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Evaluating the Sustainable Development of Agriculture Based on Multiple Linear Regression

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Abstract: Agriculture is the base of national economy, rural area is basic community and agricultural sustainable development is the base of whole society sustainable development. Studying evaluation index system of agricultural sustainable development level, constructing reasonable evaluation model, are significant for path selection and level promotion. Evaluation index system based on input and output has been built with the method of multiple regression, the interrelation between agricultural investment in fixed assets and related output indexes of agricultural sustainable development, degree of closeness and changing law have been analyzed to find the interrelation mode existing in indexes, a set comprehensive evaluation methods of agricultural sustainable development have been constructed. This evaluation method were used to evaluate agricultural sustainable development level in China's 31 provinces, can help the local government scientifically know agricultural sustainable development level, provide agricultural sustainable development with scientific basis of decision-making.

Key words: Agricultural sustainable, multiple regression, evaluation model

INTRODUCTION

Agriculture is the basic of national economy, rural area is the basic community of society. Agricultural sustainable development is the base of urban sustainable devel-opment as well as the whole society sustainable development. In order to carry out the strategy of sustainable development, the issue of agricultural sustainable development must be studied to strength the basic position and promote the economic society's sustainable development. Systematically mastering the status of agricultural sustainable development and comparing, the issues can be illuminated profoundly in theory which is significant for the construction of agricultural sustainable development system (Li, 2006; Zhao, 1998; Lin *et al*., 2000; Zhang, 1998).

In the process of decision-making, the administration section is short of complete and scientific data and knowledge. Based on the status of agricultural sustainable development in our country,taking multiple linear regression as the method, the rela-tionship between agricultural fixed assets and relative production indexes of agricul-tural sustainable development has been studied, the main influence factors that influ-ence the level of agricultural sustainable development has been analyzed, the relative data has been collected to carry out the quantitative and qualitative analysis, the comprehensive evaluation model of agricultural sustainable development that is suitable for China's situation has been constructed finally which provides systematical, theoretical and regular guidance for improving the ability of agricultural sustainable development, also helps the local government to know the level of agricultural sustainable development in local area which provides a certain theoretical foundation for customizing the reasonable policy and studying city sustainable development.

EVALUATION INDEX SYSTEM

According to the evaluation experience of agricultural sustainable development, the relationship between areas agricultural fixed assets and relative production index-es of agricultural sustainable development. Through a contrast between input and output, the levels of agricultural sustainable development in different areas are objec-tively reflected (Zhao, 2003; Xu *et al*., 2002;

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Table 1: Evaluation system

Area	Y	X1	X2	X3	X4	X5	X6	X7
Beijing	47.2	363.1	265.2	209.3	13.8	4.3	111.0	363.8
Tainjin	151.2	349.5	583.9	338	24.4	0.6	231.2	723.9
Hebei	590.4	4895.9	10349.2	4596.6	326.3	37.9	592.7	929.0
…	…	…	…	…	…	…	…	…
Qinghai	85	230.8	430.7	251.7	8.3	82.1	339.1	184.5
Ningxia	47.8	354.7	768.7	477.6	38.2	0.3	798.0	799.3
Xinjiang	219.2	1955.4	1796.7	3884.6	183.7	113.6	831.7	1514.5

Dong and Wei, 2008; Xu, 2005; Dong, 2003; Zhang, 2001). All indexes involved in research are: Y-agricultural fixed as-sets investment(billion RMB), X1-gross output value of farming, forestry, animal husbandry and fishing (billion RMB), X2-Total power of agricultural machi-nery (kilowatt-hour), X3-effective irrigated area (thousand hectare), X4-fertilizer con-sumption (million tons), X5-installed capacity of small hydropower station in rural areas (ten thousand kilowatt), X6-per capita output of main agricultural produc-tion (kilogram), X7-per capita main agricultural production for selling in rural fami-ly (kilogram), all indexes and data come from "China Statistical Yearbook". The data integrated is represented as Table 1.

EVALUATION OF AGRICULTURAL SUSTAINABLE DEVELOPMENT BASED ON MULTIPLE REGRESSION

Correlation analysis: Before the influence factors are selected finally, the correlation analysis between each sub-index of government expenditure on supporting agriculture and agricultural GDP in Table 2 is needed to carry out. Null hypothesis of test is that correlation coefficient between two variables of totality is 0. The correlation analysis process of SPSS provides the probability of hypothesis formation, formula is represented as follows:

$$t = \frac{\sqrt{n-2} * r}{\sqrt{1-r^2}}$$

(r is correlation coefficient, n is the number of sample observation, n-2 is degree of freedom)

When significance ratio $p<0.05$ in t statistic for correlation coefficient test it explains that correlation between two variables is significant, usually representing with "*"beside the value of probability; when $p<0.01$ it explains that correlation between two variables is very significant, usually representing with "**" beside the value of probability; when $p>0.05$ it explains that there is no significant correlation between two variables, only representing the value of probability.

On the platform of SPSS, the correlation analysis are separately carried out between agricultural investment in fixed assets(Y) and gross output value of farming,

Table 2: Results of multiple linear regression

Model	Coefficients[a]: Unstandardized coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.
1					
(Constant)	-22.287	41.645		-.535	0.597
X1	0.043	0.023	0.396	1.827	0.080
X2	.035	0.014	0.513	2.488	0.020
X3	0-.039	0.035	-.285	-1.118	0.275
X4	0.128	0.332	0.093	0.386	0.703
X6	0.139	0.108	0.237	1.294	0.208
X7	0.070	0.049	0.239	1.445	0.161

[a]Dependent Variable: Y

forestry, husbandry and fishing(X1), total powers of agriculture machine(X2), effective irrigation area(X3), amount of fertilizer use(X4), installed capacity of small hydropower station in rural areas(X5), per capita output of main agricultural production(X6), per capita main agricultural production for selling in rural family (X7).

By the analysis results, correlation is significant between agricultural investment in fixed assets (Y) and gross output value of farming, forestry, husbandry and fishing (X1), total powers of agriculture machine (X2), effective irrigation area (X3), amount of fertilizer use (X4), per capita output of main agricultural production (X6), per capita main agricultural production for selling in rural family (X7), namely, the experiment's purpose is to build a multiple regression model, X1'X2'X3'X4'X6 and X7 as the independent variables, Y as the dependent variable.

Multiple regression analysis: On the platform of SPSS 18, X1'X2'X3'X4'X6 and X7 as the independent variables, Y as the dependent variable, the multiple regression model has been built, the results of multiple linear regression are represented in Table.

Form Table 2 it can been seen that the correlation separately between Y and X1, X2, X4, X6, X7 is positive; but the correlation between X3 and Y is negative, the correlation between X4 and Y is positive which disagree with the practical situation (Wang *et al*., 2006; Wang *et al*., 2008; Zhang *et al*., 1999), namely, demonstrates the estimated values of X3, X4 are incredible. So that the regression coefficient -0.039 and 0.128 is insignificant, X3 and X4 representing insignificant should be eliminated, then repeat regression should be car-ried out. The results of repeat regression are represented in Table 3.

Table 3: Results of quadratic multiple linear regression

Model	Coefficients[a] Unstandardized Coefficients B	Std. Error	Standardized coefficients Beta	t	Sig.
1					
(Constant)	-12.117	39.784		-.305	0.763
X1	0.038	0.017	0.351	2.220	0.035
X2	0.028	0.011	0.410	2.571	0.016
X6	0.094	0.096	0.160	0.980	0.336
X7	0.067	0.048	0.229	1.418	0.168

[a]Dependent Variable: Y

Table 4: Performance analysis of agricultural investment in fixed assets based on Multiple Regression

Area	Predictive value (billion)	Predictive value (billion)	Level of performance	Rank
Hainan	113.2564	24.2000	4.6800	1
Ningxia	151.4456	47.8000	3.1683	2
Xizang	53.5887	24.2000	2.2144	3
Jiangsu	397.7243	225.4000	1.7645	4
Zhejiang	203.1286	131.6000	1.5435	5
Anhui	392.4905	256.4000	1.5308	6
Guizhou	125.4349	83.2000	1.5076	7
Yunnan	223.0561	153.9000	1.4494	8
Jilin	452.2271	320.0000	1.4132	9
Gansu	178.0905	128.6000	1.3848	10
Xinjiang	292.1448	219.2000	1.3328	11
…	…	…	…	…
Chongqing	133.7558	323.6000	0.4133	31

From the studies before, the correlation between Y and X1, X2, X6, X7 is positive, the relationship between agricultural investment in fixed assets and related indexes of agricultural sustainable development can be reflected by the model to some degree. Finally, influence factor model of agricultural investment in fixed assets is represented as follows:

$$Y=-12.117+ 0.038*X1+ 0.028*X2 + 0.094*X6 +0.067*X7$$

Performance analysis: On the platform of SPSS 18, X1′X2′X3′X4′X6 and X7 as the independent variables, Y as the dependent variable, the multiple regression model has been built, the results of multiple linear regression are represented in Table.

Agricultural investment in fixed assets calculated by influence factor model of agricultural investment in fixed assets is according to the agricultural investment in fixed assets estimated by related indexes of agricultural sustainable development in areas. Trough the contrast between model predictive value and practice investment value in areas, the performance level of project can be measured, namely, performance level of project can be defined as follows:

$$P_i = \frac{\tilde{z}}{z}$$

is agricultural investment in fixed assets estimated by model, z is practical agricultural investment in fixed assets in areas.

Through calculation, the results of performance level of agricultural investment in fixed assets in areas are carried out representing in Table 4. From the results analysis it can been seen that top 5 level of agricultural sustainable development are respectively: Hainan, Ningxia, Xizang, Jiangsu and Zhejiang.

CONCLUSION

Evaluation index system for agricultural sustainable development level has been constructed in this paper, influence factor model of agricultural fixed asset invest has been constructed by multiple regression method, the interrelationship between agri-cultural fixed asset invest and related production indexes of agricultural sustainable development has been analyzed to built a set comprehensive evaluation methods for agricultural sustainable development level based on the contrast between predictive value and true value, finally, agricultural sustainable development levels of 31provinces or cities have been evaluated scientifically. The results of analysis dem-onstrate that Hainan, Ningxia, Xizang, Jiangsu, Zhejiang, Anhui, Guizhou, Yunnan, Jilin and Gansu whose statuses of agricultural sustainable development are good take the first ten places and the performances of agricultural fixed asset invest in Xinjiang, Jiangxi, Fujian, Shanghai, Hubei and Shandong are larger than 1, there are great possibilities in their agricultural sustainable development; the performances of agricultural fixed asset invest in other places are smaller then 1, the levels of agricultural sustainable development in there are waited for improvement, they should do more works in fields of gross output value of farming, forestry, husbandry and fishing, total powers of agriculture machine, per capita output of main agricultural production and per capita main agricultural production for selling in rural family. The ranking results of region agricultural sustainable development levels analyzed by agricultural sustainable development level evaluation model based on multiple regression is basically in agreement with the status of China's agricultural sustainable development which provides the foundation of scientific decision for the construction of agricultural sustainable development.

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