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CHINESE AGRARIAN SECTOR DEVELOPMENT, AGRICULTURAL DEVELOPMENT AND RURAL LIVELIHOOD IN PROVINCES

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Abstract

The paper is focused on the evaluation of development of the Chinese agrarian sector and the subsequent expression of the relationship between agricultural development and rural livelihood. The characterization of processes is related to this issue, especially in the area of economic development and agriculture. Development trends of the Chinese primary sector are explored and individual sectoral changes are evaluated to deal with the construction of a composite indicator, which makes it possible to define relatively the level of the individual provinces of China, both in terms of rural livelihoods and in terms of agricultural development.

Keywords: *Agriculture, composite indicator, development, People's Republic of China, province, rural livelihood*

JEL Classification: *A14,E01, Q13*

1 Introduction

Significance of agriculture has changed during the last few decades and its transformation can be observed differently in each part of the world. Globalization plays an important role in the whole process. Removal of trade barriers has resulted in interconnection between regional and global markets. This trend is closely related to gradual creation of commodity chains which comprise all stages of production, from single farmer to final consumer. Individual countries have been focusing on production of commodities and goods in which they are able to have competitive advantage. Therefore, agriculture is no longer perceived only as a sector which is securing production of food for the population for either direct consumption or food processing. Its traditional mission has turned into a business which seeks to satisfy demand of developed society all over the world by the economies of scale. It still applies that agriculture plays a very important role in the economic life of people living in rural areas, especially in developing world. Either world or domestic market influences their decision about what kind of commodity they should produce in order to get a higher profit. And as the country develops, rural labor moves to the secondary and tertiary sectors seeking higher wages than they are in unpredictable agriculture. And that is the example of China, a diverse country which used to be a nation of farmers. With the gradual opening of China to the world, changes in the inter-sectoral structure has been on the rise due to progressive industrialization and country 's strong leadership. As a result, population 's standard of living has significantly increased and the level of poverty has been successfully reduced. At the same time the agriculture still remains a sector which employs half of working population and provides an income for several a million households.

2 Data and methodology

Composite indicator

Composite indicator is constructed by combination of few variables, which are frequently introduced in different units. It can also be said that these sub-indicators have different variability, importance and mutual dependence within individual pairs (Minařík et al., 2013). Composite indicator is a useful tool to compare performance of countries and to illustrate comprehensive issues in different fields of study. Based on observed data, the indicator can reveal relative positions of countries, regions, etc. in a given area (OECD, 2008). In order to assemble the composite indicator, it is necessary to follow these sub-steps:

Selection of sub-variables

Initially it is important to realize which sub-indicators are desirable for constructing of the composite and which phenomenon will be measured. It is necessary to work with relevant data which are not be distorted by different measurements within individual statistical databases (OECD, 2008). It is then necessary to distinguish for which indicators achievement of the greatest value is required. These are e.g. level of education, employment, business growth, etc. and they are marked as MAX type indicators. Second criterion is MIN type values for which it is desirable to achieve the lowest value (e.g. criminality, mortality, level of emissions). The optimal type criterion which includes median age or fertility does not constitute a separate group inasmuch it is easy to convert it into min type. Furthermore it is essential to realize also importance of statistical criterions and take into account possible distortion by extreme values or asymmetric distribution of data (Minařík et al., 2013). Two sets of variables had to be selected in order to cover information about mentioned areas of interest. The first set involves indicators dealing with agricultural development of China. The second set is composed of indicators evaluating level of rural livelihood. Some indicators had to be calculated from more variables due to missing of concrete indicator in the statistical database or in order to convert it to a comparable indicator. Furthermore, input data for this analysis are calculated by arithmetic mean of years 2009 – 2012.

Missing values

When using secondary data that are ordinary available, it is common for some values in the file to be missing. In spite of this, the data can be further processed however the proportion cannot be more than 5 % of the total data. One of the possible solutions is a suitably chosen method of aggregation. The second is to add missing values using an algorithm or try to calculate the missing value based on strong correlation of given indicator with some other variable (Minařík et al., 2013).

Weighting

Majority of composite indicators rely on the technique of equal weighting what in general means that each variable is given the same weight. This manner is used e.g. when author does not have sufficient knowledge about relationship among variables or it can cover up the absence of a statistical or an empirical basis. Nevertheless it doesn´t mean that variables are without the weight but that their weight is simply equal (OECD, 2008). "Easier" methods of determination of weights are according to Jadczaková (2016) as follows:

- *Rating scales* – its use is generally with odd number of rates (1, 3, 5, 7, 9) which can be according to their importance explained by words as low, below average, average, above average and high. Then standardization is performed by dividing of number of points reached by given indicator by the sum of total points of all indicators. Total number of resulting weights must be equal to one.

- *Matrix of pairwise comparison* – this method uses p×p matrix (chart) in which indicators are being compared in pars by following procedure: if the indicator from the row is considered as more important than the indicator from the column, then „1“ is assigned to the row indicator and „0“ to the column indicator. If both indicators have the same importance, we assign „0.5“ to each of them. Whereas it is pointless to equate the indicators with themselves, diagonal fields remain empty. In the end, row sums of matrix are divided by its total sum through which are gradually calculated individual weights whose sum is again 1.
- *Preference matrix*– this serves as an alternative to the previous method. In this case, weights are determined on the basis of how many times row indicator is more important than column indicator and vice versa. Therefore we assign e.g. „3“ to three times more important indicator and „1/3“ to the second from the pair instead of „1“, „0“ and „0.5“ as in Matrix of pairwise comparison whose least significant indicator gains zero weight (considered as method disadvantage).

All resources used for construction of composite indicator agree that for determination of weights expert approach is needed. Given that the experts have a different attitude towards the problem, resulting weights are then the average of individual ratings of single experts.

Standardization

Purpose of this step is to transform the original values of chosen indicators to dimensionless variables which are therefore easily aggregable. Different methods of standardization vary by their properties and may lead to different results. The most used methods are defined by (Minařík et al., 2013):

- *Ranking* – based on replacement of original values of measurable variable X_j by their ascending/descending order creating ordinal variable P_j. For MAX type indicators, sequence numbers are assigned in descending order. Opposite assignment (ascending order) is valid for MIN type indicators. By this method can be lost part of information contained in the data.
- *Z-scores* – again replaces a dimensional variable X_j by dimensionless:

$$U_j = \frac{X_j - \bar{x}_j}{\sqrt{var\ x_j}}, \ (1)$$

- with zero mean ($\bar{u}_j = 0$) and variance:

$$\left(var\ u_j = \sqrt{var\ u_j} = 1\right), \ (2)$$

– for MAX type indicator. For the second type of indicator (MIN), transformation is done by:

$$U_j = \frac{\bar{x}_j - X_j}{\sqrt{var\ x_j}}, (3)$$

– *Min-max method (re-scaling) – transforms the original scale on new range <0; 100>. For MAX type indicators* apply:

$$B_j = \frac{X_j - min\{X_j\}}{max\{X_j\} - min\{X_j\}} . 100 \ (4)$$

– *For MIN type indicators* apply:

$$B_j = \frac{max\{X_j\} - X_j}{max\{X_j\} - min\{X_j\}} . 100 \ (5)$$

In this formula $max\{X_j\}$ and $min\{X_j\}$ represent the greatest and the lowest value in the data set of *j*-indicator. Holčík et al. (2015) state that this method is recommended to be used in cases, where variables vary in scope but do not have normal distributions or contain outlying values.

Aggregation

This final summary (aggregation) is made regardless the type of standardization method used. For conversion of these transformed data into a composite indicator, two means of aggregation are used:

– *Weighted sum approach*- if there are no missing values in the data set
– *Weighted average approach*- in case of missing values in the data set

Result of aggregation is dimensionless composite indicator whose chosen method of standardization may influence final value of indicator. The value of composite indicator is a relative assessment within the examined set of variables. (Minařík et al., 2013).

The method of composite indicator has been applied in order to analyze the situation within individual regions and on the other hand examination of relationship between agricultural development and rural livelihood in China. To compare the situation and relation between these sectors it was necessary to construct two composite indicators in order to summarize more information into one complex index. Two sets of variables had to be selected in order to cover information about the areas of interest. The first set involves indicators dealing with agricultural development of China and the second set is composed of indicators evaluating level of rural livelihood. Some indicators had to be calculated from more variables due to missing of concrete indicator in the statistical database or in order to convert it to a comparable indicator. Furthermore, input data for this analysis are calculated by arithmetic mean of years 2009 – 2012. Characteristics of examined data are displayed in the table 1.

3 Results

To compare the situation and relation between agricultural development and rural livelihood in China it is necessary to construct two composite indicators in order to summarize more information into one complex index. On the beginning of the analysis is important to have information about characteristics of examined data. Into this basic statistics belongs mean, median, maximum and minimum value of data set, variance, standard deviation, variation coefficient, kurtosis, skewness and finally correlation matrixes.

Table 1 **Basic statistical characteristics – indicators of rural livelihood**

Variable	Mean	Median	Minimum	Maximum	Variance	Std.Dev.	Coef. Var.
X1	6953.93	6134.58	3705.23	15079.60	8163703	2857.22	41.08785
X2	5119.79	4520.28	2693.90	10758.93	3689213	1920.73	37.51584
X3	36097.02	29518.50	15053.25	78488.50	315951204	17775.02	49.24234
X4	0.31	0.30	0.21	0.40	0	0.05	16.69443

Source: NBSC (2014), processed by author using Statistica.

Table 2 provides results of moment based coefficients of skewness and kurtosis.

Table 2 **Skewness and kurtosis –indicators of rural livelihood**

Variable	Skewness	Kurtosis
X1	1.520342	1.883027
X2	1.832362	3.058490
X3	1.289869	0.925631
X4	-0.003816	-0.861165

Source: NBSC (2014), processed by author using Statistica.

For determination of dependency and similarity within the indicators it is necessary to construct correlation matrix. To remind, value of correlation coefficient is each time in interval <-1, +1>. These borders represent the strongest relation compared to 0 which means that between the combinations of two variables exists no correlation. In table 3 can be observed statistically significant correlations between all examined indicators. Value 0.96 meaning very high dependence can be found between per capita income of rural households and per capita consumption expenditure of rural households.

Table 3 **Correlation matrix – indicators of rural livelihood**

Variable	X1	X2	X3	X4
X1	1.000000	0.958722	0.923725	-0.556160
X2	0.958722	1.000000	0.872002	-0.413008
X3	0.923725	0.872002	1.000000	-0.586140
X4	-0.556160	-0.413008	-0.586140	1.000000

Source: NBSC (2014), processed by author using Statistica.

Value of correlation -0.41 between indicators per capita consumption expenditure of rural households and Engel's coefficient testify the lowest, although still moderate dependence. Based on these out- puts use of weighting will be applied within construction of composite indicator for first three indicators.

Table 4 **Basic statistical characteristics – indicators of agricultural development**

Variable	Mean	Median	Minimum	Maximum	Variance	Std.Dev.	Coef.Var.
Y1	5409.13	5293.86	1304.895	10310.17	4349298	2085.50	38.55516
Y2	32336.67	28149.07	9582.946	78092.57	261432626	16168.88	50.00168
Y3	0.52	0.46	0.238	1.06	0	0.23	44.62839
Y4	7.72	6.53	2.490	15.60	15	3.84	49.77093
Y5	0.46	0.47	0.109	0.93	0	0.23	49.55760

Source: NBSC (2014), processed by author using Statistica.

Table 4 displays basic statistical descriptions for second set of indicators. The highest mean and median value can be found in productivity of rural labor. The lowest and the most similar values of these measurements of central tendency have fertilizer investments. Productivity of rural labor has the most variable data and on the other hand irrigation index together with fertilizer investment indicate almost zero variance and standard deviation.

Table 5 describes asymmetry and peakedness of agricultural indicators. Compared to results of first set of indicators skewness of data are overall lower. It is given by absence of outlying observations and greater uniformity of data around arithmetic mean.

Table 5 **Skewness and kurtosis – indicators of agricultural development**

Variable	Skewness	Kurtosis
Y1	0.113333	-0.239988
Y2	0.837563	0.548816
Y3	0.526956	-0.711642
Y4	0.580297	-0.817022
Y5	0.292857	-0.682532

Source: NBSC (2014), processed by author using Statistica.

Relationship and dependency between agricultural indicators are displayed in table 6. Values marked by red color indicate statistical significance. Yet it does not have to mean high correlation between two variables. The highest value of correlation coefficient from this set can be observed between irrigation index and power investment and between irrigation index and fertilizer investment as well. On the other hand the lowest dependence is presented between productivity of rural labor and power investment. Almost identical low correlation can be seen between gross output value of agriculture per capita and fertilizer investment. This matrix can be summed up that there is no great dependence between variables and therefore it can be used for composite indicator without weighting.

Table 6 **Correlation matrix – indicators of agricultural development**

Variable	Y1	Y2	Y3	Y4	Y5
Y1	1.000000	0.106365	-0.317661	-0.194448	0.034414
Y2	0.106365	1.000000	0.584638	0.033542	0.350584
Y3	-0.317661	0.584638	1.000000	0.628860	0.620877
Y4	-0.194448	0.033542	0.628860	1.000000	0.518474
Y5	0.034414	0.350584	0.620877	0.518474	1.000000

Source: NBSC (2014), processed by author using Statistica.

Table 7 indicates results of composite indicator for rural livelihood.

Table 7 **Outcome of composite indicator – indicators of rural livelihood**

Region	SUMA	RANK	INDEX	Region	SUMA	RANK	INDEX
Anhui	69.40	21	73.02	Jiangxi	77.82	18	81.89
Beijing	225.73	1	237.52	Jilin	118.79	9	125.00
Fujian	93.30	14	98.18	Liaoning	132.69	7	139.62
Gansu	16.40	29	17.26	Ningxia	66.28	22	69.75
Guangdong	97.48	13	102.57	Qinghai	42.48	27	44.70
Guangxi	37.44	28	39.39	Shaanxi	78.55	17	82.65
Guizhou	16.30	30	17.15	Shandong	132.74	6	139.68
Hainan	61.50	23	64.71	Shanghai	212.50	2	223.60
Hebei	124.95	8	131.48	Shanxi	81.62	16	85.88
Heilongjiang	114.48	10	120.47	Sichuan	44.04	26	46.34
Henan	110.44	11	116.21	Tianjin	204.20	3	214.87
Hubei	89.58	15	94.26	Tibet	56.55	24	59.51
Hunan	50.48	25	53.12	Xinjiang	75.55	19	79.50
Chongqing	69.90	20	73.55	Yunnan	11.34	31	11.94
Inner Mongolia	101.14	12	106.43	Zhejiang	173.71	4	182.79
Jiangsu	158.67	5	166.96	**Mean**	95.03		

Source: NBSC (2014), processed by author using MS Excel.

Results of composite indicator calculated from sub-indicators dealing with agricultural development are displayed in table 8.

Table 8 **Outcome of composite indicator – indicators of agricultural development**

Region	SUMA	RANK	INDEX	Region	SUMA	RANK	INDEX
Anhui	211.29	16	108.21	Jiangxi	223.94	15	114.69
Beijing	297.14	4	152.17	Jilin	143.69	20	73.59
Fujian	312.31	3	159.94	Liaoning	178.60	17	91.47
Gansu	59.31	30	30.38	Ningxia	129.29	23	66.21
Guangdong	265.49	9	135.96	Qinghai	102.61	26	52.55
Guangxi	166.79	18	85.42	Shaanxi	139.65	21	71.52
Guizhou	45.33	31	23.22	Shandong	315.31	2	161.48
Hainan	252.86	10	129.49	Shanghai	287.14	6	147.05
Hebei	290.28	5	148.66	Shanxi	96.75	27	49.55

Region	SUMA	RANK	INDEX	Region	SUMA	RANK	INDEX
Heilongjiang	129.06	24	66.09	Sichuan	133.65	22	68.45
Henan	283.00	7	144.93	Tianjin	266.96	8	136.72
Hubei	233.54	13	119.60	Tibet	115.78	25	59.29
Hunan	250.92	12	128.50	Xinjiang	229.39	14	117.48
Chongqing	96.54	28	49.44	Yunnan	80.19	29	41.07
Inner Mongolia	144.73	19	74.12	Zhejiang	251.74	11	128.92
Jiangsu	319.89	1	163.82	**Mean**	195.26		

Source: NBSC (2014), processed by author using MS Excel.

Resulting value of correlation coefficient 0.67 in table 9 proves that between areas of investigation is significant dependence.

Table 9 **Correlation of agriculture development and rural livelihood based on CI**

	Agricultural Development	Rural Livelihood
Agricultural Development	1.000000	0.670219
Rural Livelihood	0.670219	1.000000

Source: NBSC (2014), processed by author using Statistica.

4 Conclusions

From the results of basic statistical characteristics (indicators of rural livelihood) can be observed that the highest value of median and mean have regional GDP per capita. On the contrary the lowest value of both measurements of central tendency show Engel 's coefficient. This indicator has also lowest variance and standard deviation, which tells us that the observations are very similar. In this respect the greatest variance and standard deviation was found for regional GDP per capita and then for per capita income of rural households.

The highest skewness was calculated for per capita consumption expenditure of rural households. Slightly lower value has per capita income of rural households and then regional GDP per capita. For all these indicators apply that they are right skewed and therefore is valid. Opposite result reached Engel 's coefficient, which as the only one have a negative value and thus is marked as left skewed. The same order of indicators of positive and negative values was observed at kurtosis. The first three indicators have peak distribution of data and Engel 's coefficient has flat distribution of data. High values of moment based coefficients for both per capita consumption expenditure of rural households and per capita income of rural households can be caused by presence of extreme values.

All values of skewness indicate right-sided asymmetry and in particular productivity of rural labor has the greatest value. Gross output value of agriculture per capita has the value closes to zero. Except for second indicator, all values of kurtosis are lower than 0 thus have flat distribution. Only productivity of rural labor indicates peak distribution.

From the results of composite indicator – indicators of rural livelihood is clear, that the best performing provinces are the regions with the highest economic activity, thus Beijing as first and then Shanghai and Tianjin. All these three provinces have the highest regional GDP as well as per capita income and consumption expenditure of rural households. Tianjin has the best performance of Engel 's coefficient which means that people have good living conditions. In these regions, the welfare of rural population is linked to the work of rural residents in the cities. Their income consists mainly of salary instead of their own household business. On the other hand the least favorable situation in the area of rural livelihood can be observed in Yunnan, Guizhou and Gansu. Yunnan is the province with the highest Engel 's coefficient which means that its proportion of rural inhabitant 's income spent on food is the greatest. Such conditions may seem to be the result of the fact that agriculture sector accounts for about 70 % of all rural employed persons. Gansu has the lowest value of per capita in- come of rural households and Guizhou indicates the worst result of regional GDP. Nevertheless it can be assumed that the current situation has improved. From available data is evident that during last four years regional GDP has increased about 50 %.

Composite indicator calculated from sub-indicators dealing with agricultural development are displayed indicates the best situation in the province Jiangsu followed by Shandong and Fujian. The best-rated province has high values at productivity of rural labor, irrigation index and fertilizer investment. Its weakest indicator is power investment. All three best rated provinces are located by the sea and have the greatest output of aquatic products. Shandong and Jiangsu are outside of fishery rich in cereals, potatoes and beans. The worst conditions were found primarily in Guizhou, then in Gansu and Yunnan. Attention should be drawn to the fact that they are the same as those of the previous composite indicator. Guizhou has the lowest productivity of rural labor and Gansu has the smallest proportion of irrigated cultivated land.

Situation in agricultural development can be connected financial flows from big cities and overall economic situation in the provinces. It can also be observed that these countries have the most favorable conditions for cultivation and fish breeding and therefore it is worth to invest in them. However, some data results are so diverse that there cannot be stated some clear conclusion. It can be evaluated very clearly that the least favorable conditions are in the middle belt of China. It might be a consequence of economic activity of these provinces. Most of them have high value-added into GRP from primary sector which unfortunately cohere with lower standard of living compared to the regions where industry and services prevail. Certain similarities can be observed and therefore visually deduced that among agricultural development and rural livelihood is relationship. Whether the relationship according to results of composite indicators really exists, correlation analysis verified it.

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