Factors Influencing Grain Production of Henan Province Based on Gray Correlation

LI Qiu-fang[1], KANG Guo-lei[2], LI Xiao-fang[3], LI Bing-jun[1]*

1. College of Information and Management Science, Henan Agricultural University, Zhengzhou, 450002, China; 2. Modern Education Technology Center, Zhengzhou Institute of Light Industry, Zhengzhou 450002, China; 3. Financial Division of Henan Agricultural University, Zhengzhou 450002, China

Abstract The authors analyze the existing problems and macroscopic factors influencing grain production of Henan Province, and then carry out an empirical study on the correlation between grain production and eight influencing factors in Henan Province of China by using the gray correlation analysis method. Finally, this paper puts forward related suggestions.

Key words Grain production; Input factor; Gray correlation analysis; China

There is an ancient Chinese saying that " Food is What Matters to the People". Grain production has always been related to human survival, economic development and social stability, as well as the harmonious development of society, politics and economy of China. Henan Province is located in the middle and lower reaches of the Yellow River of the mid-eastern China. It is one of the oldest agricultural production areas in China with relatively high degree of land development and utilization. Therefore, the available reserved land resources are scarce in Henan Province, especially the reserved arable land resources. Besides, Henan is a province of large population. But its arable land per capita is less than 1/4 of the national average and shows a downward trend year by year. Henan Province feeds nearly 8% of the population with only 17% of the national arable land. Thus, there is tremendous bearing pressure on the arable land of Henan Province. With the continuous increase of population and the rapid development of industrialization and urbanization, the safety of food production will be seriously threatened. Therefore, it is particularly important to excavate the potential of grain production, and to analyze the influencing factors of grain production capacity and production prospects in Henan Province.

1 Problems in grain production of Henan Province

Henan Province was unable to get rid of the " strange circle of fluctuation" since the year 1980, that is, grain production in the next year would surely be reduced after more than 2 or 3 years' yield increase. This situation lasted to the year 2004. In that year, the state promulgated a series of agricultural policies favorable to peasants, which greatly enhanced the peasants' enthusiasm for grain planting. Moreover, Henan Province invested in agricultural infrastructure in order to improve this situation. After 2004, grain yield shows an increasing trend year by year. Summer crop has broken 50 billion kg for consecutive 3 years in 2008, and has hit the historical record for 5 consecutive years, which has made new contribution to the grain production of China. But the prospect of grain production in Henan Province is still very grim.

1.1 Grim situation of the production of summer crops

1.1.1 Serious pests and diseases damage of wheat. Relatively large groups of wheat are formed due to the warm winter in recent years. Thus, the pests and diseases damage happens early in each year with the characteristics of rapid spread and large area. According to statistics, wheat stripe rust even occurs on November 7, 2007, one month earlier than the normal years. Wheat diseases and pests in Henan Province have damaged a total area of 746.67 $\times 10^4$ hm^2 until the early April, 2008, increasing by 140.00 $\times 10^4$ hm^2 compared with the normal years. Wheat disease like this is rare in history over the same period.

1.1.2 Reduction of effective irrigation area. Soil moisture monitoring in late March, 2008 shows that soil moisture in most wheat fields is appropriate, except that the relative humidity at the 0 -50 cm soil of Zhumadian, Luohe, Nanyang, Pingdingshan and other areas is between 40% and 60%, which is mild to moderate drought. Total drought area in Henan Province is about 66.67 $\times 10^4$ hm^2. And drought has been aggravated in northern, central and southwestern Henan until the early April. Wheat in April is generally at booting or heading stage, so more water is needed and the water consumption is relatively rapid. If drought can not be eased, the normal growth and output of wheat will be affected.

1.1.3 Low efficiency of field management. Recently, the number of migrant workers has increased year by year. Thus, the young and middle-aged rural labor force is lacked, and food production is under extensive management. Besides, labor forces engaged in grain production have generally low level of education and weak sense of market and information. They are

Received: March 27, 2009 Accepted: May 10, 2009
* Corresponding author. E-mail: lilylee_0819@126.com

hard to accept new technology, and can not adapt to the development of modern agricultural production.

1.2 High costs for agricultural production during spring cultivation, which influences the peasants' enthusiasm for production inputs The overall supply in agricultural commodities market is sufficient in Henan Province, but the price is relatively high, which enhances the cost of cultivation. At present, prices of fertilizer, seeds, pesticides and farm diesel in Henan market have increased compared with those over the same period last year. Among them, prices of fertilizer, agricultural diesel, agricultural film, pesticides, and seed have raised by 5.8%, 13.3%, 7.1%, and 2.0%, respectively. As a result, price rise of agricultural material products has offset the agricultural policy benefits for peasants to some extent, and has reduced peasants' enthusiasm for production inputs.

1.3 The aged irrigation and water conservancy facilities; the low ability to resist natural disasters In recent years, with the implementation of a series of benefiting-farmers policy by the central government, agricultural infrastructure in Henan Province has been improved. But it is still relatively weak on the whole; and the ability to resist natural disasters is poor. Besides, there are many problems in agricultural irrigation and water conservancy facilities, such as the poor maintenance, functional degradation, and slow renovation. Until the end of 2006, Henan Province has a total of 390.90×10^4 hm^2 of fields irrespective of drought or waterlogging, only occupying about 50% of the total arable land. This results in the relatively low ability to resist natural disasters during agricultural production. Since the year 2003, grain production reduces by about 800×10^4 t due to drought or waterlogging disasters. Therefore, problem in irrigation and water conservancy facilities is still one of the main factors restricting the sustainable and stable development of grain production in Henan Province[1].

2 Macroscopic influencing factors of grain production capacity in Henan Province

2.1 The unstable grain price and uncertain income which influence peasants' enthusiasm for grain production Grain prices in the first half years of 2003 and 2006 are high. Implementation of a series of polices to promote grain product conducted by the state and Henan Province has stimulated the rapid development of grain production[2]. Though the grain price rises, planting crops still obtains relatively low benefits compared with planting economic crops and working in cities. Benefits of grain planting have reduced significantly due to the decline in grain price and the rise in agricultural commodity in the second half year of 2005, which has very adverse impacts on food production. According to the sampling survey on 4 060 peasants households in 42 counties by the Survey Organization of Henan Province, the National Bureau of Statistics in 2006, we can obtain that the rapeseed sowing has decreased by 4.67×10^4 hm^2 due to the climate factor. Grain sowing area of the whole province has only increased by 0.8% while the planning area by wheat is enlarged by 4.67×10^4 hm^2; and the increasing range has declined by 1.2% in 2006 compared with that in 2005. Therefore, peasants usually choose planting economic crops or working in cities rather than planting crops.

2.2 The lack of flexibility in land contract; the implementation of extensive management Different regions have their own policies for adjusting the contracted land of peasants before agricultural tax relief, so that land transfer can be reasonably carried out. However, after the agricultural tax relief, reasonable transfer of land is lacked with the uneven distribution of land; and the scientific and modern farming is hard to be achieved. Therefore, adjustment of land has not only become a problem for the reform and development in rural areas, but also is one of the prominent problems affecting current grain production.

2.3 Influence of grain marketing policy National food policy is an important guarantee for the construction of food security system in China. Corresponding food policy is constituted in different historical periods, so as to guarantee the national food supply and social stability, and to promote the coordinated development of social economy. Government of Henan Province has advanced the *Announcement of the Overall Implementation of the Reform of Grain Marketing System* in 2004. Meanwhile, a series of new policies for deepening the reform of grain circulation system are issued. But the financial burden of Henan Province is too heavy; and income of grain production is greatly affected by the price of grain market. Besides, the long-term mechanism to promote the stable production of grain and the steady income growth of peasants has not yet been established.

2.4 Complicated impact of market on grain production Grain market has remained relatively stable at present. However, with the deepening of the reform of grain marketing system, both the market subject for grain management and the quantity of grain circulation have increased sharply. What's more, general layout in food production and consumption has changed along with heavier task of macroeconomic regulation and control of grain, which has put forward new demands on the market system of grain. Practice has proved that changes in the market will have very complicated impact on grain production. At the same time, domestic production has been affected by the international market. The significant increase in the international market price of grain at present has a limited direct impact on domestic market. However, based on an overall consideration of various factors, it is concluded that grain price in China will still maintain its ascending tendencies for a long time in future.

3 Comprehensive production capacity of grain in Henan Province

3.1 Comprehensive production capacity and level of grain in Henan Province Comprehensive production capacity of grain is the sum of the actual grain yield and the reduced production due to pest disasters. While comprehensive production level is the comprehensive production capacity of grain per unit area. Sowing area of grain crops in Henan Province has changed greatly in recent years, due to the variation of agricultural policy and the adjustment of grain structure. Sowing area of grain is in the state of fluctuation from 1980 to 2000; and the planting area

of grain crops has steadily increased year by year from 2001 to 2005. Until the year 2005, total area of grain has reached 9 153.41 $\times 10^3$ hm^2, increasing by 330.61 $\times 10^3$ hm^2 (3.0%). However, the proportion of grain sowing area in total sowing area of crops shows a downward trend. The actual grain production is increasing year by year (except the yield reduction in 2003, due to the extraordinary serious natural disaster) with the increasing extent of 11.0%. Grain production capacity over the same period has enhanced by 441.06 $\times 10^4$ t (only the years 2004 and 2005 are compared, because the data of 2001 and 2002 are incomplete and the year 2003 is unusual). As a result of the scientific and technological progress, comprehensive production level of grain has improved by 39.0% under the condition of little enhancement in sowing area[3].

3.2 Gray correlation analysis on factors influencing the grain production capacity in Henan Province Gray correlation mathematical analysis is an important aspect of Gray Systems Analysis. It is a method to quantitatively describe and compare a certain system development status, the essence of which is to compare the geometric relationship of the time series reflecting factor change. And the aim of gray correlation analysis is to find the main factors and the impact degree during the process of system development. Gray correlation degree is the correlation degree of two systems or two factors in a system changing with time and speed (one is the main behavior factor, the other is the related behavior factor)[3-5]. During the process of system development, we can use the sequencing of correlation degree to analyze which factors affect the main behavior factors, and which factors have little impact. Factor having big correlation degree means it has relatively greater impact on the main behavior factor; and factor having small correlation degree has no or few impact. Therefore, gray correlation analysis can distinguish between dominant factor and potential factor, and between strengths and weaknesses; it lays the foundation for analysis and evaluation. In other words, gray correlation analysis is a factor analysis of system; it is the quantitative analysis of the development process of system. It can measure the approaching degree of factors according to the development status and (dis) similarity degree of factors[6-8]. Calculation steps of correlation degree are as follows:

(1) Give out the original sequence. Reference sequence is $x_0(k) = \{x_0(1), x_0(2), \cdots, x_0(n)\}$. And m comparative sequences are:

$$\begin{cases} x_1(k) = \{x_1(1), x_1(2), \cdots, x_1(n)\} \\ x_2(k) = \{x_2(1), x_2(2), \cdots, x_2(n)\} \\ \vdots \quad \vdots \quad \vdots \quad \vdots \quad \vdots \\ x_m(k) = \{x_m(1), x_m(2), \cdots, x_m(n)\} \end{cases}$$

(2) Carry out dimensionless form of variable sequence. Dimensionless calculation of original data is carried out by the Mean Method, Initial Value Method, Interval Method and so on. We adopt the Initial Value Method to calculate the reference sequence $y_0(k)$, and comparative sequence $y_i(k)$ ($i = 1, 2, \cdots, m$; $k = 1, 2, \cdots, n$).

(3) Obtain absolute difference sequence. Reference sequence $y_0(k)$, comparative sequence $y_i(k)$ ($i = 1, 2, \cdots, m$; $k = 1, 2, \cdots, n$). The absolute value of differences at corresponding point k ($k = 1, 2, \cdots, n$; observation time or the number of observed objects) has constituted an absolute difference sequence $\triangle_{0i}(k)$:

$$\begin{cases} \triangle_{01}(k) = |y_0(k) - y_1(k)| = \{\triangle_1(1), \triangle_1(2), \cdots, \triangle_1(n)\} \\ \triangle_{02}(k) = |y_0(k) - y_2(k)| = \{\triangle_2(1), \triangle_2(2), \cdots, \triangle_2(n)\} \\ \vdots \quad \vdots \quad \vdots \quad \vdots \quad \vdots \quad \vdots \\ \triangle_{0m}(k) = |y_0(k) - y_m(k)| = \{\triangle_m(1), \triangle_m(2), \cdots, \triangle_m(n)\}. \end{cases}$$

(4) Find out the maximum absolute difference ($\triangle_{max}$) and the minimum absolute difference ($\triangle_{min}$) in the absolute difference sequence.

(5) Calculate the gray correlation coefficient.

$$\varsigma_i(k) = \frac{\min_i \min_k |y_0(k) - y_i(k)| + \rho \max_i \max_k |y_0(k) - y_i(k)|}{|y_0(k) - y_i(k)| + \rho \max_i \max_k |y_0(k) - y_i(k)|},$$

where $\varsigma(k)$ is the correlation coefficient between comparative sequence and reference sequence at the kth time period, ρ is the resolution coefficient with its value between 0 and 1 (0.5 in this paper), min min $|y_0(k) - y_i(k)|$ is the secondary minimum difference, max max $|y_0(k) - y_i(k)|$ is the secondary maximum difference, i is the line number of data, and k is the row number of data.

(6) Work out the gray correlation degree. There are many correlation coefficients with dispersed information, which is not suitable to compare. Therefore, it is necessary to convergent the correlation coefficients at different time periods into one value. And calculating the mean value is a way to solve this problem. General expression of correlation degree is $\gamma_a = \frac{1}{n}\sum_{k=1}^{n}\varepsilon_a(k) = \frac{1}{n}\{\varepsilon_a(1) + \varepsilon_a(2) + \cdots + \varepsilon_a(n)\}$, where γ is the correlation degree of between comparative sequence and reference sequence. It is generally believed that if γ_a is bigger, the factor has greater impact on reference factor[9].

After carrying out the qualitative judgments on the factors influencing grain production, we use the grain production of Henan Province $X_0(t)$ ($t = 1990, 1991, \cdots, 2007$) as the main behavior factor, and select eight related behavior factors affecting the total grain output, which are the index of sowing area of grain crops (X_1), index of labor force (X_2), index of rural electricity consumption (X_3), fertilizer index (X_4), index of agricultural plastics (X_5), index of pesticides application (X_6), index of total agricultural machinery power (X_7), and index of effective irrigation area (X_8)[10] (Table 1).

3.3 Analysis of results Table 2 reports that the importance degree of the main behavior factors affecting the grain production of Henan Province is effective irrigation area > labor force > sowing area of grain crops > application of fertilizer > total agricultural machinery power > rural electricity consumption > application of pesticides > agricultural plastics. ① Effective irrigation area has the greatest impact on grain production. In other words, effective irrigation area has played a crucial role in the improvement of grain production. Henan Province has intensified the efforts on the construction of agricultural infrastructure in recent years; and notable progress has been made in

supplement auxiliary project and water saving rebuilding in large irrigation areas. At the year 2007, the effective irrigation area in Henan Province has reached 491.49 $\times 10^4$ hm^2, accounting for about 70% of the total arable land. Thus, effective irrigation area has become an important factor affecting grain production due to the implementation of a number of major agricultural infrastructure projects in Henan Province. ② Correlation degree between grain production and labor force ranks the second, indicating that agricultural production is still extensive in Henan Province to a certain degree, and more time and labor forces should be put in order to improve grain output. Input of labor force directly affects the grain production. ③ Sowing area of grain crops is the basic guarantee of grain production. Grain sowing area from 1990 to 2007 increases a little, and sometimes even declines, but the total grain output still shows an upward tendency. Therefore, it can be concluded that the sowing area of grain crops has no significant direct pulling function on grain production. And the space for increasing grain production by solely expanding sowing area is getting smaller and smaller. Overall planning of land use in Henan Province (1997 – 2010) has advanced that we should improve the capacity of grain production by using the existing arable land and land production potential with the objective of maintaining the area of arable land. ④ Fertilizer consumption has relatively great function on the grain production of Henan Province. Statistics show that a little more fertilizer consumption has caused substantial increase of grain output. However, an over-reliance on chemical fertilizers not only boosts the production cost, but also results in consolidated land, soil degradation, and poor grain quality and taste. ⑤ Rural electricity consumption, pesticides application and agricultural plastics take the last three places, indicating that the level of agricultural modernization is still low in Henan Province, and the resistant ability to pests and disasters is weak.

Table 1 Related index of grain production in Henan Province from 1990 to 2007

Year	X_0 $\times 10^4$ t	X_1 $\times 10^3$ hm^2	X_2 $\times 10^4$	X_3 $\times 10^8$ kW · h	X_4 $\times 10^4$ t	X_5 $\times 10^4$ t	X_6 $\times 10^4$ t	X_7 $\times 10^8$ kW	X_8 $\times 10^3$ hm^2
1990	3 303.66	9 316.10	3 424	46.93	213.18	2.75	3.31	2 264.0	3 550.09
1991	3 010.30	9 040.40	3 511	52.06	239.74	3.15	3.88	2 330.4	3 676.59
1992	3 109.61	8 804.70	3 601	59.58	251.13	3.45	4.76	2 424.4	3 779.72
1993	3 639.21	8 969.00	3 658	61.10	288.21	3.84	5.44	2 624.0	3 868.33
1994	3 253.80	8 810.90	3 717	70.54	292.47	4.87	6.53	2 780.5	3 931.30
1995	3 466.50	8 810.00	3 773	85.07	322.21	5.32	7.56	3 115.4	4 044.19
1996	3 839.90	8 965.30	3 848	103.66	345.33	6.17	8.33	4 256.4	4 191.05
1997	3 894.66	8 879.90	4 015	118.27	355.31	6.95	8.49	4 337.9	4 333.06
1998	4 009.61	9 102.00	4 067	121.21	382.80	7.49	9.10	4 764.4	4 513.86
1999	4 253.25	9 032.30	4 311	122.54	399.85	7.94	9.61	5 342.9	4 648.78
2000	4 101.50	9 029.60	4 712	125.80	420.71	9.19	9.55	5 780.6	4 725.31
2001	4 119.88	8 822.80	4 688	134.61	441.73	9.41	9.85	6 078.7	4 766.00
2002	4 209.98	8 975.10	4 691	141.36	468.83	9.86	10.20	6 548.2	4 802.36
2003	3 569.47	8 923.30	4 695	144.59	467.89	9.88	9.87	6 953.2	4 792.22
2004	4 260.00	8 970.10	4 718	157.69	493.16	10.16	10.12	7 521.1	4 829.10
2005	4 582.00	9 153.40	4 752	172.15	518.14	10.84	10.51	7 934.2	4 864.12
2006	5 112.30	9 303.10	4 777	188.82	540.43	11.84	11.16	8 309.1	4 918.80
2007	5 245.22	9 468.03	4 815	223.89	569.68	12.66	11.80	8 718.7	4 955.84

Data are from the 2008 *Henan Statistical Yearbook.*

Table 2 Correlation degree of the factors affecting grain production of Henan Province from 1990 to 2007

Factors	Sequencing of correlation	Correlation taxis	Factors	Correlation degree	Correlation taxis
Sowing area of grain crops	0.786 034	3	Application of agricultural plastics	0.653 498	8
Labor force	0.800 367	2	Application of pesticides	0.670 246	7
Rural electricity consumption	0.702 386	6	Total agricultural machinery power	0.740 198	5
Application of fertilizer	0.747 397	4	Effective irrigation area	0.891 819	1

4 Countermeasures and suggestions

As the biggest agricultural province and grain production province, the Central Committee and State Council have always attached great importance to the grain production of Henan Province. The provincial party committee and provincial government of Henan Province have realized that they should always place prime emphasis on grain production during the process of speeding up the industrialization and urbanization. They will not sacrifice agriculture (especially grain production) at any time under any condition. Industrialization and urbanization should be promoted based on the stable enhancement of production level and the gradual increase of grain production. Then, in accordance with the requirements of the scientific development concept, the sound and fast development of economy and society can be achieved. We put forward several suggestions according to the analysis results of the factors affecting grain production.

(1) States should adopt a positive intervention policy, set

a reasonable lowest purchase price of grain, and improve the direct subsidy standards for grain planting, in order to make up for the revenue loss of peasants caused by the rise of production costs, to ensure the peasants a higher efficiency of grain production. Thus, both the productive enthusiasm of peasants and the output of grain are improved[2,11].

(2) Carry out scale management of grain production in major grain producing areas of Henan Province, such as Huaxian, Yingyang and Zhoukou. Peasants use their own land to buy shares, so that a small number of managers can conduct unified production. In this way, peasants can reduce production costs, improve grain output, enhance the capacity of food production, and realize the modernization and technicalization of agricultural production. Living standards of peasants can be improved by accelerating the transfer of surplus labor forces, and increasing the nonagricultural income of peasants.

(3) Strengthen the construction of agricultural infrastructure, and improve the sustainable development level of agriculture. As effective irrigation area is the primary factor affecting food production capacity of Henan Province, it is necessary to consolidate the construction of water conservancy facilities and other agricultural infrastructure. Based on a stable sowing area, inputting more in fertilizer, farm machinery and effective irrigation area is an effective way to improve the production level of grain, and is also an inevitable trend of the modernization of agriculture.

(4) Main directions to improve the comprehensive capacity of grain production are to increase input in agricultural machinery and technology, to choose a benign mode of production, to reform the farming systems, and to develop intercropping and interplanting with multiple cropping system[10].

References

[1] Henan Provincial Bureau of Statistics. Some problems in Henan grain production in 2007[EB/OL]. (2007-07-31). http://www.ah.xinhuanet.com/zhuanti/zl/200707/31/content-10730898.htm. (in Chinese).

[2] CAI XE. Some issues and strategies on the existing foodstuff price policies in China[J]. Technology Economics, 2007(9):26-29. (in Chinese).

[3] ZENG YR, ZHOU JM, YANG J, *et al.* Forecast for food comprehensive productive capabilities in Fujian and countermeasures for food safety[J]. Fujian Journal of Agricultural Sciences, 2007, 22(4): 426-432. (in Chinese).

[4] FAN JG. The grey analysis on grain output and its main input elements in Shaanxi Province from 1983 to 2004[J]. Agricultural Research in the Arid Areas, 2007, 25(3):209-212. (in Chinese).

[5] ZHANG C. Gray correlation analysis of grain yield[J]. Modern Business Trade Industry, 2008, 20(4):19-20. (in Chinese).

[6] XU SS, LIU SQ. Gray correlation analysis of grain yield of Heilongjiang Province[J]. Journal of Heilongjiang Grain, 2007(5):19-21. (in Chinese).

[7] WANG ZY, HUANGFU GY. Grey correlative analysis of grain production and factors[J]. Journal of Anhui Agricultural Sciences, 2008, 24(2):217-222. (in Chinese).

[8] BAI W, HAO JM, YANG J, *et al.* Grey relevant analysis and prediction of capital goods in grain production at regional level[J]. System Sciences and Comprehensive Studies in Agriculture, 2007, 23(3):368-371, 376. (in Chinese).

[9] LIU SF, DANG YG, FANG ZG. Gray system theory and its application[M]. Beijing: Science Press, 2008. (in Chinese).

[10] LIU J, WANG SX. The dynamic change and the regional pattern of grain production in China based on GIS[J]. Territory & Natural Resources Study, 2007(1):54-55. (in Chinese).

基于灰色关联的河南省粮食生产影响因素分析

李秋芳[1],康国磊[2],李小芳[3],李炳军[1*] (1.河南农业大学信息与管理科学学院,河南郑州 450002;2.郑州轻工业学院现代教育技术中心,河南郑州 450002;3.河南农业大学财务处,河南郑州 450002)

摘要 概述了中国河南省粮食生产存在的三方面问题:一是夏粮生产形势严峻,小麦病虫危害严重,有效灌溉面积在退化,田间管理效率较低;二是春耕生产农资价格偏高,影响了农民生产投入的积极性;三是农田水利设施老化,抗御自然灾害能力偏低。分析了河南省粮食生产能力的宏观影响因素,主要有4个方面:一是粮食价格不稳定、收益不确定,一定程度上影响了农民粮食生产的积极性;二是土地承包缺乏灵活性,实行粗放经营;三是促进粮食稳定增产和持续增收的长效机制尚未建立;四是市场变化对粮食生产的影响更趋复杂。介绍了灰关联数学模型的原理及关联度的计算步骤。根据河南省1990~2007年的统计数据,运用灰色关联分析实证研究了河南省粮食产量与其8个影响因素之间的关联情况。结果表明:影响河南省粮食生产主要行为因素的重要程度依次是有效灌溉面积、劳动力、粮食作物播种面积、化肥施用量、农用机械总动力、农村用电量、农药施用量、农用塑料施用量。最后,提出了4点相关建议:一是国家应采取积极的干预政策,制定合理的粮食最低收购价格,完善种粮的直接补贴标准;二是在河南省粮食主产区实行粮食生产规模经营;三是加强农业基础设施建设,提高农业可持续发展水平;四是加大农业机械投入,提高技术投入,选择良性生产模式,改革耕作制度。

关键词 粮食生产;投入要素;灰色关联分析

(From page 5)

组织化程度低、增收缓慢;⑤县际发展不平衡,区域差异显著。最后,提出了发展中国县域经济的思路:①推进新型工业化进程,优化县域经济产业结构;②加快农业现代化步伐,增强农业的基础地位;③加大城镇化建设力度,打破城乡二元结构限制;④确立民营经济的重要地位,加快改革和制度创新的步伐;⑤打破县内经济的思维定式,积极拓展国内外市场;⑥发挥地区优势,积极培育特色经济;⑦建立教育、科技、经济紧密结合机制,推进科教兴县战略。

关键词 县域经济;可持续发展;战略途径