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Land-Development Offset Policies in the Quest for Sustainability: What Can China Learn from Germany?

Rong Tan ^{1,*}, Rongyu Wang ¹ and Thomas Sedlin ²

¹ Department of Land Management, Zhejiang University, Yuhangtang Road, 866, Hangzhou 310058, China; E-Mail: 3100104510@zju.edu.cn

² Law and Economics Faculty & Institute for Botany and Landscape Ecology, Ernst-Moritz-Arndt-University Greifswald, Soldmannstr. 15, D-17487 Greifswald, Germany; E-Mail: sedlint@uni-greifswald.de

* Author to whom correspondence should be addressed; E-Mail: tanrong@zju.edu.cn; Tel.: +86-571-5666-2168; Fax: +86-571-5666-2012.

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Abstract: Land-development offset policies consist of measures that require compensation to be made for the negative impact of land development on agricultural production, ecological and environmental conservation, and the sustainability of economic and social development. However, when such policies are inappropriately designed, unexpected problems can result. This paper describes certain land-development offset policies that have recently been implemented in China, with a particular emphasis on three such policies: the Balancing Policy, the Linkage Policy, and the Integrated Policy. These well-intentioned environmental policies have led to unexpected ecological, social, and cultural problems. This paper also describes the core of German land-development policy, which features a distinctive compensation system that has been employed since the 1970s, and compares Chinese and German land-development policies to highlight differences in three main areas: policy purposes, governance structures, and fundamental institutions. The comparisons might help explain the unexpected outcomes in China, and they also lead to land-development offset policy recommendations for China in the near future.

Keywords: land-development offset; institutional comparison; China; Germany

1. Introduction

As one of the fundamental factors of production, land provides many of the necessities that are required for the survival of human society; the development of human society cannot be separated from the development and utilisation of land resources [1]. Similarly, land is also the key component of the natural system. The development and utilisation of land results in changes in land-use structures, which lead to additional changes in the entire natural system, *i.e.*, changes in the interactions between the (human) societal and natural ecological systems [2]. For instance, with the rapid growth of the economy in China, the breadth and depth of land use has intensified and has resulted in certain negative effects.

Published at the end of 2013, the “Official Report on the Main Results of the Second National Land Survey in China” shows that cultivated land per capita in China is 0.101 ha, which is less than half of the average level of the world (0.225 ha) [3]. Given China’s population, it can be argued that China’s cultivated land has been intensively used for its food self-sufficiency strategy [4]. The intensive use of land may be the primary reason for land degradation in China. For example, the “Bulletin of Status Quo of Desertification and Sandification in China” indicates that, by the end of 2009, there were 2,623,700 square kilometres of desertified land area in China and 1,731,100 square kilometres of sandified land area [5]. Although the levels of desertification and sandification have slightly improved compared with 2004, a study shows that the direct and indirect economic loss due to desertification and sandification might be underestimated officially. For example, the study shows that the direct loss caused by desertification in the northernmost 10 provinces in 2005 was 48.79 billion CNY (5.72 billion Euros), and the indirect loss solely due to the sandstorms resulting from desertification in those areas was 5.07 billion CNY (0.59 billion Euros). Those figures are both higher than official estimates [6]. \

It is widely accepted that land development activities in China have caused changes in the ecological system, such as decreased levels of cultivated land, degradation of land resources, and deterioration of biological habitats. Such negative effects have resulted in disorder in the natural system and have led to negative impacts on human society that threaten sustainable development in China.

Due to the pressure of potentially unsustainable development on the entire economy, the Chinese government has begun to focus more of its attention on land-development offset policies. Land-development offset has two meanings. In one sense, it indicates that land developers must reclaim a certain amount of agricultural land or ecologically preserved land elsewhere to compensate for the loss of agricultural production and ecological preservation that they cause by altering the original land uses in favour of other purposes; such policies are based on the criterion of ensuring equivalent or higher value for agricultural production or ecological preservation in the region. The second meaning of land-development offset requires land users to adopt certain measures to compensate for losses resulting from pollution and other types of damage to neighbouring regions due to the changes in land use. The criterion utilised is meant to ensure that the equivalent or higher value of agricultural production or ecological service is maintained in neighbouring regions. However, land-development offset policies in China have had certain side effects, including recently exacerbating inherent contradictions between land development and ecological conservation during the processes of urbanisation and industrialisation.

For example, local governments in some flatland counties in the Yellow River Basin have reclaimed forestry land to convert it into agricultural (grain) land to meet the requirements of the Balancing Cultivated Land Occupation and Reclamation policy (see Section 2.1), but the effects of the reclamation are contrary to the purpose of the integration of economic, ecological, and social development [7]. In certain rural land readjustment projects, farmers' properties and interests were seriously diminished, which intensified social contradictions and affected social stability [8]. Large-scale demolition and/or consolidation of rural villages for the purpose of improving rural living conditions have threatened traditional culture in some rural areas [9]. In other words, undertaking land-development offset is not easy and can lead to unexpected side effects; it has caused China to be trapped *in situations* in which it is "losing something while gaining something".

To analyse the reasons for and to provide policy recommendations regarding China's land-development offset policies, this paper attempts an institutional comparative analysis of China's land-development policies and those of an experienced country because a consensus has developed internationally about the need to adopt ecological offset measures. Germany is useful for such a comparison because its land-population intensity is similar to China's (e.g., Germany's 231 inhabitants/km² is similar to China's average of 136 inhabitants/km²) [10], and Germany is also recognised for its land-development offset policies, such as its impact mitigation regulation and eco-account systems. German policies have successfully addressed the negative effects of land development while preserving natural landscapes and biodiversity, improving the ecological environment, and ensuring the quality of life of local residents.

It is thus valuable to analyse the German experience and consider the implications for China if we want to know about factors that impact the effectiveness of land-development offsets, particularly because China is contemplating the future of its policies. This paper is organised as follows. The second and third sections will describe land-development offset policies in China and Germany, respectively. The fourth section consists of a comparative analysis of the governance structures and fundamental institutions related to land-development offset between the two countries. The implications of the comparison and conclusions will follow in the last two sections.

2. Land-Development Offset Policies in China

Rapid industrialisation and urbanisation have increased the demand for new land for construction in recent decades in China. Rural land, particularly cultivated land around cities, has inevitably been converted—often inefficiently—into construction land [4]. The "Bulletin of China's Land and Resource in 2012" indicates that the total land that was converted into construction use amounted to 615,200 ha in 2012, of which 429,100 ha was originally used for grain production. The year-on-year growth rates were 0.6% and 4.5%, respectively [11]. However, a so-called red line of cultivated land preservation should be acknowledged here, *i.e.*, the total amount of cultivated land should not be lower than 120.3 million ha by 2020. The red line (quota) indicates that only 115,200 ha land could have been converted annually since 2009 [12]. The red line policy shows that the Chinese government faces great pressure from the farmland conversion rate. To compensate for the loss of grain cultivation land and to ensure a food self-sufficiency/food security strategy, a series of land-development offset policies have been implemented to compensate the loss of land due to industrialisation and urbanisation. There are three

primary offset policies (among other less important policies): (1) Balancing Cultivated Land Occupation and Reclamation; (2) Linkage Between Urban Land Taking and Rural Land Giving; and (3) Integrated Development of Low Hilly and Gentle Slope Land. The history of these policies sketches out the main evolution of China's land-development offset measures.

2.1. Balancing Cultivated Land Occupation and Reclamation

The policy of Balancing Cultivated Land Occupation and Reclamation (the Balancing Policy) aims to ensure that the total amount of cultivated land does not decrease due to occupation by urban industries, traffic, and human settlement [10]; the Balancing Policy is the core offset policy of land development in modern China. According to Article 31 of the Land Administration Law of China [13], "The State fosters the system of compensations to cultivated land to be occupied. In the case of occupying cultivated land for non-agricultural construction, the land users occupying the cultivated land should be responsible for reclaiming the same amount of land in the same quality as that occupied", and further "Whereas land users who occupy the cultivated land are not available with conditions of reclamation or the land reclaimed cannot meet requirements, the users should pay land reclamation fees prescribed by the provincial government for reclaiming land elsewhere".

The Balancing Policy thus emphasises that the quantity of cultivated land should not decrease within a provincial jurisdiction, but it does not impose restrictions based on quality. Furthermore, although it stipulates that land users should be responsible for land reclamation, the practical choice for a land user is always to pay reclamation fees to the government, which means that local governments take responsibility for reclamation and that the government undertakes all the reclamation steps, including planning, approval, investment, implementation, and monitoring.

Although the intention of the Balancing Policy is reasonable, there are practical constraints that affect its implementation. Given the condition of human-land intensity and the scarce amount of land reserved for cultivation, the Balancing Policy itself faces a natural threshold. Some local governments have turned to reclaiming marginal lands with high ecological service values that are less suitable for grain production. For example, they have reclaimed land from sloping forest land, land around lakes, land along beaches, and wetlands. This type of land reclamation, although it meets the quantity requirement, cannot meet the quality criterion, such that it may cause further ecological damage, e.g., through soil erosion, desertification, and/or biodiversity degradation. According to the "Bulletin of China's Environment in 2012", the soil erosion area had increased to 2.95 million km² by the end of 2012 [14]. Another study shows that the average annual runoff and sediment loss amounted 287.4 m³/ha and 117.7 kg/ha, respectively, in the agricultural region between 1998 and 2011. However, rainfall levels in natural forest regions were 21.3 m³/ha and 5.4 kg/ha, respectively, during the same observation period [15], which demonstrates that inappropriate land reclamation from marginal land can result in significant ecological side effects.

There is further evidence from the survey that followed the Yangtze River Flood in 1998. There were two main reasons for the flood. The first was that the sedimentation and the riverbed in the downstream area were elevated, which was primarily caused by severe soil erosion caused by the destruction of vegetation upstream due to the conversion of land for grain production. The other cause was the land reclamation around large lakes along the Yangtze River, which affects the flood storage

volume of such lakes [16]. The most affected areas in the 1998 flood were the hundreds of dikes around the lakes in Hubei, Jiangxi and other provinces [17].

These gradually recognised implementation problems of the Balancing Policy have pushed the central government to strictly control rural land conversion for urban construction. However, given the land demand from the urban side, the government must find another way to solve the land-development offset issues. As a result of this problem, the so-called policy of Linkage between Urban Land Taking and Rural Land Giving has emerged [18].

2.2. Linkage between Urban Land Taking and Rural Land Giving

The policy of Linkage between Urban Land Taking and Rural Land Giving (the Linkage Policy) is an offset policy developed in recent years to address the strictly centralised control of land conversion by the central government and the demand for land for economic growth from the urban sector. This policy was tested in several pilot areas in 2006; since the beginning of 2009, the central government has recommended its nationwide implementation [19].

The main purpose of the Linkage Policy is to increase urban construction input at the cost/precondition of reclaiming at least the same amount of construction land for agricultural production in rural areas. “Urban land taking” refers to a legal urban expansion project that involves taking farmland to be redeveloped into land for residential or industrial use, and “rural land giving” indicates that the equivalent amount of farmland is gained elsewhere by reducing the size of rural build-up land (typically residential land) and using the remaining rural build-up land more intensively.

There is thus an offset policy within an entire project region that ensures that the total amount of construction land in rural and urban sectors does not increase and that the total productivity of farmland remains the same or even increases [18]. The Linkage Policy might also be considered a trading measure for land development rights transfer between rural and urban land users following the principle of “pollution offset” in the classical quota-trading schemes of environmental economics [20]. Thus, no decrease occurs in the quantity, and there is no degradation of the quality of the farmland during urban-land taking and rural-land giving [18]. However, in practice, the quality is always questionable, and the trading is completely dominated by the government; the government defines the project area, the amount of land, and the price.

Local government within a county-level jurisdiction dominates the design, investment, implementation, monitoring, and checking of Linkage projects. The county government will select potential areas for rural land reclamation and urban land expansion first, and then seek approval from the provincial government. The main criteria for approval include whether the budget is sufficient and whether farmers are fairly compensated and suitably relocated into neighbouring regions. The projects normally must be completed within two years to qualify as a timely project under the Linkage Policy.

Thus, it appears that the Linkage Policy is satisfactory in many ways, but there are certain practical problems that do occur. To obtain more land for urban expansion, some local governments ignore the supposed willingness of farmers and simply force them to participate in the projects. Thus, a so-called “farmers are forced to live upstairs” phenomenon pervaded many regions in 2010 and 2011 [21], where “live upstairs” indicates that farmers were relocated into multi-story buildings.

This type of offset policy addresses land-use issues at a physical level but neglects farmers' interests at a social level. It gradually causes tensions to increase between farmers and the government, which affects social stability and development. The Blue Book of China's Society [22] shows that annual mass disturbances caused by social conflicts in recent years have increased to approximately 100,000 events, and conflicts caused by land acquisition accounted for more than 50% of that number.

Additionally, implementing the Linkage Policy in some areas has also failed to protect traditional architecture and preserve historical heritage. Some ancient villages have disappeared, and the traditional customs of rural lives and production places, such as cottages, courtyards, corrals, and drying valley farms are also becoming increasingly difficult to find [23]. The social conflicts and the rural native cultural crisis are a warning post for land-development offset policies in China and has motivated the development of detailed measures.

2.3. Integrated Development of Low Hilly and Gentle Slope Land

The policy of Integrated Development of Low Hilly and Gentle Slope Land (the Integrated Policy) is a new solution meant to release pressure from both high urban demand for land at the local level and strict land-use quotas from the central government and is particularly targeted at the hilly regions of southern China. Due to the much more severe scarcity of potential reserved land for agriculture, the local government in the hilly regions has turned to land on the low hills and gentle slopes. In 2011, China's Ministry of Land and Resource issued the "Pilot Guidance for the Integrated Development of Low Hilly and Gently Sloping Land (*Diqiu Huanpo Huangtan Deng Weiliyong Tudi Kaifa Liyong Shidian Gongzuo Zhidao Yijian*)", and selected 11 provinces as the pilot areas for the development projects.

The Integrated Policy removes or changes the low hilly and gentle slope land into flat land (or uses slightly sloped land that is suitable for industry or agriculture) through load shifting, balancing earthwork, readjusting water systems and other measures. The new land can be used directly for industry. This type of land development is valuable, not only because it provides land for construction but also because it avoids occupying cultivated land. In other words, it compensates for the potential occupation of cultivated land. Cultivated land is now confronted with strict controls by the central government and must also satisfy the Balancing Policy. Thus, the Integrated Policy is another type of land-development offset policy in modern China.

As with the Balancing Policy and Linkage Policy, the Integrated Policy is dominated by the government, which covers the stages of planning, investment, implementation, monitoring, checking, registration, and transfer. If the hilly or sloped land belongs to farmers, the local governments must acquire the ownership from rural, collective-owned or state-owned entities before servicing the land.

In practice, local governments are eager to undertake such projects for purposes of local development because the Integrated Policy provides a way to avoid strict centralised control in utilising cultivated land for construction purposes. However, the central government itself is worried about the possibly negative ecological and social consequences. On the one hand, implementation of the Integrated Policy requires land acquisition, which might result in social conflicts. On the other hand, the low hilly and gentle slope lands are mostly ecologically vulnerable, and their ecological restoration capacity is limited. Implementing large-scale projects might result in irreversible damage to the local ecosystem. For example, the project could affect the animal habitats and threaten biodiversity [24].

Some studies show that the fragmentation and disappearance of natural habitats is the main reason for endangered species extinction; these factors are responsible for 48% of extinct mammals, 49% of extinct birds, and 64% of amphibians [25,26].

2.4. Summary

Preserving cultivated land, balancing the occupation and reclamation of cultivated land, and ensuring food security are the starting points and also the core targets of current land-development offset policies in China. The dominant and powerful role of the government is the main feature of the governance structure for implementing those policies. However, generally speaking, the performance of such mechanism is not satisfactory.

The Balancing Policy compensates for the amount of cultivated land but does so at the cost of the ecological service value of marginal land. It might compensate or release the negative effects of occupying cultivated land by urban expansion but that leads to new ecological damages.

The Linkage Policy attempts to solve the conflict between urban land demand and rural agricultural land preservation in an innovative way by readjusting construction land within a project area covering rural and urban areas, but the practical implementation has led to unexpected social conflicts and cultural difficulties.

The Integrated Policy seems to be an offset policy adapted to local conditions. For example, it shifts land development from occupying cultivated land to targeting untouched slope land in the hilly areas of some cities in southern China, which is considered an improvement in terms of land-use efficiency. However, it inevitably leads to environmental deterioration and negatively affects social stability.

In summary, although China's land-development offset policies were originally environmentally friendly and targeted efficient land use, implementing these policies has not led to satisfactory results. Given that there seems to have developed a worldwide consensus about land-development offsets, other countries' experiences might be valuable for China to learn from with regard to its near-term policy reforms.

3. Land-Development Offset Policies in Germany

Land-development offset in Germany, or—generally speaking—ecological offset, has been one of the main concerns of German planners since the 1970s. Now, concerns about nature conservation and compensation have become even more important at the federal level because land-use conflicts with regard to spatial planning are much more severe. For example, the federal government in Germany committed itself to reducing the growth of settlements and traffic areas from 114 hectares (2004–2007) to 30 hectares per day by 2020 [27]. That commitment shows not only that there are on-going farmland occupation activities in Germany but also that land-development offset measures are required to find synergy between development and occupation. Notably, land-development offset policies have been evolved in Germany over a long period of time. They have a strong legal basis, and the country has a well-designed planning system with sufficient public participation and a newly established market modality.

The German land-development offset process is actually an integrated ecological compensation system for offsetting interventions in or impacts on landscape and nature that does not merely focus on

land resources. However, because most development projects are related to land-use changes and because most compensation measures are based on land, we can discuss land-development offset based on the general environmental compensation policy. From the perspective of the Nature Conservation Act, an impact on landscape and nature only evolves when land resources are demanded to construct settlements or infrastructure and land use change leads to a further sealing of soil. In other words, the demolition and rebuilding of settlements or infrastructure on the same lot to the same extent does not represent an impact. Furthermore, it is to emphasize that land use changes caused by agriculture, forestry or fishery, e.g. the change of grassland into arable land, the planting, growing and harvesting of agricultural crops or the clearance of a forest, are not valued as an impact, even when landscape's and nature's transformations are quite obvious and cause negative effects.

Land-development offset has a long-standing legal basis, *i.e.*, the Nature Conservation Act [28], which addresses the role of landscape plans at different levels to fulfill the purposes of natural conservation and landscape management. For example, the landscape plans define potential areas to serve as high quality biotopes and corresponding measures for achieving ecological offset, which constitute rigorous legal bases and practical solutions for land-development offsets [29]. Various measures have been designed in the context of planning to fulfill the demands of the Impact Mitigation Regulations (IMR, *i.e.*, *Eingriffsregelung*) (The German term “Eingriffsregelung” can also be translated into English as “Intervention Regulation”, instead of “Impact Mitigation Regulation”. For reasons of simplification and unification, we concentrate on the term “Impact Mitigation Regulation” in the paper), including the compensation of biotopes and improving landscape scenery [30]. The publicised measures constitute a toolbox that can be used by different interest groups to participate and cooperate in the implementation process. After a long period of practical activity in Germany, implementing IMR has gradually changed from strictly hierarchical management to a more flexible mode of implementation, such as the newly established various eco-account systems [29]. Notably, not only the institutional innovation of the eco-account system but also its changing history can represent valuable lessons for other countries that are reforming their land-development offset policies.

3.1. Legal Basis for Land-Development Offset

Land-development offset in Germany can be traced back to the compensation principle of IMR in the Nature Conservation Act, which was enacted in 1976 (and amended in 2002 and 2009). This statute provides the legal basis for ecological compensation and landscape management in Germany and clearly defines the main aspects of natural conservation, including concepts, purposes, landscape planning, rights and obligations, stocking of offsetting measures, and responsibilities between federal and federal state governments. It also describes the implementing legislation for the compensation principles that must be passed to the Länder level (German federal state's level) [31,32].

Although the Nature Conservation Act is a formal law at the national level, its implementation may differ due to its broad and non-specific features, as well as Germany's federalism including both a certain degree of freedom and responsibility for each state at the same time. For example, federal states have to design state-level laws and landscape plans on their own [33,34]. At once, national legislation often uses opening clauses in favour of the federal state. Moreover, two competent authorities that are in charge of nature conservation and landscape management, *i.e.*, the Federal Agency for Nature

Conservation (Bundesamt für Naturschutz, BfN) at the federal government's level and the federal state's level, are defined from the national level of the Nature Conservation Act [35]. This legislative framework means that acts at the federal states' level may differ with regard to the content of laws, the design of landscape planning, and the detailed measures for ecological compensation in each state. Federal states' freedom includes the legal right to design landscape plans within each state and the right to formulate the criteria to define ecological compensation. As a result, the freedom has led to diverse implementation of land-development offsets between different federal states.

3.2. The Role of Landscape Planning and the Defined Offset Measures

Landscape planning is considered one of the most fundamental tools of environmental conservation and the basis of various ecological offset measures [29]. The content of landscape planning includes descriptions of and justifications for specified purposes of nature conservation and landscape management, and of the requirements and measures that serve to achieve such purposes. There are four levels of landscape planning in Germany: (1) landscape programmes (*Landschaftsprogramme*) for the entire area of a state; (2) landscape master plans (*Landschaftsrahmenpläne*) for several districts in a state; (3) landscape plans (*Landschaftspläne*) at the municipal level, and (4) the open space structure plans (*Grünordnungspläne*) for sections of municipalities.

Although landscape plans vary in different states, they usually contain common information about (1) the existing and anticipated status of both, nature and landscape; (2) the specific purposes of nature conservation and landscape management; (3) the assessment of the existing and anticipated status of nature and landscapes on the basis of these purposes, including any resulting conflicts; and (4) requirements and measures related to achieving the specific purposes of nature conservation and landscape management.

Normally, landscape planning—particularly at the lower levels—provides a comprehensive set of measures regarding compensation for various types of impact [29]. Landscape plans often recommend large numbers of offset measures. Therefore, landscape plans are closer to a “supply-side” planning instrument [29] and, in practice, typical compensation measures include the following: (1) improving biodiversity in habitats and protected landscapes; (2) improving agricultural practices by switching from intensive to extensive management forms; and (3) improving forest management practices [36].

Additionally, the information, objectives, and detailed conservation or development measures discussed in the landscape plans must be integrated into corresponding comprehensive spatial plans to become valid and to be implemented in practice. In 1993, the IMR was made mandatory for municipalities during local land-use planning, which reflected a policy that was originally set forth in the Nature Conservation Act. In 1998, the provisions governing how environmental impact is regulated in land-use planning were also established in the German Building Code [37].

Therefore, in addition to the Nature Conservation Act, the German Building Code also requires municipalities to draw up landscape plans, which typically facilitates the application of impact regulations. The municipalities can then prepare location and design measures for future projects on an integrated basis. Thus, landscape planning by local governments can provide the basis for IMR measures and offset calculations and can also serve as the compensation mode for compensation pools in the second phase (see Section 3.4).

3.3. The First Phase of IMR: A Hierarchy of Mitigation and Compensation

Since the Nature Conservation Act was enacted in 1976, the IMR has become its most important and effective instrument for planning authorities to evaluate the environmental impact of certain activities. It is similar to the requirement in the Environmental Impact Assessment (EIA) Directive, which aims to provide authorities with information about projects that is necessary to assess the likely significance of the environmental impact. For example, Article 5(3) of the EIA Directive states that a developer shall provide information about their project and a description of the measures envisaged to avoid, reduce, and (if possible) remedy its adverse environmental effects [38], and the authorities can then make a decision about a specific project [39].

The core principle is to conserve and develop the capacity of nature and the landscape to perform their essential functions and to define the proper mitigation, compensation and substitution (Other terms for “compensation and substitution” that are similarly used in the current literature and have the same meaning are “restoration and replacement”. Again, for reasons of simplification and unification, we concentrate on the terms “compensation and substitution” in the paper) measures to reach a balance [40]. Therefore, polluters must obey the ground rules, *i.e.*, the so-called mitigation, compensation and substitution hierarchy [29,41]. In brief, land developers who exert an impact on nature and the landscape that cannot be avoided should first mitigate such impact and then must abide by certain compensation and substitution measures with respect to the damages from such impact that cannot be mitigated.

Compensation measures must be implemented in the correct functional context. However, if such implementation is not possible, substitution can be implemented [42]. Given the two measures, the normal procedures for land-development offset include the following: (1) a preliminary judgment about the impact of the development project; (2) a determination of the most suitable method to estimate the landscape qualities and natural functions of the site; (3) a judgment as to whether the impacts of the project can be avoided or minimised; (4) designing compensation measures; (5) weighting the project with relevant interests based on public opinion sampling; (6) designing substitution measures for the impacts that cannot be mitigated; (7) calculating and guaranteeing financial issues; and (8) making a final decision about the compensation by using the balancing principle [38].

Given the two types of measures and the common procedures, the worry is that substitution measures might simply become an extra toll for a developer seeking to undertake a project that will impact the environment (Considering the implementation of the Balancing Policy in China, most developers choose to pay the government for reclamation costs rather than ensuring that the occupied land has been compensated for elsewhere). Therefore, with respect to the practical performance of the compensation principle, another requirement was introduced in 1987 for permits in Germany. Thus, approval of a development project depends on whether the project’s impact on an existing environment or landscape is acceptable (as determined by public opinion, in particular) under the compensation measures for the site [38]. The new requirement made it essential to first do everything possible to repair negative impacts. Compensation measures became the dominant requirement for project approval.

However, the requirement was so strict that it presented many obstacles for developers in practice. Thus, the Nature Conservation Act of 2002 has been modified such that both compensation and substitution might be treated simultaneously and equally. Although there is a risk that substitution

measures will be accepted that have less of a relationship with the affected functions than would have been possible under the previous act, the practical balance has improved. Nearly all federal states are now entering into the second phase.

3.4. The Second Phase of IMR: Mitigation Banking and Compensation Pools

Due to the complex procedures, the strict constraints of hierarchical management and the unsatisfactory results of IMR implementation, Germany's Federal Building Code was amended in 1998 to optimise enforcement and implementation of compensation measures; in 2002 and 2009, the amended Federal Nature Conservation Act further loosened the spatial and functional relationship between impact and offset (in-kind/onsite vs. out-of-kind/offsite), which led to the emergence of advanced and aggregated offsets (pooled spaces and measures, as well as the so-called "eco-accounts") [30,41]. The new ordinances—which offer off-site compensation in pools—commit to a much more elaborate examination of the question of how to realise the possibility of appropriate compensation at some distance from the impact. As a result, a simpler and more integrated governance mode for land-development offset emerged in the late 1990s. Since 1998, the system of so-called "eco-accounts" has been installed in many municipalities in Germany [43].

As discussed above, in addition to national level guidance, each federal state has its own regulations regarding how to implement the IMR and how to handle the required land-development offsets in practice, which emerged not only because of the different context of landscape planning but also because no specified balancing and evaluation methods are defined at the federal level [30]. The main steps for establishing an eco-account system are to be determined pursuant to the legislation of the different federal states, such as (1) recording, assessing, and accounting for advanced compensation and substitution measures; (2) requirements pertaining to the approval of such accounts and their tradability; and (3) transferring offset responsibility to third parties that carry out measures in advance [28].

Therefore, it is difficult to describe the eco-account system in detail at the national level because there is substantial diversity of organisational modes (e.g., who manages and how to manage the account) and of evaluation and balancing methods (e.g., biotope valuation procedures or compensation area coefficients) (A unified eco-account system at the national level does not exist, however a unified IMR is in progress). However, there are common characteristics among the different eco-account systems that we can discover, if we focus on how to establish a system that not only meets the requirements of strict natural conservation but also approaches the synergy between development and protection in a flexible manner. More importantly, some characteristics have already been used by other governments in reforming their countries' offset policies. Thus, we only focus on certain common characteristics here, and we sometimes use detailed cases to illustrate specific terms or organisational modes.

(1) What is the Eco-Account System?

An eco-account system is a system for stocking, measuring, and accounting for compensation or substitution measures in a region that is based on related landscape planning. There are three key elements in an eco-account system: (1) a pool of appropriate lots (PAL/*Flächenpools*); (2) a medium of exchange, like e.g. eco-points (*Ökopunkten*); and (3) eco-accounts (*Ökokonten*). Generally speaking,

as soon as a measure on one of the lots within the PAL is realised, the eco-accounts covering the entire surface of a region can be enlarged and used (or even traded in the form of eco-points) for measures to compensate or substitute impact. Detailed information regarding the three elements is described below.

Landscape plans in some states, such as in Baden-Württemberg, define the areas of existing high ecological value (“areas of maintenance”) and areas of high potential for “high quality biotopes” [43]. Those potential areas of high ecological value will be carefully investigated and planned such that suitable measures can be implemented for ecological restoration [44]. The planned areas/plots are then defined as a PAL. The following describes the steps of the planning stage.

A PAL provides collection and concentration of usable areas that are prepared for compensation; additionally, a PAL guarantees cumulative compensation with respect to suitable sites by purchase or lease within a unified planning scheme. Thus, an ecologically advantageous bundling regarding the avoidance of selectively fragmented compensation can be achieved [45].

Once a landscape plan has been designed, the eco-account (*i.e.*, an account for stocking advance compensation and substitution measures) is also defined because it is based on the PAL. When the responsible local government, the developer/polluter itself, or even a third-party agency implements the measures of the PAL or a subset of those measures, the ecological gain is accounted for in the eco-account [46,47].

How is the change in the eco-account calculated? In some states, including Baden-Württemberg, the eco-account is calculated in the form of eco-points. Eco-points are the credits that are given per lot, depending on the difference between the biotope qualities before and after the measurement realisation and the acreage of the lot. The fulfilled eco-point can be added into the overall eco-account of the municipality (or region) [45]. The eco-account elicits the principle of a savings account, *i.e.*, an ecological “credit” that is “saved up” by advanced compensation measures and later “debited” at an appropriate date. In contrast to bank accounts, eco-accounts cannot be “overdrawn”.

To simplify the booking of offsets (+) and impacts (–), most eco-accounts are based on a data bank, such as ACCESS [43]; such data banks can be updated regularly and simplify data transfer and control. The eco-points are ready for transfer to any development project that balances the ecological impacts on a market-trading basis. However, it should be pointed out that this is not an “open market or economy”. Since federal states implement the IRM and eco-account systems individually, and have differing methods to evaluate impacts, there cannot be a transfer between federal states. Moreover, federal states are divided in different natural areas depending on the landscapes and their natural functions; also a transfer between those areas is normally not possible. What is more, the PAL and eco-account are registered in the local nature conservation authorities. The authorities typically play the role of supervisor in managing eco-accounts. Of course, if the authorities have their own eco-account, they will implement the ecological restoration themselves [48,49].

(2) Running Eco-Account Systems

The diversity in accounting credits and implementation of eco-account systems is caused by the clearly defined responsibilities of federal and federal state governments in the Nature Conservation Act. At the federal level, no legal provisions exist that specify which balancing and evaluation methods will be used to determine appropriate compensation under the IMR. There are currently at least 40 published

evaluation approaches in Germany, such as the so-called verbal argumentative method (which is a qualitative descriptive approach that is based on case-by-case expert judgment) or the more quantitative approaches, which include biotope valuation procedures, compensation area coefficients, and cost-of-restoration approaches [30,50]. Every method of balancing and evaluation has advantages and disadvantages, and actually there is no commonly accepted evaluation method in all federal states of Germany.

Meanwhile, no exact information exists about the total number of pools, but more than 1000 single pools are known and they differ considerably in their structure, organisation, and financing [41]. Hence, an eco-account system can be administered by different actors, including local governments (e.g., municipalities), private investors (e.g., developers), third-party agencies (e.g., land agencies) or statutory bodies (e.g., nature conservation foundations).

If local government administers the eco-account, it will be responsible for managing the PAL, e.g., acquiring the potential plot from private owners for fulfilling the specific offset measures or implementing measures on the plots that are owned publicly. For example, the municipality of Dettingen in the federal state of Baden-Württemberg runs its own eco-account system [43].

A private investor may also sign a contract with the responsible local governments (e.g., a district administration or the county authorities) to establish pooled spaces and measures and an eco-account owned by the developer; for example, the Rhineland-Westphalian Water Supply Service (RWW) in the Dorsten-Schermbeck Cultural Landscape region [41]. The contracts include that the RWW can implement environmental offset measures at its own pooled space, which can subsequently be counted as actual compensation and substitution measures for various impacts. This type of governance has financial advantages to that of merely relying on government budgets and is effective at implementing compensation measures for developers and local governments.

A private third-party agency may also manage an eco-account for purposes of economic benefit via the trading of eco-points (such as the Ausgleichsagentur SH GmbH in Schleswig Holstein) [36]. The precondition is obtaining official authorisation; in this case, a separate supervisory structure must be implemented by the local government. Since a compensation pool offers an immediate financial advantage and also offers an indirect financial benefit regarding accelerated planning permission procedures, conducting offset has become an incentive for a third party to implement the required compensation and sell eco-points to the developers who must compensate their impact activities but do not have the opportunity to do it on their own. The land developer may sign a contract for a third party to manage a pooled space as part of the compensatory measures or may assess the ecological cost of its impact by calculating the number of eco-points to offset, which it will buy from the third party that is managing the eco-account [45,48].

In summary, land-development offset in an eco-account system may be implemented cooperatively by the government, private investors, statutory bodies, or land agencies (For example, in many cases, actors cooperate with each other, e.g., a statutory body like a foundation owns the land resources of a pooled space to make sure that they stay in nature conservationist's hands, while a land agency (in form of a limited liability corporation (GmbH)) is accountable for the management). Local governments are in charge of developing the municipal landscape plans, which form the basis of the eco-account system (for details, see [36]). Of course, the local governments can also undertake the practical measures themselves, if they choose to seek more profit. The developers are responsible for

implementing the compensation and substitution measures or buying eco-points to offset the development project, which is considered to be an overall Pareto improvement. Third-party agencies (if they exist) derive profit from selling eco-points and are responsible for management of pooled spaces and measures and help the developers to meet the final balance of the environmental impacts.

(3) An Example of an Eco-Account System in Baden-Württemberg

Given the similar design of the concepts of PAL, eco-points, and the eco-account system discussed above, the municipality of Dettingen in the state of Baden-Württemberg has undertaken the responsibility of managing a local eco-account. The Dettingen government employs four steps, which include designing the landscape plan, defining and preparing for the PAL, stocking compensation into the eco-account, and compensating for the impact of development projects.

The municipal landscape plan defines the existing areas of high quality biotopes and potential areas for high quality biotopes; the potential areas are the basis for defining the PAL. It should be noted that the lots in the defined PAL might be privately owned; therefore, the municipality should formulate a good strategy for acquiring the private lots to ensure that enough lots in the PAL reduce price speculation. Based on the short- and medium-term plans, the municipality makes the decision regarding realising offset measures on the lots in the PAL. Once the measures are completed, the eco-points are obtained and transferred to the local eco-account for future compensation use.

Table 1 shows an example for calculating eco-points on a development project. The eco-points of different land use were designed and documented in a catalogue by the authority of the eco-account system. The general range is from one point for asphalt to 64 points for very rare and highly specified biotopes, such as wetlands.

Table 1. A calculation of eco-points in Dettingen in Baden-Württemberg.

Impact: development of a new residential area on a meadow (1 ha, 60% asphalt/buildings, 4% house gardens)	
Ecological value before development (13 points for meadow \times 10,000 m ²)	130,000 points
Ecological value after development (1 point for asphalt \times 6000 m ² + 6 points for gardens \times 4000 m ²)	30,000 points
Eco-balance 1:	−100,000 points
Eco-account measure: change from intensive field use to extensively used dry pasture on a plot of 8 ha	
Ecological value before compensation (4 points for intensive use \times 80,000 m ²)	320,000 points
Ecological value after compensation (19 point for extensive use \times 80,000 m ²)	1,520,000 points
Eco-balance 2:	+1,200,000 points
Net gain:	+1,100,000 points

Source: adapted from [43].

In the example represented in Table 1, the local government fulfilled an ecological measure of changing from intensive field use to extensively used dry pasture, which obtained 1,200,000 eco-points

and was added into the local eco-account. Once the development for the new residential area on a meadow is in demand, the developer should pay the local government for obtaining the eco-points from the eco-account for the residential project. Generally, the costs are approximately 1%–5% of the land price. Therefore, the offset costs are shifted proportionally to the building owners. There remain 1,100,000 eco-points for the municipal government, which may be used to offset other projects in the jurisdiction in the future. It should be noted here that the eco-points for different land use are defined and authorised by the government. As discussed in [30], it is challenging to find a reliable evaluation method in the current stage of the development of the eco-account system.

3.5. Summary

The German concept of land-development offset is comprehensive; it is universal for all land and does not apply only to special areas. The program focuses on the ecological impacts instead of focusing on the amount of special land usage. The first priority is to reach a balance for every natural function in its current context (Balance here refers to the principle of “no net loss”. This principal aims at a neutral balance between the loss of ecological value linked to a land-development project and the gain offered by the offset). The second priority is to balance each function with another function in the same context—or with the same function in another context. The integrated compensation measures, which combine compensation and substitution, are considered to be a comparatively developed mechanism in the world [38].

Compensation measures, e.g., land consolidation and reclamation, not only restores land use but also focuses more attention on the sustainability of the entire ecological system, including biodiversity, the quality of human life, and other conditions regarding the co-existence of societal and ecological systems. Cases involving mining area restoration belong to such categories [51,52]. Substitution measures emphasise balancing the ecological services in a more general context, *i.e.*, in a spatial context that is part of a larger region and with respect to non-specific individual duties among different actors.

At later stages, the eco-account system not only improves professionalism and reduces implementation costs but also avoids the potential side effect of further land reclamation when there is no overall landscape planning. Additionally, trading measures form a pool of eco-points that facilitate larger development projects at the regional or national level. Therefore, the eco-account system is a solution that let developers and planning supervisors avoid direct involvement in these complex procedures, as well as offset-delays, moreover it gives the opportunity to launch substantial and large nature conservation projects. Meanwhile, the land-use offset constraints have become an incentive—sometimes for a third party (such as an officially authorised compensation agency)—to implement the compensation in advance.

The German land-use offset policies demonstrate the importance of public participation during the landscape-planning stage and the compensation pool formation process. As with China’s land-use offset projects, the German practice also requires land purchases from the original landowners and/or relocating farmers. In the weighting stage between designing restoration compensation and designing replacement compensation—or in the stage where planning authorities are buying lots for the PAL within the procedures of establishing an eco-account system—achieving the acceptance of various stakeholders is one of the most important requirements for approval and implementation of any offset

project [53,54]. Given this precondition, the social conflicts and the damage to local culture should be minimised, and historical heritage sites should also be preserved in the newly reclaimed areas.

It is notable that there are also challenges faced by the German model, even in its second phase. For example, land-development offset projects are not always sustainably maintained according to the offset plans. Tischew *et al.* [51] examined 326 restoration projects for traffic development in Germany but found that only 33% of these projects were properly maintained in the subsequent conservation and management stages, which reveals the absence of a long-term management mechanism in the German system. The hidden flaw is an enforcement gap for small compensation measures; this situation might be improved, if information about where and how compensation measures are carried out is made available to the public. Meanwhile, the offset measures might also be polluter permits for developers to some extent, which indicates that the developers may be able to neglect their duty to minimise or mitigate certain negative effects as much as they can and may simply rely on providing compensation, *i.e.*, by paying money [41]. Additionally, municipal governments may not always benefit from such offset policies, because they can be barriers to attracting external investment due to higher local offset costs than in other regions.

4. Comparing Land-Development Offset in Germany and China

The German land-development offset system is believed to be one of the comparatively developed models in the world; it has been in place for a long time and has demonstrable economic, social, and ecological outcomes [38]. The German model addresses the protection of the land system itself (The German mode hereafter means the second phase of IMR implementation in Germany); the entire natural system and social system are both taken into consideration. Conversely, China's model is not so satisfactory.

Generally, the land-use offset activities in China contribute to the 120 million red line of cultivated land preservation. Therefore, these activities are meaningful for national food security objectives. However, the quantity-targeted compensation has resulted in the degradation of the quality of the cultivated land at the national level because newly reclaimed land is mostly far away from regions that have well-developed facilities and infrastructure. Such land may even be untouched in an ecologically sensitive area, such as slope land or wetlands. The decreased quality actually harms food security objectives and threatens the ecological service value of the total land system. Unfair discrimination against farmers during land acquisition for the purpose of reclamation also causes many social conflicts and cultural problems. Therefore, it is valuable to discover the reasons behind the differences in land-use offset performance in the two countries, including direct governance structures and basic institutions.

4.1. Purposes of Land-Development Offset Policies

The purpose of a policy target, *i.e.*, the reasons why the policy was designed and implemented, determines the performance and outcome, to an extent. The purpose of the German policies is to provide more comprehensive land preservation, to conserve ecological service values (e.g., traditional impact regulation), and to provide compensation in a broader context to improve transparency (e.g., eco-account trading). Under such a comprehensive system, the land required for agricultural production, for human life, for stable biodiversity, for social culture, and for synergy between social

and ecological systems can be maintained and balanced. In other words, the German policies aim at a broader and integrated outcome for land-use offset activities.

By contrast, the purpose of the policies in China is much simpler, which is to preserve enough cultivated land to meet the requirements of the minimum quota determined in land-use planning. The Balancing Policy directly ensures that there will be no decrease of cultivated land if any development project must occupy agricultural land. The Linkage Policy can be considered a supplemented policy to the Balancing Policy that ensures that there will be no decrease in cultivated land because cultivated land occupation is strictly controlled by the central government. However, land occupation is also highly demanded at the local level. The Integrated Policy actually aims to occupy marginal land to compensate for the occupation of cultivated land directly. It is clear that the essential purposes of each of the three main land-use offset policies are related to cultivated land preservation, although the contents of the policies are different from one another. This one-dimensional purpose can lead to biased policy design and unexpected side effects, as described above.

4.2. Organisation of Land-Development Offset Practices

(1) Compensation Measures

Offset measures that compensate the negative impacts of land development determine the organisation and effectiveness of the offset implementation process. The German model elevates compensation measures to a higher priority than substitution measures (even in an eco-account system). Only when ecological compensation and land reclamation are impossible can substitution be considered. The offset itself also aims to mitigate and minimise the side effects of any measures, regardless if it is for compensation or substitution. For example, the measures in the eco-account system mostly involve changing intensive agricultural or forest management practices to extensive practices or protecting, maintaining, and improving biodiversity in the surrounding habitat. Pure new land reclamation is not practiced in Germany.

The Chinese system focuses on the balance of quantities of certain land-use types (e.g., cultivated land for food production) which inevitably results in compensation measures involving reclaiming another plot of land elsewhere. This type of reclamation is equivalent to the substitution compensation in the German model. Thus, both the Balancing Policy and the Integrated Policy typically locate the compensation in another spatial context rather than conducting the offset in the same place. The Linkage Policy is essentially the same and replaces land for urban expansion with land for rural construction.

(2) Governances of Implementation

In Germany, compensation is based on the “polluter-pays-principle”, which encourages competent governance structures to organise implementation. Developers have an obligation to ensure implementation of the offset, while the municipal governments also actively participate in the design and monitoring processes. Furthermore, based on the eco-account system, the actor who is in charge of the operation of an eco-account is specialised in and responsible for practically implementing the offset. This type of organisation may significantly improve the process efficiency regarding minimising transaction-costs, developer incentives, and governmental control effects.

However, in China, the government mainly organises the implementation of land-development offsets, and the costs are also mainly covered by the public budget. Although land developers must pay certain fees to the government (currently between 10 and 20 CNY/m², *i.e.*, between 1.17 and 2.35 Euros/m²), the fee is believed to be too low to compensate for all the negative impacts. Even worse, local governments may provide developers certain favourable conditions, e.g., lower cost of using land without any duties to mitigate negative impacts. Because of the GDP-oriented criterion of assessing local officials' performance, local governments are competing with one another to attract developers and investors [10]. In other words, the economic benefits are currently more important than ecological service values. Therefore, local governments take over almost all the duties of land-development offset. As discussed in Section 2, the projects are designed, implemented, and monitored by local governments themselves.

(3) Process Transparency and Fairness (Fairness here means whether the implementation of offset measures has fairly compensated all the affected interest groups. The criteria of fairness include two aspects: "polluter pays" and "the victim should be compensated for their loss")

Apparently, the detailed steps of offset activities are almost identical in both countries and include project location selection, offset planning, budgeting (and raising the budget), implementation, and monitoring/checking. However, the institutional settings behind those steps often differ between the two countries.

Practical implementation is much easier in Germany, because there exist detailed and well-established landscape planning. How a land development project would affect the environment and society and whether the compensation is suitable are issues that are considered and addressed in advance (see Section 3.2). Planning is open access to developers and the public. Therefore, developers and the public will easily know how to implement the project, and access to information also facilitates public scrutiny. Moreover, the eco-account system improves an element of specialisation and professionalism that improves the process efficiency.

China's authorities stipulate certain regulations, but the main features of the offset process might be described as a "black box". There is no transparency in how the steps are completed, practical implementation of policies are not standardised, and there is no formal report on how the offset activities are conducted after the developers pay the reclamation fee. Even for the farmers and residents who are affected directly, it is not clear how the compensation fee is used. What the public can know is that the government will officially announce whether the activities have complied with the Balancing Policy. This type of "black box" is not conducive to the actual objectives of land-use offset and does not facilitate public scrutiny.

There is another issue that typically emerges during the offset process: the fairness of compensating the affected interests groups, particularly farmers. The German land-development offset must cover all the affected interest groups. The main guarantee is from the public participations in the design of landscape planning and in the weighting step in planning the offset project. The planning system also ensures the fairness of compensation cost allocation, following the "polluter-pays-principle".

In China, farmers are always discriminated against to some extent during the land acquisition process due to their weak political position and inherent difficulties in assessing social facilities [4,10].

The incremental value of their land is used for the urban sector, but the impact on their lives and jobs is often not included in their compensation, which covers only the original value of agricultural land use. Other interested groups, such as neighbouring residents whose lands are not affected directly, cannot obtain any compensation. This unfairness in China is evidenced in the incomplete development of formal institutions (see Section 4.3 below).

(4) Assessment Criteria

The ecological–value balance is the core criterion in Germany, which is more effective than the Chinese criterion of mitigating the impacts of land development. Given an EIA basis, all the impacts would be calculated and changed into the same dimension. A single dimension covering different types of impact has many advantages over a single impact criterion, e.g., land quantity. The EIA basis makes it possible to compensate the impact in the right context and in another context—from reclaiming the same amount of land use to executing a more moderate land-use pattern. The compensation itself has fewer side effects on the natural system as a whole. It is also easier for developers to practically implement their projects; they do not need to find another piece of land, and they have more flexibility in finding the best solution regarding economic and ecological costs.

As reflected by the policy purpose, the main assessment criterion of Chinese land-development offset is whether the quantity of cultivated land is maintained. Land quality and related ecological services are neglected. The monetary compensation cost afforded by the government is not important and is not even a criterion because high-level officials focus exclusively on outcomes. The non-monetary costs, *i.e.*, the side effects of offsets, including ecological, social and cultural costs, are seldom considered. As Tan [55] notes, this one-dimensional criterion may lead to unsustainable development for the entire society in China.

4.3. Fundamental Institutions Behind

(1) Land Property Rights

Private owners own most of the land in Germany, particularly the land that is potentially suitable for conducting ecological compensation. Property is meaningfully protected by the German constitution, and affiliated rights are also clearly defined. Based on such protections, the rights and duties within land-use offset projects are also clearly distributed among the government, landowners, and land users. This framework of property rights ensures a sound basis for implementing offset activities.

In China, land-development offset typically involves reclaiming rural land for substitution measures, and most rural land belongs is owned under so-called rural collective ownership [56]. However, farmers' collective ownership frequently faces intervention from the government. Farmers can hardly refuse when the government wants to acquire rural land for the so-called public interest and convert land owned by a farmers' collective into state-owned land [57,58].

Urban land in China belongs to all people. The central government represents the people in such ownership [59]. Practically, the land administration system within the government ensures that state-owned land is well governed, which also results in a relationship that is similar to a principal-agent relationship between the central government and local government in which responsibilities are not

clearly delineated. Thus, local governments govern the land as authorised by the central government with no clearly defined responsibilities. This land property rights setting often results in a phenomenon of the “tragedy of the commons” in land administration, which eventually affects the performance of land-use offset.

First, controlling common property with no clear responsibility inevitably results in short-sightedness on the part of local governments. Only short-term benefits are considered, and long-term ecological benefits are neglected. For example, local governments tend to reduce the land-use offset burden for the developers by asking for lower compensation fees because they want to attract investment and boost their local GDP and revenue.

Second, as another function of ambiguous ownership, local governments tend to use substitution measures to offset land-use impacts because substitution cost is lower than compensation cost (although the effectiveness of substitution may be lower than compensation) because of the ambiguous duties of local governments. It is difficult for the central government to monitor and assess local activities, which further motivates opportunistic behaviour at the local level when local governments conduct offset projects in a formalised manner.

Third, common property may also cause the “free rider” phenomenon. Food security and ecological safety are pure public goods at the national level. Therefore, local governments and individuals tend to shirk their own responsibilities, which may cause an inefficient supply of land-use offset. Meanwhile, farmers themselves also face their own tragedy of the commons, *i.e.*, they will not appeal for the ecological value of their land. Farmers focus solely on economic value, because farmland ownership is a common property, whereas economic revenue belongs to the individual.

(2) Legal Basis

Another fundamental rule that determines the effectiveness of land-use offset is the legal basis. In Germany, strong legal support has been in place since 1976, as discussed above. Land-development offset is mandatory both for different levels of government and for private developers. Therefore, stakeholders must take ecological impact compensation into account when spatial planning, landscape planning, and project development approval are under consideration.

However, there is no such strong statement on land-development offset or ecological offset in Chinese laws. Even the Balancing Policy in the Land Administration Law is not strictly executed. The Balancing Policy requires consideration of other “public interests”, which means that an infrastructure project or a typical economic project that has received government approval can occupy land without considering the offset in advance. Additionally, the use of a quantity-based criterion instead of a quality-based criterion actually reduces the binding power and effectiveness of the related legal statements.

(3) Land-Use Planning

As discussed above, land-use planning is also important in the basic rules for practical land-use offset activities. The German planning system itself aims at synergy between the social system and the natural system, in addition to the sustainable interaction and development of the so-called “Social-Ecological Systems” (SES). Planning is undertaken on a spatial basis [60], *i.e.*, all land plots are specified for certain land uses and for potential future uses. Along with spatial planning, a

landscape plan is also undertaken for purposes of ecological mitigation. If the planned land use is fulfilled, then suitable offset measures should be specified [43]. Given the spatial-based feature of land planning and the attendant publicity, the land-use offset activities are well designed, observed, implemented, and monitored. The spatial planning also has a strong legal basis. The Federal Regional Planning Act (*Raumordnungsgesetz, ROG*) and Federal Building Code (*Baugesetzbuch, BauGB*), guarantee fulfilment of the polluter's duty to provide land-use offset.

The Chinese planning system is based on a centralised and quantity-based quota system that aims to preserve cultivated land and to control the expansion of urban construction [18]. Specifically, the quota system does not take into account the locations of land-use types. Given the context of quota planning, it is understandable that land-development offset at the local level focuses on balancing quotas for different types of land use. However, the process neglects unintended effects on the overall ecological system. As the practical outcomes of the Balancing Policy have shown, such policies have threatened the ecological system [55].

In addition, because the quota is not linked with location, information asymmetry is more serious between the central and local governments, which might promote more opportunistic behaviour at the local level in implementing land-development offsets. Furthermore, unpublicised land-use planning makes public supervision impossible. Although the Land Administration Law states the legal position of land-use planning, such planning has been challenged frequently by governmental intervention. Therefore, the binding effects of planning on land-development offset are dubious.

(4) Relationships among Actors

The basic relationships between the government, market forces, and the public may significantly affect institutional implementation and corresponding outcomes [61]. Implementation of land-development offsets is the same.

The German policies promote cooperation between government and the market and allow for public participation. Although traditional offset activities involve landscape planning by the developers themselves, there are many authorised agencies and companies that specialise in executing ecological offsetting. The agencies, as well as some governmental bodies at the lower level like a district's nature conservation authority (*Untere Naturschutzbehörde*) create eco-points for themselves or private landowners, who authorized them, and sell the points to developers as a substitute for the required offset duties. The eco-points come from standardised land-use offset projects executed by the agencies. The governmental authorities are responsible for supervising the offset projects. Successfully verified land-use offset projects provide agencies with the precondition to sell the eco-points for profit. Given a market basis, all parties are satisfied with possibly maximising total benefits and sharing of minimised costs. Additionally, public participation offers the public a significant role in monitoring the implementation of land-use offset activities. The participation also encourages the compliance of all the involved actors. Although the negotiation cost might increase before and during the project planning stages, the costs at later stages may be reduced by a considerable amount.

The main characteristic of Chinese land-development offset is a government-dominant pattern. Local governments take over all the procedures, including planning, negotiation, land acquisition, project implementation, and the final check. Although it has been argued that this type of public

regulation measure, *i.e.*, *eminent domain*, can reduce much of the *ex-ante* cost of achieving consensus by avoiding hold-out problems, it also inevitably incurs other costs, such as the cost of possible mistakes that are made because of asymmetric information and the bounded rationalities of the decision-makers [62]. Additionally, the special relationships between the central and local governments (*i.e.*, an incompletely defined principal-agent relationship, as described above), and the relationships among the local governments in China (*i.e.*, a “tragedy of the commons” situation), may significantly increase the transaction costs [12]. However, there is an advantage to governmental domination from the government’s point of view. The government can control revenue distribution, including the revenue from land development and, in particular, the incremental revenue from the land-use changes.

Currently, public participation in China is not sufficient in land-use offset activities or during any planning process. Meanwhile, market forces are not actively involved in implementing land-development and land-use offset projects. There is a sign, however, that market forces might improve their role in land-use offset projects in China in the near future. The central government announced recently that a market mechanism should be the dominant force in allocating resources, and there have been several policy trials in certain authorised reforms in recent years [24].

Nevertheless, comparing the land-use offset policies of China with those of Germany indicates that the main differences are at the governance structure level and at the fundamental institutions’ level. The differences discussed above reveal some of the reasons for the differences in practical performance between the two countries, which are summarised in Table 2. This comparison can serve as the basis for a discussion of the implications of the German experience for China in the next section.

Table 2. Comparison of land-development offset policies between China and Germany.

	China	Germany
Core purposes	Farmland preservation	Mitigating or minimising impacts
Organisation process		
<i>offset measures</i>	Substitution only	Compensation first, then substitution
<i>Governance mode</i>	Government pays most	Pollutant pays all
<i>Process transparency</i>	“Black box” Cost unfairly afforded	Transparent process Cost fairly afforded
<i>Assessment criteria</i>	Quota-based	EIA-based
Fundamental rules		
<i>Land properties</i>	Collectively owned or state-owned Intervention from governments	Mostly private owned Strictly protected by laws
<i>Legal basis</i>	Weak	Strong
<i>Land-use planning</i>	Quota planning Unpublicised	Spatial planning Open access
<i>Relations among actors</i>	Challenged by authorities Government-dominated	Strong legal basis Cooperation relationship

Sources: Authors’ own presentation.

5. Discussions and Implications for China

Given the comparison between the two countries, we can now discuss further what China might learn from Germany about ameliorating or reforming its land-development offset policies.

5.1. Reasons for Unsatisfactory Performance in China

Institutions essentially shape human behaviour, so they can determine the outcome of resource use [63]. Thus, it is also understandable that the poor performance of China's land-development offset policy is due to institutional problems. The long-term philosophy of governance and the related institutional settings determine the practical outcome of land-use offset.

Food security is a national strategy (or even an ideology) that has been shaped in the context of the political background domestically and international security. It has been one of the main objectives of land administration in recent decades and has helped train the focus of land administration onto maintaining a certain amount of arable land [55]. This type of governance philosophy leads to biased targets in land-use offsets in China because a substitution compensation measure is favoured over a comprehensive measure that includes compensation.

The long-term mechanism of the economic and political background in China, *i.e.*, the centralised planning systems for entire economies and for society, has indelibly impacted the structure of land administration. A quota-based land administration within a centralised land-use planning system eventually and inevitably results in a substitution compensation measure because the quota balance can only be achieved by reclaiming another plot. However, due to spatial heterogeneity, a substitution measure can cause possibly unexpected side effects of a land-use offset project elsewhere.

If these two main contexts of China's land institutions determine the choice of offset measures and governance, then the fundamental rules are determining the process and outcomes of land-use offset.

First, publicly owned land makes land-use offset a public good at the national level. Given this feature as a public good, local officials will not actively commit to public costs/duties at the individual level, even if they know that land-use offset is valuable to common interests. Such officials prefer to use land reclamation as offset method because it is cheaper and easier, and the undefined responsibilities of central and local governments lead to local opportunistic behaviours.

When local officials face a conflict between a land-use offset requirement and their own performance requirement, they prefer to make their own performance the priority, such as by reducing developer responsibility and thereby attracting their investment because more investment is better for GDP growth. Additionally, centralised governance also centralises duties. Therefore, asymmetric information exacerbates the situation. Because the local governments act as agents of the central government, they are simultaneous landholders, law keepers, planners, and implementers. It is thus understandable for the local governments to downplay the legal basis of land-use offset because the local governments themselves are making trade-offs among different interests according to different conditions.

When the legal basis is downplayed, the affiliated land-development offset planning is underestimated. Meanwhile, planning as a tool that is substantially closed to the governance structure level might originally have been designed to compensate for the flaws of the formal institutions at the institutional environment level. For example, land planning under public law or private law might have such an

effect on allocation land [64], but Chinese land planning does not fulfill this function. Current planning is hierarchically based with no linkages between specific spatial locations and defined land-use quotas. Planning design and implementation also lack public participation and monitoring. Thus, there are many undefined rights and duties in the planning, which exacerbates opportunistic behaviours of local governments and developers.

Perhaps because of the flaws of planning and the downplayed legal basis, or perhaps because of the long-term hierarchical administrative systems, the government at both the central and local levels attempts to dominate the process of land-use offset. Additionally, there might be another incentive for governmental domination, *i.e.*, enjoying or sharing more land revenues. For example, the goal of so-called “seeking land fiscal revenue [65]” has attracted more and more attention recently in China, which indicates that local governments are trying to manipulate the urban market to obtain more revenue from the transfer of land-use rights to urban land users [4]. Seeking this type of fiscal revenue from land is thought to harm the interests of farmers and later generations and to lead to unsustainable development; nonetheless, the behaviour is also understandable. Given that the main officials at local levels have terms in office that average approximately five years, these officials must try to get promoted or else they will lose the political tournament [65]. Furthermore, except for those external investors who might share certain land revenues with local governments, farmers and other actors are mostly unable to cooperate with local governments to share revenues [4]. Hence, certain theoretically efficient governance structures—such as the use of market forces or governmental cooperation with farmers’ organisations—are not common in modern China.

The institutions discussed above determine the outcomes of land-development offset. The one-dimensional land-use offset purposes under public ownership cause inefficient land administration and lead to ineffective land-development offset activities, which results in lower economic revenues, higher ecological costs, and increased administrative costs.

5.2. Reforming China’s Land-Use Offset Policies Based on the German Model

An investigation of the superior performance of land-use offset policies in Germany reveals that institutions play a significant role. The co-existence of private and public ownership of land essentially precludes governmental revenues from depending on land development revenues. The government, either federal or municipal, can thus act as a neutral supervisor of land-use offset policies within the SES of land use, which improves the rationality of target measures and the assessment of land-use offsets.

Given this basic background, the local and central governments cooperate effectively with one another and have clearly defined rights and duties. The municipal level has a strong role in tailoring local development because the municipal government designs the spatial planning, including landscape planning at the local level. Higher-level government only provides guidance at the macro level instead of intervening with detailed affairs at the local level [10]. The relationship between the local and central governments is helpful in preventing opportunistic behaviour among them. The ecological value-based criterion in the spatial planning and landscape planning makes comprehensive compensation measures possible. For example, compensation and substitution can be combined, which is conducive to the overall ecological effects.

Additionally, with public planning, the governance structure of land-use offset activities is transformed. Local governments do not struggle to cope with the illegal behaviours of developers, and they do not have to execute compensation projects themselves. The public can actively participate in and supervise implementation planning. The cooperation between government, private investors, third-party agencies, and statutory bodies that involves sharing costs and benefits is able to achieve more efficient outcomes for land-use offset. Additionally, the federal government can provide a specific and clear legal basis and guarantee, which is also an important condition for practical implementation.

The German experience has many implications for China, and the outcomes of the two countries illustrate the advantages and disadvantages of different institutional configurations. One question raised here is that, if China wants to improve its performance in land-use offset, could German institutions be used directly? The answer is definitely no. This assessment is due not just to what is typically argued—that the external conditions are different in the two countries—but also because, at its core, institutional change related to a SES is an extremely complicated process [66;67]. The institutional change should be cumulative and incremental. Otherwise, the policy changes could have undesirable side effects. Additionally, more fundamental rules require longer periods of time to change when the frequency and cost of institutional change is taken into account, and these changes may incur greater institutional costs [68]. The particular cultural, economic, and political traditions and circumstances of China that are somewhat antiquated may also cause undesirable results with respect to any international transfer of models and strategies [69].

Therefore, regarding the possibility of land-use offset policy reform in China in the near future, a cumulative and incremental strategy should be considered. For example, improving the governance structure should be the priority, rather than changing the institutional environment. Here, we argue that the following measures might be considered for solving the problems of land-development offset in China.

First, a multi-dimensional and multi-purpose framework should be established for land-use offset implementation. The sole goal of maintaining arable land should be transformed into a comprehensive framework of mitigating detrimental ecological impacts. Although changing this goal requires changing national strategies, it can be reflected easily in the design of detailed policies. Of course, the main obstacle is how to formulate a purpose that is closed to ideological norms that become binding rules [70], which, in turn, depends on the design of detailed governance structures for land-use offset. Thus, planning and organisation are required.

Second, if changes of ownership and governmental roles are not realistic in China in the near future, we can focus on changes in land-use planning and landscape planning. The current quota-based land planning system should be changed into a spatial system. At a minimum, quotas should be implemented for specific locations, which will help correct information asymmetry, reduce local opportunistic behaviours, and improve the efficiency of plan implementation. Location-based planning is also advantageous for landscape planning in land-use offset activities, as the German experience has shown. Although the government still dominates the compensation projects, eventual effectiveness might be ensured if responsibilities are clearly defined.

Third, because land-use offset tasks are clearly defined by landscape planning, the actor who implements practical tasks can be based on market negotiation, which indicates that a government-dominant organisation mode can be replaced by other more efficient modes, such as

cooperation between the government and private entities, a self-organised farmers' collective, or even a specialised agency responsible for implementing the offset for profit, which is similar to the German case.

Fourth, the land plans, including landscape planning, should be accessible to the public. Public planning is the basis for public participation and monitoring. Public monitoring ensures the seriousness and legality of the planning, which can help avoid the arbitrary intervention of local governments. More importantly, the awareness of public monitoring can improve the degree of public participation in revising new rounds of land-use planning later, which certainly is good for the effectiveness of planning and for achieving synergy and sustainable development of the economic, social, and ecological sectors. Such an improvement in public participation would significantly improve the role of land-use planning in China.

Last but not least, the proposed policy improvements (which make adjustments primarily at the governance structure level) are helpful for the cumulative and incremental reform of rules at the institutional level. For example, China may not need to change public ownership to private ownership; improvements and innovations in property rights, such as establishing tradable land development rights, might be similarly effective. Alternatively, the centralised governance of the land administration system could be reformed to establish decentralised approval authorities. A market mechanism might also be implemented as the fundamental and dominant mechanism for allocating land resources. These fundamental reforms could be easier and less costly after the aforementioned changes at the governance structure level have been realised. The proposed policy recommendations are important and helpful for the sustainability of China's development in the coming decade, and they are consistent with the appeals of the "Program of Action for Sustainable Development in China in the Early 21st Century", which was released in 2007, and the "National Report On Sustainable Development of PR China", submitted to Rio+20 by the Chinese government.

6. Conclusions

This paper has introduced the main mechanisms of land-development offset policies and described their practical effectiveness in China and Germany. A detailed comparison has also been shown in the paper, which covers three main themes: the purposes of the offset policies, the organisation of the offset activities, and the relevant basic institutions involved. The comparison reveals the direct reasons for the offset outcomes and their effectiveness. The reasons for certain essential institutions are also discussed. Given the comparatively long implementation of German land-use offset policies, we mainly emphasise the implications for China's policy reform based on the German experience, which does not mean to imply that the German model is perfect; we have also discussed some of its flaws in the text.

We follow the logic of explaining institutional change by using the four-level analysis framework of Williamson [68]. First, we discuss the causes of the unsatisfactory outcomes of China's policies at the level of the institutional environment. Then, because of the cumulative and incremental nature of institutional improvements of the "Social-Ecological System", and given the practicality and cost of institutional change, we propose possible solutions for China's policy reform that are limited to the level of governance structure. We believe that this approach meets the practical requirements of China in the near future. Our main conclusions are as follows.

First, the purposes of land-use activities, the processes of organising land-use offset activities, and the fundamental rules are the main reasons for the different levels of effectiveness of land-use offset in China and Germany. The advantages of the German model, particularly the comprehensive compensation measures and assessment criteria, the well-designed land-use planning systems, and the roles of government at the federal and municipal levels, are the most valuable references for China's policy reform.

Second, in accomplishing a reform of the land-development offset policies in China, although many unexpected outcomes of land-use offset are due to fundamental rules, such as property rights and economic mechanisms, we believe that it is better to first design new policies at the level of governance structure and argue for a cumulative and incremental approach to institutional change.

Finally, given the economic and social backgrounds of China and Germany, and considering the obvious differences in their institutional settings and the outcomes of their land-use offset activities, we believe that a comparison and analysis may also provide powerful insights for understanding land-development offset policy itself and for assessing the policies of other countries.

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Author Contributions

Rong Tan conceived and designed the study, redeveloped the parts of Chinese and German experiences and wrote the comparison between the two countries. Rongyu Wang contributed to the first version of the Chinese and German experiences, and collected the relevant information for the study. Thomas Sedlin contributed significantly to the updated version of the German experiences, and helped improve other parts.

Conflicts of Interest

The authors declare no conflict of interest.

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