BioTechnology

A Study on the Efficiency Evaluation of Recycling Economy of Agriculture in Heilongjiang Province

Yang Hui[1],Li Cuixia*[2],Yu Yang[3]
[1]College of Economics and Management, Northeast Agriculture University, Harbin, (P.R.CHINA)
[2] College of Economics and Management, Northeast Agriculture University, Harbin, (P.R.CHINA)
[3]College of Humanities and Law, Northeast Agriculture University, Harbin, (P.R.CHINA)
E-mail : licuixia.883@163.com, yanghui9797@sina.com, 123190924@qq.com

ABSTRACT

As a major agricultural province, to realize the agriculture sustainable development, it is necessary to change the traditional extensive mode of agricultural production and vigorously develop the recycling economy of agriculture. On the basis of the analysis of the status quo of the development of Heilongjiang agricultural recycling economy, this paper first selects four corresponding evaluation indicator: the economic and social development, resource input, resource recycling, and environmental safety of resource. Then, based on comprehensive evaluation indicator system of agricultural recycling economy in Heilongjiang province, after collecting the development data of agricultural economy during 2009-2012, this paper makes a quantitative analysis of the agriculture economic of Heilongjiang province. After a comprehensive evaluation of the past four years' data, the paper gains a good command of the development of agricultural recycling economy in Heilongjiang province, and then puts forward effective methods, proposal and countermeasures for the development of agricultural recycling economy in Heilongjiang province.

KEYWORDS

© **Trade Science Inc.**
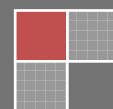
INTRODUCTION

In 2014, ecological agriculture and recycling agriculture has become a hot focus in the NPC (National Peoples Congress) and CPPCC (Chinese Peoples Political Consultative Conference). All in all, pattern of agricultural recycling economy aims to coordinate economic and social needs with natural resources for the agriculturally sustainable development[6]. Involving enterprises, clean production of farmers, recycling use of agricultural resources, ecological agriculture, and green consumption etc., agricultural recycling economy follows the law of ecological economics and strives to benefit ecological environment of agriculture, health and safety of food production and ecological industry economy. Recycling agriculture is the carrier and specific form of the development of agricultural recycling economy[1]. Based on current ecological agriculture and modern science and technology of agriculture, recycling agriculture, in essence, aims to extend industrial chain and to save resources.

THE STATUS QUO OF THE DEVELOPMENT OF AGRICULTURAL RECYCLING ECONOMY IN HEILONGJIANG PROVINCE

The natural environment and status quo of the agricultural development of Heilongjiang province

Being the far East and the far North of China, Heilongjiang province borders Russia on Heilongjiang River at north and Wusuli River at east respectively. Heilongjiang province neighbors on the Inner Mongolia Autonomous Region at west and Jilin province at south respectively. Being the largest province in the Northeast area of China, Heilongjiang province boasts an area of 473,000 square kilometers. Located at longitude 121°11′-135°05′ and latitude 43°25′-53°33 ′,land conditions in Heilongjiang province rank first in China. The total arable land area and land reserve resources accounts for more than 1/10 of China, and the per capita arable land and per capita cultivated land of farmers was about 3 times as large as that of China. But the unreasonable development and exploitation of natural resources has caused serious problems such as soil erosion, soil salinization, river pollution, drastically reduced wetlands and damages to biological diversity.

Analyses of factors of the development of agricultural recycling economy in Heilongjiang province

(1) Favorable factors

Now is the best time for development of Heilongjiang province. In addition to a variety of favorable policy supports from central government of China and China's policy of the revitalization of the traditional northeast industrial base(including Heilongjiang), combined with many major special policy and financial support, major favorable planning such as the new planning of 100 billion jin(a unit of weight ;1 jin=1/2 kilogram)of grain production capacity, planning of comprehensive test region(outer buffer zone) for the two major agricultural plains(Song nei Plain and Sanjiang Plain), and planning of ecological function district of both Da xing an ling mountain and Xiao xing an ling mountain do shower many a support to Heilongjiang province. Furthermore, endowed with superior agricultural resources and the greatest food production potential, Heilongjiang's agriculture does boast the following advantages: ideal ecology, larger farmland, advanced agricultural equipment, high-technology agriculture, best enterprises, huge market potential, international trade opportunities. It therefore follows that the development of agricultural recycling economy is facing a sea of golden opportunities.

(2) Limited factors

The development and utilization of resources in Heilongjiang province was relatively lower and food security task is tough. The contradiction between acceleration of development and protection of the ecological environment is still prominent. With the drastic grain demand increasing, demands of the quality and safety of agricultural products improving, and environmental protection requirements strict, the transformation of mode of agricultural development is a tough task, and therefore, the development of agricultural recycling economy still faces challenges.

DETAILED PLANNINGS OF THE DEVELOPMENT OF AGRICULTURAL RECYCLING ECONOMY IN HEILONGJIANG PROVINCE

In 2012, "Modern agricultural development planning of the Heilongjiang Province (2011-2015) " was formulated to build such three brands as non-genetically modified agricultural products, green food and organic food. In 2013, "Forestry Economic development planning (2013-2020)" put forward: Heilongjiang province shall focus on building such six forestry economic pillars as the forest fungi, forest fruit, forest herbal medicine, forest farming, forest vegetables, and forest planting. In 2014, "Government work report" imposed a requirement for promoting the construction of ecological civilization: on the top agenda is to foster the reform of system of ecological civilization, to implement planning for the sustainable development of ecological protection and planning of economic transition of both Da xing an ling Forest and Xiao xing an ling Forest, and to implement the planning for the sustainable development of resources-based city. In 2014, "Opinions on the deepening of rural reform to speed up modern agricultural development" put emphasis on both the development of recycling agriculture and on building powerful province of green food industry. Specifics go in the following:

(1) Planting

To promote transformation of dual structure (grain and cash crop) of planting into ternary structure (grain, cash crop and forage crop). To establish planting structure with rice, corn, soybean as the main body. According to the annual 47

million tons of straw yield, 30 million acres of farmland can be fertilized by straw stubble left by reaping machine in 2010. Meanwhile, an annual production of 0.1-0.2 million tons of organic fertilizer can be made by fast decomposing the straw. Thanks to the production of 18.2-20 million tons of straw as feeding stuff for livestock and poultry, 10 straw gasification stations can be established. So can 5 straw curing stations and 1 straw power station. Provided that new energy construction can be actively developed, it is easy to form annual production of 254 million tons of straw.

(2) Animal Husbandry

Accelerating the construction of industry system of modern animal husbandry of large scale, the standardization, and intensive cultivation. According to the reality of the ecological environment and resources, dominant breeds such as the dairy cattle, beef cattle, pigs etc. shall be vigorously developed. So shall be sheep, eggs, poultry, aquaculture and culture of special species. In 2010, output value of animal husbandry accounted for 50% of total agricultural output value compared with the former 40%, that is, there is a 10% growth rate. By 2020, the animal husbandry output value shall constitute 70% of the total output value of agriculture. Strengthening the reclamation and renewal of the 65 million mu (a unit of area; 1 mu=0.0667 hectares)of grassland resources and improvement of ecological environment for animal husbandry. Changing binary structure of farmland and developing ternary structure.

(3) Promoting the industrialization of agriculture.

Vigorously develop the processing industry of agricultural and sideline products, harness advanced and applicable technology and new high technology, accelerate the upgrading of the food industry, feed industry, improve the degree of conversion of agricultural and sideline products, extend the industrial chain. In strengthening the specialization and scale of agricultural waste utilization at the same time, it is timely to promote circulation among enterprises and regional circulation.

(4) Forestry industry.

To continue the implementation of protection project of natural forest of China's northeast area, northwest area, and north China: returning farmland to forest, strengthening system construction of ecological forest and the planting forests for villages, roads, farmland (shelter forest), timber forest and ecological forest. It is stipulated that city's shelter forest (network construction) shall be timely updated, prevention and control of desertification of western area of Heilongjiang province assured, and construction of eco-economic shelter forest of Song nen Plain achieved.

COMPREHENSIVE EVALUATION OF AGRICULTURAL RECYCLING ECONOMY IN HEILONGJIANG PROVINCE

Setting of evaluation index

The index of the economic and social development are mainly used to reflect social and economic benefits (namely, the effect of system output terminal) in the process of development of agricultural recycling economy. (2)resource input index are used to reveal the status quo of investment in agricultural production systems of the local region.(3)the evaluation index of recycling use of resources are used to reflect the use degree of system resources in the process of agricultural production[3].(4)Security evaluation index of resources and environment are used to reflect the impacts of agricultural development upon the ecological environment and resources security.

Evaluation index of development of agricultural recycling economy in Heilongjiang province

Evaluation index of development of agricultural recycling economy in Heilongjiang province are set mainly according to the following principles:(1)The economic and social development index is mainly used to mirror social and economic benefits (namely the effect of system output terminal) in the process of the development of agricultural recycling economy.(2) Resource input index are used to reveal the status quo of investment in agricultural production systems of the local region.(3)The evaluation index of recycling use of resources are used to reflect the use degree of system resources in the process of agricultural production.(4)Security evaluation index of resources and environment are used to reflect the impacts of agricultural development upon the ecological environment and resources security. Accordingly, there is the TABLE 1.

Evaluation of comprehensive index on agricultural recycling economy in Heilongjiang province

First, evaluation index numerical value of the subsystem of the recycling economy multiply the corresponding weight number. Accordingly, there is the TABLE 2,

Then add all of them, level index of each subsystem can be obtained:

$$YI_i = \sum_{j=1}^{n_i} w_{ij} x_{ij}$$

$$i = 1, \cdots, n \tag{1}$$

YI_i is the appraisal value of index of J of subsystem i

w_{ij} is the weight coefficient of the indexes of J of the sub system i;

x_{ij} is level index of the subsystem

Then multiply each level index with the corresponding weights and thereafter make the summation; the comprehensive index of recycling economy can be obtained.

$$NISI = \sum_{i=1}^{n} W_i YI_i \tag{2}$$

W_i is the weight coefficient of the subsystem

$NISI$ is comprehensive index of recycling economy

TABLE 1 : Evaluation index of development of agricultural recycling economy

Classification index	Wight	I Index of the individual event	Wight	Classification
The economic and social development index	0.194	C_1 Unit planting area agricultural GDP output value (Yuan/hectare)	0.090	Positive
		C_2 Farmers per capita net income (Yuan/per person)	0.050	Positive
		C_3 The per capita grain yield (kg/per person)	0.490	Positive
		C_4 The grain yield (kg/HA)	0.230	positive
		C_5 Unit livestock product rate (kg/HA)	0.140	positive
Resource input index	0.245	C_6 Application of fertilizer (kg/HA)	0.240	negative
		C_7 Agricultural energy consumption index (kWh/HA)	0.070	negative
		C_8 Agricultural diesel consumption index (T/HA)	0.410	negative
		C_9 Pesticide use (kg/HA)	0.140	negative
		C_{10} Agricultural film use (kg/HA)	0.140	negative
the evaluation index of recycling use of resources	0.323	C_{11} The effective utilization rate of chemical fertilizer (%)	0.198	positive
		C_{12} The comprehensive utilization of straw (%)	0.256	positive
		C_{13} Livestock manure utilization rate (%)	0.295	positive
		C_{14} Multiple cropping index (%)	0.251	positive
		C_{15} Forest coverage (%)	0.245	positive
Security evaluation index of resources and environment	0.238	C_{16} The effective irrigation coefficient (%)	0.230	positive
		C_{17} The comprehensive index of water pollution	0.279	positive
		C_{18} Farmer per capita arable land (Mu, a unit of area (=0.0667 hectares))	0.246	positive

Empirical data for evaluation of agricultural recycling economy in Heilongjiang province

According to TABLE 1, from the "statistical yearbook of Heilongjiang province", Heilongjiang Province Statistic Bureau website and Heilongjiang ProvincialEnvironmental Protection Bureau network and other related platform, related data (2009-2012) in agriculture in Heilongjiang province were collected. A few missing data can be calculated based on the rate of changing. Thereby comes the TABLE 3 Index of the individual event for recycling agriculture in Heilongjiang provnce.

Standardization of the data in TABLE 3: Given different units for the data is different, so according to the following formula (1) and (3), all data must be calculated by the dimensionless method.

$$X_{ij}^{+} = (Y_{ij} - Y_{ij}^{min}) / (Y_{ij}^{max} - Y_{ij}^{min}) \tag{3}$$

$$X_{ij}^{-} = (Y_{ij}^{max} - Y_{ij}) / (Y_{ij}^{max} - Y_{ij}^{min}) \tag{4}$$

X_{ij}^{+} means the j positive index values of the I index layers;

X_{ij}^{-} means the j negative index values of the I index layers

Y_{ij} means the initial value of j single indices of the I index layers

Y_{ij}^{max} means the maximum initial value of j single index of I index layers

Y_{ij}^{min} means the minimum initial value of j single index of I index layers

Take the data above into the formula (1) and (2). After calculating, numerical result in TABLE 4 can be seen.

TABLE 2 : Statistics table of agricultural development data from 2009 to 2012 in Heilongjiang

Index Name	2009	2010	2011	2012
The total agricultural output value (100 million yuan)	2251.1	2536.3	3223.5	3952.3
Farmers per capita net income (Yuan / person)	5207	6211	7591	8604
Grain (unit: ten thousand tons)	4352	5013	5571	5761.3
The total population (unit: ten thousand)	3826	3833.4	3834	3834
Sown area of crop (unit: ten thousand hectares)	1208.7	1387.1	1425	1448.6
The output value of animal husbandry (unit: 100 million Yuan)	870.2	965.799	1189.91	1350.7
The output value of planting industry (100 million Yuan)	1206.8	1369.19	1801.83	2315.6
The total power of agricultural machinery (10000 kWh)	3401.27	3736.29	4097.76	4549.25
The total output of meat (unit: ten thousand tons)	45	45.5	46.3	48
The amount of use of chemical fertilizer (unit: ten thousand tons)	198.8724	214.88	228.4	240.3
Power consumption (unit: 100 million KWH)	48.4	52.7	58.2	64.3
The amount of use of pesticides(unit: ten thousand tons)	6.7	7.4	7.8	8.1
Agricultural film use (10,000 tons)	6.5	6.9	7.2	7.4
The comprehensive utilization of straw (%)	51	51	58	60
Manure utilization rate (%)	57	56	58	62
Multiple cropping index（%）	98.83	101.12	99.87	100.3
Forest coverage（%）	45.2	45.2	45.2	45.2
The effective irrigation area (10,000hectares)	340.6	387.5	434.2	488.9
Comprehensive pollution index of water quality(mg/L)	0.74	0.71	0.71	0.71
Farmer per capita arable land (mu / person)	11.73	11.68	12.85	13.56

TABLE 3 : Index of the individual event for recycling agriculture in Heilongjiang province

	2009	2010	2011	2012
C_1	18624.1	18284.9	22621.	27283.58
C_2	5207	6211	7591	8604
C_3	1137.48	1307.71	1453.0	1502.686
C_4	3600.56	3614.01	3909.4	3977.15
C_5	37.2300	32.8022	32.491	33.13544
C_6	164.534	154.916	160.28	165.8843
C_7	2.81399	2.69359	2.8756	3.140446
C_8	0.09812	0.09220	0.0937	0.096093
C_9	0.00554	0.00533	0.0054	0.005592
C_{10}	0.00537	0.00497	0.0050	0.005108
C_{11}	0.16453	0.15491	0.1602	0.165884
C_{12}	51	51	58	60
C_{13}	57	56	58	62
C_{14}	98.83	101.12	99.87	100.3
C_{15}	45.2	45.2	45.2	45.2
C_{16}	0.28179	0.27936	0.304702	0.337498
C_{17}	0.74	0.71	0.71	0.71
C_{18}	11.73	11.68	12.85	13.56

The general situation of agricultural recycling economy development level of Heilongjiang province (2009-2012) was basically in accord with the development planning of agricultural recycling economy. In other words, under the strong

support of the government, the government policy work wonders. The agricultural recycling economy has been on a rapid rise. After 2010, the agricultural recycling economy shows a steady rising trend.

TABLE 4 : The comprehensive evaluation value of development of agricultural recycling economy in Heilongjiang Province

	2009	2010	2011	2012
NISI	0.396890	0.371004	0.488644	0.598891

ANALYSES OF AGRICULTURAL RECYCLING ECONOMY IN HEILONGJIANG PROVINCE

To forge the economic chain of recycling and manufacturing of agricultural enterprises

By forging recycling economy chain of food processing and livestock production and processing, also by forging recycling economy chain of forestry products processing, and accordingly agriculture industry chain shall be extensively extended and mutually connected. Furthermore, a full use of waste and pollutants can be made to realize the synchronous growth of economic benefits[2],ecological and social benefits. To forge an economic chain of recycling use of straw stubble which means straw stubble can be made a full use in the economic chain mentioned above[4], in the development of such economic chain, recycling economy chain shall accordingly be formed to combat pollution, make the best of agricultural resources and bring more economic benefits.

To strengthen the construction of agricultural recycling parks

By constructing agricultural recycling parks, gradually symbiosis of sideline products processing enterprises tend to go hand in hand with each other in a relatively closed Park Group, and thus the agglomeration efficiency is achieved[7]. The effective cohesion of planting, breeding industry, processing industry, vigorous development of the recycling economy and clean production of agricultural products for exportation shall help sideline products meet international standard in terms of quality, environmental protection and so on.

To better the pilot development of recycling economy

First, it is effective to build pilots in a couple of cities or towns which boast vast capacity of agricultural processing. Then, the experience of these pilots can be spread to the other cities and towns. It turns out that the pilots with the unique local development mode of agricultural recycling economy and the establishments of comprehensive evaluation index system for agricultural recycling economy do provide examples and reference for overall development of agricultural recycling economic.

To foster the development of recycling economy by law

Through legislation, the protection of agricultural ecological environment, as a resource, can be incorporated into the public administration of government. It is of great significance for agricultural producers, agricultural enterprises and the government to understand their responsibilities and obligations in the development of the agricultural recycling economy. Once agricultural enterprises and agricultural producers' pollutant emissions exceed the national and local standards, they shall be enforced to be inspected to ensure its agricultural cleaning production conform to local standards. It is also indispensable to reduce pollutants of agricultural production [4],rending them harmless.

RESULTS AND DISCUSSION

Based on the study of recycling economic efficiency of agriculture in Heilongjiang Province, by establishing system of efficiency evaluation, aims to find out the factors restricting the development of agricultural recycling economy in Heilongjiang Province and to explore suitable ways for the development of Heilongjiang agricultural recycling economy. By improving the ecological status quo, rationally using agricultural resources, implementing the strategy of developing agriculture through science and technology, increasing investment into infrastructure for agricultural recycling economy, adjusting and optimizing the industrial structure of agriculture[5], implementing industrialization strategy, and encouraging technological innovation, agricultural recycling economy in Heilongjiang Province is bound to boom. It thus shall ensure smooth realization of the "Twelfth Five-Year Plan" in agriculture.

ACKNOWLEDGMENT

REFERENCES

[1]   Chen Qing; A Study on the methods for Recycling Economy of Agriculture in Heilongjiang Province, Journal of Agricultural System Science and Comprehensive Study, **2**, 138-140 **(2005)**.

[2]   Wang Ke, Yu Sujun; A Relatively Effective Evaluation on Recycling Economy of Agriculture Based on DEA., Agriculatural Science of An'hui Province, **13**, 5633-5635 **(2008)**.

[3]   Wen Yongjun; A Relatively Effective Evaluation on Recycling Economy of Agriculture Based on DEA, Research on Productivity, **2**, 21-22+49 **(2009)**.

[4]   Yang Hui, Yang Xue; Research on Supply of Public Goods of Rural Communities in the Process of Urbanization in Heilongjiang, Journal of Northeast Agricultural University: Social Science Edition, **2**, 42-44 **(2012)**.

[5]   Yang Hui, Li Cuixiang; On the Supply Efficiency of Rural Public Goods: A Panel Data Analysis of 13 Areas in Heilongjiang Province, Journal of Yunnan University of Nationalities(Social Sciences), **6**, 107-112 **(2013)**.

[6]   Ye Lintang; Pattern of and Approach to Recycling Economy of Agriculture. Beijing: Xinhua Press, **(2006)**.

[7]   Yang Hui, Li Cuixiang; To Improve Structure of Farmers Consumption by Boosting level of Social Security in Villiages, Economic Review, **2**, 74-77 **(2014)**.

[8]   Zhang Xiaoxian; Comprehensive Evaluation Index System and Empircal Analysis of Recycling Economy of Agriculture in Heilongjiang Province, Agricultual Science of Hubei Province, **15**, 3740-3743 **(2013)**.