CHANGES IN AGRICULTURAL LAND USE IN CHINA: 1981-2000

Xiubin LI and Xiuhong WANG
Institute of Geographical Sciences and Natural Resources Research
Chinese Academy of Sciences

Abstract: *Rapid economic development following the 1978 reforms is well reflected in agricultural land use changes in China. By investigating the magnitude of changes in agricultural land use intensity across regions in a geographical perspective, in terms of the intensity indicators defined, explanation for the regional disparity is provided. An important implication is that economic comparative profit drives farmers to increase the intensity level for agricultural production in the western provinces at present but not forever. Lower incentive for raising agricultural land use intensity may more seriously threaten food security than the shrinking farmland area or lower technological potential.*

Keywords*: China; agricultural land use; intensity indicator; regional disparity; economic comparative profit.*

Introduction

China has undergone rapid economic development following the 1978 reforms, resulting in major land use changes (Bi, 1995; Wu and Guo, 1994; Li, 2000). In response to the changing demand of society for agricultural products, land use varies in usage type and in intensity (Ely and Morehouse, 1924; Wu and Guo, 1994; Cheng et al., 1997; Tang et al., 2000; Shoshany and Golddheleger, 2002). Changes in intensity of land use are usually the result of immediate responses to changes in profit of land use or market signals, especially in China where land resources are very limited (Li, 2000; Lu et al., 2000; Cai, 2001). Land use changes are closely related to the social and economic sustainable development and the environmental change; therefore, land use conversion has become a major area of research, especially after the International Geosphere and Biosphere Programme (IGBP) and the International Human Dimensions Programme on Global Environmental Change (IHDP) initiated their core project on land use and cover change in the mid-1990s (Turner et al., 1995; Lambin et al., 1999). However, few studies have focused on land use intensity as a major topic (Lambin et al., 2000). China has joined the World Trade Organization (WTO), which is a great achievement of the economic reforms to all the Chinese and will greatly affect the regional changes in land use intensity in the near future (Qu, 1999; Cheng, 2000; Ke et al., 2002). Better understanding of past changing processes of agricultural land use may enable the improvement of future planning strategies (Shoshany and Golddheleger, 2002). Thus, the study on the changes in agricultural land use intensity, following the 1978 reforms, is helpful to future agricultural activity in China in the processes of globalization.

China is in transition from an agriculture-dominated society to an industrial country. It has been well documented that a large area of farmland has been lost to non-agricultural use in the processes of industrialization and urbanization (Li, 1997; Li, 1999; Tan, 1999; Bi, 2000; Li, 2000). It has been claimed that most of the land lost is

the country's most fertile farmland (Lu et al., 2000; Chen and Huang, 2000; Yang and Li, 2000). It has also been argued that this may threaten food security of the country (Brown, 1995). A predictive study shows that more fertile farmland will loss to non-agricultural use in the initial period when China joins the WTO, especially in the developed provinces in China (Dong, 2000). However, this may not be as serious as claimed if there is still potential for intensification; and even more importantly, if there are economic incentives to tap this potential. This is because that under certain natural conditions, grain yield is mainly affected by land use policies, technological input, and material and labor input, which provide great potential for grain yield increase in China. A related study based on the data between 1986 and 1995 showed that (1) land use policies played a more important role in the grain yield increase than the other two factors, especially in the period when some rational policies were newly designed and executed, but did not contribute significantly to the grain yield increase over a long period of time; and (2) under certain natural conditions and relatively stable land use policies, technological input contributed more and more to the grain yield increase than material and labor input in China (Chen and Chen, 2000). China has been generally paying great attention to food production both in political and academic circles since 1949, especially since 1978 because of its largest population, although it has a lower level of agricultural land use intensity than developed countries (Yang, 2000), and sometimes carries out irrational land use policy (e.g., extensively develop cultivated land without carefully considering ecological balance, occupy rich cultivated land for non-agricultural construction without paying more attention to its large and growing population and limited cultivated land resources) and irrational food trade policy (e.g., import more grain when grain yield increases, while import little grain when grain yield decreases) (Jiang, 1999). More experience in food production management was obtained based on practical and realistic work at all levels of government, and China's land administration system was established in the mid-1980s, which was beneficial to land resources management and food production. For example, imbalance between food supply and demand was intensified in 1980-1981, 1988-1989, and 1993-1995, but significantly mitigated in 1983-1984, 1990-1991, and 1996-2000 by executing some related food and land use policies following the 1978 reforms, showing that Chinese have ability to feed themselves (Ji, 2000). According to some scientific predictions, food production potential is still great in China (Li, 1998), and increasing the comprehensive productivity of cultivated land, which is called "storing food in cultivated land instead of granary", is a rational stratagem for food security in China (Feng and Li, 2000). In addition, the state land administration bureau has realized that the main reason for large cultivated land area loss is that local land management bureau actually has no real power to manage land resources that is controlled by local government. In the international competitive situation, WTO accession will help to improve land use policies and to increase technological input, and material and labor input, which is ultimately beneficial to the increase in intensity and profit of agricultural land use in China in future (Dong, 2000; Cheng, 2000).

This paper examines the change of agricultural land use intensity in China in a geographical perspective. The authors believe that an analysis of the regional disparity helps to clarify the general land use change processes and the food security issue. The paper investigates the magnitude of change in land use intensity across regions in terms of various intensity indicators that we define. Further, explanation for the regional disparities identified is provided. Concluding remarks elucidate policy implications for future agricultural activity.

Figure 1. Three zones for changes in intensity of agricultural land use in China.

To more clearly understand changes in agricultural land use intensity, mainly resulting from the economic reforms in China, three zones, i.e., the East, Central, and West are divided, which generally reflects the economic conditions for agriculture. The natural conditions for agricultural land use vary both from north to south and from east to west in China (Wu and Guo, 1994), mainly resulting in the horizontal differentiation of agricultural land use intensities and different grain outputs. However, concerning the economic conditions for agriculture, as well as the land use profits (especially the profit of cultivated land use) and the changing trends in land use intensity (not land use intensity per se) in different provinces, in terms of various intensity indicators defined, obvious regional differentiation occurs from east to west (Li et al., 2001). This regional division is somewhat different from the conventional 'three-region' scheme used in the national statistical yearbook, which has been divided according to the social and economic developing levels in different provinces. We include Sichuan and Chongqing into the Central since their economic situations in general and agricultural development in particular are different from the other western provinces to a large extent. We exclude Guangxi, Hebei and Liaoning from the East since the agricultural land use change in these provinces is quite similar to that in the central provinces. Fig. 1 illustrates the spatial location of the three zones and the provinces included.

Change in Intensification Level of Agricultural Land Use

Both intensification and extensification of agricultural land use have been taking place in different parts of China since 1978. This process can be described by using many indicators ranging over different domains, i.e., input, output and use of land-related resources. According to data availability, this study adopted 6 indicators to analyze the change in intensification of agricultural land use. Multi-cropping index (MCI) reflects the extent to which land resources are used. Crop structure, consumption of chemical fertilizers and irrigated area reflect input level of land use. Grain yield indicates output level. Some relative values (referring to the ratio of the value in some year to that in the initial year, or regarding the value in the initial year as one) were used to describe the change in intensification level of agricultural land use.

1. Multi-cropping index (MCI)

Multi-cropping index (MCI), one of the most important indices reflecting the agricultural land use intensity and widely used in China, refers to the ratio of total sown area of crops to cultivated land area in the current year (Xu, 1990). Cultivated land area (area under cultivation) refers to farmland which is plowed constantly for growing crops, including cultivated land, newly cultivated land in the current year, farmland left without cultivation for less than three years and fallow land in the current year, rotation land, rotation land of grass and crops, farmland with some fruit trees, mulberry trees and other trees and cultivated seashore land, lake land, and etc. The land of mulberry fields, tea plantations, orchards, nurseries of young plants, forest land, reed land, natural and man-made grassland are not included in cultivated land. Ditches, roads and ridges between cultivated fields that are less than 1 meter in width in the south or less than 2 meters in width in the north are included in the cultivated land (NBSC, 2001).

As showed in Fig. 2, the multi-cropping index (MCI) generally had an order: East > Central > West. The general changing trend for MCI was different in the study period (1980-1995), with great difference in the MCI change occurring among three zones after 1987. The East had a MCI decreasing from 1988 to 1994, but slightly increasing in 1995. The Central had a relatively stable MCI. The West had a MCI increasing from 1988 to 1994, but slightly decreasing in 1995. Both the Central and the West had a very low MCI in 1985 (NBSC, 1981-1996). It was clear that the MCI varied horizontally, especially from north to south; however, obvious differentiation of the MCI change occurred from east to west. While the MCI was mainly affected by the climatic conditions, the MCI change was mainly controlled by the economic conditions for crop production.

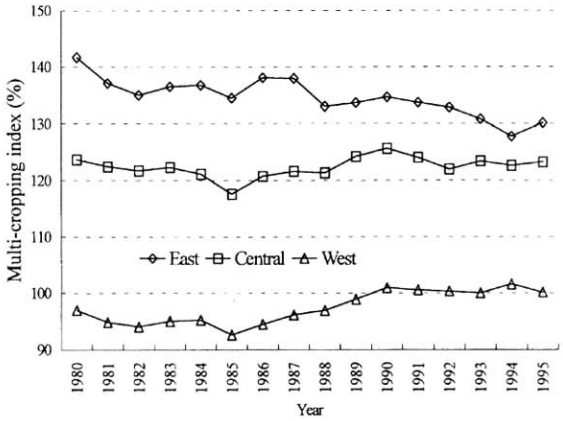


Figure 2. Regional disparity of multi-cropping index (MCI) change.

2. Crop structure in terms of sown area

Sown area of crops refers to area of land sown or transplanted with crops regardless of being in cultivated area or non-cultivated area. Area of land re-sown due to natural disasters is also included. Different crops have different labor demand. Rice is a labor-intensive crop, while maize is labor-extensive. Generally, cropping of one *mu* (1 ha =

15 *mu*) of rice needs 20 labor-days, while 10 labor-days for wheat and 8 labor-days for maize in China. In this connection, crop structure reflects land use intensity.

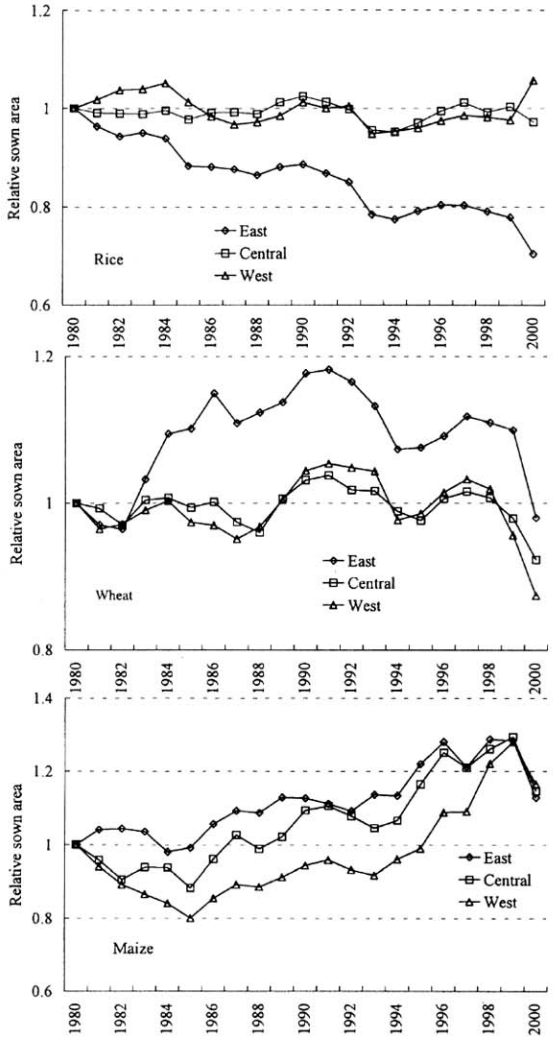


Figure 3. Regional disparity of changes in the relative sown areas of rice, wheat and maize.

Rice, wheat and maize are three main crops, with their yields closely related to the food security in China. Concerning the relative sown area of rice, the East had a decreasing sown area of rice from 1980 to 2000, which obviously decreased in 1985 and 1993; the Central had a fluctuated sown area after 1987, which reached its lowest value around 1993; and the West had a relative sown area similar to that of the Central, reaching its higher value in 1984, 1990 and 2000, and lower value in 1987 and 1993 (NBSC, 1981-2001) (Fig. 3).

Concerning the relative sown area of wheat, the East has a wider changing range of relative sown area compared with that of the Central and the West, with its higher value in 1986, 1991 and 1997 and lower value in 1982, 1994 and 2000; the Central had an

area greatly fluctuated after 1987, with its lower value in 1982, 1988, 1995 and 2000; and the West almost had a same relative sown area and a similar changing trend as the Central, which greatly decreased in 1981, 1987, 1994 and 2000 (NBSC, 1981-2001) (Fig. 3).

Regarding the relative sown area of maize, three zones generally had an increasing relative sown area from 1985 to 1999 with an order of East > Central > West. Both the Central and West had a relative sown area decreasing from 1980 to 1985 (NBSC, 1981-2001). It goes without saying that the relative sown area of each crop, which is the ratio of sown area in some year to that in 1980, can be used to reflect the change in intensification level of agricultural land use in different zones (Fig. 3).

3. Consumption of chemical fertilizers in agriculture

Consumption of chemical fertilizers in agriculture refers to the quantity of chemical fertilizers applied in agriculture in the current year, including nitrogenous fertilizer, phosphate fertilizer, potash fertilizer, and compound fertilizer. The consumption of chemical fertilizers is required in calculation to convert the gross weight into weight containing 100% effective component (e.g. 100% nitrogen content in nitrogenous fertilizer, 100% phosphorous pentoxide contents in phosphate fertilizer, 100% potassium oxide contents in potash fertilizer). Compound fertilizer is converted with its major component.

The ranking for the annually relative consumption of chemical fertilizers compared with that of 1981 had an order of West > Central >East from 1981 to 2000, especially after 1990. The West showed a continuously increasing trend at the greatest rate (NBSC, 1982-2001), reflecting that the cultivated land in the western provinces was paid more attention by its farmers.

4. Irrigated area

Irrigated area refers to areas that are effectively irrigated, i.e. level land that has water source and complete sets of irrigation facilities to lift and move adequate water for irrigation purpose under normal conditions. In general, irrigated area is the sum of watered fields and irrigated fields where irrigation systems or equipment have been installed for regular irrigation purpose.

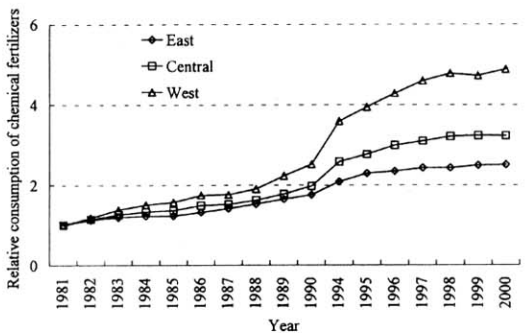


Figure 4. Regional disparity of change in the relative consumption of chemical fertilizers.

The relative irrigated area compared with that of 1981 had an order: West > Central > East (NBSC, 1982-2001). Both the West and the Central had an increasing relative value form 1981 to 2000, especially after 1991; however, the East had a decreasing value after 1991 with its lowest value in 1995 (Fig 5), although the irrigation was still very important to food production in the East.

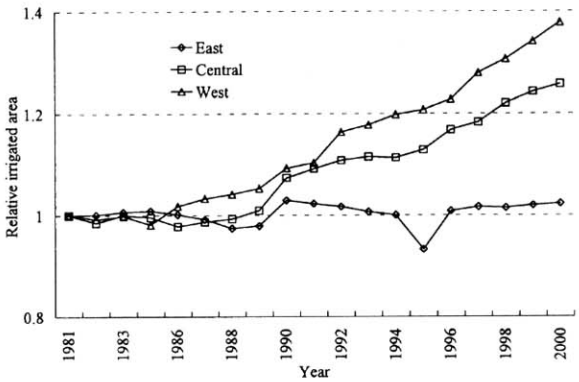


Figure 5. Regional disparity of change in the relative irrigated area.

5. Grain output

Grain yield refers to the yield in the whole country including grains produced by state farms, collective units, industrial enterprises and mines. Grain includes rice, wheat, corn, sorghum, millet and other miscellaneous grains as well as tubers and beans.

Compared with the grain yield in 1980, the relative grain yield had an order: West > Central > East after 1988, although the Central had a relative grain yield slightly higher than the East or the West before 1988 (NBSC, 1981-2001). The relative grain yield in three zones generally had an increasing trend from 1980 to 1998, but decreased from 1999 to 2000. The changing rate and fluctuant range of relative grain yield increased from east to west. Three zones had almost the same changing trend of relative grain yield from 1980 to 1987; however, the East had a somewhat different changing trend from those of the other two zones after 1987. Greater difference in the changing trend for relative grain yield between the Central and the West occurred after 1990. The East and the Central had a similar changing rate after 1994, and the West had a relatively lower relative grain yield in 1994 and 1995 (Fig. 6).

6. Grain yield per unit area

The relative grain yield per unit sown area in three zones generally increased after 1980 (Fig. 7). However, the general changing rate and fluctuant range of relative grain yield had an order of West > Central > East from 1980 to 1999, especially after 1987 (NBSC, 1981-2000) (Fig. 7).

Explanation for the Changes in Agricultural Land Use Intensity

There were many reasons for the above-mentioned changes in agricultural land use intensity in China between 1981 and 2000; however, the main reason was that farmers

tried to increase their income driven by economic comparative profit. Crop production, as a means of livelihood, had played a more important role in farmers' life in the West, resulting in the rapid increase in the agricultural land use intensity; while relatively lower comparative profit of agricultural land use and more other opportunities to make money might reduce farmers' enthusiasm for crop production in the East. Some explanation is provided as follows.

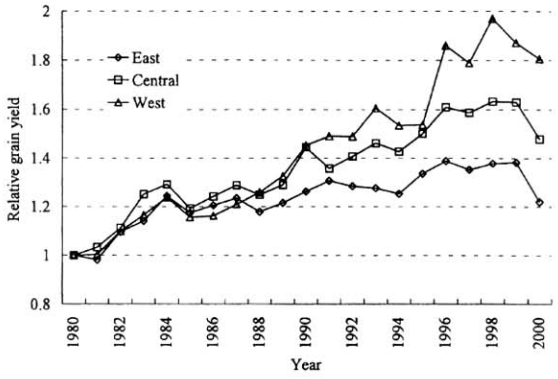


Figure 6. Regional disparity of change in the relative grain yield.

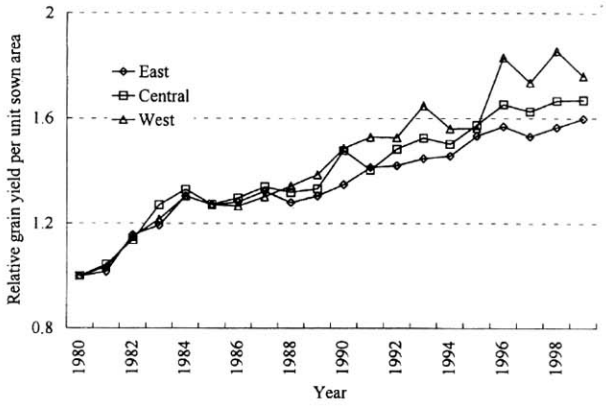


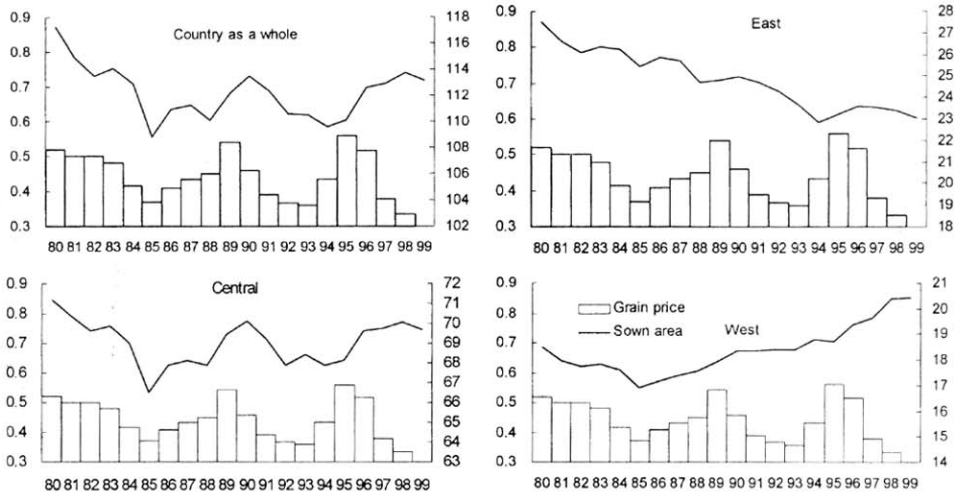
Figure 7. Regional disparity of change in the relative grain yield per unit-sown area.

1. Regional disparity of elasticity of grain-sown area to grain price

An analysis of elasticity of grain-sown area to grain price in each province, municipality, and autonomous region showed something interesting (Fig. 8). The real grain price had an effect on the grain-sown area in the whole country and the central zone. To be more exact, the grain-sown area in the country as a whole generally had a decreasing trend and fluctuated with the real grain price, lagging about one year after price change since 1990. The changing trend of sown area in the Central was similar to that in the West before 1990, but similar to that in the East after 1990.

The grain sown area in the eastern coastal provinces (except Lioaning, Hebei and Guangxi Provinces) generally decreased and had little elasticity to the increase in grain

price in the study period, especially in the late 1980s, with a little elasticity to the increase in grain price in the mid-1990s. The other way round, the grain-sown area in the western provinces (except Xinjiang and Qinghai) generally increased and had little elasticity to the decrease in grain price, especially in the early 1990s. At the end of 1990s, the grain-sown area decreased a little responding to price decreasing, possibly resulting from the increase in food products for per person in the West. It was clear that the economic comparative profit of grain production was the main reason for the regional disparity of elasticity of grain-sown area to price. Farmers in the eastern provinces had more opportunities of doing non-agricultural enterprises, which increased their income; however, most farmers in the western provinces had to depend on crop production mainly. In addition, the West had more undeveloped cultivated land resources, which could be gradually developed to compensate for the cultivated land area loss. According to the detailed investigation between 1991 and 1996, the West, Central and East had an undeveloped cultivated land area of 8.207 million ha, 4.351 million ha, and 0.956 million ha, respectively (Li, 1997).



Y axes: left – grain price in yuan/kg in 1978 constant, right – sown area in million ha; X axes: year (1980-1999)

Note: The price data was from Lu, 1999.

Figure 8. Regional disparity of elasticity of grain-sown area to grain price.

Decrease in the total rice sown area in the East showed that farmers did not pay more attention to their cultivated land. Increase in the maize sown area in three zones showed farmers tried to plant grain with little cost, high yield and high commodity rate (used for livestock's feed). Most farmers in the West continually increased the multi-cropping index, input intensification (consumption of chemical fertilizers, irrigation area, agricultural machinery and so on) in order to increase output level without paying more attention to real grain price change. For example, the MCI has potential to increase and has been increasing by using plastic sheet and some improved variety of seeds in the West. Contrastively, the eastern provinces have a higher MCI but lower potential for the MCI increase.

2. Regional disparity of output values of cultivated land and town, factory and mine

According to the detailed investigation to land use in 1996, both unit area output value of cultivated land and that of town, factory and mine decreased from the East to the West, and the unit area output value of cultivated land was much lower than that of town, factory and mine in three zones (Table 1), especially in the coastal provinces and large cities like Fujian, Zhejiang, Jiangsu and Shanghai (Liu, 2000), forming a strong economic driving force to local governments and farmers. For keeping the economic development at higher rate, some local governments changed the cultivated land into other lands with higher using profit, or planted economic crops. For continually increasing their income, farmers tried to find jobs and do non-agricultural works locally or easterly. In this situation, the cultivated land loss and the decrease in intensity of agricultural land use occurred in the eastern provinces where the second industry and the third industry more rapidly developed.

Table 1. Contrast between output value of cultivated land and output value of town, factory and mine by zone, 1996.

Zone	Cultivated land			Town, factory and mine		
		Output value			Output value	
	Area (km^2)	10^8 yuan	(yuan/ha)	Area (km^2)	10^8 yuan	(100 yuan/ha)
East	214898.2	4248.4	19769.1	18711.9	26630.7	14232.0
Central	725531.1	7374.3	10164.0	26730.7	23351.6	8735.9
West	359963.0	1924.5	5346.4	8747.7	4692.5	5364.3

Source: Liu, 2000.

3. Regional disparity of labor employment opportunities besides farming

Regional disparity of labor employment opportunities besides farming was studied according to the wage income of rural households, percentage of labor in agriculture, and percentage of labor in non-agricultural Township and Village Enterprises (TVEs) in rural areas. The wage income of rural households had an order of East > Central > West on the average according to the 1998 survey (NBSC, 1999). Percentage of labor in agriculture in rural areas had an order of West > Central > East; while percentage of labor in non-agricultural TVEs in rural areas had an order of East > Central > West according to the 1996 agricultural survey (NBSC, 1997). It was only the East that had wage income of rural households and percentage of labor in non-agricultural TVEs in rural areas greater than the average level for the whole country (Table 2).

Table 2. Labor employment opportunities besides farming by zone.

Zone	Wage income (yuan/yr.pc)	Labor in agriculture (%)	Labor in TVEs (%)
West	235	88	4
Central	480	78	7
East	1255	61	18
Country	570	75	9

Source: NBSC, 1997 and 1999.

4. Regional disparity of cultivated land loss

Rapid industrialization and urbanization has resulted in the significant loss of agricultural land in China, especially in many coastal provinces between 1980 and 2000. According to monitoring analysis in 1994, the net decreasing rate of the cultivated land area increased from the West to the East; the proportion of cultivated land used by non-agricultural construction also increased from the West to the East; the proportion of cultivated land destroyed by disasters had an order of Central > East >West; the proportion of cultivated land used by rural collectivity was East > Central > West; land use for residential construction was West > Central > East; cultivated land loss by agricultural adjustment was West > Central > East, which was mainly determined by the proportion of cultivated land returning to forest and grassland use. It was clear that the main reasons for cultivated land loss were agricultural structure adjustment and non-agricultural construction for the whole country; and the non-agricultural construction contributed more to the cultivated land loss in the coastal region (Li, 2000).

Another analysis based on China Land and Resources Almanac 2000 (MLR, 2001) also verified the above-mentioned fact. The cultivated land area loss had an order: East > Central > West by construction land use, Central > West > East by disaster destroy, West > Central > East by ecological recovery (reusing farmland for forest and grassland), and East > Central > West by horticulture and fish pool land use in 1999 (Table 3). The coastal provinces faced serious cultivated land loss by industrialization and urbanization.

Table 3. Cultivated land loss by zone, 1999.

Loss by	Construction		Disaster		Ecological recovery		Garden and pool	
Zone	Area (ha)	(%)	Area (ha)	(%)	Area (ha)	(%)	Area (ha)	(%)
East	59903.7	50.95	6131.1	5.21	15192.1	12.92	36343.0	30.91
Central	108153.6	44.92	61576.2	25.58	37051.1	15.39	33974.0	14.11
West	37201.2	7.70	66972.5	13.86	342371.1	70.83	36807.2	7.61

Source: MLR, 2001.

Driven by the economic comparative profit in the near future, the high quality cultivated land loss will be intensified in the coastal provinces (Dong, 2000). The local governments tried to keep the total amount of cultivated land area for maintaining ability of food self-sufficiency by land development, consolidation, reclamation and agricultural structure adjustment. However, newly developed cultivated land was much poorer than the cultivated land occupied that used to produce more grains (Lu et al., 2000). Controlled by the state land use policies, reusing some farmland for forest and grassland benefit to the ecological balance is suitable for the increases in MCI and yield per unit area in the West. This is because that the environmental conditions for agricultural production can be gradually improved and people will pay more attention to healthy agricultural products, which can be produced from the slightly polluted cultivated land in the West (Lu et al., 2001).

5. Regional disparity for discontinuing farming

Apart from the cultivated land area loss, decreasing sown area or abandoning sowing, which was commonly called 'discontinuing farming' was also serious problem limiting the increase of grain yield and affecting the food security in China. For example, grain sown area and grain yield greatly decreased in 2000 after the 1978 reforms, resulting from the disaster destroy, agricultural adjustment, reusing farmland for forest and grassland, and discontinuing farming (Wu, 2001). More and more yang farmers tried to do non agricultural work to earn a living in the eastern developed region; while some yang farmers went down southern or up to northern cities for living in the western underdeveloped region, which formed a common tide of discontinuing farming (Zhu, 2001).

According to a general report, there were some reasons for discontinuing farming (Cui Ronghui, 2001): (1) Lower economic comparative profit of cultivation was the main reason for discontinuing farming. Farmers could not make money but lose money in business by cultivation because of lower grain price and higher cost in recent years. For example, a household in Hongqi Village, Lianhjiang County, Anhui Province should spent 13 yuan (1 US$ = 8.3 RMB yuan) for seed, 40 yuan for fertilizer, 12 yuan for water, 10 yuan for pesticide, 130 yuan for cropping tax to plant one *mu* (1 ha = 15 *mu*) of rice, making only 115 yuan and remaining little if removing cost of labor used. Other households even had worse situations. However, a farmer could make 3 to 5 times, even several tens times amount of money than those who stayed at home. (2) Unperfected land use system created conditions for discontinuing farming. Land contract period of 30 years provided farmers with a longer period of land use right and managing right protected by law, but broken off the land circulation. Farmers tried to occupy land by contract, but tried to make more money by discontinuing farming. Charge and tax reforms had not control the tendency of discontinuing farming. More tax made farmers have no ability for cultivation. (3) More yang farmers' leaving home resulted in more discontinuing farming, because older farmers and children could not effectively cultivate with their limited physical strength, and little scientific and technical knowledge. (4) Village cadres only met farmers when some farmers

Coastal provinces like Guangdong, Fujian, Zhejiang, and Jiangsu, had made a great progress in economic development, however, faced serious problems of discontinuing farming and decreasing in grain production. The food possess per person in the aforesaid provinces was less than the country's average level by 11% in 1998, which was once greater than the country's average level by 7% in 1988. Decrease in cultivated land area directly affected the grain yield and the ability of food self-support. More seriously, the grain sown area had greatly decreased in these provinces in 1990s. For example, the grain sown area had decreased by 2.667 million ha from 1981 to 1995, which was about 50% of the total grain sown area decrease for the whole country (Zhong, 1998). Because of the lower comparative profit of agriculture management, yang farmers usually went out home to earn a living by decreasing sown area or abandoning sowing. Some farmers only plant rice once that can be planted twice a year, others left the land to older people or children in their families or asked the other farmers living in mountainous area to "look after" their cultivated land.

Very low cultivated land area per person was also a driving force for yang farmers to leave home to earn a living. According to the investigation data of cultivated land area

and vital statistics in 1999 (Li, 2000; NBSC; 2000), the order for cultivated land area per person from high to low was showed in Table 4. The cultivated land area per person was 0.060 ha/person, 0.105 ha/person, 0.182 ha/person, in the East, Central and West, respectively. Tianjin, Zhejiang, Guangdong, Beijing and Shanghai had a cultivated land area per person lower than the warning limit of 0.053 ha/person made by FAO.

Table 4. Cultivated land area per person by province, 1999.

Province	ha/person	Province	ha/person	Province	ha/person
Inner Mongolia	0.330	Guizhou	0.129	Sichuan	0.077
Heilongjiang	0.310	Hebei	0.104	Jiangxi	0.070
Ningxia	0.235	Hainan	0.100	Jiangsu	0.070
Xinjiang	0.234	Liaoning	0.100	Hunan	0.060
Jilin	0.210	Anhui	0.096	Tianjin	0.051
Gansu	0.198	Guangxi	0.094	Zhejiang	0.047
Yunnan	0.153	Shandong	0.086	Guangdong	0.044
Xizang	0.143	Henan	0.086	Fujian	0.042
Shanxi	0.142	Hubei	0.083	Beijing	0.027
Shaanxi	0.139	Chongqing	0.082	Shanghai	0.021
Qinghai	0.135				

Source: Li, 2000; NBSC, 2000.

Mainly because of the poor ecological conditions, most western and some northern provinces also had serious problems of discontinuing farming where large area of land had been developed by destroying natural forest and grassland for cultivation. A study on the cultivated land area changes in some counties in Heilongjiang, Inner Mongolia, Gansu and Xinjiang by remote sensing showed that about 50% of the developed cultivated land had been disused from 1986 to 1996 because of the deteriorating ecological conditions (Pan, 1998). In addition, regarding the cultivated land resources as public properties that might be quickly exhausted by others, farmers usually predatorily developed the cultivated land without worrying about its sustainable use (Zhang et al., 2001), which resulted in the quick decrease in soil fertilities and land desertification. However, the discontinuing farming in the West had not reduced the total grain sown area, for there was larger area of undeveloped land resources for cultivation and some potential for the MCI increase.

Discontinuing farming was seemingly a bad phenomenon affecting food security in China, but was a rational action of farmers in agricultural management, reflecting that the agricultural products were relatively superfluous at present. Under the precondition of keeping the base line of cultivated land area, the phenomenon of discontinuing farming can be changed into good thing. Discontinuing farming can be allowed to be in existence, but the cultivated land use cannot be changed into non-agricultural land use by state plan. In this situation, agricultural structural adjustment can be carried out in order to exert the ecological and social benefit of agriculture, and the moving of land use right can be accelerated in order to develop large-scaled agricultural management in the whole country, especially in the eastern provinces. In the West and Central, the discontinuing farming mainly resulted from the ecological problems, creating good chance to carry out the reusing of farmland for forest and grassland.

Conclusions

This paper examines the changes in agricultural land use intensity in China from 1981 to 2000, with a clear disparity identified among the coastal, central and western provinces. The centrally planned command economy had undoubtedly played an important role in the increase of food production in China since 1949, but gradually reduced the farmer's enthusiasm for agricultural production, because farmers almost got the same amount of income whether you worked hard or not. Historically, a new system for agricultural management was needed in all villages. After the ten-year internal chaos (1966-1976) (referring to the ten-year Cultural Revolution), a socialist market economy was gradually introduced, which greatly increased the farmer's enthusiasm for agricultural production. However, farmers could not continually increase their income with grain production, because of the great difference in profit between agricultural and non-agricultural land use. Market signals have played more and more important role in the changes in agricultural land use intensity in China following the 1978 reforms. Grain price mattered at the country level, while the economic comparative profit of grain production showed a strong influence on the regional disparity of changes in agricultural land use.

Driven by the economic comparative profit, the farmers in the coastal and some central provinces not only managed to find jobs in local TVEs or cities to earn a living by discontinuing farming, but also continually occupied cultivated land by contract for spending their possible difficult time in future. Loss in area of high quality cultivated land and increase in discontinuing farming greatly affected grain production; moreover, the farmers lacked incentive to raise yield in the coastal provinces. The western provinces also had serious problems of discontinuing farming, partly because of the economic comparative profit, mainly because of the fragile ecological conditions for cultivated land use; however, the grain production had played the most important role in the farmers' life since the regional economy was still dominated by agriculture. Therefore, the farmers in the West tried to increase the intensity level for agricultural production in order to get a higher income.

Although the study focuses on the changes in land use intensity, it also provides an important implication for the understanding of land use type conversion in the country. Studies on the latter issue showed a clear trend of farmland loss in the East and farmland gain in the West after the mid-1980s (Yang and Li, 2000; Li, 2000), which was coincident to the strong increase in agricultural land use intensity in the West and the weak increase if not decrease in the East. The most important policy implication of this study is that the central and western provinces may follow the coastal provinces to decrease grain production intensity supposed affected by a sustained economic development and agricultural policy. As mentioned in the introduction section of this paper, lower incentive for raising agricultural land use intensity may more seriously threaten food security than the shrinking farmland area or lower technological potential in China.

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