land

MDPI

Review

Research Progress and Conceptual Insights on Drought Impacts and Responses among Smallholder Farmers in South Africa: A Review

Sheunesu Ruwanza *, Gladman Thondhlana and Menelisi Falayi

Department of Environmental Science, Rhodes University, Makhanda 6140, South Africa; g.thondhlana@ru.ac.za (G.T.); falayimenelisi@gmail.com (M.F.)
* Correspondence: ruwanza@yahoo.com; Tel.: +27-46-603-7009

Abstract: Drought is a natural phenomenon which can cause widespread socio-economic and environmental impacts. Recent predictions suggest that drought frequency and intensity will increase in Southern Africa; therefore, there is a need for more scientific information on drought impacts and responses by vulnerable groups such as smallholder farmers. This scoping review examines the current state of research and conceptual insights on the impacts of drought on and responses by smallholder farmers in rural and urban settings in South Africa. We used three bibliographic databases (Scopus, Web of Science, and EBSCOHost) to search for peer-reviewed literature published on South Africa. In total, 18 articles were reviewed, and information on drought impacts and responses among smallholder farmers was analysed and synthesised. Although most of the reviewed papers identified several socio-economic (e.g., loss of livestock, income, and employment) and environmental (e.g., loss of grazing land and vegetation) impacts of drought, the identified impacts were rarely quantified, and there is a lack of analytical depth of these impacts. Smallholder farmers in South Africa implement several drought responses, and these were categorised based on (i) changes in local practices and lifestyles e.g., practising conservation agriculture, (ii) structural measures e.g., government relief programmes, and (iii) technical interventions e.g., rain harvesting. None of the reviewed papers reported on the impacts of and responses to drought on smallholder farmers in urban settings. Overall, the review noted that the literature on drought in South Africa lacks detailed quantification and analysis of drought impacts and responses, the urban drought context is poorly understood, and there is a lack of clarity on the distinction between adaptation and mitigation strategies. Improving our understanding of drought impacts across a rural-urban gradient is important if responses are to effectively reduce smallholder farmer drought vulnerability.

Keywords: drought vulnerability; smallholder farmers; socio-economic impacts; drought responses

Citation: Ruwanza, S.; Thondhlana, G.; Falayi, M. Research Progress and Conceptual Insights on Drought Impacts and Responses among Smallholder Farmers in South Africa: A Review. *Land* **2022**, *11*, 159. https://doi.org/10.3390/land11020159

Academic Editor: Hossein Azadi

Received: 7 December 2021
Accepted: 15 January 2022
Published: 20 January 2022

1. Introduction

The frequency and severity of extreme weather events, including drought, have significantly increased in the past few years [1]. The recent IPCC [1] report claims that human-induced climate change is already affecting weather patterns, as evidenced by frequent occurrences of drought and heatwaves. According to Naumann et al. [2], drought is defined as the period of abnormal soil moisture deficit caused by a shortage of precipitation, increased temperature, and excess evapotranspiration, resulting in adverse impacts on agricultural production and ecosystem functioning. Similarly, the IPCC [1] define drought as "*a period of abnormally dry weather long enough to cause serious hydrological imbalances*". The above-mentioned definitions are centred on abnormal dry weather conditions, aridity, water scarcity and the associated harm to agriculture and the environment, thus making the definition more meteorological and agricultural. In contrast, [3] viewed drought as a complex interaction of both natural and anthropogenic processes that influences the water balance. This view on drought takes into consideration socio-economic drought, which

occurs when shortage of water supply results in increased demand for economic goods. In trying to propose a more generic definition, [3] defined drought as "*an exceptional lack of water compared with normal conditions*". Indeed, the recent UNDRR [4] report acknowledges that drought is challenging to define due to its complex nature as well as variations across climatic regions and scientific disciplines. According to UNDRR [4] drought is both a natural hazard and physical phenomenon that can trigger a disaster when vulnerability and response capabilities are not sufficient to deal with the effects of drought.

The increase in global population, which has resulted in the increased demand for water under already existing poor water management and infrastructure [5], can exacerbate drought leading to increased socio-economic vulnerability [2]. Since the 1960s, Africa has experienced more than 382 drought events that have affected millions of people, particularly in the Sahel and Southern Africa regions [6]. In South Africa, major drought events have been recorded in 1973–1974, 1983–1984, 1991–1992, 1994–1995, 2014–2016, and 2017–2018 with devastating socio-economic and environmental impacts [7–9]. The 2014–2016 drought in South Africa turned the country from a grain exporter to a grain importer [8,10]. According to Shiferawo et al. [6], between 1960 and 2006, drought events accounted for approximately 25% of all-natural disasters in Africa. The recent IPCC report suggests that drought events in Africa will increase due to increased human-induced climate change [1]. The financial costs of drought are substantial. For example, GDP in SADC countries declined by approximately US$0.81 billion due to the 2015–16 El Nino induced drought [11]. In Europe, the economic consequences of drought in the 2000s is estimated at six billion Euros per year [2].

Drought is more than a natural hazard and physical phenomenon that can trigger serious socio-economic and environmental impacts, especially on the resource-poor and vulnerable communities [12]. Drought directly affects agricultural productivity, human and animal health and can cause vegetation loss, as well as water scarcity resulting in food insecurity and poverty [6]. Indirectly, drought can result in environmental degradation, increased food scarcity, reduced human welfare, and in some cases, can trigger social unrest [12]. In Africa, drought has caused significant impacts on the agricultural sector, including degradation of grazing lands, loss of crops, depletion of agricultural assets, impoverishment of farmers, particularly the more vulnerable smallholder farmers, and forced migration from communal areas to urban areas [6]. For example, the 2018–2019 drought in Zimbabwe resulted in low crop yields and loss of livestock, resulting in farm fallowing by many subsistence farmers [13]. In Mali, the 2015 drought resulted in the starvation of more than 300,000 people due to food insecurity [14,15]. In South Africa, the 2014–2016 drought resulted in vegetation and wildlife loss in protected areas, although the impacts were not catastrophic [16]. Recently, the 2017–2018 drought in the Western Cape Province of South Africa resulted in water restrictions which, in turn, resulted in knock-on effects on the economy, human health, and sanitation [9,17]. Therefore, drought impacts are diverse, affecting society, the environment, and economies differently.

The negative impacts of drought can result in shocks to individuals and the economy; hence there is a need to develop effective drought responses [8]. Drought interventions are classified as adaptation and mitigation strategies. The former refers to interventions aimed at coping with droughts, such as climate proofing (retention of soil moisture, use of drought and heat-tolerant crops and conservation agriculture) and irrigation systems. The latter refers to strategies for reducing the impacts of droughts, such as food relief [18]. Williams et al. [19] emphasised the need to develop effective drought coping, adaptation, and recovery strategies at different levels such as household, community, and state. In the past, responses to drought have been mainly reactive, mainly in the form of drought relief programmes [20]. Drought relief programmes by government and non-governmental organisations such as food and stock feed provisions have been viewed as ineffective because they tend to be reactive and offer few incentives for local people to change their approaches, particularly towards preparing for future droughts [21]. In response, drought risk management experts are advocating for the development of proactive adaptation

strategies for increasing drought resilience [20]. Pro-active adaptation strategies such as drought monitoring and ecological restoration are viewed as effective measures aimed at strengthening socio-economic and ecological systems to facilitate effective drought recovery [20]. More place-based local proactive adaptation strategies such as shifting crop planting dates, change in farming type, and reforestation projects have been implemented in South Africa and elsewhere [22]. However, for pro-active adaptation strategies to be effective, they need to be backed by policy, effective institutions, and the involvement of all stakeholders [8].

Within the agricultural sector, smallholder farmers can disproportionately bear the negative impacts of drought due to their high levels of vulnerability. Generally, a smallholder farmer is viewed as a person practising mixed crop-livestock farming on a small piece of land. This farming system heavily relies on low labour intensity to produce crops and livestock products for household food consumption and for cash income generation [23,24]. In general, smallholder farmers utilise between 1–5 ha of land for growing several crops such as maize, cotton, tobacco, and horticultural crops [25]. Furthermore, smallholder farmers are generally less equipped in terms of infrastructure, human and financial resources and agricultural equipment than large-scale farmers.

However, the contribution of smallholder farmers to food security cannot be underestimated. In sub-Saharan Africa, it is estimated that smallholder farmers produce about 75–80% of the food [26,27], which contributes tremendously to food security [28] and household welfare [29]. Despite the key role of smallholder farmers in enhancing food security, it is estimated that they use about 12% of the world's agricultural land [30], indicating high levels of marginalisation.

In South Africa, smallholder farming is largely concentrated in former homeland areas [31] and municipal commonages [32,33]. In these areas, agricultural productivity is generally constrained by a plethora of challenges, including land tenure insecurity, scarce arable land, limited access to water resources, markets, and poor extension support [34]. The increased frequency of droughts in sub-Saharan Africa, including South Africa [35], is likely to push the urban and the rural poor into further poverty.

Evidence shows that the national livestock herd declined by 15% while crop production declined by 8.4% and the farming debt increased by 9% in South Africa due to the impacts of drought [10]. This is a cause for concern because the effects of drought pose a serious threat to people's livelihoods, nutrition, and food security [36]. Empirical work on the impacts of droughts on smallholder farmers is growing in South Africa but is mainly from a rural perspective. Further, while smallholder farming is common in urban spaces [37], to the best of our knowledge, there is no consideration of the impacts of drought on smallholder farmers across a rural-urban gradient. Consequently, it is difficult to examine how broader biophysical, socio-economic, and institutional contexts influence the impacts of and responses to droughts. Therefore, a clear understanding of the impacts of and responses to drought on smallholder agricultural producers in rural and urban settings is required to advance our understanding of drought impacts needed for designing appropriate and supportive drought response strategies [35].

Considering this background, this scoping review examines the current state of research and conceptual insights on the impacts of and responses to drought on smallholder farmers in rural and urban settings in South Africa. Review outcomes can be used to (i) guide future research on drought impacts, and (ii) inform policymakers on ways to adjust and calibrate mitigation strategies.

2. Methods

Based on the methodological framework outlined by Arksey and O'Malley [38], a scoping review was conducted to synthesise the current state of research and conceptual insights on the impacts of and responses to drought on smallholder farmers in South Africa. The review included the following three steps: (1) defining the research question; (2) literature gathering; (3) data analysis and reporting of results.

2.1. Research Question

Given that the scoping review forms part of the special issue on 'The impacts of drought on ecosystem services and livelihoods in the Global South', the review was guided by the question 'What is the current state of research and conceptual insights on the impacts of drought on and responses by smallholder farmers in South Africa? We adopted a scoping review approach because it enabled us to comprehensively synthesise, document knowledge gaps and identify policy implications on the impacts of and responses to drought on smallholder farmers in South Africa [38,39].

2.2. Literature Gathering

To gather literature, numerous search queries consisting of keywords such as ('smallholder farmer' AND 'drought' OR 'drought effects' AND 'adaptation strategies' OR 'mitigation strategies' AND 'South Africa) were used to search for existing peer-reviewed literature relevant to this study in three bibliographic databases (Scopus, Web of Science, and EBSCOHost). In order to be as comprehensive as possible, the search queries had no limits to date and were tailored to suit the requirements of each bibliographic database. In addition to the three bibliographic databases, Google Scholar was used to identify any other relevant literature that might have been missed in the above-mentioned three bibliographic databases. Using the search queries, a total of 87 articles were identified across the three bibliographic databases and Google Scholar (Figure 1).

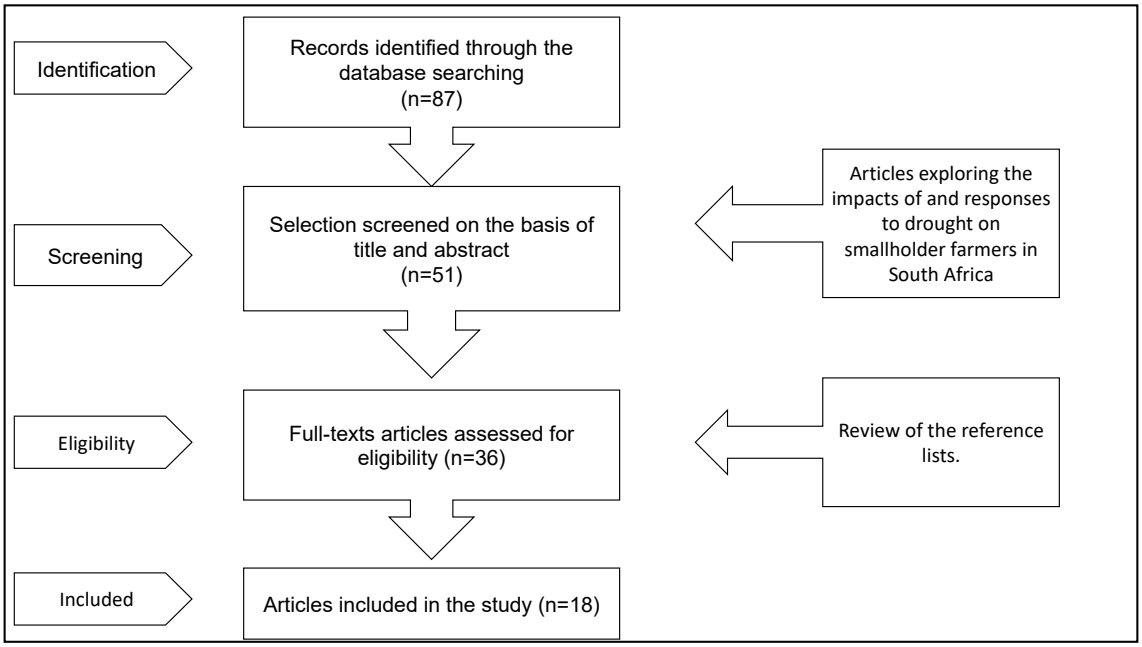

Figure 1. Steps taken in selecting literature.

During the process of selecting articles, five duplicate studies were removed. Title screening led to the exclusion of 16 articles, and a further 30 were removed during the abstract screening process. In total, 51 articles were excluded because most of the articles did not explicitly focus on the impacts of and responses to drought on smallholder farmers in South Africa. Most of the excluded articles were related to the adaptation responses of large-scale commercial farming [40,41]. Therefore, only 36 articles met the eligibility criteria (Figure 1), and these were subjected to full-text screening. Full-text screening used the following criteria:

- The articles needed to focus on drought impacts on smallholder farmers in South Africa, whether in a rural or urban setting.
- Describe at least one response to the impacts of drought.

- The articles needed to be in English.

Full-text screening resulted in the exclusion of 18 articles, and some of the excluded articles focused on the impacts of day Zero in Cape Town [9] and other non-peer-reviewed articles [42]. Therefore, only 18 articles were considered for the in-depth review, where information on the impacts of and responses to drought on smallholder farmers in South Africa was analysed and synthesised (Figure 1).

2.3. Data Analysis

Step 3 of the scoping review process involved data analysis. Analytical notes were written along each article to extract data from the 18 articles that met the inclusion criteria (Table S1). Manual coding was conducted to identify key phrases or sentences that referred to the impacts of and responses to drought. The coded data from the analytical notes were then compiled in a single Microsoft Excel spreadsheet, where descriptive statistics were calculated to summarise the data [43].

3. Results and Discussion

Of all the 18 reviewed articles, no study reported on the impacts of and responses to drought on smallholder farmers in urban settings in South Africa. This highlights a dearth of studies analysing the impacts and responses to drought in urban environments. The number of articles discussing drought impacts and responses amongst smallholder farmers was generally low between 2010 and 2018, averaging one article per year, but increased recently (between 2019 and 2021) averaging three articles per year (Figure 2). Nevertheless, the reviewed studies reported on a number of impacts on rural-smallholder farmers. Such impacts include social, economic, and environmental impacts, as well as responses strategies to these effects.

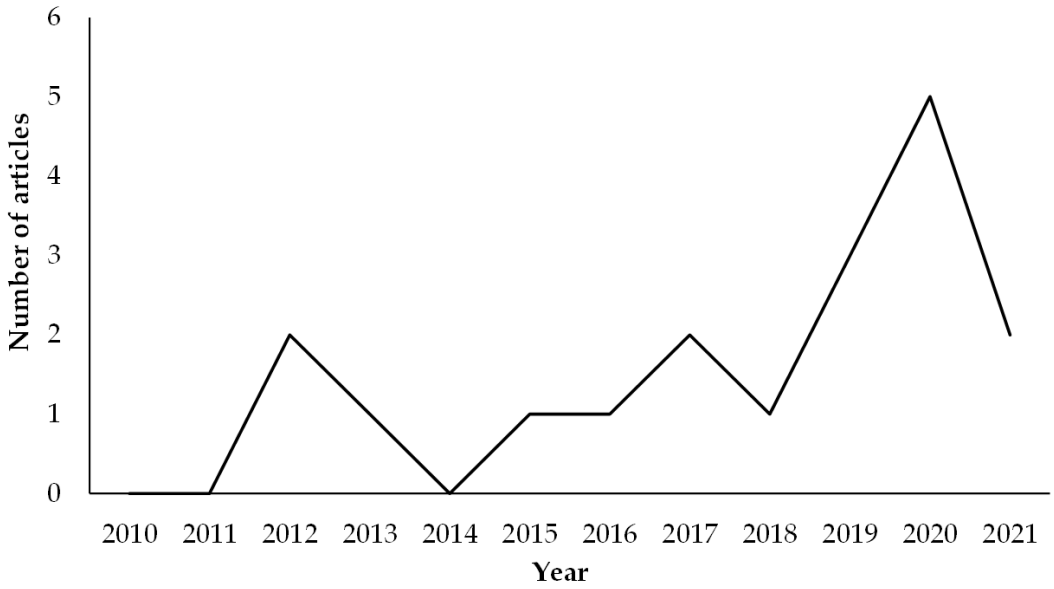

Figure 2. Plot of the number of articles published annually between 2010–2021 on drought impacts and responses amongst smallholder farmers in South Africa.

3.1. Impacts of Drought

3.1.1. Social Impacts

Drought has substantial negative social impacts on smallholder farmers in South Africa. In this review, 17% (n = 3) of the reviewed papers indicated food insecurity as the main social impact of drought [8,35,44]. For example, in uMsinga, in KwaZulu-Natal province, many smallholder farmers reported increased food insecurity during the 2014–2016 drought [35]. The same study also indicated that the reported cases of food insecurity were in the form of limited food choices and malnutrition, which resulted from the loss of crops and livestock.

Only one study reported that a high proportion of the interviewed smallholder farmers in the above-mentioned study area identified increased poverty and migration during the 2014–2016 drought [35]. Increased poverty levels and migration from rural to urban areas in search of better-paying jobs were linked to unemployment and economic stress caused by drought. Only two studies reported that drought affected livestock health due to increased temperatures and deteriorating animal drinking water quality [35,45] (Table 1).

Table 1. Categories of drought impacts identified in South Africa.

Category	Impacts
Social impacts	• Food insecurity • Increased poverty • Migration • Unemployment • Decreased animal health
Economic impacts	• Livestock loss • Crop loss • Income loss • Decrease in livestock and land prices • Increased food prices
Environmental Impacts	• Loss of grazing land • Loss of water • Deterioration of water quality • Contamination of drinking water • Increase in temperature • Loss of vegetation

The social impacts of drought on smallholder farmers are well documented globally [19], with food security being regarded as the main social impact in Africa, given the continent's dependence on the agricultural sector [46]. The drought can negatively affect all four dimensions of food security, namely food availability, access, utilisation, and stability [47]. For example, the economic loss to livestock production in KwaZulu-Natal because of the 2014–2016 drought is estimated to be more than ZAR 10 billion, which is likely to have resulted in cases of severe food insecurity in the province [16]. Also, Agri SA [10] and Lottering et al. [35] reported that most drought events in South Africa have resulted in poor crop yields resulting in the country importing cereals due to food insecurity. Food insecurity due to drought affects both food quantity and quality, although most studies tend to focus on food quantity than quality [48]. Due to a high reduction in agricultural income during drought periods, cuts in some important food items among families can result in reduced food quantity and quality, which might lead to malnutrition.

Drought is also associated with poverty, migration, and high levels of unemployment among rural farmers [35]. For example, drought can reduce farm income due to reduced agricultural production and loss of work due to reduced demand for labour owing to limited agricultural activities. South Africa is projected to experience huge decreases in agricultural productivity due to drought and other climate change related natural disasters [10]. The reduction in agricultural productivity will negatively affect food supply, which will result in increased unemployment and poverty [35]. The agricultural sector remains an important driver of economic development in South Africa, yet drought threatens to derail the pathway to economic growth due to food insecurity and poverty.

3.1.2. Economic Impacts

The loss in agricultural productivity among smallholder farmers, particularly livestock and crop loss, was reported in 67% (n = 12) and 22% (n = 4) of the reviewed papers, respectively (Table 1). Swemmer et al. [16] reported that the 2014–2016 drought resulted in approximately 33% cattle mortality in Giyani, Limpopo. Swemmer et al. [16] reported that

most of the interviewed farmers in the Msinga area of KwaZulu Natal lost approximately 43% of their cattle and 29% of their goats during the 2015–2016 drought. Bahta [49] reported that during the 2015–2016 drought, a significant number of farmers (approximately 64%) in Northern Cape Province in the France Baard District Municipality lost their livestock through drought related deaths, whilst others opted to sell the animals at low prices as a drought coping strategy. A recent study by Rakgwale and Oguttu [50] reported that smallholder farmers in the Greater Letaba Local Municipality in Limpopo lost about five livestock per farmer during the 2014–2016 drought, a significant number for these farmers given their small herd sizes. Surprisingly, most studies acknowledged that crop yield losses were a result of the decline in rainfall and soil moisture [35,44,49,51,52] but none of the reviewed studies quantified crop losses. Declines in livestock and crop productivity result in income losses to famers; however, in this review, only two reviewed papers acknowledged the loss of income as an economic impact of drought [35,53]. Besides the loss of income from livestock deaths, it was also acknowledged that the selling of animals and farm assets at low prices, increased fodder prices during drought years, and the buying of animal vaccines and disease treatment chemicals resulted in further income losses for farmers [35,54]. The economic impacts of drought associated with decreases in livestock prices and land prices were identified by Lottering et al. [35] and Ngaka [53], respectively. Only two studies reported increased food prices as an economic impact of drought faced by smallholder farmers [8,35].

Several drought-related economic impacts (e.g., livestock, crop, and income loss) were mentioned in most of the papers we reviewed; however, few papers quantified the magnitude of economic losses, and none valued the loss in monetary terms. The 2015 drought in South Africa is estimated to have resulted in income losses amounting to billions of rands due to crop and livestock losses [10], but this loss is not disaggregated by farming type and regions. Crop failures and animal loss due to loss of moisture and grazing pastures, respectively, are the main drivers of economic losses associated with drought in communal areas. For most smallholder farmers, the economic losses are huge because agricultural activities depend on natural rain compared to commercial farmers who have irrigation infrastructure [35]. Recent reports suggest that maize production among smallholder farmers in South Africa dropped significantly between 2014–2016 due to drought [8,10]. This drought-driven reduction in maize production will result in significant food insecurities and economic losses to farmers and the country. Moreover, drought is behind the decline in wheat production, resulting in South Africa importing more than one million tons of wheat during the 2014–2016 drought [10]. This is likely to have an adverse impact on ordinary people across the country as bread prices continue to increase. Similarly, livestock farming plays a key livelihood role for most smallholder farmers; however, the loss of grazing lands, drinking water, and heat stress has contributed to economic losses for most farmers [45]. These income losses further push smallholder farmers into poverty as they struggle to sustain livelihoods and buy basic food during drought years.

Loss of agricultural productivity during drought will trigger further losses in the agricultural sectors, including increased imports of agricultural products, loss of revenues from the agricultural sector, and increased food prices. For example, Austin [55] reported that the 1991–1992 drought in South Africa resulted in approximately 52% decline in cereal yields and 27% decline in agricultural gross domestic product. Such drought driven economic declines have knock-on effects on society and individuals as the increase in food products will push more people into poverty.

3.1.3. Environmental Impacts

A handful of drought impacts on the environment were mentioned in the review, including loss of grazing land (33%, n = 6), loss of water (17%, n = 3), deterioration of water quality, contamination of drinking water, increase in temperature (11%, n = 2), and loss of vegetation (11%, n = 2) (Table 1). Lottering et al. [35] showed that 34% of the interviewed

participants in uMsinga, KwaZulu-Natal reported a loss of grazing, loss of water, and deterioration of water quality as the main environmental impacts facing smallholder farmers. Vetter et al. [45] showed that the loss of grass, trees, and water sources in grazing lands resulted in severe animal deaths as animals were weak and had to walk long distances in search of food and water. In contrast, Swemmer et al. [16] reported that the impact of drought on grazing grass composition was varied as some areas showed a decrease in some palatable grass species whilst others showed an increase. They also reported that the impact of drought on savanna trees and shrub mortality was not widespread as mortality rates for some tree species was recorded in some regions but not others. Jordaan et al. [56] and Maponya and Mpandeli [57] found that the loss of grazing grass was severe in degraded areas since vegetation did not grow, leaving smallholder farmers in these areas with limited fodder for their livestock. Water scarcity and decreased quality resulted in soil moisture depletion and low dam levels [35]. These soil and dam water shortages resulted in crop failures, loss of grazing land, and water scarcity for animals [35,45,58]. These drought related impacts are exacerbated by an increase in temperature, which characterises most drought conditions. Hot temperature conditions were found to cause a major threat to ecosystems [35,45].

Environmental impacts of drought on smallholder farmers are easy to identify because most of them manifest in reductions in crop and livestock production [16]. However, few papers quantify these environmental impacts because some impacts such as loss of tree species tend to manifest after the drought. In some cases, the effects vary depending on the area (e.g., flora is not uniformly affected by drought across different vegetation types) [16,45]. Drought alters ecosystem processes and functions mainly through its impacts on water availability, increased temperature, and soil moisture loss [35]. Water and soil moisture deficit caused by drought drives ecosystems beyond their resilience thresholds, thus leading to negative environmental effects [45]. For example, the increase in temperature during drought results in loss of soil moisture, leading to reduced plant growth and loss of grazing land, which will subsequently cause livestock loss [45]. This makes the impact of drought on the environment cascading as impacts such as increased temperature accelerate the crossing of thresholds resulting in induced effects in other connected human and ecological subsystems.

Drought is associated with water deficit and decrease in water discharge in rivers. Water quality tends to decrease during decreased water levels in rivers due to accelerated algae growth caused by increased nutrient suspension and decreased dissolved oxygen concentration [59]. Changes in water quality can trigger human and animal health problems due to drinking contaminated water. Keshavarz et al. [60] highlighted that access to clean water is compromised when drought occurs, leaving both humans and animals vulnerable to waterborne diseases such as cholera, typhoid and diarrhoea for humans and salmonellosis for animals. Therefore, the effect of drought on water resources severely affects livelihoods leaving most people in poverty.

3.2. Drought Response Strategies

Literature on the social-economic impacts of drought documents different coping strategies that smallholder farmers implement to cope with drought impacts. Understanding how and why smallholder farmers respond to the impacts of drought can provide insights into the range, forms and types of coping strategies which can enhance future adaption strategies [52]. Out of all the papers reviewed, 83% (n = 15) dealt with drought coping strategies that include short-term relief programmes to long term changes in practices and sustainable technological innovations. The suite of coping strategies reported can be divided into three, namely changes in local practices and lifestyles, structural measures, and technical interventions (Table 2).

Table 2. Reported drought coping strategies.

Category	Coping Strategies
Changes in local practices and lifestyles	• High yielding crop varieties • Drought resistant crops • Changing planting dates • Planting fast maturing crop varieties • Mixed cropping • Crop rotation • Conservation agriculture (zero and minimum tillage) • Adjusting fertiliser inputs • Food reserves • Buying supplementary food • Farm abandonment and fallowing • Seeking employment • Destocking or culling • Buying supplemental feed • Selling livestock • Moving livestock to new areas • Reducing calving rate • Remedies • Abandoning farming • Getting cash loans
Structural measures	• Government interventions • NGO support • Social networks
Technical interventions	• Irrigation systems • Rain harvesting • Drilling boreholes

3.2.1. Changes in Local Practices and Lifestyles

Concerning changes in local practices and lifestyles, the reviewed studies show varied drought response measures including the use of high yielding crop varieties, drought-resistant crops, changing planting dates and shortening cycle crop varieties, intercropping and conservation agriculture, among others. The review shows that farmers responded to the effects of drought by growing improved and short-cycle varieties. For example, Kom et al. [52] reported that smallholder farmers in Vhembe District in Limpopo province of South Africa have noted an increasing decline in crop yields and pest attacks on traditional crops due to droughts. In response, they have been gradually replacing indigenous seed species, including traditional beans and maize species, with sweet potatoes, sugar beans, tomatoes, Irish potatoes, and hybrid maize seeds. Droughts are also associated with unpredictability of and prolonged dry spells with adverse impacts on crop growth and productivity. In response, farmers report shifts from cultivating traditional crops to cultivating drought-resistant cultivars and crops such as maize, beans and onion varieties, among others [35,52]. However, Mpandeli et al. [44] found that smallholder farmers in the Limpopo province responded to the drought by cultivating drought-resistant crops such as groundnuts and sorghum.

Farmers also cope with drought impacts through changing their planting calendars, with planting taking place when it rains and shifting to the cultivation of shortening cycle crop varieties. For example, Kom et al. [52] found that most farmers have shifted to shorter-cycle crops varieties as a coping mechanism, including changing planting and harvesting dates. These measures can reduce the effects of crop damage or loss from droughts-related impacts such as crop growth failure and increases in crop diseases and pests. Farmers also practiced intercropping as an adaptation strategy [35], where different

crops are cultivated simultaneously, which reduces the risk of food insecurity if one crop fails. Intercropping can also be beneficial to soils as the combination of grains (e.g., maize) and legumes (e.g., cowpea and beans) can allow nitrogen fixation. Vilakazi et al. [61] also document the use of drought resistant crops, early mature crops, crop rotation, intercropping, changing planting dates and crop diversity and conservation tillage as strategies employed by farming communities in KwaZulu Natal province to manage soils and water in response to droughts. Conservation agriculture methods such as minimum tillage and zero tillage are also increasingly practiced in the face of persistent droughts and water scarcity [35]. Mpandeli et al. [44] show that some farmers in Sikhukhume District Municipality in Limpopo province practiced conservation agriculture to increase yields in the face of persistent dry spells. Other short-term strategies for minimising the effects of droughts include finding new sources of food, seeking employment, and keeping food reserves [49,62,63].

For livestock farmers, destocking is a common coping strategy for dealing with the effects of drought, that is, decreased forage production and diminished food available for livestock [44,49,53]. Ngaka [53] reported that livestock farmers in the Eastern Cape and Free State Provinces of South Africa employed various drought coping mechanisms, including destocking through livestock trade, moving livestock to other areas, sourcing extra water and supplementing feed for the livestock. Vetter et al. [45] show that smallholder farmers in the KwaZulu Natal province use evergreen woodland trees such as *Boscia albitrunca, Olea europaea* ssp. Africana, *Schotia* sp., and *Maeru* sp., as sources of supplementary feed for their livestock. Farmers also purchase feed including yellow maize and lucerne as supplemental feed [45], but very few farmers can afford this due to the prohibitive costs. For example, supplementary feed can add to the costs of livestock production, and these costs are often beyond the reach of already struggling smallholder farmers. In some cases, government assistance with supplemental fodder for livestock has been reported [50,58]. However, some livestock owners profited from droughts by buying more livestock taking advantage of the reduction in prices as struggling farmers attempt to get rid of 'excess' livestock to cope with drought. Another drought coping strategy for livestock farmers includes culling [49,50,62] and improving the calving rate, which can be achieved by selling low producers and calves that calve late in the calving period. Other coping measures reported by livestock farmers include obtaining bank loans but only for those who could provide collateral security [8], abandoning farming, leasing part of the farms and creation of social networks for dealing with the effects of drought collectively [49].

3.2.2. Structural Measures

The second set of drought coping strategies emerging from the reviewed papers relates to structural measures, including the role of government, NGOs, and social networks in providing drought mitigation and response such as training, funding, information provision, and relief (food and feed) provisions [50,63]. For example, Swemmer et al. [16] report that following livestock mortalities in Limpopo and Kwazulu Natal provinces, livestock farmers were able to cope with drought through the provision of supplementary feed for cattle via the government drought relief efforts. Lottering et al. [35], Bahta [49], Rakgwale and Oguttu [50], and Jordaan et al. [58] also report government drought relief programmes, including the provision of food for home consumption and supplementary feed for livestock as a coping mechanism for farmers, though the level of satisfaction among farmers varied. Some papers showed that farmers had a high level of dissatisfaction concerning the role of the government in executing drought relief programmes, arguing that relief programmes often get to the intended recipients very late or are inadequate or unavailable at all [52]. Jordaan et al. [58] reported that despite a plea for drought relief by smallholder farmers in Northern Cape province following the 2010 drought, no assistance was provided. The reviewed papers suggest that the lack of support from the state, such as information provision, drought awareness campaigns, drought risk reduction strategies and provision of resources for enabling drought responses make smallholder farmers

unable to institute strategies for reducing the impacts of droughts. Further, despite the role of NGOs in providing drought adaptation support, NGO support is not a common coping strategy among smallholder farmers and is reported in only one instance [63].

Further, while social networks such as farmers' associations, church groups, women's groups, and stokvels create platforms for drought information exchange, and sharing of resources (e.g., food) in times of need which can reduce farmers' vulnerability to drought, only two [44,49] out of all the reviewed papers highlighted social networks as a drought coping strategy. The reviewed papers suggest that social networks were not existent or fully functional. For example, Bahta et al. [51] found that smallholder farmers in the O.R. Tambo District in the Eastern Cape province viewed social networks as ineffective in drought risk mitigation. Social networks such as farmers' associations were reported to be non-functional. Based on work in the O.R. Tambo District, Muyambo et al. [64] argue that the lack of external support negatively affects smallholder farmers' ability to cope with drought.

3.2.3. Technical Interventions

The third set of drought coping strategies is focused on technical interventions. Studies show that farmers are shifting to irrigation facilities due to extreme temperatures and reduced rainfall [35,50,52]. The reviewed papers show that some smallholder farmers use furrow and sprinkler irrigation systems for use before the onset of rains or in case of delayed rain [8]. Though, in some cases, the irrigation infrastructure predates the recurrent droughts, farmers are increasing their focus on small-scale irrigation as a drought coping mechanism, with evidence suggesting farmers with access to water produce more yields than those without [52]. Other smallholder farmers, albeit few, invested in the drilling of boreholes for their livestock to cope with water scarcity, but this option is expensive for many farmers. For example, Rakgwale and Oguttu [50] found that only 6% of smallholder livestock farmers reported drilling boreholes as a drought coping strategy in Greater Letaba Local Municipality in Limpopo province. Taken together, there are important linkages between the different categories of coping strategies, and these linkages should be understood, especially how combining them can improve their effectiveness and the capacity for smallholder farmers to cope with future droughts.

3.3. Ideas for Advancing drought Impacts Research

The review shows that the impact of drought is mainly analysed from a socio-economic perspective with a key focus on food insecurity and crop and livestock losses. The available literature provides useful insights on the impacts of droughts on- and coping strategies by smallholder farmers but does not provide a complete picture. The major gaps in the available literature can be summarised as; (1) lack of quantitative assessments of the reported drought impacts and inadequate analytical depth on the effects of socio-economic, geographic, and institutional context on the impacts of drought, (2) limited focus on urban contexts, so the rural-urban gradient is poorly understood, and (3) lack of clear distinction between adaptation, and mitigation strategies.

First, there is a lack of quantitative assessments of the socio-economic and environmental impacts of droughts on smallholder farmers. Apart from a few studies that show the proportion of households reporting certain impacts such as food insecurity, reduction in crop yield and livestock losses, these impacts remain vague. To get better insights into the impacts of drought, there is a need for real quantitative assessments, including across socio-economic and cultural contexts, e.g., income, wealth, gender, and ethnicity. The impacts of drought e.g., crop loss and food insecurity and livestock loss are not evenly distributed across landscapes and groups of people. For example, well-off households might not experience drought in the way poor households are affected because poor households might lack the financial means to mitigate the impacts associated with drought, while well-off households have fallback options such as food reserves and cash income to buy supplementary food and feed. Further, evidence suggests that gender, access to

and ownership of land and local knowledge all have impacts on the benefits people can get from land, and by extension these factors can shape how the impacts of drought are experienced. In addition, comparison of the impacts of droughts in different geographic contexts through the spatial correlation between drought impacts and region can be useful in drought risk planning because as drought frequency and intensity are projected to increase, regions exploited for crop and livestock productions will likely be impacted more than remote areas.

An understanding of the impacts of drought on smallholder farmers informed by quantitative and comparative assessments can help craft drought adaptation interventions such as irrigation infrastructure and water harvesting technologies to cope with future water scarcity for enhancing smallholder farmers' wellbeing. Therefore, future research should provide analyses of the impacts of droughts, including the magnitude of the impacts and questions of how impacts are experienced across socio-economic, political, and cultural gradients to advance our understanding of drought impacts. We believe that the socio-economic and political/institutional contexts can provide contours within which the impacts of drought can be better understood, and by so doing, shift away from simplistic identification of drought impacts. Improving analytical depth can be useful to our current understanding of the impacts of droughts because this can provide rigour and insights into the magnitude of impacts in ongoing debates. We believe rigorous analysis can benefit policy debates and engender knowledge shifts on the subject—which for the most part, is not evident in the available literature. Without this, the notion of drought impacts remains fraught with misunderstandings, making it difficult to design context-specific strategies for mitigating and adapting to the impacts of drought.

Second, the reviewed studies are largely rural-based and do not assess the impacts of drought on smallholder farmers along a rural-urban gradient. Yet, small-scale crop and urban livestock production is a common livelihood activity particularly for the urban poor [65]. Particularly in South Africa, urban livestock production is widespread and livestock graze in designated grazing areas known as commonages [32]. In general, these commonages are poorly managed and characterised by land degradation and poor infrastructure [33], and recurrent droughts compound the problem.

However, there is little analysis of the impacts of droughts on livestock production by smallholder farmers in urban spaces, making it difficult for city authorities to better understand and improve the capacity to cope with future droughts. We argue that without proper response mechanisms, urban livestock production will become an increasing source of conflicts in urban spaces between livestock owners and non-owners as livestock forage green spaces such as parks and streets, as has already been reported [66]. A focus on drought impacts along a rural-urban gradient can offer different perspectives to our understanding of drought challenges and identify similarities and differences that can enhance more general knowledge of impacts of and adaptation to drought. Further, covering both urban and rural sites in different geographic contexts (e.g., inland, coastal) can provide the opportunity to explore interconnected and cascading drought risks and impacts across different social groups and landscapes. This approach will allow crafting of resilient evidence-based solutions for reducing future drought impacts across social-economic, political, and geographic contexts. Beyond informing practical responses to drought, a rural-urban gradient approach can contribute to drought impact scholarship, needed to advance debates and leverage appropriate responsiveness.

Third, the available literature on drought coping strategies is beneficial in understanding the different strategies employed by smallholder farmers in the face of droughts but does not categorise the impacts by socio-economic groups and spatial context, which does not benefit drought scholarship. Further, the reviewed studies tend to identify all the reported drought coping measures, without however organising these into adaptation and mitigation strategies. Given that drought is a complex phenomenon, failure to distinguish between adaptation and mitigation measures may result in a lack of understanding of the

complexities of drought impacts, and how support systems can be provided to improve the capacity of smallholder farmers to adapt to drought in the long term.

4. Conclusions

Drought is a destructive natural hazard of which impacts can be widespread and devastating on resource-poor smallholder farmers, placing them in jeopardy. The socio-economic and environmental impacts of drought on smallholder farmers in South Africa are multiple, including food insecurity, increased poverty, unemployment, loss of grazing pasture and water which subsequently result in loss of livestock, crops, and income. Understanding these impacts is important for developing effective drought response strategies; however, the reviewed literature lacks an accurate assessment of the magnitude of drought impacts on smallholder farmers. Most of the identified drought impacts focused on short-term livestock and crop production losses. In contrast, there is limited focus on quantification and economic valuation of drought impacts.

The reviewed literature documents a suit of different drought response strategies that smallholder farmers implement, and these can be divided into (i) changes in local practices and lifestyles e.g., changing plant varieties and practising conservation agriculture, (ii) structural measures e.g., government interventions and creation of social networks, and (iii) technical interventions e.g., rain harvesting and drilling of boreholes. However, it was acknowledged that some drought responses, e.g., drought relief programmes, are reactive, therefore, the need to develop proactive response strategies, e.g., conservation agriculture which helps to conserve soil and water.

This review provides valuable information for designing drought responses among smallholder farmers. Firstly, the review highlights the importance of quantifying current drought impacts so as to improve the ability to predict future socio-economic and environmental impacts of drought on smallholder farmers. However, accurate drought quantification requires constant drought monitoring, availability of drought data, and effective quantification methods. Secondly, the limited focus of studies on drought impacts on smallholder farmers in urban contexts shows that the rural to urban drought gradient is little studied in South Africa. The increase in urban population and resource use e.g., water, make urban centres more vulnerable to drought, which highlights a huge research need on drought impacts and responses in urban spaces. Lastly, risk-based drought responses include monitoring, mitigation, and adaptation strategies, yet most studies fail to distinguish these. For drought responses to be effective, there is a need to distinguish short term mitigation measures such as institutional drought relief programmes from long-term adaptation measures such as dam and borehole construction to improve infrastructure.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/land11020159/s1, Table S1: List of 18 publications considered in the review.

Author Contributions: S.R.: Conceptualisation, Funding acquisition, Validation, Writing— original draft, Writing—review & editing; G.T.: Validation, Writing—original draft, Writing—review & editing; M.F.: Validation, Writing—original draft, Writing—review & editing. All authors have read and agreed to the published version of the manuscript.

Funding: Funding for the review writing workshop were provided through the strategic internationalisation project between Sweden and South Africa in research, education and innovation (SASUF).

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Data available on request from the authors.

Acknowledgments: The authors acknowledge Chenai Murata for editorial comments.

Conflicts of Interest: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

1. IPCC. Summary for policymakers. In *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*; Cambridge University Press: Cambridge, UK, 2021.
2. Naumann, G.; Cammalleri, C.; Mentaschi, L.; Feyen, L. Increased economic drought impacts in Europe with anthropogenic warming. *Nat. Clim. Chang.* **2021**, *11*, 485–491. [CrossRef]
3. Van Loon, A.F.; Gleeson, T.; Clark, J.; Van Dijk, A.I.; Stahl, K.; Hannaford, J.; Di Baldassarre, G.; Teuling, A.J.; Tallaksen, L.M.; Uijlenhoet, R.; et al. Drought in the Anthropocene. *Nat. Geosci.* **2016**, *9*, 89–91. [CrossRef]
4. United Nations Office for Disaster Risk Reduction (UNDRR). *GAR Special Report on Drought 2021*; United Nations Office for Disaster Risk Reduction: Geneva, Switzerland, 2021.
5. Olagunju, A.; Thondhlana, G.; Chilima, J.S.; Sène Harper, A.; Compaoré, W.R.N.; Ohiozebau, E. Water governance research in Africa: Progress, challenges and an agenda for research and action. *Water Int.* **2019**, *44*, 382–407. [CrossRef]
6. Shiferawa, B.; Tesfaye, K.; Kassie, M.; Abate, T.; Prasanna, B.M.; Menkir, A. Managing vulnerability to drought and enhancing livelihood resilience in sub-Saharan Africa: Technological, institutional and policy options. *Weather Clim. Extremes* **2014**, *3*, 67–79. [CrossRef]
7. Bundy, C. *The Rise and Fall of the South African Peasantry*, 2nd ed.; David Philip: Cape Town, South Africa, 1988.
8. Baudoin, M.-A.; Vogel, C.; Nortje, K.; Naik, M. Living with drought in South Africa: Lessons learnt from the recent El Niño drought period. *Int. J. Disaster Risk Reduct.* **2017**, *23*, 128–137. [CrossRef]
9. Sousa, P.M.; Blamey, R.C.; Reason, C.J.C.; Ramos, A.M.; Trigo, R.M. The 'Day Zero' Cape Town drought and the poleward migration of moisture corridors. *Environ. Res. Lett.* **2018**, *13*, 124025. [CrossRef]
10. Agri SA. *A Raindrop in the Drought: Report to the Multi-Stakeholder Task Team on the Drought*; Agri SA's Status Report; Agri SA: Pretoria, South Africa, 2016.
11. Dessus, S.; Tovey, C.S. *El Nino Drought in SADC: Economic Impacts and Potential Mitigation Solutions*; Presented at El Nino High Level Round Table; UN Office for the Coordination of Humanitarian Affairs (UNOCHA): London, UK, 2016.
12. Edossa, D.C.; Woyessa, Y.E.; Welderufael, W.A. Analysis of droughts in the central region of South Africa and their association with SST anomalies. *Int. J. Atmos. Sci.* **2014**, *2014*, 508953. [CrossRef]
13. Frischen, J.; Meza, I.; Rupp, D.; Wietler, K.; Hagenlocher, M. Drought risk to agricultural systems in Zimbabwe: A spatial analysis of hazard, exposure, and vulnerability. *Sustainability* **2020**, *12*, 752. [CrossRef]
14. Giannini, A.; Krishnamurthy, P.K.; Cousin, R.; Labidi, N.; Choularton, R.J. Climate risk and food security in Mali: A historical perspective on adaptation. *Earth's Future* **2017**, *5*, 144–157. [CrossRef]
15. Bhaga, T.D.; Dube, T.; Shekede, M.D.; Shoko, C. Impacts of climate variability and drought on surface water resources in Sub-Saharan Africa using remote sensing: A review. *Remote Sens.* **2020**, *12*, 4184. [CrossRef]
16. Swemmer, A.M.; Bond, W.J.; Donaldson, J.; Hempson, G.P.; Malherbe, J.; Smit, I.P.J. The ecology of drought—A workshop report. *S. Afr. J. Sci.* **2018**, *114*, 1–3. [CrossRef]
17. Parks, R.; Mclaren, M.; Toumi, R.; Rivett, U. *Experiences and Lessons in Managing Water from Cape Town*; Grantham Institute Briefing Paper 29; Imperial College London: London, UK, 2019.
18. Solh, M.; Van Ginkel, M. Drought preparedness and drought mitigation in the developing worlds drylands. *Weather Clim. Extremes* **2014**, *3*, 62–66. [CrossRef]
19. Williams, P.A.; Crespo, O.; Abu, M.; Simpson, N.P. A systematic review of how vulnerability of smallholder agricultural systems to changing climate is assessed in Africa. *Environ. Res. Lett.* **2018**, *13*, 103004. [CrossRef]
20. Crossman, N.D. *Drought Resilience, Adaptation and Management Policy (DRAMP) Framework Supporting Technical Guidelines*; UNCCD: Bonn, Germany, 2018.
21. Dai, A. Drought under global warming: A review. *WIREs Clim. Chang.* **2011**, *2*, 45–65. [CrossRef]
22. Zhou, H.; Wang, X.; Wang, J. A way to sustainability: Perspective of resilience and adaptation to disaster. *Sustainability* **2016**, *8*, 737. [CrossRef]
23. Van Averbeke, W.; Denison, J.; Mnkeni, N. Smallholder irrigation schemes in South Africa: A review of knowledge generated by the Water Research Commission. *Water SA* **2011**, *37*, 797–808. [CrossRef]
24. Herrero, M.; Thornton, P.K.; Bernués, A.; Baltenweck, I.; Vervoort, J.; Van De Steeg, J.; Makokha, S.; Van Wijk, M.T.; Karanja, S.; Rufino, M.C.; et al. Exploring future changes in smallholder farming systems by linking socio-economic scenarios with regional and household models. *Glob. Environ. Chang.* **2014**, *24*, 165–182. [CrossRef]
25. Muimba-Kankolongo, A. *Food Crop Production by Smallholder Farmers in Southern Africa: Challenges and Opportunities for Improvement*; Academic Press: London, UK, 2018.
26. Antonaci, L.; Demeke, M.; Vezzani, A. *The Challenges of Managing Agricultural Price and Production Risks in Sub-Saharan Africa*; ESA Working Paper; FAO: Rome, Italy, 2014.
27. Nyambo, D.G.; Luhanga, E.T.; Yonah, Z.Q. A review of characterization approaches for smallholder farmers: Towards predictive farm typologies. *Sci. World J.* **2019**, *2019*, e6121467. [CrossRef] [PubMed]
28. Saint Ville, A.S.; Hickey, G.M.; Phillip, L.E. Addressing food and nutrition insecurity in the Caribbean through domestic smallholder farming system innovation. *Reg. Environ. Chang.* **2015**, *15*, 1325–1339. [CrossRef]
29. Tembo, G.; Tembo, A.; Goma, F.; Kapekele, E.; Sambo, J. Livelihood activities and the role of livestock in smallholder farming communities of Southern Zambia. *Open J. Soc. Sci.* **2014**, *2*, 299. [CrossRef]

30. Lowder, S.K.; Skoet, J.; Raney, T. The number, size, and distribution of farms, smallholder farms, and family farms worldwide. *World Dev.* **2016**, *87*, 16–29. [CrossRef]
31. Zantsi, S.; Mack, G.; Mann, S. Cultural innovation, aspirations and success among smallholders in former homelands of the Eastern Cape province of South Africa: Theory and evidence. *Int. J. Soc. Econ.* **2020**, *47*, 404–422. [CrossRef]
32. Davenport, N.A.; Gambiza, J. Municipal commonage policy and livestock owners: Findings from the Eastern Cape, South Africa. *Land Use Policy* **2009**, *26*, 513–520. [CrossRef]
33. Davenport, N.A.; Shackleton, C.M.; Gambiza, J. The direct use value of municipal commonage goods and services to urban households in the Eastern Cape, South Africa. *Land Use Policy* **2012**, *29*, 548–557. [CrossRef]
34. von Loeper, W.; Musango, J.; Brent, A.; Drimie, S. Analysing challenges facing smallholder farmers and conservation agriculture in South Africa: A system dynamics approach. *S. Afr. J. Econ. Manag. Sci.* **2016**, *19*, 747–773. [CrossRef]
35. Lottering, S.J.; Mafongoya, P.; Lottering, R. The impacts of drought and the adaptive strategies of small-scale farmers in uMsinga, KwaZulu-Natal, South Africa. *J. Asian Afr. Stud.* **2021**, *56*, 267–289. [CrossRef]
36. Devereux, S. The impact of droughts and floods on food security and policy options to alleviate negative effects. *J. Agric. Econ.* **2007**, *37*, 47–58. [CrossRef]
37. Davenport, N.; Gambiza, J.; Shackleton, C.M. Use and users of municipal commonage around three small towns in the Eastern Cape, South Africa. *J. Environ. Manag.* **2011**, *92*, 1149–1460. [CrossRef] [PubMed]
38. Arksey, H.; O'Malley, L. Scoping studies: Towards a methodological framework. *Int. J. Soc. Res. Methodol.* **2005**, *8*, 19–32. [CrossRef]
39. Tricco, A.C.; Lillie, E.; Zarin, W.; O'Brien, K.; Colquhoun, H.; Kastner, M.; Levac, D.; Ng, C.; Sharpe, J.P.; Wilson, K.; et al. A scoping review on the conduct and reporting of scoping reviews. *BMC Med. Res. Methodol.* **2016**, *16*, 1–10. [CrossRef]
40. Myburgh, D.W. The response of farmers to the drought hazard in the Karoo environment. *GeoJournal* **1994**, *33*, 401–410.
41. O'Farrell, P.J.; Anderson, P.M.L.; Milton, S.J.; Dean, W.R.J. Human response and adaptation to drought in the arid zone: Lessons from southern Africa. *S. Afr. J. Sci.* **2009**, *105*, 34–39.
42. Schreiner, B.; Mungatana, E.; Baleta, H. *Impacts of Drought Induced Water Shortages in South Africa: Economic Analysis*; Water Research Commission Report; Water Research Commission (WRC): Pretoria, South Africa, 2018.
43. Falayi, M.; Gambiza, J.; Schoon, M. A scoping review of environmental governance challenges in Southern Africa from 2010 to 2020. *Environ. Conserv.* **2021**, *48*, 235–243. [CrossRef]
44. Mpandeli, S.; Nesamvuni, E.; Maponya, P. Adapting to the impacts of drought by smallholder farmers in Sekhukhune District in Limpopo Province, South Africa. *J. Agri. Sci.* **2015**, *7*, 115. [CrossRef]
45. Vetter, S.; Goodall, V.; Alcock, R. Effect of drought on communal livestock farmers in KwaZulu-Natal, South Africa. *Afr. J. Range Forage Sci.* **2020**, *37*, 93–106. [CrossRef]
46. Ngcamu, B.S.; Chari, F. Drought influences on food insecurity in Africa: A systematic literature review. *Int. J. Environ. Res. Public Health* **2020**, *17*, 5897. [CrossRef] [PubMed]
47. FAO. *The Impact of Disasters and Crises on Agriculture and Food Security*; Food and Agriculture Organization of the United Nations: Rome, Italy, 2018.
48. Epstein, A.; Benmarhnia, T.; Weiser, S.D. Drought and illness among young children in Uganda, 2009–2012. *Am. J. Trop. Med. Hyg.* **2020**, *102*, 644–648. [CrossRef]
49. Bahta, Y.T. Smallholder livestock farmers coping and adaptation strategies to agricultural drought. *AIMS Agric. Food.* **2020**, *5*, 964–982. [CrossRef]
50. Rakgwale, T.J.; Oguttu, J.W. The impact of the 2014–2016 drought in Greater Letaba Local Municipality: How the farmers coped and factors that were significantly associated with loss of animals. *Int. J. Disaster Risk Reduct.* **2020**, *50*, 101869. [CrossRef]
51. Bahta, Y.T.; Jordaan, A.; Muyambo, F. Communal farmers' perception of drought in South Africa: Policy implication for drought risk reduction. *Int. J. Disaster Risk Reduct.* **2016**, *20*, 39–50. [CrossRef]
52. Kom, Z.; Nethengwe, N.S.; Mpandeli, N.S.; Chikoore, H. Determinants of small-scale farmers' choice and adaptive strategies in response to climatic shocks in Vhembe District, South Africa. *GeoJournal* **2020**, *85*, 1–24. [CrossRef]
53. Ngaka, M.J. Drought preparedness, impact and response: A case of the Eastern Cape and Free State provinces of South Africa: Original research. *Jàmbá—J. Disaster Risk Stud.* **2012**, *4*, 1–10. [CrossRef]
54. Matlou, R.; Bahta, Y.T.; Owusu-Sekyere, E.; Jordaan, H. Impact of agricultural drought resilience on the welfare of smallholder livestock farming households in the Northern Cape Province of South Africa. *Land* **2021**, *10*, 562. [CrossRef]
55. Austin, W.D. Drought in South Africa: Lessons Lost and/or Learnt From 1990 to 2005. Master's Thesis, University of the Witwatersrand, Johannesburg, South Africa, 2008.
56. Jordaan, A.; Bahta, Y.T.; Phatudi-Mphahlele, B. Ecological vulnerability indicators to drought: Case of communal farmers in Eastern Cape, South Africa. *Jàmbá—J. Disaster Risk Stud.* **2019**, *11*, a591. [CrossRef] [PubMed]
57. Maponya, P.; Mpandeli, S. Climate change and agricultural production in South Africa: Impacts and Adaptation options. *J. Agri. Sci.* **2012**, *4*, 48. [CrossRef]
58. Jordaan, A.J.; Sakulski, D.; Jordaan, A.D. Interdisciplinary drought risk assessment for agriculture: The case of communal farmers in the Northern Cape Province, South Africa. *S. Afr. J. Agric. Ext.* **2013**, *41*, 44–58.
59. Gobler, C.J. Climate change and harmful algal blooms: Insights and perspective. *Harmful Algae* **2020**, *91*, 101731. [CrossRef]
60. Keshavarz, M.; Karami, E.; Vanclay, F. The social experience of drought in rural Iran. *Land Use Policy* **2013**, *30*, 120–129. [CrossRef]

61. Vilakazi, B.S.; Zengeni, R.; Mafongoya, P. Indigenous strategies used by selected farming communities in KwaZulu Natal, South Africa, to manage soil, water, and climate extremes and to make weather predictions. *Land Degrad. Dev.* **2019**, *30*, 1999–2008. [CrossRef]
62. Makaya, E.; Rohse, M.; Day, R.; Vogel, C.; Mehta, L.; McEwen, L.; Rangecroft, S.; Van Loon, A.F. Water governance challenges in rural South Africa: Exploring institutional coordination in drought management. *Water Policy* **2020**, *22*, 519–540. [CrossRef]
63. Muthelo, D.; Owusu-Sekyere, E.; Ogundeji, A.A. Smallholder farmers' adaptation to drought: Identifying effective adaptive strategies and measures. *Water* **2019**, *11*, 2069. [CrossRef]
64. Muyambo, F.; Jordaan, A.J.; Bahta, Y.T. Assessing social vulnerability to drought in South Africa: Policy implication for drought risk reduction. *Jàmbá—J. Disaster Risk Stud.* **2017**, *9*, a326. [CrossRef] [PubMed]
65. Foeken, D.W.J.; Ouwor, S.O. Farming as a livelihood source for the urban poor of Nakuru, Kenya. *GeoForum* **2008**, *39*, 1978–1990. [CrossRef]
66. Shackleton, C.M.; Guild, J.; Bromham, B.; Impey, S.; Jarrett, M.; Ngubane, M.; Steijl, K. How compatible are urban livestock and urban green spaces and trees? An assessment in a medium-sized South African town. *Int. J. Sustain. Urban Dev.* **2017**, *9*, 243–252. [CrossRef]