

Brand-Economics and Case Study of Recycling Crop Stalks

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Abstract: It is an important method to realize the circular utilization of crop stalks by processing them into organic fertilizer. On one hand, there is a huge resource of crop stalks in China; on the other hand, there appears variously serious pollution. Based on the concept of double cycle, this paper analyzed the behavior of the farmers and firms separately based on the strict mathematical analysis. It proves that only when the double circulation is realized, manufacturers can fundamentally solve the difficulty of being only recycling but non-economic so as to ensure the stable development of crop stalks recycling system.

Key Words: Crop Stalks; Circular Economy; Double Circulation; Brand Establishment

1 Introduction

Crops stalks are the by-products of agricultural production, as well as a kind of valuable biological resources. According to relevant statistics, our annual crop stalks that could be collected are up to 687 million tons, of which 215 million tons are under utilization, proportioning 31.31 percent. The main part of the unutilized are burnt. How to make good use of the crop stalks resources, and promote the circular agriculture is an urgent problem to be solved. Meanwhile, as an agricultural country, China is the biggest country of fertilizer consumption with 43 billion kilograms of chemical fertilizers applied annually; the production and consumption are both up to above one third in the world. Under the exacerbation of resources constrain, whether plantation can stabilize its sustainable development greatly depends on the input and scientific application of chemical fertilizers. However, the fast-paced development of chemical fertilizer industry also brings our agriculture tremendous difficulties. Firstly, improper application of chemical fertilizers results in the decrease of solid quality and pollution, for instant there appears quite serious nitrogen pollution in China; secondly, the utilization efficiency of chemical fertilizers is not high, generally below thirty percent; the annual lose of nitrogen fertilizer is nearly worth 40 billion RMB. Solid is the basic of agriculture development, while the excessive application of chemical fertilizer is to threaten the sustainable development of agriculture. With government's attention and great support in agriculture, the recycling of crop stalks by processing into organic fertilizers develop with fast pace. However, many manufacturers encounter a predicament in practice ---only recycling but non-economic, that is, manufacturers input high expenditure to realize the resources recycling, but the market value of products cannot fill up the cost even there is no market for the products so as they rely on the preferential policies and capital aid of government in order to survive. As to the phenomenon of being only recycling but non-economic, some scholars attributes it to technology or the constraint of the system. Though it's seen that some manufacturers achieve breakthrough technologically and institutionally, their recycling economic pattern still couldn't efficiently work with high speed, some even quite unstable. For example, Shandong Quanlin Jiayou Fertilizer Co. Ltd of China possesses international advanced technology of fertilizer production, but its sales have been restricted by market, which constrains its rapid development.

The theory of the Economics of the Coming Spaceship of Earth put forward by Kenneth E. Boulding in 1966 was considered as the early representation of circular economics. Frosch Robert and Gallopoulos Nicolas^[1] put forth that there are no absolute waste in industrial manufacture, and industrial manufacture and environmental protection can be completely harmonized by appropriate management. David Pearce and Kelly Turner^[2] brought forward the concept circular economy in their book and divided it into natural cycle and industrial cycle. Recently, as the concept of cleaner production and low carbon been advanced, the theory development and study of circular economy has been attached a great importance.

Presently, scholars are carrying out their study on circular economy from three different perspectives as follow: Firstly, conception based on ecology mainly views circular economy naturally as an economy of ecological protection, which requires ecological law rather than mechanic law to instruct the economic activities of human society, like Qu Geping^[3] and Suren Erkman^[4], etc.. Secondly, viewpoint based on market economy considers circular economy as a new-style economy form as well

as an advanced development pattern of economy, and it functions under the regulation of market system and comply with the law of market economy. Circular economy and market economy are consistent with each other in terms of functioning system. It is more efficient but costs less in management to develop circular economy by employing market system than compulsory measure, such as Li Yunyan^[5], Zhang Xiaolan^[6], etc. Thirdly, views from government intervention reckon hold the opinion that government's function is to stabilize the whole economy and relocate the economic resource. In the middle of transition from conventional economy to circular economy, government should be posed as the main entity of responsibility in boosting the development of circular economy, like MaZhong^[7], et al. The studies on this respect analyze from the macroscopic perspective the significance of circular economy and the functional laws and features of circular system, though they failed to give any instructional suggestion on the various problems which exists in the virtual practice of microcosmic enterprises.

As to the recycling of crop stalks, present documentaries analyzed from the methods of crop stalks recycling and its profit, for example, Zhang Anlai^[8] summarized the current troubles in utilizing crop stalks, meanwhile posed new approaches of industrializing crop stalks utilization from the pattern of self-sufficiency, enlarging the government investment on the exploit and utilization of stalk resource, establishing system to evoke the consciousness of people to utilize stalk resource. Wang Jing^[9] studied the multi-profit of four general models of crop stalks utilization in circular economy, and put forward the current problems existing in crop stalk utilization and brought up the solutions. The similar studies include Cao Mingchong's^[10], Liu Zhongxiang's, Li Yangning's and Liu Tingting's^[11], etc. The studies on this respect emphasized the methods and social profit of stalk recycling, however, they didn't provide any solution on whether and how circular system could sustainably develop.

Therefore, from the nature of crop stalks recycling and brand economics, this paper analyzes the conditions and measures to realize the circulation, aiming to provide theoretical instruction for the circular development of China's stalk resource.

2 Study on the Double Circulation Model of Crop Stalks

Developing circular economy and establishing circular society is the important pathway and feasible method of implementing sustainable development strategy. On the Central Symposium on Population, Resource and Environment in 2003, General Secretary Hu Jintao put forth that accelerating the transformation of model of economic growth, penetrating the development concept of circular economy into regional economic development enable the maximum exploitation of resource.

Currently, in China the technology of utilizing crop stalks to produce organic fertilizers is comparatively mature, but the application of organic fertilizers is not optimistic. Professor Zhang Fusuo from Resource and Environment Department of Chinese Agriculture University introduced that in EU half of the solid nutrients are from organic fertilizers, the other half from chemical fertilizers. On the contrary, 70 to 80 percent of the solid nutrients are from chemical fertilizers, with organic fertilizers only taking 20 percent in China. In the process of crop stalks recycling, the limitation of farmers utilizing organic fertilizers leads to the poor recycling efficiency. Therefore, it's not when the recycling of crop stalks realizes the material cycle technologically, the recycling of crop stalks becomes a system which can work automatically and circularly. It needs the market to approve and produce economic benefit, which means the crop stalk recycling system could develop stably and enduringly when the value cycle has been achieved. From above, it can be seen that crop stalks recycling actually embraces double circulation: material cycle and value cycle. The detailed model analysis is as follow.

2.1 Double circulation model

Crop stalks recycling actually embraces double circulation: material cycle and value cycle, as is shown in diagram one. Any problems with any segment will result in the breakdown of the entire recycling system, failing to realize the sustaining development.

First is the material cycle with manufacturers as the leading factor. Manufacturers through certain technology process crop stalks into organic fertilizers and sell them to farmers who fertilize their crops with organic fertilizers and sell the collected crop stalks to the manufacturers when the crops are harvested. This cycle demands manufacturers to guarantee a smooth material transition in technology and process.

Second is the value cycle with farmers as the predominant factor. Farmers purchase organic fertilizers and fertilize them in their crops. After harvest, farmers decide to or not purchase organic fertilizers according to the profit and loss of crops in the season. The magnitude of deviation between the income and cost of farmers determines the stability of this cycle. The bigger the deviation is, the

more actively the farmers purchase organic fertilizers, and the more stable this cycle is. When the deviation is smaller (even minus), farmers are to purchase less organic fertilizers even not, which weakens the link of this cycle even leads to the breakdown.

In the double circulation of circular economy, material cycle is the precondition of value cycle; value cycle is the guarantee of the consistent development of material cycle. Neither can be dispensed if this recycling system commands an everlasting and stable development.

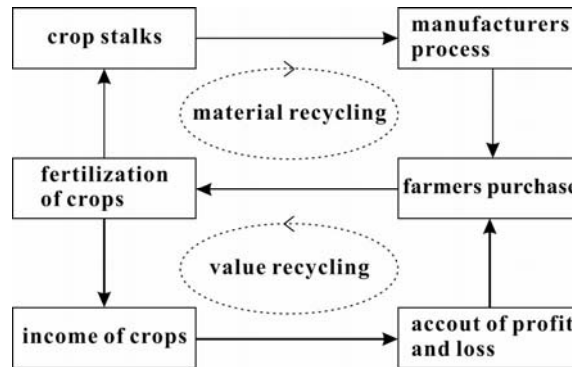


Figure 1 Double Circulation Model of Crop Stalks Recycling

2.2 Decision analysis of farmers purchasing organic fertilizer

It can be seen from double circulation model that the material cycle is crucially dependent on technology of manufacturers. In term of the current technology, the technology and process of processing crop stalks into organic fertilizer are comparatively mature. Therefore, material cycle can be well-realized. The key of value cycle is whether farmers purchase organic fertilizers, which determines the entire circular system. Farmers' purchasing decision is dependent on the account of the profit and loss of agricultural products. In order to simply analyze, this paper provide the following assumption on the demand analysis of consumers; firstly, rationality assumption. Suppose farmers are rational economic men, they pursue the maximum individual interests. When the expenditure is determinate, they pursue the maximum profit, or when the profit is determinant, they pursue the minimum expenditure. Secondly, technology assumption. Presume plantation technology is even during the researching period, for instance, there is no any obvious change in seeds cultivation and vermin prevention. Thirdly, product assumption, that is, there is no distinction between crops.

Suppose during t period farmers didn't apply organic fertilizers, the profit is

$$R_t = P_t \cdot Q_0 - C \tag{1}$$

R_t 、 P_t 、 Q_0 respectively stand for the profit of crops, price and crop yield during t period. C stands for the cost of crops, including seeds, chemical fertilizer, tractor-ploughing, pesticide, irrigation, threshing, delivery, manual work, etc..

During t+1 period, farmers' consideration as to purchase organic fertilizer is shown as below:

$$R_{t+1} = \begin{cases} (1 + \alpha)P_t \cdot Q_0 - C & \text{when farmers purchase organic fertilizer(2)} \\ (1 + \alpha)P_t \cdot (1 + \beta)Q_0 - (C'' + P_0q_i + L) & \text{when farmers not purchase organic fertilizer(3)} \end{cases}$$

Among it, α stands for fluctuation rate of agricultural products; β represents the increasing rate after applying organic fertilizer; P' is the price of organic fertilizer; q_i stands for the amount of organic fertilizers applied; L is the labor cost of applying organic fertilizers. When $C' - C = \Delta C$, (3) - (2) comes to:

$$\Delta R_{t+1} = \beta(1 + \alpha)P_t \cdot Q_0 - (\Delta C + P' \cdot q_i + L) \tag{4}$$

Only when $\Delta R_{t+1} > 0$, farmers choose to purchase organic fertilizers; when $\Delta R_{t+1} \leq 0$, farmers choose not to purchase organic fertilizers. Furthermore, the greater ΔR_{t+1} is, the more actively farmers purchase organic fertilizer, the greater the purchasing amount is.

From formula (4), it can be seen that, on one hand, the extra cost ($\Delta C + P' \cdot q_i + L$) of applying

organic fertilizers is determinate; on other hand, in terms of the increase of income, although the increasing rate of crop yields is relatively stable, the fluctuation rate of products' price is strong, which farmers are difficult to predict. If $\Delta R_{t+1} > 0$, we can figure out the minimum of the increase of farmers' income, that is,

$$\alpha > \frac{\Delta C + P' \cdot q_i + L}{\beta P_t \cdot Q_0} - 1 = \alpha_0 \quad (5)$$

It can be seen from above formula, only if the increase of agricultural products must be greater than α_0 , farmers' income after applying organic fertilizers can be guaranteed to increase. Otherwise, their incomes will decrease. The prices of agricultural products fluctuate greatly. This indeterminate income and determinate costs largely affect farmers' enthusiasm to purchase organic fertilizers.

2.3 Demand analysis of organic fertilizer manufacturers

Each farmer's demand quantity composes of the total demand quantity (Q') of the entire organic fertilizer market, shown as follow:

$$Q' = \sum_{i=1}^n q_i \quad (6)$$

As to an individual organic fertilizer manufacturer, its demand function is as follow,

$$q_j = Af(P', C_c) \quad (7)$$

Among it, Q' represents the products demand f enterprises, A stands for the advance of technology and process and $A \in [0, 1]$, P' represents products' prices, C_c stands for the choice cost [12-13] of consumers. when $\frac{\partial q_j}{\partial P'} < 0$, $\frac{\partial q_j}{\partial C_c} < 0$, formula above holds on. In terms of the feature of double circulation of circular economy, to realize material cycle by the progress of technology and process is the precondition of achieving the whole system. Therefore, shown as in formula (3), when $A=0$, which means manufacturers didn't realize the material cycle in term of technology and process, $Q_c=0$. When $A=1$, that is, the material cycle in term of technology and process is completely realized, $q_j = f(P', C_c)$.

At this point manufacturers' demand depends on two factors, that is, product price and choice cost. It can be concluded from formula (6) that manufacturers can, on one hand, increase product demand by decreasing the price. According to neoclassic economics demand law, demand reduces when price rises, while price declines demand increases. However, in reality we find that product which takes a large market share is often not the lowest priced product. The result of price war is that manufacturers can't afford their own huge losses so as to bankrupt. Therefore, to decrease price can increase product demand to some extent. On the other hand, manufacturers can reduce the choice cost of product by brand establishment, so as to increase the product demand. According to the theory of band economics, the production capacity of manufacturers is Q_y ; the selectivity of the product (actual sales) is Q_c , choice cost is $C_c : C_c = \sum C_{ck} (k = 1, 2, \dots, n)$, then the following formula holds on:

$$Q_y = Q_c + C_c \quad (8)$$

That is, $Q_y - C_c = Q_c \quad (9)$

According to the analysis above, we can conclude that production efficiency $E_y : E_y = \frac{Q_c}{Q_y}$, choice efficiency $E_c : E_c = 1 - \frac{C_c}{Q_y} = \frac{Q_c}{Q_y} = E_y$. Obviously, actual production efficiency constantly equals choice efficiency, that is, when production capacity is invariable, the external choice efficiency of the market determines the internal production efficiency.

When $C_c > 0$, $Q_y > Q_c$, $E_y < 1$, $E_c < 1$, which suggests that low choice efficiency leads to the excess of production capacity over choice capacity, further bringing overproduction and resource wasting inside manufacturers. When $C_c = 0$, $Q_y = Q_c$, $E_y = 1$, $E_c = 1$, which shows that choice efficiency reaches its maximum; Production capacity equals choice capacity, that is, consumers' choice

cost is zero. At this point production efficiency perpetually maintain in its climax. From the analysis above, it can be known that to lessen the choice cost of consumers by brand establishment is the insurance to maximize production efficiency of manufacturers. In another word, the important guarantee for the smooth implementation of value cycle is brand establishment.

3 Analysis of Government Function

Marketing economic entities are in line with the main principle of maximizing their own interests to carry out economic activities. First of all, for farmers the inherent problems of organic fertilizers have a great impact on purchasing decision; firstly, although the nutrient content of organic fertilizer is relatively comprehensive, active ingredient content is low, much lower than the active ingredient in chemical fertilizer. Furthermore, the process of decomposition in soil and absorption by plants is slow, difficult to meet the crop yield and efficient demands. Secondly, the price of organic fertilizers is high; thirdly, the bulk of organic fertilizer increase the labor intensity, lower the efficiency; and in countryside most young adults are migrant workers, therefore majority of farmers rely on chemical fertilizers in order to economize on time and labor. China's rural land system is implemented in the rural collective, long-term contracts with farmers. As to farmers, they have a right to use the land but in a limited time. As to the land leasers, they have the right of using the land in the contract period. Therefore, farmers give little consideration to the continuous use of land and damage and pollution to the environment, while focusing on short-termed gains. Next, as to the organic fertilizer manufacturers, the cost of scientific and technological research and initial investment of circular economy is large. Many projects produce very little profit or even loss. Therefore, the government plays an important role in circular economy. The role of government embodied in two respects.

3.1 To block activities of pollution and ecological damage

Firstly, government should strictly block activities of pollution and ecological damage. At present, as the rapid development of China's industrialization, environmental pollution is becoming more and more serious. Environmental issues are now a worldwide problem. Government should ensure the economic development while paying attention to environment protection. On problem, management system within specified period is correspondingly introduced throughout the country to regulate enterprises which produce environment pollution, such as to limit their corporate loans. Government increase penalties for the polluting enterprises, increase business costs of enterprise pollution, which is conducive to control this phenomenon.

3.2 To direct and support conducts of sustainable development

Secondly, government should direct and support the conducts of sustainable development. Government can subsidize the farmers who apply organic fertilizers. Next, on the certification of agricultural products, government agencies should enhance the investigation and research while timely formulating relevant laws and regulations and preferential policies to guide, support and encourage the pollution-free, green and organic agricultural products, and carry out joint enforcement, strengthen cracking down on making and selling counterfeit goods in the agricultural inputs market and agricultural markets, so as to effectively protect pollution-free, green and organic agricultural products, actively create a better environment favorable for the production and development of pollution-free, green and organic agricultural products.

To summarize up, crop stalks recycling actually embraces double circulation: material cycle and value cycle. On one hand, to process crop stalks into high-quality organic fertilizers requires technological and process progress, which demands enterprises to invest a larger sum in research and advanced technology of R&D. While government adopts preferential policy to encourage circular economy, some enterprises achieve a breakthrough on technology and process of resource recycling. On the other hand, in market competition, organic fertilizer manufacturers should develop appropriate strategies and measures for brand establishment after fully studying the purchasing patterns of its target customers, to realize the value cycle of products. It can be concluded from above analysis that the reason of being only recycling but non-economic lies in: some enterprises which practice circular economy, though already have realized material resource circulation, didn't achieve value cycle and cannot produce economic benefits, further leading to failure of lasting and stable development of circular system. The propensity of market economy maximizing the benefits makes people simply pursue short-term economic benefits. Circular economy is an important form of sustainable development, as well an undertaking with long-termed benefits. Therefore, government intervention in circular economy also plays a significant role.

4 Conclusions

In order to develop recycling of crop stalks stably and sustainably, double circulation must be achieved, that is, material cycle and value cycle. The former needs enterprises to achieve the cycle of crop stalks in term of technology and process. Value cycle is that organic fertilizers need to be approved and purchased by consumers. The key is to reduce the choice costs of consumer through brand establishment. Enterprises can fundamentally solve the difficulty of being only recycling but non-economic only if the double circulation is realized.

In the recycling of crop stalks, to ensure the stable, lasting, efficient development of circular system, we consider we could perform well from two aspects: first, the central enterprises of circular system must carry out brand establishment for the terminal customers. Circular system is a strongly-interdependent system. Central enterprises should gain the brand pulling force through brand establishment directly aiming to terminal consumers so as the entire circular system gain the developing momentum. Second, government should encourage and guide circular system. Government provides assistance in financial support, preferential policies, consumer guide, legal protection and other aspects for the development of circular system. The recycling of crop stalks is an important part of circular economy, one of ways of sustainable development. This paper described the conditions and the corresponding measures of the stable and sustainable development of stalks recycling system, providing referential recommendations for the development of other circular economy in China.

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