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Farmland Preservation and Land Development Rights Trading in Zhejiang, China

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1. Introduction

Development in the modern time has created unprecedented wealth in many societies. This material prosperity has also altered the physical landscape and brought about tremendous challenges to the environment and the human society. Industrial wastes contaminated soil and polluted air and water, compromising human health and the quality of life. Rapid urban expansion encroached upon farmland, destroyed natural habitat, and diminished biodiversity. These sustainability issues revealed the Janus-faced nature of development and have fueled a world-wide preservation movement, especially in the developed countries (Ihse, 1995; Antrop, 2004). Fewer people called for a complete halt of development but many people believed that slowing down the progress might be necessary for restoring the natural balance.

Trading carbon emission rights is grabbing people's attention lately (Manne and Richels, 1991, 2004), but regulating land use has long been recognized as one important way of managing development in a society (Brueckner and Fansler, 1983; Kline and Wichelns, 1996; Pacione, 2001). There are, however, different views about effective and efficient land regulations in the fields of economics and urban planning. Until recently, the dominant view endorsed direct government intervention in the form of zoning, acquisition, eminent domain, etc (Heimlich and Anderson, 2001). This view faced skepticism from people who questioned the ability of bureaucrats to strike a right balance in land designation. Government officials might underestimate the real cost of lost development opportunities for the landowners therefore adopted too restrictive land regulations. On the other hand, these regulators might be bought off by developers and preserve too little natural habitat from the community's perspective (McConnell et al, 2007). After Coase's seminal paper on social cost, tradable rights began to attract supporters among urban planners as a superior form of land regulation (Coase, 1960; Barrows and Prenguber, 1975; Mills, 1980; McConnell et al, 2006; Tavares, 2003; Thorsnes and Simon, 1999; Pruetz and Pruetz, 2007). Instead of directly mandating use for specific land plots, governments should define development rights and allow owners of these rights to trade on the open market. Voluntary exchanges could achieve both goals of preservation and land use efficiency.

While the debate on land development rights has generated exciting new ideas, most studies tend to focus on innovations and practices from the United States and other European

countries. Developing countries are generally believed to be behind the development curve and have yet to reach the stage of preservation. To some extent, this perception unfortunately matches the world reality well. But in many fast growing developing countries, the single-minded pursuit of development has already resulted in some major ecological disasters and awakened the awareness of long term sustainability issues in the population. Despite the pressure for growth, policy makers in those societies were forced to be open-minded to more innovative land regulations to accommodate both development and preservation. We fill in this gap by analyzing local experiments of land development rights trading in one Chinese province, Zhejiang in this paper. In particular, we ask the following questions: Why did this innovation come about? Was it a result of larger social preservation movement? Moreover, how were development rights defined and traded on the market? Did the voluntary transaction enhance both goals of land preservation and development?

Zhejiang is one of the most developed provinces in China, but unlike in post-industrial societies, the initial driving force for this innovation did not come from any major preservation movement in the province, rather the local governments in Zhejiang were responding to the central government's requirement of farmland preservation. Likewise, the central government did not react to preservationists' pressure either but only intended to address one perennial problem: food insecurity. This was a common issue in fast industrializing and urbanizing societies but particularly acute in China. Economic reform turned local governments into entrepreneurs and local officials had strong incentive to acquire land for industries and businesses. As a result, farmland declined at an alarming rate and the top leadership was deeply concerned about the potential implications for China's ability to feed its population. This prompted the central leadership to adopt a strict and highly centralized land use regulation regime and assigned limited quotas for farmland conversion for each local government in the country.

This tight regulatory regime was particularly constraining for fast growing regions. As one of the fastest growing economies in China, Zhejiang province also had the worst land endowment. To generate more land for development, local officials in Zhejiang started to innovate and rewarded land development rights to regions that reclaimed farmland from wasteland or rural construction land. They also encouraged land-rich areas to trade out these

rights to places with more development opportunities. Preliminary evidence shows that, through trading, poor yet land-rich regions were able to earn financial compensations from their land development rights and narrowed their gap with rich areas. The latter, on the other hand, obtained valuable land use quotas to attract investments and grow businesses. These happened while the total amount of farmland in the province remained stable. In this sense, this innovation has allowed Zhejiang to manage both development and farmland preservation well.

Our study complements the growing literature on preservation and land use regulation. The world is facing many environmental challenges, such as pollution, global warming, destruction of nature, and loss of biodiversity. While we should certainly celebrate the growing affluence in "emerging" market economies, such as China and India, rapid industrialization and urbanization in these places have also accelerated the environmental deterioration. Scholars need to broaden the scope of discussion and study the policies and practices in these societies as well. After all, future solutions to the global problems need cooperation and even leadership from these countries. We need to understand how preservation issues are conceived in those societies and how policies are designed and why. This understanding can serve as a foundation for future cooperation. Our study also offers a comparative angle to study preservation in other developing countries, which may have very different dynamics than those in developed societies. In the case of China, it was the central leadership's concern about food security that prompted their decision to preserve farmland.

Scholars have discussed land use regulation in China and analyzed how the system was abducted by growth-oriented local governments (Lin and Ho, 2005; Ding, 2003; Yang and Li, 2000). In order to promote economic development and generate fiscal revenues for infrastructure building in cities, local officials acquired large amount of farmland and converted it into development parks, commercial districts, and residential complexes. While acknowledging the tremendous challenge in preserving farmland in China, our study of development rights trading in Zhejiang offers a glimpse of hope. Based on some preliminary evidence we have gathered, market transactions have resulted in more efficient allocation of land use quotas among regional governments. The transfer payments for development rights helped suppress the development impulse in relatively poor areas. More systematic research is clearly needed to draw any

definitive conclusion but this innovation holds a lot of potential and should be discussed more often in the policy circle.

The rest of the paper proceeds as follows. We first briefly explain why the central government adopted the farmland preservation policy and introduce how the centralized land use regulation operates to obtain its goals. The next section examines the impact of this strict regulation on Zhejiang province. We analyze the creation of development rights and the expansion of the provincial quota trading market. The next section presents some preliminary evidence to assess the effect of this trading mechanism. We finally conclude with some general implications.

2. Food security, farmland preservation, and the centralized land use regulation

2.1. Toward the "toughest" farmland regulation in China

China has less than 9% of world farmland yet more than 20% of world population. Simple mathematics can explain why one top priority of the Chinese leadership is to keep its population fed. The ruling party's obsession with food security also came from a traumatic experience in the early years of the new republic. Due to a combination of bad weather and policy failure, more than 30 million people starved to death in 1959 and 1960, making it the largest famine in human history (Yang, 1996). Economic reforms raised agricultural productivity but also discovered more lucrative use for farmland. Growing income in farming household created a housing boom and millions of peasants built new houses on plots for agricultural use. The expansion of Township and Village Enterprises accounted for a large share of the occupied farmland in the rural areas as well. In order to promote development, the central government adopted a fiscal contract system, whereby local governments could retain a share of their surplus revenues (Oi, 1995). Local officials encouraged the construction of small industries and allotted cheap farmland as an incentive. During the 1982-86 period, farmland decreased at an alarming rate of about 8.5 million mu per year. This prompted the central leaders to action and the State Land Administrative Bureau (SLAB) was established to oversee land use in the country.

This first serious land regulation fell short of expectation. After a temporary slowdown in the 1987-89 period (less than 3 million mu per year), total lost farmland returned to the 5 million range in the early 1990s. The legalization of land use rights in the 1987 Land Administrative

Law has contributed to this development (Lin and Ho, 2003). By separating land use rights from land ownership, the central government lowered the barriers for foreign investors but it also opened the gate for regional competition. Growth-oriented local governments raced against each other to build larger and better industrial parks so investors would bring businesses and taxes to local economies. Urban growth also generated demand for residential houses and infrastructures in the cities, which put more pressure on farmland. At the same time, as land owners, local governments earned sizable fees from leasing out land on the market and they became more and more dependent on this source of extra-budgetary revenue after the 1994 tax reform (Zhou, 2007). In short, a number of factors strengthened local governments' drive for more land development in the 1990s.

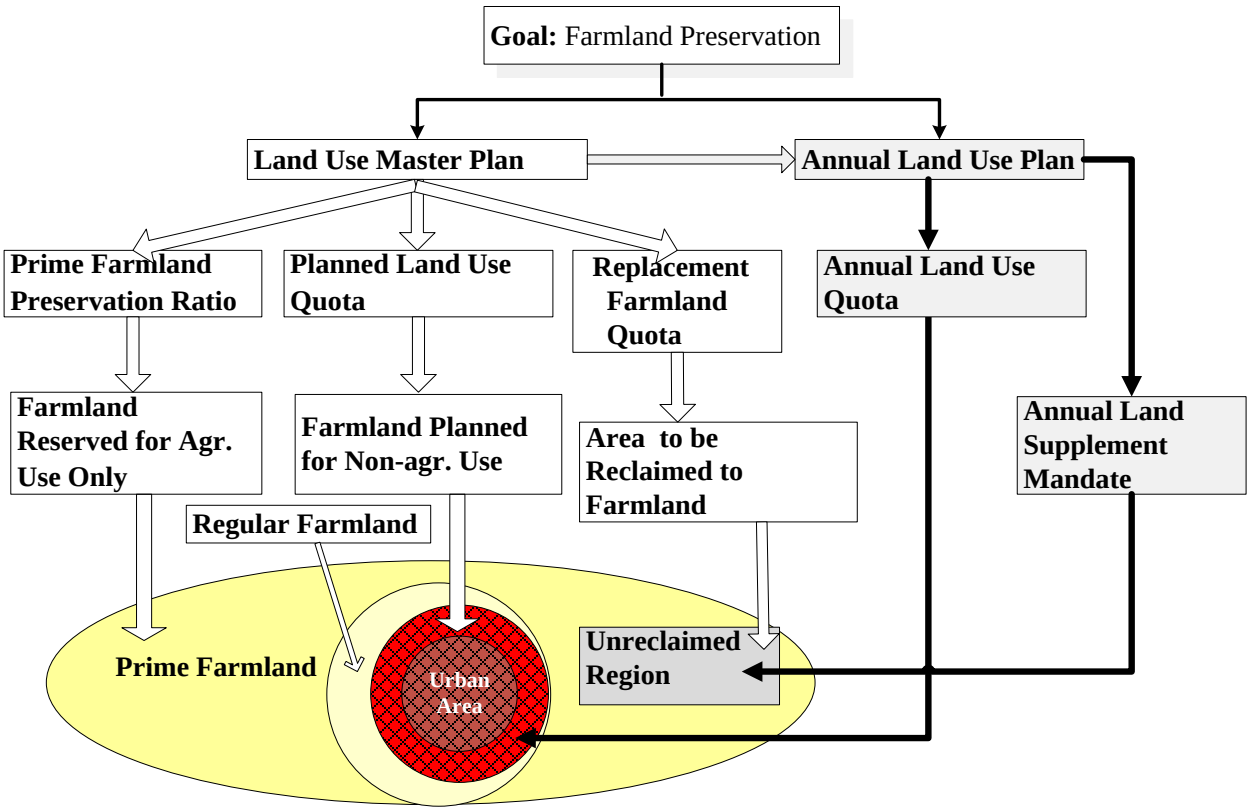
One incident, however, became the catalysis for a major regulatory change. An American environmentalist, Lester Brown, published his book, *Who Will Feed China*, in 1995. He questioned China's ability to feed its growing population as cropland and water became scarcer in the future and warned that huge grain imports from China would cause food crisis in the world. It immediately set off a debate and Chinese scientists and policy makers challenged Brown's data and analysis. But the top leaders got the message and acted swiftly. In April 1996, the Central Party Rural Work Leadership Group charged the State Land Administrative Bureau to study farmland protection and conduct surveys in 13 provinces and 12 major cities in the country. In the first two months of the next year, the central leaders convened three special meetings and listened to the findings from these researchers. They were particularly concerned about the rapid agricultural land conversion in 17 urban areas as shown in the Landsat photographs for 1987, 1991, and 1995 (Lin and Ho, 2003). By April, the center decided to adopt the "toughest" policy to preserve farmland in the country and ordered the Land Administrative Law to be revised to provide a clear regulatory framework.

2.2. Regulating land use under the new system

The 1998 Land Administrative Law departs from the fairly chaotic land management system in the 1980s and vests a lot of regulatory authority in the hands of the central government. Figure 1 provides a simple illustration of this highly centralized system. Land Use Master Plan (*tudi liyong zongti guihua*) and the Annual Land Use Plan (*niandu tudi liyong jihua*) are two major instruments to achieve the ultimate goal of farmland preservation. The Master Plan sets

long-term (usually 10-15 years) regulations on both the quantity and spatial distribution of agricultural land in a locality that is allowed to be converted to construction land (*jianshe yongdi*, referring to land for non-agricultural use). The annual land-use plan breaks down these long-term objectives for each year. Each level of government, from the center to the township, must formulate and observe their land use plans. The township land-use planning is the lowest and the foundational planning where the specific size and location of each land conversion project is marked. In principle, any conversion of agricultural land must fit in the Master Plan and the Annual Plan in a locality. It also needs to correspond to the specific location stipulated in these plans. Since land use plans from upper level governments always precede and override those from below, this institutional framework establishes a highly centralized land use regulatory system in China.

Figure 1. Land Use Regulatory System in China



The first National Land Use Master Plan came into effect in 1997 and covered the period between 1997 and 2010. Its primary goal was to ensure that at least 120 million hectares of arable land should be preserved by 2010. To achieve this goal, the central government introduced two types of land quotas to control land use in both spatial and temporal dimensions: the "planned farmland conversion quota" (PFCQ) (*nongyongdi zhuanyong guihua zhibiao*) defined by the Land Use Master Plan and the annual PFCQ (*nongyongdi zhuanyong jihua zhibiao*) defined by the Annual Land Use Plan. For example, the PFCQ, as stipulated in the 1997 Master Plan, regulates the total amount of arable land that can be converted to non-agricultural use over the period (1997-2010). The Annual Plan specifies the total quotas for non-agricultural use of land for each year and provides direct land use regulation on individual lots. The size and location of the convertible land are specified in the annual PFCQ, which presumably cannot be changed once the plan is approved. In principle, the total size of newly occupied non-agricultural land, as well as its spatial distribution in a locality, if added up by years, must be consistent with the total PFCQ defined by the Master Plan. In another word, for any piece of agricultural land, land use quota must be acquired through the Master Plan and the Annual Plan before land use conversion can take place. As such, the land use quota for construction, as stipulated in the Master Plan and the Annual Plan, tightly controls the amount of convertible arable land in a specific locality and in a specific year.

As shown in Figure 1, besides land use quotas, the conversion of arable land is further regulated through two other means: "replacement farmland quota" (*buchong gengdi liang*) and "prime farmland preservation ratio" (*jiben nongtian baohulv*). Even if the quota is available for converting existing arable land to non-agricultural uses, a locale must fulfill the "replacement farmland quota". The same amount of new arable land must be cultivated, either through land consolidation or reclamation of waste or construction land, to compensate for the lost arable land for the planned construction use. Like PFCQ, this replacement quota is also handed down in conjunction with the land use plans from the central government. This quota aims to maintain the so-called "dynamic balance" (no net loss) in the total amount of arable land within an administrative jurisdiction during the Master Plan period and for each level of local government. As a matter of fact, this was the first time in the history of People's Republic that the government used public authority to regulate the total amount of farmland in the country.

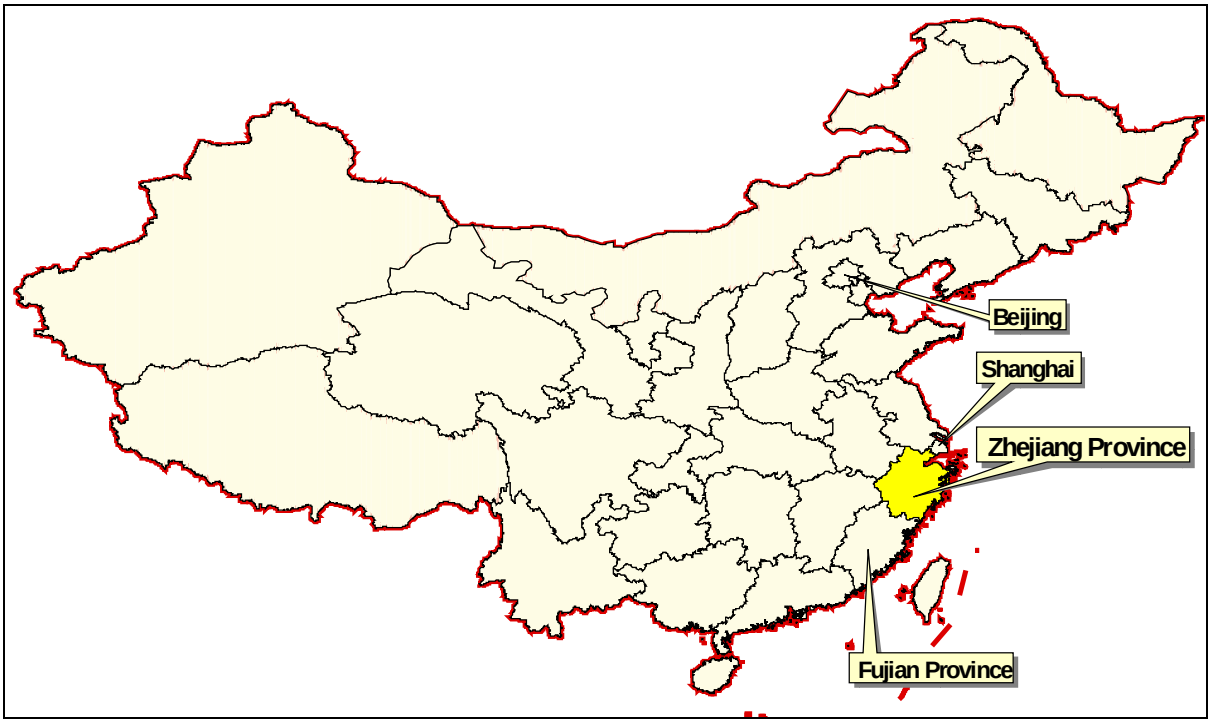
Both the 1998 Land Administration Law and the Prime Farmland Preservation Regulation issued by the State Council in the same year spell out the "prime farmland preservation ratio" requirement clearly. Each province, autonomous region or municipality directly under the central government must preserve more than 80% (mostly around 85%) of its total arable land as prime farmland (defined as the farmland reserved for agricultural use only). This land should be clearly marked in the Master Plan as well as in its physical location. Conversion of prime farmland to non-agricultural use is highly restricted, if not totally prohibited. The only exception, according to the Article 15 of the 1998 Prime Farmland Preservation Regulation, is key national projects for energy, transportation, irrigation, or military installations. And these conversions must be approved by the State Council, regardless of the size of the plot.

In sum, "planned farmland conversion quota", "replacement farmland quota", and "prime farmland preservation ratio" give the central government the means to regulate land use in the country. By setting these quantitative targets and centralizing land approval authority, the top leaders can control the pace of development and preserve sufficient amount of farmland for food production.

3. Development rights trading in Zhejiang: innovation under pressure

A coastal province located in Southeast China (Figure 2), Zhejiang has been one of the most economically dynamic provinces since the economic reform. From 1978 to 2008, Zhejiang achieved an annual GDP growth of 13.08%, ranking the third among all Chinese provinces, only after Guangdong and Fujian provinces. Zhejiang's annual GDP growth during 1998-2008 was still as high as 12.40%, ranking the fifth in the whole nation (NBS, various years). In 2007, the per capita GDP in Zhejiang Province reached CNY 42,214, ranking the first among all the Chinese provinces except the three municipalities directly under the central government (Beijing, Tianjin, and Shanghai).

Figure 2. Zhejiang Province in China



Data source: National Fundamental Geographic Information System

However, Zhejiang has perhaps the poorest land resource in China. Being the smallest coastal province in the country, Zhejiang had a total land area of 101,800 square kilometers in 2007, only about 18.19% of which is arable. Zhejiang's population by 2007 was 51.2 million, 3.8% of the nation total, while the share of Zhejiang's arable land in the nation was merely 1.58%. Therefore, the per capita arable land for Zhejiang was only 0.038 hectare, about 40% of the national average (0.095 hectare).

3.1. Land regulation and efficiency loss in Zhejiang

Like everywhere else in China, land use in Zhejiang is regulated by policies and plans as discussed in section 2, including the Master Plan and the Annual Land Use Plan, replacement farmland quota, and prime farmland preservation ratio. These quotas are all handed down from the center to the province, and then to each level of sub-provincial governments until the township level.

The *Land-Use Master Plan for Zhejiang Province (1997-2010)* was approved by the State Council in 1999 and enacted in the same year. This plan stipulated that a maximum of 66,667

hectares of agricultural land could be converted for construction purposes during the 1997-2010 period. After reserving a quota of 6,667 hectares for its own, Zhejiang provincial government distributed the remaining quota of 60,000 hectares to the eleven prefectures by the following rules. First, if the city got provincial key projects in transportation, irrigation, water conservancy, land quota would be allocated to these projects directly. Second, land quotas were reserved for sub-provincial-level projects in transportation, irrigation, water conservation, or rural residential reconstruction. The formula was based on each city's existing construction land in these four categories and quotas were allocated proportional to its share in the province. Third, the rest would be distributed to each city based upon its existing size of urban buildup area, GDP from secondary and tertiary industries, and the predicted urban area for each city (Zhejiang Provincial Bureau of Land and Resources, 1997).[2] The breakdown of the plan quotas into different prefectural level cities in Zhejiang is shown in Table 1.

Second, as Zhejiang Province was allowed to convert 66,667 hectares of existing farmland for non-agricultural uses, the arable land replacement required that a minimum of 66,667 hectares of new arable land should be developed elsewhere to prevent net loss of farmland. The arable land replacement quota for Zhejiang was actually 77,333 hectares, higher than Zhejiang's planned quota in the Master Plan (66,667 hectares). The provincial government broke down the 77,333-hectare quota and allocated them to each prefectural-level city according to its share of the planned quota of farmland conversion.[3]

Finally, the National Land Use Master Plan assigned 180,733 hectares of prime farmland preservation quota to Zhejiang. This accounted for 85.05% of the total arable land in Zhejiang. Though dramatic differences existed across cities in terms of arable land endowment and future demand for non-agricultural land, the Zhejiang provincial government applied this same ratio to each prefectural-level city, with a variation of no more than 2% across cities (Table 1).

[2] Urban planners in China typically predict the urban area of the end of the planning period by first projecting urban population (including local permanent residents and migrants). The predicted area is then calculated by projected population times the urban land-use standard (100 square meters per person) specified by the Chinese Ministry of Housing and Construction.

[3] Replacement farmland quota only applies to land converted for industrial and residential purposes. Reduction in arable land by natural disasters and conversion to forestry land does not require such a dynamic balance.

Following similar rules, this mandate was then distributed to the county level and further to the township level governments.

Table 1. Sub-provincial distribution of various quotas and ratios in Zhejiang (1997-2010)

City	Area of arable land 1996 (10,000 hectares)	Planned quotas (10,000 hectares)	Replacement farmland quotas (10,000 hectares)	Prime farmland preservation Area (10,000 hectares)	Prime farmland preservation ratio（%）
Hangzhou	25.33	0.99	1.25	21.28	84.00
Ningbo	25.58	0.84	1.12	21.75	85.00
Wenzhou	26.00	0.99	1.36	22.10	85.00
Jiaxing	21.94	0.37	0.45	18.87	86.00
Huzhou	14.67	0.27	0.34	12.62	86.00
Shaoxing	21.16	0.71	0.88	17.99	85.00
Jinhua	24.12	0.47	0.63	20.50	85.00
Quzhou	14.21	0.33	0.41	12.08	85.00
Zhoushan	2.88	0.08	0.11	2.44	85.00
Taizhou	20.73	0.64	0.83	17.62	85.00
Lishui	15.91	0.29	0.35	13.52	85.00
Reserved quota by the province		0.67			
Zhejiang	212.53	6.67	7.73	180.77	85.05

Source: Land Use Master Plan in Zhejiang Province (1997-2010)

This centralized land-use regulation imposed mounting constraint on the province's urban development. For example, for the 1997-2001 period alone, actual arable land converted to non-agricultural purposes had already reached 66,613 hectares, implying that the province had nearly used up all the planned quota (66,667 hectares) for 1997-2010. Huge imbalance also existed across the province. For instance, the six prefectural level cities including Hangzhou, Ningbo, Shaoxing, Huzhou, Jiaxing, and Jinhua used 46,906 hectares of arable land by 2001, 17.56% higher than their 1997-2010 quota! The other five cities (Quzhou, Lishui, Zhoushan, Taizhou, Wenzhou) converted 19,208 hectare arable land, 80.71% of their 1997-2010 quota. Therefore, the Master Plan imposed a very harsh constraint on land use conversion for Zhejiang province as a whole. At the same time, the substantial cross-region discrepancy indicated a lack of consideration of land endowment and land demand in the initial assignment of land conversion quotas to different areas. For Zhejiang, particularly those economically vibrant cities, the constraint was manifested in the following dimensions.

First, land use quotas assigned to Zhejiang could not meet local land demand and slowed down the province's urbanization and industrialization. According to a projection by Zhejiang Urban System Planning (1996-2010), Zhejiang's demand for construction land would be as high as 93,333 hectares between 1997 and 2010. Limited land-use quotas forced all the cities in Zhejiang into a shortage of non-agricultural land supply. The relatively developed cities in Zhejiang, in particular, faced tighter constraints in non-agricultural land quotas as compared to the less developed ones. To make things even worse, since the annual land use quotas were allocated more or less evenly across years while land development needs varied substantially across years due to economic fluctuations, the annual land use plan usually could not meet local land demand effectively, resulting in failed business opportunities in high growth periods.

Second, given limited amount of arable land yet strong demand for construction land, it became extremely difficult, if not impossible, for Zhejiang province to fulfill the central government's requirement of replacement farmland quota. This was particularly true for those more developed cities since they could hardly cultivate an equal amount of arable land in their jurisdictions. New arable land could be developed either through land consolidation (*tudi zhengli*) and land reclamation (*jianshe yongdi fuken*). Developed cities had already used land quite intensively and did not have much room for consolidation or reclamation.

Finally, designating "preservation zone of prime farmland" also limit the spatial possibility of urban development. In terms of spatial distribution of land quotas, the specific location of land that could be converted defined by the Master Plan might well not be able to satisfy actual project needs. The Master Plan only provided a very rough projection of non-agricultural land use and urban expansion for the next 10 to 15 years. This often implied that some development projects could not be effectively carried out unless they violated the regulation of the Master Plan. Once the land use quotas and the specific spatial location of prime farmland were determined, there was very little room to make adjustments. Imposing uniform "replacement farmland quota" and "prime farmland preservation ratio" failed to factor in the regional differences in local land endowment and in local land reclamation and consolidation costs. As early as the late 1990s, local governments in fast growing cities such as Hangzhou, Ningbo, Shaoxing, and Wenzhou, realized that local urban and industrial development had been seriously

hindered by their inability to generate new arable land and by the spatial designation of prime farmland preservation zones.

3.2. Growth of a development rights market

The centralized land use regulation, as discussed in the previous section, leads to serious mismatch between upper-level quotas and local development needs. This problem is seen across the country but particularly in different localities within the Zhejiang Province. The key issue here is that an information asymmetry exists between the upper level government, as the principal of land use regulation on the one hand, and the lower level governments, as the agent of implementing upper level policies on the other. Though in principle allocating quotas by equalizing the marginal productivity of non-agricultural land across localities can help to maximize land use efficiency, this is technically difficult because lower level governments have incentives to over-report their land use needs. More importantly, quota allocation is a highly politicized process. Since more land use quotas mean more growth potential, local governments fight hard in the negotiation process and question whatever “objective” criteria the center uses in the calculation.

The dilemma between top-down quotas imposed on a relatively equal basis across regions on the one hand, and regional heterogeneity in both land endowment and demand for agricultural land on the other, made local implementation of the centralized land use regulations highly problematic. This was particularly true for the most developed prefectures in Zhejiang, such as Hangzhou, Ningbo and Wenzhou. These cities boasted the fastest growth of urban and industrial development in the province. At the same time, millions of migrants from other localities of Zhejiang and from other provinces worked and lived in these cities. As early as the late 1990s, the Zhejiang provincial government was under huge pressure from these cities to allocate more land use quotas and grant more exceptions in fulfilling their quotas in prime farmland preservation and farmland replacement. As a response, the Zhejiang provincial government gradually established a development rights market by creating new land use quotas. As discussed below, some of its practices were local officials’ skillful utilization of policies from the central government. Other innovations constituted more daring breaches of the existing regulatory framework. In terms of the size and regional coverage, this market can be analyzed as two

integral parts: land development rights (LDR) transfers in one region and LDR trading across different regions.

3.2.1. Transferring LDRs within a locality

In addition to prime farmland, there are another two categories of farmland in China, i.e., the regular farmland (*yiban nongtian*) and the farmland reserved for non-agricultural uses. As shown in Figure 3, prime farmland is reserved for agricultural uses only (yellow). In most areas, around 85 percent of total arable land is prime farmland. As to the remaining 15 percent, part of it is specified by the Master Plan for future non-agricultural uses (checkered red), and the other part is regular arable land (stripped peach). For localities where planned quotas and annual quotas could not satisfy local land use demand, the regular arable land constitutes a potential source for urban expansion within their administrative boundaries. However, it is also very difficult for a city to simply convert the "regular arable land" for construction uses since, under the Master Plan, this type of land is still designated for agricultural purposes. Therefore, to convert this type of land legally, some extra quotas must be created and the Master Plan has to be revised. In the late 1990s, Zhejiang provincial government innovated in the following three areas to overcome these barriers.

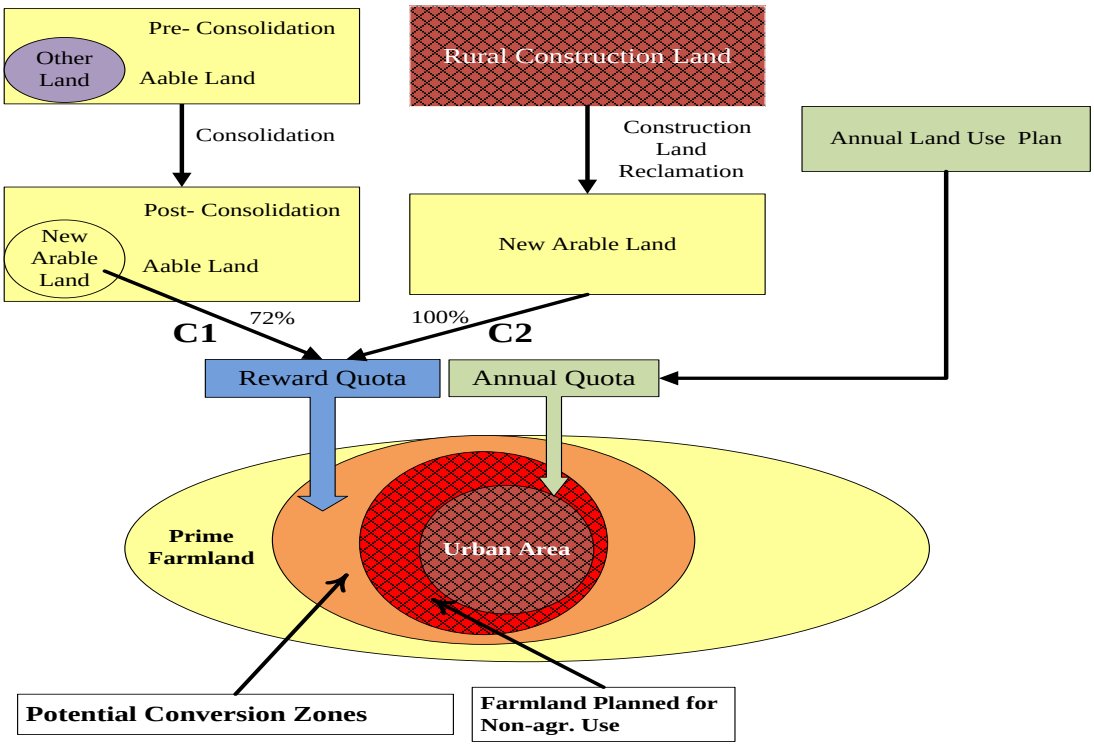
Creation of new land use quotas

In China as well as in many other countries, land consolidation can not only raise farming productivity by improving land quality, but also develop extra arable land since many abandoned land parcels such as isolated garden plots, pond plots and tomb plots can be converted into quality arable land (Monke, Avillez, and Ferro, 1992).[4] Borrowing from neighboring Jiangsu Province and Shanghai Municipality, Zhejiang Province initiated a series of policies to

[4] Land consolidation may be broadly defined as measures to improve land quality that includes (a) expanding the irrigated area and improving plot and irrigation and drainage conditions; (b) improving farm plot configuration, including the plot size, shape, and layout, through a suitable merging of smaller and irregular-shaped plots into larger ones of a regular size and shape; (c) improving farm road systems to provide better access to plots for both workers and machinery; (d) reducing fragmentation of a farmer's land into many small, noncontiguous plots scattered in many locations (Bonner, 1987，Wu et al, 2005). For example, a land consolidation project that covers 1000 hectares of land, of which existing arable land is 800 hectares. If 100 hectares can be used for irrigation and road system, there will be 100 hectare more arable land that can be generated by land consolidation (small oval inside the "post-consolidation arable land" block in Figure 3).

encourage land consolidation. Local governments were awarded construction land use quotas as high as 72 percent of the newly cultivated arable land through land consolidation, a quite high-powered incentive. For example, if a land consolidation program spanned an area of 100 hectares at a cost of CNY 2,250,000 and about 10-hectare of new arable land were generated, given the incentive policy, local governments could obtain 7.2 hectare land-use quota (shown in Figure 3 as C1). Therefore, the cost of acquiring one additional hectare of construction land quota by land consolidation was about CNY 312,500 (2,250,000/7.2) per hectare. Local governments could recover this cost easily from land leasing fees paid by urban land users when they leased out land for non-agricultural purposes. This reward quota policy clearly incentivized local governments to carry out land consolidation in their jurisdictions. The 1998 Land Administrative Law offered incentive for land consolidation as well but allowed only 60% of newly cultivated farmland to offset "farmland occupied for construction purpose". In 1999, the Ministry of Land and Resources clarified that the new farmland could only be used for offsetting construction land quotas in the Master Plan (Ministry of Land and Resources, 1999). Therefore, rewarding new land use quotas in Zhejiang has clearly exceeded central authorization and expanded the total construction land areas in Zhejiang.

Figure 3. Creation of reward quotas in Zhejiang Province



Another approach to generate extra land use quota was to reclaim rural construction land (i.e. land for housing and rural industries) into arable land in agricultural areas so that cities could still expand without incurring net loss in arable land. This could be done, for example, by demolishing the sparsely distributed rural residential houses and arranging farmers to relocate to a more densely built residential area. A policy was introduced in 1999 to encourage this change, with the promulgation of "Urbanization Scheme of Zhejiang". Local governments could obtain an equivalent amount of extra construction land quotas if certain amount of non-agricultural land within their jurisdictions was reclaimed to arable land (shown in Figure 3 as C2). Afterwards, this policy was formally adopted province-wide in 2000 (Zhejiang Provincial Government, Document 77, 2000). This policy was in accord with the central government policy and the Ministry of Land and Resources in fact used this 100% construction land use quota as an incentive for land reclamation (Ministry of Land and Resources, 1999).

Besides more land for development, these extra quotas also allowed for more flexibility in their usage. The annual land use quota had a time limit on a yearly basis and expired if a locality did not use it for the year specified by the Annual Plan. Instead, quotas through land consolidation and reclamation could be accumulated over time and used at any time. Zhejiang province actually created a bank for these land reward quotas. Each locality had its own reward quota account in the Provincial Bureau of Land and Resources. Through this institutional design, reward quotas worked like a deposit in a bank checking account. As shown later in the paper, this reward quota bank became the basis for trading LDRs across localities in Zhejiang.

Designation of potential conversion zones

These reward quotas, however, were only a necessary condition for a locality to use more land for non-agricultural purposes. According to the Master Plan, local governments could only use the quotas in a pre-defined area that is allowed to be converted for construction purpose (checkered red in Figure 3). This type of land must be marked as such in the Master Plan. Since 2000, the Ministry of Land and Resources further required that that all local governments must designate clearly specific locations as prime farmland (yellow in Figure 3). To use these extra

quotas, local governments must be able to find a piece of land physically. Regular farmland was the only option but it needed to be legitimized through local laws and changes in the Master Plan.

Zhejiang provincial government again exploited an opening in central government's policy very skillfully. Since rewarding extra land use quotas through land reclamation was perfectly legal and encouraged by the Ministry of Land and Resources. Regions with reward quotas should be able to redeem their construction land somewhere. Prime farmland was off-limit and farmland for non-agricultural use (checkered red in Figure 3) was for planned quotas only, the only reasonable interpretation of the central spirit was to convert some regular farmland. Since these quotas resulted from reclaimed construction land, the total amount of farmland did not change in the province, again something in line with the central government. In 2000, Zhejiang started to designate parcels of regular farmland neighboring major urban and rural residential areas as "potential conversion zones" in the land use plans (striped peach in Figure 3).[5] Just like the "farmland planned for non-agricultural use" convertible along with planned quotas, "potential conversion zones" could be used when reward quotas were available. This change in land use plans provided a legitimate means for reward quotas. Since 2000, most cities and counties in Zhejiang have designated some regular arable land areas as "potential conversion zones".

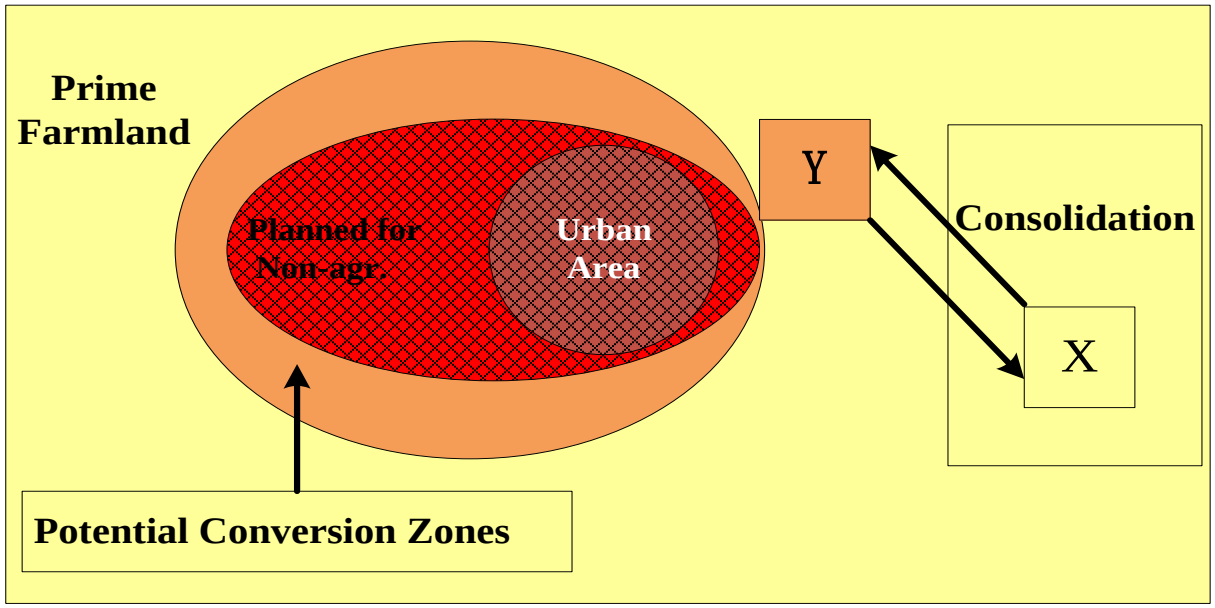
Collective relocation of prime farmland

The widespread practice of "potential conversion zones", however, still did not fully guarantee the availability of non-agricultural land even if a reward quota was acquired. If a land lot has been designated as prime farmland (rather than regular farmland) in township land use plans, it could not be included into the "potential conversion zones", thus unavailable for urban land use. As a result, Zhejiang province adopted another policy known as "collective relocation of prime farmland" (*jiben nongtian jizhong zhihuan*). This policy was started in 1999 when Zhejiang provincial government decided to build a grain base for commercial sales (*shangpin*

[5] In reality, only parcels of regular farmland were designated as potential conversion zones. Making this distinction in Figure 3, however, will be too messy and cloud other real important details.

liang jidi) of 666,667 hectares through land consolidation (Zhejiang Provincial Government, Document 190, 1999). In order to motivate city governments to cooperate, the provincial government promised that, if the newly consolidated arable land was qualified as prime farmland, local governments could swap the locations of this new arable land with an equal-sized prime farmland close to major cities and buildup areas (Zhejiang Provincial Government, Document No. 12, 2001). Figure 4 illustrates this swap. For example, this figure depicts land usage in city A. Surrounding the urban area are regular farmland for non-agricultural use under the Master Plan (checkered red) and regular farmland (striped peach). Because these types of land can be converted or potentially converted to construction land, they are more valuable. Suppose city A generates a plot of high quality farmland (X) through land consolidation on existing prime farmland. Under the new policy, city A can "swap" X for Y of an equal area closer to the urban buildup area. Since arable land through land consolidation (X in this case) is generally classified as regular farmland, it can be designated as a "potential conversion zone" in the land use plan. For the city, the total amount of prime farmland and regular farmland remains unchanged and only the physical location of X and Y is switched. Because land value rises drastically with its proximity to urban centers, this physical change brings about huge profits for city A. But this policy in essence relaxed the geographic restriction of prime farmland under the Master Plan, creating more space for reward quotas.

Figure 4. Collective relocation of prime farmland



3.2.2. LDR trading across regions

Though transferring LDRs within a locality somewhat reduced land use constraints, there were still significant regional disparities in local capacity to effectively break out of these constraints. Some developed cities in Zhejiang province, such as Hangzhou, Ningbo and counties like Yiwu, Yueqing, Rui'an and Shaoxing, had more buoyant demand for non-agricultural land use quotas than other less-developed cities. Yet, their limited land endowments hardly allowed them to have much freedom to earn extra quotas through land consolidation and reclamation. In addition, with the demanding requirement of "prime farmland preservation ratio" and the limited potential in cultivating replacement arable land, these localities could not take advantage of local policies such as "potential conversion zones" and "collective relocation of prime farmland". After numerous policy discussions at different levels of governments and repeated negotiations between land administrative bureaus and land users, pressure for policy change gradually accumulated and led to LDR trading across localities in Zhejiang province. The expansion of LDR market further relaxed the quantitative and spatial restrictions on local development.

Reward quota trading

In 2000, Zhejiang provincial government granted official permission to trading reward quotas across localities (Zhejiang Provincial Government, Document No. 77, 2000). This policy allowed less developed localities in Zhejiang to choose between using the quotas for their own development purpose and trading the quotas out to other localities for extra-budget revenues. For more developed localities, they could decide between reducing investment thus lowering land demand and buying quotas from other localities for urban expansion. This policy opened up a huge LDR market and quickly flourished. Many developed cities took advantage of this market to trade in valuable land use quotas to support their fast growing economies.

Prime farmland preservation quota trading

In addition to land use quotas, local government must preserve certain percentage of their farmland as prime farmland. Due to varying land endowments, some regions had limited land resources and, after preserving more than 80% of their farmland, they simply could not find enough physical space for growing businesses and urban expansion, even if they could trade in reward quotas from other areas. To facilitate the development of a cross-regional reward quota

market, Zhejiang Provincial Bureau of Land and Resources further allowed local governments to trade their prime farmland preservation quotas across regions in March 2001 (Zhejiang Provincial Bureau of Land and Resources, 2001). This policy opened the possibility of one locality paying another locality for protecting certain amount of prime farmland on the former's behalf. Like reward quota trading, this market relaxed another major quantitative restriction under the centralized regulatory system.

Replacement farmland quota trading

There was the third regulation of replacement farmland quota. Each regional government must replace construction land quotas with new farmland. In each region, these two quotas should be able cancel each other out and achieve a dynamic balance. While some localities had plenty of room for land consolidation and reclamation, others had utilized their land quite intensively and could not generate enough farmland to make up for the loss within their boundaries. This limited the ability of these governments to claim their quotas in the Master Plan. Some regions pushed the provincial governments to exempt their replacement farmland quotas. Clearly a mutually beneficial trade could be reached between these regions and areas with plenty of land endowment. In 1999, Hangzhou city asked another city (Shangyu) to develop some new arable land in the latter's territory on Hangzhou's behalf. In the same year, Zhejiang province formally endorsed this practice and started to charge fees from localities that requested others to help fulfilling their replacement farmland quotas (Zhejiang Provincial Government, 1999). A new market finally took shape.

In sum, facing tight land regulations from the central government, local governments in Zhejiang gradually built a quite sophisticated LDR market system. By changing Master Plans to facilitate the transactions of reward quotas, prime farmland preservation quotas, and replacement farmland quotas, Zhejiang governments on all levels have been quite entrepreneurial and took full advantage of ambiguities and openings in central policies.

4. Some preliminary evidence

Market transactions in LDRs should enhance overall allocation efficiency. Local governments can trade out their land use rights for financial compensations and buyers should have more productive use of the land. In this sense, development rights trading offers a good

method for managing development. Because Zhejiang's innovation has breached some central policies, there have been some criticisms in China's policy circle and local officials were not willing to disclose all relevant information. As a result, we cannot conduct a thorough and systematic evaluation of this experiment in Zhejiang. However, we did gather some information through government statistics, in-depth interviews, and internal publications. We provide a preliminary assessment of this innovation's impact on preservation and development.

4.1. Farmland preservation

The central spirit of the 1998 Land Administrative Law was to keep the total farmland stable, if not increasing. The Zhejiang experiment facilitated this goal by offering powerful financial incentives for land consolidation and reclamation. Local governments could use newly cultivated farmland to redeem reward land use quotas, which were quite valuable in the market. Or they could trade these farmland to other regions to fulfill the latter's replacement farmland quotas. Regions with high quality land could also receive financial compensations for preserving prime farmland on others' behalf. Between 1999 and 2004, land consolidation alone yielded 121,380 hectares of new arable land. Despite sizable conversion to construction land for industrialization and urbanization, total area of farmland in Zhejiang declined only modestly from 1.612 million hectare in 1997 to 1.594 million in 2004 (Zhejiang Statistical Yearbook, 2008). Another indicator, i.e. prime farmland, reveals a similar pattern. Table 2 summarizes information about prime farmland for each city in Zhejiang in 1999 and 2004. After some trading of prime farmland preservation quotas, the total area of prime farmland in Zhejiang actually inched up a bit.

In addition to quantity, the quality of farmland also matters for food security. Scholars and policy analysts critical of the Zhejiang model often questioned the farmland quality as a result of land consolidation and reclamation (Tan and Dai, 2004). It has been reported that some local governments rushed to convert fish ponds, river banks, and hill tops into prime farmland so they could earn reward quotas or trade them out to other regions. This could result in low productivity and undermine food security in the future. Our own field work shows that, while this falsification did exist in the earlier years, the Zhejiang provincial government has since established a rigorous inspection system. The provincial Land and Resources office examined all land consolidation projects and kept records of quota trading in the province. Moreover,

according to government statistics, grain output increased from 5,199 kg/hectare in 1997 to 5,796 kg/hectare in 2006 (Zhejiang Statistical Yearbook, 2008). Part of this productivity gain can be explained by technological improvement, but during the same time period, grain productivity for the whole country increased only by 7.75%. Zhejiang's 11.5% increase is much higher and the cultivation of high quality farmland, especially the development of one million hectare of "standard farmland" (*biaozhun nongtian*), through land consolidation must have played an important role as well.[6] Of course, more systematic data are needed to evaluate land quality after the introduction of LDRs in Zhejiang.

Table 2: Trading and Prime Farmland Preservation (Unit: 10,000 hectares)

City	Prime Farmland 1999	Preservation Ratio (%) 1999	Prime Farmland 2004	Preservation Ratio (%) 2004	Change of Prime Farmland
Hangzhou	21.28	84.00	19.81	78.23	-1.46
Ningbo	21.75	85.00	21.10	82.47	-0.65
Wenzhou	22.10	85.00	21.90	84.20	-0.21
Jiaxing	18.87	86.00	18.86	85.96	-0.01
Huzhou	12.62	86.00	13.49	91.99	0.88
Shaoxing	17.99	85.00	18.06	85.36	0.08
Jinhua	20.50	85.00	20.22	83.84	-0.28
Quzhou	12.08	85.00	13.53	95.21	1.45
Zhoushan	2.44	85.00	2.42	84.06	-0.03
Taizhou	17.62	85.00	17.46	84.24	-0.16
Lishui	13.52	85.00	14.04	88.28	0.52
Total	180.77		180.89		

Source: Zhejiang Provincial Bureau of Land Resources

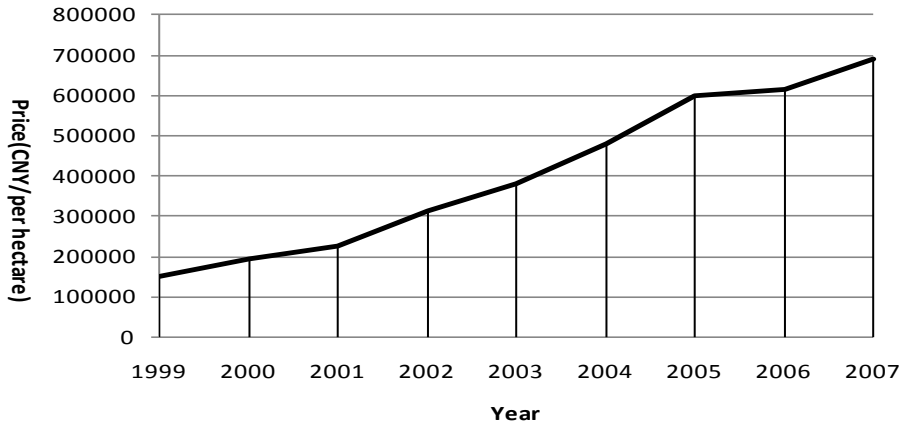
4.2. Equalizing development opportunities

Market transactions have the added benefit of creating a win-win scenario for all regional governments. Rich regions can purchase development rights to build needed infrastructure for their fast growing industries, businesses, and urban population. Poor regions, usually with more land resources and little business opportunities, earn financial resources they desperately need for providing local public services. This effect can be shown in the trading of the three quotas.

[6] Standard farmland has better irrigation and other servicing facilities and therefore is of higher quality than prime farmland.

First, reward quotas constituted a major supplement to land use quotas handed down from the central government. According to the first Land Use Master Plan, Zhejiang province could convert only 66,667 hectares of farmland for non-agricultural uses between 1997 and 2010. Land consolidation alone created 87,386 hectares of new land use quotas in the 1999-2004 period. Without these quotas and market transactions, it is hard to imagine that developed regions such as Hangzhou, Wenzhou, Ningbo could have maintained their double-digit growth rates and Zhejiang could have absorbed more than 10 million migrant labor in the past decade. At the same time, revenues from trading out reward quotas have contributed to fiscal spending in some under-developed regions. Jinyun county is an underdeveloped region in central Zhejiang. In 2006, it launched a large scale land consolidation project and acquired 658 hectares of new farmland, which earned them a reward quota of 473 hectares of new construction land. It sold 393 hectares of these quotas to rich cities such as Ningbo, Shaoxing, Wenzhou, and Jiaojiang for CNY 281 million. Its total budgetary revenue in 2006 was only CNY 285 million![7] We can partly infer its magnitude from the price on the quota market (Figure 5). When the market started in 1999, the average price of reward quota was CNY 150,000 per hectare. It gradually rose to CNY 480,000 per hectare by 2004 and further climbed to CNY 690,000 per hectare by 2007. By the end of 2004, 20,000 hectare worth of reward quotas had exchanged hands with a total value of CNY 10 billion, a sizable transfer to poor regions. [8]

Figure 5. Prices of Reward Quota from Land Consolidation



[7] Personal interview with a Jinyun county Land and Resources bureau official.

[8] Personal interviews with provincial Land and Resources bureau officials.

Second, Table 2 tabulates results before and after trading of prime farmland preservation quotas. The market has enabled regional governments in Zhejiang to break free from the almost uniform preservation ratio and make choices according to their land endowments and development environments. Not surprisingly, relatively developed regions, such as Hangzhou, Ningbo, Wenzhou, Jinhua, scaled down their prime farmland preservation ratios and traded their obligations to other regions. This opened up more farmland for designation of potential conversion zones in these areas. Once they had reward quotas, local governments could build industrial parks or other infrastructures. Poor areas like Huzhou and Quzhou became more specialized in prime farmland preservation. No systematic data are available to gauge the size of the market value but we know that the price rose from CNY 22,500 per hectare in 2001 to CNY 30,000 per hectare in 2003. There have been 40,000 hectares of trades and the total value should between CNY 900 million and CNY 1.2 billion.[9]

Finally, replacement farmland quotas constitute another major source of redistribution. For the 2,000 hectares of trade with Shangyu in 1999 discussed above, Hangzhou city paid CNY 99 million in four years.[10] In addition to reward quotas, Jinyun county also engaged in trading replacement farmland quotas. In 2006, it initiated 10 wasteland development projects and cultivated 161 hectares of new farmland. Yiwu and Cixi cities paid Jinyun CNY 41 million for this land to fulfill their replacement quota.[11] Figure 6 makes this redistributive pattern more visible. It shows all counties that traded in and out the LDRs between 1999 and 2008. The counties in orange color traded in LDRs while those in gray traded out during this period. Other counties (the blank area) achieved self-sufficiency in LDRs. Though there were three types of LDRs traded across counties, the counties that traded in different LDRs were generally the same places, so was true for the counties that traded out each of the three LDRs.[12] For example,

[9] Personal interviews with provincial Land and Resources bureau officials.

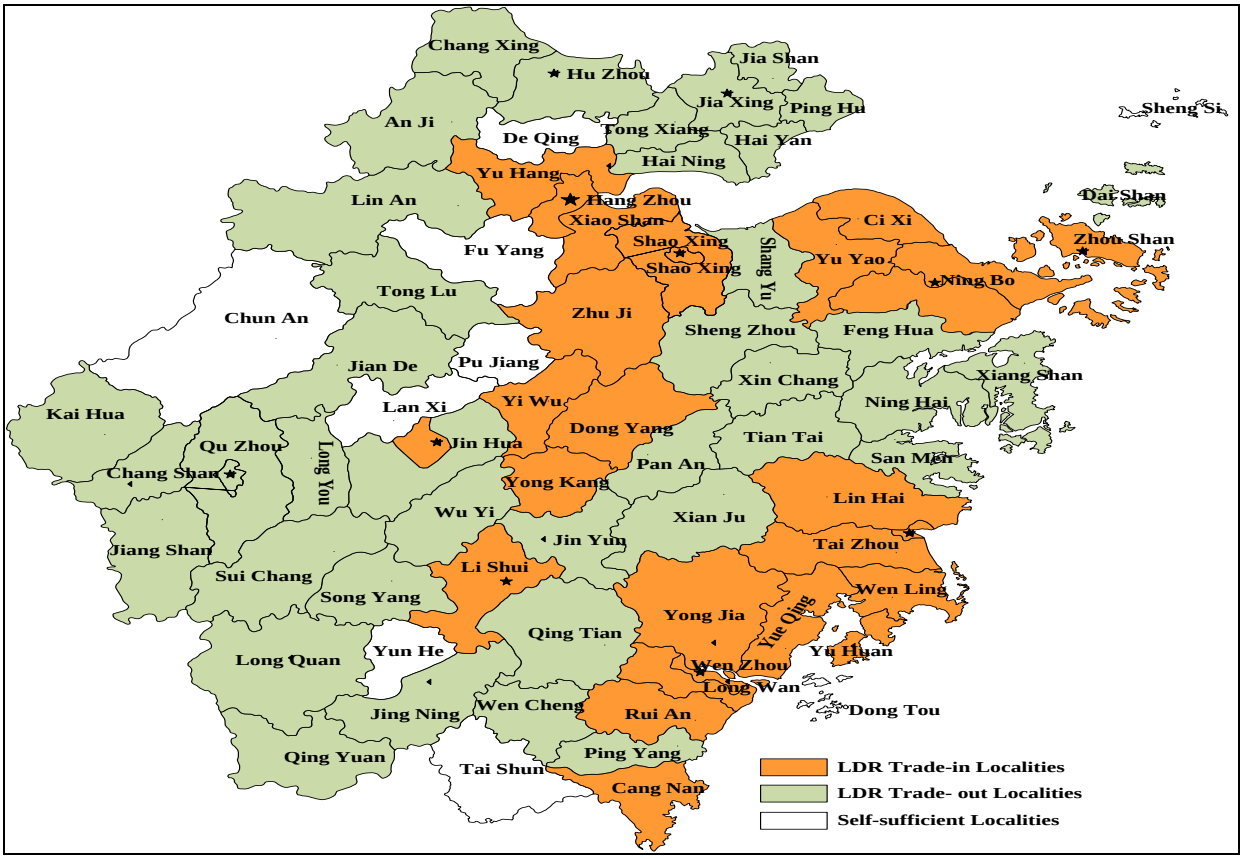
[10] Personal interviews with provincial Land and Resources bureau officials.

[11] Personal interview with a Jinyun Land and Resources bureau official.

[12] The only exception as far as we know is Xinchang County in Shaoxin prefecture. With a lot of reward quotas from land consolidation, it traded out reward quotas to other counties before 2008. With a large national water conservancy project that would use 400 hectare arable land in 2009, Xinchang found that it could no longer fulfill its "prime farmland preservation ratio". Therefore, Xinchang paid Shenzhou county in the same prefecture CNY 60 million and asked the latter to preserve 330 hectare on its behalf.

Changxin is a poor county in Zhejiang. Between 1999 and 2008, it traded out 2,313 hectares of reward quotas and 107 hectares of replacement farmland quotas, and preserved 2,666 hectares of prime farmland for other localities in Zhejiang. On the other hand, Beilun is a developed county in Ningbo city. During the same period, Beilun purchased reward quotas of 627 hectares from other localities and other regions preserved 802 hectares of prime farmland and developed 1,006 hectares of arable land on its behalf.[13]

Fig. 6. LDR Trading-in and Trading-out Localities in Zhejiang



Therefore, the evidence seems to support the claim that development rights trading in Zhejiang has managed development and preservation well. Both affluent and poor regions have benefited from fast industrialization and urbanization.

[13] Personal interviews with provincial Land and Resources bureau officials.

Conclusion

Land use regulation has long been used as an effective way of managing development and preservation in many countries, but a highly centralized land-use regulation such as China's is rare. This system not only defines annual land-use quotas but also specifies concrete locations of each land lot through a series of Master Plans from the central government all the way down to the township government level. The power of planning and approval is highly centralized. While food security is a legitimate concern for a populous country, the overly restrictive land regulation has imposed very high costs on the economy. Bureaucrats generally lack good information to make efficient land use decisions, especially in a country as big and diverse as China. Like any bureaucracy, local governments also fight hard for their "fair" shares in the allocation of land use rights. Since the onset of the new regulation in late 1990s, many developed regions in China felt the pain of abiding by the roughly equally distributed land quotas. The emergence and growth of a LDR market in Zhejiang could be viewed as an expression of that frustration and an exhibition of human ingenuity in exploiting profitable opportunities. The flexibility and market transactions in Zhejiang have unlocked huge development potentials for both developed and developing regions in the province. Notably, these goals were achieved with the total farmland unchanged.

This paper focuses on the origin and evolution of the Zhejiang model, with detailed analysis of the operation of the market. Our empirical evaluation is preliminary and systematic data about land transaction, land quality, and local public finance are clearly needed to assess the effectiveness of this institutional change. Equally important is its impact on local ecology and biodiversity. While future research should answer these important questions, we believe that our analysis offers something useful for other developing countries that try to cope with the need of preservation in their catch-up stage. Of course, every society has its own unique conditions and faces different challenges. Any comparison needs to take these historical, cultural, and economic differences into consideration. To China's policy analysts, our discussion can shed some light on the highly contentious debate about land regulation now. In China, the clash between development and preservation was manifested as a bargaining between the central government and local governments. The central government may have a more "encompassing" interest and cared about food security and farmland preservation. On the other hand, local governments allied

with businesses and were more focused on its own development and revenue generation. This local coalition might take China down to a destructive course in the future. Due to similar concerns, the central government regarded some practices in Zhejiang as driven by growth-thirst local governments and halted some of them, such as trading prime farmland preservation quotas. While the concern about falsification is legitimate, more rigorous inspection should be able to address these problems in practice. To meet the growing pressure on land as modernization intensifies in China, the central government must stop treating local officials as irresponsible actors. After all, China is a large and extremely diverse country. These officials have valuable local information and represent legitimate interests. They should be an active part of the land regulatory regime and the LDR trading in Zhejiang offers such a possible platform. As the room for future LDR trading is shrinking in more developed provinces, there is even stronger rationale for adopting this market nationwide and encourage inter-provincial LDR trading.

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