Establishment of Rural Housing Land Standard in China

SONG Wei[1], CHEN Baiming[1], ZHANG Ying[1, 2], WU Jianzhai[3]

(*1. Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing 100101, China*;
2. Gradute University of Chinese Academy of Sciences, Beijing 100049, China; *3. Agriculture Information Institute,*
Chinese Academy of Agriculture Sciences, Beijing 100081, China)

Abstract: On the basis of rural household survey in 12 provinces of China in 2005, this research built an econometrical model to find the area standard for rural housing land. This standard is expected to facilitate rural housing land administration, efficient and intensive housing land use and policy making. This research concludes: 1) according to the household survey data, the average area for rural housing land in China is about 235.26 m^2, and the rural housing land mainly includes unused land (42.89%) and house construction land (37.76%) with the average floor-area ratio of 0.42; 2) the indexes in the standard concern the factors such as location, landform, house form, household population and cultivated land area per farmer, which all have significant effects on rural housing land use; 3) the reasonable area for rural housing land may be 150 m^2 in average before 2020, and the referential standards in different provinces are 120 m^2, 130 m^2, 140m^2, 150 m^2, 160 m^2, 170 m^2, 190 m^2, 200 m^2, 210 m^2, 220 m^2, 230 m^2 and 250 m^2 respectively; and 4) if there are less than two persons or more than five persons in a family, these standards need to be decreased or increased by 7%. When the cultivated land area per farmer is lower than the provincial average, the standards have to reduce by 3.5%.

Keywords: rural housing land; area standard; rural household survey; China

1 Introduction

Rural housing land has existed in China with a prolonged history (Long *et al*., 2007). After the founding of the People′s Republic of China (PRC) in 1949, the property rights of rural housing land continued to change until the Rural Collective Land Property was formed, i.e. collective ownership and individual using right (Li *et al*., 1998; Ho, 2001). Accordingly, planned land allocation was adopted as the major measure in the acquirement of rural housing land (Chen and Summerfield, 2007; Gu *et al*., 2008), featuring socialistic characteristics. Since the implementation of the reform and opening up policy in 1978, the rural housing demands have grown along with the increasing income of the farmers and triggering waves of rural house construction (Jin, 1989; Wu, 2003). As a result, the farmers′ housing conditions were greatly improved. From 1978 to 2007 in rural China, the per-capita floor space of houses increased from 8.1 m^2 to 31.6 m^2; the proportion of reinforced concrete-structured houses increased from 2.04% to 39.56% (National Bureau of Statistics of China, 2007). However, the construction of rural houses will inevitably lead to the shrinking cultivated land (Yang and Li, 2000; Xu, 2004; Song *et al*., 2006; Tian *et al*., 2007). Furthermore, the land resources have been wasted because of the lack of unified planning and organization in house construction and the ignorance of laws. Hence Sargeson (2002) raised the questions, ′why farmers in high-yield areas of populated regions often extensively use the already precious cultivated land to build houses′ and ′why can not Chinese government curb the trend of the rural housing expansion, though it has issued laws to conserve cultivated land for food se-

curity′. To protect the cultivated land from excessive occupation of house construction in rural areas, each province in China has established standards of rural housing land, which are so far not effective enough (Long *et al.*, 2007). In 2005, the rural housing land amounted to 9.1161×10^6 ha in total and the per-capita area reached 361.43 m². However, the average floor-area ratio of rural housing land was very low (Song *et al.*, 2008).

According to the Land Administration Law of the People′s Republic of China (Law Centre of Law Press China, 2009), the proprietorship of rural housing land belongs to the rural collective and farmers only have the use rights. Although rural housing land is the collective ownership, Chinese farmers traditionally believe that they are inheritable (Yang, 2007). Farmers usually pay close attention to the size and boundary of their rural housing land (Zhou, 2007). In some extreme cases, several farmers died in neighbor conflicts. Therefore, it is important for China to establish a proper standard system for rural housing land. Low standard would not meet the farmers′ demands for living and producing and thus lead to disputes and social problems; yet, unreasonable high standard would not help the intensive use of rural housing land and cultivated land conservation. The standards of rural housing land were established at the provincial level for a long time. Most of them can not keep pace with rural housing development. More-over, because of the lack of consistent and standardized methodology, the provincial standards varied even among the regions with similar natural, economic and social conditions (Fang and Liu, 2008; Song *et al.*, 2008).

Hence on the basis of survey data, this research intends to select the proper control factors, establish a calculation model, and provide an approach to build standards for intensive use of rural housing land, in order to improve management level of rural housing land in China.

2 Methods

2.1 Household survey

For the lack of statistics, the data of rural housing land adopted in this research were from the household survey in 2005. From July to September in 2005, students in China Agriculture University (CAU) were organized to gather the basic information of rural housing land in their hometowns. In advance, they were trained for five days about the survey aim, skill and method. Then they went home and finished the survey questionnaires, which involved the economic conditions of villages and local households, utilization of rural housing land and cultivated land, *etc*. There are 16 counties or districts of 12 provinces, including 575 farm households, were surveyed (Table 1 and Fig. 1). The results were processed

Table 1 Sample spots of household survey for rural housing land in China

| Location of sample spots			Sample size	
Province	Prefecture-level city	County or District	Village	Farm household
Tianjin		Ninghe	1	30
Sichuan	Ziyang	Jianyang	2	39
Shanxi	Jincheng	Gaoping	2	40
	Luliang	Lin	1	17
	Taiyuan	Loufan	2	29
Shandong	Yantai	Longkou	4	38
Inner Mongolia	Wulanchabu	Zhuozi	4	59
Jiangxi	Jiujiang	Ruichang	1	45
Jiangsu	Changzhou	Wujin	2	31
Heilongjiang	Mudanjiang	Dongning	3	30
Hebei	Xingtai	Neiqiu	4	30
Fujian	Quanzhou	Shishi	3	51
	Fuzhou	Changle	2	17
Beijing		Daxing	3	21
		Haidian	15	78
Anhui	Hefei	Feixi	2	20
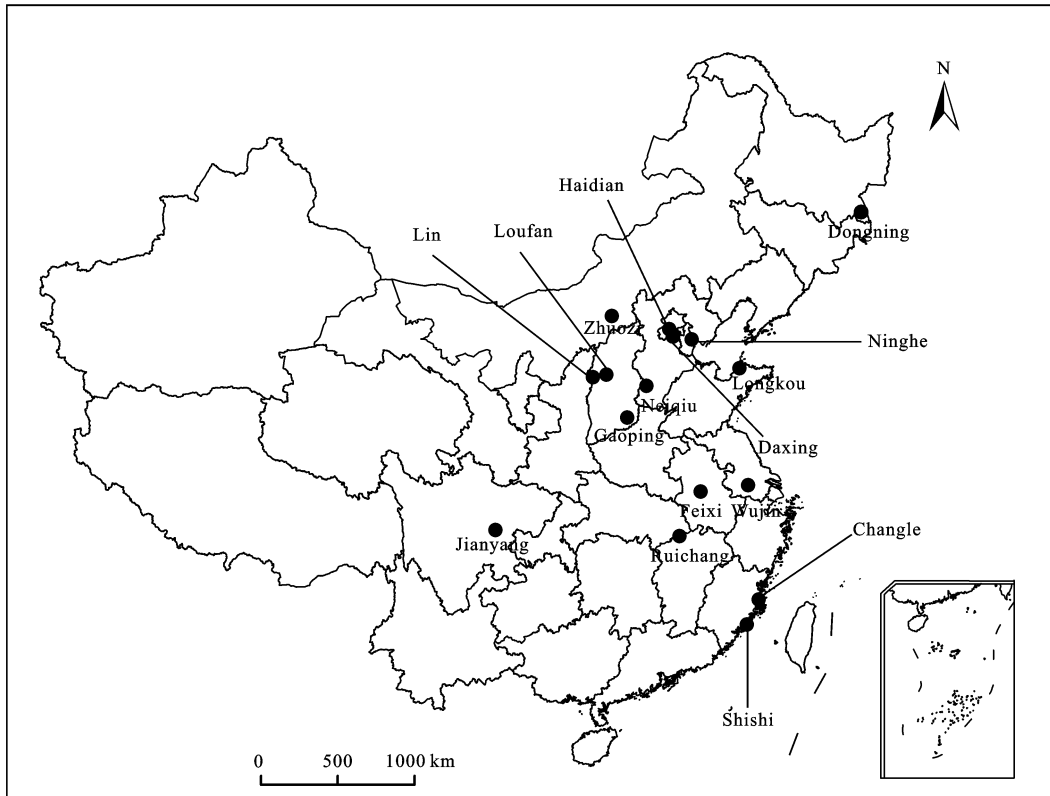
Fig. 1   Location of survey counties or districts

with SPSS 11.5 and Excel.

2.2   Representativeness test of survey data

The data quality has a significant impact on the data sufficiency. If the quality of survey data is poor, the survey results may not exactly reflect the original features of survey subjects. Therefore, the representativeness test has to be carried out to examine survey data′s quality. This research adopts the probability test to judge whether the samples are in an approximately normal distribution. The positive result may guarantee the quality of the survey data (Cao and Tao, 2002; Wang *et al.*, 2005). According to the test results (Fig. 2 and Fig. 3), area and floor-area ratio of rural housing land show the normal distribution. Consequently, the data were proved good in quality and considered to be well describing the general situation of rural housing land in China.

3   Results and Analyses

3.1   Average area of rural housing land

The average area of rural housing land of 575 farm households is 235.26 m^2. Maximum is 1100 m^2 in Inner Mongolia and minimum is 60 m^2 in Anhui and Beijing (Table 2). The local average in Anhui is as small as 118.92 m^2. On the contrary, that in Heilongjiang reaches 449.89 m^2. In Anhui, Shandong, Sichuan, Fujian and Jiangxi, the average value ranges from 100 m^2 to 200 m^2, while it is between 200 m^2 and 300 m^2 in Hebei, Shanxi, Tianjin, Beijing and Jiangsu. The average values of rural
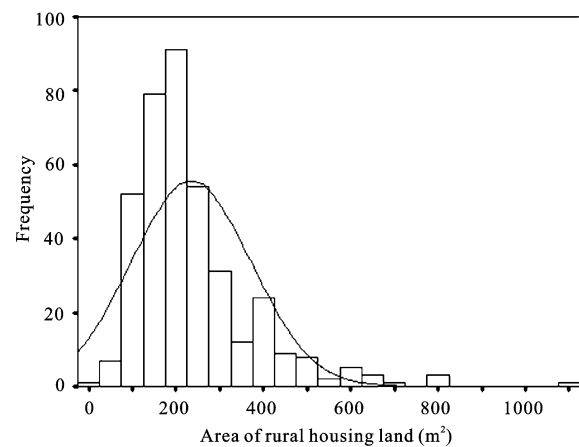

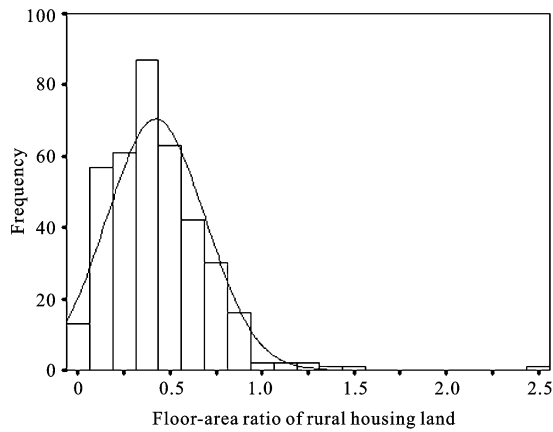Fig. 2   Normal distribution tests for rural housing land area

Fig. 3　Normal distribution tests for floor-area ratio of rural housing land

housing land exceed 300 m^2 in Inner Mongolia and Heilongjiang.

Geographic conditions and customs are the two important factors for the regional disparity. For example, rural houses in Heilongjiang have both the front yard and back yard. This design causes a bigger area of rural housing land in that province. In addition, with the livestock breeding, the rural housing land in Inner Mongolia usually occupies a large place.

Most rural houses in Beijing, Shandong, Hebei, only have one courtyard and farmers there do not raise a large number of livestock. Therefore, the use of rural housing land in there appears more intensive, and the area of rural housing land is smaller than that of Inner Mongolia and Heilongjiang (Table 2). The plain land-

form is scare and precious in Sichuan which leads to a small area for rural housing land. Because of the climate and customs, the rural houses in Anhui and Fujian are mostly storied buildings with small-sized area and intensive land use.

3.2　Structure of rural housing land

For the purpose of land use, we divided rural housing land into five types (Table 3): house construction land (used for constructing bedroom, living room, *etc*), sundry placing land (used for placing sundries, such as farm tools and grain), facility construction land (used for constructing kitchen, toilet, *etc*), livestock raising land (used for raising livestock, such as pigs, chickens and cattle) and unused land (land with no cover). The household survey shows that the unused land takes 42.89% (Table 3), house construction land takes 37.76%, facility construction land takes 8.84%, sundry placing land takes 7.98% and the livestock raising land takes 2.53%. Unused land and house construction land are two main land use types in rural housing land.

According to the proportions of house construction land (Table 3), the surveyed provinces are ranked from higher to lower as: Fujian, Shandong, Sichuan, Beijing, Jiangsu, Shanxi, Inner Mongolia, Anhui, Hebei, Jiangxi, Tianjin and Heilongjiang. Due to hot and rainy climate, the rural houses in Fujian are generally storied buildings. As a result, the area of rural housing land in Fujian is small and the proportion of house construction land remains high. With many bungalows, that proportion becomes smaller in Heilongjiang, Tianjin, *etc*. The rural house in China is not only for living but also for pro-

Table 2　Average area for rural housing land in different provinces (m^2)

Province	Samples	Minimum value	Maximum value	Average value	Standard error
Anhui	20	60.00	200.00	118.92	37.22
Beijing	99	120.00	800.00	272.93	102.58
Fujian	68	60.00	540.00	164.16	73.96
Hebei	30	142.00	254.90	201.20	23.89
Heilongjiang	30	320.00	625.00	449.89	82.21
Jiangsu	31	100.00	800.00	288.00	150.29
Jiangxi	45	100.00	300.00	172.00	77.27
Inner Mongolia	59	72.00	1100.00	381.94	282.27
Shandong	38	80.00	260.00	149.16	32.75
Shanxi	86	70.50	674.00	217.05	125.66
Sichuan	39	120.00	200.00	156.67	38.30
Tianjin	30	103.00	368.00	220.76	61.30

Table 3   Subclasses' proportion of rural housing land in different provinces (%)

Province	HCL	SPL	FCL	LRL	UL
Anhui	35.10	9.11	9.11	10.62	36.06
Beijing	42.61	4.72	11.72	0.00	40.95
Fujian	62.50	2.07	10.82	2.67	21.94
Hebei	34.70	16.41	11.85	10.69	26.35
Heilongjiang	7.43	5.72	3.07	2.59	81.19
Jiangsu	40.63	6.92	14.84	3.55	34.06
Jiangxi	29.25	17.56	8.19	8.50	36.50
Inner Mongolia	37.00	25.44	0.00	6.41	31.15
Shandong	48.38	14.67	13.59	0.88	22.48
Shanxi	39.26	11.16	6.59	1.90	41.09
Sichuan	47.18	0.71	7.87	2.97	41.27
Tianjin	25.38	9.80	2.38	0.27	62.17
Average	37.76	7.98	8.84	2.53	42.89

Notes: HCL is house construction land; SPL is sundry placing land; FCL is facility construction land; LRL is livestock raising land; UL is unused land

ducing, especially for livestock raising. Therefore, the livestock raising land occupies some spaces in rural housing land. As a whole, the proportion of livestock raising land in more developed regions such as Beijing, Tianjin, Fujian and Shandong, is small because the net income per farmer in these areas is high and few farmers raise livestock presently. On the contrary, in developing regions such as Hebei, Anhui and Jiangxi, farmers raise livestock to earn more money. Thus, these regions have higher proportion of livestock raising land.

In general, the proportion of facility construction land in more developed regions such as Shandong, Hebei and Beijing, is bigger than Inner Mongolia and Heilongjiang, because the heating system occupies more rural housing land. For example, in Haidian District of Beijing, there are boilers in rural house occupying 15 m² in average. In more developed regions such as Jiangsu and Fujian, with higher net income per farmer, the rural households can afford more functional rooms, for example dining-room, washroom, cook room, which occupy more space and lead to a higher proportion of facility construction land.

The regional disparity of the proportion of sundry placing land is not obvious. However, the proportion appears higher in Inner Mongolia, Jiangxi, Hebei and Shandong than in Fujian and Beijing. The maximum proportion of unused land reaches 81.19% in Heilongjiang, and the minimum is 21.94% in Fujian (Table 3). The proportion of unused land is determined by the rural house forms. Bungalow means a higher percentage; storied building means a lower one. The unused land is necessary, but its size should meet the requirement of intensive land use.

3.3   Floor-area ratio of rural housing land

The floor-area ratio of rural housing land is defined as the ratio of floor area against the total. Strictly speaking, the floor-area ratio of rural housing land is different from the general conception. In general, the floor-area ratio is the ratio of floor area to the land area of whole residential community. A rural house can not be regarded as a residential community. By the same token, land of a residential community is composed of not only rural housing land but also rural road land, grass land, store land, *etc*. Therefore, the floor-area ratio of rural housing land is generally bigger than that of residential community. The survey results show that the average floor-area ratio of rural housing land is 0.422 with the minimum of 0.020 in Inner Mongolia and the maximum of 1.500 in Jiangsu (Table 4).

The floor-area ratio becomes smaller in the regions with larger rural housing land area (Table 2 and Table 4). In addition, house form can affect the floor-area ratio of rural housing land. The floor-area ratio of storied building is generally bigger than that of bungalow. As a whole, the floor-area ratio of rural housing land in the southern China is higher than that in the northern China, and the floor-area ratio in the eastern China is higher than that of the central or western China.

3.4   Supply and demand analysis for rural housing land

For lack of statistic data, this research simply analyzed the supply and demand in rural housing land. In general,

Table 4   Floor-area ratio of rural housing land in difference provinces

Province	Sample	Minimum value	Maximum value	Average value	Standard error
Anhui	20	0.494	0.980	0.716	0.126
Beijing	99	0.149	0.792	0.427	0.159
Fujian	68	0.200	0.911	0.625	0.167
Hebei	30	0.212	0.501	0.348	0.076
Heilongjiang	30	0.030	0.128	0.074	0.026
Jiangsu	31	0.111	1.500	0.479	0.293
Jiangxi	45	0.120	0.889	0.539	0.368
Inner Mongolia	59	0.020	0.800	0.245	0.220
Shandong	38	0.158	1.311	0.418	0.277
Shanxi	86	0.100	1.321	0.393	0.227
Sichuan	39	0.270	0.679	0.438	0.156
Tianjin	30	0.048	0.546	0.254	0.138

there are considerable demands on better housing conditions and new construction. From 1978 to 2007, the per-capita floor space of houses increased from 8.1 m^2 to 31.6 m^2 (National Bureau of Statistics of China, 2007). And thanks to the increasing incomes, the expectation for better houses continues to grow. Considering the natural increase of rural population, the demand for rural housing land will be inevitably huge.

Yet the supply is limited. Most rural housing land are transferred from cultivated land, but now the area of existing cultivated land is very close to the target inventory in 2020. According to the Outline of Land Use Planning in China (2006–2020) (The Ministry of Land and Resources of China, 2008), the target inventory of cultivated land is 1.212×10^{10} ha in China in 2020. In fact, the cultivated land quantity in 2006 decreased to 1.2178×10^{10} ha. Furthermore, the limited quota of cultivated land occupation have been mostly assigned to urban and town construction. In some regions, the examination and approval for rural housing land even have been pended. The contradiction between the supply and demand is obvious.

4   Discussion

4.1   Widely adopted policy for rural housing land standard in China
The 62nd article of the Land Administration Law of the People′s Republic of China (Law Centre of Law Press China, 2009) prescribes that one farm household can only have one piece of rural housing land and its area can not exceed the local regulations of the provincial

governments. Therefore, the establishment rights of area standard for rural housing land are vested to provincial governments and the standards in different provinces may be greatly varied. The provincial regulations about rural housing land standards, which are mainly the implementation rules for the Land Administration Law of People of Republic China (Law Centre of Law Press China, 2009) in different provinces, demonstrate that the current system of rural housing land standard in the mainland of China is composed of two parts (Table 5): the standard control index system to differentiate standard areas of various rural housing land, and the standard value of rural housing land, i.e. the area size of rural housing land. Generally one to five values were selected according to the control indexes of position, landform, household population, cultivated land areas per farmer or the land occupation sources for rural house construction. Diversified standard values and categories are the two major features for standard system of rural housing land in China.

4.2   Construction of econometrical model for rural housing land area
The control indexes are the factors which can significantly affect rural housing land area. According to the analysis of the current standard system for rural housing land and previous researches, factors such as position, landform, household population, cultivated land area per farmer and house form, were selected as possible control indexes for rural housing land standard. But they should be confirmed in accordance with their influences.

According to the above analysis and previous re-

Table 5 Standard system widely adopted for rural housing land in the mainland of China

Region	Control indexes of standard					Standard value
	P	L	HP	CLA	LOSC	
Beijing	√	×	×	×	×	167 m² and 200 m²
Tianjin	×	×	×	√	×	167 m² and 200 m²
Hebei	×	√	×	√	×	200 m², 233 m² and 467 m²
Shanxi	×	×	×	√	×	133 m², 200 m² and 267 m²
Inner Mongolia	√	×	×	√	×	250 m², 300 m², 500 m² and 600 m²
Liaoning	×	×	×	√	×	200 m², 300 m² and 400 m²
Jilin	×	×	×	√	×	250 m², 220 m², 330 m² and 350 m²
Heilongjiang	√	×	×	×	×	250 m² and 300 m²
Shanghai	×	×	√	×	×	100 m², 150 m², 160 m², 180 m² and 200 m²
Jiangsu	√	×	×	√	×	135 m² and 200 m²
Zhejiang	×	√	×	×	√	125 m², 140 m² and 160 m²
Anhui	√	×	×	×	√	160 m² and 220 m²
Fujian	×	×	√	×	√	80–120 m²
Jiangxi	×	√	×	×	√	120 m², 180 m² and 240 m²
Shandong	√	×	×	√	√	133–267 m²
Henan	×	√	×	√	×	134 m², 167 m² and 200 m²
Hubei	×	×	×	×	√	140 m² and 200 m²
Hunan	×	×	×	×	√	130m², 210 m² and 180 m²
Guangdong	√	√	×	×	√	80 m², 120 m² and 150 m²
Guangxi	√	√	×	×	×	100 m² and 150 m²
Hainan	×	×	×	×	×	175 m²
Chongqing	×	×	√	×	×	20–30 m² per farmer
Sichuan	×	×	√	×	×	20–31 m² per farmer
Guizhou	√	√	√	×	×	120 m², 130 m², 140 m², 170 m² and 200 m²
Yunnan	√	×	×	×	×	20m² and 30 m² per farmer or 100 m² and 150 m² per farm household
Tibet	–	–	–	–	–	–
Shaanxi	√	√	×	×	×	133 m², 200 m² and 267 m²
Gansu	×	×	×	√	×	200 m², 267 m² and 330 m²
Qinghai	√	×	×	×	√	200 m², 300 m², 350 m² and 450 m²
Ningxia	×	×	×	×	√	270 m², 400 m² and 540 m²
Xinjiang	×	×	×	×	√	200 m², 300 m² and 400 m², 500 m², 600 m² and 800 m²

Notes: 1) Unless specifically noted as area standard per capita in the table, the unit of rural housing land standard is area per farm household. 2) P is position; L is landform; HP is household population; CLA is cultivated land area per farmer; LOSC is land occupation source of rural house construction

searches, an econometrical model was constructed for rural housing land areas:

$$\ln Y = \beta_1 \ln(Population) + \beta_2 \ln(Land) + \beta_3 Position + \beta_4 Landform + \beta_5 House\ Form + \varepsilon \quad (1)$$

where Y is the rural housing land area per farm household; *Population* is the person number of a farm household; *Land* is cultivated land area per farmer; *Position* is the location of rural housing land (the location have two options, i.e. the urban-rural interlocking belt and pure rural region; the former is given value 0, the latter equals 1); *Landform* is the terrain of rural housing land (including plain and hill with values of 0 and 1 respectively); *House Form* is differentiated as bungalow and storied buildings (the form of bungalow is endowed with value 1, storied buildings with 0); β_i is unstandardized coefficient; ε is residual.

The survey data of rural housing land were regressed by Weighted Least Squares (WLS), and showed a sig-

nificant value of 0.0000 (Table 6). The results of regression coefficients show that independent variables of *Population*, *Land*, *Position*, *Landform* and *House Form* all have significant effects on rural housing land area (their *P* value are all less than 0.05). The independent variables, *Population* and *Land,* have positive effects on rural housing land area, which means the higher value of variables *Population* and *Land*, the bigger area of rural housing land. Relatively, *Population* plays a more important role for its bigger unstandardized coefficient (Table 6). According to the unstandardized coefficient of pseudo variable, if other conditions are the same, the rural housing land area in pure rural region is larger than that in the urban-rural interlocking belt; the rural housing land area in hilly regions is larger than that in plain; the rural housing land area in the form of bungalows is bigger than that of storied buildings. The unstandardized coefficient of three pseudo variables shows that the pseudo variables′ effects on rural housing land area from high to low are: *House Form*, *Position* and *Landform*. Because the five independent variables all have significant effects on rural housing land area, they are all selected as control indexes for standard system.

4.3 Establishment of rural housing land standard in different provinces
This research has established an econometric model for rural housing land area. The overall test of the model proves that it matches well with the survey data. Thus this model can help to rationally calculate the rural housing land standard. However, along with the changes in household population, average cultivated land area, position, landform and rural house form, the area standard of rural housing land will alter. Therefore, this research gives a standard system rather than a concrete standard value.

Some basic parameters in the econometric model, such as the average household population and the average cultivated land area per farmer in different provinces in 2020 were forecasted. Then the area standard for rural housing land in different provinces was calculated in accordance with the endowed values of three pseudo variables (*Position*, *Landform* and *House Form*). Because each pseudo variable has two optional values, eight standards will be produced under the permutation and combination of three pseudo variables. Yet so many standards can not concisely show the average size of rural housing land at provincial level. Therefore, this research draws an average standard through endowing the three pseudo variables an average value of 0.5. The calculation results of rural housing land standard are showed in Table 7.

4.4 Adjustment of rural housing land standard produced by econometric model
The values of rural housing land standards seem scattered after they were produced by the econometric model. To keep the result neat, the values are rounded (Table 8). Thus, the average standards of rural housing land in different provinces are 120 m², 130 m², 140 m², 150 m², 160 m², 170 m², 190 m², 200 m², 210 m², 220 m², 230 m² and 250 m² respectively in twelve standard ranges. There are 5 provinces with the standard value of 130 m², 5 provinces with 250 m², one with 160 m² and another one with 230 m². Other standard values are assigned from 2 to 3 provinces each.

4.5 Establishment of control index system for rural housing land standard
In the above calculation, the rural housing land standards are worked out only for provincial average household size (*Population*) and average cultivated land area per farmer (*Land*). Unlike dumb variable, parameters *Population* and *Land* are two regular variables

Table 6   Regression results of function coefficients

Model	Unstandardized coefficients		Standardized coefficients	Sig.
	β_i	Standard error	Beta	
Constant	4.4397	0.0689		0.0000
Ln(*Population*)	0.1680	0.0388	0.1763	0.0000
ln(*Land*)	0.0802	0.0128	0.2636	0.0000
Position	0.2524	0.0265	0.4058	0.0000
Landform	0.1236	0.0266	0.1853	0.0000
House Form	0.5760	0.0390	0.6008	0.0000

Table 7 Calculation results of rural housing land standard in different provinces (m^2)

Region	Average value	C1	C2	C3	C4	C5	C6	C7	C8
China	152.05	104.90	118.70	186.60	211.15	135.01	152.78	240.18	271.78
Beijing	157.92	80.18	90.73	142.63	161.39	103.20	116.78	183.58	207.73
Tianjin	192.33	105.80	119.72	188.21	212.97	136.18	154.09	242.24	274.11
Hebei	211.75	107.83	122.02	191.82	217.05	138.79	157.05	246.89	279.37
Shanxi	200.61	110.59	125.14	196.72	222.61	142.34	161.06	253.21	286.52
Inner Mongolia	253.38	119.61	135.35	212.78	240.77	153.95	174.21	273.87	309.90
Liaoning	223.78	109.59	124.01	194.96	220.61	141.06	159.62	250.93	283.95
Jilin	249.23	118.21	133.76	210.28	237.95	152.15	172.17	270.66	306.27
Heilongjiang	250.60	121.38	137.35	215.92	244.33	156.23	176.78	277.91	314.47
Shanghai	133.46	103.06	116.61	183.33	207.45	132.64	150.10	235.96	267.01
Jiangsu	136.46	103.79	117.45	184.63	208.92	133.59	151.17	237.64	268.91
Zhejiang	115.48	92.29	104.43	164.18	185.78	118.79	134.42	211.31	239.11
Anhui	146.43	108.32	122.58	192.7	218.05	139.43	157.77	248.02	280.66
Fujian	119.71	99.19	112.24	176.46	199.67	127.67	144.47	227.12	257.00
Jiangxi	127.59	105.72	119.63	188.07	212.82	136.08	153.98	242.07	273.92
Shandong	199.31	106.62	120.65	189.67	214.62	137.23	155.29	244.13	276.25
Henan	169.09	107.81	121.99	191.78	217.01	138.76	157.02	246.85	279.32
Hubei	132.62	109.89	124.35	195.49	221.21	141.44	160.05	251.62	284.72
Hunan	136.13	104.57	118.33	186.03	210.50	134.6	152.30	239.43	270.94
Guangdong	118.77	98.42	111.36	175.07	198.11	126.67	143.34	225.34	254.99
Guangxi	129.12	106.99	121.07	190.33	215.37	137.71	155.83	244.97	277.20
Hainan	187.55	113.26	128.16	201.48	227.98	145.78	164.95	259.32	293.44
Chongqing	146.29	103.93	117.60	184.88	209.21	133.77	151.37	237.96	269.27
Sichuan	126.47	102.96	116.51	183.16	207.26	132.53	149.96	235.75	266.77
Guizhou	171.45	108.89	123.21	193.7	219.18	140.15	158.59	249.31	282.12
Yunnan	154.83	111.46	126.13	198.28	224.37	143.47	162.34	255.21	288.79
Tibet	220.03	118.85	134.48	211.42	239.23	152.97	173.09	272.12	307.92
Shaanxi	186.51	106.42	120.42	189.32	214.22	136.98	155.00	243.67	275.73
Gansu	246.49	116.79	132.16	207.76	235.09	150.32	170.10	267.41	302.59
Qinghai	206.86	101.27	114.59	180.15	203.85	130.34	147.49	231.87	262.37
Ningxia	231.27	112.76	127.59	200.59	226.98	145.13	164.23	258.18	292.14
Xinjiang	251.67	120.54	136.39	214.42	242.63	155.14	175.55	275.98	312.29

Notes: C1, C2, C3, C4, C5, C6, C7 and C8 are the rural housing land standards under the conditions of locating in urban-rural interlocking belt and plain region with house form of storied buildings, urban-rural interlocking belt and hill region with house form of storied buildings, urban-rural interlocking belt and plain region with house form of bungalow, urban-rural interlocking belt and hill region with house form of bungalow, pure rural region and plain region with house form of bungalow, pure rural region and plain region with house form of storied building, pure rural region and hill region with house form of storied building, and pure rural region and hill region with house form of bungalow respectively

without fixed values, resulting in infinite combination of the two variables. Therefore, the econometric model can only estimate the standards under provincial average level of parameters *Population* and *Land*. In fact, even in the same province the two parameters differ in different zones. Therefore, the standard calculated by the econometric model still needs to be adjusted according to the variation. The population forecast of rural household shows that the average family members are between 3 and 4. Therefore, the rural housing land for the household with less than 3 or more than 4 persons needs to be adjusted. In the econometric model, independent variables *Population* and *Land* are expressed in logarithm forms. Hence their coefficients are elastic (the rural housing land area changes by a certain percentage, when the variable *Population* or *Land* changes by one

percent.) In the econometric model, the unstandardized coefficient of variable *Population* is 0.1680 (Table 6). Since the average rural household population is about 3.5 in China, the standard of rural housing land should decrease by 7% in the case of a household with two persons according to the percentage change of household population compared to the average value (decreased of 42.86%) and elastic value (0.1680). Similarly,

the standard should increase by 7% for a household with five people. Of course, the rural housing land standard can not be endlessly adjusted along with the change of family members. Lower standard hinders farmers to build houses; higher standard affects the intensive use of rural housing land. Therefore, a 7% reduction from the original standard is adopted for the household with 1 or 2 persons, and a 7% increase to the original standard is

Table 8　Standard values of rural housing land in different provinces (m²)

Region	Average value	C1	C2	C3	C4	C5	C6	C7	C8
China	150	110	120	190	210	140	150	240	270
Beijing	160	80	90	140	160	100	120	180	210
Tianjin	190	110	120	190	210	140	150	140	270
Hebei	210	110	120	190	220	140	160	250	280
Shanxi	200	110	130	200	220	140	160	250	290
Inner Mongolia	250	120	130	200	240	150	170	270	310
Liaoning	220	110	120	200	220	140	160	250	280
Jilin	250	120	130	210	240	150	170	270	310
Heilongjiang	250	120	140	220	240	160	180	280	310
Shanghai	130	100	120	180	210	130	150	240	270
Jiangsu	140	100	120	180	210	130	150	240	270
Zhejiang	120	90	100	170	190	120	130	210	240
Anhui	150	110	120	190	220	140	160	250	280
Fujian	120	100	110	180	200	130	140	230	260
Jiangxi	130	110	120	190	210	140	150	240	270
Shandong	200	110	120	190	220	140	160	240	280
Henan	170	110	120	190	220	140	160	250	280
Hubei	130	110	120	200	220	140	160	250	290
Hunan	140	110	120	190	210	140	150	240	270
Guangdong	120	100	110	180	200	130	140	230	260
Guangxi	130	110	120	190	220	140	160	250	280
Hainan	190	110	130	200	230	150	170	260	290
Chongqing	150	100	120	190	210	130	150	240	270
Sichuan	130	100	120	180	210	130	150	240	270
Guizhou	170	110	120	190	220	140	160	250	280
Yunnan	150	110	130	200	220	140	160	260	290
Tibet	220	120	130	210	240	150	170	270	310
Shaanxi	190	110	120	190	210	140	160	240	280
Gansu	250	120	130	210	240	150	170	270	300
Qinghai	210	100	120	180	200	130	150	230	260
Ningxia	230	110	130	200	230	150	160	260	290
Xinjiang	250	120	140	210	240	160	180	280	310

Notes: C1, C2, C3, C4, C5, C6, C7 and C8 are the rural housing land standards under the conditions of locating in urban-rural interlocking belt and plain region with house form of storied buildings, urban-rural interlocking belt and hill region with house form of storied buildings, urban-rural interlocking belt and plain region with house form of bungalow, urban-rural interlocking belt and hill region with house form of bungalow, pure rural region and plain region with house form of bungalow, pure rural region and plain region with house form of storied building, pure rural region and hill region with house form of storied building, and pure rural region and hill region with house form of bungalow respectively

for the household with 5 persons or more.

As for the change of parameter *Land*, it is harder to establish unified adjusted values, because the cultivated land areas vary greatly in different provinces. The cultivated land area per farmer at provincial level is applied as a reference. If the local average is lower than the provincial average, the rural housing land standard there should be decreased; if the local average is higher than it, the rural housing land standard remains unchanged. Because of the complexity in the cultivated land area per farmer, the adjusted values of rural housing land area can only be roughly estimated. Through comparing the coefficients of parameter *Population* and *Land*, it can be found that the latter are about half of the value of the former (0.0802). Therefore, when the cultivated land area per farmer is lower than the average provincial level, the rural housing land standard should decrease by 3.5% (about half of 7%). Thus, the control system is established for rural housing land standard (Table 9).

4.6   Comparison between household survey data and widely adopted standard of rural housing land

At present, 55.32% of the rural households exceed the current standard of rural housing land by 62.28% in average. There are three reasons: firstly, the current standard can not satisfy farmers′ demand for living and producing; secondly, some rural housing land were approved before the adoption of the standard, and at that time the rural housing land area maybe relatively larger thanks to the loose standard system; and at last some farmers break through the standard to expand their residences to the land around. However, the average floor-area ratio of over-expanded houses is 0.200 lower than the normal ones. Hence, the reason for over-expansion is the inefficient use of rural housing land. Farmers are accustomed to satisfy their land requirements through expansion rather than improving floor-area ratio.

4.7   Comparison between standard established hereby and current standard

The current standard system has considerable regional disparities. The values range from 80 m² to 800 m² per farm household. This may be caused by different natural conditions, customs, and house forms, but more importantly, by the lack of standardization and inconformity in the process of establishing standard at provincial level. As a result, regions with similar natural conditions and customs have major difference in standard values.

Furthermore, storied houses became more and more popular in rural area, changing the land use pattern. But this effect is still not considered in the current standard system. On the contrary, in the proposed standard system of rural housing land, the calculation model incorporates the house form factors on the basis of the household survey.

Compared with the current standard system, the standard values in new standard system are more diversifiable. In current system, there are only 1 to 5 standard values for the provinces. In the proposed system, there are definitely 8 standard values covering the factors of landform, position and house form. Moreover, in contrast to current system, the new standard system provides the average values at the national and provincial level. The average values are mostly between the minimum values and maximum values in the current standard system. But the minimum values of new standard

Table 9   Control index system for rural housing land standard

Position	Landform	House form	Standard value	Population of farm household		Cultivated land area per farmer (Less than average provincial value)
				≤2	≥5	
Urban-rural interlocking belt	Plain	Storied building	C1	–7%	+7%	–3.5%
Urban-rural interlocking belt	Hill	Storied building	C2	–7%	+7%	–3.5%
Urban-rural interlocking belt	Plain	Bungalow	C3	–7%	+7%	–3.5%
Urban-rural interlocking belt	Hill	Bungalow	C4	–7%	+7%	–3.5%
Pure rural region	Plain	Storied building	C5	–7%	+7%	–3.5%
Pure rural region	Hill	Storied building	C6	–7%	+7%	–3.5%
Pure rural region	Plain	Bungalow	C7	–7%	+7%	–3.5%
Pure rural region	Hill	Bungalow	C8	–7%	+7%	–3.5%

system are usually lower than that in the current system, but the maximum value are higher. This means that the proposed system widened the select range of standard values based on the factors of position, landform and house form. In a word, the new standard system is more flexible.

5 Conclusions

The household survey of rural housing land in China shows that the average area of rural housing land is about 235.26 m^2 with an average floor-area ratio of 0.42. The rural housing land is mainly composed of unused land (42.89%) and house construction land (37.76%). Affected by geographic and economic conditions, customs and rural house forms, there are obvious disparities in area, land use structure and floor-area ratio of rural housing land.

Parameters, namely *Position*, *Landform*, *House Form*, *Population* and *Land*, all have significant effects on rural housing land area. But in the current standard system, some factors are not considered while setting the standard values. And the calculating methods vary in different provinces. Therefore, this research tries to provide a control index system for area standard for rural housing land that includes the five control indexes, i.e. position, landform, rural house form, household population and cultivated land area per farmer. Nine standard values for rural housing land were calculated under the permutation and combination of three parameters *Position*, *Landform* and *House Form*. The reasonable area for rural housing land may be 150 m^2 in average before 2020, and the referential standards in different provinces are 120 m^2, 130 m^2, 140 m^2, 150 m^2, 160 m^2, 170 m^2, 190 m^2, 200 m^2, 210 m^2, 220 m^2, 230 m^2 and 250 m^2 respectively. In addition, the rural housing land standard need to be further adjusted according to the household population and cultivated land area per farmer. If there are less than two persons or more than five persons in a family, these standards need to be decreased or increased by 7%. When the cultivated land area per farmer is lower than the provincial average, the standards have to reduce by 3.5%. Compared with the current standard system, the proposed standard system considers more factors, adopts unified method and provides more value options. The new standard system may be applicable to adjust the current policies and management of rural housing land in China.

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