Factors Affecting the Income of Farmers

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Abstract Based on the introduction of factors affecting the income level of farmers in China, a total of 31 provinces, autonomous regions and municipality cities are taken as samples to select 13 factors affecting the income level of farmers, which are arable land area (X_1), disaster area (X_2), effective irrigation area (X_3), fertilizer application (X_4), mobile phone (X_5), personal computer (X_6), people joining in the new rural cooperative medical care (X_7), rural investment (X_8), household – use machine (X_9), agricultural product price (X_{10}), proportion of labor force with above junior high school education (X_{11}), rural delivery route (X_{12}), and rural electricity consumption (X_{13}). At the same time, factor analysis method is used to analyze the factors affecting the income level of farmers. Result shows that common factors affecting the income of farmers are the agricultural production factor F_1, the expanded reproduction factor F_2, the information use factor F_3, and the output reduction factor F_4. At present, education degree of farmers and ability of farmers in grasping information have relatively great impact on the income of farmers, and can effectively promote the income growth of farmers. Scores of F_1 in Henan, Shandong and Hebei are generally higher; Jiangsu, Guangdong, Zhejiang and Shandong Provinces have relatively high scores of F_2; Shanghai, Beijing and Guangdong have relatively high scores of F_3; and Hunan, Hubei and Xinjiang have relatively high scores of F_4. Finally, countermeasures are put forward to improve the income of farmers based on empirical study.

Key words Farmers' income, Influencing factors, Factor analysis method, China

The "Three Agricultural Problems" is the fundamental problem of China. Establishing modern agriculture, developing the rural economy and increasing farmers' income are always the major issues for Chinese government. Therefore, research on factors affecting the income growth of farmers is of great practical significance. In recent years, there are many researches on the factors affecting the income of farmers in China. For instance, Lin Jing carries out empirical analysis on the relationship between the transfer of rural surplus labor force and the income growth of farmers, pointing out that the transfer of rural surplus labor force has made relatively great contribution to the growth of farmers' income[1]. Fang Dongli analyzes the change of farmers' income and puts forward 5 countermeasures to improve farmers' income, including implementing the strategy of industry-financed agriculture, developing agricultural industrialization management, improving the comprehensive productivity of agriculture, accelerating the transfer of rural surplus labor force, and deepening rural reform[2]. Zhang Peng *et al.* carry out the granger causality test on the relationship between agricultural import and farmers' income change. Their research result shows that agricultural import and farmers' income have long-term cointegration relationship, but have no significant interaction[3]. However, there are few empirical studies on the factors affecting the income of farmers by using factor analysis method. Based on this, a total of 31 provinces, autonomous regions and municipality cities are taken as samples to study on the factors affecting farmers' income by factor analysis method, so as to provide a theoretical support for the income increase of farmers.

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1 Index selection, data source and research method

1.1 Index selection A total of 31 provinces, autonomous regions and municipality cities in China are taken as samples in the year 2008. According to the principles of comprehensiveness, accessibility and scientific nature, 13 indices are selected to construct the index system affecting farmers' income, which are arable land area (X_1), disaster area (X_2), effective irrigation area (X_3), fertilizer application (X_4), mobile phone (X_5), personal computer (X_6), people joining in the new rural cooperative medical care (X_7), rural investment (X_8), household – use machine (X_9), agricultural product price (X_{10}), proportion of labor force with above junior high school education (X_{11}), rural delivery route (X_{12}), and rural electricity consumption (X_{13}).

1.2 Data source Data are mainly from the 2009 *China Statistical Yearbook*, and the 2008 *China's Rural Household Survey Yearbook*.

1.3 Research method Factor analysis method means to integrate the information reflected by variables into several disrelated factors, and then use these factors instead to carry out statistical analysis, such as regression analysis, cluster analysis, and discriminant analysis. And these factor values can also be used directly to carry out comprehensive evaluation and classification.

1.3.1 Establishment of Factor Analysis Model[4].

$X = AF + \varepsilon$

$Cov(F, \varepsilon) = 0$, that is, F and ε are not relevant;

$D(F) = \begin{bmatrix} 1 & & 0 \\ & 1 & \\ 0 & & 1 \end{bmatrix} = I_m$, that is $F_1, \cdots\cdots, F_m$ are not relevant and their variances are all 1;

$D(\varepsilon) = \begin{bmatrix} \delta_1 & & 0 \\ & \delta_2 & \\ 0 & & \delta_p \end{bmatrix}$, that is, $\varepsilon_1, \cdots\cdots, \varepsilon_P$ are not relevant and their variances are different.

In the equations, $X = (X_1, \cdots, X_P)'$ is the p-dimensional random vector constituted by the observable p indices, $F = (F_1, \cdots\cdots, F_m)'$ is the unobservable vectors, F is the common factor of X, that is, the comprehensive variable mentioned above, a_{ij} is the factor loading, that is the load of the ith variable on the jth common factor, matrix $A = (a_{1j}, \cdots\cdots, a_{ij})$ is the factor loading matrix, and ε is the specific factor of X, representing the part of variable can not be explained by common factor, which is equivalent to the residuals in regression analysis. Specific factors and the specific factor and common factor are independent.

1.3.2 Basic steps of factor analysis. Steps of factor analysis are as follows: firstly, carry out standardization of raw data. The function of standardization is to eliminate the dimensional effects on variables, and standardization will not change the correlation coefficient of variables. Secondly, calculate the correlation coefficient matrix of standardized data, as well as the eigenvalues and eigenvectors of correlation coefficient matrix. Thirdly, conduct orthogonal transformation, usually using maximum variance method to polarize the factor load. After rotation, the factors still show orthogonality. Fourthly, determine the number of factors, calculate the score of factor and carry out statistical analysis.

2 Data treatment and factor analysis

2.1 Standardized processing of data SPSS16.0 Statistical Analysis Software is used to carry out standardized processing on raw data, so as to eliminate the dimensional effects on different variables[5-6].

2.2 KMO and Bartlett Spherical Test SPSS16.0 Statistical Analysis Software is used to carry out KMO and Bartlett Spherical Test on the 13 variables[7]. Test result shows that the value of Bartlett Spherical Test is 386.688, indicating that correlation matrix is not a unit matrix and factor analysis can be carried out. Correlation coefficient data show that there is high correlation among indices and it is necessary to conduct factor analysis and to extract common factor. KMO value is an index to compare the values of correlation coefficient and partial correlation coefficient. Value close to 1 shows that the effect of factor analysis is good. In this researcn, KMO value is 0.704 > 0.500, indicating that analysis result of factor can be accepted.

2.3 Determination of common factor According to Table 1, four common factors can be determined based on the principles of eigenvalue greater than 1 and cumulative contribution rate bigger than 80%. The cumulative contribution rate of four common factors is 86.6%, indicating that most of the information can be summarized by the four common factors. Table 2 reports the maximum variance rotation of factor loading matrix. According to the correlation between common factor and related indices, X_1, X_3, X_4, X_7, X_9 and X_{12} have relatively great load on the first factor (F_1); X_8 and X_{13} have relatively great load on the second factor (F_2); X_5, X_6 and X_{11} have relatively great load on the third factor (F_3); and X_2 and X_{10} have relatively great load on the fourth factor (F_4). Combining with the meanings of indices, F_1, F_2, F_3, and F_4 represent the agricultural production factor, the expanded reproduction factor, the information use factor, and the output reduction factor, respectively, which together affect the income of farmers.

Table 1 Eigenvalue and cumulative contribution rates of factors

Factor	Eigenvalues	Contribution rates//%	Cumulative contribution rate//%
F_1	5.774	44.416	44.416
F_2	3.155	24.272	68.688
F_3	1.246	9.585	78.273
F_4	1.079	8.304	86.576
F_5	0.540	4.155	90.732
F_6	0.419	3.225	93.956
F_7	0.301	2.315	96.271
F_8	0.176	1.358	97.629
F_9	0.096	0.738	98.367
F_{10}	0.077	0.592	98.959
F_{11}	0.062	0.479	99.437
F_{12}	0.044	0.342	99.779
F_{13}	0.029	0.221	100.000

Table 2 Factor score coefficient matrix after rotation

Index	Score of factor			
	F_1	F_2	F_3	F_4
X_1	0.858	−0.110	−0.153	0.101
X_2	0.346	−0.219	−0.030	0.826
X_3	0.913	0.243	−0.059	0.118
X_4	0.886	0.317	0.059	0.128
X_5	−0.265	0.278	0.779	−0.155
X_6	−0.207	0.343	0.872	−0.153
X_7	0.728	0.475	0.080	0.253
X_8	0.417	0.845	0.196	−0.106
X_9	0.898	0.236	−0.001	−0.045
X_{10}	−0.030	0.113	−0.302	0.862
X_{11}	0.417	−0.117	0.811	−0.093
X_{12}	0.675	0.606	−0.015	0.267
X_{13}	0.179	0.875	0.242	−0.081

2.4 Score of factor Regression method is used to obtain the factor score coefficient matrix. Table 3 reports that scores of F_1 factor in Henan, Shandong and Hebei are generally higher than in other provinces, because these provinces are located in plain and the large area of farmland is suitable for the application of agricultural machinery. A good farmland water conservancy facility can promote the growth of crops; scientific and reasonable fertilization along with an improved logistics and distribution system can promote the development of local agriculture. Therefore, Henan, Shandong and Hebei Provinces have relatively good condition for agricultural production. Secondly, Jiangsu, Guangdong, Zhejiang and Shandong Provinces have relatively high scores of F_2 factor, indicating that these provinces have relatively good industrial base, and have abundant funds to invest in agriculture again, to improve the varieties of agricultural products, to enhance the agricultural science and technology, to promote the efficiency of agricultural production, and to increase the income of farmers. Thirdly, Shanghai, Bei-

jing and Guangdong have relatively high scores of F_3 factor, indicating that farmers in these provinces and cities have relatively high education level, and can capture market information by telephone and computer. However, Qinghai, Gansu and Tibet have relatively low scores of F_3, indicating that farmers in these provinces have relatively low education level, which is not conducive to capture market information. And the income of farmers in Qinghai, Gansu and Tibet is also relatively low. Fourthly, Hunan, Hubei and Xinjiang have relatively high scores of F_4 factor, indicating that these provinces have strong capacity to defend against the price risk and the disasters.

Table 3 Score of factor

Region	Score of common factor							
	F_1		F_2		F_3		F_4	
Beijing	-1.027	27	-0.756	25	1.807	2	-0.366	20
Tianjin	-0.749	22	-0.836	27	0.874	6	-1.261	30
Hebei	1.856	3	0.061	10	0.128	11	-1.011	29
Shanxi	0.340	11	-0.951	29	-0.209	19	-0.534	23
Inner Mongolia	0.678	6	-1.151	30	-0.311	21	-0.214	16
Liaoning	0.119	13	-0.119	14	-0.102	17	-1.000	28
Jilin	0.363	10	-0.863	28	0.091	13	-1.720	31
Heilongjiang	1.156	4	-1.379	31	-0.327	22	0.452	8
Shanghai	-1.320	30	-0.226	17	2.454	1	-0.484	21
Jiangsu	0.416	9	3.123	1	-0.175	18	-0.355	19
Zhejiang	-0.753	23	1.993	3	0.529	7	-0.062	14
Anhui	0.975	5	-0.149	15	-0.425	23	-0.161	15
Fujian	-0.813	24	0.329	7	1.027	5	-0.493	22
Jiangxi	-0.071	18	-0.350	18	-0.014	16	0.401	11
Shandong	2.109	2	1.263	4	0.270	10	-0.887	27
Henan	2.441	1	0.259	8	-0.236	20	-0.343	18
Hubei	0.586	7	-0.537	23	0.437	9	2.083	2
Hunan	0.222	12	-0.023	12	0.124	12	3.517	1
Guangdong	-0.447	21	2.273	2	1.279	3	0.607	6
Guangxi	0.091	14	-0.510	22	1.220	4	0.525	7
Hainan	-0.823	25	-0.796	26	0.062	14	-0.583	24
Chongqing	-0.996	26	0.078	9	0.004	15	0.798	4
Sichuan	0.428	8	0.389	6	-0.464	24	0.680	5
Guizhou	-0.424	20	-0.358	19	-0.607	25	0.433	9
Yunnan	-0.038	16	0.025	11	-0.673	26	0.409	10
Tibet	-1.594	31	0.882	5	-2.824	31	-0.644	26
Shaanxi	-0.021	15	-0.396	20	0.471	8	-0.332	17
Gansu	-0.123	19	-0.496	21	-0.994	29	-0.056	13
Qinghai	-1.283	29	-0.057	13	-1.734	30	-0.586	25
Ningxia	-1.239	28	-0.181	16	-0.920	28	0.185	12
Xinjiang	-0.057	17	-0.540	24	-0.763	27	1.002	3

3 Countermeasures

3.1 Increasing the investment in land The empirical study shows that land area is the main factor affecting the income of farmers, most of the income of farmers is from the cultivation of land, since labor is the source of wealth[8]. The key to protect the interests of farmers is to protect the arable land, which is also the strategy security of national grain safety. Government should increase investment in agriculture to improve the output efficiency of land, and further establish and improve the rural medical care system, to improve the life of farmers and to reduce their expenses.

3.2 Improving the education degree of farmers Education degree is a main factor affecting the income of farmers. As for a county, junior middle school education has made higher contribution to farmers' income than high school and technical secondary school[9]. The above researches also indicate that improvement of farmers' education degree is closely related to the income of farmers. Only when the education degree of farmers is improved, can we enhance the level of agricultural modernization and urbanization. Improving the education degree of farmers can transfer a part of rural labor forces from heavy manual work and low-level work, and can change a certain number of farmers into specialized workers in order to improve the labor productivity.

3.3 Reinforcing the construction of rural communication facilities Low income of farmers is an important reason for information asymmetry in market, which leads to low sell price but high market price of agricultural produces, because most of the profits are in the circulation. At present, income of farmers is relatively low, information communication expenditure per capita accounts for an extremely low proportion in rural per capita expenditure. Therefore, it is necessary to reinforce the construction of rural communication facilities in order to grasp more market information. According to the analysis mentioned above,

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from the predominance distribution of the competitive effect of crop farming, forestry, animal husbandry and fishery that the agricultural development of a region is inseparable from the full play of its resources advantages.

4 Conclusion and suggestions

4.1 Conclusion After the analysis on the agricultural structure change and agricultural competitiveness, we can conclude that:

(1) Since 1983, the weight of the crop farming in Hubei Province experienced fluctuating reduce, and the animal husbandry and fishery saw continuous increase, the status of animal husbandry and fishery got further strengthened, the weight of the output values of crop farming, forestry, fishery and animal husbandry become gradually less, and the adjustment of agricultural structure in Hubei Province tends to stabilize.

(2) Compared with other four provinces in Central China, Hubei has relative more competitive agriculture, but the structure of crop farming and fishery is unreasonable, the competitiveness of fishery and agricultural services is in an inferior position.

(3) The agricultural industrial structure in nearly half of 17 regions in Hubei Province is unreasonable, the agriculture in over half of the regions are not competitive, their development falls behind the average level of the whole province and hinders the regional economic development, the crop farming and animal husbandry in each region need to be further adjusted, their forestry does not show significant development and hasn't taken full use of its advantages with 4/5 mountainous areas. The agricultural services in each region have low efficiency and are still at a low level.

4.2 Suggestions Through the analysis, I think that, the further development focus and adjustment orientation of the agriculture in Hubei Province should be based on its natural conditions, resources endowment and current differences in the economic status of each places, Hubei should work out measures to suit local conditions, take full use of its advantages, extend its production chain and go on the development road with regional characteristics. For example, in regions with vast water area, we should improve the fish production, optimize the culture structure and enhance the competitiveness of aquatic products brands; in those mountainous areas, in addition to protect the ecological environment, we should also conduct comprehensive development of the mountains, and develop economic forest and fruits as well as herbivorous livestock and poultry and other characteristic industries; while in those plain regions, in the premise of ensuring food production, we should further optimize the planting structure and crop varieties, and improve the competitiveness of agricultural products.

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developed areas ,such as Shanghai, Beijing and Guandong, have relatively high expenditure in information. When farmers grasp more information, phenomenon of " Cheap Grain Harms the Farmers" can be reduced and farmers can take their advantages in participating in the market competition.

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