Breaking Key Obstacles on Developing Circular Agriculture and Promoting Agricultural and Pasture Resources Benefit

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Abstract The present situation, problems and constraints of the circular agriculture development in Hebei Province are systematically analyzed, the subject modes suitable for the development of circular agriculture and the value-added potential are described, and finally some proposals are put forward.

Key words Circular agriculture, Major obstacles, Agricultural and pasture resources

The shortage of agricultural resources, as well as the traditional extensive, highly consuming, low-income but high-pollution mode of production in Hebei Province have brought about some serious problems, such as environmental deterioration, ecological damage and further shortage of resources, which have become the obstacles to the sustainable development of agriculture. In recent years, the demonstration construction of national eco-agricultue and the construction of eco-home project have made great contributions to the eco-agricultural construction in Hebei Province. A series of new technology is promoted, which not only promotes the structural adjustion in the demonstration areas, but also drives the development of a series of recycling agricultural management models, and lays a foundation for the development of Hebei circular agriculture. It can be said that the agriculture in Hebei Province has taken the path of circular development in some areas and demonstration regions. But the overall development of circular agriculture is still at the primary stage of development.

The present studies and practices of circular agriculture mainly focus on its concept, connotation and macro perspective[1-3], or some simple model and some circular chain based on one type of resources[4-9], and study of regional circular economy is mainly carried out in a unit of administrative district and economic area[10-15]. It is of great prctical significance to construct an overall regional development concept according to local restricting factors and resources. In this paper, the development status, problems and obstacles of the circular agriculture in Hebei Province are introduced, the major pattern and its appreciation potential are analyzed, and finally some suggestions for the development of Hebei circular agriculture are proposed for the references of local government and related departments.

Received: January 29, 2012 Accepted: January 15, 2013
Supported by the Youth Foundation of Hebei Academy of Agricultural and Forestry Sciences (08149402A).
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1 Status and problems of the circular agricultural development in Hebei Province

1.1 The circular agriculture in Hebei Province is still at the stage of low-level and steady development The development of circular agriculture in Hebei Province during the latest ten years is analyzed and evaluated, and it is found out that the economic and social development, the recycling use of resources, and the reduced input of resources have all been improved. However, the recycling use and the reduced input of resources improve slowly and are still at a low level, which have become a major restricting factor to the development of circular development. In addition, the index of resources and environmental safety shows a steady decline trend, indicating that the agricultural resources and environment in Hebei Province are exacerbating.

1.2 The chain of resources recycling is short and direct, and has low added values The short and direct chain of resources recycling is mainly embodied in the utilization of straws and animal manures. At present, about 0.12 billion t animal manure is produced in Hebei Province per year, 99% of which, however, is only used for fertilizers, and only the left 1% is processed into new type of feed and energy. Thus the animal manure has become the trough of resources recycling in circular agriculture.

About 376 360 000 t straws are produced from the planting industry every year, whose utilization efficiency, however, is only 92.04%, and burning rate is 7% -8%. About 60% of the straws are used for fertilization (direct returning to farmlands and composting), and only about 30.9%, 0.8% and 0.2% are reused in the form of pass-rumen straws or to cultivate edible fungi and coals. The value-adding potential of straws is far from being fully exploited.

1.3 The input of resources is increasing annually, but the utilization efficiency is declining, and the ecological environment is exacerbating As is shown by the analysis of the resources input (including irrigation water, seeds, pesticide, fertilizer, plastic sheeting, *etc.*) in Hebei agricultural production, the development of circular agriculture is mainly influenced by the fac-

tors of high fertilizer and pesticide input, low recovery rate of plastic sheeting and reduced production efficiency of fertilizers. During the ten years between 1996 – 2007, the effective utilization rate of fertilizers reduced from 74.37% to 67.8%, leading to the high residues of N and P in soil, further exacerbate the soil environment and cause serious non-point pollution. However, the available K is in great deficiency, and its consumption amount is three to eight times the input amount, the soil structure is imbalanced. The use of pesticide has improved from 11.10 kg/hm^2 to 13.35 kg/hm^2, and it has become the main obstacle to agricultural clean production and the uplift of products quality. The utilization amount of plastic sheeting is increasing year by year, but its recovery rate is still maintained between 57% – 58% during the ten years, the recovery rate of ground plastic film is even zero, which has caused serious soil pollution. During the ten years, the irrigation factor of farmlands declined from 0.882 to 0.869, the imbalance between the supply and demand of agriculture water use is aggravated.

2 The major obstacles to the development of circular agriculture in Hebei Province

The major obstacles to the development of circular agriculture in Hebei Province are as follows: firstly, the agricultural production requires high input of resources; secondly, the agricultural and pasture wastes are inefficiently reused; thirdly, the safety factor of resources and environment is declined. The four indexes of Hebei circular agriculture, including the reduced input of resources, the recycling use of resources, the safety of resources and environment, and the social and economic development, are 70.7, 35.9, 23.3 and 19.8. The key to overcome the obstacles lies in how to scientifically input the resources, improve the resources efficiency and reach the objective of high-efficient resources use.

From the ranking of the 23 factors restricting the development of circular agriculture, the major restricting factors include the fertilization amount, plastic sheeting use, recycling rate of animal manure, pesticide use, the commodity rate of agricultural, forestry, animal husbandry and fishery products, as well as the utilization rate of pass-rumen straws. Among the first five factors, the three factors of fertilization amount, plastic sheeting use and pesticide use belong to the factors of resources input. Therefore, it can be concluded that the circular agriculture development in the whole province is mainly restricted by the input of resources, the recycling use of wastes and the safety issues of resources and environment caused.

3 Three major models suitable for the development of Hebei circular agriculture and their appreciation potentials

There are lots of circular agriculture development models, but only three are suitable for the development of Hebei Province: firstly, the independent circular mode of planting industry; secondly, the multiple recycling model of resources among the planting industry; thirdly, the recycling model of rural life and production. But the three models aim differently.

3.1 The recycling model of planting industry The fertilizer-saving and water-saving agriculture should be actively developed. The scientific fertilization and irrigation could save about 105 kg/hm^2, a total of 900 000 t fertilizer saved in the whole province, and save more than 750 m^3/hm^2 water, a total of 1.5 – 2 billion m^3 water saved in the whole province.

3.2 The multiple recycling model of resources among the planting industry The returning of pass-rumen straws to field should be actively developed. The utilization efficiency of pass-rumen straws has been improved from 54.8% to 100%, which can improve the utilization of straws to 9 700 000 t. The breeding industry generates 2.5 billion Yuan to the revenue of Hebei Province.

3.3 The recycling model of rural life and production The animal manure can be transformed into biogas. The animal manure produced by family and large-scale breeding is recycled, which not only improves the utilization efficiency of resources and generates great economic benefits, but also effectively prevents the environmental pollution caused by agricultural wastes and improve rural living environment. To carry out family biogas project aims at those scattered breeders, and the implementation of "one family, one biogas tank, one hearth" project solves the farmers' needs for domestic fuels. A batch of large-scale biogas production and processing enterprises are built surrounding the large-scale breeding base. After separation and processing, 60% CH_4 and 40% CO_2 are obtained, the CH_4 is mainly used for urban and rural life, while CO_2 is mainly used for the production of greenhouse vegetables, which has greatly improved the production of vegetables. If all the manures are recycled for biogas in the while province, about 82.9 billion m^3 biogas will be generated, whose energy is equivalent to 273.57 billion t coal, which can satisfy the domestic energy needs of 21 800 000 farmers and generate an annual revenue of around 30 billion Yuan.

4 Suggestions on the development of circular agriculture

The development of circular agriculture is of great social and economic significance to the protection of resources and environment as well as the new countryside construction in Hebei Province, and it also has great development potential. However, the development of circular agriculture in Hebei Province is still at the primary stage, the following problems still need to be solved.

4.1 Technical support The agricultural circular economy has no fixed pattern, and it is generally developed according to local conditions. The industrial chain and operating model of circular agricultural economy should be combined with diverse factors, including the biology, environment and agricultural economy. At present, the technical study of circular agriculture is generally carried out from the macro perspective, which, however, is still weak for the practical development of the circular agriculture industry.

Both the capital and talents input should be increased to improve the existing model. Moreover, more circular agricultural models should be explored by technical innovation, so as to accommodate to local circular agricultural development.

4.2 Firancial support The development of circular agriculture industry should be supported by certain amount of money. On the one hand, to establish and sustain the circular agriculture industry is based on money, on the other hand, some industrial model has no obvious economic benefits, instead, it generates high ecological benefits. Without the government investment, the circular agriculture cannot be developed and promoted. A series of policies have been carried out in the key areas of development, a complete set of price, investment and compensation mechanism has been established, and a government-promoted, market-driven and public-participated mechanism will be gradually built.

4.3 Services support With strong extensiveness, the industrial chain of circular agriculture proposes high requirements for the supportive services. It concerns not only the width of professional scope, but also the fields of economy and market. Some measures should be adopted to build a supportive service system: firstly, to formulate laws and regulations to promote the development of this industry, including the focus, layout and investment mechanism of the industry; secondly, to increase the capital investment, form a multiple investment mechanism combining the government investment with social investment. The government should increase its investment on those with great ecological benefits, while the social investment can focus on those with great economic benefits; thirdly, to innovate the technology, and explore more development models for circular agriculture industry, so as to provide powerful technical support and adapt to the needs for circular agricultural development.

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