but very often they were converted into plantations for crops like rubber and palm oil or they were planned as sites for the large scale transmigration of people from the overpopulated islands of Java, Bali, and Madura. In the area there were also mining activities. At the same time, the infrastructure in terms of roads was developed. The Trans Sumatra Highway, running from the north of the south of Sumatra was cutting through the forests and very soon a dense web of secondary and tertiary roads started to be developed [57].



Figure 4. Map of Sumatra, indicating the territory of the Orang Rimba.

Specifically for the Orang Rimba, just like for all other ‘isolated tribes’ the Indonesian government implemented a special development program. In so-called resettlement villages the scattered living people were housed in an effort to turn them over a number of years into modern Indonesian citizens. They had to give up hunting and gathering and become permanent agriculturalists. In addition, their children had to be sent to school and they had to embrace one of the officially accepted religions in Indonesia [57].

Though some of these resettlement villages were actually built, most of the Orang Rimba refused to live in them. They preferred the forest, even the remnants of the forest or the heavily logged over forest to living in such neat villages under daily supervision of government officials and ‘community workers’. They preferred to stay at a safe distance from the Malay people, who have always looked down on them as being primitive and dirty [58] (see Figure 5).

In the past few decades, the lowland forests of Central Sumatra have become one of the most severely degraded areas in the whole of Southeast Asia [59,60]. Large-scale logging followed by conversion into oil palm rubber plantations, or clear cutting the forests to make room for transmigration sites for people from the overpopulated islands of Java and Bali have reduced the amount of relatively intact forest to marginal areas compared to the original forest cover. A road network of highways and connecting roads to all major towns and settlements has provided relatively easy access to the forest resources, which is further supported by a dense web of logging roads and other secondary roads that connect the plantations to processing units for palm oil or rubber. These roads have provided ample opportunities for spontaneous migrants from various parts of Sumatra and other Indonesian islands in search of arable ‘empty’ land. From satellite images, it is clear how the road network facilitated

this encroaching process. Only a relatively small portion of the area have been designated as national parks or reserves with a lower protection status [58].



Figure 5. A small group of Orang Rimba is moving through the heavily logged forest in Central Sumatra. Hunting wild animals and collecting food like wild tubers and fruits become increasingly difficult under such circumstances (© Persoon, August 1988).

The results of these processes for the Orang Rimba have been enormous. They could no longer make a living in the forests the way they had done in the past. One way or the other they had to adjust to the new circumstances. They did not avail of ways to resist these outside pressures. On the contrary: their reaction was usually one of retreat and avoidance. But with little forest left to retreat to, they had to adjust to the new conditions. They have done in various ways. Some have been able to survive in a more or less traditional way in some of the protected areas such as the national parks of Bukit Duabelas or Tiga Puluh. At the other end of the spectrum there are, what is being called ‘the highway nomads’, people who hang around in bus terminals along the major roads. They beg for some food or money or try to sell medicinal plants from the forest or wild honey. In between those extremes there are various kinds of adaptation. Some Orang Rimba make a living by so-called ‘garden hunting’, which takes place in the extensively used forest fields of the Malay people. The Orang Rimba hunt wild animals which the Malay people consider as pests for their agricultural crops (like bananas, cassava, and a variety of fruit trees). Animals like wild pigs, deer, and monkeys like to forage in those gardens because of the relative abundance of food. For that reason, the Malay villagers consider these animals as pests. By allowing the Orang Rimba to hunt in the forest fields, they reduce the loss of food crops for the Orang Malay while hunting itself is not as difficult as in the rain forest itself because of the higher density of animals. The Orang Rimba may also be hired by the Malay people to harvest the rubber or to do other types of paid work in their forest gardens. In this way a kind of symbiosis has developed between some Orang Rimba and the Malay people [57,61].

Other Orang Rimba have decided to pick up agriculture and they have started to plant rubber trees in small gardens in already logged-over forest. By producing latex, they avail of a cash crop that can yield money to buy rice, cigarettes, sugar, coffee, canned fish, and a range of other products. Some of them have done relatively well in recent years and they have succeeded in buying motor bikes and hand phones. But they continue to live in relatively simple huts or even lean-to’s at a safe social

distance from the settlements of the Malay people. They may visit shops or weekly markets in the villages but their social contacts with the villagers remains limited [62].

But there are also less fortunate Orang Rimba, or people who have for one reason or the other have not been able to make the transition to become farmers themselves or who have not been able to enter into a kind of symbiotic relationship with Malay farmers. Some groups survive in the oil palm plantations by hunting wild pigs, which do surprisingly well in these plantations by foraging on the fallen fruits of the oil palm. Some Orang Rimba may also get small amounts of money or hand-outs in kind by the companies as a form of compensation for the loss of forest and all its resources.

In looking back at the old predictions about the Orang Rimba as being on their way to either extinction or complete assimilation, it is surprising to realize that they have been able to develop new strategies for survival. They have neither gone extinct nor have they completely assimilated into the Malay village communities or into the Javanese transmigration settlements. They have gradually developed a range of adaptation strategies based on their knowledge, skills, and preferences. In doing so they have continued to resist to enter into mainstream Indonesian village life with all its facilities in terms of education, health care, religion, and administration. Their preferred lifestyle has remained the same in the sense of staying at a safe distance from the Malay or Javanese communities in order to avoid social conflicts and discrimination on the basis of their ascribed characteristics. At the same time, they have been creative and innovative enough to make the best possible use of whatever opportunities became available with the arrival of logging companies, and the waves of migrants. They also realized in time that a transition from a hunting and gathering way of life to a more sedentary life based on the cultivation of cash crops like rubber was unavoidable. The range of modes of survival developed by the Orang Rimba is a clear example of the enormous amount of resilience that they have and that they have used in order to avoid the long predicted types of futures for them in terms of them going extinct or becoming the 'victims of development'. There can be no doubt about the fact that the combined impact of all types of human interventions in the territory of the Orang Rimba is far greater than the impact of the change in annual rainfall or the small increase in temperature [58].

3.3. The Mentawaians of Siberut, West Sumatra (Indonesia)

The Mentawai Archipelago is a chain of islands off the west coast of Sumatra. The four largest islands are inhabited by an indigenous group called the Mentawaians, and a small number of migrants. The archipelago has a total population of about 65,000 of which 35,000 live on the largest island Siberut. The people live in what used to be a dense tropical rainforest. Traditionally the autonomous patrilineal clans were living in small settlements along the banks of the main rivers that were flowing through the forest. Their houses, including the long house where all communal activities were taken place, were solid constructions made of locally available material. In addition to agricultural activities, they also hunted wild animals (in particular wild pigs, monkeys, and deer) and they domesticated pigs and chickens around their houses and field huts. Fishing took place along the coast and in the rivers and small lakes. Sago starch extracted from the sago palm (*Metroxilon sagu*) was the staple food. As a result of the abundant natural resources and the knowledge and skills of the local people developed over generations to make wise use of the resources, occasional visitors to the islands were always impressed by the material wealth, the elaborate rituals, and the physical fitness of the people, based on a large variety of types of food (see Figure 6).

Their complex religious system, known as *sabulungan*, including extensive taboo periods, was based on a belief in spirits in all living plants, animals, and the natural forces. The division of labor was limited to that between men and women. Every man and woman was supposed to acquire, avail and apply all skills and knowledge necessary throughout their life. The medicine man was the only exception. He was the one to restore harmony between humans and the spirit of the environment in case disturbances had occurred. He also availed of extensive knowledge of medicinal plants. To a large extent the people were economically self-sufficient. Limited exchange with Minangkabau traders

of copra and rattan for tobacco, iron wear, and a number of other products had taken place for a long period [63].



Figure 6. Map of Siberut Island.

According to the Indonesian government, and earlier already to the Dutch colonial administration, the Mentawaians were thought to be rather primitive pagan people. In waves of governmental interventions, the local people were ordered to settle in larger villages, give up their traditional religion, and change their food habits. Instead of eating sago, considered a 'lazy man's food', rice cultivation was strongly promoted. Also, the domestication of pigs around the settlement was condemned as a 'bad tradition' to be replaced by modern animal husbandry focused on goats, cows, and water buffalos. The traditional religion, considered 'an excuse for extreme laziness', was to be replaced by one of the officially recognized monotheistic religions in Indonesia. In short, and just like many other indigenous groups in Indonesia, the Mentawaians had to become socially, culturally, and economically like all mainstream Indonesians [57,64].

In the 1970s and 1980s, large logging concessions were granted to companies. Since the late 1970s various initiatives were undertaken to protect the natural environment as well as the traditional lifestyle of the local population. In 1981, Siberut was declared a Man-and-Biosphere Reserve by UNESCO, and WWF and Survival International were working together to promote the traditional and sustainable lifestyle, claimed to be in harmony with nature [65]. In the early 1990s about half of the island of Siberut was declared a national park (192,000 ha) and all logging concessions were cancelled. Since the late 1980s, Siberut started to attract numerous western tourists attracted by the image of a colorful 'Stone Age Culture, living in harmony with nature'. Quite a few coffee table books, documentary films,

and an entertainment television program based on living among the ‘jungle people’ promoting this image made the island a popular destination for these kinds of tourists [66].

So in fact there were two contradictory tendencies. On the one hand, the Indonesian government wanted to ‘civilize and develop’ the local people and turn them into modern Indonesians, while at the same time, tourists came to enjoy and have a firsthand experience of community living according to old traditions with extensive rituals. Because some areas were frequently visited by tourists while others were not, the difference between the two types of orientation also became stronger over the years. Welcoming visitors in one’s impressive longhouse in the forest, looking ‘traditional’, and performing colorful rituals paid off in terms of groups of tourists who were willing to pay well for such an experience, while Mentawaians in a dull resettlement village doing their daily agricultural and social activities, but without the elaborate and colorful rituals, did not attract such visitors. But the attitude towards ‘tradition’ or ‘modernity’ is not only determined by the attention of outsiders. A relatively large group of Mentawaians have, after years of being confronted with development and cultural policies, decided that the best way forward is to get involved in new economic opportunities, to allow children to enjoy higher education, and to forget about the traditional pig keeping and living in the traditional longhouse (see Figure 7). In order to do so they need new knowledge and skills to cope with the new challenges of generating a steady cash income.



Figure 7. Once a day, the free roaming pigs are fed. This traditional form of keeping animals allows the animals to flee to safe places in times of floods while even in dry periods, water can always be found in the lowland forest environment (© Persoon, August 2009).

Since 1999, shortly after the fall of President Suharto, the Mentawai Archipelago became an autonomous district as one of the first areas to enjoy regional autonomy which would spread all over the country. Ethnic Mentawaians can now be elected as districts officials and the Minangkabau no longer dominate local politics. Though the main orientation of the present district officials is without doubt towards modernization and economic development, at the same time there is also a tendency to hang on to certain symbols of the traditional culture as a kind of identity marker. So a huge part of the budget is being spent on the construction of roads, bridges, and harbor infrastructure to improve trade and transport possibilities. The head of the district has also agreed to a major investment plan for an international resort with an airport, luxury hotels, and all kinds of other facilities in the southern part

of Siberut. But at the same time, he is also supporting a yearly festival for Mentawaiian music and art forms, which may move into a kind of 'folklorization' of traditional culture [64].

Just like in other areas in Indonesia, the Mentawaiian Islands are also experiencing climate change in terms of extended periods of drought and more excessive rainfall, even though specific information on this is not available. In general, these changes do not generate major problems for the local people. The structure of the island's vegetation and hydrology, the characteristics of the soil in combination with the variety of livelihood practices (hunting, fishing, agricultural, and animal husbandry) have always prevented problems in terms of food or water scarcity. The lowland rainforest with extensive swamps did not completely dry out. People did not experience failures of crops simply because of the fact that they do not depend on rice cultivation or other annual crops. Sago palms and fruit trees survive even if rainfall is limited during certain periods. Floods do occur but with elevated houses on poles on the river banks and with agricultural crops that can easily withstand excessive water for shorter periods of time, this has never caused major problems. The same also counts for their domestic animals. As they are freely roaming around, the semi-domesticated pigs and chickens will find a safe place during floods and even in the dry periods, they are always able to drink in the rivers that never run dry. In that context, there was traditionally already a strong resilience to cope with the variability of the climatic and weather conditions on the islands.

More than climatic change however, the islands are facing serious hazards from another source, that is earthquakes and tsunamis. Because of its geographical location, the area is prone to frequent earthquakes and dangerous tidal waves. After the massive earthquake of 26 December 2004 near Aceh (North Sumatra), followed by the destructive tsunami that killed about 240,000 people in Indonesia alone, the Mentawaiian Islands have experienced many more earthquakes in recent years. Several big earthquakes with or without tsunamis occurred along the Sunda megathrust and the great Sumatran fault in 2006, 2007, 2009, and 2010. As a result, some people have given up their dwellings along the coast and moved inland towards the hills. Others have built emergency houses in case such events will happen again [11,67]. Various initiatives have been taken to install early warning systems on the islands and evacuation plans in case the islands are being hit again by such hazards. Geologists predict that, sometimes in the future (but nobody can tell when this is going to happen), the islands may sink because the tectonic Indo-Australian Plate on which they are located, is slowly subsiding underneath the Sunda plate. On a small scale, the phenomenon is already visible: the small islands on the east side of Siberut are slowly subsiding while coastal erosion forces people to move their houses further inland. Though people have collective memories about these dramatic events and in the oral tradition interpretations are being mentioned, they do not offer sufficient options to cope with them, let alone face 'the great earthquake' as predicted by geologists. Compared to the knowledge and skills needed to face present-day impact of climate change, these events are of a radically different scale and potential impact [11].

3.4. The Ngaju Dayak of Central Kalimantan (Indonesia)

The Ngaju Dayak are one of the numerous indigenous Dayak tribes in Borneo with a total population of over one million. In addition to the Dayak, there are also other ethnic groups living in the Indonesian part of Borneo, such as the Banjarese in the southeastern part of the island or the Malay and Chinese, mainly living in the coastal towns and villages. In addition, there are also migrants from other Indonesian islands such as the Buginese from Sulawesi, or people from Java, Bali, and Madura who have come in the context of the official transmigration program. The Ngaju Dayak occupy a major part of the Indonesian province of Central Kalimantan. One of the sub-tribes is formed by the Katingan Ngaju Dayak named after the Katingan river running from the center of the heart of Borneo to the mouth of the river in the south, The Ngaju Dayak occupy in particular the low-lying peat swamp forests south of the provincial capital of Palangka Raya (see Figure 8).



Figure 8. Map of Central Kalimantan, indicating the territory of the Katingan Ngaju Dayak and the boundary of Sebangau National Park.

They live in small villages on the elevated banks along the two main rivers in the area: the Katingan River and the Sebangau River. In between the two rivers, there is an extensive peat swamp forest which is home to a large population of *orang utan*, and numerous other species of animals. The Ngaju Dayak adhere a religion that is called *kaharingan* with a strong belief in spirits in the environment. Ancestor worship is also crucial. The elaborate rituals related to the second burial of family members (called *tivah*) and the erection of wooden statues around the little house in which the bones are kept, are crucial elements in the culture and identity of the Ngaju Dayak [68,69].

Traditionally the main sources of livelihood for the Ngaju Dayak have been fishing, rice cultivation, and the collection of non-timber forest products of which various species of rattan, *gemor* (bark from a specific tree—*Alseodahne* sp.—which is used to produce anti-mosquito coils and glue), and *jelutung* (latex from a tree species called *Dyera costulata*, that is used for making chewing gum, paint, and priming cement) are by far the most important ones [70].

In the dry season, the people prepare their rice fields by cutting trees in the peat swamp forest and burning them once they are sufficiently dry. After burning the withered vegetation, rice seeds are placed in small holes made with a planting stick in between the stems and branches that are left after the fire. They do so by calling in the help of their family and friends. In the past, they have also planted rubber trees but because of falling prices and problems with selling the latex, these rubber gardens have not been well maintained. However, these old rubber trees are extremely useful for the rattan to climb to the canopy. Initially people were also planting rattan seedlings but nowadays the

density of rattan plants and the amounts of seeds produced are so abundant that planting seedlings is no longer necessary. Numerous seedlings are to be found on the forest floor. Because of the long and sharp thorns harvesting of rattan is quite a tough job, done by men as well as women.

The Sebangau peat swamp forest is adjacent to an area that was targeted to become a very large area for rice cultivation. The so-called 1 million hectare Mega Rice Project (MRP) of former president Habib, who became president of Indonesia when Suharto was forced to step down in 1998. The MRP aimed to turn the extensive peat swamp into a giant rice field to feed the ever growing Indonesian population. The project was initiated in 1995 in spite of the warnings sent out by numerous parties that predicted that the MRP would adversely impact the natural and socio-cultural environment [71]. After cutting the forest, large drainage canals were dug to get rid of the surplus water from the swamp. Some timber species also had commercial value and thousands of logs were sold on the international market. The massive forest fires of 1997/98 that occurred in Indonesia however also struck this mega-rice project, before any rice seedling was planted. The drained and dried out deep peat soil started to burn on a large scale. These fires would last for months, as peat fires are extremely difficult to extinguish. But in the middle of this environmental disaster, the heavy equipment was moved into the Sebangau area, and it was used to start digging canals that could be used for pulling out the logs of valuable tree species. A few hundred small saw mills were constructed along the Katingan and Sebangau rivers. Thousands of logs were sawn into beams and planks to be sold in the international timber market.

Though the initial activities were started by former migrant workers from the Mega Rice Project, soon local people, and in particular the young men from the Sebangau area, joined the logging activities in an effort to profit from this new opportunity to earn substantial amounts of money, and to do so within a short time [70,72] (see Figure 9).



Figure 9. Pulling logs out of the peat swamp of Sebangau through recently dug canals. The canals are useful for transportation but they also drain the water from the swamp, which makes it susceptible to fire during extensive dry periods (© Persoon, October 2004).

It did not take long however before these activities started to draw the attention from some policy makers, environmental scientists and conservation agencies. In addition to the yearly outbreak of massive peat swamp fires, which also cause serious health problems for the human population, the combination of the draining of the swamps, the logging activities and the fires, also caused large problems to the wildlife in the area. In particular the iconic animal of the area, the *orang utan*, was threatened. Hundreds of *orang utan* were killed in the fires, just like many other animals. In a

surprisingly short period plans were made to turn Sebangau into a protected area with the support of local authorities, the provincial university and WWF. During the Conference of the Parties (COP) of the Convention on Biological Diversity (CBD) of 2004, held in Kuala Lumpur, Indonesia announced the Sebangau area as a national park with an area of more than 600,000 ha. To make this work as a conservation area, one of the first things that needed to be done was to stop all logging activities and to close the canals to avoid the further draining of the peat swamps. In addition, all saw mills had to be closed and dismantled too. In theory this was easier said than done of course, as many people had invested substantial amounts of money and energy in the digging of the canals, the setting up of the saw mills, and in attracting a substantial work force. Also, many local people had found employment in the logging sector. They were not willing to give up their source of income easily.

After a difficult and pretty rough time, the park management with the support of WWF, succeeded in fighting the logging activities, which had been illegal from the beginning but which were never actually stopped. Most of the larger canals were closed by the construction of dams, thereby reducing the further drainage of the swamp and subsequently also avoiding the drying out of the peat soil. For the local people alternative sources of livelihoods were being developed in the field of the processing of non-timber forest products, agriculture, fisheries, and eco-tourism. However, though these alternatives were well intended, they could never completely replace the income generated by the logging activities [72]. Many of the young and able men started to look for other income generating activities outside the Sebangau area. Most of them found employment in the palm oil plantations or left for the major towns in the province. Only few of them returned home to pick up fishing, rice farming, or collecting NTFPs again.

This part of Kalimantan, like the rest of Borneo, has experienced various aspects of climate change. In particular the extended El Niño periods have had their impact. But the impact of the drought periods has very much been aggravated by human activities through the draining of the swamps and the logging activities. Large areas have been deforested, the peat swamp forests have been drained, by which they became susceptible to peat land fires. Biodiversity and wildlife have been reduced and threatened. Populations of some animals, in particular the larger mammals, have been reduced dramatically. The conservation status of Sebangau as a national park has to some extent limited the possibilities of expanding rice fields, or the collection of non-timber forest products from within the park. This is also one of the conditions under which funding for the area has become available under the so-called REDD+ scheme. Among others, the government of Norway has made money available for the protection of the park on condition that the area is well protected and no further degradation takes place. Along the boundaries of the park, the options for local resource use are still available, but for the younger generation these options are no longer attractive and they no longer suffice. The intermediate period with the extensive logging activities and the flow of money and goods has changed their aspirations and just like in so many other areas, they move away from their home areas and the traditions that have long determined the local life style.

4. Discussion

There is ample evidence from the examples given above that indigenous peoples in Southeast Asia, as those in other regions, have been able to survive in their home environment on the basis of the extensive knowledge about the available resources and the practical skills to turn them into food or other useful products. This extensive knowledge about animals and plants, their characteristics, and the ecosystems in which they live, has grown over generations and it has been transmitted to the next generation by explicit knowledge transfer, by imitation, and by other means of learning such as storytelling. Time and time again, this knowledge has been recognized by researchers from diverse disciplinary backgrounds [10]. The indigenous peoples have also incorporated new experiences for instance after experiencing irregular natural and environmental hazards like heavy storms, excessive flooding, or earthquakes. They have learned to avoid risks related to such events [40]. They have adjusted their modes of food production, their house construction, and in some cases also

the very location of their settlement. They have also been able to make use of the wide range of natural resources to survive during periods of hardship. There were always emergency types of food available or they could rely on extensive exchange relations with neighboring groups. Mobility or being able to move to other places in times of trouble has also been a strategy to avoid or mitigate serious problems. Over time, they have benefitted from interaction with outsiders and they have incorporated new knowledge and practical skills, including useful tools obtained through this interaction, in their enriched indigenous knowledge systems [73,74].

Most of the indigenous peoples have been faced with interventions of outsiders in their search for timber or valuable minerals. Governmental policies were usually aimed at bringing the nomadic or scattered population together into larger resettlement villages, where development programs could be implemented. Sedentarization and permanent agriculture were to replace the mobile lifestyle based on hunting and gathering, often in combination with particular forms of shifting agriculture. Such programs of 'imposed development' have only had limited success, particularly in the initial phases of their implementation. Explicit resistance to such programs has been rather minimal. Most of the groups simply do not avail of sufficient numbers of people or levels of social organization to openly oppose such programs, even though they may profoundly disagree with their aims. They may also be intimidated by the government officials and implementing agencies to speak out against these plans. They have to fight with what J. Scott [75] labeled as the 'weapons of the weak', that is civil disobedience, retreat, and other less obvious forms of non-compliance.

But over the years, the combination of the environmental changes brought about by the encroachment of the logging and mining companies, the increased interaction with various groups of outsiders, and the implementation of the programs of imposed development, has changed and limited indigenous peoples' options. Silent retreat is no longer a solution and in many cases adjustment to the new circumstances is unavoidable. In particular, the younger generation is gradually losing its interest in the traditional way of life of their parents and grandparents. Usually the young men are the first to have increased interaction with the outside world and they become familiar with the attractions of the modern and urban world. Acquiring new knowledge and skills is necessary to have success. They lose their interest in traditional knowledge and skills, which they no longer consider necessary for their future. Slowly they become estranged from their home community and some of them may leave their village in search of paid jobs elsewhere. Depending on the wider social context, some may keep a selective interest in their ethnic identity and some traditions.

One of the aspects of the increased interaction with the outside world is related to the transmission of information. In countries like the Philippines and Indonesia, climate change has become a dominant theme in the discourse about causes of natural hazards, environmental changes, and phenomena like flooding and coastal erosion. Very often 'climate change' is put forward as an explanation for particular events or conditions [12,13]. But what aspect of climate change in particular is held responsible for such events and to what degree is less obvious. The scale and duration of forest fires in the peat lands for instance cannot be attributed only to the extended dry periods. Without large scale logging and draining of the peat swamp forests, the fires could not have occurred at the same scale and intensity as they have done in recent years. In an interesting report about impact of climate change, issued by the US National Intelligence Council, the overall conclusion for the region was very clear: 'Southeast Asia faces a greater threat from existing manmade environmental challenges than from climate change to 2030.' [20].

5. Conclusions

Blaming 'climate change', which is an abstract notion without easily identifiable actors, often is a politically more convenient and less dangerous strategy than looking more closely at the impacts of specific forms of unsustainable resource use and the people or official agencies who are responsible for them. Through the public campaigns to increase awareness about climate change, the wide media attention for this topic, and the attention that many NGOs are paying to it, climate change has become

an often used theme in the discourse and rhetoric about environmental changes that is nowadays also often used by indigenous peoples in the context of Southeast Asia [12].

However, as we have seen above, the way climate change manifests itself is not the same across the region. Some areas experience less rainfall, while other areas experience more rainfall. Variation in temperature also varies. Also on top of that, in some cases, as we have seen in the case of Mentawai, geological phenomena like subsidence, or in other cases earthquakes or tsunamis, have equally had a large impact on the environmental conditions in which these indigenous peoples have survived so far and that they intend to continue to live in for the future.

Most importantly, based on our experiences among these communities, we argue that the main causes of current and past environmental change and its serious impacts on livelihoods and wellbeing, should be attributed to the processes of deforestation and land conversion that we have described in the case studies. Interventions that will address these pressing issues will go a long way in making forest-dwelling indigenous communities more resilient towards present and future impacts of climate change. An awareness and appreciation of the wealth of their ecological knowledge, while including their practical skills, can be of great value in the design and the implementation of such interventions.

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Article

Adapting to Climate Change in Semi-Arid Rural Areas: A Case of the Limpopo Basin Part of Botswana

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Abstract: Climate change and anthropogenic pressure are increasingly modifying and interfering with ecosystem functions and limiting the delivery of ecosystem products, livelihoods, and adaptive response capacity in many developing countries. We identify measures by which local people in the semi-arid Limpopo Basin part of Botswana are responding to climate change and fluctuations in ecosystem products and examine socio-economic attributes of households influencing their adoption and discuss their adequacy. Our study used a case study of Bobirwa sub-district and employed key informant and household interviews to collect qualitative and quantitative data. Thematic analysis was used to analyze textual data from key informant interviews while frequencies, proportions, and Chi-squared tests were used to analyze the adoption of different strategies. A multinomial logit (MNL) regression was used to analyze the influence of several social, demographic, and economic attributes of households on household adaptation choices. We attributed the high adoption of on-farm adaptations to the simultaneous influence of more severe droughts and the free input support through the government's Integrated Support Programme for Arable Agriculture (ISPAAD). Our findings suggest that current adaptations were inadequate and implementation of the ISPAAD programme required fine-tuning to be more effective. Results of the MNL regression provide critical information on the barriers and enablers of adaptation in the sub-district yet offer important entry points for improving current adaptations. Therefore, the government needs to put measures that encourage investments in the processing of ecosystem products in rural areas to broaden the livelihood base and possibly reduce overdependence on rainfed agriculture. However, the extent to which this can be achieved depends on the level of government commitment to supporting local initiatives to addressing the climate change threat.

Keywords: adaptation; barriers; climate change; drought; ecosystem products; enablers; indigenous and local knowledge systems; resilience; semi-arid areas; transformation

1. Introduction

Climate is a unique but important exogenous determinant of vegetation and crop productivity. Climate change threatens ecosystem products, food production, and food security in Bobirwa sub-district similar to what has been found in other parts of the world [1]. For developing countries, where resilience to changes in climate is weak, the consequences are even more pronounced and widespread [2]. Ecosystem products and subsistence agriculture are critical to alleviating extreme poverty and significantly contribute to rural livelihoods in many developing countries [3]. However, climate change impacts on local ecosystems threaten the adaptive capacity of poor people [4–6].

Previous studies have highlighted threats imposed by adverse climate on agricultural productivity and vegetation-based provisioning services as shown in studies elsewhere [7]. The impacts of adverse climate and human activities in Bobirwa sub-district which include fluctuations in biodiversity, ecosystems, and ecosystem products have been identified before [8]. The occurrence of extreme weather events such as droughts in Bobirwa sub-district could further limit the availability of ecosystem products such as Mopane caterpillars (*Imbrasia belina*) which were reported to significantly contribute to the income and food security among communities in Bobirwa sub-district and other areas elsewhere as also found by [9].

Studying current human adaptations may highlight challenges or inadequacies of human efforts which enable identification of more innovative ways of coping with climate change impacts [10,11]. Previous studies such as [12–14] found that human adaptations among the poor and marginalized in developing countries were sub-optimal and could easily surpass current performances. For ecological systems, biodiversity keeps adapting to the changing climate [15,16]. However, some species adapt faster than others and the less adaptable ones are increasingly threatened. Therefore, adaptations in natural systems can no longer be left to occur naturally given the increased interference from humans. This contrasts with human and semi-natural systems where adaptations are relatively easier to achieve. This is because measures often have shorter cycles than in natural systems which often have longer life cycles to achieve the same [17]. Therefore, measures that enforce certain regulations are required to help socio-ecological systems to adapt [18]. Botswana is already experiencing the adverse impacts of climate change as evident from the frequent droughts, erratic rainfall patterns, heatwaves, and warming temperatures [19]. With the high dependence of livelihoods in rural areas on agriculture and ecosystem products, the frequent exposure to climate change impacts threatens livelihoods, particularly of the poor who often have low adaptive capacities. Recent studies have shown the increased vulnerability of Botswana to climate change [20]. The most vulnerable livelihoods are those that depend on agriculture, biodiversity, water, and other natural products. This highlights an urgent need for these sectors to effectively adapt [19]. Though local communities in Botswana have a long experience with droughts, this could imply that they have in place measures to minimize or moderate these impacts. However, the vulnerability of agriculture, biodiversity, water, and other natural products which underpin livelihoods in many developing countries not only depends on the extent and magnitude of climate change but also on society's adaptive capacity [21].

While the choice and extent of adaptation may highlight the capacity of humans to adapt to the multiple stresses caused by climate change, enhancing such capacities requires an understanding of the factors which influence adaptation decisions. This is a critical step towards seeking ways to improve the resilience to the incremental impacts caused by climate change. Despite several studies such as [21,22] agreeing that awareness of the changes in climate is critical to adaptation decisionmaking, the same cannot be said for semi-arid areas where indigenous people have experienced impacts similar to climate change for many years. As climate change adaptation is at a local scale, the present study uses a case study of Bobirwa sub-district in the Limpopo Basin part of Botswana to understand the adaptation behaviour of indigenous people. This is important for providing context-specific recommendations that can enhance local adaptations; hence, the findings from this study cannot be generalized for other similar areas, in Botswana, or elsewhere.

Previous studies that analyzed adaptation to climate as well as the factors influencing the choice of adaptation strategies in developing countries have mainly focused on single livelihood strategies and have often been done at the regional level or across several countries [12,23,24]. Findings from such studies are not only highly aggregated but too general and limited to be useful for local communities where the threats of climate change are highly localized. This study, therefore, examined the actual household-level responses including the factors enabling or limiting the adoption of various strategies at the disposal of households in the semi-arid Bobirwa sub-district. The study employed an established approach in examining the adaptation behaviour of individuals and households in rural farming communities in Africa [14,25,26]. Precisely, this study applied the multinomial logit (MNL) regression

model to examine the determinants of households' adaptation choices. This technique has been extensively employed to analyze adaptation decisions involving multiple options. The advantage of MNL is that it is simpler and more sound than other available options such as the multinomial probit (MNP) [23]. The analysis was guided by the following research questions:

- What are the socio-economic attributes of the households in the semi-arid Bobirwa sub-district?
- How are local people responding to differential impacts of adverse climate and fluctuations in key provisioning ecosystem services (ES) in Bobirwa sub-district?
- What is the current extent of adaptation by households in Bobirwa sub-district?
- Which socio-economic attributes and factors influence household adaptation choices and behaviour of households in Bobirwa sub-district?

2. Materials and Methods

2.1. Study Area

The Limpopo River Basin part of Botswana is ecologically and economically significant to indigenous people and surrounding communities. Our case study, Bobirwa sub-district is situated between 28°09'10" E to 29°21'42" E and 22°35'17" S to 21°35'56" S and lies entirely within the Limpopo River Basin part of Botswana. The sub-district has an altitude ranging between 590 and 886 m making it the lowest part of Botswana hence has a network of channels that drain into the Limpopo River [8]. The sub-district boundary forms the national boundary with Zimbabwe to the north-east and South Africa to the south-east where the Limpopo River marks the boundary. Figure 1 below shows the location map of Bobirwa sub-district in Botswana, the villages and settlements in Bobirwa sub-district, as well as the location of Botswana in Africa. Although local ecosystems in the Limpopo Basin are essential to livelihoods and human well-being, they are greatly threatened by adverse climatic conditions as well as anthropogenic pressure. According to the 2011 National Population and Housing Census report, the population of Bobirwa sub-district was 71,936, comprising of 34,247 males and 37,689 females from 19,213 households with an average household size of 3.74 and a population density of 5.05 people/km² [27].

The study area is highly susceptible to droughts, erratic rainfall fluctuating well below 400 mm/year in most years [20]. The recent (2010–2016) average minimum and maximum winter temperatures were 7.1 °C and 24.5 °C while for summer they were 17.6 °C and 31.3 °C, respectively. Thus, the average winter and summer temperatures were 15.8 °C and 24.5 °C, respectively. However, summer temperatures have often exceeded 38 °C in the last 5 years with occurrence of heatwaves [20]. Average potential evapotranspiration of 1400 mm has been estimated in Bobirwa sub-district which reduces rainfall effectiveness. Bobirwa sub-district experiences frequent droughts (once every 2–4 years) and extreme weather events such as heatwaves, strong storms, strong winds, and flash floods; therefore, it is considered a semi-arid hotspot [20,28]. High variability in both rainfall amount and intensity and recurrence of extended droughts and dry spells is characteristic of the study area. Nonetheless, Bobirwa sub-district experiences a less severe climate than other parts of the country which allows crop and livestock production as well as supporting considerable biodiversity which supports local livelihoods through the delivery of several timber and non-timber forest products [8,29]. The main crops grown under rain-fed conditions are maize, sorghum, millet, cowpeas, groundnuts, round nuts, and watermelons. Subsistence livestock and poultry production, a mainstay of the local economy, is mainly characterized by the rearing of cattle, goats, and chickens under free-range [8].

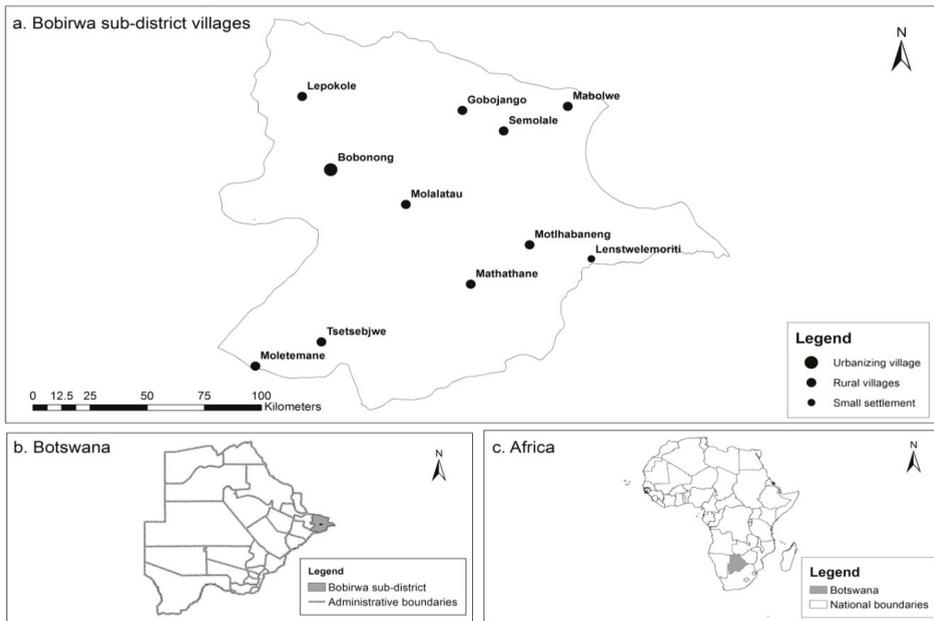


Figure 1. Map of Bobirwa sub-district showing study villages.

2.2. Data Collection

We used a household survey to collect quantitative and qualitative data for this study. A total of 310 semi-structured questionnaires were administered to heads of households who had been pre-selected through stratified and random sampling procedures. Eight villages were selected randomly from the sub-district and village lists were then obtained from the Bobonong Sub-Land Board. A proportionally representative sample was drawn from each village list using random numbers generated using R studio. Each village sample had an excess of 50% of the potential participants to cater for cases where the household head or household was not available as reflected on the lists from the Sub-Land Board. A request and notification for actual interviews were sent at least 2 weeks in advance through the traditional leadership led by Chiefs who, together with the Village Development Committees (VDCs), helped identify and notify the pre-selected participants. Reminders for interviews were sent again four days and a day before the actual interview date through the VDCs who then reminded the participants and confirmed their availability for the interview. For those not available or who decided not to participate, the VDC then replaced them with the next available participant from the list with the 50% extra participants for each selected ward. The chances of not finding participants were therefore very minimal.

Each head of the 310 randomly selected households in Bobirwa sub-district who consented to be interviewed were asked about their household demography and to state their income and income sources, household assets, farming implements, livestock owned, arable land owned, access to climate information and channels used, input use, and crop production. They were also asked to state their farm and off-farm coping strategies and adaptative responses to climate change and variability. Specifically, households were asked to report actual practices implemented against climate change and/or more severe droughts within the last 5–10 years in order to capture climate change-induced adaptation strategies. The adaptation options in the household questionnaire were partly informed by the key informant interviews and participatory mapping process. In the absence of the head of household (De jure head), the most senior member of the household available (De facto head) was interviewed.

2.3. Data Analyses

Descriptive statistics such as frequencies, means, proportions, and standard deviations were used to characterize and summarize household demographic, socio-economic attributes, and adaptation strategies adopted. The Chi-square test (χ^2) at $p = 0.05$ level of significance was used to assess the statistical differences between adopters and non-adopters of different adaptation strategies as well as the extent of adoption. These analyses were accomplished using the Statistical Package for Social Sciences (IBM SPSS ver. 20). Factors influencing the uptake of the various adaptations by households were analyzed using Multinomial Logit (MNL) regression in STATA ver. 14.2 software. The significance of the influence of the factors was assessed at $p = 0.05$ while the explanatory power of the regression model was assessed using the F-statistic (pseudo R^2). The sections below specify the MNL model and describe the variables used in the model and their hypothesized direction of influence.

2.3.1. Adaptation Model Specification

Considering the multiple adaptation response measures implemented by some of the households, and to facilitate analyses, the higher-level adaptation strategies were categorized as follows: 0 = Off-farm adaptations; 1 = Crop management practices; 2 = Livestock management practices; 3 = Land and soil management practices; and 4 = Water management practices. Given adaptation decisions that involve multiple options, and similar to several related studies such as [23,30,31] the study employed the multinomial logit regression (MNL) techniques to evaluate choice decisions.

The study applied the MNL model as follows.

Let A_i be a random variable representing the choice of climate-related adaptation strategy adopted by any household. The assumption is that each household is faced with a set of distinct, mutually exclusive choices of climate change-induced adaptation strategies. The study also assumed that these adaptation strategies are influenced by several socio-economic attributes, household demography, perceptions on climate change, and other factors X . The MNL model for adaptation choice illustrated below is specified by the relationship between the probability of choosing adaptation option A_i , and a set of explanatory variables X , e.g., socio-economic attributes, household demography, perceptions on climate change [32].

$$Prob(A_i = j) = \frac{e^{\beta_j' x_i}}{\sum_{k=0}^j e^{\beta_k' x_i}}, j = 0, 1, \dots, J \quad (1)$$

where β_j is a vector of coefficients on each of the predictor variables X . Equation (1) was normalized to remove indeterminacy in the model and then approximated to produce the j log-odd ratios similar to other studies elsewhere [25,30].

The dependent variable was therefore the log of each adaptation strategy in relation to the reference category (off-farm adaptations). Although the MNL model is relatively easy to compute, the resulting coefficients are difficult to interpret and misleading [32]. Therefore, in order to understand and interpret the influence of explanatory variables on the probability of choosing a particular adaptation strategy, marginal effects (ME) were computed following other studies [30,31]. The ME predict the changes in probability of a particular adaptation strategy being adopted with respect to a unit change in a particular explanatory variable [32]. The signs of the ME may be different from that of their corresponding MNL model coefficients. This is because the sign of the ME depends on both the sign and the magnitude of all the MNL model coefficients.

2.3.2. Model Variables, Variable Description, and Expected Influence

The dependent variable in the empirical model approximation for this analysis was the type of adaptation strategy adopted and implemented by any single household and initially had 6 possible options only, i.e., 0 = No adaptation; 1 = Crop management practices only; 2 = Livestock management practices only; 3 = Land and soil management practices only; 4 = Water management practices only; and 5 = Off-farm adaptations. However, after preliminary analyses of the responses, options 3 and 4

were combined due to fewer responses in the latter. For this model only, the option for “No adaptation” was dropped from the analyses as it had 2 cases only, which did not allow the statistical modelling [32]. Notes that each option of the dependent variable must have at least 12 cases to allow MNL modelling.

The following adaptation options were finally used for the analysis, and these included different combinations of multiple practices: 0 = Off-farm adaptations; 1 = Crop management practices only; 2 = Livestock management practices only; 3 = Land, soil, and water management practices only; 4 = Crop + Livestock management practices combined; 5 = Crop + Land, soil, and water management practices combined; and 6 = Crop + Livestock + Land, soil, and water management practices combined. The off-farm adaptation was used as the reference category. The choice of explanatory variables and the hypothesized direction of influence was guided by empirical literature such as [25,26,31]. Table 1 summarizes the explanatory variables used for empirical estimation together with their expected direction of influence on farm-level adaptations.

Table 1. Summary of possible explanatory variables and hypothesized direction of influence.

Explanatory Variable	Description	Expected Influence
Household head type	Type of household head (1 if De jure, 0 if De facto)	+
Age	Average age of household head (years)	+/-
Age group	(1 if young, 0 if adult or elderly)	+
Gender	Gender of main decision-maker (De jure head of household) (1 if female; 0 if otherwise)	-
Marital status	Marital status of the head of household (1 if married, 0 otherwise)	+
Formal education	Number of years in formal education	+
Primary occupation	Primary occupation of household head (1 if head is full-time farmer; 0 if part-time farmer)	+
Formal employment	Number of people formally employed in the household	+
Household size	All people actually staying and depending on the household size	+
Rooms in main house	Number of rooms in the main house	-
Arable land owned	Arable farm size in hectares	+
Annual income	Total annual income of household (BWP)	-
Annual remittances	Total remittances accruing to the household (BWP)	-
Remittances financing adaptations	Proportion of remittances used for financing adaptation (BWP)	+
Community-based Natural Resource Management (CBNRM) dividends	Dividends received from CBNRM in the past 10 years (BWP)	+
Land tenure arrangement	Ownership status of agricultural land (1 if household owns privately; 0 otherwise)	+
Tropical livestock units (TLU)	A factor representing the total livestock units owned based on dairy cow = 1 livestock unit [33]	+
Agricultural input subsidy	Receive agricultural inputs from government or other organizations (1 if full or partial input subsidy; 0 if otherwise)	+
Major farm implement	Major farm implements used for farming (1 if tractor or animal drawn, 0 if use hand-held implements)	+
Climate information	Access to climate and agricultural information (1 if access, 0 otherwise)	+
Type of climate information	Type of climate information mostly used (1 if mostly scientific/meteorological services; 0 if mostly traditional knowledge)	+/-
Knowledge of local climate	Knowledge of changes in local climate (1 if knowledgeable of changes in climate; 0 if not)	+

The expected direction of influence shows the hypothesized influence of each explanatory variable on the uptake of adaptation measures to address the impacts of climate change in Bobirwa sub-district. A positive (+) (negative (-)) sign shows that a particular explanatory variable is expected to enable (hinder) the adoption of specific measures against climate change. Other explanatory variables could either enable or hinder (+/-) the uptake of climate change adaptation measures.

3. Results

3.1. Socio-Economic Attributes of Respondents

Table 2 below is a characterization of the study participants and summarizes the key social and economic attributes which are assumed to be critical determinants of household adaptive capacity. Table 2 shows the frequencies, associated proportions (%) or means (as appropriate) of these attributes and the *p*-values of the Chi-square tests of differences among different respondents.

Table 2. Socio-economic attributes of households in Bobirwa Sub-district, Botswana.

Socio-Economic Attributes		N/Mean	% of Cases	DF	χ^2	<i>p</i> -Value
Average age of household head	Young (20–40)	57	18.4	2	9.332	0.009 **
	Adult (40–60)	128	41.3			
	Elderly (>60)	125	40.3			
Gender of household head	Female: (De jure)	173	55.8	1	7.688	0.006 **
	(De facto)	74	23.9			
	Male: (De jure)	55	17.7			
	(De facto)	8	2.6			
Marital status of household head	Married	80	25.8	4	16.585	0.000 **
	Divorced/Separated	10	3.5			
	Widowed	63	20.3			
	Single	146	47.1			
	Partner (unmarried)	10	3.2			
Education level of household head	None	84	27.1	4		0.014 *
	Primary	122	39.4			
	Secondary	71	22.9			
	Vocational	21	6.8			
	Tertiary	12	3.9			
Employment status of household head	Full-time on-farm	100	32.3	1	0.160	0.689
	Part-time on-farm	210	67.7			
Average household size [available during the last 12 months]	Female	3.28	55.8			
	Male	2.60	44.2			
Average emigrants per household	Female	1.24	45.8			
	Male	1.48	54.2			
Average arable farm size (ha)	Total land owned	8.85	-			
	Cultivated area	2.32	26.2			
Average annual income of household (BWP)	<5000	193	62.3	4	4.160	0.385
	5000–10,000	39	12.6			
	10,001–15,000	19	6.1			
	15,001–20,000	15	4.8			
	>20,000	44	14.2			
Proportion of remittances invested in climate change adaptation	<50%	33	10.6	4	9.956	0.996
	50%	17	5.5			
	75%	34	11.0			
	100%	18	5.8			
	None	208	67.1			

Table 2. Cont.

Socio-Economic Attributes		N/Mean	% of Cases	DF	χ^2	p-Value
Ownership status of agricultural land	Own privately	198	63.8			
	Family land	13	4.2			
	Communal land	16	5.2	4	7.300	0.132
	Rent/lease privately	21	6.8			
	No agricultural land	62	20.0			
Livestock owned	Cattle	6.27	37.4	1	0.201	0.654
	Donkeys	1.42	26.1	1	5.117	0.077
	Goats	7.77	55.5	1	9.633	0.008 **
	Sheep	1.02	10.3	1	0.649	0.421
	Poultry	7.47	61.3	1	0.389	0.533
Government agricultural input support received	Full subsidy	145	46.8			
	Partial subsidy	17	5.5	3	1.145	0.887
	Paid full cost	33	10.6			
	None	115	37.1			
Major farm implements used	Hand-held	204	65.8	1	3.514	0.037 *
	Animal-drawn	137	44.2	1	9.257	0.026 *
	Tractor-drawn	11	3.5	1	0.004	0.950
Access to climate and agricultural information	Yes	282	91.0	1	0.071	0.790
	No	28	9.0			
Information channels used	Cellphone	293	94.5	1	12.515	0.003 **
	Radio	160	51.6	1	7.667	0.105
	Television set	197	63.5	1	6.678	0.083
Adoption of new crops or farming practices informed/influenced by	Radio or TV programme	242	78.1	1	3.940	0.047 *
	Seasonal weather forecasts	226	72.9	1	8.413	0.015 *
	Extension officers	220	71.0	1	4.729	0.094
	Village Chief (Kgosi)	130	41.9	1	0.028	0.868
	Observing other farmers	123	39.7	1	334	0.248
	Farmer organizations	72	23.2	1	3.219	0.073
Major type of climate/weather information used frequently	Farmers' Magazines	26	8.4	1	0.764	0.382
	Meteorological services	181	58.4	1	4.270	0.039 *
	Traditional knowledge	129	41.6			

Significance level; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Source: Household Survey Data, 2017.

Table 2 shows that there were significantly more female-headed (79.7%) than male-headed (20.3%) households. The majority of main decision-makers (de jure) at the household level were also female (55.8%). Regarding the marital status of the household heads, 47.1% were single (never married), 25.8% were married, and 20.3% were widowed. The majority of the household heads (41.3%) were adults (40–60 years), 40.3% of the heads of household were elderly (>60 years), and the remainder (18.4%) were young (<40 years). The average household size was 5.9, with more female members (3.3) of household than males (2.6). Household heads (decision-makers) who had primary education or higher (72.9%) were significantly higher ($p < 0.05$) than those who had no formal education (27.1%). A third (33.5%) of the household heads—46% of those who had formal education—had post-primary school education.

Among the households surveyed, 68% owned agricultural land either “privately” or as family land, 20% did not own any agricultural land while the rest either rented land privately (6.8%) or used communal land (5.2%). Just over two-thirds of the household heads (67.7) were part-time farmers and 32.3% were full-time farmers. The average total land holding per household was 8.85 ha. On average, only 2.25 ha was cropped. Regarding livestock, 61.3% of the households owned poultry (mainly chickens), 55.5% owned goats, 37.4% owned cattle, 26.1% owned donkeys, and 10.3% owned sheep. Some owned more than one type of livestock. On average, each household owned six cattle, one donkey, seven goats, one sheep, and seven chickens.

The major farm implements used by households differed among households with most households using hand-held implements such as hoes (65.8%) while others used animal drawn (using donkeys) ploughs (44.2%) and tractor-drawn implements (3.5%). There was no significant difference ($p >$

0.05) between households using hand-held implements and those using animal or tractor-drawn implements. At least half of the households (52.3%) received government input support under the Integrated Support Programme for Arable Agriculture (ISPAAD) although this was not significantly different ($p > 0.05$) from those who did not benefit during the 2016/2017 agricultural season. Although a higher proportion of the households (62.3%) had annual cash incomes below BWP5000 (US \$450), the difference with those who had higher incomes was not significant ($p > 0.05$). Only 32.9% of the households received remittances which they also invested varying proportions in agricultural climate change adaptations.

The majority of the households (91.0%) had access to climate and agricultural information. However, there was no significant difference ($p > 0.05$) between those households which mainly relied on climate information from the Meteorological Services Department (58.4%) and those relying on traditional knowledge (41.3%). Regarding access to information, 63.5% of the households surveyed had at least one television set, 51.64% had at least one radio and 94.5% had at least one cellphone. At least 70% of the households reported that the adoption of new farming practices was influenced by radio or television programs, seasonal weather forecasts, and information from extension officers. The information which influenced adoption of new farming practices by surveyed households was received through village chiefs (Kgosi) (41.9%), observing other successful farmers (39.7%), farmer organizations (23.2%), and farmers' magazines (8.4%).

3.2. Actual Household-Level Adaptation Responses

The sections below summarize the adoption and implementation of various actual adaptation measures: crop management, livestock management, land and soil management, water management, and off-farm adaptation practices by households. The results show the frequencies and associated proportions (%) of households that reported the different adaptation measures including the Chi-square test of difference between the households that reported using the measure and those that did not. The figures following each table allow visualization of the extent of the adoption of the different measures and practices under each broad strategy.

3.2.1. Crop Management Practices

Among the various crop management measures identified in the study area, Table 3 shows that most of the households adopted drought-tolerant crop varieties (72.6%) followed by early maturing crops (70.6%). Other crop management practices adopted by many households included sequencing their cropping (58.7%), changing planting times (51.0%), and introducing new crops not grown previously (40.0%). The least adopted crop management measures were conservation agricultural practices (24.5%) and having plots in other villages or geographical areas (21%).

Table 3. Crop management adaptation strategies used by households in Bobirwa sub-district.

Adaptation Measure	N	% of Cases	DF	χ^2	p-Value
Adopted drought-tolerant crops varieties	225	72.6	1	0.610	0.435
Sequential timings of cropping	182	58.7	1	1.323	0.250
Adopted early maturing crops	219	70.6	1	0.214	0.643
Introduced new crops not grown before	124	40.0	1	1.199	0.274
Using conservation agriculture	76	24.5	1	3.522	0.172
Had plots in different geographical areas	65	21.0	1	2.759	0.097 *
Changed planting times (early planting)	158	51.0	1	0.001	0.975

Significance levels: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Source: Household Survey Data, 2017.

Figure 2 below shows the extent of the adoption of different combinations of crop management measures by households in the study area.

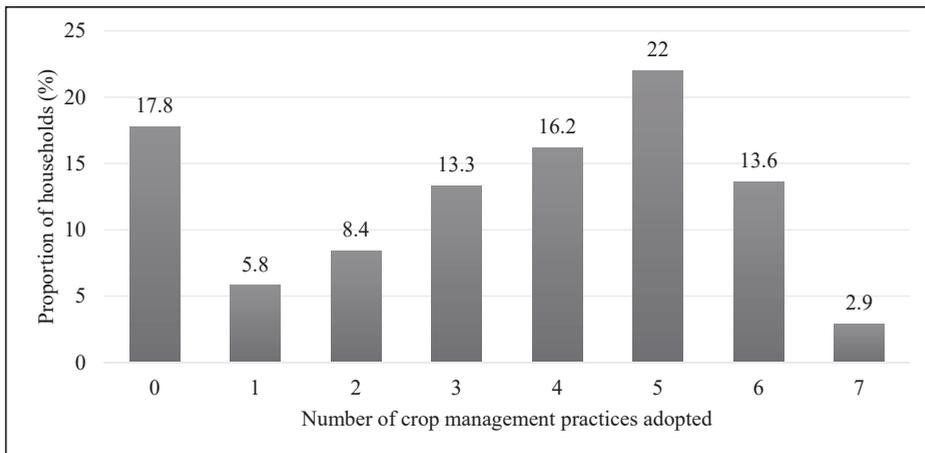


Figure 2. Extent of adoption of crop management and adaptation measures (n = 310).

A proportion of 17.8% of the households did not adopt any crop management practice while 82.2% adopted at least one crop management practice between 2006 and 2017. Most of the households (22%) adopted five different crop management measures which was followed by adoption of four different measures (16.2%). Those who adopted three and six different measures were 13.3% and 13.6%, respectively. A mere 2.9% adopted all the seven crop management measures identified in this study while 14.2% adopted at most two measures.

3.2.2. Livestock Management Practices

Table 4 shows the proportion of households which adopted the different livestock management practices leading to 2017. Selling livestock including destocking was practiced by most of the households (41.3%) followed by use of supplementary feeding (37.7%) and temporary migration of livestock in search of better pastures and water (36.5%). About 33% of the households sought grazing rights from other villages while about 26% bought improved breeds of the same livestock or changed the composition of their livestock. The least practiced measure among the livestock management practices was formation of associations such as grazing associations with only 14.2% of the households reporting adoption of this practice. Fewer households reported receiving livestock through government projects (19%) while others started animal rearing as a diversification of their livelihoods (18.7%).

Table 4. Livestock management adaptation strategies by households in Bobirwa sub-district.

Adaptation Measure	N	% of Cases	DF	χ^2	p-Value
Used supplementary feeding	117	37.7	1	8.860	0.003 **
Changing the composition of livestock	79	25.5	1	6.622	0.010 *
Got grazing rights from other traditional authorities	102	32.9	1	0.845	0.358
Livestock sale/destocking	128	41.3	1	4.012	0.045 *
Moving livestock to other geographical areas	113	36.5	1	4.257	0.039 *
Purchase of new types of the same animals	81	26.1	1	5.866	0.015 *
Received livestock through government/NGO	59	19.0	1	0.000	0.997
Started animal rearing/feed lot	58	18.7	1	1.352	0.245
Formed associations/collectives, e.g., grazing	44	14.2	1	2.694	0.101

Significance levels: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Source: Household Survey Data, 2017.

Figure 3 below shows that those households which did not adopt any livestock management practice were the majority (30.6%). Of the 69.4% households that adopted at least one of the nine livestock management practices, 13.9% of the households adopted a single livestock management practice while 14.2% of the households which adopted two practices. Households which adopted three or more livestock management practices were 10% or less with only 1.3% of the households adopting all the nine practices identified in the study area.

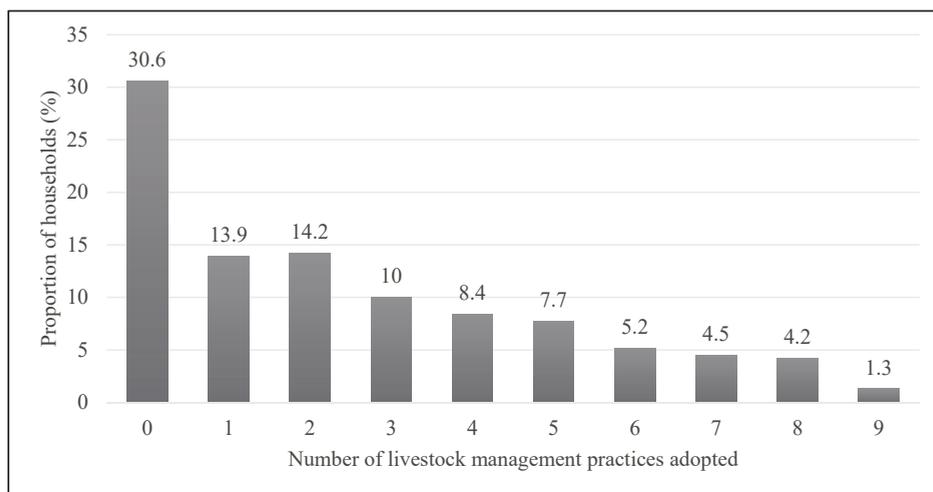


Figure 3. Extent of adoption of livestock management and adaptation measures (n = 310).

3.2.3. Land and Soil Management Practices

Table 5 shows the different land and soil management practices including the proportion of households who actually practiced each of the measures during the decade. Between 2006 and 2017, 71.9% of the households sought advice from the extension service worker while 61% went on to use seasonal forecasts and drought early warning information provided through various channels and platforms within each village. About 49% of the households changed time of harvesting as a land or soil management strategy while close to 42% used various soil and water conservation techniques as well as clearing more agricultural land to grow more crops. The least adopted land and/or soil management practices were seeking agricultural land in other geographical areas (25.8%), changing fertilizer, pesticide or herbicide use (19.4%), and use of irrigation (8.1%).

Table 5. Land and soil management adaptation measures by households in Bobirwa sub-district.

Adaptation Measure	N	% of Cases	DF	χ^2	p-Value
Sought for planting land in better place	80	25.8	1	0.782	0.376
Increased cultivated area to go grow more	130	41.9	1	0.028	0.868
Introduced irrigation	25	8.1	1	0.002	0.967
Changed harvesting times	151	48.7	1	0.137	0.711
Changed use of fertilizers and agrochemicals	60	19.4	1	1.005	0.316
Used seasonal forecasts/drought early warning systems	189	61.0	1	9.389	0.002 **
Used extension services for advice on farming	223	71.9	1	9.172	0.010 *
Used soil & water conservation methods	128	41.3	1	1.306	0.253

Significance levels: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Source: Household Survey Data, 2017.

Figure 4 shows that there was a very high level of adoption land and/or soil management practices with 86.4% of the households adopting one or more of the eight measures identified in the study area. Almost 17% of the households adopted three different measures in Table 5 while 16.2% adopted two different measures. Approximately 44% of the households adopted between four and eight different land and/or soil management measures inclusive of the 1.6% who adopted all the land and/or soil management measures identified in the study area. Less than 9% of the households implemented only one land and/or soil management practice in Table 5 while 14.6% of the households did not adopt any land and/or soil management practice.

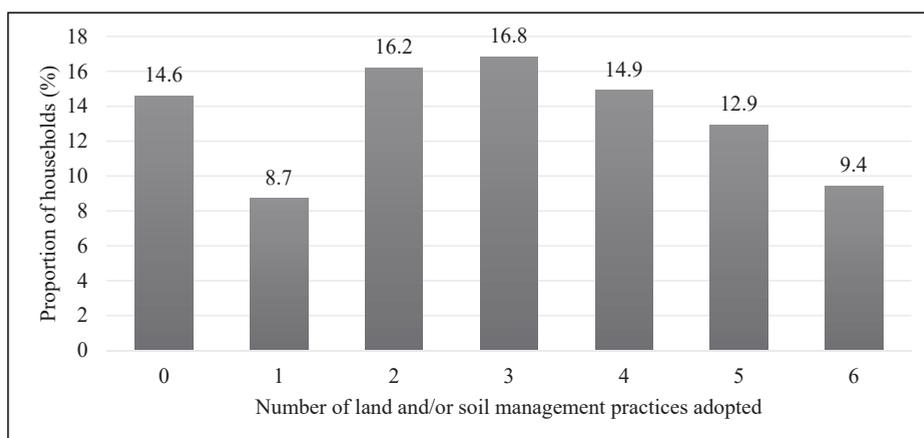


Figure 4. Extent of adoption of land and/or soil management measures (n = 310).

3.2.4. Water Management Practices

From the seven water management practices identified in the study area and presented in Table 6, rainwater harvesting was practiced by most of the households (51.6%). The second most practiced measure was protecting some water sources for use during the dry season with 42.6% of the households reporting the practice. Some households (35.2%) reported making use of small earth dams around their village while another 33.2% resorted to drilling boreholes or wells to access groundwater especially at the "cattle posts". Up to 28% of the households reported rehabilitating water points such as deepening wells. Only 4.2% reported using drip irrigation although this was largely practiced in backyard gardens.

Table 6. Water management adaptation strategies used by households in Bobirwa sub-district.

Adaptation Measure	N	% of Cases	DF	χ^2	p-Value
Rainwater harvesting	160	51.6	1	2.399	0.121
Using drip irrigation	13	4.2	1	2.757	0.097
Started pumping from rivers	59	19.0	1	0.000	0.997
Drilled a borehole/well (ground water)	103	33.2	1	2.306	0.129
Used earth dams	109	35.2	1	2.054	0.152
Rehabilitation of water points	87	28.1	1	0.172	0.679
Conserve/protect water sources for dry season	132	42.6	1	0.112	0.737

Significance levels: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Source: Household Survey Data, 2017.

Figure 5 shows that the highest proportion of households (23.6%) in the study area did not adopt any of the water management practices followed by those who implemented just one practice (22.7%) among the seven measures at their disposal. A proportion of 19.1% and 11% implemented two and three different water management measures, respectively. At least four up to a maximum of seven

different water management practices were implemented by a proportion ranging between 6 and 9% of the households within the last decade.

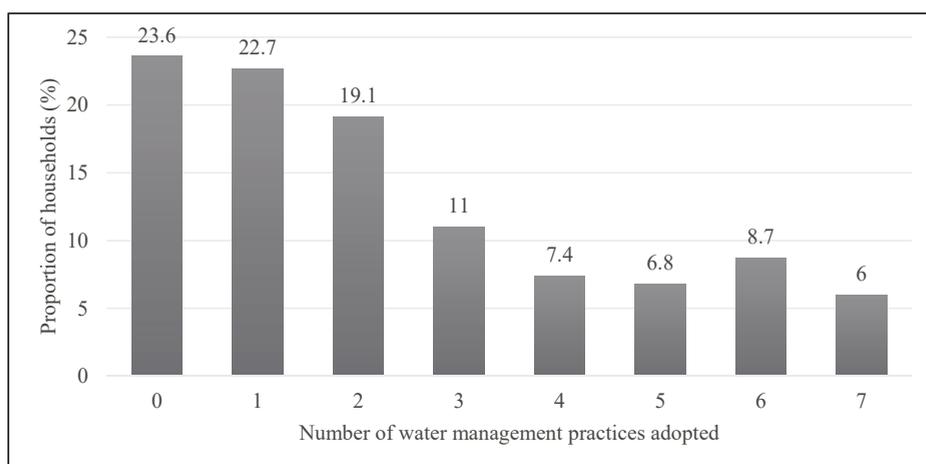


Figure 5. Extent of adoption of water management and adaptation measures (n = 310).

3.2.5. Off-Farm Adaptation and Management Practices

Table 7 shows the various off-farm adaptation measures some of which are related to provisioning ES. Up to seven different off-farm responses were identified in the study area. Among the measures involving the exploitation of provisioning ES were starting a small business, trading in at least one provisioning ES (31.9%), such as selling charcoal and/or firewood (45.2%). Some reported to forming committees to protect natural pastures and/or water for their livestock (14.5%) while others invested in grain storage (39%) or hired out grazing land to livestock owners (5.5%) to raise income. A significant proportion of the households (78.1%) reported the migration of some of the household members in search of employment in neighboring towns such as Selebi Phikwe or to major cities such as Francistown and Gaborone.

Table 7. Off-farm adaptation measure used by households in Bobirwa sub-district.

Adaptation Measure	N	% of Cases	DF	χ^2	p-Value
Started a small business e.g., selling NTFPs	99	31.9	1	0.001	0.550
Hiring out grazing land	17	5.5	1	1.160	0.560
Charcoal production/firewood	140	45.2	1	2.476	0.116
Members migrate in search of employment	242	78.1	1	2.033	0.015 **
Joined/formed savings group/cooperative	114	36.8	1	0.687	0.407
Formed committee to protect pastures/water	45	14.5	1	0.552	0.457
Invested in grain storage	121	39.0	1	0.212	0.645

Significance levels: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Source: Household Survey Data, 2017.

The extent of adoption of various combinations of the off-farm measures in Table 7 is shown in Figure 6.

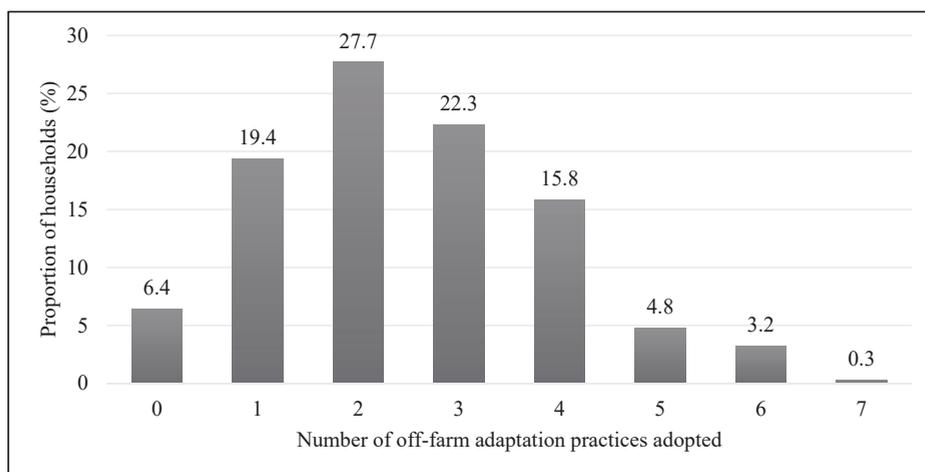


Figure 6. Extent of adoption of off-farm management and adaptation measures (n = 310).

Only 6.4% of the households did not have any off-farm adaptation measures indicating that there was a high proportion of households using ecosystem products and other off-farm livelihood options to cope with the adverse impacts of climate. Most of the households used two (27.7%) followed by three (22.3%) off-farm adaptations in Table 7. About 19% of the households were engaged in only one or four different off-farm activities to complement cultivated agriculture and livestock production as a livelihood source and a coping mechanism. The combined proportion of households engaged in at least five up to a maximum of seven different off-farm adaptation initiatives and coping mechanisms was 8.3%. Almost 85% of the households used up to four different off-farm adaptation initiatives in Table 7.

3.2.6. Aggregated Climate Change Adaptation and Management Practices

Table 8 shows that when all the above measures were combined to form five mutually exclusive adaptation strategies, i.e., crop management (82.3%), livestock management (64.5%), land and/or soil management (85.5), water management (76.5%), and off-farm adaptation initiatives (95.2%), less than 1% of all the households was not involved in any of the practices between 2006 and 2017. This indicates a very high level of at least 99% adoption of one or more adaptation and management strategy to the adverse effects of climate and fluctuating provisioning ES in Bobirwa sub-district.

Table 8. Aggregated climate change adaptation strategies by households in Bobirwa sub-district.

Adaptation Measure	N	% of Cases	DF	χ^2	p-Value
No adaptation at all	2	0.64	1	0.773	0.379
Crop management practices	255	82.3	1	0.257	0.612
Livestock management practices	200	64.5	1	3.728	0.054
Land and soil management practices	265	85.5	1	0.869	0.351
Water management practices	237	76.5	1	1.012	0.314
Off-farm adaptation practices	295	95.2	1	0.001	0.975

Significance levels: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Source: Household Survey Data, 2017.

It is important to note that the adaptation strategies and coping mechanisms in Table 8 were not implemented as mutually exclusive strategies. The different combinations of response strategies by households in Bobirwa sub-district are summarized in Figure 7. Approximately 49% of the households

in Bobirwa sub-district implemented all the five adaptation strategies and coping mechanisms presented in Table 8. About 26% of the households implemented four strategies during the same period while 12.3% implemented three strategies. Those households which implemented either two or three strategies contributed a proportion of 5.8% apiece while less than 1% reported not implementing any adaptation initiative between 2006 and 2017.

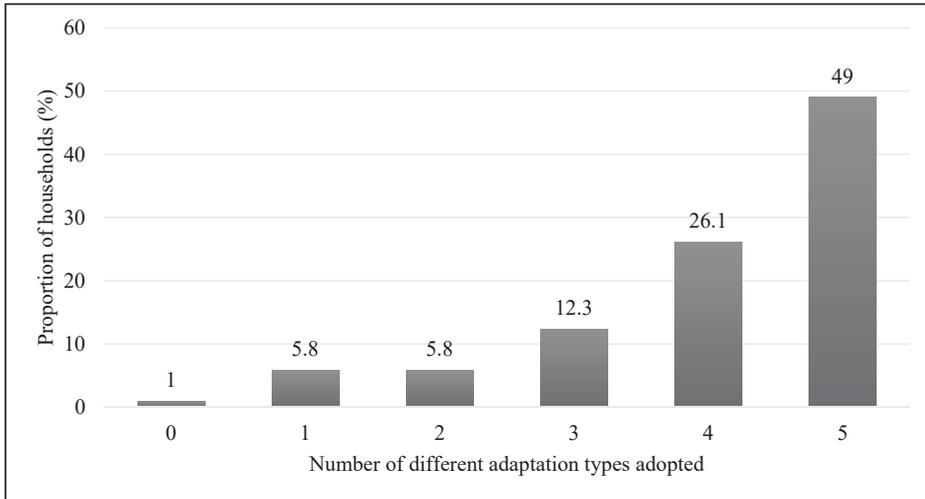


Figure 7. Adoption levels of different adaptation strategies (n = 310).

Those who adopted water management practices were combined with those who adopted land and soil management practices to form a single category. Therefore, a total of seven categories (including combinations of strategies) were used for the multinomial logit analyses, i.e., the final adaptation options after considering all the actual combinations were 0 = Off-farm adaptations (reference category); 1 = Crop management practices only; 2 = Livestock management practices only; 3 = Land, soil and water management practices only; 4 = Crop + Livestock management practices combined; 5 = Crop + Land, soil and water management practices combined; and 6 = Crop + Livestock + Land, soil and water management practices combined.

3.3. Determinants of Adoption of Climate Change Adaptation Strategies

The estimation of the MNL model for the determinants of the choice of adaptation strategy mix to the variable but adverse impacts of climate was accomplished by normalizing the “Off-farm adaptation” category to become the reference category. This allowed analyses and comparisons of the different actual adaptation strategy mixes used by different households in Bobirwa sub-district. Table 9 presents the MNL model marginal errors together with their standard errors (in parentheses) and levels of significance.

Table 9. Marginal effects of the determinants of adaptation strategy mix in Bobirwa sub-district.

	Actual Adaptation Strategies Implemented						
	001	010	011	100	101	110	111
Age (years)	−0.126 (0.131)	−0.095 (0.056)	−0.079 (0.054)	−0.091 (0.061)	−0.072 (0.080)	−0.091 * (0.042)	−0.060 (0.039)
Formal education (years)	0.149 (1.966)	−0.610 (0.941)	0.405 (0.909)	−0.286 (1.039)	−2.494 (1.596)	0.808 (0.743)	0.613 (0.700)
Gender	18.892 (3614.380)	0.647 (1.103)	−0.504 (0.931)	−0.277 (1.137)	−0.177 (1.383)	0.308 (0.810)	−0.087 (0.754)
Occupation	2.910 (1.941)	−0.056 (1.370)	1.126 (1.043)	2.506 * (1.048)	0.710 (1.451)	1.435 (0.867)	1.555 (0.841)
Household size	−0.138 (0.248)	−0.260 * (0.125)	−0.188 (0.113)	−0.149 (0.127)	0.144 (0.148)	−0.154 (0.082)	−0.085 (0.076)
Cropped area (ha)	0.143 (0.490)	−0.523 (0.299)	−1.328 ** (0.407)	−0.136 (0.208)	−0.250 (0.340)	−0.004 (0.129)	−0.038 (0.122)
Tropical Livestock Unit	0.223 * (0.095)	−0.099 (0.199)	0.200 * (0.089)	0.072 (0.121)	0.144 (0.100)	0.085 (0.089)	0.164 (0.086)
Annual remittances (BWP)	−0.000 (0.000)	−0.000 (0.000)	−0.000 (0.000)	−0.000 (0.000)	−0.000 (0.000)	−0.000 (0.000)	−0.000 (0.000)
Annual income (BWP)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	−0.000 (0.000)	−0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Remittances for adaptation	−0.031 (0.019)	−0.003 (0.015)	−0.024 * (0.011)	−0.008 (0.012)	−0.018 (0.015)	−0.013 (0.010)	−0.015 (0.009)
CBNRM dividends (BWP)	0.002 (5.793)	0.017 (1.902)	0.017 (1.902)	0.003 (3.289)	−0.000 (4.309)	0.017 (1.902)	0.017 (1.902)
Rooms in main house	−0.316 (0.415)	−0.150 (0.184)	−0.438 * (0.198)	−0.455 (0.236)	−0.011 (0.271)	−0.298 * (0.148)	−0.339 * (0.140)
Land tenure	−27.027 (1249.241)	0.546 (0.932)	0.666 (0.869)	1.600 (0.986)	1.470 (1.317)	0.878 (0.688)	1.136 (0.652)
Climate information	19.233 (11,173.577)	0.050 (0.938)	0.049 (0.963)	1.224 (1.353)	19.170 (9872.211)	1.064 (0.845)	1.163 (0.759)
Formal employment	0.706 (1.548)	1.564 (0.933)	1.485 (0.955)	0.902 (1.442)	1.589 (0.935)	1.124 (0.975)	1.581 (0.932)
Adult (41–60)	−1.137 (2.772)	0.696 (1.172)	0.712 (1.291)	0.307 (1.437)	−1.892 (1.894)	1.988 (1.023)	0.891 (0.945)
Elderly (>60)	1.212 (4.404)	1.422 (2.204)	2.469 (2.203)	2.155 (2.407)	−0.455 (2.835)	3.638 * (1.742)	2.325 (1.628)
Constant	−30.058 (11,743.619)	6.418 * (3.251)	7.406 * (2.962)	4.994 (3.530)	−13.467 (9872.212)	4.162 (2.608)	3.983 (2.450)
Observations	308						
Base category	Off-farm adaptation						
Prob > Chi ²	0.0000						
Pseudo R ²	0.2503						
Log likelihood	−330.212						
Likelihood Ratio Chi ²	220.478						

Standard errors in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Source: Household Survey Data, 2017. Key: 001 = Livestock-related Adaptations Only; 010 = Land, Soil and Water Conservation Adaptations Only; 011 = Land, Soil and Water + Livestock-related Adaptations; 100 = Crop Adaptations Only; 101 = Crop + Livestock-related Adaptations; 110 = Crop + Land, Soil and Water Conservation Adaptations; and 111 = Crop + Livestock + Land, Soil and Water Conservation Adaptations.

The results in Table 9 show a p -value of the F-statistic (Prob > Chi²) of 0.000 indicating that the variables used in the model, including the model itself, are very significant ($p < 0.05$). The null hypothesis which states that the social and economic attributes considered in this study do not explain the adaptation choices by households in Bobirwa sub-district is rejected since the model F-statistic has an R² greater than zero. Therefore, the attributes of households considered in this study significantly explain some of the variability in adaptation choices by households in the study area, i.e., with a pseudo R² of 0.2503, about 25% of the choice of adaptation strategy mix by households in Bobirwa sub-district was due to variations in the different social and economic attributes in Table 9. Table 9 shows that several variables had a significant influence ($p < 0.05$) on the type of adaptation measure chosen by households.

Table 10 above gives a summary of the different adaptation strategies whose likelihood of adoption was positively or negatively influenced the different socio-economic attributes of the surveyed households. Whether a variable has a positive (negative) or a significant (non-significant) influence on the adoption of any adaptation strategy does not imply a “cause-effect” relationship although, in some instances, causality does exist. Table 11 below shows how the factors considered in explaining household adaptation choices (Table 9) influenced the extent of the adoption of the different strategies. The same explanatory variables revealed a lower inference power on the extent of the adoption of adaptation strategies as shown by a pseudo R² value of 0.1578, i.e., only 15.78% of the variation in the extent of adoption by the surveyed households can be explained by those factors which influenced the choice of adaptation strategies by households in Bobirwa sub-district.

Table 10. Summarized influence of determinants of adaptation in Bobirwa sub-district.

Variable	Positive Influence	Negative Influence
Age (years)		001, 010; 011; 100, 101; 110, 111
Formal education (years)	001; 011; 110; 111	010; 100; 101
Gender	001; 010; 110	011; 100; 101; 111
Occupation	001; 011; 100; 101; 110; 111	010
Household size	101	001; 010; 011; 100; 110; 111
Cropped area	001	010; 011; 100; 101; 110; 111
Tropical Livestock Units	001; 011; 100; 101; 110; 111	
Annual Remittance (BWP)		001; 010; 011; 100; 101; 110; 110
Annual income (BWP)	001; 010; 011; 110; 111	100; 101
Remittances for adaptation (BWP)		001; 010; 011; 100; 101; 110; 110
CBNR dividends (BWP)	001; 010; 011; 100; 110; 110	101
Size of house (Affluence)		001; 010; 011; 100; 101; 110; 110
Land tenure	010; 011; 100; 101; 110; 110	001
Access to climate information	001; 010; 011; 100; 101; 110; 110	
Formal employment	001; 010; 011; 100; 101; 110; 110	
Adults (40–60)	010; 011; 100; 110; 110	001; 101

Key: 001 = Livestock-related Adaptations Only; 010 = Land, Soil and Water Conservation Adaptations Only; 011 = Land, Soil and Water + Livestock-related Adaptations; 100 = Crop Adaptations Only; 101 = Crop + Livestock-related Adaptations; 110 = Crop + Land, Soil and Water Conservation Adaptations; and 111 = Crop + Livestock + Land, Soil and Water Conservation Adaptations.

Table 11. Marginal effects of determinants of the extent of adaptation in Bobirwa sub-district.

	Number of Simultaneous Adaptation Strategies Implemented				
	One	Two	Three	Four	Five
Age (years)	0.000 (.)	−0.032 (0.024)	−0.022 (0.019)	−0.024 (0.018)	−0.013 (0.017)
Gender	0.000 (.)	0.412 (1.077)	−0.208 (0.822)	0.184 (0.783)	−0.284 (0.749)
Occupation	0.000 (.)	1.474 (0.996)	1.596 (0.872)	1.342 (0.839)	1.545 (0.819)
Household size	0.000	−0.099	−0.126	−0.089	−0.055

Table 11. Cont.

	Number of Simultaneous Adaptation Strategies Implemented				
	(.)	(0.104)	(0.088)	(0.077)	(0.073)
Cropped area (ha)	0.000	−0.545 *	−0.046	−0.227	0.001
	(.)	(0.241)	(0.127)	(0.123)	(0.109)
Tropical Livestock Unit	0.000	0.185	0.057	0.175	0.172
	(.)	(0.103)	(0.106)	(0.096)	(0.096)
Annual remittances (BWP)	0.000	0.000	0.000	0.000	0.000
	(.)	(0.000)	(0.000)	(0.000)	(0.000)
Annual income (BWP)	0.000	0.000	0.000	0.000	0.000
	(.)	(0.000)	(0.000)	(0.000)	(0.000)
Remittances financing adaptation (%)	0.000	0.007	−0.012	−0.016	−0.014
	(.)	(0.014)	(0.009)	(0.009)	(0.009)
CBNRM dividends (BWP)	0.000	0.023	0.002	0.023	0.023
	(.)	(24.288)	(32.898)	(24.288)	(24.288)
Rooms in main house	0.000	−0.455 *	−0.203	−0.247	−0.264 *
	(.)	(0.199)	(0.147)	(0.135)	(0.131)
Formal employment	0.000	−19.507	0.847	0.862	0.745
	(.)	(11,005.975)	(0.828)	(0.827)	(0.827)
Constant	0.000	2.573	3.494	4.340 *	3.703 *
	(.)	(2.260)	(1.814)	(1.711)	(1.665)
Observations	308				
Base category	One				
Prob > Chi ²	0.0000				
Pseudo R ²	0.1578				
Log likelihood	−346.714				
Likelihood Ratio Chi ²	129.957				

Standard errors in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

3.3.1. Gender of Main Decision-maker

Table 9 shows that the gender of main decision-maker in the household (De jure household head) had no significant effect ($p > 0.05$) on the adoption of any strategy. Results show that households with females as the main decision-maker were less likely to adopt Land, Soil, and Water + Livestock-related Adaptations; Crop Adaptations Only; Crop + Livestock-related Adaptations; and Crop + Livestock + Land, Soil, and Water Conservation Adaptations and more likely to adopt off-farm adaptations. Conversely, households with male decision-makers were more likely to adopt the four adaptation strategies compared than they would off-farm adaptations. On the contrary, households with females as main decision-makers had higher chances of adopting Livestock-related Adaptations Only; Land, Soil, and Water Conservation Adaptations Only; and Crop + Land, Soil, and Water Conservation Adaptations than off-farm adaptations. Similarly, households with male decision-makers were less likely to adopt the three adaptation strategies than they would off-farm adaptations. Gender had no significant influence on the adoption of any of the strategies.

3.3.2. Age of Household Head

The negative coefficient on age shows that elderly heads of households were less likely to adopt any of the seven on-farm adaptation strategies than off-farm adaptation strategies. This implies that households headed by younger people were more likely to adopt any of the on-farm adaptation strategies or combinations thereof, than they would off-farm adaptations. The influence of age was only significant ($p < 0.05$) on the adoption of two different adaptation strategies, i.e., of Land, Soil, and Water Conservation Adaptations as well as on the adoption of Crop + Land, Soil, and Water Conservation Adaptations. A unit increase in the age of the farmer was therefore expected to significantly ($p < 0.05$)

reduce the chances of adopting these two adaptation strategies while chances of all the other remaining strategies decline but not significantly.

Adult heads of households (41–60 years) were more likely to adopt Land, Soil, and Water Conservation Adaptations Only; Land, Soil, and Water + Livestock-related adaptations; Crop Adaptations Only; Crop + Land, Soil, and Water Conservation Adaptations and Crop + Livestock + Land, Soil, and Water Conservation Adaptations than off-farm adaptations. The only adaptation that was more likely to be significantly adopted by adult heads of households ($p < 0.05$) was Crop + Land, Soil, and Water Conservation Adaptations. Adult heads of households were also less likely to adopt Livestock-related Adaptations Only and Crop + Livestock-related Adaptations compared to off-farm adaptations though not significantly ($p > 0.05$) while young heads of households were more likely to adopt these on-farm adaptations. Elderly heads of households (>60 years) were more likely to adopt all the on-farm adaptation strategies, except for Crop + Livestock-related Adaptations, compared to off-farm adaptations. The only adaptation that the elderly heads of households were more likely to adopt significantly ($p < 0.05$) compared to off-farm adaptations was Crop + Land, Soil, and Water Conservation Adaptations.

3.3.3. Occupation and Employment Status of Household Head

Table 9 indicates full-time farmers had more significant ($p < 0.05$) chances of adopting Crop Adaptations Only; Crop + Land, Soil, and Water Conservation Adaptations; and Crop + Livestock + Land, Soil, and Water Conservation Adaptations than they would off-farm adaptations. Conversely, part-time farmers were less likely to adopt the same adaptation strategies than off-farm adaptations. Full-time farmers were also more likely to adopt Livestock-related Adaptations Only; Land, Soil, and Water + Livestock-related adaptations and Crop + Livestock-related Adaptations than off-farm adaptations though not significantly ($p > 0.05$). Adoption of Land, Soil, and Water Conservation Adaptations Only by full-time farmers was less likely compared to off-farm adaptations but this was not significant ($p > 0.05$). Vice versa is true for part-time farmers.

Households with formally employed members had significantly higher chances of adopting Land, Soil, and Water Conservation Adaptations Only; Crop + Livestock-related Adaptations; and Crop + Livestock + Land, Soil, and Water Conservation Adaptations than they did off-farm adaptations. Those with no formally employed members were less likely to adopt these measures. Though not significant ($p > 0.05$), households with formally employed members were more likely to adopt the four remaining on-farm adaptation strategies, i.e., Livestock-related Adaptations Only; Land, Soil, and Water + Livestock-related adaptations; and Crop Adaptations Only; Crop + Land, Soil, and Water Conservation Adaptations compared to off-farm adaptation while households with no formally employed members had lesser chances. Thus, formally employed members enhanced adoption of all on-farm adaptations, and hindered off-farm adaptations, by their households.

3.3.4. Dry Land Cropped Area

Households with bigger dry land cropped areas were less likely to adopt six of the seven adaptation strategies compared to off-farm adaptations and those with smaller farm sizes. As cultivated dryland area increased, households in the study area were less likely to adopt of Land, Soil, and Water Conservation Adaptations Only; Land, Soil, and Water + Livestock-related adaptations; Crop Adaptations Only; Crop + Livestock-related Adaptations; Crop + Land, Soil, and Water Conservation Adaptations; and Crop + Livestock + Land, Soil, and Water Conservation Adaptations but also increase the adoption of Livestock-related Adaptations Only. This was only significant ($p < 0.05$) in the adoption of Land, Soil, and Water + Livestock-related adaptations and Land, Soil, and Water + Livestock-related adaptations. Increasing dryland cultivated area by households reduced the chances of adopting these adaptation strategies than it did for off-farm adaptations.

3.3.5. Household Size

Table 9 shows that larger households had fewer chances of adopting Livestock-related Adaptations Only; Land, Soil, and Water Conservation Adaptations Only; Land, Soil, and Water + Livestock-related adaptations; Crop Adaptations Only; Crop + Land, Soil, and Water Conservation Adaptations; and Crop + Livestock + Land, Soil, and Water Conservation Adaptations. This was only significant ($p < 0.05$) in the adoption of Land, Soil, and Water Conservation Adaptations Only; Land, Soil, and Water + Livestock-related adaptations; and Crop + Land, Soil, and Water Conservation Adaptations. Bigger households were only more likely, yet not significantly ($p > 0.05$), to adopt Crop + Livestock-related Adaptations. Thus, bigger household sizes discouraged adoption of all, except combinations of crop and livestock adaptations which were enhanced by larger households.

3.3.6. Climate Information

Access to climate information enhanced chances of adopting any of the on-farm adaptation strategies than it did to off-farm adaptations though none of the influence was significant ($p > 0.05$). Conversely, households with poor or no access to climate information were less likely to adopt on-farm adaptation strategies (Table 9). Therefore, access to traditional or scientific climate information encouraged the adoption of any the on-farm adaptations considered in this study.

3.3.7. Household Wealth

Several variables in the model indicated household wealth, i.e., remittances, annual income, remittances financing adaptations, and the number of rooms in the main house. Annual remittances non-significantly ($p > 0.05$) reduced the chances of adopting all on-farm adaptation strategies. Higher proportions of remittances meant for financing agricultural adaptations reduced the chances of households taking up any of the on-farm adaptations. The influence was only significant ($p < 0.05$) on the adoption of Land, Soil, and Water + Livestock-related adaptations. Households received lower agricultural remittances were more likely to use them for the intended purpose.

More household income reduced the chances of adopting Crop Adaptations Only and Crop + Livestock-related Adaptations but increased chances of households adopting Livestock-related Adaptations Only; Land, Soil, and Water Conservation Adaptations Only; Land, Soil, and Water + Livestock-related adaptations; Crop + Land, Soil, and Water Conservation Adaptations; and Crop + Livestock + Land, Soil, and Water Conservation Adaptations. Annual income had no significant influence on the chances of adopting any of the on-farm adaptation strategies ($p < 0.05$).

The number of rooms in the main house significantly ($p < 0.05$) reduced the chances of adopting Land, Soil, and Water + Livestock-related adaptations; Crop Adaptations Only; Crop + Land, Soil, and Water Conservation Adaptations; and Crop + Livestock + Land, Soil, and Water Conservation Adaptations than they did off-farm adaptations. More rooms in the main house non-significantly ($p > 0.05$) reduced the chances of adopting Livestock-related Adaptations Only; Land, Soil, and Water Conservation Adaptations Only and Crop + Livestock-related Adaptations. Households with bigger main houses were therefore less likely to adopt any on-farm adaptation strategy than off-farm strategies as well as compared to those with smaller main houses.

3.3.8. CBNRM Benefits

Table 9 shows that households that received any monetary or non-monetary benefits from CBNRM programs between 2006 and 2017 were more likely to adopt Livestock-related Adaptations Only; Land, Soil, and Water Conservation Adaptations Only; Land, Soil, and Water + Livestock-related adaptations; Crop Adaptations Only; Crop + Land, Soil, and Water Conservation Adaptations; and Crop + Livestock + Land, Soil, and Water Conservation Adaptations although they were less likely to adopt Crop + Livestock-related Adaptations. Those that did not were less likely to adopt any of these strategies.

Receiving CBNRM benefits did not have any significant influence on the adoption of any of these strategies ($p > 0.05$).

3.3.9. Tropical Livestock Units (TLU)

The aggregated population size of different livestock species in Tropical Livestock Units (TLU) significantly enhanced the likelihood of adopting Livestock-related Adaptations Only; Land, Soil, and Water + Livestock-related adaptations; and Crop + Livestock + Land, Soil, and Water Conservation Adaptations. Higher TLU also increased chances of adopting Crop Adaptations Only; Crop + Livestock-related Adaptations; and Crop + Land, Soil, and Water Conservation Adaptations but the influence was not significant ($p > 0.05$). Households with higher TLU were less likely, and non-significantly ($p > 0.05$), to adopt Land, Soil, and Water Conservation Adaptations.

3.3.10. Agricultural Land Tenure Arrangements

Ownership of agricultural land had enhanced chances of adopting Land, Soil, and Water Conservation Adaptations Only; Land, Soil, and Water + Livestock-related adaptations; Crop Adaptations Only; Crop + Livestock-related Adaptations; Crop + Land, Soil, and Water Conservation Adaptations; Crop + Livestock + Land, Soil, and Water Conservation Adaptations. Adoption of Crop + Livestock + Land, Soil, and Water Conservation Adaptations was the only strategy significantly ($p < 0.05$) influenced by owning agricultural land. Households that owned agricultural land were less likely to adopt Livestock-related Adaptations Only though the influence was not significant ($p > 0.05$). Conversely, households that did not have full ownership of agricultural land were less likely to adopt any on-farm adaptation strategies.

4. Discussion

4.1. Households' Adaptation Strategies to Climate Change

The findings show that communities in Bobirwa use both on-farm and off-farm strategies to respond to climate change impacts. The prevalence of livestock management and agronomic practices to manage crops, land, soil, and water indicate the importance of agriculture as a livelihood strategy in Bobirwa. Several studies have shown the importance of subsistence agriculture to rural livelihoods in southern Africa [13,34,35].

The adoption of agronomic practices such as growing drought-tolerant and early maturing crops, the use of seasonal forecasts, and consulting agricultural extension officers by the majority of the surveyed households could be attributed to the ISPAAD initiative by the Department of Crop Production in the Ministry of Agriculture. Under ISPAAD, poor farmers were provided with free improved seeds, fertilizers, agrochemicals, tillage, and access to credit and extension services [36]. The low usage of fertilizers, pesticides, and herbicides reported by most households could be due to drought-induced crop failure before farmers could apply agrochemicals issued under ISPAAD. The free inputs under the ISPAAD programme were also associated with the increase in the cropped area among the surveyed households. Several studies have shown increased uptake of agricultural adaptation initiatives that are promoted by governments and non-governmental organizations [37–39].

In addition to the input support and free tillage up to 5 ha under ISPAAD, encouraging households to expand their cropped area, the expansion of cultivated area to grow more crops reported by 42% of the households could also be attributed to the increasing severity of droughts. A study by [40] in the Gaborone dam catchment in Botswana, also found that farmers expanded their croplands in order to maximize yields given the rising drought-induced crop failure. The low adoption of practices such as conservation agriculture and in-field soil and water conservation by farmers may explain the low yields of major grain crops among smallholder farmers in Botswana [41]. A study by [42] in several southern African countries attributed the low adoption of conservation agriculture by smallholder farmers to limited knowledge and their huge labour requirements. Agricultural extension services

need to increase farmer education and demonstrations to improve awareness and subsequent adoption of relevant practices by households [43].

The fewer households who had farms in different geographical areas could indicate the high demand for agricultural land in Bobirwa. This may also be due to the slow processing of new farms by the Land Board. The isolated cases of clearing of land for cultivating crops in communal grazing areas where crop production was prohibited provides further evidence that accessing new farmlands in Bobirwa sub-district was either difficult or a lengthy process.

The low adoption of livestock adaptations is attributed to the low ownership of livestock by households in Bobirwa sub-district. For instance, only less than 38% of the households owned cattle or donkeys while goats were owned by 56%. The low adoption of livestock adaptations was also found among smallholder farmers in southern Africa by [26]. With goat production shown to significantly contribute to the livelihoods of rural communities in Botswana, government programs such as Livestock Management and Infrastructure Development (LIMID) through the Department of Animal Production need to expand the programme [44]. This can allow more poor farmers to benefit from the programme; thereby, increasing livestock ownership in the sub-district. The high ownership of chickens by households owning chickens was attributed to the ability of free-range chickens to survive the harsh conditions [45].

The moderate adoption of livestock sales and destocking by livestock farmers is mainly attributed to the increasing severity of droughts. A study by [46] found that only 4% of livestock farmers in Bobonong and 23.7% of those in Kgalagadi in Botswana destocked their livestock through selling. Similar to findings from both studies, surveyed households in Bobirwa sub-district expressed reluctance to destock even with increasing severity of droughts as more livestock provided them with several subsistence needs, were a store of wealth and considered an adaptation to droughts, i.e., more tolerant than crops [43], also found low destocking levels by rural farmers in Amathole District Municipality, Eastern Cape Province of South Africa, partly because of similar reasons.

The adoption of livestock supplementary feeding was supported by the availability of crop residues and the ability of better-off households to purchase supplementary feeding. The low adoption of changing composition of livestock could be due to low annual incomes reported by most of the surveyed households [43,46]. Moving livestock to other geographical areas and seeking grazing rights from other traditional authorities were limited by the Foot-and-Mouth Disease (FMD) which restricted farmers from moving their livestock beyond the study area [47]. Even the formation of grazing associations was constrained by communal ownership of grazing land where individuals do not have exclusive rights. Despite grazing areas in Bobirwa sub-district being freely accessible to all community members, there was no strict control of grazing or grazing area [46].

The low adoption of livestock adaptations in Bobirwa sub-district including the few households who reported receiving livestock through government projects or those who started animal rearing as a diversification of their livelihoods may indicate that the LIMID programme only benefited few poor households. This may also show that the LIMID programme was ineffective as it failed to benefit many poor households in the study area [48]. There is a need for intensifying livestock production among poor households through increasing the capacity of initiatives such as LIMID through promoting livestock production systems, markets, and institutions that enhance sustainability [49].

The low adoption of off-farm adaptation strategies in Bobirwa sub-district could indicate that livelihood opportunities outside rain-fed agriculture were limited. The most dominant off-farm activity was the emigration of household members (78%) in search of economic opportunities in neighboring towns. This provides further evidence of the limited opportunities outside rain-fed agriculture in the study area. With about two-thirds (67%) of the households not receiving remittances from emigrated household members and annual income below BWP5000 (US \$450), livelihoods in Bobirwa sub-district are heavily hinged on subsistence agriculture. Other off-farm adaptations included the exploitation of several timber and non-timber products such as selling of firewood (45.2%) and non-timber forest products such as Mopane caterpillars.

The surveyed households only reported a few ecosystem products among their adaptation responses. This is different from findings in a study by [43] in the Amathole District Municipality in South Africa, where rural farmers reported exploitation of several non-farm flora and fauna species among their climate change adaptation strategies. Several studies have shown the importance of wild fruits and wild foods towards household food and income requirements in Botswana [9,50,51]. Failure to recognize the importance of provisioning ES among climate change adaptation strategies by households in Bobirwa sub-district may explain the lack of measures to improve the sustainability of their delivery among the reported off-farm strategies.

The diversity of laborious agronomic practices (crop, land, soil, and water) adopted under crop adaptations could also be limiting the adoption and diversity of off-farm adaptation practices by households in Bobirwa sub-district. Overall, on-farm adaptations were adopted by most of the surveyed households. This may be due to households adopting at least one of the different practices. The findings also suggest that households in Bobirwa sub-district may have integrated crop adaptations as part of their livelihoods possibly due to crop production being one of the main livelihood strategies. The low adaptation of livestock adaptations is consistent and comparable with the fewer households owning livestock suggesting that increasing livestock ownership could also livestock adaptations. The lack of provisioning ES among off-farm adaptations may indicate a poor perception of these as adaptation strategies to climate change. In order to enhance the importance of provisioning ES as climate change adaptation strategies in Bobirwa sub-district, more awareness, investment, regulations, and policy are required to guide conservation and sustainable exploitation given the growing human population. Similarly, investments are required to diversify and enhance off-farm livelihood opportunities to reduce overreliance on rainfed agriculture which is risky.

4.2. Determinants of Adoption of Climate Change Adaptation Strategies

The R^2 of 0.2503 for the overall model indicates that 25.03% of the variation in the choice of adaptation strategy mix (dependent variable) was due to the variations in the different social and economic factors of the households (explanatory variables). Though this value is low, the pseudo R^2 for MNL models to explain social and behavioral outcomes, e.g., adaptation choices of households in Bobirwa sub-district, are usually low as shown by studies elsewhere [23,52]. The low R^2 also suggests that there could be other relevant factors not included in the model which may explain the adaptation choices by households in the study. In the study area, these could include the mean annual temperature, mean annual precipitation, drought severity and recurrence, the extent of government programs such as Ipelegeng ("cash-for-labour") and ISPAAD, market development, migration and extent of human-wildlife conflicts. Those attributes with p -values below 0.05 significantly influence the adaptation choices of households in Bobirwa sub-district. Whether a variable has a positive (negative) or a significant (non-significant) influence on the adoption of any adaptation strategy should not imply a "cause-effect" relationship. However, where causality exists, this could be an important entry point for transforming current adaptation initiatives to be more effective and sustainable [53].

4.2.1. Gender of Household Head

The non-significant effect of the gender of the main decision-maker on the adoption of any strategy ($p > 0.05$) indicates that the differences in the adoption of any strategy were not statistically different between female and male decision-makers at the household level. Female decision-makers at the household level were less likely to take up Land, Soil, and Water + Livestock-related Adaptations; Crop Adaptations Only; Crop + Livestock-related Adaptations; and Crop + Livestock + Land, Soil, and Water Conservation Adaptations compared to male-headed households as shown by the negative coefficient. These findings contrast those from other studies which found gender of the main decision-maker to significantly influence their choice of adaptation strategies among farming communities [13,30,54].

Although female decision-makers in households in Bobirwa sub-district were more likely to adopt livestock production and management practices as the only adaptive response, women and young people mostly reared chickens and small livestock such as goats. This could be due to the low feed demands by chickens and small livestock compared to large livestock such as cattle [44,55]. Studies such as [26] also found that male-headed households in Southern Africa were more likely to diversify livestock and crop production including other off-farm activities to manage the impacts of climate change than their female counterparts. Therefore, female-headed households in Bobirwa sub-district could be limited by the numerous household chores, childcare as well as the demanding nature of many agricultural adaptations. Such multiple tasks reduce the time for women to take up diversified adaptations as revealed by the negative relationship between female decision-makers at the household level and the adoption of several adaptation strategies.

Considering that female decision-makers only had higher chances of adopting Livestock-related Adaptations Only; Land, Soil, and Water Conservation Adaptations Only; and Crop + Land, Soil, and Water Conservation Adaptations, it may suggest that women in Bobirwa sub-district still face challenges in accessing resources such as land, relevant information and capital compared to male-headed households. Despite the high ownership of information communication channels such as mobile phones, television sets, and radios among the surveyed households, information asymmetry between males and females is very high among many rural farming communities as shown by studies elsewhere in Africa [13,34,56]. This could suggest that less relevant or inadequate information is shared through these channels. In addition, with only 32.3% of female heads of households being full-time farmers, where most of the household heads were females (79.7%) in a rural farming community, this further highlights the limits imposed on rural women by the several roles they perform.

As most of the heads of households were part-time farmers, both men and women in Bobirwa were expected to have limited time to fully implement most of the agricultural practices despite being the main decision-makers. However, unlike in other studies where women and children were mostly implementers of adaptation practices and decisions made by males, in Bobirwa sub-district, it is important for decision-makers to make adaptation decisions and policies which resonate well with women and young people. Being the majority of the household decision-makers, women can easily influence and inform the type of adaptations that require government support for them to be more effective. With the Government of Botswana culture of participatory decision-making through consulting communities in a bottom-up approach [57], adaptation policy and planning can easily cater for the gendered challenges within communities.

4.2.2. Age of Household Head

The negative influence of age of the main decision-maker on all the seven adaptation strategies shows that aging hinders the adoption of any of the current adaptation strategies. However, aging only significantly reduced the adoption of Land, Soil, and Water Conservation Adaptations and that of Crop + Land, Soil, and Water Conservation Adaptations. These findings are different from previous studies like [25] where the age of the main decision-maker in the household was shown to significantly enhance adaptation to climate change by farmers in the Nile Basin of Ethiopia. The limitations imposed by aging in Bobirwa sub-district could be attributed to the reduced planning horizons and agility as people grow older. Therefore, elderly farmers were less likely to take up long-term adaptation decisions, particularly those involving demanding tasks. Despite the findings, elderly heads of households in Bobirwa sub-district could play a significant role in promoting successful adaptations by passing on the knowledge and experience acquired over the years to young people who are not only energetic but still have longer planning horizons. Young people are also more likely to integrate such knowledge with emerging adaptation measures.

With adult heads of households (41–60 years) more likely to adopt Land, Soil, and Water Conservation Adaptations Only; Land, Soil and Water + Livestock-related adaptations; Crop Adaptations Only; Crop + Land, Soil, and Water Conservation Adaptations and Crop

+ Livestock + Land, Soil, and Water Conservation Adaptations compared to young heads of households (<40 years), this shows that adult farmers were more experienced than young farmers [25]. Importantly, this could mean that the peak of adoption was reached in adulthood (41–60 years) and declined among the elderly. Studies by [23,34,58] also found age to be a proxy of, and correlated to, experience. Therefore, despite the declining adoption of adaptations with age, adult and elderly farmers in Bobirwa sub-district could be more knowledgeable and experienced about the dynamics of climate change adaptation than younger farmers.

4.2.3. Dry Land Cropped Area

The negative influence of increasing the cropped area on the adoption of all adaptation strategies except livestock adaptations could be influenced by the surveyed household heads being mostly part-time farmers. Bigger farms require more resources and time to implement the various agronomic practices which part-time farmers may not have. Since most of the households (62.3%) had annual incomes below BWP5000 (US \$450), these could be inadequate for financing adaptation practices. Therefore, increasing the cropped area could be further limited by the low incomes. The emigration of at least two economically active household members in search of employment opportunities in neighboring towns and cities often results in households composed of more children and the elderly whose labour may not be available for farming. A high composition of children adds a strain on women—who usually have multiple household chores—through providing care which limits the time available to implement the numerous agronomic adaptation practices.

Although agricultural expansion was viewed by local communities as an adaptation to more severe droughts, the results suggest that bigger farms, which require more time and effort to implement various agronomic and adaptation practices, were a barrier to climate change adaptation in Bobirwa sub-district. Therefore, smaller farms require less time and effort for land preparation and implementing the various agronomic practices given the small household sizes (5) and low ownership of donkeys (26.1%), which are solely used for draft power in the study area. Despite the majority of households (63.8%) reporting that they owned agricultural land privately with papers, croplands in Bobirwa sub-district are communally owned and can be partitioned for other members as the human population grows [27]. Therefore, households could be reluctant to invest in meaningful and lasting adaptation strategies on their farms. This could be a barrier to the implementation of various adaptations on larger farms which may be targeted for partitioning than smaller farms.

The increased chances of the adoption of livestock-related adaptations with bigger cropped areas could be attributed to the complementarity between livestock and crop production. Livestock such as donkeys provide draft power for tillage while crop residues from crop production are increasingly used for feeding livestock during the dry season. Therefore, bigger farms encourage farmers to undertake livestock practices as an adaptation strategy as there exists a mutual relationship between the provision of draft power from livestock while residues from crops are used to supplement livestock feeds especially when pastures are scarce. A study by [46] reported that as part of the pre-drought preparations in Bobonong (village in Bobirwa), farmers stored crop residues of sorghum and maize for their livestock. Similarly, as a response to the declining availability of natural pastures, households could stock up and feed their livestock with crop residues from bigger farm sizes even with crop failure.

4.2.4. Household Size

The negative influence of bigger household sizes on the adoption of all the adaptation strategies, except one on crop and livestock adaptations in sub-district, could be attributed to the low composition of able-bodied and economically active members due to emigration. Although bigger household sizes have been shown to improve the adoption of adaptations by studies such as [59], the contrasting results from this study are likely due to the high composition of children, the elderly, and women. This is mainly due to the emigration of mostly young and adult members of the household who could be providing labour on the farms.

Young people living and working in neighboring towns and cities, particularly young women, often leave their children under the care of their parents or grandparents and return to the cities. This often leaves most households with many minors who require childcare which further limit time for working in the fields. As effective adaptations to climate change often require farmers to undertake several activities beyond their usual seasonal routines, this requires more labour and time resources which are limited by emigration of able-bodied household members. For instance, land, soil, and water conservation practices are usually labor-intensive. Therefore, households with several able-bodied members who are available to work on the farm may be able to take up several climate change adaptation measures than those households with fewer such members. There is a need for government programs to enhance livestock production, particularly donkeys which provide draft power for tillage. Government programs such as the ISPAAD, which assist poor farmers with free tillage and other inputs, also need to assist local communities to own tractors which they can control and schedule. This can increase the effectiveness of the programme and the timing of activities.

4.2.5. Climate Information

The very high access to climate and agricultural information (91%) by surveyed households in Bobirwa sub-district is attributed to the high ownership of cellular phones (94.5%), television sets (63.5%), and radios (51.6%). This is shown by the high proportion of households who were influenced or informed by radio or TV programme (78.1%) to adopt new farming practices. The high literacy level as shown by more than 72% of household heads with formal education further suggests that people were able to comprehend the messages sent through cell phones, radios, television sets, and print media. Therefore, the positive influence of access to climate information on the adoption of all the adaptation strategies could be attributed to the high ownership of communication gadgets and high literacy levels. High access to climate information by the surveyed households is also attributed to face-to-face interaction with extension officers (71%), village chiefs (*DiKgosi*) (41.9%), other successful farmers (39.7%), and farmer organizations (23.2%). [26] also reported a high uptake of adaptation measures among smallholder farmers who perceived changes in climate in southern Africa.

Although formal education was shown to enhance the adoption of Livestock-related Adaptations Only; Land, Soil, and Water + Livestock-related Adaptations; Crop + Land, Soil, and Water Conservation Adaptations; and Crop + Livestock + Land, Soil, and Water Conservation Adaptations, the effect was not significant. This may suggest that information on climate change and adaptation acquired through formal education could be inadequate to significantly enable effective adaptations in the study area. A study by [60] in 11 African countries noted that perceiving climate change was critical to decision-making and choosing the appropriate strategies to adopt. There may be need for improving the education curriculum to include climate change adaptation studies at all levels of formal education up to the tertiary level to enhance the adoption of adaptation practices that are more informed, effective and relatively inexpensive. The negative influence of formal education on the adoption Land, Soil, and Water Conservation Adaptations Only; Crop Adaptations Only; and Crop + Livestock-related Adaptations could therefore be due to less relevant information acquired over the years.

The quality and spatial resolution of climate information are also critical particularly for crop-related adaptations where the timing of certain operations is an important factor. The non-significant influence of climate information on the adoption of appropriate adaptation strategies could be due to the high spatial resolution of climate information by the Meteorological Services Department (MSD). For instance, weather information and seasonal forecasts in Botswana are often generalized and focus on the district levels to be of much relevance to decision-making at the sub-district, village, and farm levels. There is a need for the MSD to issue more localized weather and climate information which are more relevant at the farm level. With multiple information channels accessible to households (e.g., cellular phone, television, and radio) and the high literacy levels in Bobirwa sub-district, these could enhance the sharing of more localized, detailed, and relevant weather and climate information as well as climate change adaptation strategies.

With households depending mainly on traditional knowledge (41.3%) and meteorological services (58.4%) for climate information, the two climate information sources need to be complementary. The influence of non-formal and traditional knowledge on the adoption of agricultural adaptations among rural communities need to be well understood, validated, and synchronized with scientific information from formal institutions such as MSD. In addition to observing changes in vegetation, crop phenology, and growth patterns, information from the MSD, Ministry of Agriculture and other relevant institutions could significantly influence decisions at the household level and enhance the timely adoption of more appropriate adaptation measures.

Decentralized weather forecasting could allow more localized, relevant, and timely forecasting that can allow stakeholders and local communities to synchronize the traditional indicators with the scientific information from MSD. Extension information from the Ministry of Agriculture also needs to be current to enable farmers to adopt crops and practices suitable to the agroecological conditions in the study area that agricultural adaptations can be impactful [46].

4.2.6. Household Wealth

Several variables in the model were indicators of household wealth, i.e., remittances, annual income, the proportion of remittances financing adaptations, as well as the number of rooms in the main house. Nonetheless, it was important to examine their individual effects. The negative influence of remittances, annual income, and the number of rooms in the main house on the adoption of almost all the adaptation strategies suggests that wealthier households in Bobirwa sub-district had less direct dependence on agriculture and ecosystem products. This is consistent with previous studies which showed that poor households were more dependent on the ecosystem products than wealthier households [61,62]. Therefore, as household wealth increases, households in Bobirwa sub-district were more likely to buy household food requirements and pay for other requirements than producing themselves.

Other studies have shown a positive influence of wealth and higher incomes on the adoption of agricultural adaptation in South Africa [43], Niger [39], and Zimbabwe [13]. The surveyed households in Bobirwa sub-district were therefore less likely to depend on the ecosystem products, particularly from agriculture and woodlands, with increasing income. Higher incomes enable households to purchase their food requirements than produce it themselves given the severe droughts. Therefore, increasing opportunities for off-farm incomes could effectively reduce the dependence on natural ecosystems and help with conservation efforts. Reduced human dependence on ecosystem products can allow biodiversity regeneration, enhance the condition of local ecosystems and improve the delivery of provisioning ES.

4.2.7. Occupation and Employment Status of Household Head

The positive influence of being a full-time farmer on the adoption of all adaptation strategies except Land, Soil, and Water Conservation, unlike part-time farmers, is attributed to more disposable time resources to practice or implement these adaptations. Although formal employment is usually associated with sustained and reliable income, annual income and remittances have already been shown to have a negative influence on the adoption of almost all the adaptation strategies. However, other positive, non-monetary benefits of formal employment among household members in the study area are related to access to recent, up-to-date, and relevant climate and agricultural information which allows them to make informed decisions using experience gained in a formal setting. Other studies have shown that household members working outside their communities were not only bringing new information, ideas, and technologies but were also influential in the decision-making of their households [7,63].

4.2.8. CBNRM Benefits

Receiving monetary or non-monetary benefits from CBNRM programs increased the adoption of all the adaptation strategies in the model. Although the influence was not significant for all the adaptation strategies, the provision of CBNRM benefits to the community was likely to provide a source of livelihood. As an alternative source of income and incentive for conserving local resources, CBNRM benefits were likely to motivate farmers to take up agricultural adaptations and, in a way, reduce overexploitation and overdependence on other ecosystem products. Coordinated efforts by relevant departments such as National Parks and Wildlife, Forestry, and Range Resources and Tourism and Hospitality are needed to further enhance CBNRM benefits among communities in Bobirwa sub-district to encourage them to conserve the local ecosystems.

4.2.9. Tropical Livestock Units (TLU)

Higher Tropical Livestock Units (TLU) improved the likelihood of the adoption of all strategies in Bobirwa sub-district except Land, Soil, and Water Conservation Adaptations. Therefore, increasing livestock ownership by households in the study area encouraged the adoption of adaptation strategies. For instance, households with more livestock such as cattle, goats, and sheep were expected to easily take up livestock practices to safeguard them from climate change or drought-induced loss of pastures and disease outbreaks [46]. Donkeys are an important source of draft power in Bobirwa sub-district and facilitate the adoption of labor-intensive adaptation practices such as land and soil management which involve tilling the land. Draft power is critical for smallholder farmers in the study area since household labour was shown to be constrained by the emigration of able-bodied household members in search of economic opportunities as explained earlier. Enhancing livestock ownership, particularly donkeys, increases draft power which can facilitate the adoption of such agronomic practices as soil and water conservation, changing to new crops, varying planting dates as well as diversification of crop enterprises. These practices are labour intensive; therefore, less likely to be adopted in the absence of, or with inadequate, currently low ownership of tractors or draft animals, particularly donkeys.

As livestock are not only a source of income but also a form of wealth, previous studies have shown that being wealthy was associated with improved access to information [14,38,64]. Access to climate and agricultural information has already been shown in this study to remarkably improve the uptake of adaptation strategies. Several previous studies also showed that wealthy households had more access to information which in turn influence uptake of technologies and other innovations such as conservation agriculture and climate-smart agriculture more than poor farmers with less or no livestock [39,43,65]. However, the negative effect of TLU (livestock), which reduced the chances of taking up Land, Soil and Water Conservation as an adaptation strategy, could be because such sole adaptations have fewer welfare effects on the households. Therefore, smallholder farmers were more likely to adopt those strategies which have multiple benefits.

4.2.10. Agricultural Land Tenure Arrangements

The positive effect of officially owning agricultural land on the adoption of all the adaptation strategies except Livestock Adaptations is attributed to the relative security of tenure which allows farmers to invest in different adaptations. Several studies also found a positive correlation between ownership of agricultural land and adoption of adaptation strategies, improved technologies as well as farm investments and developments [37,43,65]. Conversely, those who did not own agricultural land were discouraged from investing on the land as they lacked security of tenure to make any significant investments on the land.

Although the ownership of agricultural land by households in the study area was reported as private ownership, this was different from the freehold tenure on privately-owned farms. Households in the study area did not have exclusive rights to their agricultural land as it was communal land. However, being issued certificates of occupation provides households with relative security compared

to those who rent, occupy illegally, or have temporary use of family land. Expediting the issuance of agricultural land by the local Land Board and securing land ownership could encourage households to invest in long-lasting adaptations.

4.3. Implications of Current Adaptation Responses in Bobirwa Sub-Districts

How communities perceive climate change has implications on the adoption of strategies including the type of strategies implemented [46]. The socio-economic attributes, adaptation choices, and the determinants of these choices discussed in this study may have several implications for communities in Bobirwa sub-district. The semi-arid climate experienced in the sub-district highly exposes several economic sectors to the incremental impacts of climate change. Although local communities perceived a more adverse climate, their long experience of droughts appears to be causing household response strategies seem as part of their normal life. [46] also found that droughts had become a norm in Bobonong, such that local communities had become used to them. Therefore, the high adoption of different adaptation strategies by households in Bobirwa sub-district may suggest that current practices have been integrated as part of their livelihoods. However, failure to appreciate the incremental impacts of climate change by communities in Bobirwa could be limiting them from transforming and scaling up their adaptive responses.

The low crop yields during the study period given the free input support to farmers under ISPAAD suggest that current adaptation practices used in rain-fed crop production in the study area were inadequate. This could be partly due to the failure of the ISPAAD initiative to recognize the agroecology of the study area as a semi-arid area including issuing non-suitable crops and varieties for the prevailing climate. Less effective crop adaptations could mean that the production of food in Bobirwa sub-district will remain constrained and threaten household food security. The continued expansion of agricultural land in which households cannot fully implement effective adaptations may also indicate inadequate adaptations. Such less productive agricultural expansions are usually at the expense of biodiversity loss which underpins the delivery of provisioning ES.

Despite the devastating impacts of droughts, destocking and selling part of livestock remained low in the study area. With several uses of livestock such as food, draft power, source of income and a sign of wealth, households in Bobirwa sub-district seem reluctant to reduce their livestock even with severe droughts. Moreover, grazing at the communal grazing areas (cattle posts), including livestock ownership per household, was neither limited nor controlled. Under such circumstances, destocking remained an unpopular adaptation response [46]. The concentration of large livestock such as cattle threatens the sustainability of natural pastures at the cattle-posts. Livestock may end up moving longer distances in search of pastures which wastes their energy while also exposing them to theft and predation. In addition, farmers may eventually be forced to sell their livestock at much lower prices in the event that droughts are severe and prolonged.

While the surveyed households seemed reluctant to destock their livestock, the adoption of other strategies such as supplementary feeding, migrating livestock in search of pastures, and changing livestock composition by some households could indicate a desire to adapt their livestock production. While wealthy households may be able to purchase supplementary feed for their livestock, poor households may need to be assisted with subsidized feeds during severe droughts to avoid weight loss, reduced fertility, and deaths. Considering the smaller herds by poor households, it may be difficult for them to recover breeding stock that may be lost during droughts [46].

The failure to destock large livestock such as cattle which are susceptible to severe droughts despite receiving seasonal forecasts and drought early warning systems also highlight challenges faced by farmers in this regard. As highlighted before, the failure to destock is mainly attributed to FMD. However, other challenges included limited markets (caused by FMD), the low prices at local markets may be better than drought-induced livestock deaths. Failure to adequately adapt livestock production may further limit the availability of draft power particularly from donkeys. Although draft power in the sub-district is provided by donkeys, livestock adaptations mainly focused on cattle and goats

which provide subsistence benefits such as meat and milk. This could have serious implications on crop production and adaptations which depend on draft power provided by donkeys. The increasing demand for free tillage services under ISPAAD requires that farmers provide their own tillage using draft power to minimize delays; hence, the need to also target donkeys in livestock adaptations.

For poor households, their current vulnerabilities may increase due to loss of biodiversity caused by inadequate adaptations in agriculture such as unnecessary agricultural expansions [66]. With warming and drought severity in Bobirwa sub-district likely to continue rising in the near future, the threats on livelihoods could be huge under current adaptation regimes similar to findings in other studies [67]. Since none of the adaptation measures were aimed at conserving or improving biodiversity, there is an urgent need for measures to safeguard the basis of provisioning ES in the sub-district. Communities in Bobirwa sub-district need to be proactive and engage the government, traditional authorities, civil society, private sector, and NGOs for guidance and support in addressing challenges in agriculture (crops and livestock), water, tourism, health, and migration [1,68].

With a growing human population, low agricultural productivity, and biodiversity loss, further investments are required to improve agricultural productivity and conservation of natural ecosystems in Bobirwa sub-district [69]. Similar to concerns by [70], a rise in food imports caused by low investments in African agriculture could make food unaffordable for poor households in the sub-district. Therefore, the implementation of initiatives such as ISPAAD and LIMID needs to be more effective and enhance agricultural productivity while also limiting the unnecessary loss of biodiversity [71,72]. However, such planned adaptations need to consider the associated trade-offs so that addressing low agricultural productivity does not infringe on the delivery of ecosystem products.

5. Conclusions

The high level of adaptation of off-farm and on-farm adaptations shown in this study suggests improved knowledge of the adverse incremental impacts of climate change. The high-level of adoption and implementation of on-farm and off-farm adaptation strategies shown by the local communities was mainly attributed to the perceived increase in the frequency and severity of droughts together with warmer temperatures in recent years. Although the choice and mix of adaptation strategies adopted by communities in Bobirwa sub-district may also indicate a high receptiveness to government programs in the agricultural sector, they also reveal inadequate responses to effectively act against incremental climate change. In their current state, the adaptation strategies in the sub-district may soon become redundant as the impacts of climate change become more intense. There is a need for government programs such as ISPAAD to also educate smallholder farmers and provide them with more localized information on climate forecasts, climate change, droughts and relevant agronomic practices to improve the efficacy of current responses. This could improve awareness among farmers and allow more efficient adaptations through accepting input packages that suit the agroecology of their area and not just their preferences. The government also needs to promote the establishment of off-farm opportunities in rural areas by encouraging investments which encourage processing and value addition of ecosystem products to broaden the livelihood base and possibly reduce overreliance on rainfed and dryland agriculture. Among the social and economic attributes of households, which had a homogeneous influence across all the available adaptation strategies, were the age of the household head (negative), annual remittances to the household (negative), the proportion of remittances devoted to financing adaptations (negative), number of rooms in the main house (negative), climate information (positive), and formal employment (positive). Among those largely associated with a high uptake of adaptations were years of formal education, being a full-time farmer, tropical livestock units, annual income, CBNRM benefits, land tenure arrangements, and being an adult, or elderly head of household. Being a female head of household, bigger household sizes, and bigger cropped area were largely associated with low adoption of the different adaptation strategies. The influence of these socio-economic attributes of households provide critical information for adjusting government

programs such as ISPAAD and provide important entry points for influencing uptake of more effective adaptations by local communities.

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Article

Adaptation to Extreme Hydrological Events by Javanese Society through Local Knowledge

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Abstract: Understanding the effects of local knowledge on actions and decisions taken during a crisis is important; empirical studies and scientific data can be instructive to this end. This study integrated local knowledge (*Pranata Mangsa*) in Jawa, Indonesia, with scientific data on diurnal rainfall, extreme precipitation events, using the Local and Indigenous Knowledge System (LINKS). The results showed that *Pranata Mangsa* has informed aspects of agriculture including crop calendars, crop patterns, and farming activities, for over 1000 years in Jawa. *Pranata Mangsa* also enhances community resilience by mitigating the effects of extreme droughts; this finding was validated using scientific data.

Keywords: *Pranata Mangsa*; local and scientific knowledge; LINKS; community resilience

1. Introduction

Extreme hydrological events, including drought and floods, occur in various parts of the world [1]. The mechanisms involved are extremely complex and poorly understood [2]. Global warming has affected the hydrological cycle, leading to more frequent and intense precipitation events [3]. Recent studies suggested that future global warming will lead to significant changes in the intensity and frequency of precipitation, which is very likely to be associated with a higher risk of urban drought and floods [4]. Drought can be classified into four categories: meteorological, agricultural, hydrological, and socio-economic drought [5]. There is no universally accepted definition of drought, and no index that applies to all types thereof [6].

The United Nations Environment Programme [7] defines adaptation as follows: “In human systems, the process of adjustment to actual or expected climate and its effects to moderate harm or exploit beneficial opportunities. In natural systems, the process of adjustment to actual climate and its effects; human intervention may facilitate adjustment to expected climate”. Adaptive capacity, community resilience, and strategies adopted in human and natural systems to adjust to uncertainties in the climate should be assessed, along with the frequency and/or severity of climate events [8]. Sensitive systems are needed to ensure survival [9].

Local knowledge can increase the resilience of communities, and enables them to develop adaptation strategies, including early warning systems in the face of an uncertain climate [10–12]. Anthropologists and sociologists have developed theories of local knowledge, dating back to the 1930s and 1940s. For example, Redfield introduced the “folk-urban continuum” concept in 1944 [13],

according to which risk reduction can only be achieved through a social process as opposed to a technical, engineering-based process [14]. A catastrophic tsunami was predicted by communities in Aceh, Indonesia based on their local knowledge (*Smong*) [15]. Local knowledge is also being used to prevent and mitigate damaging phenomena linked to climate variability in Zimbabwe, such as flooding [16] and droughts [17]. Many studies have characterized local knowledge as a dynamic and complex body of knowledge, practices, and skills that are developed and preserved by towns or communities through their experiences over time. However, no study has assessed whether local knowledge pertaining to agriculture can enhance community resilience by mitigating the effects of floods and drought.

The Local and Indigenous Knowledge System (LINKS) was proposed by the United Nations Educational, Scientific and Cultural Organization (UNESCO) as a method for integrating local knowledge with scientific studies of disaster risk reduction (DRR) and climate change adaptation (CCA). LINKS has been used to emphasize the relevance and advantages of local knowledge through empirical data. Local knowledge is transmitted from one generation to the next, and may help to mitigate disaster and promote CCA [18].

In Indonesia, local knowledge plays a role in improving disaster preparedness. For example, *Smong* played a role in the response to the Indian Ocean earthquakes and resulting tsunamis that occurred in 1907 and 2004 [15]. Local agricultural knowledge, including *Aneuk Jame* (in Aceh), *Parhalaan* (in Sumatra), *Paladang Dayak* (in Kalimantan), and *Pranata Mangsa* (in Jawa) has been used to strengthen community resilience to natural disasters over a long period, and can be traced back to ancient agricultural kingdoms (beginning in 700 AD) [19].

In 1960, the Indonesian government strictly implemented a national program consistent with the Green Revolution, whereby conventional farming was replaced with modern practices (e.g., mechanization, pesticide use, and changes in crop types) [20,21]. Local knowledge was treated as outdated and unscientific by this program, which led to self-sufficiency in rice production by the 1980s. Indonesia was recognized internationally for its favorable policies with respect to the Green Revolution, even being granted the honor of making a speech to other Food and Agriculture Organization (FAO) member countries [22], whereas the local knowledge was regarded only as a traditional culture rather than a practical guideline. However, the new practices were criticized in terms of the high costs, land degradation, and use of unsustainable agricultural practices [23]. Farmer demonstrations also occurred, with one farmer stating: “We were free and able to make our own decisions of what to plant, when to plant, and how to plant based on traditional local knowledge” [24].

The history of local knowledge over the past 1000 years in Indonesia is rich, especially as it pertains to agriculture, which is the focus of this study. Several important questions remain; for example, can an effective agriculture system be achieved based on local knowledge without scientific data; and how does local knowledge relate to DRR and CCA? Hence, we validated and verify the components of local agricultural knowledge, namely *Pranata Mangsa*, using a scientific approach, and to classify them according to whether they have a scientific basis and can be related to DRR and CCA.

2. Materials and Methods

2.1. Study Area

We conducted our research on Jawa island, Indonesia (Figure 1). Jawa has a total population of 150 million and there are three ethnic groups: Betawi, Sundanese, and Javanese. It has an area of ~130,000 km², which is about 6.8% of the total land area of Indonesia [25]. An original manuscript from Mangkunegaran Palace in Surakarta, Jawa Tengah, Indonesia, was studied as a source of local knowledge. Scientific analyses were conducted in Indramayu (6°21′ S, 108°19′ E; Jawa Barat Province), Sukoharjo (7°40′ S, 110°49′ E; Jawa Tengah Province), Sleman (7°42′ S, 110°20′ E; Yogyakarta Province), and Ngawi (7°24′ S, 111°25′ E; Jawa Timur Province).

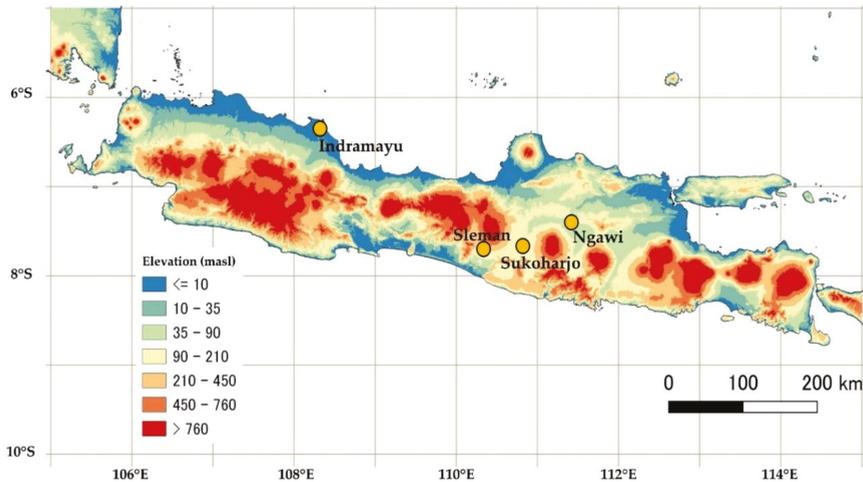


Figure 1. Map of study area in Jawa island, Indonesia.

2.2. Analysis of Local Knowledge

Pranata Mangsa is written in the Javanese language of *Aksara Kromo*. Unfortunately, *Pranata Mangsa* has not been officially translated into other languages, and its applications remain limited. We translated *Pranata Mangsa* into Bahasa Indonesia, which has been recognized as an official language of Indonesia ever since the country gained independence, on 17 August 1945. We also translated it into English, as one of the official United Nations (UN) languages for international communication.

2.3. Analysis of Scientific Knowledge

Local knowledge was examined by scientific knowledge of the following hydro- meteorological events and systems.

1. Diurnal rainfall. We analyzed Tropical Rainfall Measuring Mission (TRMM) precipitation data, which is collected by the National Aeronautics and Space Administration (NASA) and Japan Aerospace Exploration (JAXA). The TRMM produces global precipitation estimates based on remotely sensed data. The daily 3B42 product (TRMM Multi-Satellite Precipitation Analysis, version 7) used in this study is available at <https://giovanni.gsfc.nasa.gov/giovanni>. Data for the period 1998–2015 (18 years), with spatial and temporal resolutions of 0.25° and 3 h, respectively, were analyzed.
2. Extreme events. We used the standardized precipitation index (SPI), which employs the gamma function to assess the likelihood of floods and drought based on the probability distribution of long-term precipitation [26]. The SPI is defined as follows:

$$SPI = \frac{x_i - \bar{x}}{\sigma}$$

where, x_i is a specific period (e.g., monthly, annual) rainfall during the year i , \bar{x} , and σ are the long term mean and standard deviation in the specific period. Floods and drought were identified using the *SPI* scale, as shown in Table 1. Positive and negative *SPI* values indicates that precipitation is above and below average, respectively [27]. We calculated *SPI* values based on monthly precipitation using the 18 years precipitation of TRMM.

Table 1. The floods and drought classification on standardized precipitation index (SPI) indices.

SPI Values	Classification
≥2	Extremely floods
1.50 to 1.99	Severe floods
1.00 to 1.49	Moderate floods
−1.00 to −1.49	Moderate drought
−1.50 to −1.99	Severe drought
<−2	Extreme drought

3. Farming system. We consulted previous studies to obtain data on crop patterns, fertilization, and water management.

2.4. Scientific View of Local Knowledge and Adaptation Strategies

The Local and Indigenous Knowledge Systems (LINKS) is a UNESCO interdisciplinary initiative that works: (1) to secure an active and equitable role for local communities in resource management; (2) to strengthen knowledge transmission across and within generations; (3) to explore pathways to balance community-based knowledge with global knowledge in formal and nonformal education; (4) to support the meaningful inclusion of local and indigenous knowledge in biodiversity conservation and management, and climate change assessment and adaptation [18]. We adopted LINKS to examine the components of *Pranata Mangsa*: crop calendar, crop pattern, and farming system; these domains were classified into four LINKS categories [18].

LINKS Category I: types of local and indigenous knowledge in this category include: (a) observations of celestial bodies (e.g., the moon, sun, and stars), which could help communities predict hazards; (b) environmental observations, such as of the direction and strength of winds; color, formation, and location of clouds; plants; and animal behavior; (c) materials used by local people for disaster mitigation, preparedness, responses, and recovery (e.g., for houses, as well as food eaten during periods of food scarcity); (d) environmental regulations, which play a major role in preventing and mitigating hazards such as coastal erosion, landslides, and floods (e.g., *Tara Bandu*, practiced in Timor-Leste, which governs social relations and places restrictions on the use of natural resources).

LINKS Category II: this category includes faith-based beliefs, and traditional rituals, legends, and songs. These phenomena cannot be explained in scientific terms, but are practiced by communities to improve resilience and “inner strength”. Thus, it is necessary to maintain these practices across generations. Faith-based beliefs and practices have been reported by many disaster survivors to improve community resilience, strengthen their will, and enable them to move forward. Such comments were made repeatedly by survivors of Typhoon Haiyan/Yolanda, which struck the Philippines in November 2013.

LINKS category III: this category includes local and indigenous knowledge related to climate change and disaster prediction that cannot be understood from a scientific perspective. For example, people in Rapu-rapu island, Philippines, believe that a typhoon will occur when fish keep on moving with no rest, but researchers reported that the sign is not related to meteorological elements and as a behavior of fish for mating or food searching.

LINKS category IV: this category includes beliefs with no scientific basis that cannot be used for weather or disaster prediction. *Aneuk jame* which is a local knowledge in the coastal area of Aceh, Indonesia, has a belief that a hazard or disaster will occur when dogs howl loudly. This sign has no scientific evidence and is not related to the disaster.

3. Results and Discussion

3.1. Pranata Mangsa: An overview

In what we term “the kingdom era”, Javanese society had four social classes: *Brahmana* (religious leaders), *Ksatria* (soldiers), *Waisya* (peasants), and *Sudra* (businessmen). The peasants were agrarian people who adhered to the “*Hamemayu Hayuning Bawana*” social philosophy, which focuses on creating a harmonious world through sustainable and environmentally friendly practices [28]. Javanese society in the kingdom era, i.e., from the Majapahit (700 AD) to the Mataram (1855 AD) kingdom, established local knowledge on water management and agricultural systems. King Mpu Sendok (929 AD) proposed the creation of many small farm reservoirs around the Brantas River (320 km length) in Jawa Timur and Bengawan River (600 km length) in Jawa Tengah [19]. On 22 June 1855, King Sri Susuhunan Pakubuwono VII introduced the practice of using *Pranata Mangsa* as a crop calendar, and as a basis for organizing agricultural activities. The words *Pranata* and *Mangsa* mean rule and season, respectively

The crop calendar starts around the summer solstice (on 22 June). On initial inspection, *Pranata Mangsa* appears very complicated and confusing because the number of days in each month varies from 23 to 43, as shown in Figure 2; this shape is based on the library of Mangkunegaran palace, which visualizes the *Pranata Mangsa* calendar. However, more careful examination revealed that the calendar is based on local cosmology. *Pranata Mangsa* has 12 months: *Kasa*, *Karo*, *Katelu*, *Kapat*, *Kalima*, *Kanem*, *Kapitu*, *Kawolu*, *Kasanga*, *Kadhasa*, *Sadha*, and *Dhesta*. The first 6 months have 41, 23, 24, 25, 27, and 43 days, respectively. The sequence is reversed in the latter 6 months, except for the 8th month, which has 26 rather than 27 days in normal years (*Wuntu*; it has 27 days in leap years (*Wastu*)). This local knowledge guides peasants to plan their activities in accordance with the seasonal cycle (Table 2).

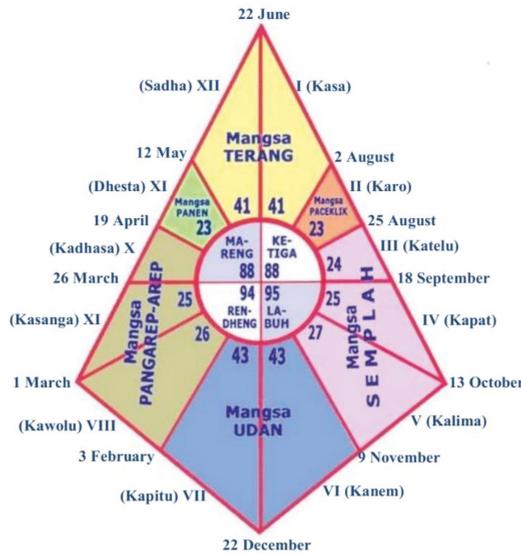


Figure 2. *Pranata Mangsa* in the Gregorian calendar. The numbers represent the numbers of days in the seasons and months, respectively.

Pranata Mangsa has a unique climate classification system: Javanese peasants use *Titen* to understand the progression of the seasons. *Titen* refers to the understanding, skills, and philosophies of Javanese peasants, accrued through their long history of interaction with the bioclimate. Together with other environmental factors, the bioclimate is crucial to the existence, growth, reproduction, and distribution of living organisms [29]. The bioclimates of various organisms have been well documented [30].

Based on bioclimatological parameters, *Pranata Mangsa* distinguishes among four climatic seasons, as follows:

Table 2. Description of the *Pranata Mangsa* on each *Mangsa*.

No	Months	Seasons	Timeseries	Bio-Climatological Signs	Farmer Activities
1	Kasa	Ketiga–Terang	22 June–1 August (41 days)	Leaves fall down; grasshopper goes into the ground; high temperature	Bera or fallow land; Time to burn rice straw
2	Karo	Ketiga–Paceklik	2–24 August (23 days)	Kapok tree (<i>Ceiba pentandra</i>) has flowering	Istisqa rituals
3	Katelu	Ketiga–Semplah	25 August–18 September (24 days)	Bamboo sprouts were growing	Palawija planting
4	Kapat	Labuh–Semplah	19 September–13 October (25 days)	Kapok was fruit development, Birds eggging or hatchlings	Palawija
5	Kalima	Labuh–Semplah	14 October–9 November (27 days)	Rainfall comes to the earth	Palawija harvesting and Seren Taun ceremony
6	Kanem	Labuh–Udan	10 November–22 December (43 days)	Fruit trees become mature with a small fruit	Land preparation on Paddy field
7	Kapitu	Rendheng–Udan	23 December–3 February (43 days)	High precipitation, and flooding in a river	Rice transplanting to the field
8	Kawolu	Rendheng– Pangarep–arep	4–28/29 February (26/27 days)	Cats reproduction time	Fertigation on paddy vegetative phase
9	Kasanga	Rendheng– Pangarep–arep	1–25 March (25 days)	Cicadidae has sounded in nature	Paddy on reproductive phase
10	Kadhasa	Marèng– Pangarep–arep	26 March–18 April (24 days)	Walang sangit (<i>Leptocorisa oratorius</i> Fabricius.) attack to paddy field	Paddy on ripening phase
11	Dhesta	Marèng–Panèn	19 April–11 May (23 days)	Kapok fruit has mature	Paddy harvesting
12	Sadha	Marèng–Terang	12 May–21 June (41 days)	Gulungan	Gulungan ceremony

- Katiga*, which is also called the dry season, begins when leaves start to fall (*Sesotyā murcā ing embanan*), the soil becomes cracked (*Bantālā rengkā*), and bamboo buds appear (*Sutā manut ing bāpā*). *Sate sember* is the peak of the dry season. *Katiga* has a duration of 88 days and occurs during *Kasa*, *Karo*, and *Katelu*.
- Labuh*, which can be translated as “shifting seasons” (dry to rainy), is considered to begin when the bioclimate induces a feeling of “peace in the heart” (*Waspā kumembeng jroning kalbu*). The arrival of rainfall (*Pancuran mas sumawur ing jagad*) leads to a “holy feeling” associated with the green color of plants (*Rāsā mulyā kasuciyan*). *Labuh* has a duration of 95 days and occurs during *Kapat*, *Kalima*, and *Kanem*.
- Rendheng*, or rainy season, begins when pests and diseases are carried by the wind (*Wisā kéntir ing marutā*). Other signs of this season include cats mating (*Anjrah jroning kayun*) and *Garengpung*, which is an appealing sound made by a species of Cicadidae (*Wedharing wacānā mulyā*). *Rendheng* has a duration of 94 days and occurs during *Kapitu*, *Kawolu*, and *Kasanga*.
- Marèng*, which like *Labuh* also refers to “shifting seasons” (from rainy to dry), begins during the “animal gestation period” (*Gedhong mineb jroning kalbu*), which can also be translated as “flowering time” (e.g., for Kapok trees [*Sesotyā sinārāwèdi*]). Spring water dries up during this period (*Tirtā sah saking sasānā*). *Marèng* has a duration of 88 days and occurs during *Kadhasa*, *Dhesta*, and *Sadha*.

Pranata Mangsa informed the organization of the farming system used by Javanese peasants, including crop patterns, irrigation, and field activities. The farming season starts on *Kasa* (22 June). The crop pattern for a given year is referred to as *Berâ-Palawija-Paddy*, which is described in more detail below.

1. *Kasa* and *Karo* are months characterized by *paceklik* (food scarcity) and a lack of precipitation, which leads to rapid depletion of the water supply provided by small farm reservoirs in rainfed land. *Berâ* means “take a rest”. This concept is applied to the land itself; i.e., no planting activities occur in the fields. The farmer’s activities at this time are as follows: (1) burning rice husk and straw from the previous harvest; and (2) praying to God to make it rain, in a ritual known as *Istisqa*.
2. *Katelu* and *Kapat* correspond to the end of the dry season and the early part of the rainy season, respectively. In these months, Javanese peasants begin to cultivate *Palawija*, i.e., a secondary crop (e.g., maize, soybean, and peanuts), to alleviate food scarcity.
3. *Kalima* is a month in which farmers come to the field to pray to God, and express gratitude for any rainfall in a ritual called *Seren taun*.
4. *Kanem* to *Kadhasa* are characterized by rice planting, land preparation, and water and pest management. For water management, the *macak-macak* system is used, which is characterized by intermittent flooding irrigation. Pest management involves planting refugia plants and placing *Sesajen* in the field.
5. *Dhesta* and *Sadha* are special months for Javanese farmers. These months coincide with harvest time and a ceremony called *Gulungan*, in which farmers bring their agricultural products to a public area and eat and sing together to express their happiness and gratitude to God.

3.2. Extreme Events

Precipitation is a crucial component of the water cycle [31], and is the variable most strongly associated with atmospheric circulation in weather and climate studies [32]. Analysis of rainfall data showed that the total annual precipitation is 2233, 2396, 2702, and 2937 mm year⁻¹ for Indramayu, Ngawi, Sleman, and Sukoharjo, respectively. Figure 3 shows that the average precipitation amount in *Kasa*, *Karo*, and *Katelu* is below 100 mm day⁻¹, with the lowest amount being just 12.63 mm day⁻¹ (in *Karo*, Indramayu). The highest rainfall amount was recorded in *Kapitu*, Sukoharjo, at 601.16 mm day⁻¹. Monitoring precipitation is crucial to the well-being of local residents; too much rainfall endangers life and property, while too little causes droughts that negatively impact agriculture and can lead to starvation. Hence, analysis of extreme precipitation events (e.g., drought and floods) is necessary.

The SPI is recommended for assessing drought and floods. It has the following advantages: (i) only a single input variable (precipitation) is necessary, (ii) both wet and dry periods can be analyzed, (iii) analyses can be performed at different time scales, (iv) droughts and floods can be categorized, and (v) the probability-based structure can aid risk management and decision analysis [27]. In this study, the SPI was used at the 1-month time scale to identify drought and floods, informed by *Pranata Mangsa* and the Gregorian calendar, with the goal of successful adaptation to extreme events. The SPI is an index for extreme events comparing with the average and results in different values depending on the range of the specific period, even if the same precipitation data is adopted. During the observation period (1998–2015) both drought and flood occurred (in 1998 and 2010, respectively). Figure 4 (upper) illustrates the superiority of *Pranata Mangsa* over the Gregorian calendar for mitigating the effects of extreme drought events in all regions, except Indramayu. However, *Pranata Mangsa* was not useful for mitigating the effects of extreme floods, except in Sleman, as shown in Figure 4 (bottom). These results suggest that *Pranata Mangsa* has limitations in the size and location of the community; in line with the term of local knowledge, which is composed of understanding, skills, and philosophies developed by the local society with long histories of interaction with their natural surroundings.

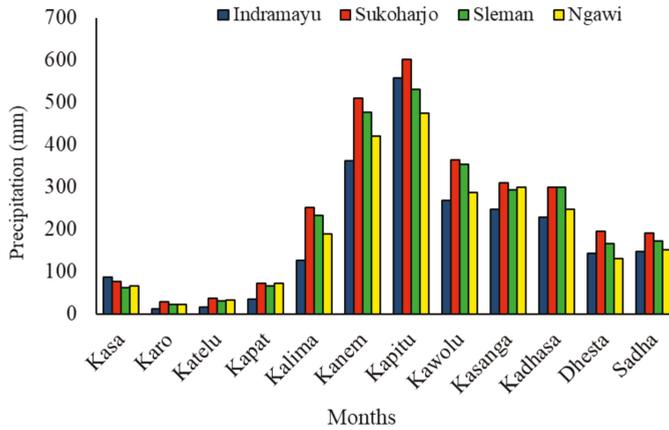
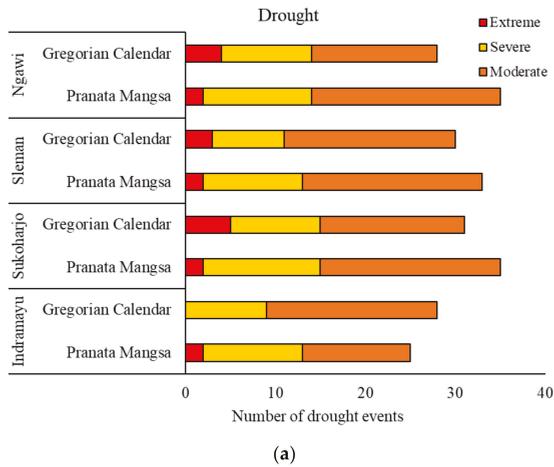
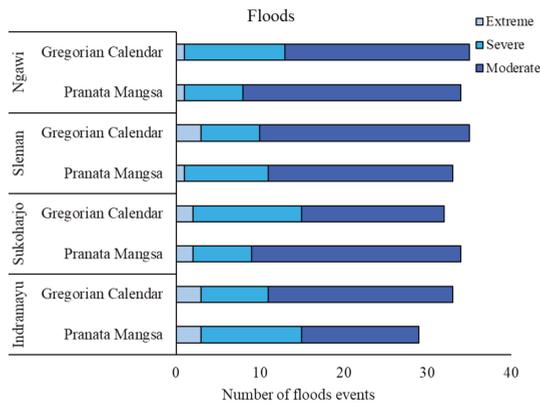


Figure 3. The intensity of precipitation during 1998–2015.



(a)



(b)

Figure 4. The severity levels and number of drought (a) and floods (b).

3.3. LINKS: Integrating Local and Scientific Knowledge

Previous studies have documented the effectiveness of LINKS for reframing local knowledge in scientific terms, for example to mitigate the effects of hydro-meteorological disasters in coastal areas. *Smong* was used in Aceh to strengthen communities following the tsunami disaster in 2004, while *Ai lulik* and *Fatuk lulik* were used to predict and prevent landslides in Timor Leste, and *Rapu-rapu* was used to predict typhoons in the Philippines [15]. However, these studies did not comprehensively explain how local knowledge has been applied in the absence of scientific data, nor how to manage small areas affected by certain kinds of disasters using local knowledge. In this study, we applied LINKS to the agricultural system in Jawa, using *Pranata Mangsa* as a framework. Thus, local knowledge was used in association with scientific data (e.g., on diurnal rainfall and extreme hydrological events) to adapt to floods and drought conditions.

We found that *Pranata Mangsa* can be interpreted using LINKS. Our findings confirmed that local knowledge can be integrated with scientific data to increase the resilience of Javanese agricultural communities to floods and drought. Our initial analysis, LINKS I, showed that diurnal rainfall data accorded with the characteristics of, and transition among, seasons. *Sate sumber* refers to drought, which is concerning for farmers but can be well explained by empirical data. *Sate sumber* may occur during *Kasa*, *Karo*, and *Katelu* when the precipitation amount is below 50 mm day⁻¹. In response, the *Bera-Palawija* crop pattern was established in *Katiga* and *Labuh* based on *Pranata Mangsa*, and has reduced crop losses, improved soil quality, and increased soil moisture. In addition, farming activities are scheduled with water management (*Macak-macak*), soil recovery, and pest management in mind, thus, increasing the number of panicles and paddy yield in Indonesia [23], and reducing water consumption and methane emissions [33]. Also, *Berâ* and the application of burnt rice husk (2 tons ha⁻¹) as an organic amendment can alleviate meteorological and agricultural drought through the “restland” concept. This can allow farmers to adapt to the effects of widely varying precipitation amounts [34], and will improve soil bulk density and porosity [35].

As discussed above, some aspects of *Pranata Mangsa* cannot be explained by, or integrated with, scientific data, but nevertheless have a significant effect on DRR and CCA (based on our second analysis, LINKS II). Our analysis of local knowledge indicated that rituals and ceremonies promote respect for God and nature among Javanese peasants. As an example, *Istisqa* is a farming activity practiced when the dry season arrives, based on faith-based beliefs and designed to make communities more resilient. According to our LINK IV analysis, some components of *Pranata Mangsa* cannot be related to DRR or CCA, including *Sesajen*, which is the rituals to the God by placing some materials, including myrrh, fruit, and cigarettes at the side of the field for repelling pest or as a pest management. Our results showed that the components of the local knowledge were verified and validated by a scientific data approach, so as to inform policies supporting farming activities, and empower communities to make informed decisions regarding adaptation and DRR.

To our knowledge, this was the first study to investigate the effectiveness of LINKS for integrating local and scientific knowledge of agriculture to mitigate the effects of drought and floods. Our results indicated that *Pranata Mangsa* can be easily integrated with scientific data, enabling optimal strategies for DRR and CCA to be adopted by scientists, farmers, and policymakers. Although LINKS was successfully used to integrate *Pranata Mangsa* with scientific data, the applicability of this approach to other knowledge systems in Indonesia should be assessed in future work.

4. Conclusions

Pranata Mangsa is an important system of local agricultural knowledge used in Jawa, and includes information regarding climate conditions, crop patterns, and farming activities. All of these areas can be related to DRR and CCA based on scientific data. Rituals and ceremonies help communities build resilience, but cannot be explained in scientific terms. Such activities will continue to be engaged in by communities.

It is important to recognize that *Pranata Mangsa* is not wholly effective for DRR and CCA: there are limitations to its utility, depending on: (1) the size and location of the community; (2) the commitment of the participants, especially from the younger generation; and (3) support from stakeholders and policymakers concerned with adaptation to, and mitigation of the negative effects of, extreme hydrological events. In conclusion, this study successfully used LINKS to integrate local and scientific knowledge for flood and drought risk reduction and CCA, which should increase the resilience of communities.

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Article

Sinking Islands, Drowned Logic; Climate Change and Community-Based Adaptation Discourses in Solomon Islands

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Abstract: The saltwater people of Solomon Islands are often portrayed to be at the frontline of climate change. In media, policy, and development discourses, the erosion and abandonment of the small, man-made islands along the coast of Malaita is attributed to climate change induced sea-level rise. This paper investigates this sinking islands narrative, and argues that a narrow focus on the projected impacts of climate change distracts attention and resources from more pressing environmental and development problems that are threatening rural livelihoods.

Keywords: policy narratives; resilience; climate finance; rural development; indigenous peoples; media; participation; development projects; Pacific; Malaita

1. Introduction

“Sinking islands”. With this alarmist headline, the Malaita Star, a popular magazine in Solomon Islands, draws attention to the impact of climate change on the saltwater people of Malaita (see Figure 1). These wane asi, literally people of the sea, live on small islands constructed from coral rocks. In the media, the wane asi are consistently portrayed as the first victims of climate change: the proverbial canaries in the coal mine. For instance, in an opinion article in the Solomon Star in 2016, the nation’s leading newspaper, Reverend Philemon Akao [1] highlights the vulnerability of the saltwater people:

“As if we were enticed by a dream, the rising sea level is a reality unjustly struck at the very core of my people’s sanity. It denies our dignity to live just as it destroyed our vulnerable homes and left us homeless. Once my people were warriors, now we’re but a displaced uprooted people. Along our beautiful Lau lagoon, human made islands are washed, destroyed to their cores, uninhabited, deserted and ruined by Mother Nature. Unlike the frigate birds in the sky forced by the high tide and return when the tide is low, my people are uprooted and flogged unjustly by the effects of climate change and never to return to where they once lived. (. . .) In the midst of climate change, a time death is what we see every day in the suffering of people and victims living without hope for the future, who among us is prepared to offer the uprooted and displaced people a place to live?”



Figure 1. The sinking islands of Malaita (Malaita Star, 2016, 2017).

Similar claims are regularly made in science, policy, and development discourses. There is broad scientific consensus that people on low-lying islands in the Pacific are highly vulnerable to future climate-induced sea-level rise, and that there is an urgent need to invest in adaptation mechanisms [2,3]. But little is known about how local people in remote rural areas, such as Malaita, perceive and deal with climate change [4,5]. Rebecca Monson and Joseph Foukona [6] write in an edited volume on climate displacement that the wane asi in Lau Lagoon increasingly have to cope with changing wind patterns, extreme weather events, and coastal erosion:

“The people of Lau have experienced unusually high tides on several occasions. High tides have washed through the villages, destroying kitchens that are built directly on the ground of the islands; flooding houses; and carrying refuse from the toilets that surround the islands. Some islanders are now attempting to relocate to the mainland but most wish to remain on their islands.”

James Asugeni et al. [7] report that the inhabitants of six artificial islands in East Malaita are deeply concerned about climate change, and contemplate moving to higher ground. And John Walenenea [8] documents the loss of freshwater wells in Langalanga Lagoon due to saltwater intrusion caused by a rising sea-level.

In the National Adaptation Programs of Action (NAPA), the Ministry of Environment, Climate Change, Disaster Management, and Meteorology (MECDM) identifies the wane asi as: “being the most vulnerable to climate change (. . .) many of these communities and/or villages live on or at the edge of the sea and are often subject to impacts of storms, storm surge, sea-level rise, drought, saltwater intrusion, and flooding” [9]. Several civil society organizations have also highlighted the plight of the wane asi. The Climate Displacement Land Initiative, for example, witnessed that: “increasing numbers of these islands are now beginning to lay uninhabited as residents leave behind destroyed homes and flee the ever-worsening consequences of climate-change” [10]. In the same way, the Community Conservation Resilience Initiative [11] conducted participatory resilience assessments on two man-made islands in Lau Lagoon, and concluded that:

“Sea level rise is a major external threat that impacts (. . .) communities throughout the Solomon Islands. It is one of the biggest challenges in both the short- and long-term and is forcing the communities to consider measures as drastic as relocating to the mainland in Malaita.”

A clear narrative emerges from these newspaper articles, scientific publications, and policy documents: (1) The rising sea-level is flooding the artificial islands and forcing the wane asi to relocate to higher grounds; (2) tropical cyclones are destroying sea walls and houses; (3) saltwater intrusion is contaminating freshwater sources; (4) higher sea water temperatures and ocean acidification are

degrading coral reefs and depleting coastal fisheries; (5) changing rainfall patterns are negatively affecting agricultural productivity and exacerbating food insecurity; and (6) substantial climate finance and development aid is therefore needed to enable the wane asi to adapt to these changes.

This paper investigates this sinking islands narrative and questions whether the socio-ecological changes on the artificial islands of Malaita can be solely attributed to climate change. It notices a significant mismatch between the climate change discourse manifested in the media, policy, and so-called Climate Change and Disaster Risk Management (CCDRM) projects, and the everyday realities and problems of people on Malaita [12–14]. This paper argues that a narrow focus on the impacts of climate change distracts attention and resources from other, more pressing problems that are threatening rural livelihoods and are eroding people’s capacity to adapt to rapid environmental change [15,16].

2. Background: The Saltwater People of Malaita

The distinction between wane asi (saltwater people or to’aiasi) and wane tolo (forest people or to’aitolo) is a salient feature of human ecology in Melanesia [17,18]. The wane asi are fishers who barter fish for root crops and vegetables with the wane tolo, shifting cultivators who inhabit the forested interior of Malaita (see Figure 2). This distinction is not absolute. Nowadays, many wane asi maintain agricultural plots and many wane tolo are fishing, and intermarriage is common [19]. Nonetheless, many communities continue to identify themselves as wane asi: The livelihoods, worldview, and identity of these people revolve around fishing and the sea.



Figure 2. Women barter fish for root crops in Lau Lagoon (J. van der Ploeg 2017).

Little is known about the origins of the “island builders of the Pacific” [20]. Oral history recounts that the first artificial islands were constructed in the 16th century by people from the uplands of Malaita fleeing from war, sorcery, or famine [21]. It has also been postulated that the island settlements were an adaptation to endemic malaria in the lowlands [22]. In any case, a vibrant culture developed in the lagoons and mangrove forests of Malaita. The most important ethnic groups are the Lau, on the northeast coast, and the Langalanga, on the west coast.

2.1. The Lau

Lau Lagoon extends for approximately 35 km on the northeast coast of Malaita. The shallow lagoon harbors a rich diversity of coral reefs, seagrass meadows, and mangrove forests. There are approximately 94 artificial islands in the lagoon [23]. Several more artificial islands are located in neighboring Suava Bay. These settlements are built by manually hauling and piling up coral rocks on shallow reefs [24]. Small new extensions are constructed for new households. As a result, some islands form a maze of small raised platforms connected by narrow bridges. Some of these man-made islands,

such as Sulufou, Funafou, Foueda, and Tauba, are relatively large (>1 ha), and are densely populated. Others are very small (<100 m²). Some islands are built as extensions of natural islands or rock outcrops in the lagoon. Others are constructed in the mangroves by constructing coral rock walls, often more than 3 m high, and filling the enclosure with gravel and sand. In most cases, these islets are just above the high-water mark (<30 cm), and most houses are constructed on stilts (see Figure 3).



Figure 3. Funafou Island in Lau Lagoon (J. van der Ploeg, 2015).

Fishing forms the basis of people's livelihoods in the lagoon, and the Lau have an in-depth knowledge of their marine environment [25]. A great variety of fishing methods is used. Fish, crabs, marine turtles, and a variety of shells are bartered for root crops and vegetables with Baegu and Baelelea farmers from the uplands [26]. A complex tenure system regulates access to and use of marine resources in the lagoon. Coral reefs and deep pools are generally claimed by patrilineal clans, locally referred to as tribes [27]. In principle, land and sea rights are exclusionary, but in practice other clans often have usufruct rights. Seagrass meadows and the deep sea are de-facto open access. Traditionally, the Lau have managed their fisheries by imposing temporal closures for certain reefs [28].

In the 19th century, there were virtually no settlements along the coast of Malaita, with the exception of the artificial islands of the wane asi [21]. During the colonial period, wane tolo moved from their small, scattered hamlets in the uplands to large, permanent villages in the coastal areas [6]. Many wane asi left the artificial islands to settle in these new communities, a process that has continued ever since. Today, a large Lau community resides in the national capital, Honiara, and the provincial center, Auki. But the artificial islands remain important for people's identity and worldview, also for people born and raised in town. Several artificial islands in the lagoon, such as Abu, Kwaleunga, Longoaia, Kwaloai, Madanga, Kwailabesi, and Foufoiasi, have been abandoned. At the same time, new islands are constructed in the lagoon, mainly to develop tourism facilities. Nowadays, approximately 3600 people live in Lau Lagoon; much less than one hundred years ago [29].

Two Lau communities, Walande and Fanalei, are located on South Malaita, approximately 130 km south of Lau Lagoon. At least 12 generations ago, people settled here to hunt dolphins [19]. The porpoises are killed for their teeth, which are used for customary marriage and compensation payments, and for their meat, which is an important source of income and food for these communities. These two islands feature prominently in the climate change discourse in Solomon Islands as prime examples of sinking islands [30,31] (see Figure 4). Approximately 750 people now live in these two communities.



Figure 4. The remains of the Anglican church of Fanalei (J. van der Ploeg, 2018).

A closely affiliated ethnic group are the Kwai, who live on two densely populated islands on the East coast of Malaita: Kwai and Ngongosila. People here speak Guala'ala'a, which was used as a trading language along the coast [21]. Reliable census data is lacking but it's estimated that around 900 people live in these two communities. The saltwater people from Kwai and Ngongosila, and several other small artificial islands scattered around Uru Harbor, trade fish with the Kwaio people from the uplands. Ngongosila was settled in 1955 when the South Sea Evangelical Mission built a church on the island [29].

2.2. *The Langalanga*

Langalanga is a 22 km long lagoon on the west coast of Malaita, and is one of the most densely populated regions of the country. Historically, the Langalanga people bartered fish for crops with the Kwara'ae, shifting cultivators who inhabited the forested hinterlands of the lagoon [32]. The saltwater people built artificial islands on the barrier reef of the lagoon and in the mangroves, and specialized in the production of tafuli'ae—strings of polished shells, which are traditional wealth items used throughout the Solomon archipelago for trade, feasts, and compensation and marriage payments [33,34]. There are around 59 artificial islands in Langalanga lagoon, most of them located in the mangroves and sago swamps. Approximately 6000 people live in the lagoon, including those in the settlements around Auki such as Aoke Island, Niu Kaloka, Ambu, and Lilisiana [29].

Historically, the livelihoods of the Langalanga people were characterized by much geographical mobility: Fishers moved along the west coast of Malaita to exploit a variety of marine resources, and they traded shell money with people from different islands [35]. European contact fundamentally altered livelihoods, trade networks, and social relations in the lagoon. The labor trade and evangelization efforts provided new goods such as steel axes, fishhooks, and guns, which enhanced agricultural productivity and led to widespread violence [21]. In 1909, the British colonial government established a station at the northern tip of the lagoon, present-day Auki town. In the 1930s, several shipyards were established in the lagoon. As a result, Langalanga people dominated inter-island trade in the British Solomon Islands Protectorate [36]. But in other ways the mobility of saltwater people, which was an important strategy to respond to environmental changes and shocks, became increasingly restricted. As more and more people settled along the coast, conflicts erupted over access to fishing grounds. Despite these developments, fishing remains the primary source of food and income for the saltwater people of Langalanga [37]. However, the widespread use of dynamite in the 1950s and overharvesting have led to a rapid decline in the productivity of the fisheries [38,39]. The limited prospects beyond the subsistence economy have stimulated urbanization: The saltwater communities around Auki town,

such as Lilisiana, have grown rapidly over the past fifty years (see Figure 5), and many young and educated people migrate to Honiara in search of a better life.

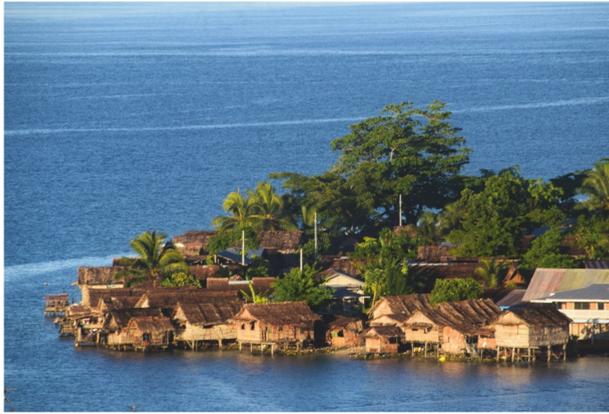


Figure 5. Lilisiana in Langalanga Lagoon (J. van der Ploeg 2018).

3. Methodology

To illustrate the popular sinking islands narrative, a qualitative content analysis was conducted on articles published in the *Solomon Star* from January 2015 to March 2020 on the effects of climate change in Malaita Province [40,41]. Articles on climate change that did not specifically focus on Malaita were not included. Articles in the other daily newspaper in Solomon Islands, the *Island Sun*, were not included because this newspaper is often unavailable on Malaita. In total, 73 articles were compiled (in print and on-line) and encoded. Newspaper articles on climate change were published irregularly, with quite a few articles published in March 2015 in the aftermath of cyclone Pam, and in September 2017 in preparation for the United Nations climate change conference in Bonn, chaired by Fiji. A coding framework was developed by deriving categories directly from these newspaper articles. A potential problem of this inductive approach is the identification of all potentially relevant categories in the absence of a theoretical model. Yet, the categories of the coding framework overlapped to a large extent with key themes from the academic literature.

This paper tries to contextualize some of the claims made in these newspaper articles and reconstruct local socio-ecological events through an iterative process of inference and induction. Bradley Walters and Andrew Vayda [42] advocate such analysis to unravel the interacting causes of environmental change. Instead of relying on preconceived conceptual models and questionnaires, this flexible methodology enables the researcher to pursue lines of enquiry that emerge during fieldwork. An example from the field can illustrate this. Coastal erosion is threatening the small island of Ta'arutona in the West Are'are Lagoon, a process that is often attributed to climate change. Instead of asking if the recurrent floods were the effect of climate change, the authors walked around the island with key informants, asked people to describe the events, and discussed plausible explanations. The sinking of Ta'arutona Island seems to have started in the year 2000, after the mangroves on the island were cut for firewood to dry copra. Villagers say that the removal of the mangrove buffer has exposed the island more directly to waves. In December, king tides overflow the island, particularly when there is a strong northwestern wind. The floods, sometimes up to 30 cm above the ground level, destroy homegardens and coconut groves, and damage houses, despite the efforts of the villagers to build sea walls. People are concerned about an impending tsunami, and several households have re-settled on the mainland. Most young people from the village have moved to Honiara, which makes the maintenance of the sea walls problematic. Climate change induced sea level rise could play a role in the flooding of the island, but other neighboring villages in the lagoon, such as Pipisu and Rohinari,

seem much less affected. As such, a more nuanced, complex, and uncertain explanation emerges for the environmental changes on Ta’arutona.

The analysis draws primarily on ethnographic fieldwork on Malaita in the period 2015–2018. In this period, the authors made several field trips in the context of the research and development program of WorldFish in the province [43]. The authors made repeated visits to villages in Langalanga Lagoon, Lau Lagoon, West Are’are, East Malaita, and South Malaita to identify threats to coastal fisheries and rural livelihoods. Spontaneous interviews with community leaders, fishers, school teachers, church elders, customary chiefs, and members of women and youth groups were held on-site using Solomon Islands Pijin, the lingua franca of the country. In total, informal interviews were conducted with 171 people (61 women and 110 men) in 62 villages (see Figure 6 for the location of the villages mentioned in the text). In accordance with the WorldFish policy on ethics of research involving people, all respondents gave verbal prior and informed consent for an interview. No cash payments were made to the respondents. Community meeting were held in all villages before conducting the interviews to explain the aim and methods of the research. Information collected during the interviews was recorded in the author’s notebooks, and triangulated when possible. These interviews were complemented with information from the community ward profiles compiled by the Provincial Government Strengthening Program (PGSP) and the community profiles of the Rural Development Program, Phase 2.

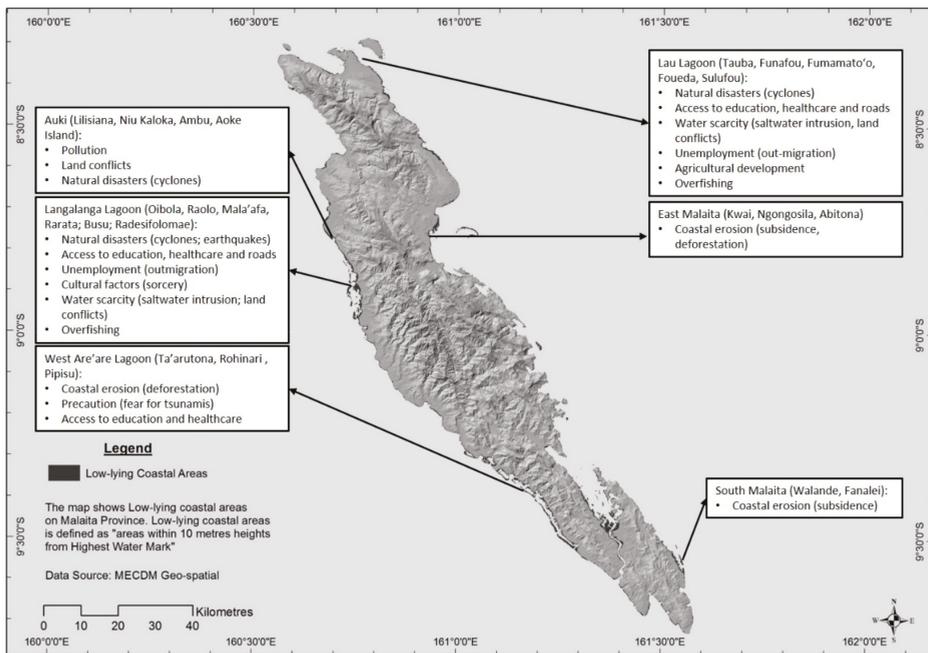


Figure 6. Artificial islands on Malaita mentioned in the text, highlighting the main reasons why people abandon these places.

This research methodology clearly has limitations. First, by relying mainly on local ecological knowledge to describe and understand complex and long-term biophysical and ecological processes, this analytical framework is subject to criticism. But in the absence of quantitative, locality specific data, a situation that is unlikely to change in the near future, it is the only feasible way to generate empirical information in many remote rural areas in the tropics [44]. Second, this analytical framework might seem to have limited value for policy makers, donors, and development practitioners. This paper

does not provide practical recommendations to improve CCDRM projects targeting the wane asi. Instead, the aim is to nuance a priori assumptions on the local impacts of climate change, and to better understand the links between climate change and other environment and development problems. It is hoped that this will lead to a better allocation of climate change funding.

4. Results: Content Analysis

A qualitative content analysis of newspaper articles documents how people in Solomon Islands perceive the threats posed by climate change (see Table 1). Of the 73 articles published in the Solomon Star on climate change on Malaita from 2015 to 2020, 34 (47%) identify sea-level rise as a critical and imminent threat for coastal communities. This recurrent theme is best expressed in a newspaper article from 2017:

“At the heart of the climate change concern is the looming disappearance of our tiny atolls in the region underwater. Communities living on these low-lying atolls have little hope because of the threat being posed by the rising tide (. . .) The last thing we want to see happen is our islands turning into a watery grave.” [45]

Table 1. Content analysis of articles published in the Solomon Star (2015–2020) on climate change in Malaita (n = 73).

Themes	Frequency	Percentage (%)
1. Sea-level rise	34	47
2. Extreme weather events (tropical cyclones)	18	24
3. Saltwater intrusion	10	14
4. Higher sea water temperatures	3	4
5. Changing rainfall patterns	8	11
6. Climate change adaptation measures	44	60

Note: there can be more than one theme per article.

Tropical cyclones are also often mentioned in newspaper articles on climate change on Malaita: Eighteen articles (24%) specifically mention the impact of extreme weather events on the livelihoods of saltwater people. One article prominently features a photograph of the abandoned houses on Walande Island:

“Every year there is some sort of an event whether it be prolonged dry season which throws all our crops of whack, a cyclone that we could only prepare for for 24 h, increased rainfall and flooding that surprised us in the night, killing our children and robbing us of our homes. This is our normal.” [46]

Ten articles (14%) highlight the problems for agriculture and drinking water caused by saltwater intrusion.

“Seasonal crops that (the saltwater people) relied on for survival such as yam and pana are adversely affected. (. . .) Fruit trees are no longer bearing fruit and the coastal swamps that used to host their swamp taro patches are devastated by saltwater intrusion killing their crops in the process. Coastal wells and streams that the island residents depended on for survival are either dried up due to extreme temperatures or suffer as a result of saltwater intrusion.” [47]

Other climate change threats highlighted in the Solomon Star are higher sea water temperatures (4%) and changing rainfall patterns (11%).

Forty-four articles bring up a potential climate change adaptation measure (60%). A major topic is the resettlement of island communities on the mainland (19 articles). Samson Sade, for example, writes that people on the man-made islands in Lau Lagoon in North Malaita are facing an “*existential threat*” and that resettlement is unavoidable:

“The rise in sea levels and erratic weather patterns make these islanders no longer safe in (their) homes so intimate with the sea. As a result, the residents have no choice but to flee the ever-deteriorating impacts that climate change has brought on their island environments.” [47]

Other articles focus on introducing new drought- and salt-resistant crops (four articles), highlight the need to reduce CO₂ emissions (four articles), and call for resilient infrastructure (four articles). Three articles highlight the need to strengthen community-based resource management, for example, the protection of mangroves. Another three articles focus on enhancing the capacity of government agencies. The need to educate the public on the threats posed by climate change is mentioned in only two newspaper articles. Other articles propose climate change adaptation measures as diverse as setting up a carbon trading scheme, mainstreaming gender in decision making processes, strengthening community-based monitoring, praying, and playing soccer.

Many articles in the Solomon Star describe a specific CCDRM project implemented by government agencies or development organizations such as WorldVision and Solomon Islands Red Cross. Projects issue a press release, conduct an activity, or invite journalists to join a field visit. As such, the articles on climate change reflect, to a large extent, the logic and priorities of these CCDRM projects. More problematic is that the budgets of these projects are also often mentioned in the newspaper, which can raise unrealistic expectations of people and lead to skepticism. Stephen Di’isango [48], for instance, records the frustrations of villagers in the province:

“There are huge sums of money injected into programs supporting implementation of the national climate change strategies by Solomon Islands Climate Change program (at least 10 million Solomon dollar) but no one knows or sees the effect of it . . . ”

Particularly, the plans of MECDM and the provincial government to facilitate the resettlement of people from the artificial islands have generated much friction:

“In 2011, then Minister for Environment John Moffat Fugui announced Fanalei and its nearby sister island of Walande would be amongst the first atolls and islands the government was looking at implementing relocation programs over the next two years. The relocation, he said, will be funded under a 30 million dollar European grant. Six years on, the residents of Fanalei said they are yet to see or receive any funding assistance from the national government.” [49]

False expectations of financial assistance risk undermining the adaptive capacity of coastal communities. Historically, the wane asi were highly autonomous communities with no central authority, who could respond to changing environmental conditions, for example, by building higher sea walls or settling in better locations (see Asugeni et al. [50] for a recent example of community-based adaptation to climate change). However, nowadays many communities seem to be waiting for the government to take action. Leslie Sanga [51], for example, quotes a villager from East Malaita who says:

“The rising sea is now under some of our houses, it’s only a matter of time before these houses collapse. Soon, we will have to relocate. There’s no question about that. But who will fund our relocation? That’s the question we’ve kept asking. Relocation is not cheap, it’s like starting life all over again. So we need the government to assist us build new homes.”

In fact, many people do not want to resettle. Ronald Toito’ona [52] highlights the experiences of the wane asi on Kwai Island on East Malaita:

“For years they have built seawalls around the island, with no direct support from the government. Most have also refused to relocate to the mainland, not wanting to leave their ocean life behind. ‘We are the salt-water people and we have a very close bond to the beach and island environment,’ said Erastus David Mafane, an elder living in the island of Kwai. ‘Relocating to the mainland might be a better idea for others, but not us.’”

5. Discussion

The sinking islands narrative has become deeply embedded in public perception and policy discourses in Solomon Islands, and forms the foundation of climate change policies and CCDRM projects. It is, however, based on several assumptions, simplifications, and inconsistencies.

5.1. Sea-Level Rise

In the climate change discourse, sea level rise is presented as a critical and imminent danger for Pacific Islanders. For instance, an article in the Island Sun read: “sea level rise is the biggest threat for the artificial islands now, as most of the man-made islands are now partially under-water even from normal high tides” [53]. However, the common assertion that climate change induced accelerated sea-level rise erodes the artificial islands and thereby forces people to relocate to the mainland confounds causes and effects. Over the past years, some artificial islands have indeed been abandoned, but this usually happened after its inhabitants relocated to the mainland. Thus, the abandonment of the islands leads to erosion; not the other way around. The islands require constant maintenance to avoid the collapse of the sea walls; when people no longer live on the islands, they slowly fall apart.

There is no doubt that the saltwater people are leaving the artificial islands. For example, in the 1970s, approximately 5500 people lived on the islands in Lau Lagoon [25,54]. The 2009 census recorded 3616 people in the lagoon [55]. It would, however, be erroneous to attribute this decline to sea-level rise. Malaria and tribal warfare, the main reasons to live on the artificial islands, are no longer acute and menacing threats. People have settled around the missions, schools, hospitals, and roads on the mainland, a process that started in the 1920s and has continued ever since. The saltwater people have also diversified their livelihoods: Many people have expanded their gardens and created cash crop plantations on the mainland. More recently, there has been an exodus of people to Honiara. Ben Buga and Veikila Vuki [56], for instance, estimate that 70% of the young people of Foueda, an artificial island in Lau Lagoon, have moved to the capital in search of jobs or to attend school.

Sea-level rise manifests itself primarily during king tides. Catherine Wilson [57], for example, writes that, on Raolo Island in Langelanga Lagoon: “the tides are getting higher, the waves come right across the island during the wet season.” To some extent, this has always been the case. The Anglican missionary Walter Ivens [20], who travelled around Malaita between 1895 and 1909, for example, writes:

“The islands are all built up to a height sufficient to keep out high spring-tides, and the only danger of flooding is in December and January, when the very high tides which then occur may be banked up in the lagoons by a strong north-east wind. At such times it is not uncommon for the water to come into the houses, but this is part of the life and nobody minds.”

(emphasis added)

One problem with the sinking islands narrative is that it neglects such historical records. What seems to have changed over the past century is not so much the occurrence of flooding, but rather people’s vulnerability to flooding: People have more goods, such as papers and electronics, that cannot become wet, and new buildings are often constructed with concrete and timber instead of sago stalks. Raolo Island is, in fact, an interesting case. Most households abandoned the artificial islet after cyclone Namu in 1986 and built a new settlement on the mainland. But during the ethnic conflict in the early 2000s, these people were forced to abandon their new village by Kwara’ae land owning clans. It illustrates the complex dynamics of settlement patterns on Malaita.

5.2. Extreme Weather Events

Few climate change effects capture the public imagination so much as extreme weather events. Climate change models in fact predict a substantial decrease in the total number of tropical cyclones in the Southwest Pacific, although the intensity of the remaining storms might increase [58]. Along the coast of Malaita, severe storms have destroyed entire islands. Tropical cyclone Angela, for example, caused a

9 m (!) storm surge that flooded the artificial islands in Langalanga in 1966 [59]. A year later, in 1967, cyclone Annie destroyed houses and coconut plantations in North Malaita, and in 1972, tropical cyclone Ida caused massive devastation in the province and encouraged landward migration [35]. Several artificial islands in Langalanga Lagoon, such as Rarata Island, were permanently abandoned after cyclone Namu in 1986, the worst tropical cyclone to have affected Solomon Islands on record (see Figure 7). It illustrates that tropical storms have always been an integral part of life for coastal communities in the archipelago [60]. In fact, cyclones also create opportunities: The village of Abitona in East Malaita was built on a sandbank created by a severe cyclone in the 1920s. The new land proved attractive to settle on, particularly as there were no existing land claims. Nowadays, the village is flooded by king tides in December and January, but whether this is a new phenomenon or caused by climate change, soil compaction, the cutting of mangroves, or a combination of these factors, remains unclear.



Figure 7. Rarata Island in Langalanga Lagoon (J. van der Ploeg, 2017).

Albert et al. [61] conclude that the erosion of reef islands in Solomon Islands results from a dynamic interplay of extreme weather events, plate tectonics, ocean currents, and anthropogenic factors, such as inappropriate infrastructural development, rather than climate change alone. Kwai Island on East Malaita provides a clear example of the convergence of multiple stressors:

“The islands of Kwai and Ngongosila are feeling the effects of increasingly severe weather and rising tides. (. . .) Elders say they were once triple their current size. (. . .) ‘Kwai Island during our childhood days is a very beautiful place. There are huge trees in the island, where we also did gardening,’ said Janet Logafe Billy, 70, who was born on Kwai and left for the mainland after getting married. Today, the island is transformed, (she) says. The big banyan trees by the shores are gone, which has resulted in soil erosion.” [62]

A geological survey in 1990 concluded that, during the northwestern monsoon winds from September to March, the so-called koburu, currents are eating away the eastern side of Kwai Island [63]. Most of the sand is trapped at the southern part of the island, a process that is reversed during the ara season when the wind blows from the southeast. Overall, the island has not changed significantly in size since the 1960s. But nowadays there are more permanent houses on the island, which has led to deforestation. Whereas the island was covered with forest in the 1960s, there are now virtually no more trees on the island. Particularly, the cutting of large dalo trees (*Calophyllum inophyllum*) along the shoreline for firewood and to make space for houses seems to have worsened the coastal erosion problem.

5.3. Saltwater Intrusion

Climate change will have substantial impacts on freshwater aquifers, particularly on low-lying islands in the Pacific [64]. John Walenene [8], for instance, documents saltwater intrusion in two saltwater communities in Langalanga Lagoon: Busu Island and Radesifolomae. Wells have become unsuitable for drinking as a result of saltwater intrusion, and women now have to paddle considerable distances to collect water during dry periods. But that is only one part of the story: The villages used to have a functional water system, but the dam and the water pipes were vandalized during a land dispute. Similar issues occur in Lau Lagoon, where water pipes that provide water to the artificial islands are occasionally blocked or damaged during land conflicts. Climate change will likely sharpen these social issues [65], but attributing freshwater scarcity on the artificial islands solely to global warming is flawed.

Lilisiana is another interesting case in this respect. This village features prominently in the climate change discourse, and is targeted by a number of CCDRM projects [30]. Lilisiana was built in the 1920s on the outskirts of the newly established government station in Kwaibala, present day Auki town. More saltwater people settled in the village in the aftermath of cyclones in 1952, 1972, and 1986 [29]. At present, Lilisiana is the largest neighborhood of Auki, with approximately 500 inhabitants. Houses are built on the narrow beach and in the mangroves between Osi Lake and Auki Harbour. During cyclones, king tides, and heavy rainfall the village is inundated. Climate change will exacerbate these drainage problems, but is not causing the flooding. The lack of solid waste management facilities and poor urban planning are arguably more proximate causes for the recurrent floods.

In some other cases, the desertion of an artificial island has categorically nothing to do with climate change. Mala'afa Island in Langalanga Lagoon, for example, was abandoned after all members of the land-owning clan died of sickness or committed suicide. People attribute this to sorcery, and think the island is cursed.

5.4. Higher Seawater Temperatures

To illustrate the climate change impacts on coastal fisheries, the State of the Environment in Oceania report [66] quotes George Alabeni from the Airahu Rural Training Centre in the Solomon Islands:

"The sea is very hot sometimes and it is not pleasant. Older people have not seen it like this before. The world is changing, everything is changing. Before you just go down to the shore and might take fish and see a lot of seashells, crabs and the beauty of the sea; everything. Good temperature. There are birds all around the beach, very white beach. Now seabirds' coastal homes are being destroyed, and dead fish are washing up on shore. We don't expect it, and it's new to us. We have never seen those things happening."

Indeed, higher seawater temperatures will negatively impact coastal fisheries through coral bleaching and ocean acidification [67,68]. Compared to other countries in the region, coral bleaching has so far caused limited damage to coral reefs in Solomon Islands [28]. In practice, it is difficult to untangle the multiple stressors of coral reefs and their ability to produce fish. Albert et al. [69], for example, document a large algal bloom in 2011 in Marovo Lagoon in Western Province, which had detrimental impacts on live coral cover and shellfish. But whether this dead zone was caused by increased seawater temperatures, eutrophication due to logging-induced sedimentation, the overharvesting of detritivorous sea cucumbers, or a combination of these factors remains unclear.

The sinking islands of Fanalei and Walande on South Malaita provide another example of the difficulties of disaggregating the multiple stressors of tropical coastal ecosystems in remote, data-scarce areas in the developing world. Geologically, the southeast coast of Malaita is affected by rapid subsidence and earthquakes [70] (see Figure 8). Fanalei Island was heavily impacted by a 7.8 magnitude earthquake in December 2016: A large crack formed and a part of the low-lying island subsided. After this event, tides started to flood the village, and many people relocated to the mainland. Walande Island was largely abandoned in 2017, a process that commenced in 1987 when

the Anglican Church of Melanesia fostered an agreement with wane tolo land owners, built a church, and encouraged the wane asi to settle in the new village [30]. Interestingly, before settling on Walande Island, people lived on Namo Island, which was abandoned in the 1930s after a tsunami (see Figure 9). And in the mythical past, the ancestors of the people of Walande lived on a small off-shore island called Hile, which was, according to oral history, also destroyed by a tsunami (also see Nunn et al. on the disappeared Pororourouhu Islands off the coast of South Malaita [71]). Other coastal areas on Malaita are also subject to geological upheaval: Gold [72], for example, reports that two severe earthquakes in October 1931 destroyed several artificial islands in Bina Harbor in Langalanga Lagoon. In fact, fear for an impending tsunami or cyclone is an important motivation for many wane asi to move from the artificial islands to the mainland.



Figure 8. Rapid subsidence on the southeast coast of Malaita (J. van der Ploeg, 2017).



Figure 9. Walande Island on South Malaita (J. van der Ploeg, 2018).

5.5. Changing Rainfall Patterns

Most people on Malaita equate climate change with changing weather patterns. The PGSP ward profiles illustrate this clearly: People on the artificial islands identify erratic rainfall as the main climate change threat [29]. For instance, William Pwaisiho [73] quotes a man from Walande on how he feels about climate change:

“The weather is abnormal, it’s not really following the pattern as we have seen before. (. . .) I feel scared about it. And even our children too are often scared. Because it’s beyond our reach, what we are going to do about it. It’s out of the way we can control it.”

Heavy rains can make the daily canoe trip to school hazardous for children (see Figure 10). During the koburu season, women have difficulties travelling to the market. Many wane asi have therefore opted to relocate to the mainland.



Figure 10. Children on their way to school (J. van der Ploeg, 2016).

It is predicted that changing rainfall patterns will constrain subsistence agriculture in the Pacific [74]. In Solomon Islands, rainfall patterns have shown little change since the 1960s [75], and there is no indication that extreme rainfall or drought is currently threatening food security on Malaita. The notorious 1997/1998 El Niño drought affected gardens in North Malaita, but the most serious problems were felt in the urban centers and on remote coral atolls [76]. Historically, the wane asi cultivated swamp taro, yams, and sweet potatoes on the mainland. Traditional crop rotation schemes and fallows have been shortened as farming systems have intensified over the past fifty years [77]. Consequently, soil degradation, erosion, and pests have become serious problems. Agricultural development is further hampered by a structural lack of technology, skills, credit facilities, farm-to-market roads, reliable energy supplies, and agricultural extension services [78]. There are a number of concerns about food security and nutrition on Malaita, particularly related to the replacement of traditional diets by cheap, nutritionally-poor imports, such as noodles, and its long-term impacts on health [79]. A number of other interconnected social and political problems, such as youth unemployment, poor healthcare and education, gender-based violence, land tenure disputes, corruption, alcoholism, urbanization, and expectations of modernity further contribute to food insecurity and health problems. These multiple stressors highlight the complexity of contemporary food systems [80] and the limits of focusing on a single explanatory factor when trying to solve these problems.

5.6. Climate Change Adaptation Projects

The sinking islands have become a dominant theme in global and local climate change discourses, and have become some sort of litmus test for international donors, government agencies, and development organizations [12]. Over the past ten years, a variety of CCDRM projects have been implemented on the artificial islands of Malaita (see Table 2). It is estimated that, in the period 2010 to 2016, at least USD 112 million has been allocated for CCDRM projects in Solomon Islands [81].

Table 2. Examples of Climate Change and Disaster Risk Management projects in Malaita Province.

Project Title	Implementing Agency	Donor	Timeframe	Aim	Budget (USD)	Source
Coping with Climate Change in the Pacific Island Region (CCCPIR)	SFC, GIZ, SPREP and USP	BMZ	2009–2015	Strengthen the capacities of Pacific Island Countries and regional organizations to cope with the anticipated effects of climate change affecting communities across the region.	20,000,000	https://www.spc.int/cccpir
Pacific Adaptation to Climate Change (PACC)	MAL and SPREP	UNDP, USAID, GEF	2009–2014	Reduce climate vulnerability by demonstrating best-practice adaptation in three key climate-sensitive areas: coastal zone management, food security and food production, and water resources management	5555,000 (national allocation)	https://www.adaptation-undp.org/sites/default/files/downloads/pacc_cb_sol.pdf
Mangrove Ecosystems for Climate Change Adaptation and Livelihoods (MESCAL)	IUCN	BMU	2010–2013	Address the key challenges of mangrove management to increase the resilience of the people to climate change and improve livelihoods in five Pacific Island Countries	3100,000	https://www.iucn.org/downloads/mescal_undterm.pdf
Malaita Community Resilience and Livelihoods Project	World Vision	ANCP	2010–2014	Enhance community resilience to mitigate the effects of natural disasters on food and livelihood security in 15 communities in Malaita Province		https://www.wvi.org/sites/default/files/HEA%20Fact%20Sheet%20Solomon%20Islands%20-%20Final%20-%20Updated%20Apr1%202013.pdf
Strongem Waka lo Community to Kaikai (SWOCK)	MAL and MECDM	UNDP	2011–2015	Promote community-based climate change adaptation activities that enhance food security and livelihood resilience in pilot communities on the artificial islands of Malaita	5533,500	https://www.gcca.eu/programmes/solomon-islands-climate-assistance-programme-projects/af-solomon-islands
Solomon Islands Climate Assistance Program (SICAP)	MECDM	EU	2011–2014	Reduce vulnerability of communities living on low-lying atolls, artificially built islands, and other low-lying coastal areas in Solomon Islands	3170,000	https://www.gcca.eu/programmes/solomon-islands-climate-assistance-programme-projects/af-solomon-islands
Climate Change and Food Security	SFC	USAID	2012–2014	Evaluate and implement innovative techniques and management approaches to increasing the climate change resilience of terrestrial food production systems for communities in Fiji, Kiribati, Samoa, Solomon Islands, Tonga, and Vanuatu	4000,000	http://ccprojects.gsd.spc.int/documents/root_docs/SFC%20USAID%20Project%20Overview.pdf
Coastal Community Adaptation Project (C-CAP)	DAI	USAID	2012–2017	Improve small-scale community infrastructure and building local capacity for disaster prevention and preparedness in the Pacific	18,370,000	https://pdf.usaid.gov/pdf_docs/PA00MSXM.pdf
Community Resilience to Climate and Disaster Risk Project (CRISP)	MECDM	World Bank/GEF	2014–2020	Increase the capacity of selected rural communities to manage natural hazards and climate change risks	9130,000	https://projects.worldbank.org/en/projects-operations/project-detail/P112613
Solomon Islands Water Sector Adaptation Project (SIWSAP)	MECDM and MMERE	UNDP	2014–2019	Improving the resilience of water resources to the impacts of climate change in order to improve health, sanitation, and quality of life, and sustain livelihoods in target vulnerable areas	6850,000	https://www.adaptation-undp.org/projects/dcf-solomon-islands-water-sector-adaptation-siwsap
Pacific Ecosystems-based Adaptation to Climate Change (PEBACC)	SPREP	BMU	2014–2019	Explore and promote ecosystem-based adaptation options for adapting to climate change	5575,000	https://www.international-climate-initiative.com/fileadmin/Dokumente/2015/PEBACC_Factsheet.pdf

Notes: ANCP: Australian NGO Cooperation Program. AUSAID: Australian Aid. BMU: German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety. BMZ: German Federal Ministry for Economic Cooperation and Development. DAI: Development Alternatives Inc. EU: European Union. GEF: Global Environment Facility. GIZ: German Corporation for International Cooperation. IUCN: World Conservation Union. MAL: Ministry of Agriculture and Livestock. MMERE: Ministry of Mines, Energy and Rural Electrification. SFC: Pacific Community. SPREP: Secretariat of the Pacific Regional Environmental Programme. UNDP: United Nations Development Programme. USAID: United States Agency for International Development. USP: University of the Southern Pacific.

Many of these projects aim to build on the indigenous knowledge of the wane asi in order to identify and strengthen “participatory community-based climate change adaptation planning processes” [82]. The Solomon Islands Red Cross, for example, facilitated vulnerability and capacity assessments on several artificial islands in Lau and Langalanga. It found that “access to usable water is a major problem due to increasing salinization of local water tables caused by rising sea levels” [83], and subsequently donated rainwater storage tanks to several communities. The United Nations Development Program implemented the Strongem Waka lo Community fo Kaikai (Strengthening Communities for Food Security) project, which organized community meetings to assess the impacts of climate change, physically mapped projected sea-level rise by placing red pegs 1 m above the high-water watermark to raise people’s awareness of climate change, and distributed vegetable seeds [84]. And the Community Resilience to Climate and Disaster Risk Project of MECDM conducted scoping visits in twenty communities in Langalanga Lagoon and on Small Malaita to develop community-based disaster risk management plans.

But, despite this grassroots rhetoric, most CCDRM projects remain strongly donor-driven and technocratic, and participatory processes are highly manipulative [85,86]. It is perhaps not surprising that when consultants for the Coping with Climate Change in the Pacific Island Region project visit a village, people will identify climate change as a problem in order to secure rainwater storage tanks, seeds, building materials, training opportunities, and other forms of support. People’s experiences with the Coastal Community Adaptation Project (C-CAP) project on Malaita illustrate the problems of many CCDRM projects. At the start of the project, the national media reported extensively on the USD 17.9 million grant to support local-level climate change interventions in 77 villages in nine Pacific Island countries. On its website, MECDM reported that USD 65,000 would be available for each of the ten villages selected on Malaita, including five saltwater communities in Langalanga Lagoon and two artificial islands in East Malaita. In all these communities, C-CAP facilitated a participatory process to “identify current and projected climate change impacts, map existing community infrastructure assets, and prioritize infrastructure-related adaptation needs” [87]. The project then contracted a construction company to place four 50,000 L polyethylene water storage tanks in all these villages (see Figure 11). In Oibola, for example, C-CAP placed four tanks. Here, people appreciate the new drinking water system and make intensive use of it, but people also know that a rainwater storage tank costs around USD 1700 and question what happened with the budget of the ministry. Clearly, people understand that the construction, transport, labor, and administration costs need to be included, and that these costs are relatively high in Solomon Islands. They have much less sympathy for the costs of the scoping visits, consultants, participatory maps, community workshops, and climate change adaptation plans. After all, people already know what the problems are in their village, and that the project would eventually provide a rainwater storage tank.



Figure 11. Rainwater storage tank on Kwai Island (J. van der Ploeg, 2017).

People on the artificial islands strategically link their needs and priorities to climate change issues to gain access to development aid. In the words of Simon Foale [88], people simply “play along” to obtain hand-outs and cargo. As a result, climate change is directly linked in the public perception to development aid. In many villages, this has fostered aid dependency and clientelism, or what is locally sometimes labelled as a “hand-out mentality” [89]. This opportunistic rent-seeking behavior explains, to a large extent, why villagers consistently report that climate change is threatening their livelihoods. Another reason is that local perceptions and worldviews are increasingly influenced by global discourses [90]. The wane asi read newspapers articles, watch movies, browse the web, and check Facebook, and they use this information to contextualize and give meaning to their daily experiences. Modern education, urbanization, information technology, and mass media often depreciate ecological knowledge and traditional coping strategies, and promote modern solutions for environmental problems, a process that CCDRM projects, often unintentionally, reinforce [91,92].

By focusing on anticipated climate change impacts, such as sea level rise, most CCDRM projects divert scarce government resources and capacity from more urgent environment and development problems, and risk undermining the efforts of coastal communities to address these problems [92,93]. CCDRM projects typically target only a few opportunistically selected communities, thereby fostering political clientelism and opportunistic rent seeking. Externally-funded projects typically neglect the limited capacity of the national government, by-pass provincial and customary governance structures, and promote capital intensive interventions, which makes it impossible to sustain or scale-out these interventions. Much funding is siphoned off through institutional overheads, consultants, inception meetings, and training workshops. In the end, very little reaches vulnerable communities [81]. The mismatch between publicly announced climate funds and the actual activities on the ground fuels suspicion of malversation and corruption, and often causes friction between villagers, project staff, and government officials. This is particularly problematic because international climate funding often takes place at the expense of existing development aid and in a context of deteriorating public services, state-sponsored resource extraction, political patronage systems, and a history of failed development projects [94]. Health care, education, infrastructure, and other basic government services in the rural areas remain very poor, despite ambitious government plans and substantial international development aid after the civil unrest in 1999–2003 [95]. As a result, people have become deeply cynical of the ability of the government and development organizations to improve conditions [96,97].

Moreover, many proposed community-based adaptation measures, such as building rainwater storage tanks, farming corals, raising awareness, and establishing homegardens seem woefully inadequate for the projected impacts of climate change [98,99]. In a certain way, many investments of CCDRM projects in water systems, relocation, or agriculture weaken traditional coping mechanisms such as mobility, autonomy, communal labor, and livelihood diversity that have enabled saltwater people to adapt to environmental change.

6. Conclusions

In sum, little reliable scientific information is available on how climate change impacts on the dynamics, vulnerability, and resilience of coastal lagoon systems in the Pacific [100]. There is, however, strong evidence that unsustainable fishing methods, such as small mesh gillnets and spearfishing at night, are impacting on coastal fisheries on Malaita [101]; that corporate logging causes erosion and siltation of coastal ecosystems in the province [102]; and that the clearing of mangroves threatens the food security and livelihoods of the wane asi [103]. It is well-known that communities in the province are coping with a range of social issues such as alcoholism, crime, and domestic violence [104]. It is documented that 52% of households on Malaita lack access to an improved source of drinking water, that 85% do not have basic sanitation facilities [105], and that 40% of two to five-year-old children in wane asi communities are malnourished [79]. It is also widely acknowledged that public infrastructure in Solomon Islands, such as rural health clinics, schools, roads, bridges, and wharfs, have deteriorated over the past twenty years [106]. Addressing these problems will

reduce the vulnerability of coastal communities to long-term impacts of climate change. The reverse is unfortunately not the case. In fact, a narrow focus on climate change adaptation tends to distract from other, more pressing environment and development problems [107].

So why does the sinking islands narrative remain so persistent, despite the uncertainty, complexity, and contradicting empirical evidence? Partly, it can be attributed to opportunism from government agencies, donors, civil society organizations, and rural communities [108]. Partly, it offers a simple solution for a range of wicked problems: Reductionism is useful, and perhaps even necessary, to mobilize financial resources in the international political arena [109]. And, partly, the sinking islands discourse is what Ilan Kelman has called a ‘convenient distraction’ [107]. A focus on climate change de-politicizes environmental and development problems: By emphasizing a new, external, and all-surpassing natural hazard, decision-makers mask their failure to address the root causes of people’s vulnerability, such as poverty, weak governance, corruption, and inequality [110]. After all, it is much easier to draft a community-based disaster risk management plan than to hold logging companies accountable, enforce fishing gear restrictions in remote areas, operate rural health clinics, or organize community committees to maintain water supplies.

This paper is not belittling the long-term impacts of climate change on coastal communities in the Pacific. The point is that the climate change threats projected by journalists, policy-makers, and development experts are often highly uncertain and distant, and that the wane asi have to cope with a range of more severe and urgent problems right now. The saltwater people should not be portrayed as helpless victims of climate change. Instead the focus should be on finding practical ways to enable these people to cope with rapid social and environmental changes.

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Article

Understandings, Practices and Human-Environment Relationships—A Meta-Ethnographic Analysis of Local and Indigenous Climate Change Adaptation and Mitigation Strategies in Selected Pacific Island States

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Abstract: Local and Indigenous knowledge systems worldwide indicate adaptation and mitigation strategies to climate change. Particularly in regions that are massively affected by climatic changes, such as the Pacific Island States, there is a need for increased and combined research on the role which these knowledge systems can play internationally. For this reason, this article provides a synthesis of empirical results and approaches to local and Indigenous climate change adaptation and mitigation strategies in selected South Pacific Island States by using a meta-ethnographic approach. The reviewed literature is associated with the sub-disciplinary perspective of the Anthropology of Climate Change. The results of the meta-ethnographic analysis are discussed based on three thematic focal points: First, the empirical ground of local understandings of climate change and its theoretical conceptualization(s) are constituted. Second, the results of practices for adaptation to climate change are synthesized and presented in detail throughout one example. Third, the synthesis of climate change mitigation practices is outlined with a specific focus on human-environment relationships.



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Keywords: climate change adaptation and mitigation; local and Indigenous knowledge systems; South Pacific Island States; anthropology of climate change; meta-ethnography

1. Introduction

In the cyclone season between 2014 and 2015 Fiji had been hit by several strong storms. Two of them were categorized as tropical cyclones—Pam and Reuben. (For an explanation and assessment of the storm categorization, see the 2015 annual climate summary for Fiji: <https://www.met.gov.fj/index.php?page=climatedataold#2015annualSum2018.09.25%2000.41.33.pdf>). As I could encounter in Fiji in 2015, local people understood the unusual frequency and intensity as caused by climate change. (In 2014 and 2015, I visited Southern Fiji on two occasions while partaking in a voluntary service, each for a period of four to six weeks between July and September. For anonymization, the persons on whose statements these introductory sentences are based on, are not further identified.) Due to increased flooding as a result of the severe storms, local communities considered relocating to higher-lying areas. Also, the meaning and potential loss of local knowledge came into focus: Semi-modern houses, which were built with corrugated iron roofs were, in a local area of Southern Fiji, understood to withstand the storms much worse than the traditionally built "Bures" which showed a higher permeability of wind currents [1].

These local points of discussion are in line with what scientific research has found: Based on scientific, technological, and socio-economic information from 2014, the Intergovernmental Panel on Climate Change (IPCC) points out that low-lying regions are most vulnerable to the consequences of climatic changes [2]. Amongst these, the Pacific Island States are most affected by natural disasters worldwide, the consequences being economic loss, diminishing water resources, and destruction of local ecosystems amongst others. [2–4]. On a further note, most recent evidence based on satellite data from August

2020 suggests that the ice sheet losses in Antarctica are currently close to the worst-case scenario depicted by the IPCC [5]. The published research results were compared with forecasts of climate models directly related to a predicted rise in sea level and the associated vulnerability [6,7] (Hereby, scientists of different disciplines discussed vulnerability within a societal/governmental context: especially in the field of governance the concept of vulnerability seems to obscure how political actions create or reinforce structural inequalities and vulnerability of marginalized groups [6,7]. Under the scientific perspective of modern risk societies, the extent of social vulnerability is essentially determined by the means and opportunities available to individuals and societies to deal with and manage risk situations [6] p. 169. Applied to a Pacific perspective on climate change adaptation this is the point of departure for a critique or expansion of how to grasp vulnerability, since practical possibilities for Pacific societies are also influenced by global power inequalities that possibly enhance vulnerability.) of coastal regions worldwide [8].

The 22 Pacific Island Countries and Territories [9] are experiencing multiple consequences of climate change, while at the same time being comparatively dependent on the maritime ecosystem for a nutritional basis and infrastructure [9,10]. The states differ based on a variety of factors such as (colonial) history, ethnic groups, ecological environment, and geology, with the consequences of climate change for each region being shaped in particular by their classification as high- or low-lying regions. Because of their immense regional variation, natural disasters, droughts, sea-level rise, and fish depletion are counted in varying degrees among the local impacts of climate change [9]. These local impacts in turn involve different following consequences and (ecological) interactions as exemplified by Kumar and colleagues concerning sea-level rise:

“Accelerated sea-level rise will result in higher inundation levels, rising water tables, higher and more extreme flood frequency and levels, greater erosion, increased salt water intrusion, and ecological changes in coastal flora and fauna” [10], p. 5

These changes further affect socio-economic factors, which is reflected in scientific assessments predicting enormous economic losses for Pacific Island States [3]. At the same time, the consequences for different states cannot be equated: While Papua New Guinea, Solomon Islands, Tonga, and Vanuatu are among the most disaster-prone nations worldwide, low-lying states, including Kiribati and Tuvalu, are particularly at risk from sea-level rise [9]. Nonetheless, recent findings conclude that all Pacific Island Countries have exceptionally high vulnerability to the impacts of climate change [9]. In order to tackle these consequences, knowledge about strategies for climate change adaptation and mitigation are essential. But since the impacts of human-made climate change affect particularly young and future generations, the question of how this knowledge is generated and passed on becomes necessary as well [11].

Still, inhabitants of Pacific Island States already realize and experience the consequences of climate change firsthand. Moreover, research has shown that local, traditional, and Indigenous ways of living can contain strategies on how to adapt to climate change and are therefore crucial [12–14]. With this in mind, the research questions of this article are the following:

What are local and Indigenous understandings of climate change in selected Pacific Island States and how can they be conceptualized? Which adaptation practices to climate change already exist? How are these practices transferred to younger generations and how do they relate to international efforts to mitigate climate change? In order to answer these questions, I conducted a meta-ethnography that synthesizes previous empirical findings based on scientific literature. The article is thus intended to provide a literature-based overview of previous research results and to reinterpret them in terms of further research potential with a specific focus on the entanglement of local strategies and international ambitions.

Due to the number of different states and the high dispersion of their regional location, not all 22 Pacific Island Countries and Territories were regionally focused in this study.

Historical and regional aspects as well as the degree of affectedness were used as selection criteria. Thus, data collected in the politically independent, smaller Pacific Island States were included, which is why data collected in New Zealand and Papua New Guinea was excluded from the regional focus of the analysis. For reasons of more precise regional situatedness of the results, the regional focus was further placed on the southern Pacific Island States. Additionally, the low-lying, as well as disaster-prone regions of Kiribati, Solomon Islands, Tonga, Tuvalu, and Vanuatu [9], represented the center of interest. Since a large body of literature was based on research conducted in Fiji and Samoa, these were also focused on due to their regional fit. The nature of the environments of the states included in this research nonetheless exhibits a high degree of diversity, which is why this study primarily depicts local diversity rather than comparing a presumed homogeneity.

The synthesized data was assigned to the theoretical sub-discipline of the Anthropology of Climate Change, which has emerged over the last two decades under the umbrella of Environmental Anthropology. The Anthropology of Climate Change aims at analyzing the phenomenon of climate change in a multifaceted way [15–17]. For this reason, it discusses how people conceptualize climate change and adaptation to climate change in different contexts [18–20] with a specific focus on Indigenous realities and an engaged rather than only descriptive approach [19,21]. Epistemological approaches of Social and Cultural Anthropology are especially required because they enable us to not only understand knowledges on practical adaptation to climate change but also to culturally translate different understandings, ideas, and knowledge [22]. This article is part of my broader Ph.D. project that wants to contribute to this sub-discipline. The project examines local and Indigenous climate change negotiations and adaptation practices in the South Pacific and how they relate to international educational policies, such as Education for Sustainable Development (ESD) and Climate Change Education (CCE). The scientific results described so far show the relevance of the topic for exactly the southern Pacific region and let an urgency of the discussion of this article and its empirical basis appear in a new light.

2. Methods and Materials

In order to answer the research questions, the method of meta-ethnography was chosen. Meta-ethnography is characterized on the one hand by the synthesized presentation of empirical qualitative data [23,24]. On the other hand, it enables a new, interpretative compilation of the results to create a meta-level of ethnographic description that allows for new insights [23–25], as constituted in the following:

“Meta-ethnography is a method that allows synthesizing qualitative studies in order to achieve a new conceptual understanding of a particular phenomenon. [...] Such a method can lead to more concise findings as well as to new conceptual frameworks, thus shedding light on gaps in literature”. [24], p. 2

For these stated reasons, meta-ethnography was preferred to other methods of systematic literature reviews. Meta-ethnography, as developed by Noblit and Hare [23] summarizes, compares, and interprets different qualitative studies not only in order to shed light on gaps in research, but also to create added value to conceptual frameworks concerning the given topic [24,25]. In line with the approach, a seven-step procedure was carried out: (1) getting started—record identification, (2) deciding on what is relevant to the initial interest, (3) narrowly reading the studies, (4) determining how the studies are related, (5) translating the studies into one another, (6) synthesizing translations, and (7) expressing synthesis [23]. At its core, meta-ethnography is a synthesis of interpreting the interpretations of ethnographic results and “guides the researcher in translating results from one study to another to form a new conceptual understanding of a particular phenomenon” [24], p. 3 The explicit quality of the method lies not only in aggregating scientific results but also in expressing the results within a new set of relations in the next step, resulting in a kind of ethnography that achieves new insights for a meta-level [23,24].

The following flow diagram in Figure 1 [26] illustrates my methodical approach in the implementation of the 7-step procedure according to Noblit and Hare [23].

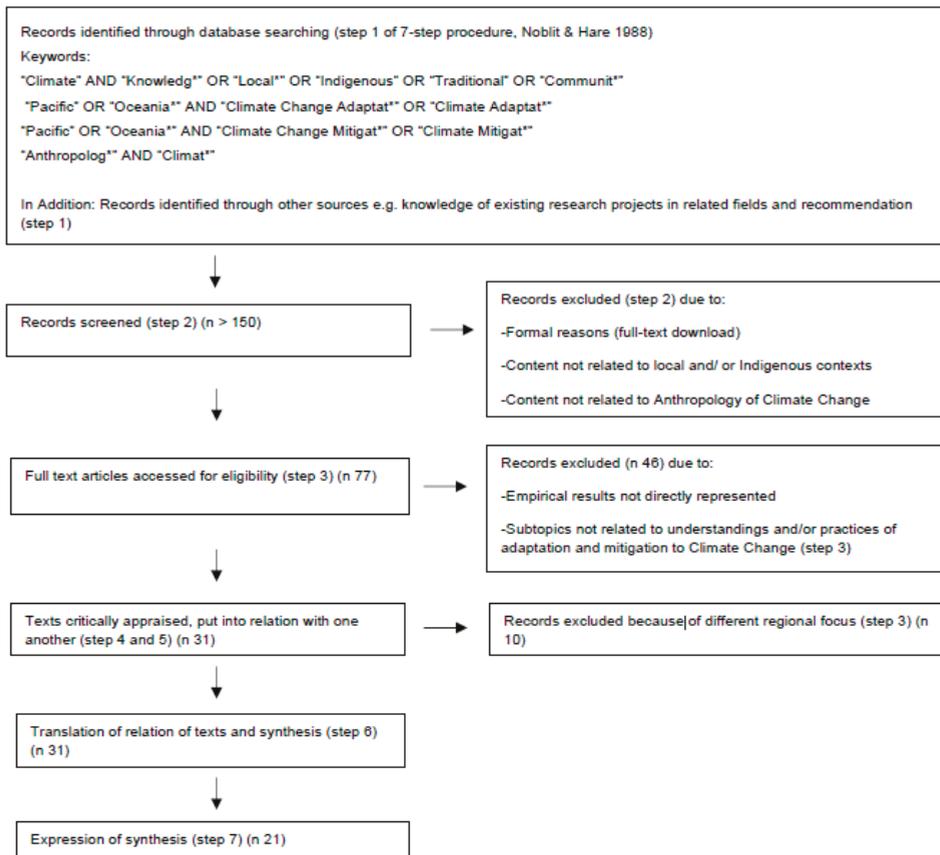


Figure 1. Flow Diagram of the Different Phases of the Applied Meta-Ethnography.

To begin with, a literary research was carried out with the library database of the Free University Berlin (included databases among others are ProQuest, ScienceDirect, and Web of Science (For additional information on which databases are included please see: https://dbis.ur.de/dbliste.php?bib_id=fub&colors=31&ocolors=40&lett=a&lc=S&fc=S#S)). The main keywords used for the literary research are to be summarized as following: “Climate” AND “Knowledg*” OR “Local*” OR “Indigenous” OR “Traditional” OR “Communit*”; “Pacific” OR “Oceania*” AND “Climate Change Adaptat*” OR “Climate Adaptat*”; “Pacific” OR “Oceania*” AND “Climate Change Mitigat*” OR “Climate Mitigat*”; “Anthropolog*” AND “Climat*”. Following extensive research (Step 1), over 150 documents were screened (Step 2) and reduced (n 77) based on the topic expressed in the title and/or abstract. Records were excluded (step 2) due to not matching the following criteria: Formal reasons (full-text download); Content related to local and/ or Indigenous contexts; Content related to an Anthropology of Climate Change. These criteria were also reflected in a practice question which I introduce in the following paragraph. During Step 3 all remaining texts were thoroughly read and thus more narrowly screened according to their topic or methodological relevance. On this basis, again, those texts were excluded, which were methodologically or thematically not relevant. The inclusion criteria consisted of the representation of empirical data and the relation of its subtopic to understandings and/or practices of adaptation and mitigation to climate change. The remaining literature (n 31) was compared, put into context, and interpreted (steps 4–6). As a synthesizing basis for this article, texts that were

not regionally relevant were not considered (n 10). The only publications that remained were those that were thematically, methodically, and regionally pertinent (n 21). In a final step the results were synthesized (step 7). (The timeline of the search was defined as follows: The majority of the literature search was conducted from November 2019 to May 2020. Minimal follow-up research was conducted in September and October 2020 to synthesize the results). This synthesis is carried out in Section 3 throughout a descriptive summary and discussion of the results of the meta-ethnographic analysis concerning the following three thematic aspects: First I present what local understandings of climate change and beliefs about climate change could be identified within the analysis and how they are conceptualized within the different literature. Section 3.2 outlines one example of local and Indigenous practices on adaptation to climate change and expresses how this can be interpreted and further discussed throughout the results of the meta-ethnographic analysis. In Section 3.3 the insights concerning climate change mitigation are presented which lead to a synthesis of human-environment relationships and their meaning within an international context. Following the quintessence of meta-ethnography, the results also use individual texts from step 4–6 for interpretative classification.

While conducting the meta-ethnography, I added the aspect of using a practice question to the method. I adopted this procedure from the principles of rapid reviews [27]. The method was developed within the context of scientific policy advice to create a certain way of synthesizing evidence within the domain of public health by short deadlines [27]. (Rapid reviews have been used especially in response to ad-hoc events whose further research is being debated and where urgent social and political solutions are needed. Several examples of rapid reviews can be found concerning Covid-19.) Rapid reviews have been established in the scientific landscape mainly in the development and discussion of new fields of knowledge and were combined with meta-ethnography [28]. The creation of rapid reviews supported by meta-ethnography defines the following principles: development of practice question, defining the search for evidence, critical appraisal of the information sources and synthesizing the evidence [27,29]. When using rapid reviews, it is important to underline that this type of review does not replace a systematic review [28], p. 717 and can only be understood as a condensed form of it, which is why I only added some of its principals to the meta-ethnographic approach. In this sense, the following practice question was used for the meta-ethnographic analysis: Which empirical results from the field of Climate Change Anthropology are already available on the use of local and Indigenous adaptation and mitigation of climate change with a regional focus on the South Pacific Island States? The search for evidence was further defined throughout the document types (policy briefs and anthropological scientific literature both peer-reviewed articles and book publications) and language (English and German).

Despite the above described benefits, meta-ethnography is also criticized for the danger of blurring a systematic literature analysis and a more inductive-interpretive approach, as well as for its vaguely defined structure [25,30]. For this purpose, on the one hand it is necessary, especially in the comparison of empirical results, to remain close to the empirical origin and to separate classifications and interpretations in the synthesis [24], p. 7. On the other hand, I created the flow diagram portrayed in Figure 1 to outline the structure of the methodical approach more thoroughly. A further limitation of the method can be linked to a scientific debate on postpositivism:

“Validity of interpretations of meta-ethnographies is of concern to the scientific community partly due to postpositivist norms of replicability. However, this should not be an issue when conducting a meta-ethnography since this method stems from the interpretive paradigm, which accepts and recognizes that all interpretations are but one possible interpretation of findings”. [24], p. 7

Also, due to the social phenomenon of climate change denial, it is important to illustrate in this context that objectively measurable impacts of climate change are already present for the Pacific region and are thus not interpreted. At the same time, I attempt to illustrate the

value of this analysis in terms of particularized findings of specific contexts in Section 1, which is additionally reflected in the clarification of regional specificities throughout Section 3.

3. Results and Discussion

In this Section the results of the meta-ethnographic analysis are presented whilst set into relation with another. They are further discussed in the light of additional literature.

3.1. Understandings of Climate Change in Local and Indigenous Contexts

The empirical results from the analysis of the different texts reveal that there is a diversity of understandings of climate change and adaptation amongst Indigenous groups: One study taken out in Fiji [31] showed that the participants of the studies had “different views about what climate change is and what impacts it will have on their livelihoods” [31], p. 60. This can either be the case within a single country, or as a comparative study of Tuvalu, Samoa and Tonga illustrates—within different countries [32]. But how were differing views and understandings of climate change further described and for what underlying reasons? The comparative study taken out in Tuvalu, Samoa and Tonga indicates that climate change was generally perceived by locals as

“increases in temperature or »increased heat of the sun«. [...] Respondents from Tuvalu emphasized the lack of rain and severe drought conditions in their replies to the open questions. In Samoa, people described both extremes, i.e., too little and too much rain. And in Tonga, the experience and expectation of heavy rainfall were more prevalent than the experience and expectation of lack of rain. [...] With the regard to changes of wind, replies reveal that in Samoa and Tonga the focus lies mainly on the occurrence of tropical cyclones”. [32], pp. 154–155

In Gucake’s study on Fiji more than half of the participants expressed that “climate change is the changes in the weather patterns” [31], p. 52. Other field research, particularly in Tuvalu and Kiribati, illustrated that climate change was primarily associated with a rising seawater level and thus, was associated with the Christian Noah Story [32,33]. A repetition of the Noah Story was partially thought of as a non-recurring tragedy [33].

Data collected in Fiji, Lata and Nunn [34] found out that a call for climate change action was perceived as an “alien and remote” (p. 177) concept that does not relate to one’s own daily life. The further description of this insight is that information on action leading towards climate change mitigation was provided in foreign languages, mainly English, which was not the participant’s mother tongue (p. 177). Also, the participants have not yet felt threatened by it but only understood other Pacific countries like Australia or Kiribati (p. 180) as concerned nations, even though in another part of the survey they identified environmental concerns (p. 178). In addition to these results the study of Wit and colleagues [20], partly based on research carried out in Vanuatu, expresses the following: Local assessments of extreme weather events such as floods or storms differ massively from their representation and perception in the media, as people rather focus on traditional knowledge systems and in one case even neglected warnings on up-coming severe weather events [20], p. 11. In a recently published article in this Special Issue van der Ploeg and colleagues describe a media discourse on climate change in the Solomon Islands. They conclude that “a narrow focus on the projected impacts of climate change distracts attention and resources from more pressing environmental and development problems that are threatening rural livelihoods” [35], p. 1. Their localized description of the rural livelihoods of the Lau people and its comparison to the media narrative of sinking islands represent a challenging gap of different types of understandings and narratives on climate change.

Beyerl and colleagues explain the varying perceptions of environmental changes between inhabitants of Tuvalu, Samoa and Tonga and even within the countries throughout the following indicators:

“(i) Geographical and climatic differences between the island states and (ii) selected socio-demographic variables. The socio-demographic factors that proved most relevant include (i) the size of the settlement in which respondents live, (ii) their distance to the sea, (iii) their interaction with nature, and (iv) their self-assessment of their own religiosity”. [32], p. 143

The indicators presented in this study do not yet refer to the other studies but could provide an explanation for the other results [20,31,34]. Also, the indicator of ii.i and ii.iii are in line with the findings of Hetzel and Pascht [36]: They carried out research in Vanuatu on urban sense-making of climate change of young, urban Ni-Vanuatu and hinted towards a big interest of the participants in western scientific knowledge on climate change. The reasons for this will be further discussed in Section 3.2 but comparing their results for example to the ones of Gucake, where the research was taken out in a more rural place, the thesis becomes fortified, that one’s livelihood needs to be aligned to the concept of climate change.

Next to these different understandings of climate change, the synthesis showed that in almost all of the studies concerning an Anthropology of Climate Change there is a discussion about how these different understandings can be contextualized and by which perspective a scientific consideration in consequence of postcolonial power distributions is meaningful [18,20,35]. Therefore, presenting the findings that scientifically discuss local and Indigenous understandings of climate change would be insufficient without describing that the phenomenon of climate change within this discourse is also understood as a peak of global power inequalities, as Crate and Nuttall sharpen up:

“Climate change is environmental colonialism at its fullest development—its ultimate scale—with far-reaching social and cultural implications. Climate change is the result of global processes that were neither caused nor can be mitigated by the inhabitants of the majority of climate sensitive world regions now experiencing the most unprecedented change. Thus indigenous peoples and other place-based peoples find themselves at the mercy of—and having to adapt to—changes far beyond their control. Yet climate change is a threat multiplier. It magnifies and exacerbates existing social, economic, political, and environmental trends, problems, issues, tensions, and challenges”. [17], p. 11

It is important to bear in mind that this perspective can also carry the risk of victimizing people from the ‘Global South’ as pointed out by van der Ploeg among others. In the investigation of how people from the ‘Global South’ understand their ‘vulnerability’, recent anthropological research has shown that local understandings are not accompanied by narratives of victimization as especially studies carried out in Fiji and Vanuatu but also in regions outside the South Pacific showed [20,34,37]. On the contrary Fair constituted that in Vanuatu climate change would allow (Indigenous) communities to articulate the importance of Indigenous knowledge and the practical and moral superiority of Ni-Vanuatu *kastom* practices [37], p. 187. Local responses to climate change would therefore have counter-hegemonic potential and would demonstrate the agency [37] of inhabitants of the so-called Small Island States [18]. Besides, empirical results with a focus on other regions presented that the vulnerability to climate change of individual population groups could thus be reduced and resilience created by using local, ecological, and intergenerational knowledge and practices [38–42] (I do not use resilience in this paper to describe the adaptive capabilities of a system in a scientific and technical sense [41]. Instead, adaptive resilience [38] is intended to describe the actor-centered process of dealing with and reacting to a changing environment and to focus on the transformative [38] core of practices and knowledge for adaptation to climate change [41]. However, the concept of resilience has also been strongly criticized scientifically: on the one hand, natural and social science definitions diverge widely [42]. On the other hand, the use of resilience, especially in governance contexts, suggests a kind of obligation for actors to adapt to changing living conditions, for example due to the effects of global capitalism or climate change [42].).

To be understood as a validation of the portrayed data so far, Beyerl and colleagues refer to the necessity to scientifically present different perceptions for setting a basis to discuss and create more sustainable ways of life [32], p. 186. For this aim, climate change needs to be defined in a more differentiated way. Furthermore, other anthropological research continues to examine how knowledge about climate change is developed into subjective, situational, and normative ideas in their local contexts [43,44]. Reviewing different approaches on how to grasp a notion that focusses particularly on the claim of differentiation, and the possibility to describe how changes in understanding occur, the definition of climate change as a travelling idea arose: By understanding climate change and the complex debate on it as a theoretical concept of a “travelling idea” [20] Wit and colleagues aim to understand local views on climate change and global ideas of climate change as coexisting realities, to analyze their interplay and to introduce decisive results into politics in the sense of applied and engaged anthropology [15]. The concept of climate change as a travelling idea enables researchers to recognize local understandings of climate change as dynamically intertwining understandings, to place them in new contexts of meaning, and thus to place their comparison and translation at the center of the analytical perspective. Building on Hulme [45], they, therefore, postulate that climate change should be understood as a “travelling idea” that contains different realities and perceptions (Following this approach, they do not devalue “truths” of climate change.) depending on the local context [20] and the power structures that shape it.

Summarizing the meta-ethnographic findings on local and Indigenous knowledge concepts of climate change in the selected Pacific Island States a claim for a differentiated perspective on differing understandings of climate change appeared. Furthermore, the literature review showed that a current standard is to put climate change into the perspective of global power structures without victimizing Indigenous groups or people of the ‘Global South’ in general but also considering the possibilities and potential of environmental knowledge and creating resilience. Both claims could be met by theoretically defining different ideas on climate change as travelling ones, only becoming veritable in its individual contextualization.

3.2. *Adaptation Practices on Climate Change based on Local and Indigenous Knowledges*

What examples of local adaptation practices in the selected Pacific Island States based on local and Indigenous knowledge systems were found in the conducted meta-ethnographic analysis?

In 2019 Klöck and Fink [46] paint a picture of residents of these islands as resilient agents of knowledge production in the way they adapted to the long histories and respective environments the different islands have shaped and are still shaping (p. 1). The dependence and strong attachment to marine resources is seen as a high sensibility regarding consequences of climate change in other studies as well:

“[I]n all three countries [Samoa, Tonga, and Tuvalu], changes of marine life were mentioned, mostly the decrease of fish and shellfish, and impacts on coral reefs. These changes were predominantly described in connection with increased temperatures, but also as results of human activities like pollution, coral and sand mining, land reclamation, as well as destructive fishing practices and overfishing.”. [32] p. 157

The participants of Gucake’s research in Fiji further recognize that they are vulnerable both to maritime impacts (e.g. sea-level rise, coastal erosion, salinization of soils), as well as to severe weather events (mainly tropical storms and rain) [31], p. 54–55. Characteristics of islands are further described as resource-limited and isolated [46]. Culture or more specific human-environment interactions are therefore outlined as to play an important part in the way to deal with living on an island. Especially traditional and orally transferred practices and knowledge systems are understood as key to adapting to climate change on islands [31,37,47,48]. In ethnographic studies, such reference was increasingly made to

the peculiarities of Indigenous knowledge concerning seasonal calendars, the observation of changes in their direct environment, and sea navigation in Tuvalu and Samoa [47,49]. In his empirical study, Lefale thus sets up a detailed designation calendar for different weather and wind analyses in Samoa, which is used for severe weather forecasts [49]. Also, in 2019, Moncada and Bambrick postulated that the inhabitants of Rabi Island in northern Fiji are already using strategies to deal with cyclones, flooding, and dry seasons, for example by setting up a water management system or better drainage systems [50]. In individual studies, which were integrated into the present meta-ethnography, the use of freshwater resources was addressed [51,52]. In southwestern Fiji local communities adapted to rationing borehole water as this resource was understood to be finite [51], p. 507. Also, the diet changed, including fewer vegetables and more fish cooked with coconut, and relatives from other regions became suppliers for those vegetables and fruits that could not be harvested in the participant's region due to water scarcity [ibid.]. In terms of agricultural land usage and protection against severe weather events Currenti and colleagues identify the following adaptation strategies:

“In terms of planning ahead, some people are planting more fruit trees around their houses to provide both food and shelter in the future. [...] Villagers have also relocated agricultural plots from flood-prone areas to the steep slopes of the surrounding hills. This has reduced the exposure of agriculture to flooding but has created new problems through landslides, which have already damaged roads and buildings, and resulted in further loss of arable land”. [52], p. 74

Also, my notes on-site mentioned in the introduction show that the inhabitants actively deal with climatic changes and adapt to them. Even though adaptation strategies in the Pacific region are discussed in many ways and do not only refer to dealing with severe weather events, this chapter focuses on these adaptation strategies and thus takes up my informant's estimation stated at the beginning of the article. To delve deeper into the practices themselves and the implication for the transfer of knowledge they bring, this chapter will focus on the example of housebuilding, mentioned in research conducted in Fiji, Tuvalu, and Vanuatu.

As early as 1972–1982 Campbell examined local adaptation to tropical storms in Fiji and explained why traditional construction methods can withstand storms to a greater extent than semi-modern building constructions [1]. This illustrates that the description of my Fijian informant regarding the wind-resisting qualities of “Bures” is scientifically mirrored. The person also postulated that the existing adaptations do not continue to exist due to a lack of disclosure. In the following which took place after Cyclone Pam, Fair points out a further reason why Kastom thatched houses are safer:

“As just one example, of the thankfully few deaths that happened during the cyclone, many were reportedly caused by flying iron sheeting, torn from the roofs. In many accounts I heard of those, responsibility was not centred on the relationship between excessive emissions in faraway countries and increases in extreme weather events, but the failure to keep kastom. Kastom thatched houses are not deadly if they collapse in high winds, whereas those who had perished in the cyclone had become literal victims of Westernisation and its dangerous and unstable concrete houses. [...] Within Vanuatu it became evident that climate change was an opportunity to articulate the importance of indigenous knowledge, the practical and moral superiority of Ni-Vanuatu kastom practices, Christian forms of connection and care for nature and community, and potentially advocate for a renaissance of pre-capitalist values and forms of livelihood, in the face of increasing urbanisation and Westernisation”. [37], p. 187

The accusation of ‘modern’ ways of life, which Fair refers to and for which corrugated iron roofs are one example, hint towards the possibility of reviewing whether Indigenous lifestyles and techniques might not be more suitable to climate change adaptation. Thereby

the view on Kastom thatched houses shifts from ‘traditional’ to, in a way, ‘innovative’ when adding safety to deal with the consequences of climate change. A different empirical study [50] focused on how coastal communities on remote Rabi Island, situated off the east coast of Fiji’s second-largest island Vanua Levu, are affected by climate change. The study finds that participants tend to adopt sustainable short-term coping strategies when hit by shocks [50] like cyclones, floods, and dry seasons. Long-term adjustments seem to be related to cultural knowledge, but there was no detailed information based on empirical material found for this region within the analysis. Following these results, the question arises on how this cultural, traditional knowledge is passed on and secured?

Based on his research Gucake points out that oral narratives contain a specific value in transferring knowledge of adaptation to climatic changes over generations [31]. This tradition was already used in former times to adapt to previous climatic changes in interacting with the local environment by the respective Indigenous groups he researched (Itaukai of the province Nadroga in Viti Levu, the main island of Fiji) [31], p. 23. Gucake states that a lot of these oral narratives were lost since locals increasingly ignored them.

“The replacement of this loss came in the form of western narratives such as posters, charts, and brochures. There is/was a lost opportunity to use oral narratives/traditional knowledge in long term and sustainable ways to address climate change issues”. [31], pp. 16–17

He furthermore states that a loss of traditional knowledge has been caused by “the change in lifestyle and family structure, introduction of television and movies and urban drift” [31], p. 58. Literacy is also cited as a reason why less emphasis is placed on oral transmission [ibid.]. In addition to the described process of modernization, an empirical study of Hetzel and Pascht in Vanuatu provides further explanation as to why young ni-Vanuatu distance themselves from traditional knowledge: The authors describe it as a valuable tool for islanders to engage with the world beyond their island. For the younger generation, it was understood of particular value to create new lifestyles in line with a ‘modern, westernized world’ as which scientific knowledge towards climate change was perceived [36]. They further argue that traditional knowledge was over time complemented and even replaced. Contrarily to Gucake they recognize this as a possibility for young islanders to interact globally.

“Climate change, together with scientific knowledge, experienced as a phenomenon that has local impacts, reaches Vanuatu from outside of the country. We argue that climate change and related scientific knowledge provide connections to the outside world, and thus is associated with this outside orientation”. [36], p. 104

Traditional knowledge might be set into relation with rural areas whereas the younger urban generations have closer daily access and parallels to scientific knowledge, as well as the context in which it was generated [36], p. 121.

In Section 3.2 I used the example of housebuilding to depict how local and Indigenous knowledge systems create resilience in dealing with climate change. At the same time, it becomes clear that the implementation of this is not a guaranteed success, especially in a world, shaped by global and local influences: On the one hand, Indigenous strategies for adapting to climatic changes exist and even contain possibilities of creating resistance. On the other hand, the implementation of these practices is declining. One possible explanation for this phenomenon is that younger generations try to find answers to climate change within Western response systems, as the concept of climate change itself was brought to them by ‘the West’ too. This conceptualization was also displayed in Section 3.1. While offering the possibility of interaction with Western knowledge concepts of climate change, at the same time it undermines the importance of adaptation strategies inherited in Indigenous knowledge systems.

3.3. Local and Indigenous Human-Environment Relationships and International Climate Change Mitigation

The results of the meta-ethnographic analysis concerning mitigation strategies based on local and indigenous knowledge systems in the Pacific Island States revealed that almost no direct mitigation practices could be identified for the region of the South Pacific. Nevertheless, examples of Indigenous peoples' mitigation practices beyond the region of the South Pacific were found in the methodical steps 4-6 such as the use of agroforestry in the Sahel zone which plays a special role in preserving biodiversity [53,54].

The only case hinting at the usage of a concrete mitigation practice close to permacultural agriculture systems was found in Hetzel and Pascht's publication in 2019 [55]. They portray the outcomes of a workshop carried out by an NGO in Vanuatu, during which permaculture techniques, among others, were taught. In this case, originally non-western knowledge was now used and taught to non-western societies [55]. Knowledge about the cultivation method as well as the examples of cultivation in gardens of two different regions showed that the participants creatively brought together different practices and knowledge systems, which they developed in NGO workshops, but also one already used before [55]. Moreover, since different species were found in the garden, the question came up whether biodiversity methods were in a way already cultivated before. Based on the information of their interlocutors the authors state that "creating diversity in the realm of cultivation is an established practice in Vanuatu" [55], p. 212.

Rather than finding more concrete examples of how mitigation practices are carried out in the Pacific Island States, the results of this article provide an indirect answer to this question of what mitigation practices occurred. Set into the context of human-environmental relationships, certain ways of life and livelihoods were depicted in different studies [31,32,55]. As one example Beyerl and colleagues describe the following:

"In general, respondents, particularly in Tuvalu and Samoa, referred to an overuse, abuse, or unwise use of resources. Irresponsible and selfish behaviour of not taking care of the environment were mentioned along with valuing money more than the consequences of such behaviours, economic activities, greed, and modernisation. Changed conservation and consumption patterns, societal changes, bad manners of the youth, and new religious denominations came up in the explanations as well". [32], p. 158

What this statement presents is a specific approach on how to understand environmental 'positive' behavior and how this relates to local and traditional ways of life. Ramos-Castillo and colleagues underline that Indigenous peoples stand out through a close relationship with the environment they live in [48]. This relationship inherits knowledge in how to respond to climate change as discussed in Section 3.2. Indigenous knowledge, although new to climate science, has been long recognized as a key source of information and insight in domains such as agroforestry, traditional medicine, biodiversity conservation, customary resource management, impact assessment, and natural disaster preparedness and response [56]. These practices are based on knowledge systems that understand the long-term benefits of agriculture and biodiversity as a key indicator of success like the findings of Hetzel and Pascht constituted [53]. These practices, therefore, contain a knowledge-based quality. Fair explores religious responses on climate change in her study and concludes that through religious framings of climate change challenges as behavioral 'negative' options (e.g., carbon emission framed as a sin), counter-narratives are created which support the value of local, more sustainable lifestyles (a spiritual devotion) in contrast to western, industrialized lifestyles [37], p. 175. These rather philosophical human-environment relationships and livelihoods are understood as a form of mitigation strategy by themselves. This becomes very concrete in how Gucake describes oral narratives of the participants of his research: "Mitigation is inbuilt into oral narratives that demand a greater responsibility for our actions on the environment and I feel that this should not be left out of the equation" [31], p. 65. Gucake's account is supported by general

assessments of how livelihoods of Indigenous peoples are perceived as ways of life that can provide resilience for climate change and when looking at extreme prognoses, even a survival strategy:

“Comprising only four per cent of the world’s population (between 250 to 300 million people), [indigenous peoples] utilize 22 per cent of the world’s land surface. In doing so, they maintain 80 per cent of the planet’s biodiversity in, or adjacent to, 85 per cent of the world’s protected areas. Indigenous lands also contain hundreds of gigatons of carbon—a recognition that is gradually dawning on industrialized countries that seek to secure significant carbon stocks in an effort to mitigate climate change”. [56]

If we look at Indigenous ways of life, these are mostly the ones producing the least CO₂ and the least non-biodegradable waste as well as using the least non-renewable resources [56]. Moreover “Indigenous peoples play a fundamental role in the conservation of biological diversity and the protection of forests and other natural resources” [48], p. 2. Although the literature review of empirical findings on the mitigation of climate change through local and Indigenous knowledge in the selected Pacific Island States was limited, individual examples of diversity concepts and permaculture were found. Furthermore, the analysis showed that a mitigation quality is inherited within specific worldviews, understandings and creations of human-environment relationships.

4. Conclusions

Summarizing the results of the meta-ethnographic analysis, it can be expressed that the concept of local and Indigenous understandings of climate change needs a differentiated and contextualized view since local understandings differ. For this approach, the conception of climate change as a travelling idea seems fruitful to differentiate local understandings of climate change. In Section 3.2 several adaptation strategies in the Pacific were identified focusing on the example of housebuilding and passing on traditional practices via oral narratives as well as the discussion of how they further develop since the oral transmission is understood as challenged. Section 3.3 could show that a mitigation strategy not only lies in biodiversification techniques but in the value of understanding Indigenous peoples as knowledgeable actors with advanced awareness of sustainable livelihoods. Most importantly, human-environment interaction and an understanding of sustainable lifestyles can be recorded as a mitigation strategy that is in significant contrast to lifestyles in industrialized countries. Summarizing the review on climate change mitigation in the context of local knowledge systems and relating it to a narrative which urges us, as people, to save the ecosystem earth as we know it, one question arises: Is there a possibility that industrial nations can learn from an Indigenous knowledge on resourcefulness to reduce their ecological footprint without taking advantage of it or culturally imperialize it?

Knowledge of climate change mitigation, (i.e., understanding the advantages of parallel use of soils by perennial trees and annual crops), can be beneficial for other localities: Practices of agroforestry were successfully transformed into others contexts [54,57]. Still, an essential characteristic of Indigenous knowledge is precisely its local embedding and thus its high degree of contextualization, which becomes strengthened by the isolated dimension of islands. Nevertheless, as Lazrus [47], p. 285 argues, an understanding of islanders must not only show the isolation of islands but also the global connection of the island’s lives to other countries on economic and social levels. Hau’ufoa used the thesis of a “sea of islands” to show how a life lived on islands was also possible because of an exchange of people and goods with faraway places [58]. This notion supports the idea to transfer mitigation strategies into other parts of the world since islanders are here portrayed as interconnected centers to and influenced by the world instead of faraway isolated areas. At the same time, it is still questionable how this knowledge can be passed on and grasped in its high contextualization which would be necessary as the results of Section 3.2 identify. Furthermore, it is unclear how this knowledge will, could, or should not be given greater

significance in international policies, since the appropriation of this Indigenous knowledge system might support postcolonial policy structures [46,59].

At the international, educational level, this challenge is answered with global education policy programs such as ESD and CCE, which the individual countries implement on the recommendation of the United Nations Educational, Scientific, and Cultural Organization (UNESCO). Local and Indigenous knowledge on climate change adaptation and mitigation has exactly the quality of knowledge that ESD wants to create to apply solution-oriented action for sustainability [60–62]. But even though they inherent important lessons for international policies of ESD [62], “we should be careful not to view local knowledge as a panacea, and integrating it with Western science as necessarily easy and effective” [46], p. 7. In this sense-making it is of importance to ensure that the usage of Indigenous knowledge does not follow a commercialized logic. In this context, ‘Āina-based education (‘Āina-based education is defined as teaching and learning fundamentally through the connection of people and human community with ‘āina hence the land, sea and air. ‘Āina refers to the environment that nourishes, heals and thus preserves people. Didactic and content-related topics such as community-based learning, self-empowerment strategies or knowledge and handling of local vegetation are central themes [63,64].) from the North Pacific in Hawai‘i might show that environmental knowledge of Indigenous peoples has been successfully integrated, not instrumentalized, and was implemented in local contexts defined by civil society, not into forgiven western educational structures [63,64]. This also secured the intergenerational disclosure of knowledge. Indigenous knowledge systems or livelihoods could additionally be perceived as a source to generate resilience beyond one social group within the framework of international policies: For example, as an own variation of education for industrialized societies that presents ideas for more sustainable human-environmental relationships.

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Article

Decolonizing People, Place and Country: Nurturing Resilience across Time and Space

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Abstract: Indigenous peoples are easily classified as either dangerously vulnerable or inherently resilient to climate risks. There are elements of truth in both categorical statements. Yet neither is completely true. Indigenous vulnerability and resilience, and Indigenous groups' adaptive responses to climate change, need to be understood in the messy contexts of lived experience, rather than either elegant social theories or didactic ideological politics. Climate change action and research needs to acknowledge and engage with the knowledges, ontologies and experiences of diverse Indigenous groups, along with the specific histories, geographies and impacts of colonization, and their consequences for both the colonized and colonizers. Climate change action and research needs to be integrated into wider de-colonial projects as the transformative impacts of anthropogenic climate change are inadequately addressed within both colonial and post-colonial frames. Negotiating respectful modes of belonging-together-in-Country to reshape people-to-people, people-to-environment and people-to-cosmos relationships in Indigenous domains is essential in responding to planetary scale changes in coupled human and natural systems. This paper outlines an approach that nurtures Indigenous self-determination and inter-generational healing to rethink the geopolitics of Indigenous resilience, vulnerability and adaptation in an era of climate change and the resurgence of Great Power geopolitics.

Keywords: climate change; country; coupled human and natural systems; Decoloniality; geographical scale; indigenous peoples; ontological pluralism; ontological and existential risk; social and environmental justice

1. Acknowledging

So much begins with acknowledging. Where denial narrates absence, silence and closure, acknowledging opens possibilities. Acknowledging invites relationships, engagement and connection. It challenges difference and invites conversation. In our era of denial—of climate change, human rights, identity, connectedness and mutual dependence—acknowledging is important. Acknowledging Indigenous peoples' rights and the rapid environmental changes currently occurring across multiple places, multiple scales, and multiple species and systems opens opportunities for learning, collaborating, understanding and surviving across boundaries of difference.

Dharug Nura is the place now known as Greater Sydney, on the east coast of the southern continent. I was born and have lived and worked in this Country for most of my life. It was, and remains, the traditional Country [1] of the Dharug-speaking clans who faced the first waves of British settler colonialism on the southern continent of Australia in the late 18th Century. In Dharug Nura, it was always customary for guests and visitors to wait to be welcomed by the people of that Country, and to acknowledge the Country and its people, places and stories. In the customary law of many of the First Nations of the southern continent, the Welcome to Country not only introduces a visitor to the current inhabitants (human and non-human) of a place to offer recognition and protection. The

Welcome also invites the guest to recognize their own obligations towards the Country and its people, and its inhabitants and its pasts, presents and futures.

Warami Wellamabani Didjergura Ngara

This is the acknowledgement that I used when presenting this paper to the conference that inspired this collection of papers. *Welcome wherever you are from. Thank you for listening.* This greeting in the Dharug language, recognized the commonality between myself as a speaker and the listeners in my audience. Unlike the ethical presence of spoken delivery to an audience, however, distillation in print delays or even avoids conversational engagement, where ideas might be contested, responded to, refined and revised. The immediacy of the face-to-face relationship of speaker and audience creates both invitation and challenge. Presenting the paper as text renders our relationship as detached writer-and-reader, rather than as listeners-to-each-other sharing time-and-place. It separates us from each other in time and place—even though we share both time (Anthropocene) and place (Earth).

As a geographer, I have spent several decades grappling with relational concepts of time–space, place and scale. Let me stretch across time, place and scale to open my invitation and challenge to you by acknowledging Dharug Nura and Dharug yura, the Country and Ancestors of the First People of the Wallumattagul clan, the Wullamai black snapper fish people, of the Dharug Nation. I pay respect to their Elders past, present, emerging and future, the wisdom and knowledge passed down through their generations, and the Dharug knowledge being generated in the present. I also acknowledge the Indigenous peoples of the places where many of you are reading this paper, and the Indigenous peoples of Taiwan, where many of these ideas were discussed and debated in the conference that gave rise to this special issue of Sustainability.

2. Reconsidering Indigenous Vulnerability and Resilience in Climate Risk Discourses

Contemporary academic discourse addresses both the nature of anthropogenic climate change and the risks it poses to particular people, places and human systems, and the natural systems to which we are all coupled in complex ways. Two important discursive threads invoke the concerns of Indigenous peoples. One emphasizes vulnerability, arguing that Indigenous groups are particularly vulnerable to climate risks—often because of their indigeneity [2]. The other thread emphasizes Indigenous peoples' exceptional adaptive capacity as being relevant to framing responses to climate change [3,4]. Indeed, it often argues that Indigenous resilience will produce solutions to the problems created by anthropogenic climate change.

Both these discursive modes frame Indigenous dimensions of climate risks, suggesting that Indigenous societies in general have either particular weaknesses or particular strengths that are exposed by climate change. While both offer insights into conditions facing particular Indigenous groups, they both risk stereotyping, oversimplifying and marginalizing the diverse experiences, insights, understandings and lessons that might be generated by engaging with Indigenous peoples.

Like all generalizations, each of these discursive threads reflects some truth. But neither is always nor completely true. Context matters in how we think about the intersection of Indigenous geographies and histories with the realities, discourses and policy responses to anthropogenic climate change. Ostrom [5] acknowledged that there are no easy solutions to problems in coupled human–natural systems: no panaceas. There is “no simple way of representing, understanding or responding to the complexity in settings that are simultaneously biophysical and cultural” [6] (p. 2). Nor are the diverse cultures and experiences of Indigenous groups reducible to some sort of Indigenous-singular that reflects a distinctive and common approach to being human.

Drawing on philosophical traditions of radical contextualism [7], this paper suggests the context of climate change needs to be better understood as involving multiple scale frames (both spatial and temporal) of alienation and belonging. Policy, science and practice all need to develop a much more sophisticated literacy in the scale politics of responding to the risk landscapes that Indigenous groups negotiate.

We have to learn to think anew—to think in ways that take seriously and actually respond to information, understanding and knowledges as if difference confronts us with the possibility of thinking differently [6] (p. 4).

3. Procedural Vulnerability

Veland suggests that procedural vulnerability amplifies the risks many Indigenous groups face from anthropogenic climate change [8,9]. State agencies easily assume (or perhaps hope) that their administrative procedures will adequately address the needs of all their citizens. It might be more accurate to say that the settler-colonial state assumes that all its citizens should conform to the requirements of the state. In settler-colonial societies, histories of racism, misunderstanding and greed mean that many state procedures and the policies that support them fail to recognize, acknowledge, or respond to realities that affect Indigenous peoples within their jurisdictions. Structural racism, historic injustices, dispossession, violence and the normal features of colonial contexts create very different risk landscapes for Indigenous peoples. Even well-intentioned actions reinforce and produce vulnerability [2,10–13].

Drawing largely on experience from Australia, this paper concludes that Indigenous vulnerability, resilience and adaptive responses need to be understood and engaged with in relation to the messy contexts of lived experience in settler-colonial societies, rather than either elegant social theories or didactic ideological politics. The diverse knowledges, ontologies and experiences of different Indigenous groups, along with the particular (scaled) geographies and histories of colonization, and their impacts on and consequences for both colonized and colonizers, need to be taken seriously—discussed, debated and considered carefully, rather than simply treasured or ignored. Climate change researchers need to take them seriously and engage with the histories, geographies and current processes of colonization affecting Indigenous groups as Indigenous groups themselves consider (and renegotiate) the risk landscapes that are woven around them by climate risk and policies, procedures and practices of disaster risk reduction. Scholars need to include Indigenous groups as part of their critical audience.

4. Anthropogenic Climate Change Is a Colonial Legacy

Anthropogenic climate change is a colonial legacy that is having transformative impacts on the coupled human-and-natural systems on which survival depends. Neither colonial nor conventional post-colonial frames that leave the deep colonizing of Indigenous domains unrecognized, unacknowledged and unchallenged will allow actions to address those impacts safely and sustainably.

In the southern summer of 2019–2020, even prior to the impacts of the Covid-19 pandemic, Australia experienced a series of ecological tragedies. For example:

- In Australia’s largest inland river system, the Murray–Darling Basin, prolonged drought contributed to mass fish kills [14–16].
- Extensive wildfires in an extended fire season raged across Eastern, Southern and Western Australia, bringing death and destruction, including the destruction of the small rural primary school at Wyaliba—a school which I helped to establish in 1984 [17–20].
- Massive dust storms moved topsoil from inland areas of the continent affected by prolonged drought [21].
- Extreme storm events left large areas of Sydney blacked-out and flooded for many days, and wreaked havoc on coastal areas with high tides, coastal flooding and huge swells [22,23].

There was a chorus of inaction and denials from the national government that such events were linked in any way to anthropogenic climate change [19,24,25]. The subsequent emergence of the Covid-19 pandemic and its social and economic implications have further diffused the public debate of failing policies on climate, energy and environment as economic growth is again prioritized over environmental and social sustainability by neoliberal forces.

In responding to the unprecedented drought which threatens the water supply and continuing economic activity in multiple communities across Australia's Murray–Darling Basin, for example, governments have ordered scientists to relocate fish from the river to 'save' them. The market solutions entrenched by intergovernmental agreements, which have seen rich investors buy water rights to create profit, and zero allocation of water to the Barkindji people, whose native title rights to land in the basin were recognized in 2015 after 18 years of legal struggle [26], are under review. But the overallocation of water persists. Marketization has not resolved failed relationships within and between communities, their water sources and their economic viability under changing environmental conditions. This should, perhaps, come as no surprise [27,28]. But it certainly comes at a high social and environmental cost [21,29].

As communities are disconnected from reliable water supply, they fragment and dis-integrate. Some people leave, while the remaining groups and individuals compete for dwindling resources. People look for both saviors and scapegoats—and become depressed when neither can be found. In places where the scars of colonial racism run deep, these communities have never really shared common ground. They see the place they share differently. The deep understanding of environmental change embedded in Indigenous Australian cultures, and their resilience in adapting to change, in surviving, in remaining present, has rarely been acknowledged by the systems that colonization imposed to produce wealth for the settler-colonial society and its imperial (and, later, state and national) governments.

Historically, settler-colonial systems operated as if the erasure of Indigenous peoples from the physical landscape could secure colonial property systems and the wealth they would produce [30]. Contemporary market failures and the exhaustion of ecosystems, such as is occurring in inland Australia, underpins (yet another) phase of failure of colonization. Inland Australian landscapes were long misunderstood by their ambitious colonizers [31–34]. As elsewhere, Australia's European colonizers assumed that their arrival (and even their anticipated arrival—for example, in South Australia, the Crown sought to argue that native title in that state was extinguished two years before any colonial occupation by actions of the British Colonial Office in London [35]) marked the beginning of history [36], and gave them a right to possess places and dispossess (and annihilate) their peoples. They assumed that their presence superseded any existing system of governance in the ancient jurisdictions and gave them unchallenged ownership of the resources created in other times, such as underground water and energy resources.

The settlers, and the governments that created them, told stories that asserted that their hard work and sacrifice, and the risks they took in travelling so far into places that were unknown (to them), gave them a God-given, and therefore unchallengeable, right to possess, to exploit, to do as they wished. Wolfe reflected that:

settlers generally have a lot to say about work, sacrifice, and earning things the hard way. The refrain is familiar, the implication constant: We deserve what we have—or, more pointedly: We have a right to this land . . . As the settler takes over the territory, so does the territory take over the settler—hence the distinctive vascular condition of having the land run in one's blood. Land is settler colonialism's irreducible essence in ways that go well beyond real estate. Its seizure is not merely a change of ownership but a genesis, the onset of a whole new way of being—for both parties. Settlers are not born. They are made in the dispossessing, a ceaseless obligation that has to be maintained across the generations if the Natives are not to come back. [37] (p. 1)

Therefore, let me ask this question: what is revealed when the monumental failure of colonial stewardship, responsibility and care in Australia is laid bare by such dramatic crises at the whole-of-landscape scale? If the genesis it underpins has failed, what is left? Such failure reveals the uncivilized, primitive, barbaric and ignorant actions perpetrated by settlers upon both the people and Country of First Nations in the name of civilization (and in the service of self-interest). Those actions, those original denials, laid foundations of failures that others continue to amplify into the present. Those empowered by Australia's colonizing systems refused to understand, value and protect fundamental connections between human and natural systems, between societies and environments,

and between people and their places. They promulgated that failure as something to be admired, celebrated and continued when they advocated Australia's right (indeed necessity and even obligation) to maintain its fossil-fueled economic occupation of the southern continent in international climate change negotiations.

As the theme of this special issue suggests, the economic models of colonialism were always based on crossing spatial boundaries and collapsing temporal boundaries. But they did so without understanding the relationships that were threatened, or the forces being unleashed. The assumption underlying those models was that growth without limits (or at least systems in which the growth of wealth for some seemed to have no limits) was both desirable and possible. That was simply normal. Growth could be fostered by crossing spatial boundaries to continuously consume the resources of other people's places, other people's livelihoods. It could be fostered by collapsing space-time to convert the energy of bygone ages into political power over places and their populations, and into a future that sought to preclude any alternatives.

As growth was measured and celebrated, and as wealth was distributed to the deserving rich, it seemed that the pauperization of local populations and the degradation of their landscapes could be modelled and treated as an externality that did not affect the logic or resilience of the colonizers' systems. After all, under the conditions created by settler colonialism, environmental capital in general—and land, water, timber, minerals, and fossil fuels in particular—were free and effectively unlimited. They became the property of the sovereign settler-colonial states.

Australia's 18th Century European colonizers assumed that the customary owners of the diverse landscapes of the southern continent were simply too 'primitive' to be accorded rights or recognition. In the landscapes the colonizers coveted, they saw the bounty of nature (which was theirs to take) rather than the product of Aboriginal Australians' careful management and their civilizations' nurturing of the continuing connection between people, place and cosmos [38,39].

However, the Australian civilizations that were violently displaced by European colonialism were amongst the first human cultures to develop agriculture, baking and aquaculture. They were violated along with the landscape [38]. The colonizers dismissed those ancient jurisdictions and institutions as primitive and without law, culture, or civilization. The civilizations of the southern continent reflect some 65,000 years of human experience, thinking and adaptation [40] connected by continuing culture. They offer profound examples of what connecting-to and belonging-to place means in the context of large-scale environmental change.

What was achieved in those ancient jurisdictions was, in Gammage's words, a "majestic achievement":

only in Australia did a mobile people organise a continent with such precision . . . They sanctioned key principles: think long term; leave the world as it is; think globally, act locally; ally with fire; control population. They were active, not passive, striving for balance and continuity to make all life abundant, convenient and predictable. They put the mark of humanity firmly on every place. They kept the faith. The land lived . . . This was possession in its most fundamental sense. If terra nullius exists anywhere in our country, it was made by the Europeans. [39] (p. 323)

The profound failure of settler-colonial stewardship on the southern continent fundamentally reflects the same economic and geopolitical forces that are the drivers of anthropogenic climate change. The greed of imperial kleptocrats might have been replaced by global entrepreneurs whose unimaginable wealth has been so powerfully criticized in the efforts to address the climate emergency [41,42], but the risks imposed on Indigenous groups have remained and been amplified.

5. Rethinking the Scale Frame of Risk Landscapes

There is extraordinary complexity in the contemporary risk landscapes that are affected by anthropogenic climate change. There is also extraordinary complexity in the contemporary risk landscapes negotiated by Indigenous groups whose right to exist, to retain language, culture and a

place in contemporary space and time is so profoundly challenged by the logic of settler-colonialism. It is important to recognize that vulnerability and resilience sit side by side in those risk landscapes, and that strategies to respond and adapt to changing circumstances are never simply technical.

Climate risks (along with disaster risks, health risks, and broader societal, environmental and political risks), and responses to them are experienced, reconsidered and enacted in locally contingent landscapes. Climate injustice is just one element of the broader context of injustice constructing the risk landscapes many Indigenous groups negotiate in their everyday lives. Current circumstances in Indigenous Australia reflect histories of dispossession, denial and erasure [43]. The unfolding climate emergency challenges not only our understanding of our shared place in rapidly changing social, economic and political circumstances, but also in planetary scale systems. In particular places, the climate emergency unfolds as much as a crisis of belonging as a crisis of survival. At the planetary scale, any sense of belonging-together-in-place which underpins the possibility of common risk and common futures is constantly threatened by the economics, politics, and philosophies of competition, privilege and entitlement in globalizing human systems.

Dominant academic and political discourses frame the risks of climate change as pre-eminently global. That is, those discourses frame the most urgent risk landscape as being embedded in a singular global system whose complexity requires world-class experts to be privileged in decision-making. Technological optimists fantasize geo-engineering solutions at global and even greater-than-global scales [44,45], and the politics of negotiation affirm the primacy of nation states in producing solutions (see e.g., [46,47]). Even the most recalcitrant state actors are given more influence than even the wisest non-state Indigenous actors (see e.g., [47]).

Crisis narratives encompass the ecological, financial, political and climatic dimensions of coupled human and natural systems. Human societies (and those with whom we share the planet) face once-unimaginable risks, but in framing these as 'global', they risk being disconnected from the scales of conventional human sociality. Human societies approach thresholds for apocalyptic failure in planetary scale systems that are crucial to survival [48]. Our survival and prosperity are complexly dependent on these coupled human and natural systems that are on the brink of irreversible and consequential change. In these new global risk landscapes, crisis narratives offer glimpses of the possibility of an ending of the world. New technologies extend (or collapse) time horizons. New globalized spatial links shift the cumulative impacts of changing human–human and human–nature relationships, and combine them in ways that threaten multiple extinctions and even human and planetary survival. But narratives of growth and progress have been so naturalized and normalized that they obscure the lived experiences of Indigenous peoples. Even the crime of genocide and the wickedness of ecocide have been made invisible.

While the global disaster narratives reflect important truths, the everyday landscapes of risk continue to reflect the mundane issues of disease, poverty, food security, violence and marginalization of particular groups of people in specific places. The Covid-19 crisis has reminded us that there is always a risk that these everyday risks will intrude into global geopolitics. This is not to evoke the site-focused or flattened ontology advocated by Marston and her colleagues [49]. Rather, it is a call to recognize that the places and systems drawn into our contemporary risk landscapes are always scaled—spatially and temporally. The time horizons of everyday risks are often framed in terms of much shorter-term survival from day-to-day and week-to-week, rather than in terms of epochal shifts to an Anthropocene [50]. It is in these everyday risk landscapes that Indigenous peoples' vulnerabilities and resilience are generally performed. Despite the plethora of threats and repeated predictions of their imminent demise in many places across the world, Indigenous Peoples survive, adapt and persist. Their survival challenges colonizing narratives of their extinction, disappearance, absorption, inferiority, or irrelevance. The celebration of survival should not, of course, diminish the risks and very real violence experienced by Indigenous peoples in specific places under various forms of colonial governance. Nor can the need to recognize and address the genocide, inhumanity and criminality in the relations between various state and corporate actors and Indigenous groups be avoided or delayed.

In considering the narratives of impending catastrophe, however, it is worth acknowledging that Indigenous survival speaks loudly to narratives of sustained resilience, survival, adaptation and responsiveness.

6. Ontological Risk as Context

Many contemporary risks are unprecedented, and were quite literally unimaginable in earlier settings [51]. The scales at which they are constructed and performed reshapes the lived landscapes of risk in ways that undermine people's (and peoples') capacity to recover from and adapt to disaster events. They need to be understood as ontological risks because they put at risk the foundations of the possibility of existence. Human experience is not simply 'existence' or 'being' (as conceptualized, e.g., by Heidegger [52]), nor even 'being-together' (as discussed by, e.g., Nancy [53]), but 'belonging-together-in-place' e.g., [54]. Those things that threaten our environmental and social relations, and the human and natural systems within which become part of human societies, constitute ontological risks. In the Anthropocene, whole societies face ontological risks—situations which undermine people's understanding of the cosmos and their place within it. These are risks that create uncertainty at an ontological level. The previously unthinkable, unspeakable and unknowable becomes entrenched in the landscapes and relationships of everyday risk. As part of this, many Indigenous societies face the challenge of adapting and responding whilst being surrounded by hostile settler societies and confronted by state programs intended to erase their ways of life and being. This is the continuing unnatural disaster of colonization in everyday lives [13].

The dominant discourses of science, governance and power have assumed the validity of their own claims to universal and singular truth in defiance of the realities of ontological pluralism in contemporary coupled human and natural systems [7,55–57]. Following the insights of Stoffle and his colleagues [58–61], Anthropocene discourses must confront human systems with previously unimaginable risks. Those elements which form the building blocks of human society and provide the ontological certainties of existence have become uncertain and at risk. A previously unimaginable ending of the world (see also, e.g., [62]) must become a topic of common discourse.

In disaster studies, attention is given to the cycle of preparation, risk reduction, emergency response, recovery, reconstruction and further preparation [63–68]. Yet these expert-centered discourses are often deaf and blind to the nuances of local, non-technical knowledges and experiences. Sustainability science [69] and post-developmentalism [70,71] offer some valuable critiques of the dominant conversations. But Indigenous critique, which often foregrounds issues of the profound insight of local knowledges, understanding and values [6,72], offers an important additional element of challenge. There is a scale politics at work in this critique. Indigenous discourses are not simply 'local', but often articulate a connectedness that insists on holding global systems of economic, environmental and political governance accountable. There is an important sense in which they give the local ontological priority in ways that currently-dominant global discourses, including the Anthropocene narratives, seem to have trouble in conceptualizing.

7. Narrating Risk and Power

In the dominant expert narratives, the acceleration towards tipping points in multiple planetary scale systems [73] (see also e.g., [74,75]) reinforces the idea that only those with global expertise should be empowered to act decisively. As Veland and Lynch put it, the stories we tell ourselves matter. Dominant storylines about climate change and risks “rest on the assumption that there can be a unified grand narrative of human-environment relations . . . [but this] unwittingly constrains the solutions we are prepared to admit” [76] (p. 4).

They note that these linear narratives also reinforce the colonial narration of “linear and authoritarian histories” and imply (or perhaps simply assume) that only interventions that conform and respond to the linear narratives of progress will shift the narrative and the outcome. Furthermore, as Liverman puts it, such narratives also “tend to obscure the historical geographies of anthropogenic

climate change and have fostered solutions that are often unequal and somewhat ineffective in reducing the risks” [47] (p. 280).

Even where it is contested by climate change denial, many of the narratives built on the assumption that history follows a linear trajectory focus on market-based solutions and the attractive opportunities for investment in those solutions as avenues for continued growth [77]. Yet such storylines often ignore (or deliberately bury) historic and continuing environmental injustices that are just as central to the narrative and its outcomes as the stories of success, wealth and privilege. They silence the environmental and social implications of market failures. Indeed, the inter-national system’s ongoing reluctance to provide a legal framework that would provide justice—or even recognition—for environmental refugees reinforces the colonial thrust of contemporary geopolitics. It has hard to see how conventional geopolitical processes addressing climate change will be able to “stop the proliferation of dangers for indigenous peoples . . . Environmental injustices aren’t any less likely in actions taken in the spirit of urgency to adapt to climate change and mitigate a 2 °C rise” [78] (p. 2).

Whyte suggests there is a paradox underpinning much of the discussion about Indigenous people and climate risks:

Consent, trust, accountability, and reciprocity are qualities of relationships that are critical for justice-oriented coordination across societal institutions on any urgent matter. Yet they are precisely the kinds of qualities of relationships that take time to nurture and develop. That is, they are necessary for taking urgent action that is just, but they cannot be established urgently. [78] (p. 2)

8. Scaling Time and Space in Risk Landscapes

Reconceptualizing the narratives of climate risk as a multiplicity of disconnected or singular local narratives is no panacea for tackling the difficult conversations of extinction, catastrophe and adaptation. A shift in how scale is used as a lens on these issues may, however, help to bring new things into clearer focus. Leaving the scale of catastrophe at the global, seeing it solely in terms of global governance mechanisms and intergovernmental treaties, tribunals and action plans leaves the risks as literally unimaginable for many people and communities. For those whose faith is focused on technological fixes, narratives such as the idea of a “good Anthropocene” [79] promise new ways of delivering energy, new ways of transporting goods and people, and new solutions to the risk of annihilation through large scale projects of global cooperation in geo-engineering [80] or global governance [81,82].

Of course, the scale politics of genocide, ecocide and catastrophe always play out between the local and the global, the past and the future and, as Dalby notes, the good, the bad and the ugly [83]. The global is always local (and vice versa). The interdependence of human and natural systems means that wholly isolated local or solely global systems do not exist in the Anthropocene. Shifting thinking about the scales at which risk is embodied to recognize that the landscapes of risk are always simultaneously biophysical and cultural demands the recognition that the ways in which key relationships (ecological, geopolitical, economic) are scaled demands a shift in thinking that moves the focus from indicators to relationships. That shift also demands a shift in our thinking about temporal scales to encompass inter-generational trauma and responsibility [84].

Confronted with the recognition of unimagined risks, ongoing unnatural disasters and ontological and existential apocalypse, Indigenous peoples’ experiences of rapid, catastrophic transformation in coupled human and natural systems at the scale of their known worlds offers a powerful experiential window on how to address the possible ending of the world. For too long, the long and terrible shadow [85] of the linear narratives of settler-colonial conquest that underwrite the superiority and inevitability of imperial power and corporate ascendancy have muted—and even silenced—more modest narratives of connection, belonging and accountability.

In offering some brief windows on Indigenous experience, my intention is not to be exhaustive or encyclopaedic, but to evoke an understanding of both the tragic history and the remarkable resilience of many First Nations around the world. There is no simply positive or naively optimistic story to be

told here, but there are some important pointers to what is possible—and what transformation might be possible—if we accept that climate change is a legacy of colonialism and injustice that extends well beyond the focus on climate debates.

9. Nurturing Decolonial Resilience across Space, Time, and Difference

It is increasingly clear that an existential risk to multiple human and natural systems is posed by anthropogenic climate change. The risks and their potential consequences confirm that continuing to assume that ‘nature’ is somehow under human governance and management is a dangerous assumption. Equally, assuming that natural or human systems are autonomous or independent at the smaller scales that human governance systems (nations etc.) generally occupy is deeply flawed. Rather, our common human context needs to be recognized in terms of complexly and inescapably coupled human-and-natural systems.

While it is true that many Indigenous knowledge systems have weathered large scale disruption from environmental, social and cosmological processes, their contributions to or fate in light of the existential risks posed by anthropogenic climate change cannot be adequately addressed without contesting the colonial or post-colonial frames that conventionally define and limit the nature, agency and rights of Indigenous peoples. Yuchi scholar Dan Wildcat, from the Muscogee Nation of Oklahoma, put it this way:

[T]hose of us who have been paying attention to our homelands already know ... the world we live in is changing, not the interior spaces and places where the majority of us situated in the midst of the modern industrial and postindustrial societies spend our days and nights, but the world of unbounded landscapes and seascapes that constitute what humankind denominates the natural world. Climate change, however, is only one of many drivers of change. Its effects cannot be isolated from the multiple social, political, economic, and environmental changes confronting present-day indigenous and marginalized communities. Indigenous peoples have long and multi-generational histories of interaction with their environments that include coping with environmental uncertainty, variability, and change. [86] (p. 509)

In other words, the broader risk landscapes, the longer historical and wider geographical scales of contemporary Indigenous experience demand that we pay attention to issues of justice and sustainability in our more-than-human settings in developing the thinking that might allow a more inclusive ‘us’ to respond to the unnatural disaster that industrialized colonization has visited upon all of our human and non-human companions on the planet. New thinking about climate risk must include the negotiation of respectful modes of belonging-together-in-Country that reshape people-to-people, people-to-environment, and people-to-cosmos relationships in Indigenous domains.

10. Rescaling the Climate Crisis

Recognizing this, acknowledging the simultaneously local-to-global and molecular-to-cosmos relevance of Indigenous experience demands a framing (and re-framing) of climate change that shifts across scales. The conventional discourses, which frame climate change in global and near future scale frames, constrain how the challenges are conceptualized and what actions are prioritized. Shifting the scale frames to nurture thinking at the scales of Indigenous self-determination and inter-generational healing allows climate change discourse to bring into focus key issues, such as the geopolitics of Indigenous resilience, vulnerability and adaptation, and reframes the resurgence of Great Power geopolitics.

A wider decolonial project must develop respectful modes of negotiating belonging-together-in-Country. It must reshape human-to human relations across boundaries of difference and prioritize justice, as well as insisting on state and corporate actors delivering on commitments to reduce the human burden on climate systems. It must acknowledge the continuing presence of Indigenous connections to place, to culture, to history—and to diverse futures. It must nurture modes of becoming

that reconnect people-to-people, people-to-environment and people-to-cosmos relationships within and beyond Indigenous domains. It needs to recognize that the disruption of these connections underpins the colonial project in order to release resources and energy for the accumulation of obscene wealth and unsustainable burdens on climate systems.

The current disconnection of people from place and environment is marked at multiple scales:

- from the alienation of individuals and disfunction of families and towns, to the melting of permafrost, glaciers and ice sheets;
- from the local wildfires in particular places to the shifting of seasonal patterns of fires so that fire seasons in northern and southern hemispheres now overlap;
- from the myopic failures of local planning systems to secure communities from predictable risks of floods, storms, or fires, to the self-interested myopia of the political classes in major nations while the data drives the recalibration of global insurance systems.

We could think of scale as mediating or moderating all of these relationships. But that is not enough. We certainly need to think differently about scale and the creation and moderation of vulnerability and resilience because these relationships are actually enacted through scale. For example, the scale of Indigenous governance is not something that develops in isolation. Indigenous self-determination and self-governance are always moderated by relationships internal to the dynamics of a particular Indigenous group, and others that reflect the external dynamics that constrain the exercise of governance. In other words, the scale of Indigenous autonomy is always contested and in complex relationships across the scales at which the power and action of formal government administration is constructed and exercised.

Thinking in terms of scale-as-relation [87,88] enables us to think differently about the narratives that reinforce the power of global institutions in climate discourses. It also enables us to rethink the task of decolonizing responses to climate risks facing Indigenous groups.

If one thinks of the dynamics in global climate politics simply in terms of a top-down global hierarchy, understanding what's going on reduces things to either bilateral (global–local) hierarchies or to the enactment of a policy in a local setting. It is easily assumed that the global does (and should) dominate. The paternalistic, colonizing argument says the international system cannot ultimately support Indigenous autonomy, because it will dilute the power to act globally (i.e., to act at the necessary scale) or will split national sovereignty (i.e., disempower the state institutions that are necessary to enforce global actions). That sort of thinking lays the foundations for ongoing deep colonizing. It reproduces the colonial pattern of not holding institutions to account for their impacts across space, time and difference. It allows the present systems of global privilege to continue accumulating and mal-distributing wealth, power, energy and resources from the past and the future—and to masquerade as the only alternative source of solution to the current climate emergency.

11. Conclusions: Decolonizing for Resilience in Times of Vulnerability

New thinking about the risk landscapes that confront Indigenous peoples arising from anthropogenic climate change can be built through acknowledgement of and respectful engagement with many Indigenous groups. This will reframe the issues in ways that will challenge many conventions of both thinking and action. It might also allow a shift which recognizes that “current transformations require political actions in numerous places, not just where it has long been assumed political power lies” [83] (p. 47).

The late Deborah Rose wrote powerfully about the force of deep colonizing and the way it corrupts even well-intentioned efforts to transform the impacts of colonization (e.g., [89]). Similarly, Haalboom and Natcher reminded us that our own academic discourses reshape how vulnerability is amplified in unintended ways by the presentation of our evidence and the narratives that people construct in response [2]. These are part of the procedural vulnerability imposed on Indigenous groups. But climate risks render us all more vulnerable.

Climate risks render Indigenous groups more vulnerable not because of their indigeneity, but because their lives are so often marked by intergenerational legacies and the newly created scars of colonialism. Brazilian educator Paulo Freire [90–92] reminded us long ago that those scars also mark those who might think of ourselves as the beneficiaries of colonialism. While I am deeply conscious of the risk of shallow applications of Freirean pedagogy as a universal solution becoming another form of deep colonizing (see e.g., [93,94]), I also recognize the value of Freirean approaches in providing a locally-referenced reading of the landscapes of risk and colonization. In internalizing conquest, accumulation and wealth as the markers of achievement, our so-called ‘modern’ societies have been taught to deny and disconnect. Small dissonances and occasional inconveniences in local systems of wellbeing are only now (slowly and unevenly) being reinterpreted as indicators of larger scale problems of systemic crisis. In terms of justice, sustainability and equity, the emperors and their administrators never had any clothes! From the imperial rulers of the 15th Century to the corporate mandarins of big oil, big auto and big trade, the fabric of their power has always been woven from the labor, energy and opportunity of other places, other times and other peoples.

In thinking that the power of colonialism settled their claims of entitlement to power, wealth and privilege, settler-colonial societies discounted the lessons of Indigenous nations who negotiated more sustainable relationships with and connections to place. The colonizers’ restless wanderings across temporal, spatial and ecological boundaries allowed the societies they produced to steal from the past, the present and the future. The stories spun to justify their actions were woven from threads of faith, politics and ideology that became central to the modern world’s understanding of itself. Those dominant (and dominating) narratives rendered all but impossible to imagine—perhaps intentionally—the alternatives woven in the experiences and practices of Indigenous autonomy, climate justice, the recognition of climate refugees, and the restructuring economic relationships for justice, equity and sustainability across time, space and difference. Indeed, for many people and peoples alienated from any prospect of belonging-in-place and sustainable relationships in coupled human-and-natural-systems, such alternative narratives have become literally unthinkable. Sometimes, in responding to or opposing those dominant narratives, we don’t see just how deeply our thinking is captured by their framing of the challenges. We don’t realize what has become unthinkable under the influence of the colonizers’ self-serving stories.

In working with many Indigenous leaders over my professional life, I have drawn some fundamental conclusions about what lessons for scholars, scientists and academics might be drawn from their resilience, patience and determination:

- Bear witness and document what one witnesses. The importance of witnessing should not be underestimated [95–100]. But it is also imperative that scholars recognize that their privilege as witnesses does not give them free license to interpret and authorize. As Geertz noted, our observations of experience are always already framed by our education and theorizing [101,102], and Bell et al.’s approach of “engaged witnessing” [103] is perhaps close to what I want to suggest is needed.
- Be patient, persistent and humble in leadership. It is important to remember that the fundamental imperatives of many Indigenous struggles are really about the exercise of rights to do the everyday things of their lives—not to perform in the political theatres of law, politics and economics, but to hunt and fish and spend time in their families and Country. While some might be seduced from time to time by the opportunities of money and power, I am humbled by the words of Chief Billy Diamond, who led the negotiation of Canada’s first ‘modern treaty’, the James Bay and Northern Quebec Agreement, who talked about just wanting the opportunity to exercise the rights that the treaty recognized, and not having to return to the negotiating table over and over again in order to hold governments accountable for implementing the treaty properly [104].
- Offer interpretation, understanding and explanation not only to the already rich and powerful, but importantly also to the people whose lives are affected by change. It is important that information and explanation is accessible to others and based on the available evidence, and this requires

acknowledgement, engagement and discussion (education), not just the assertion of expertise by leaders and advisors—humility is required, as is the ability, willingness and opportunity to listen. Recognize that what constitutes evidence in different realms and settings will vary (sometimes unpredictably) over time and between circumstances.

- Connection and belonging are important, but in new circumstances we need to get the scales (spatial, temporal, ecological and social) right, rather than assume that things remain the same. Indigenous cultures are contemporary and dynamic—they are not some sort of window on the human past, but the context of Indigenous peoples continuing experience—the past-present-future continuous that is the foundation of The Dreaming, which informs Australian Indigenous ontology.
- Take responsibility—there is no shortage of mythical, political and scientific narratives about the need for people to understand that knowledge has consequences and there is a responsibility attached to knowledge. The failure to take responsibility for knowledge, insisting on the construction of ignorance, and the denial of causal and ethical relationships between actions, events and knowledge—these things are warned against in multiple human narratives, from those that shape relations in the ancient jurisdictions of First Nations to the drivers of contemporary research ethics.
- Consider what sort of Ancestor you want to be—at the conference on which this special issue of *Sustainability* was imagined into life, Professor Gregory Cajete articulated this question in ways that profoundly challenged many aspects of my thinking and being. The Ancestors of Indigenous nations are often eulogized in ways that risk forgetting that the Ancestors were people like ourselves, who were acting with courage, humility and integrity to connect possible futures to their own pasts and presents. They became the sort of revered Ancestors who made it possible for us to be and for our coupled human-and-natural systems to continue becoming, but they were actors who were responding to challenges of survival, justice and integrity, just like us.
- Act—silence and inaction cannot be justified. While there are many perspectives on what constitutes just action (and what action is appropriate in various settings), the cycles of understanding-acting-and-reflecting that are embedded in the ethical advice to human communities encoded in sacred texts, mythical narratives and research methodologies are clear that understanding brings a responsibility to act, and that actors are to be held accountable.

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Essay

Indigenous Science, Climate Change, and Indigenous Community Building: A Framework of Foundational Perspectives for Indigenous Community Resilience and Revitalization

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Abstract: This essay presents an overview of foundational considerations and perceptions which collectively form a framework for thinking about Indigenous community building in relationship to the tasks of addressing the real challenges, social issues, and consequences of climate change. The ideas shared are based on a keynote address given by the author at the International Conference on Climate Change, Indigenous Resilience and Local Knowledge Systems: Cross-time and Cross-boundary Perspectives held at the National Taiwan University on 13–14 December 2019. The primary audience for this essay is Indigenous Peoples and allies of Indigenous Peoples who are actively involved in climate change studies, sustainable community building, and education. As such, it presents the author’s personal view of key orientations for shifting current paradigms by introducing an Indigenized conceptual framework of community building which can move Indigenous communities toward revitalization and renewal through strategically implementing culturally responsive Indigenous science education, engaging sustainable economics and sustainability studies. As an Indigenous scholar who has maintained an insider perspective and has worked extensively with community members around issues of culturally responsive science education, the author challenges all concerned to take Indigenous science seriously as an ancient body of applied knowledge for sustaining communities and ensuring survival over time and through generations. The author also challenges readers to initiate new thinking about how to use Indigenous science, community building, and education as a tool and a body of knowledge which may be integrated with appropriate forms of Western science in new and creative ways that serve to sustain and ensure survival rather than perpetuate unexamined Western business paradigms of community development.

Keywords: Indigenous science; climate change; Indigenous community; self-determination; sustainability; Indigenous peoples; traditional ecological knowledge; social and environmental justice

1. Introduction

In many Indigenous communities, efforts are underway to find sustainable and culturally responsive community-based models that help to strengthen Indigenous communities and do not perpetuate their long-standing social or cultural issues. Over the last three decades, various Native initiatives in the United States have evolved which attempt to rebuild Indigenous nations from the inside out. Their intent is to build infrastructures that serve a broader spectrum of the community, explore local resources and solutions, advocate for local rather than governmental control of community development, and most importantly evolve from the cultural and practical knowledge foundations of the communities themselves. These efforts represent an indigenized approach to applying sustainable

environmental education for community resilience and revitalization. This kind of process-oriented strategy for community education and action can form a contemporary context for the application, creative expression, and evolution of Indigenous science.

This essay explores strands of thought and previous writing of the author leading to the articulation of a general framework for contemporary Indigenous community building. It begins with the philosophy of Indigenous science, followed by the challenges of climate change, and issues with Western models of development. These strands set a context for understanding why learning about community is important, the importance of creating relevant community building models, and the need for a new generation of Indigenous studies that prioritizes sustaining healthy Indigenous community.

2. The Principles of Indigenous Science

First it is important to understand what is meant by “Indigenous science” and why Indigenous science is important to consider as a cornerstone for creating an authentic Indigenous approach to the contemporary and future building of Indigenous communities. The development of knowledge through Indigenous science is guided by spirituality, ethical relationship, mutualism, reciprocity, respect, restraint, a focus on harmony, and acknowledgment of interdependence. This knowledge is integrated with reference to a particular people and “place” toward the goal of sustainability and perpetuation of culturally distinct ways of life through generations. Indigenous science perceives from a holistic, “high context,” and relational worldview that includes all relational connections in interdependent dynamic balance in its essential considerations and activity. In contrast, Western science perceives from a “low-context” view, reducing context to a minimum with a focus on material objectivity, either-or logic, and reproducibility [1,2].

Indigenous Science

A working definition of “Indigenous science” is “that body of traditional environmental and cultural knowledge unique to a group of people which has served to sustain that people through generations of living within a distinct bioregion”. All of this is founded on a body of practical environmental knowledge which is learned and transferred through generations of a people through a form of environmental and cultural education unique to them. Indigenous science is really Indigenous knowledge and may also be termed “traditional ecological knowledge” (TEK) since a large proportion of this knowledge served to sustain Indigenous communities and ensure their survivability within in the environmental contexts in which Indigenous communities were situated [3].

Indigenous science may also be defined as a “multi-contextual” system of thought, action, and orientation applied by an Indigenous people through which they interpret how nature works in “their place.” Indigenous knowledge may be defined as a “high-context” body of knowledge built up over generations by culturally distinct people living in close contact with a “place”, its plants, animals, waters, mountains, deserts, plains, etc. Indigenous science is learned through oral transmission; based on observation over generations; relies on cyclic time orientation; applies quantification at a macro level; incorporates a specific cultural/literary style and represents ideas through symbolism; focuses on knowledge that is contextually specific to tribal culture and place; and knowledge that is conserved through time and generations through oral and visual traditions.

There are four challenges to doing sustainable education. These are: (1) creating better, more integrated science and accounting tools to measure biophysical wealth; (2) getting people involved; (3) transforming societal value systems through “empathic education”; and (4) improving knowledge transfer around sustainability [4]. Tied to these challenges is addressing associated issues revolving around human health, social justice, equity, economic development, ethics, and governance. The context of relationship in which this occurs must bring about the balanced and ethical interaction of three interacting contexts of relationship between individuals, community, and the environment. In these understandings and relationships, the aim must be to maintain cultural diversity, protect

human health, create sustainable economic relationships, reconcile social issues non-violently, and most essentially protect the environmental life support system.

Culturally responsive sustainability education for Indigenous peoples also requires the inclusion of Indigenous knowledge on an equal par with modern Western science. This is a relatively new and radical idea for Western science and education which has been met with much debate. Proponents of inclusion of Indigenous science argue that all cultures have developed a form of science which is important to the overall diversity of human knowledge related to the biosphere. However, for some, only Western science is “true science” and all other forms of knowledge must be subordinate. Despite such attitudes, teaching for sustainability provides a context for the inclusion of Indigenous science in all aspects of science education [5]. Indigenous science in its expression as traditional ecological knowledge (TEK) integrated with appropriate insights and models from the evolving field of “sustainability” provides possibilities for creative models for Indigenous communities to sustain themselves and their cultural ways of life in the 21st century and beyond.

3. Indigenous Peoples and Climate Change

Indigenous Peoples are close to the land and many still depend on it for their livelihood. Many still abide by a historical relationship to places based on their tribal relational worldview. Today, Indigenous Peoples find themselves increasingly vulnerable to the negative impacts of climate change. Meeting for the past thirty years in the context of many associated conferences and forums, Indigenous people have been discussing and documenting climate change and its impact on them. Using traditional ecological knowledge and their experience, they have been describing the same drastic shifts scientist now recognize as occurring. The scale of change presents severe challenges for tribal culture and well-being.

Throughout North America, climate change has already drastically impacted Indigenous Peoples. As the crisis of climate change unfolds, Indigenous Peoples are being affected in pronounced ways. Coastal tribes are impacted by sea rise to the extent that some villages may have to be relocated. Climate change significantly affects cultural ways of life and place-based rights of many Indigenous tribes. Species and treaty boundaries are directly affected because they are based on place. There is loss of traditional knowledge due to the loss of key plants, animals, and the cultural contexts that formed the traditional foundation of relationship tribes once had with these entities.

These impacts can also include food and water insecurity in the face of crop failure due to drought, flood, insect infestations, or disease. They can include loss of fisheries or plants and animals that Indigenous Peoples have traditionally depended on due to habitat loss or human migration. They can include new health hazards such as new virus strains (COVID-19, Ebola, SARS, HIV, etc.), antibiotic-resistant bacteria, and other harmful microbial agents due to loss of natural diversity and the continued encroachment of humans into natural environments. In some cases, this has precipitated the forced migration of Indigenous Peoples into urban settings many times leading to poverty and homelessness.

“[Many] small communities are suffering particular hardships, and indigenous cultures, traditions, and languages are facing major challenges to their existence [6].”

Historically, Indigenous Peoples have survived epidemics, extreme weather events, droughts, floods, wars, colonization, displacement, and religious conversion. In the face of these challenges, Indigenous Peoples remained highly adaptive and resilient. In addition, Indigenous Peoples share an ethic of mutual-reciprocal relationship and responsibility toward one another and the natural world. Therefore, plants, animals, and the natural world are not viewed as resources but as valued relatives that have the right to exist and be cared for responsibly [7]. It is these orientations that can provide a foundation for creating different kinds of educational, leadership, and social-economic activities that strengthen community while simultaneously mitigating the challenges of climate change for all.

4. Indigenous Communities and Western Economic Development

The term “economic development” connotes new language for old practices in the minds of many Indigenous Peoples. Paradoxically, the modern social concept of development and the value structure that goes with it both attract and exploit Indigenous people and communities. That is, Indigenous people are made to feel that they need development through the good graces of external agents to exist in modern society. This is a self-serving view on the part of governments and corporations, and it largely negates the possibilities for “creative” development initiatives that may emerge from within Indigenous cultures themselves. Nonetheless, many Indigenous people are enticed into thinking that the only way to progress is to adopt colonial ways to solve community problems [8].

Yet, when some Indigenous communities examine government or private sector economic development programs, they find little relevance to their real lives and community practices. They are suspicious of more external control and further disruption of their cultural or community life. They suspect that profit or benefit of these initiatives will flow to others outside the community. This is often exactly what happens [9]. Many community members become frustrated, apathetic, dependent on external agents, and resigned to surviving from day to day. All of this disempowers real community renewal and serves to perpetuate community apathy and various social ills such as poverty, alcoholism, domestic violence, drug abuse, and exodus of many members from a community in search of a better life and livelihood [10].

Some Indigenous communities may apply conventional models of Western economic development out of sheer necessity to serve pressing needs of their community members. But they often face challenges which prevent them from utilizing these models to their full potential. These challenges can include the lack of the necessary administrative infrastructure, lack of skilled or adequately educated people to perform needed work, inadequate startup capital, political instability, and general absence of basic regulatory codes or jurisdictions. Often, when Indigenous communities and their economic development efforts are viewed by governmental or private funding agencies, they are viewed as poor or marginal risks at best and always in need of external co-signers or capital [11]. This scenario plays out in many contexts throughout the Indigenous world and reflects another legacy of colonization and the continued political, cultural, and economic disenfranchisement experienced by Indigenous communities.

For example, in the United States, even after years of heavy investment by government and private sector agents, American Indian communities remain the least economically developed of the population. This continued lack of economic development is many times the result of policies and approaches that have been applied based on conventional Western economic development approaches. At other times it is the result of poor governmental leadership or the absence of practical “self-rule”. In addition, approaches such as the “entrepreneurial” model or “Chamber of Commerce” promotional models have had limited success and have not been sustainable in many Indigenous communities because they are predicated on largely unexamined assumptions of Western development and capital investment which have limited applicability in Indigenous communities [11].

This is not to say that there have not been successful applications of these models and other models in Indigenous communities. But on closer examination one sees that these successes are largely the result of close collaboration with and authentic involvement of Indigenous communities in respectful ways by all external agents involved. It is through such a spirit of authentic collaboration that an atmosphere of mutual trust evolves to form a foundation for the empowerment and efficacy of sustainable Indigenous community building.

However, the view of some Indigenous community leaders, that Western notions of development and its paradigm of “progress” with little regard for social, cultural, and ecological consequences is an extension of colonialism, has been gaining momentum. As is the view that the Western economic paradigm and its focus on material economic indicators as the sole measure of development perpetuates a distorted and dysfunctional vision of what is in fact a dynamic multi-dimensional, multi-contextual social, cultural, and spiritual process for Indigenous communities [11]. As a result of such views of

negative manifestations of the application of Western economic development models, many Indigenous peoples have begun to actively search for alternatives and new paradigms of “development” which are sustainable and more in-line with their cultural and spiritual ethos [8].

5. Creatively and Effectively Addressing the Sustaining of Indigenous Communities

In the context of climate change, Indigenous leaders are realizing that addressing basic sustainability factors, such as ensuring freshwater supplies, secure food supplies, and mediating impact on key plant and animal species, also requires attention to our practiced forms of community. It requires our re-forming of traditional eco-knowledge and the exercise of our sovereignty at every level. It requires that we plan locally and cooperate with other communities or tribes as well as educational agencies, NGOs, and governmental agencies. It requires that Indigenous Peoples create, as they once did, unique solutions to issues of physical and communal survival. Given these propensities, it is important to consider the following strategic orientations for how Indigenous science, traditional environmental knowledge, and communal ingenuity may be engaged toward the development of sustainable Indigenous education and community building at the community level.

The use of traditional ecological knowledge in a balanced relationship with other forms of knowledge to address the challenges of climate change is an essential activity. In an Indigenous context, traditional knowledge is handed down through generations, based on stories and experiences of a People through time. Empirical knowledge is gained through careful observation and practice over time. Revealed knowledge is personal and collective insights gained through vision, ritual, and ceremony. Contemporary knowledge is gained through experience, problem-solving, and applying contemporary knowledge to sustaining people and community. This form of knowledge includes contemporary forms of education including science and other skills learned in a contemporary setting. In reality all three of these forms of knowledge are needed in addressing the challenges of climate change and community building.

Today, there is a compelling need for communal action and simultaneously a lack of the communal cohesiveness necessary to address climate change issues. People today are searching for meaning. Many lack a sense of the communal good. Collectively, we struggle without recognizing the need for communal virtue and ethical action. A healthy society can only come from healthy communities comprised of self-determining individuals acting and taking responsibility for their actions for all [8]. This is the essence of the traditional Indigenous view of community. And it is this compelling need for communal action that must be energized to address the challenges of global climate change in both Indigenous and non-Indigenous communities. Community is a socially learned perception. Humans are social beings. We learn to be in community through participating and learning in community. Indeed, this process of communal renewal and action has begun to take hold among many Indigenous and non-Indigenous people worldwide.

Dee Hock, in his book, *Birth of the Chaordic Age*, states, “the essence of community, its very heart and soul, is the non-monetary exchange of value: things we do and share because we care for others, and for the good of the place . . . It arises from a deep, intuitive, often subconscious understanding that self-interest is inseparably connected with community interest” [12].

Creating Community is an essential ongoing task that requires work and constant attention but provides us with invaluable benefits. Community provides us with a perception of belonging and supports a sense of identity. It places our identity in context. It requires participation and commitment. It requires support of individuals and in turn supports individuals. Community creates a synergy through which it attains coherence, which is to say when you are in community, you feel it in a tangible way [13]. Practiced forms of traditional community and culture have been an integral factor in enhancing the resilience of Indigenous communities through time. Yet, Indigenous communities have also been impacted by historical trauma, social change, and economic and political upheaval. Indigenous communities are an integral foundation of Indigenous life, yet they are significantly vulnerable in confronting modern forces of change. Therefore, creating community in conscious and

healthy ways must be both a practice and foundational strategy as Indigenous communities fully express their innate communality to address the challenges of climate change.

Healthy community processes reflect and reinforce ethical values which serve to preserve community cohesion and sustainable use of natural resources. Healthy community gives us a sense of purpose. In its requirements for a collective agreement on core values, participation, communication, commitment, collaboration, and trust it connects us to our humanity. To function in a healthy way requires our conscious choice, our participation in a shared responsibility, an acceptance of healthy community norms and accountability. It requires us to respect one another, to have accountability to one another, and to practice reciprocity, transparency, and efficacy. In addressing these requirements, we learn and internalize what it is to be in healthy relationship. By being in a healthy community our innate sense of human communality is awakened and guided in positive ways. Indeed, from this perspective, community is the medium and the message [13].

6. Creating a New Paradigm of Indigenous Community Development

Environmental scientists, policy makers, and community developers create and apply theories to the ever-evolving complex situations of a rapidly degrading global environment. Environmental educators create curricula to bring about both an awareness and deeper understanding of chronic ecological issues. New models are constantly being debated and alternatives applied to address specific environmental situations. Yet, most of this work continues to be done and viewed from the “old” paradigms of Western science and policy development. Success and impact of these models continue to be tied to traditional and mono-dimensional economic references such as numbers of people trained or graduated, goods and services delivered, loans or profits made, etc. While these are quantifiable indicators of impact or relative success, it must be remembered that they are but one kind of indicator. Deeper level indicators which reflect the broader dimensions of change or impact are rarely researched and when they are, they are rarely taken seriously. The so-called business “bottom line” psychology continues to predominate as what is most valued in measuring relative success of a development initiative, even as community and environmental issues continue and even worsen. This is the case in many Indigenous communities that attempt to apply Western concepts of development to their unique community development issues. In general, we know more about the issues than ever before yet continue with the old paradigm of thinking and actions, seemingly helpless as we continue to speed ahead to ecological disaster. A deeper and more conscious education about sustainability and the development of a new consciousness therein are key to making the necessary changes for our collective survival.

However, to measure long term “sustainability” of a model or initiative, the net must be cast much broader to be inclusive of the more holistic and less easily quantifiable context of a natural community inclusive of humans. Historically, the traditional Indigenous paradigm of “development” began with gauging the sustainability of an initiative or application of a body of knowledge in reference to how well it helped an Indigenous community “survive” through time and in a place. Indeed, Indigenous communities have the historical, philosophical, and even spiritual foundations from which they may build new and sustainable models for community renewal and revitalization. Many have the cultural and historical foundations to operationalize new sustainable paradigms if they build upon their own creative sense of what it takes to be sustainable and to survive [8].

The movement on the part of some Indigenous leaders and scholars to Indigenize foundational aspects of Indigenous development in ways that are more closely aligned with Indigenous world views is itself a very practical creative strategy to address very real issues of sustainability. In addition, this movement toward “indigenization” is tied to an evolving and increasingly holistic and comprehensive approach to building Indigenous nations. Recognizing the role of local Indigenous knowledge and creating infrastructures from the inside out based on inherent strengths with an eye toward “sustainability” are some of the key tenets of this movement toward indigenization. Indigenous people are learning, creating, and evolving in their development of models for sustainability. Much of these

processes are occurring outside the confines of Western academe, institutions, government agencies, and NGOs. They are being engaged in by and through the communities themselves as emergent and organic creative actions directly addressed at the issues and needs of the communities in real time.

This community-based creative process might be summarized as follows: gaining firsthand knowledge of community needs through “problem-based action research”, developing a comprehensive understanding of the history and “ecology” of a community economy, implementing strategies for regaining control of local economies, creating models based on lessons learned and the application of research of practices that work, and cultivating networks for mutual support and action. This reflects authentic empowerment of communities from grassroots activity within the communities themselves. This also implies the need for a community education process that is initiated by the community in partnership with external expertise to produce solutions.

This new movement and new thinking regarding Indigenous development is in direct contrast with the standard approaches of the past which mimic the Western mono-dimensional model of development. Indeed, the underlying assumptions, aims, and effect of the Western model must be questioned in terms of their ultimate sustainability. It is through the application of the lens of their own histories of sustainability that Indigenous people are coming to realize the wisdom and consequences of applying the Western model of development to their circumstances. It is also the application of the conceptual framework of sustainability that gives the greatest opportunity to the application and even evolution of Indigenous science as a living and evolving base of knowledge upon which Indigenous communities might rely.

In using “sustainability” from perspectives that originate from within Indigenous communities as a guiding paradigm for building Indigenous nations, the underlying assumptions and mono-dimensionality of the standard Western development model becomes apparent. Upon close examination, the limitations of the prevailing Western development paradigm in helping Indigenous communities realize their goals of empowerment, renewal, and revitalization are also apparent.

7. Creating Community Education That Anticipates Change

The creation of community-based curricula that are transformative and anticipate change and innovation must be viewed as an essential activity in the development of a contemporary and sustainable orientation to Indigenous education. Indigenous science curricula development presents the opportunity to integrate principles of sustainability along with appropriate traditional environmental knowledge. In this way, Indigenous science forms a foundation for community renewal and revitalization. In engaging the development of curriculum in this way, Indigenous science also evolves and expands in scope. Indeed, Indigenous science has always reflected this ability to integrate, expand, and create new knowledge. As community members and allies learn, strategize, plan, and act together in relationship to addressing real and pressing issues, they create a learning community that can weave and integrate traditional knowledge with practical skills and contemporary knowledge in ways that are creative, effective, and lead to new insight and community knowledge. The following are guiding considerations which can help to initiate and eventually achieve these aims.

7.1. Building New Curricula Models

The creative process involved with the development of such new curricula is best achieved through the adaptation of metaphors and symbols that have meaning within Indigenous contexts. For example, in an American Indian context the Medicine Wheel, Corn, or Tree of Life symbolism have deep metaphorical meanings that frame essential goals and visions of Indigenous education and sustainability. As community members and educators work to unpack the meaning of such cultural metaphors, they actively begin to engage their cultural history, their epistemology, and discuss how to address issues related to community sustainability. Much of this work is already underway among some Indigenous educators as they work with Indigenous communities and students around place-, land-, and project-based curriculum models.

7.2. Building Sustainable Native Nations

In the movement toward building sustainable Native nations it is important to emphasize renewing and revitalizing Indigenous communities and economics which are sustainable in the “lived” reality of the community. This means that the work being done must make sense to community members and have direct and practical application to their everyday life. This consideration is enacted through engaging the enterprise of appropriate and relevant education at every level around the project of sustaining Indigenous communities and cultures. Building Native nations is most sustainable when initiatives emerge from Indigenous communities themselves.

7.3. Creating a Framework for Introducing Sustainable Indigenous Knowledge

The broader conceptual framework of “sustainable” development forms a hospitable context for the introduction of principles of Indigenous science into community education, planning, development, and policy. Within this framework, traditional environmental knowledge (TEK) can provide models and creative insights necessary to renew and revitalize Native communities. However, this requires vision, commitment, research, and sustained effort on the part of community members and allies to consciously create a long-term plan for community renewal.

7.4. A New Generation of Indigenous Studies

The development of a sustainable emphasis in building Native nations will also require the development of a new kind of Indigenous studies that moves beyond the constraints of Western academe and its various institutional expressions and hegemonies. Such studies should be predicated on involving students in the exploration of the practical application of the vision of creating renewed and revitalized, sustainable, and economically viable Indigenous communities related to the lived realities of Indigenous Peoples and relating their stories through their voice and forms of communication.

As a community-based rather than institution-based activity, Indigenous studies can help us find balance and orientation as we move forward. On the one hand, it can feed our steps of renewal and revitalization with Indigenous knowledge and science. Furthermore, it can train us in the practice of critical thinking and self-awareness. With these skills, we can adjust our course and keep moving in directions true to our Indigenous values, ways, knowledge, and goals.

In this re-envisioning of Indigenous studies, we as Indigenous people must take a hard, honest look at our current economic and community development policies, planning, and process, which may at times make us “complicit” with our own continued exploitation and less resilient in the face of the challenges of climate change and globalization.

Dependency, silence, and conformity to modern notions of social development simply perpetuate colonization in ever-recycling forms, both subtle and overt. As Indigenous people we are continually required to make ourselves understood in dominant society. This is particularly the case in business, government, and higher education and its various expressions in academia. When we Indigenous people must struggle to make ourselves understood—to try to explain and justify what we think, why we think what we do, and why we do what we do—we inadvertently become complicit with the system that dominates us. We get caught up in a never-ending cycle that takes attention and energy away from the more essential questions and tasks of preserving or rebuilding Indigenous societies.

There is a dynamic to this lack of awareness by those in the colonizer/dominating role. They fail to recognize that dominating is what they are doing. Not having been on the receiving end, they often fail to recognize this learned pattern in their behavior and policies. So, the various expressions of this inherent and unacknowledged bias continue to impact open and creative communication. It will take critical awareness on all sides to break the pattern and disrupt its self-perpetuation.

8. Strategic Considerations for Sustainable Indigenous Community Building

Making sure that we have orientations that align with the visions that we have and what we want to accomplish is essential as we plan for change and challenge. To this end, I offer the following considerations for building a community of educational and sustainable practice that provides firm foundations for teaching, learning, and acting in community toward engendering resilience and sustainability of Indigenous communities now and in the future. They are simple precepts, but in their implications and implementation form they can be profoundly effective.

8.1. Be Clear about Your Resources and Premise

People, community, culture, and land are foundational resources of Indigenous community building. It begins with Ecological Integrity. Start from the premise that what you do has integrity and honors “life-giving” relationship. A Sustainable Orientation must be the guiding ethic throughout the process. In other words, take the time necessary to consciously build in a process which sustains community, culture, and place. A Vision and Sense of Purpose must guide activities. This means envisioning that is done with an intimate relationship to revitalization and renewal of community. Apply the Indigenous precept of thinking and acting with a vision of seven generations and beyond.

8.2. Community Building Has a Spiritual Purpose

In Indigenous thought, communal action is integrated with spiritual purpose. Human life and Indigenous communal life stem from spiritual agency. Therefore, integration of the cultural interpretations of the guiding spirit of an activity becomes an essential component of Indigenous sustainable development. In an Indigenous context, actions stem from respect for and celebration of the *Spirit of the Land, People, and Community*. There is respect for all in the community and all that defines a community and the land that nourishes the community. This emphasis requires engaging participation of community at all levels through the acknowledgment of spiritual purpose. In this sense, the spirit of community now and in the future is both the medium and beneficiary of community-building activities [8].

8.3. Practiced Relationship

The Indigenous worldview is a relational worldview. Building upon and extending relationships are an essential process for development. Restoring and extending the health of the community must remain a key goal. In all this activity, the initiative should generate a dynamic and creative process of problem solving. Community at every stage is about creating a process of revitalizing old relationships and creating new ones that serve the vision and purpose of building a healthier community. Today, being in community cannot be taken for granted. It requires conscious practice which comes through the actual process of building community.

8.4. Deep Commitment

There must be sustained commitment for developing the necessary skills to initiate and maintain development activities. In addition, there is need for commitment to community renewal and to mutual reciprocal action and transformative change. Community building is a long-term effort and requires consistent commitment of individuals and the community over time to be successful. Deep commitment of community members to the doing what is necessary to heal and move our communities forward tends to be the single most important factor for success of community projects.

8.5. Learning from the Experiences of Other Indigenous People

Collaboration, dialogue, and research with other Indigenous communities about the models or approaches they have used to revitalize or implement sustainable development within their community is an essential activity. Indeed, many times we are our own best resource and advisors when it comes

to community-building activities because such collaboration is grounded in the shared experiences of lived realities that we have shared.

9. Conclusions

In conclusion, Indigenous science and community-based sustainability education can be strategically applied to educate for the recreation of cultural economies around an Indigenous paradigm of sustainability. This begins by learning the history of your Indigenous way of sustainability and exploring ways to translate its principles into the present. There must be research into the practical ways to apply these Indigenous principles and knowledge in tandem with what is deemed useful from modern systems of knowledge and practice. Added to this, Indigenous people must revitalize, re-learn, or otherwise maintain their traditional environmental knowledge and add what is appropriate and relevant from other cultural knowledge traditions toward addressing their contemporary needs and the needs of their future generations. This can be accomplished through applying Indigenous communal strengths of resourcefulness, industriousness, collaboration, and cooperation. In addition, we must once again apply our collective and historical ability to integrate differences in our political organizations, forge alliances and confederations, and reintroduce our propensity for trade and exchange. We have ancient systems of extended family, clan, and tribal relationships that we can mobilize in positive ways to implement sustainable changes in our economies. We have developed modern political, social, and professional trade organizations, federations, associations, and societies which we can enlist in addressing the challenges which we now collectively face. In addition, we are evolving Indigenous critical studies, Indigenous theory, research methods, and pedagogy to assist us in these tasks. These are the critical areas of Indigenous education which must continue to be explored and operationalized toward the development and revitalization of Indigenous communities as we face the challenges of surviving the ecological, social, and political challenges of a climate-changed world.

A perennial question lingers in the air; the question is, “What kind of ancestor do you want to be?” This question was first posed by Anishinaabe elder, Michael Dahl in conversation with Winona La Duke, Indigenous activist and author, at her home on the White Earth reservation. This profound question calls us to bring forth ancient wisdom and generational ethics necessary for the survival and well-being of the human community. It also calls into question colonial overconsumption of earth’s resources and domination of people globally that today threatens the viability of the earth’s life-support systems [14]. As Indigenous Peoples, inherently and collectively, I think we know the answer to this question. What we must do now is act on it!

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