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Characteristics and influencing factors of grass-feeding livestock breeding in China:
An economic geographical perspective

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Abstract: The development of grass-feeding livestock breeding is the key to promoting the transition from grain-consumption type animal husbandry to grain-saving type animal husbandry in China, and to solving the problem of competition for grain between people and livestock. From the perspective of economic geography, this paper first defines the conversion standard for the breeding quantity of livestock, and then uses exploratory spatial data analysis technology and econometric models and methods to systematically investigate the sequential variation process, geographical aggregation characteristics, and influencing factors of grass-feeding livestock breeding in China. The study results show the following: 1) The breeding quantity of grass-feeding livestock in China has an obvious overall growth trend, but there is an obvious difference among the livestock species. During the period 1978–2012, the breeding quantity of grass-feeding livestock in China grew by 92.5%; and the breeding quantity within the same period was beef cattle > sheep > dairy cow. 2) On the county scale, the number of increasing areas of the breeding quantity of grass-feeding livestock is larger than the number of decreasing areas, and the growth rate of breeding quantity of grass-feeding livestock in northern China is higher than that in southern China, which initially forms the pattern of "hot in the north and cold in the south". 3) The spatial Durbin model shows that the per capita output of grain, proportion of productive land area, urban per capita disposable income, agricultural mechanization level, agricultural labor productivity and policy factor have positive effects on the development of grass-feeding livestock breeding, while the per capita GDP, urbanization level and proportion of non-agricultural income have obvious negative effects on it. 4) Grass-feeding livestock breeding in China can be divided into six major types of areas, and each type of area should be regulated and controlled in terms of their respective focus of attention according to regional conditions and situation of agricultural production.

Keywords: grass-feeding livestock; animal husbandry; grain; spatiotemporal dynamics; influencing factors

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1 Introduction

Food is an important national strategic resource, and food security is a matter of national economy and common livelihood (Wan, 2008). Although the food production of China realized "11 consecutive growths" in 2014, the per capita food consumption quantity there tends to be stable with the economic development and improvement of people's living standards. However, the demands for feed grain have increased substantially, which causes the constant rise of grain import. After the founding of the People's Republic of China, the breeding quantity of main livestock in China has increased rapidly. The total output of meat, poultry and eggs in China remained the highest in the world for many consecutive years since 1991, and the proportion of the total output value of animal husbandry in the total output value of agriculture increased from 18% in 1980 to 30% in 2012, and this proportion has increased more rapidly in recent years (Fu *et al*., 2012). Meanwhile, the rigid demand for feed grain has seen an obvious growth, and solving the supply and demand problem of feed grain has become the most important task of grain security of China (Wang and Xiao, 2013).

Development of grass-feeding livestock breeding is of great importance to guaranteeing national grain security. Grass-feeding livestock can convert the non-grain feed resources to animal by-products by its special-structure digestive system and physiological functions, while also acting as the main source of supply of beef and mutton and dairy products for human beings. As an important component of modern animal husbandry, grass-feeding livestock breeding complies with the national situation of "less cultivated land area and abundant grassland resources" in China, follows the change tendency of residents' food consumption structure, and also reduces the feed grain consumption, which is the key to solving the problem of competition for grain between people and livestock in China, and has great practical significance. From the point of view of economic geography, we should clarify the spatiotemporal dynamic change process and characteristics of grass-feeding livestock breeding in China and master the critical influencing factors, so as to provide support for the decision-making of macro-adjustment of grass-feeding livestock breeding in China. However, the existing academic researches tend to place emphasis on the spatial pattern change of the overall livestock breeding (Neumann *et al*., 2009; Cecchi *et al*., 2010; Li *et al*., 2010; Saizen *et al*., 2010) and analyze its gravity center curve characteristics (Fu *et al*., 2012), as well as environmental pollution of breeding to the atmosphere, water body and land. The research areas are mainly concentrated in the European and North American countries (Neumann *et al*., 2009; Orhan *et al*., 2009; Sanderson *et al*., 2010; Fu *et al*., 2012; Eshel *et al*., 2014), with less research on China. How have the spatiotemporal dynamics of grass-feeding livestock breeding changed in China? What kind of spatial pattern does the breeding show? Which factors influence the spatial changes of breeding? The existing research results fail to give effective answers to the above questions, thus related researches are urgently needed. For this purpose, this paper selects the main types of grass-feeding livestock to systematically elaborate the spatial change tendency of grass-feeding livestock breeding in China, reveal the influencing factors, divide the different types of areas, and define the optimized regulation and control emphasis points in different types of breeding areas, by adopting the exploratory spatial data analysis method, etc., so as to provide a reference for the healthy and sustainable development of the grass-feeding livestock breeding industry in China.

2 Research methods and data

2.1 Data

The vector data of China's county administrative divisions are taken from the national fundamental geographic data base of the State Bureau of Surveying and Mapping. In view of the availability of data, this paper only considers the three major types of grass-feeding livestock: beef cattle, dairy cow and sheep. The socio-economic data and agricultural statistical index are mainly taken from the *China Statistical Yearbook*, *60 Years Statistical Data in Agriculture of the New China* and *China Rural Statistical Yearbook*, while the data of the breeding quantity of grass-feeding livestock are mainly taken from the agricultural investigation data, livestock statistics and statistical yearbook of each province. In order to guarantee the inter-annual comparability, this paper makes uniform corrections to the adjustment of administrative division and county units with changed names by regarding 2000 as the reference year. During the data analysis, the data with large discrepancy are eliminated, and the abnormal values or county unit with missing data of the same year are replaced with the adjacent year. In total, the data of more than 1926 counties (excluding the Hong Kong, Macao and Taiwan regions) were obtained and summarized.

2.2 Methods

2.2.1 Conversion standard of breeding quantity

In order to facilitate the uniform analysis and comparison of different types of livestock, this paper uses the livestock unit (*AU*) to realize the standardized conversion of livestock breeding quantity. The specific conversion formula is as follows (Kellogg *et al.*, 2000; Li *et al.*, 2007):

$$AU = \sum\left(T_i \times k_{ij} \times \lambda_{ij} / \mu_{ij}\right) \quad (1)$$

where T_i is the breeding stock of the livestock type i, k_{ij} indicates the proportion of the type j of livestock type i in the breeding stock, λ_{ij} represents the number of annual marketing batches or the breeding stock time of the type j of livestock type i, and μ_{ij} is the number of livestock in each livestock unit of the type j of livestock type i (Table 1).

Table 1 Conversion standard parameters for the livestock unit of grass-feeding livestock (Kellogg *et al.*, 2000; Wang, 2004)

Main types of grass-feeding livestock		Proportion of livestock on hand (%)	Quantity of livestock in each livestock unit	Number of annual marketing batches	Annual time of livestock on hand (month/month)
Dairy cow	Adult cow	60	0.74	–	12/12
	Calf	15	4	–	5/12
	Replacement cattle	25	0.94	–	12/12
Beef cattle	Fattened cattle	42	1.14	1.5	–
	Bull	2	1	–	12/12
	Calf	13	4	–	5/12
	Reproducible cow	43	1.14	–	12/12
Sheep	Lamb	15	12.97	–	4/12
	Adult sheep	85	6.98	1	–

2.2.2 Gravity center model

The gravity center of elements indicates the spatial mean value of the elements and is the statistical description of spatial pattern of the elements (Song and Ouyang, 2012). The calculation formula is as follows:

$$\bar{X} = \sum_{i=1}^{n}\left(A_i \times x_i\right) \Big/ \sum_{i=1}^{n} A_i \tag{2}$$

$$\bar{Y} = \sum_{i=1}^{n}\left(A_i \times y_i\right) \Big/ \sum_{i=1}^{n} A_i \tag{3}$$

where A_i is the total elements in the area i; (x_i, y_i) is the geometric center coordinate of the area i; and $(\bar{X},\ \bar{Y})$ is the gravity center coordinate of this element.

2.2.3 Variable set and measurement model selection

In combination with the occurrence conditions of grass-feeding livestock breeding, and taking into account of the availability of data, this paper mainly selects and investigates the influence of the following variables on the grass-feeding livestock breeding: 1) Resource endowment factor: productive land area per labor (sum of cultivated land area and grassland area / agricultural labor force x_1), per capita output of grain (grain output / total population x_2) and proportion of productive land area (sum of grassland area and cultivated land area / land area x_3). 2) Macro economy and market factors: per capita GDP (areal GDP/total population x_4), population urbanization rate (urban population/total population x_5), urban per capita disposable income (x_6), and proportion of non-agricultural income (x_7). 3) Agricultural productivity factors: per unit seeded area yield of grain (grain output / seeded area x_8), agricultural mechanization level (Long *et al*., 2012) (total power of agricultural machinery / cultivated land area x_9), agricultural labor productivity (Long *et al*., 2012) (gross product of primary industry / agricultural labor force x_{10}). 4) Policy factors: set the dummy variables in accordance with the layout plan of advantageous region of beef cattle and sheep issued by the Ministry of Agriculture (Yang and Wang, 2013) x_{11} (advantageous region x_{11}=1, non-advantageous region x_{11}=0).

Considering the complexity, autocorrelation and variability of spatial data, the influence of the explanatory variable on the explained variable will be different in different regions, thus we first adopt the Global Moran's I statistics to test the spatial autocorrelation of data. If there is no spatial autocorrelation, then the global linear regression model (OLS regression) can be adopted for the estimation (Wang *et al*., 2015; He and Liu, 2007). The calculation formula is as follows:

$$Y=b_0+b_1x_1+b_2x_2+b_3x_3+b_4x_4+\ldots+m \tag{4}$$

where Y is the breeding quantity of grass-feeding livestock, and b_i (i=1, 2, 3, …, n) respectively corresponds to the partial regression coefficients of x_j (j=1, 2, 3, …, n). If there is spatial autocorrelation, then the spatial lag model (SLM), spatial error model (SEM) and spatial Durbin model (SDM) can be further selected for the purpose of estimation. The spatial Durbin model not only considers the spatial autocorrelation of dependent variables, but also considers the spatial autocorrelation of independent variables, which means that the dependent variable is not only influenced by the independent variable of this area, but is also influenced by the independent variables and dependent variables in other areas. For this purpose, this paper adopts the spatial Durbin model to analyze the influencing factors of spatiotemporal dynamic changes of grass-feeding livestock breeding. The basic form of spatial Durbin model is as follows (Ye and Fang, 2013):

$$y = \rho wy + \beta X + \gamma wX + \varepsilon \quad (5)$$

where *wy* and *wX* are respectively the spatial lag items of the dependent variable and independent variable, *w* represents the spatial weight matrix, ρ and γ are the spatial lag coefficients, β is the elastic coefficient of the independent variable, and ε is the random error item which meets $\varepsilon \sim N(0, \sigma^2 I_n)$.

3 Results

In this part, we analyzed time series variation characteristics of grass-feeding livestock breeding at first, and then, dynamic characteristics of grass-feeding livestock breeding and its influencing factors were explained in detail. Finally, we zoned grass-feeding livestock breeding into six types.

3.1 Time series variation characteristics of grass-feeding livestock breeding

3.1.1 Obvious growth situation of total breeding quantity of grass-feeding livestock

We calculate the breeding quantity of grass-feeding livestock of China in 1978–2012 by means of the standardized conversion method of livestock breeding quantity, and the calculation results show that the breeding quantity has an obvious overall growth trend since the reform and opening-up (Figure 1). The breeding quantity increased from 6060.8 10^4 AU in 1978 to 11665.7 10^4 AU in 2012, which shows a growth rate of 92.5%. The breeding quantity shows fluctuation in some periods, in which the period 2005–2010 had the largest fluctuation, and the breeding quantity decreased from 10617.1 10^4 AU in 2005 to 9596.6 10^4 AU in 2006. Up to 2009, the breeding quantity of grass-feeding livestock basically recovered to the level in 2005. The changing trend of grass- feeding livestock of China in 1978–2012 is fitted by using multiple functions, and it is found that the linear fitting curve can more effectively describe the changing trend of breeding quantity of grass-feeding livestock during this period, with the fitting degree reaching 0.96. It can be further found from the fitting curve that the breeding quantity of grass-feeding livestock showed a stable growth trend during the period 1978–2012, and the growth trend is obvious.

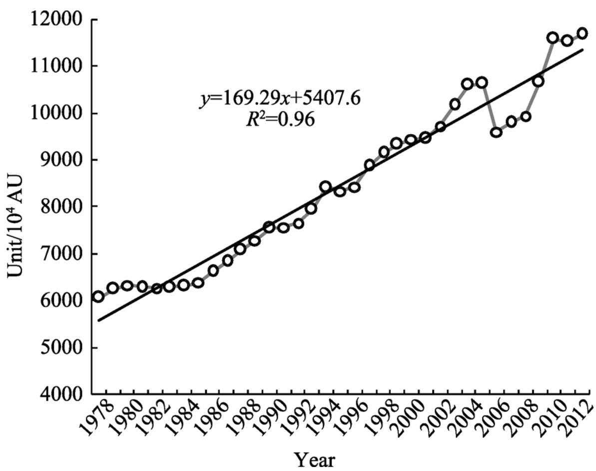

Figure 1 Overall changing trend of breeding quantity of grass-feed livestock in China during 1978–2012

3.1.2 Obvious differences in aspect of growth trend among the grass-feeding livestock species

It can be seen from Figure 2 that the

three grass-feeding livestock species in China during 1978–2012 have obvious difference in terms of breeding quantity and changing trend. Overall, the breeding quantities of beef cattle, dairy cow and sheep are obviously increased by 0.67 times, 30.45 times and 0.68 times, respectively, during the study period. It is found through comparative analysis that the breeding quantity at the same period are beef cattle > sheep > dairy cow.

Overall, the breeding quantity of beef cattle in China during the period 1978–2012 showed an obvious increasing trend. The growth within 1978–2005 was stable; the breeding quantity in 2006 was reduced by 688.9 10^4 AU compared with 2005, which shows a high falling rate; the breeding quantity started to recover rapidly since 2008 and increased to 6492 10^4 AU in 2010. The fitting degree of cubic polynomial function curve was 0.857, and it can be calculated by further solving the fitting function that the breeding quantity of beef cattle is in the interval of increasing function. During the research period, the breeding quantity of sheep in China also showed an increasing trend, but fluctuation within a narrow range was frequent, which had a close relationship with the fast growth rate, short raising cycle and other production characteristics of sheep. The cubic polynomial function curve can better describe the changing trend during this period, and the fitting degree is 0.97. It can be seen from the fitting curve that the breeding quantity of sheep succession trend had a slight decrease and slow increase. Compared with the changes of breeding quantity of cattle and sheep, the change rule of breeding quantity of dairy cow within 1978–2012 showed a different trend. After the fitting of this changing trend by using the multiple functions, it is found that the fitting degree of quadratic polynomial curve reaches up to 0.97. It can be seen from the fitting trend that the breeding quantity of dairy cow within 1978–2011 had an obvious growth trend, in which the breeding quantity within 1978–1997 showed a slow increasing trend, while the breeding quantity within 1998–2011 showed a rapid growth trend, which signifies that the change of breeding quantity of dairy cow has an obvious stage characteristic.

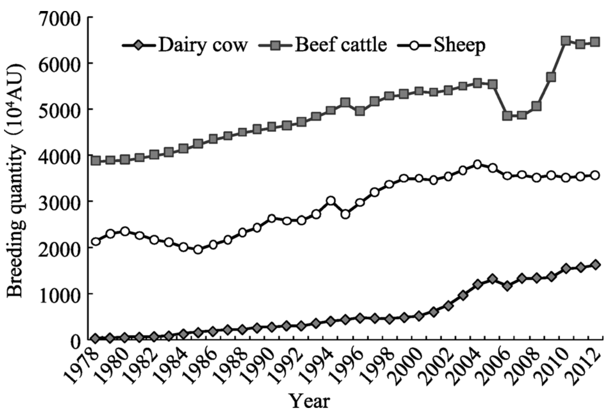

Figure 2 Overall changing trend of breeding quantity of dairy cow, beef cattle and sheep in 1978–2012

3.2 Spatial pattern and evolution of grass-feeding livestock breeding

We calculate the gravity center of breeding quantity of grass-feeding livestock in 1990, 1995, 2000, 2005, 2008 and 2011, in accordance with the gravity center model of elements, and draw the gravity center migration path. Figure 3 shows that the gravity centers of breeding quantity of grass-feeding livestock transferred towards the west during 1995–2000 after the migration towards the northeast direction in 1990–1995, then experienced the changes of transfer towards the northeast direction in 1990–1995, and towards the northwest direction in 2005–2011. It can be seen that the growth rate of breeding quantity of grass-feeding livestock in northern China is larger than that in the southern during 1990–2011.

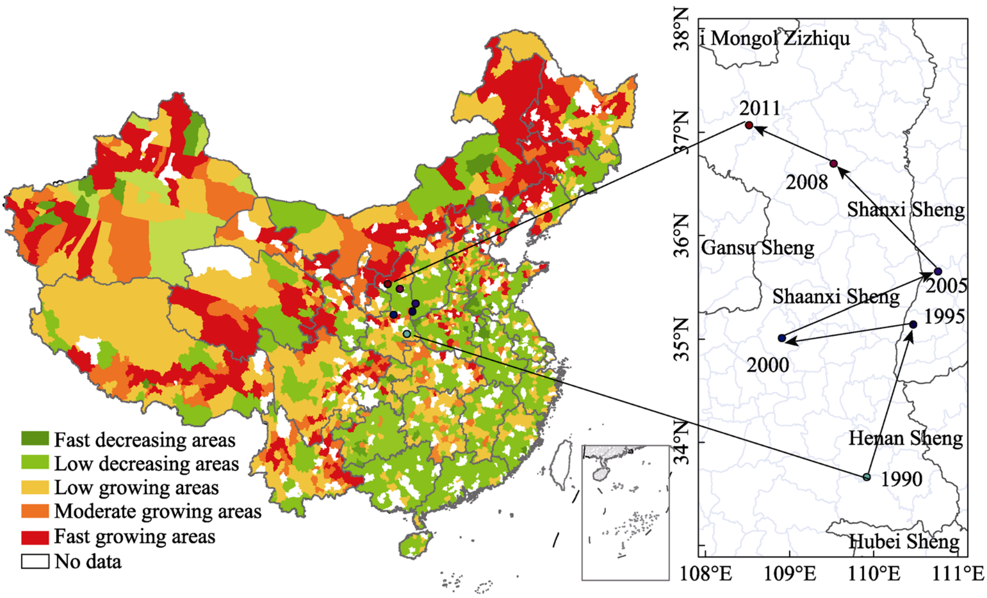

Figure 3 Dynamic pattern of grass-feeding livestock breeding and its gravity centers during1990–2011

In order to further reveal the dynamic change process of the spatial pattern of the grass-feeding livestock breeding in China, the research areas are divided into five types: low decrease, rapid decrease, low increase, moderate increase and fast increase (Figure 3). On the county level of all of China, the number of increasing areas of grass-feeding livestock breeding quantity in counties of China is much greater than the number of decreasing areas. Specifically, the decreasing areas are concentrated in central China, the hilly area south of the Yangtze River, Nanling Mountains region, Yangtze River Delta region and Pearl River Delta region; the distribution of increasing areas is scattered, and the northeastern China mainly exhibits the fast growth type; and the other types of increasing areas are mainly distributed in western China and the Huang-Huai-Hai Plain region. The Yangtze River Delta, Pearl River Delta and other areas with rapid development of urbanization have always been cold spot areas for breeding. This has a certain coupling relationship with the spatial differentiation pattern of China's regional economic zonal difference. The farming-pastoral areas in Inner Mongolia, the Qinghai-Tibet Plateau region, and Xinjiang constituting the major traditional pastoral regions in China provide a solid foundation for the development of grass-feeding livestock by virtue of their rich grass resources and breeding experience, and these regions have always been hot spot areas for the breeding of grass-feeding livestock. In addition, although the grass-feeding livestock industry in the double cropping rice producing areas in China has seen a certain development in recent years, yet traditional rice farming practice still dominates most of the regions which are located in the cold spot areas of breeding.

3.3 Influencing factors of spatiotemporal evolution of grass-feeding livestock breeding

It can be seen from Table 2 that the Moran's I index values are positive and are obviously at the 1% statistical level. The spatial correlation test results show that the grass-feeding livestock breeding of China has positive spatial autocorrelation. Therefore, it is more suitable to use the spatial measurement model to realize the regression. The Hausman test refuses the indistinctive null hypothesis between the fixed effect model and random effect model, thus the fixed-effect spatial Durbin model is selected to analyze the influencing factors.

Table 2 Spatial autocorrelation test and Hausman test

Index	1995	2000	2005	2008	2011
Moran's I	0.392***	0.473***	0.514***	0.374***	0.489***
Hausman Test	297.3				
R^2 Adj	0.923				
Log Likelihood	2.0596				

In the spatial Durbin model, the independent variable comprehensively reflects the influence degree on the dependent variable through the direct effect, indirect effect and total effect (Table 3).

Table 3 Effect estimation of influencing factors of changes of grass-feeding livestock breeding

Variable	Total effect	Direct effect	Indirect effect
x_1	–0.033	–0.019	–0.014
x_2	0.286***	0.266***	0.060**
x_3	0.391***	0.303***	0.088*
x_4	–0.173***	–0.097***	–0.076
x_5	–1.328***	–1.030***	–0.298***
x_6	0.486**	0.283*	0.203**
x_7	–0.665**	–0.353***	–0.312
x_8	–0.031	–0.018	–0.013
x_9	0.222***	0.130***	0.092***
x_{10}	0.169**	0.098**	0.071**
x_{11}	0.264***	0.154**	0.110

Note: ***, ** and * respectively represent the fact that the statistics are obvious respectively at the confidence levels of 1%, 5% and 10%.

In terms of resource endowment factor, the direct effect, indirect effect and total effect of the productive land per capita on the grass-feeding livestock breeding are negative, but not obvious. The per capita output of grain and proportion of productive land area have obvious positive effects on the breeding, and their direct effects are stronger than the indirect effects. This means that the abundance of forage grass and feed resources has a direct positive impact on the development of the grass-feeding livestock breeding industry, which also explains the reasons of grass-feeding livestock breeding aggregating in the advantageous area of fodder grass production.

The per capita GDP, urbanization level and proportion of non-agricultural income have obvious negative effects, and their total effect values are respectively –0.173, –1.328 and –0.665. This signifies that the development of regional economy and improvement of urbanization level provide non-agricultural employment opportunities for farmers while improving their non-agricultural income, but this also has strong and direct negative effects on the grass-feeding livestock breeding, and the negative effects occurring in the adjacent areas are also very obvious. The urban per capita disposable income is mainly reflected as the consuming ability, and its indirect effect on the grass-feeding livestock breeding is obvious. The indirect effect value is 0.203, and is obviously above the 5% confidence level.

The estimation results of agricultural productivity factors show the following: the direct effect, indirect effect and total effect of per unit seeded area yield of grain on the grass-feeding livestock breeding are not obvious, which means that the grain yield ability has a smaller impact on the grass-feeding livestock breeding compared with the regional grain abundance. However, the improvement of agricultural mechanization level and agricultural labor productivity have a very obvious positive impact on the grass-feeding livestock breeding, and the total effect values are respectively 0.222 and 0.169.

The total effect estimation coefficient of policy factor is 0.264, and is obvious above the 1% confidence level. The estimation coefficient of direct effect is 0.154, which is obvious and is not zero at above the 5% confidence level. The indirect effect is not obvious. This signifies that the layout planning of national advantageous areas has an obvious positive effect on the development of local grass-feeding livestock breeding. This is mainly due to the timely implementation of local supporting policies and measures under the guidance of the national macro layout.

3.4 Zoning and regulating control of grass-feeding livestock breeding types

In order to further reveal the objective law of the regional differentiation of grass-feeding livestock breeding in China and provide a basis for the development of grass-feeding livestock breeding and related strategic decision-making, this paper selects the dynamic degree of grass-feeding livestock breeding, Getis- Ord G* index value, breeding quantity and unit land bearing capacity by regarding the county district as the basic unit, and adopts clustering methodology to divide the breeding areas of grass-feeding livestock into six major areas (Figure 4). This paper also discusses the basic guidelines for the optimized regulating control in combination with the basic characteristics and "regional condition" of the grass-feeding livestock breeding. 1) The Type I areas are mainly distributed in northeastern China. These areas are the hot spot areas of grass-feeding livestock breeding in China. In recent years, the breeding quantity has grown fast and the unit land bearing capacity faces great pressure, thus it is necessary to speed up the conversion of feeding production mode and control the areal breeding quantity, and the pasturing area must strictly implement the national balance system between forage area and animals. 2) The Type II areas are mainly located in the Huang- Huai-Hai Plain region. The grass-feeding livestock breeding grows at an intermediate speed and the unit land bearing capacity also faces increasing pressure, thus it is necessary to develop the fattening industry and guide the industrial division of specialization work in combination with the advantages of regional grain production base. 3) The Type III areas are located in eastern and southern China, areas with developed economy, high urbanization level and small breeding quantity of grass-feeding livestock. The breeding quantity of grass-feeding livestock in these areas shows a rapid decreasing trend and the land bearing pressure is relatively small, thus they are considered cold spot areas of

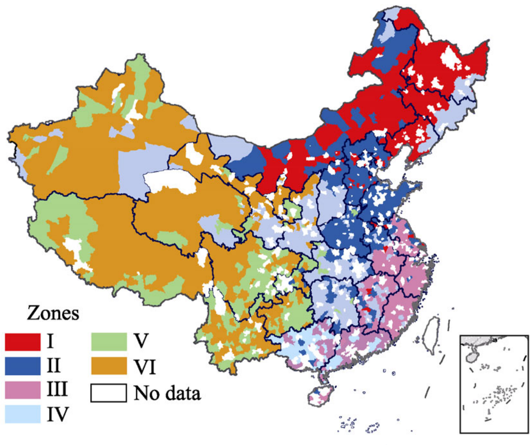

Figure 4 Divisions of grass-feeding livestock breeding in China

grass-feeding livestock breeding, and it is necessary to strictly protect the cultivated land, suitably increase the breeding quantity, and develop high-efficiency modern animal husbandry. 4) The Type IV areas are mainly distributed in the Loess Plateau and Hubei and Hunan Provinces. Grass-feeding livestock breeding shows a low-speed growth in these places, and the land bearing pressure is slightly increased, but this pressure is mainly low pressure. In view of the regional location and geological and geographical conditions, it is recommended to suitably develop the facility feeding, while paying equal attention to the reasonable utilization of resources and ecological protection. 5) The Type V areas are concentrated in southwestern China, and the grass-feeding livestock breeding quantity in these regions mainly shows low-speed reduction. However, considering the high precipitation and serious water and soil loss, it is necessary to focus on the ecological conservation when developing grass-feeding livestock breeding, by making full use of the grassy mountains and slopes and grass resources. 6) The Type VI areas are mainly located in the western pastoral regions, with large breeding quantity of grass-feeding livestock and rapid growth. Although the region is located in the hot spot and sub-hot breeding areas, yet the ecological environment here is very fragile as most of its part is located in the arid area and high and cold areas of the Qinghai-Tibet Plateau. Therefore, the regional resources and environmental features should be relied on convert the production mode of animal husbandry, plant grass, control livestock to develop the characteristic plant-eating animal husbandry economy, build high-end brands, and implement the strategy of success through quality (not quantity) to increase the income of herdsman.

4 Conclusions and discussion

The study and judgment of the spatiotemporal dynamics and influencing factors of the grass-feeding livestock breeding is an important scientific basis for development planning of grass-feeding livestock. By means of spatial analysis technique and measurement model, this paper found that:

(1) The breeding quantity of grass-feeding livestock in China during the period 1978–2012 shows a stable growth trend, and the number of county areas with increased breeding quantity is obviously larger than the number of decreased areas; however, there is an obvious difference in the breeding quantity growth trend among the livestock species, i.e. the largest breeding quantity in the same period is beef cattle, followed by sheep and dairy cow.

(2) The spatial pattern of grass-feeding livestock breeding undergoes great changes, and the hot spot breeding areas such as the farming-pastoral region in Inner Mongolia, the Qinghai-Tibet Plateau region, Xinjiang and the Huang-Huai-Hai Plain region, Greater

Khingan Mountains and the Northeast China Plain region were gradually formed in 2011, while the main double cropping rice producing areas in China, such as the hilly area to the south of the Yangtze River, Nanling Mountains region and developed areas along the southeast coastal zone have always been the cold spot breeding areas. Therefore, we can see that the spatial differentiation characteristic of "hot in the north and cold in the south" is very obvious.

(3) The per capita output of food, proportion of productive land area, urban per capita disposable income, agricultural mechanization level, agricultural labor productivity and policy factor have positive effects on the development of grass-feeding livestock breeding, while the per capita GDP, urbanization level and proportion of non-agricultural income have obvious negative effects on it. This effectively explains the reasons for which the grass-feeding livestock breeding of China shows the layout in the areas with abundant resources of grass and forage, relative backward economic development, few non-agricultural employment opportunities, high agricultural mechanization level, and policy advantages. Specific to the six major breeding areas of grass-feeding livestock, each type of area should positively adjust the breeding scheme of grass-feeding livestock, coordinate the relationship between the areal breeding and land bearing capacity, improve the utilization efficiency of regional resources, and promote the sustainable development of the regional grass-feeding livestock breeding, in combination with the factors such as the breeding quantity and dynamic change of grass-feeding livestock, natural resource base, environmental background conditions, etc.

The development of grass-feeding livestock breeding is of great significance to guaranteeing the supply of animal by-products and mitigating the conflicts of competition for grain between people and livestock, and this issue under discussion has attracted much more attention of the concerned government departments and all sectors of society. This paper initially reveals the fact that the spatiotemporal differentiation characteristics and influencing factors of the grass-feeding livestock breeding in China, the optimized study on the breeding pattern of grass-feeding livestock from the perspective of geographical division of labor and professionalization, environmental effect of grass-feeding livestock breeding, and the calculation of resource consumption and utilization efficiency in regional grass-feeding livestock breeding still requires further deep study.

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