Evolution of the Land Consolidation System in China

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1. Introduction

It is widely accepted that fragmented land ownership tends to decrease farmland productivity (Pašakarnis and Maliene 2010; Latruffe and Piet 2014; Jürgenson 2016; Zang et al. 2019). As a result, the concept of land consolidation appeared in the 14th century in Europe (Demetriou et al. 2012; Liu and Zhao 2017). It was originally designed as an agriculture-oriented policy tool and defined as readjustment and reallocation of arable land parcels to improve their quality and quantity (Vitikainen 2004; Pašakarnis and Maliene 2010; Hiironen and Riekkinen 2016; Zhou et al. 2020).

However, this traditional understanding of land consolidation has evolved due to the development of the modern society. Alongside the urbanization and industrialization processes, a large extension of land is in need of urban infrastructure construction and urban planning, which gives incentive to reorganize the rural land (Tan and Zhou 2015; R. Wang et al. 2019). Besides, rural–urban inequity also raises the demand for modernization in rural areas (Crecente et al. 2002; Liu 2014). Furthermore, the protection of the living conditions and ecological environment calls for an urgent care of rural land use (Foster et al. 2003). All these issues can be solved also by means of land rearrangement. In the 1990s, some western European countries started to regard land consolidation as a tool to fulfill public demands (Pašakarnis and Maliene 2010). Then, land consolidation was promoted as an indispensable measure for integrated rural development (Thomas 2006).

Though many developing countries have implemented land consolidation policies, not all of these practices achieved the expected results (van Dijk 2007; Janus and Markuszewska 2017). Policy-makers may face heterogeneous social obstacles such as lack of public participation, overregulation by the government, lack of government capacity, food security issues, or problems related to undeveloped rural regions (Lisec et al. 2014; Djanibekov and Finger 2018; Ahmed et al. 2018; Nguyen and Warr 2020). This makes cross-regional policy comparisons extremely difficult. The literature is clear that certain land consolidation policies can play an important role in the rural society. However, further study is still in need to illustrate the mechanisms of different policies. Then, is it possible to find an

effective medium to estimate and compare the economic, social, and ecological functions of multi-purposed land consolidation policies under a similar background in stimulating sustainable development? Interestingly, as a transitioning country, China has experienced a complex situation in land management, and may provide suitable examples.

China has a long history of land consolidation, dating back to the 10th century BC, and land consolidation programs started soon after the funding of the People's Republic of China in the 1950s (Lu 2002; Huang et al. 2011). However, for decades, land consolidation in China was only regarded as an agriculture-focused instrument without considering its social, economic, and ecological functions. For example, in the era of planning economy, farmland consolidation was widely implemented as a supporting policy of people's commune. That is to say, modern land consolidation in China did not exist until the 1980s (Jiang et al. 2015; Long et al. 2019; Zhou et al. 2020). Since the reform and opening in 1978, rapid urbanization and industrialization in China have greatly changed the traditional small-farmer society in rural areas. Thus, land consolidation is no longer a simple agricultural approach, and new technologies and administrative methods have emerged. In the past 30 years, land consolidation in China, guided by the central government and implemented nationwide, has evolved greatly and faced different issues, including food security, rural development, political trade-off, and environmental problems.

The transition of the land consolidation system in China provides insights into the patterns of institutional change and policy performance. During the past 30 years of urbanization, China encountered similar social problems as many other countries, including food security, rural decline, and environmental loss (Liu 2014; Long 2014; Liu and Li 2017; D. Wang et al. 2019). The land consolidation policy was altered over time, whereas the basic institutional framework has remained unchanged. Under these circumstances, the evolution of certain policies reflects not only the purpose of policy-makers but also the response of the society. Hence, different policies can be discussed in the same context, especially to examine their working mechanism and driving force. By illustrating the evolution process of China's land consolidation system and contrasting the motivation, characteristics, and performance of each stage, this study aims at answering the following two questions: (a) how the land consolidation policy worked and performed in China; (b) why the previous system shifted to another one and what the characteristics of the institutional change are.

With these tasks, this research traces back the formation and evolution of the land consolidation system in the past 20 years. The form and method of land consolidation in China varies by region and by time. It is therefore inappropriate to

compare local practices directly across time periods. Instead, a temporal-sequence study of country-level policies can abstract the perception and target of central decision-makers. Based on official laws, policies, and reports, this paper adopted a qualitative policy analysis approach. The institutional changes of land consolidation system were identified and characterized to find the internal mechanism of rural land use-related policies.

In an international perspective, it is also necessary and worthwhile to clarify how the Chinese land consolidation system works and why it changed through time. On the one hand, the problems and demands that China faced are applicable to many developing countries, such as agricultural decline and the social-ecological land use problem. The policies implemented in China can serve as a "toolbox" which can be used by policy-makers to formulate rural land plans. On the other hand, the transition experience of industrialization, urbanization, privatization, and marketization in China is also beneficial to other transitioning countries, especially in South Asia and Central and Eastern Europe. With economic growth and social transformation, those countries should tailor their land management policy accordingly. Likewise, the pattern of institutional change in China can also provide a learnable example to avoid social conflict and maintain a sustainable rural development.

2. Literature Review

The function of land consolidation is tightly linked to the arable land fragmentation issue. Many studies pointed out that unfavorable size and unsuitable shape of farmland are detrimental to agricultural production, as they increase the cost of organization and production and decrease the possibility of agricultural innovation (Thomas 2006; Latruffe and Piet 2014; Hartvigsen 2014; Sklenicka et al. 2014). Some other researchers illustrated that the fragmented farmland and property right may be tragic for the commons and reduce the investment incentive of farmers (Zang et al. 2019). On the other hand, some researchers argue that proper land fragmentation can increase the biodiversity and reduce risks for farmers (Ciaian et al. 2018; Ntihinyurwa et al. 2019). However, it is still widely accepted that the land fragmentation issue should be governed especially in developing countries including Central and Eastern Europe, Asia, and Africa (Hartvigsen 2014; Zang et al. 2019), which calls for the implementation of land consolidation.

In land fragmentation research, land consolidation studies mainly focus on the evaluation of procedures and effects. Many researches have primarily concentrated on its influence on agricultural productivity, using a quantitative method. Wan and Cheng (2001) estimated that the exogenous addition of one plot results in a reduction

of annual crop output of 2 to 10 percentage points. Rahman and Rahman (2009) analyzed the rice production in Bangladesh by means of the stochastic production frontier framework and indicated that a 1% increase in land fragmentation would reduce the rice output by 0.05%. Hiironen and Riekkinen (2016) estimated the expected cost and benefit of a land consolidation program in Finland which reduced the average production cost by 15% and fulfilled a positive net value. Lai et al. (2015) indicated, through an econometric analysis of north China, that the consolidation of 2.28 plots into 1 plot can increase machinery use by 10% and crop output by 0.5–1%. Most of these studies revealed a positive relationship between land consolidation and crop yield. Colombo and Perujo-Villanueva (2019) indicated that land consolidation brought about a more stable property structure and saved production costs by 5.8% to 15.3% (Colombo and Perujo-Villanueva 2019). Janus and Markuszewska (2019) proved that land consolidation can still improve farmland quality and reduce land abandonment in the long term.

While land consolidation policies have become increasingly diverse, more and more scholars are setting their sight on rural transition and non-farm sector development, especially in Eastern and South Asia. Otsuka et al. (2013) suggested that Asian governments should support land consolidation programs to decrease the average production costs according with wage growth (Otsuka et al. 2013). Nguyen and Warr (2020) used panel data for Vietnam to figure out that land consolidation encouraged more rural labor to participate in non-farm sectors, which stimulate rural development. Many studies in China also presented similar results. Tan et al. (2008) observed that the separate land property right gave rise to rural labor price, and land consolidation may motivate rural resident to move to urban areas. Liu and Li (2017) found that under the trend of urbanization and attendant rural decline, rural workers and immigrants might suffer from limited knowledge and low income, while land leveling and assorted agricultural infrastructure construction projects improved rural conditions and provided more chance in rural area.

Other researchers focused on the social effect of land consolidation programs. In Eastern and Central Europe, communism during the national land privatization process influenced farmers' attitude towards land consolidation (Pašakarnis and Maliene 2010). van Dijk (2007) demonstrated the relationship between personal identity, social emotional bonds, and land property right in Central Europe and pointed out the inadequacy of traditional land consolidation policies. A research in Estonia also supported this view, indicating that land consolidation transactions violated the non-economic motivations of farmers and prevented the conservation of social capital (Grubbström 2011).

Recently, the ecological system is becoming a new perspective of land consolidation studies. A study in Galicia showed that land consolidation which increases the use of fertilizers and pesticides is harmful to the local landscape (Crecente et al. 2002). In recent years, many researches estimated the ecological influence of land consolidation by landscape ecology methods. Guo et al. (2020) indicated the long-term ecological benefit of land consolidation programs based on remote sensing. Zhong et al. (2020) implied that land consolidation programs can improve soil conservation services in Southeast China. Meanwhile, some scholars also argued that the ecological equality in China will degenerate in the overall process, even though restoration approaches of land consolidation can improve the ecological performance in certain periods (Shan et al. 2019). These inconsistent conclusions reflect the diverse ecological impact of land consolidation programs in different natural–social context.

Moreover, the topic of the organization and institution of land consolidation programs is also widely discussed. Lisec et al. (2014) figured out that a better perception of the landowner increases the possibility of land consolidation, which calls for better public participation. Haldrup (2015) introduced an agreement-based land consolidation mode which granted non-state sectors including NGOs and landowners a stronger voice in negotiation in order to satisfy the local interest. Ahmed et al. (2018) indicated that chiefs in Ghana played a negative role in achieving the public interest, going beyond a legal land management system. In Uzbekistan, the cotton production-oriented land consolidation process was controlled by the state, which increased the production risk and reduced farm incomes (Djanibekov and Finger 2018). Zhang et al. (2019b) provided evidence from China to prove that the internal opportunity and ability of farmer decides the performance of land use, while self-organization with sufficient government facilitation can effectively stimulate land consolidation projects. Another research in southwest China introduced a new consolidation method, in which agricultural companies can lease scattered farmlands from farmers and implement land consolidation projects to develop a mechanized agriculture (Zhang et al. 2019a). Besides the discussion of centralization and decentralization, these researches further provide a glimpse into the relationship between local background and institutional arrangement.

Virtually, it can be concluded that land consolidation projects all over the world have experienced three stages, from an agricultural focus to a rural society focus and eventually concentrating on ecosystem conservation. This is apparently according to the demands in different developing countries. However, though the international literature on land consolidation provides a possibility to compare the performance of

different policies, it is still difficult to compare cases in heterogeneous backgrounds. For example, weak government power, lack of property right rules, and insufficient technology are the main obstacles in Africa (Ahmed et al. 2018), while East Asian countries are facing the process of urbanization and rural decline (Liu and Li 2017), and South Asian countries are facing the conflict of a growing population and a limited non-farm labor demand (Rahman and Rahman 2009; Nguyen and Warr 2020). Hence, the mechanisms and characteristics of different land consolidation institutions have not been investigated. However, the different stages of development of China's land consolidation policy happen to provide an opportunity for comparing results from different systems.

In the Chinese context, the land consolidation issue has attracted increasing attention in recent years. The related literature is continuously growing. Research has discussed in depth the relative performance of the Chinese land consolidation system mentioned above, including agricultural output (Wan and Cheng 2001; Jiang et al. 2015; Liu and Li 2017), rural development (Tan et al. 2008; Liu and Zhao 2017; R. Wang et al. 2019), soil erosion (Fan 2006; Gao and Liu 2010), and ecological service (Liu et al. 2019; Zhong et al. 2020). Newly emerging local practices have also been introduced, such as collective self-organization and market-led transactions (Zhang et al. 2019a, 2019b). However, most of these studies are limited at the regional level in a certain period and lack a comprehensive investigation at the national level. In other words, after 20 years of implementing a land consolidation policy, it remains to be discussed how the national system has influenced rural land utilization and why this system has been significantly modified. It is vital to clarify the impact by different institutions at different stages, considering the significant institutional changes that occurred in the past. A few studies have tried to identify different stages of the Chinese land consolidation policy (Long et al. 2019; Zhou et al. 2020), but the feature and developing path of each stage remain unclear. This study therefore argues that previous land consolidation studies have focused on the impact on single aspects and may ignore how the land consolidation system itself was planned and transformed.

3. Background and Concept

3.1. Understanding the Modern Land Consolidation System

Land consolidation can achieve several sustainable development goals (SDGs) to face the risks of food, security safety, environment, and poverty (United Nations 2015) (Table 1). Although land consolidation projects always take place in rural areas, they influence both the urban and the rural society (Louwsma et al. 2017; D.

Wang et al. 2019). While clean, safe, and sufficient food provisions are threated by urbanization and industrialization, land readjustment and rearrangement increase the productivity of arable land and contribute to SDG 2 (Zero huger) (Jin et al. 2017). The vitalization of agriculture not only increases the income of farmers, but also promotes an equal distribution of benefits among the relative stakeholders, which supports SDG 1 (No poverty) and SDG 10 (Reducing Inequity) (Pašakarnis and Maliene 2010). Moreover, since land consolidation reshapes the rural society, the rural living environment and social welfare (SDG 3, 4, and 6) improve (Lu et al. 2019). In urban development, land consolidation also provides an economized way of land assembly in order to facilitate peri-urbanization and urban redevelopment (SDG 11) (Louwsma et al. 2017). Notably, a proper land use arrangement can also contribute to SDG 15 (Life on land) by reducing land degradation and conserving biodiversity (Liu et al. 2019).

There are multiple cases to verify the relationship between land consolidation and sustainable development. In Ghana, the government advocated an agricultural reform to combine small parcels into a mechanized farmland, which continuously increased the rural production efficiency and diversity, eradicated extreme hunger, and reduced poverty by half (Ecker 2018). In Vietnam, land consolidation projects encouraged farmers to participate in the off-farm labor market and increased off-farm income, which could contribute to the rural–urban equity (Nguyen and Warr 2020). In Latvia, the implementation of land consolidation projects led to the improvement of the rural living conditions, including less soil erosion, better draining facilities, less air pollution, and better biodiversity conservation (Jankava and Gečaitė 2017). In Western Europe, land consolidation projects stimulated rural recreation and agro-tourism during water governance, serving as an auxiliary approach to developing rural economy and infrastructures (Stańczuk-Gałwiaczek et al. 2018). In north India, land consolidation not only created the conditions for the construction of rural hospitals, educational facilities, and affordable housing, but also protected and restored natural habitats through planning and provided rural public transportation facilities (Munnangi et al. 2020).

Table 1. Sustainable development goals (SDGs) and land consolidation. Source: Own illustration.

SDG	Target	Possible Land Consolidation Activities Contributing to SDG
1	No poverty	Develop mechanized and modernized agriculture to improve rural income; Create rural non-farm sector jobs to increase income
2	Zero hunger	Increase agricultural productivity and diversity
3	Good health and well-being	Provide space for rural public health, transportation facilities construction; Renew rural housing and improve rural landscape;
4	Quality education	Provide space for rural school construction
6	Clean water and sanitation	Demarcate the boundaries of wetlands, rivers, and lakes to conserve natural resources
10	Reduce inequity	Guarantee the welfare and property right of farmers; Vitalize rural industry to reduce the rural–urban gap
11	Sustainable cities and communities	Stimulate peri-urbanization and urban redevelopment; Enrich social capital in rural communities;
15	Life on land	Arrange conservation and restoration projects to protect biodiversity

Therefore, in recent years, the concept of land consolidation has been comprehensively expanded, covering economy, administration, engineering, and legislation (Long 2014; Zhou et al. 2020). Multiple land financing initiatives and the property market expand the possibilities of consolidation programs (Hartvigsen 2014). Besides, the abundant technological approaches, including assessment, planning, construction, and ex-post evaluation, enable land consolidation projects to improve the machinery, ameliorate land production conditions, and conserve the ecosystem (Liu and Zhao 2017; Mika et al. 2019; Shan et al. 2019). Moreover, the diverse legislation and administration modes, such as state-led, market-led, and self-organized, can inspire farmers to participate in land consolidation (Tang et al. 2017; Zhang et al. 2019a, 2019b).

The modern land consolidation system has already been applied all around the world not only to improve agricultural efficiency but also to achieve other goals including agricultural modernization, interregional equity, and sustainability (Long et al. 2019). Even though land consolidation in different regions has diverse

purposes, empirical practice shows that it is an effective tool to improve the agricultural output, promote the local economy, and protect the environment. (Demetriou et al. 2012; Janus and Markuszewska 2019; Zhou et al. 2019).

3.2. China's Concerns on Land Issues

As the most populous country in the world, China has a comparatively limited land resource. The arable land area per capita is only one-fourth of the world average. Moreover, the rapid economic growth and urbanization gave rise to the decline of cultivated land and fragmented land holdings (Xu 2004; Lai et al. 2015). Both the expansion of urban area and the blowout of township enterprises created more demands for construction land. As a result, while the urbanization rate grew from 17.92% to 24.52%, 3.13 million hectares of farmland quickly disappeared between 1980 to and (National Bureau of Statistic of China 1987). In addition, the increasing population and the changing diet structure might even exacerbate the existing pressure on food demand (Wang et al. 2018). This phenomenon has soon attracted the attention of the central government, mainly because of the food security issue associated with the shrinkage of agricultural land.

Notably, the decline of arable land is closely related to the Chinese public land ownership system, which is characterized as a rural–urban dual management system (Long et al. 2010; Tan et al. 2011). The government monopolizes the construction land resource in the primary land market, which means the central and state governments are the only legal providers of new urban construction land. Hence, to meet the demands of the rapid economic and urban growth, local governments tend to implement a large numbers of land acquisition programs (Y. Li et al. 2018; L. Wang et al. 2019). In addition, since the compensation for farmers is comparatively much lower than the price of land, local governments as the main operators can obtain an enormous financial income in the acquisition process. As a result, some policy-makers transferred more cultivated land, exceeding the real demand of development, for local governments' interest (Tan and Zhou 2015).

In the pursuit of preventing the over-occupation of arable land, a series of policies were introduced. In 1986, the State Council of China determined "cherishing and rationally using every inch of land and protecting the cultivated land" as a basic state policy (State Council of People's Republic of China 1986) and set up the Land Administration Bureau which is responsible for national land management affairs in China. In June of the same year, the first special law on land, the Law of Land Administration (LLA), was approved by the central government. For the first time, land consolidation was defined as farmland development and reclamation. In 1987,

based on these strategy and policy, a land development meeting was held in Liaoning, advocating more land development to maintain the area of arable land, followed by pilots projects carried out by several provincial governments. From then on, even though most of the consolidation processes were still conducted at grassroots level, arable land protection started (Yun et al. 2016).

However, even though the central government had already noticed the advantage of land consolidation in resuming agricultural production, improving agricultural infrastructure, and keeping farmland area, there was no specific law or related department to govern the national land consolidation process. For a long time, land consolidation in the LLA was just a principle definition without any compulsory requirement or practical guidance (Huang et al. 2011).

The public opinion and social problems in the middle 1990s further magnified the government concerns on food security. In 1994, Lester Brown wrote his famous article "Who will feed China" to express his worries about China's food self-sufficiency and the potential global food crisis (see Brown 1994). The aerial picture of 31 main cities in China in 1996 showed that non-agricultural construction land had expanded rapidly, and arable land had been unexpectedly over-occupied. Consequently, the central government was eager to strengthen a centralized control on land.

3.3. The Formation of the Modern Land Consolidation System in China

China's truly modern land consolidation system was established in 1997. After 10 years of practice, over 400 counties had operated land consolidation by the end of 1997 (Land Rehabilitation and Consolidation Center 2014). Considering their comparatively limited scale, these practices did not affect the whole picture of the reduction in arable land. Having said that, local rulers developed some successful strategies and accumulated a lot of experience from them.

Three major events marked its birth. At the administrative level, the former Land Administrative Bureau was reorganized into the Ministry of Land and Resources of China (MLRC), and a specified department for land consolidation was established. The new department, the National Land Consolidation and Rehabilitation Center, which has also provincial and municipal branches, is responsible for all the related affairs, including initiating national land consolidation projects, providing technical guidance for local land consolidation, managing land consolidation and restoration funds, and conducting engineering and technical research.

At the institutional level, the land use planning system, also known as the land use regulation system, was formulated. The beginning of this system was in 1997, when *The Notice on Further Strengthening Land Management and Practically*

Protecting Cultivated Land called for the implementation of a policy that "links the occupation of cultivated land with development and rehabilitation" (State Council of People's Republic of China 1997). In 1998, this *Dynamic Equilibrium of Total Farmland* system was set up. To further illustrate it, it states that the amount of cultivated land transformed into construction land should not exceed the amount of land reclamation in that region. Based on it, China adopted a set of planning policies which constituted a unified and top–down land use quota system (Tan and Zhou 2015). Three main quotas were designed by the central government and allocated to governments at different levels, covering the maximum of construction land, the minimum of cultivated land, as well as the annual amount of land-use change from farmland to construction land (Tan and Beckmann 2010). All of these quotas focused on farmland. To put it in another way, in this nationwide top-down land planning system, the number of farmlands was the crucial factor which strictly constrained urban expansion and rural modernization. As a key part of restoring and even developing new arable land, land consolidation was soon accepted and implemented.

At the legal level, the LLA was amended in 1998. This document stated that "the State encourages land consolidation", and indicated land consolidation as an indispensable part of the land use planning system. The *Land Management Law Implementation Regulations,* amended later, required that "county- and township-level governments should set up rural collective economic organizations to formulate land consolidation programs in accordance with the overall land use planning" (State Council of People's Republic of China 1998). During this period, MLRC established the first batch of land development and demonstration zones in 20 provinces. Therefore, land consolidation has become an important part of the land use planning system and is gradually evolving into a mature administrative system.

Nowadays, land consolidation has been a comprehensive approach to managing cultivated land. Even though different scholars may have diverse definitions, it is widely accepted in the Chinese academic circle that land consolidation is far beyond simple agricultural production (Zhang et al. 2014; Long 2014; Wang and Zhong 2016; Yun et al. 2016). According to the LLA of 1998, land consolidation is defined as

> the governments at the county and township (town) level, who should organize rural collective economic organizations to comprehensively develop farmland, water, roads, forests, and villages, improve cultivated land quality, increase the effective arable land area, improve agricultural production conditions and the ecological environment in accordance with the overall land use plan. (National People's Congress of People's Republic of China 1998, article 41)

Obviously, both researchers and governments notice the social-economic and ecological functions of land consolidation, such as rural growth, environment protection, and sustainable development. There are some key characters of modern land consolidation: multiple elements including administration, economy, law, and engineering transform and optimize local land use, in accordance with multiple goals and land use planning or urban planning.

3.4. Key Factors of China's Modern Land Consolidation System

While the socio-economic environment changed greatly in the past 40 years, land use in China has also faced a significant change, which has diversified the motivation of land consolidation. Besides the traditional aim of food production, there are five main motivations that play important roles in the establishment and evolution of the modern land consolidation system (Table 2).

Firstly, the demand for industrialization and urbanization still exists, and the sufficient supply of construction land is a crucial reason of the economic miracle of the past 40 years (Ding 2003; Liu 2014). Under the red-line control of land use planning in China, the only possible way to provide enough urban land is to dig the potential of rural land (Liu et al. 2014; Tan et al. 2020). It means that land consolidation should not only rehabilitate more arable land but also create more space for urban expansion.

Secondly, the inefficiency of rural land use in China severely restricts the economic development in rural areas. Rural decline is gradually becoming significant worldwide (Liu and Li 2017). According to the China Statistic Yearbook, the housing area per capita of rural residents increased by 38.6 square meters from 1978 to 2017. While the rural population migrates to urban areas, a large number of rural housings emerge and expand, at the cost of reducing farmland (Mullan et al. 2011; Tang et al. 2017). This phenomenon is known as "village hollowing" (Liu et al. 2019). The paradox of extensive construction land and intensive arable land implies that there is a need to rearrange and renew rural land. Besides, agricultural mechanization should also play a vital role in improving farm efficiency and release labors in the first sector (Tan et al. 2008; Lai et al. 2015; Nguyen and Warr 2020).

Additionally, the wealth gap between rural and urban areas is still huge (R. Wang et al. 2019). Likewise, the infrastructure and public services are comparatively insufficient, leading to worse living conditions for villagers. As the physical carrier, the land resource is both the most important resource of rural vitalization and the most valuable asset for economic growth. Therefore, to promote rural–urban integration and realize a sustainable rural development, rural land must be efficiently managed and utilized.

Moreover, the economic and social structures in rural China are being reshaped due to the great transformation in labors, capital, technology, and institutions (Li et al. 2014; Yang et al. 2016). These changes inevitably affect the spatial arrangement of rural land (Long 2014). Consequently, current land property arrangements and land use plans may not be suitable for the demand of a new form of rural living. That is to say, land consolidation can be implemented as a spatial method in the process of restructuring of the rural society.

Finally, degradation of land quality and environment also exists (Foley et al. 2005; Fan 2006; Gao and Liu 2010). Notably, the lack of effective governance on farmland contributes to problems such as soil erosion, pesticide overuse, nutrition imbalance, and pollution, which have long restricted China's agricultural development. On the other hand, land use is also an important factor for the sustainability of the ecological system. For example, the increase in the area of arable land usually comes from the reclamation of unutilized land and will finally affect the local carrying capacity and biodiversity (Zhang et al. 2014). In general, since the governance of land resource will influence the environment in a complex way, comprehensive land consolidation is needed to reduce negative externalities and provide ecosystem services.

Table 2. Key factors of modern land consolidation in China. Source: Own illustration.

Factor	Phenomenon	Requirenment for Land Consolidation
Urbanization	Unsufficient construction land provision	Integrate rural land to expand urban growth space
Rural decline	Ineffective rural land use; Rural to urban migration	Stimulate rural renewal and agricultural mechanization
Rural–urban inequity	Rural–urban wage gap; Lack of rural welfare	Encourage rural land financing and rural non-farm sector development
Social reshape	Modernized rural living	Use spatial planning to fit and restructure a stable rural society
Ecological degradation	Soil erosion, pesticide overuse, nutrition imbalance, and pollution	Reduce negative environmental impact; enhance ecological restoration projects

Thus, the internal driving factor of land consolidation is the demand of optimization, adjustment, and transformation of the rural socio-economic structure during the industrialization and urbanization processes. This transformation in rural China is so significant that numerous social relationships and values have been reshaped. For rural residences, land consolidation may provide an opportunity to embrace modern lifestyles (Long 2014; R. Wang et al. 2019).

Yet, land consolidation today in rural China has not fully achieved its aims; for instance, the concern about the ecological effect of land consolidation is limited (R. Wang et al. 2019). Another example is the quota system. Many people criticize this policy for over-emphasizing the increase in the amount of cultivated land, which makes the number of cultivated area growth become the main or only criterion when evaluating land consolidation (Du et al. 2018).

One possible reason for this deviation may be the Chinese context. The land consolidation system is shaped by the incentives and constraints in the current political structure. Those who conduct local land consolidation projects are usually more interested in economic rewards, and the decision to start a project is based on a financial trade-off. Furthermore, though the central government has strong incentives to guarantee food security and protect the environment, the decision process and vertical regulation are always costly and difficult (Tan and Zhou 2015). Despite this, the hierarchical management system is not always to be blamed, because the current land planning system still establishes a reallocation and monitoring mechanism among multi-level governments and provides essential financial support for rural development. Above all, it is more important to readjust the existing consolidation system to meet the demand in the real world.

4. The Evolution of the Land Consolidation System in China

Though the land consolidation practices before 1997 were mainly adopted at the local level and did not operate as well as expected, it is obvious that the increasing efforts allowed the central government to accumulate experience and confidence. After that, a national land consolidation system was gradually established and was developed in three main steps (Table 3)

Table 3. Main developing steps of land consolidation in China. Source: Own illustration.

Period	Goals	Main Focus	Policy Tools	Result
Exploring (1997–2004)	Food production	Increase farmland area; Reclaim undeveloped land	Dynamic Equilibrium of Total Farmland; Basic Farmland Protection; Extra Farmland Quota (in some provinces)	2200 national investment consolidation projects from 8 batches; Supplemented 1.4267 million hectares of arable land
Developing (2004–2012)	Food production; Rural–urban equity	Maintain farmland area; Improve farmland quality; Rearrange construction land	Dynamic Equilibrium with same quality; High-Standard Farmland; Linkage between Urban Land Taking and Rural Land Giving (LUTRG)	Supplemented 1.484 million hectares of arable land with same land quantity; Arranged 57,360 hectares of LUTRG
Comprehensive Governance (Since 2013)	farmland area; farmland quality social equity eco-system	Maintain farmland area; Improve farmland quality; Rearrange construction land; Ecological protection and restoration	Comprehensive/ Overhaul Land Consolidation; Ecological red line; Urban–rural land property reform	Over 300 pilot projects of overhaul consolidation; 15 provinces finished ecological red line; Over 150,000 villages participated in land reform

4.1. Exploring Period of Land Consolidation (1997–2004)

Consistent with the description in the LLA, land consolidation in this period mainly focused on constructing agricultural infrastructure and promoting the quality and quantity of farmland (Tan et al. 2006; Tang et al. 2019). In other words, the central government aimed at increasing enough arable land by means of reclamation and rehabilitation at first, to cover the decrease of cultivated land

(Liu et al. 2014; Zhou et al. 2020). Low- and medium-yield farmland consolidation, as well as abandoned industrial and mining land reclamation were the main source of increasing cultivated land in that period (Fan 2006). The main reason might be the strong concerns on food security, and most of the land consolidation projects were implemented around crop production. Meanwhile, since 2000, the Chinese government has launched a large-scale national *Grain to Green* program, which aims at controlling soil erosion and land desertification by converting 146.7 million hectares of arable land into forest and grassland (L. Wang et al. 2019; Yan 2019). This ecological restoration program further stimulated the demand of maintaining arable land. It can be assumed that land consolidation from 1997 to 2004 was somehow a continuation of the traditional agriculture-oriented land consolidation practice. However, two main differences distinguish the traditional and modern approaches.

The first characteristic is the national spatial planning system. In 1999, the State Council promulgated the *Outline of the National Land Use Plan (1997–2010)*. Authorized by the newly amended LLA, this outline had unprecedented authority and importance and emphasized the protection of arable land and the practice of the *Dynamic Equilibrium of Total Farmland* system. The primary purpose of this plan was to preserve the 120 million hectares of arable land. This planning and quota system has strong hierarchical characteristics, since it establishes that the central government decides, allocates and monitors land use change as well as the operation process of land consolidation. As a result, a nationwide multi-level system was built, which can better balance the regional supply and demand and provide a public resource for local operators.

Besides, the *10th Five-Year Planning* from 2001 to 2005 that guided all aspects of the national economy was also highly concerned with land rehabilitation and consolidation. In 2001, the *National Land Development and Consolidation Plan (2001–2010)* which advocated to replenish 2.76 million hectares of arable land until the end of 2010 was issued, and then the first batch of land consolidation projects supported by nation-level finance were set up.

Another initiative of this period was the quota incentives of the land planning system. The LLA tried to advocate local land consolidation, but no incentive mechanism was adopted at first. However, in response to the central government advocating on land consolidation, Zhejiang Province created a new construction land quota in its provincial area in 1998. Specifically, when a land consolidation project was implemented and a certain extent of arable land was created, a construction land quota equal to 72% of its area was also created. Therefore, the local government in Zhejiang could convert an extra amount of rural land into urban construction land

after land consolidation, offsetting the cost of land consolidation projects by the rent of the additional land. Because the demand of construction land in Zhejiang was abundant, the local government could at the same promote local development and get financial income time by means of land consolidation. In the end of 2003, over half of the new construction land in Zhejiang came from the extra quota system.

Actually, the institution innovation in Zhejiang broke the regulation of the central government. The MLRC first required that the extra quota of municipal government should be taken into account in the total provincial quota, which meant that the extent of cultivated land occupation was still under the cap of central planning. However, later in 2000, several documents such as the Regulation of Land Consolidation extended this quota system to the central level. Therefore, land consolidation projects could exceed the limitation on construction land while in line with the land use planning. The MLRC cancelled all these systems in 2007, but a supplementary system which will be introduced later was issued soon.

By the end of the five-year planning in 2005, China had arranged over 2200 national investment consolidation projects from 8 batches, with a total investment of nearly 29 billion yuan, and a total of 25 billion yuan had been issued. About 1.58 million hectares of cultivated land were developed and reorganized through those projects (Wu 2015).

At this stage, land consolidation plays a very important role in ensuring that the extent of cultivated land does not decrease (Liu et al. 2018). As of the end of 2005, China had supplemented 1.4267 million hectares of arable land, while the area occupied by construction and subjected to disasters during the same period was 1.348 million hectares. All provinces achieved a dynamic equilibrium of total arable land (Fan 2006). During this period, land consolidation effectively realized the core task of arable land protection by mainly reclaiming undeveloped land, while reclaiming constructed land as a supplement (Lichtenberg and Ding 2008; Du et al. 2018). However, despite the fact that the farmland area remained stable, the newly reclaimed and supplemented land had comparatively a low quality and contributed little to crop production (L. Wang et al. 2019).

4.2. Developing Period of Land Consolidation (2005–2012)

With the successful completion of the *10th Five-Year Planning*, the red line of cultivated land in rural areas was effectively protected. However, due to the development and utilization of undeveloped land resources in the past decade, it was increasingly difficult to further reclaim farmland in order to increase its extent (Yun et al. 2016). At the same time, the gap between urban and rural areas had

further widened. Therefore, how to solve urban–rural equity problem and realize rural development had become an important issue for maintaining social stability.

Around 2005, the strategy of land consolidation was updated from "number management" to "rural comprehensive management" (Tang et al. 2019). On the one hand, while food security was still one of the core issues, the improvement of rural infrastructure with the main purpose of increasing the quality of farmland and increasing food productivity had gradually become the mainstream. On the other hand, the improvement of rural areas, which includes both agricultural land and rural construction land, had become an important approach to rural land improvement.

In 2004, based on the protection of the cultivated land quantity, China proposed that "the quantity and quality of supplementary cultivated land should be converted into grades, to prevent replacing more with less and replacing the good with the bad" (State Council of People's Republic of China 2004). In other words, after arable land is occupied by urban construction, not only the area of arable land cannot decrease, but also the productivity of arable land cannot reduce. Since 2005, MLRC issued several policy documents, taking the improvement of comprehensive agricultural production capacity as the starting point for land consolidation. Nonetheless, clear requirements and standards of quality-oriented land consolidation were set up, regarding soil, irrigation, spatial distribution, and pollution. To further carry out the practice of preserving and promoting the quality of cultivated land, in 2006, MLRC established demonstration areas for basic farmland protection in 116 counties nationwide. Through the implementation of land consolidation to build "high-standard basic farmland", it achieved large-scale, high-yield, complete infrastructure, and disaster-resistance agricultural goals. Though food production growth still mainly depended on the increase of arable area, quality control remained indispensable (Du et al. 2018). From 2006 to 2012, 1.484 million hectares of cultivated land were supplemented, which corresponded to the amount of farmland occupied by urban construction, and all followed the rule of quality and quantity equilibrium.

Notably, village rearrangement and renewal associated with land consolidation rapidly developed in this period. In contrast, the reclamation of rural construction land had started a little earlier. In 1999, the MLRC formulated a policy of *Land Exchange*, which allowed rural residents to swap the land use of their farmland and housing land without changing the area. Considering the cost of demolition, reconstruction, and reclamation, this policy was rarely implemented. Likewise, in 2000, Zhejiang updated its extra quota system, which originally only allowed farmers to increase cultivated land area by farmland consolidation, to covering construction land reclamation. According to this, if the local government got some

increasing farmland through demolition and consolidation of former construction land, it could obtain the same amount of construction land quota and then spend it in urban expansion or trade in quota market. Though Zhejiang was soon ordered to abolish this policy because of the risk of social and political instability, its experience attracted the interest of the central government.

After the State Council proposed in 2004 that "the increase in urban construction land should be linked to the reduction in rural construction land" (State Council of People's Republic of China 2004), MLRC began to gradually implement the pilot work of a new quota system called *Linkage between Urban Land Taking and Rural Land Giving (LUTRG)* in 2005. Similar to the exploration in Zhejiang, this national system allows local governments to preserve land, cultivate more arable land during the land consolidation process, and use the related profits for local development. Importantly, different from the system in Zhejiang, this LUTRG system should be approved by the central government, thus land use can be vertically controlled. As a result, LUTRG encouraged local governments to improve the efficiency and intensity of land use in rural settlements (Tan et al. 2020).

The LUTRG pilot project achieved very significant results. In 2012, the LUTRG quota reached 57,360 hectares nationwide. Especially, the Chinese government stimulated the domestic economy through monetary policy during the 2008 economic crisis, which indirectly played a strong role in increasing the urban construction land price. The rapid growth of urban land rent had caused a huge gap between agricultural land and construction land prices. As a result, the financial benefits that LUTRG programs could provide far exceeded the cost of adopting land consolidation, which soon became an important incentive for local governments. Discovering this opportunity, many local governments in China began to implement LUTRG to reorganize rural areas. Therefore, the inefficient rural construction land use was improved.

4.3. Comprehensive Period of Land Consolidation (Since 2013)

The report of the 17th Central Committee of the Communist Party of China (CCCPC) in 2007 proposed eco-civilization as a main strategy. As an important approach to optimizing and managing natural resource, land consolidation was also updated to *Comprehensive Land Consolidation*, which was given a rich ecosystem connotation.

This comprehensive concept was raised in 2012 when MLRC formulated the *National Land Development and Consolidation Plan (2011–2015)*. It was defined as a systematic project aimed at improving rural production, living conditions, and the

ecological environment by comprehensively consolidating farmland, water, roads, forests, and villages. Moreover, later in 2017, the *National Land Development and Consolidation Plan (2015–2020)* further illustrated the purpose of comprehensive land consolidation including large-scale agriculture, population concentration, industrial agglomeration, and urban–rural integration. Another similar idea is the *Overhaul Land Consolidation*, which emphasizes that land consolidation and rural governance should link together all the factors of a socio-ecological system, reinforcing the diverse actors and intensifying a cross-regional cooperation in resource management. In December 2019, the central government launched a pilot project for *Overhaul Land Consolidation* nationwide and planned to set more than 300 pilot projects in 2020. Another policy design was the *Ecological Redline*, referring to the spatial boundary between natural ecological service functions, environmental quality and safety, and natural resource utilization. Until the end of 2018, 15 ecologically important provinces had already formulated their ecological redline. The remaining provinces were required to complete the redline by the end of 2020. Apparently, the rural society and ecosystem structure are facing a tremendous change under this new round of comprehensive consolidation.

Besides, another main change took place in the rural–urban relationship (Liu 2014). Several reforms of the current rural–urban land dual system were adopted, when a large number of large-scale land consolidation projects were implemented at the provincial level according to the overall reform plan. In 2015, the MLRC launched a new round of urban–rural land property reform, selecting 33 county-level pilot areas throughout the nation for reform of land acquisition, housing land, and commercially used construction land in rural China. So far, over 150,000 villages have participated in the reform, which includes the marketization of the rural property right, the decentralization of land management, the diversification of land use, and the support to rural industry. These reforms have achieved significant success in giving farmers land property rights, coordinating multiple plans, innovating urban–rural market mechanisms, and optimizing the allocation of natural resources (Cao and Zhang 2018; Tan et al. 2020; Xie et al. 2019).

In 2016, the Chinese central government introduced *China's National Plan on Implementation of the 2030 Agenda for Sustainable Development*, which aimed to achieve SDGs through political, economic, social, and ecological construction. In response to the SDG 15 (Life on land), this agenda especially emphasized the *Grain to Green* program and ecological restoration of land. Therefore, against the backdrop of land degradation and ecological loss, comprehensive land consolidation projects were implemented with afforestation, grass planting, and ecological engineering

projects such as the prevention of soil erosion. Later in 2017, the Chinese government proposed the idea of *Ecological Redline* which refers to areas in which development is prohibited. Until now, land consolidation has corroborated its sustainable development function of green and clean food provision, rural infrastructure construction, and environmental protection.

Nowadays, land consolidation is more than engineering method for agricultural purpose. First, at the method level, land consolidation involves multi-dimensional governance tools such as economics, administration, and engineering. Secondly, at the institution level, relative formal institutions, for instance the land planning and quota transactions system, have become an integral part of land consolidation, and vice versa. At the target level, land consolidation has a richer connotation in pursuing more non-agricultural and non-economic objectives. Nevertheless, at the spatial level, both urban and rural systems are involved in the implementation of land consolidation.

5. Influence of Land Consolidation

5.1. Food Production

Land consolidation has played a vital role in ensuring China's food security (Lichtenberg and Ding 2008; Zhang et al. 2014; Jin et al. 2017). From 1997 to 2018, China invested 76.17 billion dollars on national land consolidation projects, and 42.7 million hectares of developed farmland (35% of national farmland) were constructed (Bryan et al. 2018). Through land leveling, field roads, farmland irrigation and drainage, and farmland forest network projects, land consolidation increased the potential of farmland production, increased the provision of infrastructure in rural areas, promoted the development of mechanized agriculture, and effectively increased the amount of food while retaining the amount of cultivated land productive forces. Since the implementation of land consolidation nationwide in 1997, while the total area of arable land has gradually decreased because of urbanization, China's total grain output has increased from 504 million tons in 1997 to 664 million tons in 2019, which thoroughly compensated the loss of farmland (Song and Pijanowski 2014). Although the increase is also closely attributed to other relative factors such as technological progress and scientific management, there is no doubt that the land consolidation policy, represented by high-standard basic farmland construction, has huge significance for improving land productivity and realizing a modern agricultural production (Du et al. 2018). As its primary goal, land consolidation has to some extent alleviated the threat of food security resulting from the reduction in the

amount of cultivated land and effectively promoted the efficient use of agricultural land and is the fundamental way to ensure national food security.

This is consistent with the SDG of food security. According to the Report on China's implementation of the Millennium Development Goals (2000–2015), China has reduced the portion of malnourished population from 23.9% in 1990 to 10.6% in 2014, halving the population suffering from hunger (Ministry of Foreign Affairs People's Republic of China and United Nations System in China 2015). In 2019, China achieved 470 kg of food output per capita and a grain self-sufficiency rate of over 95% (National Bureau of Statistic of China 2019). As a country with a huge population, China solves the food provision problem for 20% of the international population with only 9% of global arable land, which alleviates the international food provision pressure. Therefore, the land consolidation program has made a remarkable contribution not only to diminishing hunger in China, but also to ensuring global food security.

5.2. Spatial Arrangement

Rural space is the basic carrier of rural vitalization and rural–urban integration development. Currently, land consolidation projects have deeply reshaped the rural spatial structure of China (Long 2014). On the one hand, land consolidation directly changes the spatial arrangement of land use. While the productivity of cultivated land improves, the physical characteristics of farmland is also altered. For instance, intensively organized cultivated land may not only provide a better yield, but also change the terrain and land use, which will affect the lifestyle and human–nature relationship in rural areas. Consequently, in those rural construction land use cases of comparatively higher density which resulted from land consolidation and LUTRG projects, village's spatial forms, farmers' production methods, and lifestyle have also changed dramatically (Lo et al. 2016; Chen et al. 2018).

In this process, land consolidation programs serve as the primary way for contemporary China to solve the problem of inefficient land use in both rural and urban areas. With the help of market mechanisms, land consolidation successfully meets the demand for new construction land of urbanization and industrialization and realize the optimal allocation of urban and rural land. For example, LUTRG, through the transformation and redevelopment of rural residential areas, has concentrated the resettlement of previously excessively extensive rural construction land without threatening the red-ine of cultivated land. Furthermore, the land quota created by means of land consolidation can also supply the necessary construction land for urban development, easing the pressure of urban expansion. Additionally, agricultural

infrastructures, health and education facilities, affordable housing, and roads are offered and promoted, which greatly improves the living conditions in rural areas (C. Li et al. 2018). In this way, land consolidation optimizes the allocation of the rural land resource and promotes sustainable development. This rural village renewal along with land consolidation can improve the health, education, and living conditions of rural residents, meeting the SDGs of rural sustainable development.

Spatial changes in rural China are the inevitable consequence of socio-economic development (Zhou et al. 2013). Considering the migration of labor, flow of capital, and spread of technology between the rural and the urban areas during the process of urbanization and industrialization, there is a need for a modern spatial distribution. In certain areas of China, land consolidation projects lead to social conflict, because the over-agglomeration of villages violates the plans of farmers. Rural residents have to live uncomfortably in the new rural communities, while their economic sources and lifestyle remain unchanged, and they suffer from higher costs of production and living (Lo et al. 2016). To achieve the goal of rural development, operators should establish favorable rural production, living, and ecological spaces in the land consolidation process.

5.3. Rural–Urban Equity

As an important policy instrument to promote rural vitalization, land consolidation is essential to improve rural productivity and living standards, which is beneficial for achieving the SDG of reducing the rural–urban gap. For a long time, rural development has been one of the first topics of concern of the Chinese government. A large number of related policies such as those related to rural renewal and new rural construction have been formulated. In fact, the function of land consolidation is highly consistent with the needs of rural renewal, which determines that land consolidation can be implemented as an important work platform for rural development.

The most direct impact of land consolidation is to increase farmers' income and improve the rural living environment (Wu et al. 2005; Du et al. 2018). Undoubtedly, because land consolidation can effectively increase the agricultural production, farmers will also benefit from it and augment their economic income. However, considering that the share of agricultural income in the income of rural residents is decreasing, more economic benefits farmers receive from land consolidation come from quota transactions. Due to the high price of construction land in recent years, the construction land quota generated by the land consolidation project can get a generous return in the land property market. In addition, farmers are property owners of rural land, which means that after deducting the development costs,

a considerable portion of the profit from the land consolidation quota transaction will be distributed to villagers or rural collectives. In addition, rural roads, houses, landscapes, and supporting facilities have also been developed and improved during the land consolidation process. For example, high-quality houses with masonry and concrete structures have already become common in rural China.

The land consolidation also brings indirect opportunities for sustainable rural development. In the past two decades, China's rural economy has developed vigorously, with modern agriculture, tourism, and processing industries in rural areas developing especially rapidly. The reason is that the land consolidation policy effectively revitalizes those inefficient rural lands and at the same time allows rural residents to obtain the capital necessary for development through the redistribution of land market revenue. Both of them stimulate the development of rural industries. This is why the land consolidation project is widely supported in rural China. In recent years, the central government has also implemented the land consolidation project as an important way to boost the rural economy and reduce the urban–rural inequality.

5.4. Ecology Conservation

The purpose and function of land consolidation from an ecological perspective have changed significantly over time. If the previous consolidation approaches ignored the ecological impact, the first two stages of the modern land consolidation system in China still put environment conservation and restoration in a secondary position. Consequently, environmental issues including soil erosion, water pollution, and biodiversity decline have emerged (Shan et al. 2019; Zhong et al. 2020; Guo et al. 2020). This caused a confusing paradox: the restoration programs such as the *Grain to Green* sacrificed arable land to improve environmental services, meanwhile land consolidation projects reclaimed undeveloped land to supplement arable land, which decreased the rural ecosystem capacity. This contradiction weakened the significance and effectiveness of the land consolidation system.

In recent years, increasing attention has been paid to the ecological conservation function of land consolidation projects. The relevant comprehensive consolidation framework has also provided solutions to environmental issues linked to land resources utility in rural areas. Due to the relatively short period of policy implementation, the results of these initiatives are still unclear. However, despite this, the approaches for water governance, mine rehabilitation, and farmland ecological improvement in some pilot projects partially reflect the ecological tendency of the comprehensive land consolidation approach. This provides the possibility to conserve and restore the rural environment to meet the demand of SDGs.

5.5. Institutiol Establishment

Land consolidation is an indispensable part of China's land use planning and regulation system. The implementation of nearly every rural land-related policy, whether it is about cultivated land preservation, rural construction land reclamation, or ecological land protection, should be ultimately settled on land. Therefore, land consolidation is an inseparable policy tool to govern rural issues. Actually, since the *10th Five-Year Planning*, the continuous improvement of the land consolidation system has been synchronized with the development of the land control system. The land consolidation management framework including project management, supervision, acceptance, quota control, and market-based transactions has become one of the foundations of China's rural land governance system. More importantly, thanks to the land consolidation project, China's land planning system can introduce a more flexible mechanism of quota market into the hierarchical administrative process. By this mean, the spatial rearrangement and readjustment of cultivated land can be implemented under a cross-regional context, which can better balance and coordinate the multiple demands from different actors. Currently, under the triple requirements of cultivated land protection, economic development, and ecological civilization, the land use regulation system is still the institutional basis of China's land management, in which land consolidation will continue to play an irreplaceable role.

6. Conclusions

Given the goals of sustainable development, this research reveals three main developing steps of Chinese land consolidation system and summarizes its background, characteristics, motivations, and effects. Two main findings result from this research:

(1) The evolution process is conducted in a top–down manner by the central government, while local exploration and pilot projects provide a learning experience for states;
(2) Land consolidation projects can have a positive effect on food production, spatial utilization, rural sustainable development. and ecology conservation, but their details should be handled according to each specific context.

From a traditional agricultural approach to a modern comprehensive system, Chinese land consolidation has extended its multiple goals and introduced diverse methods, which are related to changes in the national interest and focus. The potential crisis of food security in the end of the 1990s urged the Chinese government to put forward land consolidation programs. Later in the early 2000s, the rapid urbanization

brought about the imbalanced development between rural and urban regions, which further called for economic and social promotion in rural areas. Recently, the space for urban and rural development further shrank, so it has been necessary to utilize land resources in a more efficient and economical way in place of the extensive land use model in the past.

In addition, in coordination with rural changes during the urbanization and industrialization process, land consolidation projects have been widely implemented to improve farmland productivity, rural infrastructures, construction land supply, and eco-system services. Meanwhile, even if there are still some negative externalities, such as over-agglomeration of rural villages and ignorance of biodiversity, this current modern system is running effectively with respect to food supply, rural vitalization, and urban development. Besides, environmental improvement related to land consolidation projects is gradually beginning to appear.

Additionally, other developing countries can learn from this experience that land consolidation and readjustment can exert a great influence on many aspects of economy and society, from food production to sustainable rural development and efficient urban development. These purposes can be pursued intensively at the same time by land consolidation because of its multifunctionality. Notably, one possible solution is the quantity policy, such as land quota. It can well guide local actors in participating in land consolidation activities to a proper degree, especially when supervision and regulation abilities are limited. Secondly, spatial policies, for example plans by the state or the federal government, can be implemented for issues with strict constraints. This requires a comparatively stronger government, as well as local actors who can express their interest through public participation. However, there is no rule that fits every case. More importantly, because of the the complexity of each situation, all initiatives should be decided carefully, and their side effects such as ecological loss, should be considered.

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