

# Local Governments' Behaviors Study on the Improvement for Farmers' Cleaner Production in Factor Markets<sup>1</sup>

## ETUDE DU COMPORTEMENT DES GOUVERNEMENTS LOCAUX SUR LA PRODUCTION PROPRE DES PAYSANS DANS LES MARCHÉS DE FACTEUR

Chen Hong<sup>2</sup>

**Abstract:** Both in developed and developing countries, governments of all levels pay much attention to the weak industry---agriculture and try their best to find out the effective way to develop it. Cleaner production in agriculture is the effective way to realize sustainable development in China. According to the behavioral features of local governments and the actuality of agriculture development, the thesis holds that the realization of agricultural cleaner production depends on the interest games between economic bodies and perfect market system. Besides, set up the operation mechanism for agricultural products and factor markets will help the development of cleaner production. Local governments allocate the resources by controlling all kinds of markets. The thesis mainly discusses the local governments' behavior models based on factor markets. Adjust the farmers' production behaviors with the constraints of capital, lands, labor and so on. Optimize combination between multi-items. Local governments will influence farmers' choice by changing their production functions. The thesis also analyzes how can local governments accelerate the process of agricultural cleaner production and improve competitive power in local areas by influencing the management environment of agricultural products' producers.

**Key words:** Local governments, Factor markets, Target functions

**Résumé:** Tant dans les pays développés que dans les pays en développement, les gouvernement de toutes les échelles prêtent attention à l'industrie faible --- agriculture, et font leur possible pour trouver le moyen efficace du développement agricole. La production propre dans l'agriculture est une voie efficace pour réaliser le développement durable en Chine. Selon les caractéristiques comportementales des gouvernements locaux et l'actualité du développement agricole, le présent essai pense que la réalisation de production propre agricole dépend du jeu d'intérêt entre les corps économiques et du système parfait du marché. En plus, instituer le mécanisme opérationnel pour les produits agricoles et les marchés de facteur aidera au développement de la production propre. Les gouvernements distribuent les ressources en contrôlant toutes sortes de marchés. L'article traite essentiellement les modèles comportementaux des gouvernements locaux basés sur les marchés de facteur : ajuster les comportements productifs des paysans avec les contraintes de capital, de terre, de labeur, etc ; optimiser la combinaison de multi-articles. Les gouvernements locaux vont influencer le choix des paysans en changeant leurs fonctions de production. L'article analyse aussi comment les gouvernements locaux peuvent accélérer le processus de la production propre agricole et élever la compétitivité dans des régions locales en influençant l'environnement de management des producteurs agricoles.

**Mots-Clés:** gouvernements locaux, marché de facteur, fonctions cible

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Heilongjiang Education Department projects: Study on cycle agricultural development mode and evaluation index system in Heilongjiang (11513019)

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<sup>2</sup> School of Economics and Management, Northeast Forestry University, China.

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In 16th CPC report, to construct modern agriculture is the new mission, new target and new requirement of developing agriculture in the new stage. Agricultural cleaner production is the new agricultural production. By adopting advanced technologies, making good use of natural resources and agricultural chemicals, it provides pollution-free agricultural products, which can guarantee people's health. Meanwhile, the reduction and reuse of the agricultural wastes in the production keep the ecological equilibrium and realize the sustainable development. It is the product of enhanced global environment consciousness, the direction and trend of developing agriculture in the 21<sup>st</sup> century. China is a big agricultural country, to accelerate the development of agricultural cleaner production is the important and ear gent mission.

The key factor of developing agricultural cleaner production is to set up the operation mechanism of agricultural products and factor markets in cleaning production and perfect the market system. Local governments allocate the resources by controlling all kinds of markets. Imperfect market is a representation of market failure in agricultural cleaner production. The local governments can adopt macroeconomic policies to optimize the market's structures and strengthen its functions. In order to realize the efficiency of resource allocation, the government may provide financial subsidies to the farmers and agricultural products processing enterprises for more quantity, lower price and competitive power. Besides, the government may take the laws to protect the competitive efficiency of the market. The thesis mainly discusses how local governments' behaviors can influence factor markets for agricultural products and promote cleaner production.

## 1. DECLARATION AND BASIC HYPOTHESIS FOR THE MODELS

Agricultural cleaner production will make great use of the resources, improve the environment and ensure the products' security. It also reflects the harmony between human and the nature and spirits of coming with the times. It is based on new technology and new equipment. Therefore, in order to promote agricultural cleaner production, local governments should encourage farmers to participate in scientific researches and develop technological equipments for local places according to the actual production situations.

According to the agricultural mechanism and industrial development conditions in China, there are three forms for agricultural cleaner production: Type of single family, type of production base and type of ecological environment protection. The main body of single family is the farmer. The farmer is the major

decision unit for rural economic activities in China and controls the agricultural products market. The main body of production base is the enterprise. The main body of environmental protection includes the farmer, enterprise and the local governments. The farmer is the basis of developing agricultural cleaner production. The thesis mainly discusses how local governments' behavior can influence the factors input in agricultural products and the models of promoting agricultural cleaner production. The thesis regards the farmer as the production main body in primary markets for simplification. The products include pollution-free agricultural products for energy and water conversation in cleaning production and general products. According to the reform demands for agricultural fees in China, their producers can enjoy the agricultural tax exemption. Adjusting farmers' behaviors subjects to the resources. Therefore we will face the decision of factors input with the constraint of resources when adjusting farmers' behaviors. With the constraints of capital, land and labor and so on, local governments may change the production functions to influence the production behaviors and promote the course for agricultural cleaner production.

### 1.1 Local governments' behaviors

Models for local governments' behaviors are multiple objectives, fuzzy and complicated. Under the condition of agricultural fees reduction, the connection for the function reformation of local governments and finance is the key factor.

In order to discuss local governments' behaviors based on the factor market, the utility models for local governments' behaviors can be simplified as the behavioral target functions in agricultural cleaner

production:  $\bar{U} = p_i q_i + \mu_i I_i$ ,  $p_i q_i$  is the total quantity of agricultural products and concerned by governments of all levels for dressing warmly and ear people' s fill, Three Agricultural Issues and food security.  $I_i$  are other aspects that local governments concern.  $\mu_i$  is the preferential degree between the two targets, obviously, when  $\mu_i \rightarrow 0$ , and the quantity of agricultural products is preferred, when  $\mu_i \rightarrow \infty$ , other targets are preferred. Assume the agricultural budget of the local government in the place is  $G + t\pi_i = s_i c q_i + I_i$ ,  $G$  is non-tax revenue of the local government, maybe includes central transfer payment, off-budget fiscal revenue and so on,  $t\pi_i$  is the total revenue from the producers,  $s_i c q_i$  is the subsidies for cleaner production enterprises in the beginning,  $I_i$  are the financial expenditure in other aspects that local governments concern. As the decision variables, subsidy rate  $s_i$  and financial expenditure  $I_i$  will maximize the target function.

## 1.2 Farmers' economic behaviors

### 1.2.1 Features for farmers' economic behaviors

The farmer is a kind of social organization form constituted by the kin. According to the response of external information, farmers' economic behaviors cover many kinds of behaviors including resources organization, agricultural products processing and so on. The behaviors should satisfy their material and spiritual needs in specific economic environment. Economic targets are the farmers' economic intension for production, including three aspects: get basic means of livelihood, improve the living conditions, and maximize the economic benefits. To fetch the economic benefits is the basis of the other two aspects.

Input behaviors in farmers' economic activities are directly relevant with the production process and output (including the products people need and negative effect people don't need). As the "economic man", farmers will maximize the benefits under different constraints. They cover the law and regulations, policies, budgets, technological conditions of production, price and so on. In the economic analysis, we assume benefits maximization is farmers' sole target. Namely, maximize the difference between the income and cost. The income depends on the price and quantity of the products, the cost is decided by the factors' price and dosage. In order to maximize the benefits, farmers' behaviors will be away from welfare maximization of the whole society. Therefore, the aim of governments' behaviors is to change the factors that influence farmers' behaviors and uniform the targets of maximizing farmers' benefits and social welfare.

### 1.2.2 Factors influencing farmers' economic behaviors

The farmer is the main body of the market in rural economic mechanism of China during the reformation period. The rate of products commercialization, farmers' operation behaviors towards the lands and technology adoption will be controlled by state's policy and the market mechanism and their own quality.<sup>3</sup>

1<sup>st</sup>. Directive function of state's overall policy. Since the rural mechanism reform in 1978, though the farmers have become the main bodies of productive activities in agriculture, their behaviors are influenced and controlled by internal and external environments. The internal factors include the capital, workers' quality, income level, consumption accumulations and so on. The external factors include policy of produces circulation, produces investment, lands operation, scientific and technological promotion and so on. In

these policies, policy of state's investment, price and concrete behaviors of the governments will give guidance for farmers' micro-economic behaviors and control the total quantity, when regulating the macro-economic structure and allocating social resources and wealth.

2<sup>nd</sup>. Guidance functions of the market. The motive and results of farmers' economic behaviors, even the governments' intervention policies for economic behaviors should consider the market's status and trend. It includes the market processing of agricultural products and production materials, agricultural cost, operation modes and so on. The market is like an invisible hand, playing its role all the time. Many facts indicate that the governments' standards for farmers' economic behaviors and the markets' orders will come into effect when they obey the rules in the markets, or the standards fail. Due to the small economic units, the desperate farmers are weak in the market. They can't fetch the accurate information. Besides, the information of the market at present can only influence the agricultural production. The lagged information often brings tremendous economic venture to the farmers.

3<sup>rd</sup>. Vital function of farmers' quality. The farmers have been the main bodies in rural economy since reform and opening up to the outside world. They have their own lands. Further, they can develop key projects, professional productions and make decisions according to the plans, demands of the agricultural products and local resources advantages. However, farmers' capability of decision and usage of agricultural science and technology are restricted to the quality of culture, science and technology and management and administration. For most farmers haven't read so many books, in the production they will invest without comprehensive consideration and choose improper technology. The economic behaviors will hold back the development of agricultural cleaner production.

## 2. FACTORS FLOWING RELATIONS OF PRODUCTION FACTOR MARKETS FOR PRIMARY AGRICULTURAL PRODUCTS

### 2.1 Flowing features of capital factors

Capital flowing among farmers is to get higher profit rate in the existing risk level. Two types of farmers attract the capital flow directly and indirectly. The indirect forms depend on the financial markets, such as household savings flow to some farmers through bank credit market and financial institutions in a certain area determine the capital flow. Accordingly, the efficiency of the financial system determines the cost of capital flows. The risk of capital flows is dispersed mainly through the screening of financial institutions. The direct form is supported by direct investment from large

<sup>3</sup> Kong Zhifeng. The operation modes research on Chinese eco-agriculture, economy and science and technology press, 2006:219-230(Chinese)

farmers. They will decide the direction of capital flows and assume the relevant risks.

The indirect form is based on the direct investment, while the insufficient capital of the investment needs the help from financial institutions. On the one hand, financial institutions don't participate in production activities directly. They provide finance according to the development perspective, financial indices and credit conditions. The production and operation conditions and credit circumstances will decide whether the area can attract capital flows through financial system. On the other hand, the formation of direct investment needs internal advantages and information in the industry, higher adventure preferential level and certain initial capital. Indirect investors don't have the conditions. Therefore the investment should be finished through the financial system.<sup>4</sup>

Although from an overall perspective, the flow scale of the indirect form will be greater. For the local governments who try to attract capital flow to the agricultural cleaner production, the form of direct investment capital will be more meaningful. First, based on inherent resources of regional economy, the direct investment of the capital can directly promote the development process of the regional agricultural cleaner production; Second, direct investment will stimulate the flow of indirect capital. But the indirect capital flows will not affect the new direct investment, and they should take the inherent direct investment as the foundation. When there is not enough direct investment, the accumulation of funds even flow to other areas through the financial system; Third, local governments have greater power in the direct investments than the indirect ones. The local governments control the direct investment through tax reduction and cancellation, infrastructure improvement, government's efficiency promotion and so on. Local governments intervene in the indirect capital flows only by restricting bank loans and other ways. To control the indirect capital has become more difficult in the situation of marketed financial institutions gradually.

## 2.2 Flowing features of land factors

The lands transformation between two kinds of agricultural producers simply depends on the diversity of lands production rate in the two kinds of production companies. The transformation cost of agricultural lands usage represents in the input in technology of lands restoration, human and so on. Suppose it as  $c$ , after the transformation of usage direction, the lands revenue rate difference is  $n_1 - n_2$ , and all achievable lands in local areas is  $N$ , then  $N(n_1 - n_2) \leq c$ , the producers wouldn't change the usage direction. Only when  $N(n_1 - n_2) > c$ , the farmers will change the usage direction,

but  $n_1 - n_2$  depends on the capital flows to a great extent. The capital flows subject to local governments' behaviors; therefore the thesis mainly discusses the relations between capital factors flow in capital market and local governments' behaviors.

## 2.3 Flowing features of labor factors

To see from the rough aspect, actual wage rates difference will decide the labor flows among different production modes, the labors flow from lower actual wage rates to higher ones. From the view of approximating reality, nearly all the factors that influence individual utility can be the inducement factors of labor flow, such as working environment and security. The thesis holds that the embodiment of farmers' utility is the difference in revenue rates. However, labor transformation needs cost too. The cost for labor transformation from the general agricultural products processing enterprises to cycle agricultural products processing enterprises represents at penalty, new post training fees, original chain rupture in the society and the difficulty of setting up the new ones. If  $w_1 - w_2 \leq c$ , ( $w_1$  is the wage rates for cycle agricultural products processing enterprises,  $w_2$  is the wage rates for traditional agricultural products processing enterprises,  $c$  is the transformation cost) the labors won't transfer, only when  $w_1 - w_2 > c$  the labors can transfer from the traditional departments to the agricultural cleaner production departments. Production factors flow interactively. Generally, to see from the realistic conditions in agriculture, the capital flow can make the lands and labors transfer from one department to another.

## 3. FACTORS MARKET FOR PRIMARY AGRICULTURAL PRODUCTS----BEHAVIOR MODELS FOR FARMERS

Local governments can attract capital flow to certain industries through adjusting the taxes and fees in agricultural cleaner production, influencing the capital tax coverage. Besides, changing the infrastructures can attract the capital too. Under the mechanism of current revenue in China, farmers don't need to pay the fees, no matter what the production models are. Therefore, the thesis just considers attracting capital flow to agricultural cleaner production through improving public service. In the thesis, the public service is generalized, including: Formulate preferential development policy for cleaner production in agriculture, establish development information platform for cleaner production in agriculture, provide

<sup>4</sup> Gong Liutang, Xie Danyang. Provincial difference analyses for factor flowing and marginal productivity in China, 2004(1):45-53

responsible services and set up long-term green pollution-free product sales networks and so on.

**3.1 Single-element model of primary agricultural products market without the intervention of local governments**

To facilitate the analysis, suppose the farmers produce pollution-free agricultural products and general products through two forms of production modes, namely, agricultural cleaner production and general production. For now in China there are sufficient even surplus labors, the production of primary agricultural products mainly depends on the lands and capital. The price is the exogenous variable. Suppose the farmers' total revenue is:  $Y = I_1 + I_2$ , ( $Y$  is the farmers' total revenue  $I_1$  is the profits that the farmers produce pollution-free agricultural products,  $I_2$  is the profits that farmers produce general agricultural products). If all the other factors are fixed, only the lands  $n$  is variable, then:

$$y = I_1(n_1) + I_2(n - n_1) \\ = [p_1 q_1(n_1) - c_1(n_1)] + [p_2 q_2(n - n_1) - c_2(n - n_1)] \quad (1)$$

$$\frac{dy}{dn_1} = p_1 \frac{dq_1}{dn_1} - \frac{dc_1}{dn_1} - p_2 \frac{dq_2}{dn_1} + \frac{dc_2}{dn_1} \quad (2)$$

If the lands revenue function for pollution-free products is linear, the maximization point for the farmers must lie on the boundary point. Namely,  $n_1 = 0$ , or  $n_1 = n$ , when  $n_1 = 0$ , farmers' profit is:

$$y = I_1(0) + I_2(n) = p_2 \cdot q_2(n) - c_2(n) \\ = \left[ p_2 \cdot \frac{q_2(n)}{k} - \frac{c_2(n)}{k} \right] \cdot n \quad (3) \\ = [p_2 \cdot AP_2 - AC_2] \cdot n = AR_2 \cdot n$$

$AR$ ,  $AC$ ,  $AP$  are the profits, cost and quantity for each agricultural unit.

In the same way, when  $n_1 = n$ ,  $y = AR_1 \cdot n$

Therefore, if  $AR_2 > AR_1$ , then  $y_1 > y_2$ , and then at the point of  $n_1 = 0$ , the farmers will use all the lands to produce pollution-free products through agricultural cleaner production and maximize the profits.

If  $AR_2 < AR_1$ , then  $y_1 < y_2$ , and then at the point of  $n_1 = n$ , the farmers will use all the lands to produce agricultural products through general production and maximize the profits.

If  $AR_2 \approx AR_1$ , then  $y_1 \approx y_2$ , the farmers can combine the two production methods of land use freely and choose according to their needs and preferences

variables.<sup>[3~5]</sup>

Rural land distribution system in China hasn't formulated the lands for pollution-free products only. Farmers' decisions mainly depend on the comparison of per unit lands' profit margin  $AR_1$  and  $AR_2$  between pollution-free products and general products. Per unit lands' profit margin is decided by products' price, average quantity and cost. To detect from the development process of agricultural cleaner production in China, the price of general products is lower than that of the pollution-free ones', but the difference is not very big. While the average quantity of pollution-free products is lower than the general ones', the average cost is higher. So, without the governments' intervention, the promotion of agricultural cleaner production will be slow. In order to push on the development process of agricultural cleaner production, the local governments should explore pollution-free products markets, set protective price. Give subsidy to farmers according to reduced quantity of chemical fertilizers. In this way the average cost can be lowered and the average profit rate for each unit will be raised.

**3.2 Multi-element model of primary agricultural products market with the intervention of local governments**

According to Mustsumi Matsumoto's summary (1998), public service function represents in two ways. The first one is the type of factor-augmenting. Its influence to the

function is  $Mf\left(\frac{L}{M}, \frac{k}{M}, B\right) = f(L, k, B)$ ,  $M$  is the numbers of manufactures. In such condition, the influence of public service  $B$  is similar to  $A$  in Cobb-Douglas Production Function. The other form is the type of firm-augmenting. Its influence to the

function is  $Mf\left(\frac{L}{M}, \frac{k}{M}, MB\right) = f(L, k, MB)$ . In such condition, the influence of public service  $B$  is just like to increase one production factor in Cobb-Douglas Production Function, but it is still linear homogeneous.

Use the model above for reference to set up behavior model for local governments in primary agricultural products with indirect capital flows in factor markets. Here, we take the type of factor-augmenting to set up the model for local governments according to production features of primary agricultural products.

Suppose the direct production factors of primary cycle agricultural products just include the capital and lands ( $K, N$ ), then the function is :

$$q_1 = f_1(k, N, B) = ABN_1^\alpha k_1^{1-\alpha} \quad (A \text{ is the existing advantages of the area}) \quad (4)$$

First order optimality condition :

$$f_{k_1} = AB(1-\alpha)\left(\frac{L}{K}\right)^\alpha = \frac{f(1-\alpha)}{K_1} \quad (5)$$

$$f_{N_1} = AB\alpha\left(\frac{N}{K}\right)^{\alpha-1} = \frac{f(\alpha)}{N_1} = n_1$$

Here, we just consider the indirect capital flow, therefore suppose the marginal profit rate for the capital is  $f_k(K, N, B) = r + t$ ,  $r$  is the general profit rate for the capital that is decided by the existing total quantity under the general equilibrium of consumption and accumulation. The agricultural tax rate is  $t$ , decided by the central government, therefore,  $r, t$  is fixed. Then:

$$\frac{f(1-\alpha)}{K_1} = r + t \quad (6)$$

$$\frac{f(\alpha)}{N_1} = n_1$$

$$\frac{K_1}{N_1} = \frac{[n_1(1-\alpha)]}{[(r+t)\alpha]} \quad (7)$$

This means farmers' profit maximization require the capital and lands should be in proportion. First, suppose  $n_1 < n^* + c$ , it means the lands don't transfer between the two production forms. We assume  $N$  as the fixed lands for cycle primary agricultural products.

Realize the profits maximization by adjusting the land outputs rates, meanwhile, make the capital flows among different departments to satisfy the proportion demands of the capital and lands, according to the capitals first order optimality condition we can get the capital requirements and lands output rate.

Capital requirements :

$$K = N[AB(1-\alpha)(1+t)]^{\frac{1}{\alpha}} \quad (8)$$

Agriculture tax exemption , when  $t=0$ ,

$$K = N_1[AB(1-\alpha)]^{\frac{1}{\alpha}} \quad (9)$$

Revenue rate for each unit :

$$n_1 = [A_i B \alpha^\alpha (1-\alpha)^{(-\alpha)} (r+t)^{(\alpha-1)}]^\frac{1}{\alpha} \quad (10)$$

$$\text{When } t=0, \quad n_i = [A_i B \alpha^\alpha (1-\alpha)^{(-\alpha)} r^{(\alpha-1)}]^\frac{1}{\alpha} \quad (11)$$

The capital flow will make the lands transformation; it will become the condition for farmers' profits maximization:

$$\frac{\partial K_1}{\partial B} = \frac{N[A_i B(1-\alpha)(1+t)]^{\frac{1}{\alpha}}}{B\alpha} = \frac{K_1}{B\alpha} > 0 \quad (12)$$

Namely, local governments' public service towards agricultural cleaner production will help capital flow to the industry. And the service is influenced by the behavior model for local governments.

Target function for local governments:

$$\bar{U} = \sum p_i q_i + \mu I \quad (13)$$

Suppose  $\theta$  is the proportion that cycle agricultural products account in the gross output,  $p_1 = 1$ , then the target function is:

$$\bar{U} = \frac{f_1}{\theta} + \mu I \quad (14)$$

For all the tax for primary agricultural productions is dismissed, the constraint for local governments is  $TR=B+I$  ( is the transfer payment of higher authorities ,  $B$  is the public service expenditure for cycle cleaner production ,  $I$  is other governmental target expenditures for finance )

Put the constraint condition to the target function, the first derivative for  $B$  is :

$$\frac{\partial \bar{U}}{\partial B} = \left[ f_B + f_k \frac{\partial K}{\partial B} \right] - \mu = 0 \quad (15)$$

Get:

$$B = \theta \mu \alpha^{\frac{1}{1-\alpha}} [AN^\alpha]^{\frac{1}{\alpha-1}} \left[ \frac{r}{1-\alpha} \right] \quad (16)$$

Therefore, in the equilibrium status, the local governments' public service level of agricultural cleaner production is influenced by many factors including behavior preference , transfer payments , the proportion of pollution-free products in total value of out-put , capital revenue rates , elastic coefficient for factor income , agricultural lands in the area. If the local governments prefer the agricultural cleaner production in the area and make the farmers use farm manure, they must turn to the public service for help and attract capital transformation and inflow. Besides, more capital and lands will provide more financial resources for the governments in public service. In the initial period of agricultural tax exemption and agricultural cleaner production, the governments' public service capability is decided by transfer payments to a great extent.

#### 4. CONCLUSIONS AND DISCUSSIONS

In the agricultural cleaner production, we have studied the formation and development of factor markets that influenced by the local governments' behaviors. The conclusion is that to encourage direct investment in agricultural cleaner production is one of the most

effective methods to promote the process for cleaner production, increase farmers' income, transfer the surplus labors in rural areas, improve the products' quality and promote sustainable economy development. But the governments should take economic methods rather than administrative orders to attract direct investment. On the one hand, fierce competition will help improve the output of the whole industry, provide more jobs, and improve consumer surplus and social welfare. What's more, the technology radiation brought by the direct investment will lower other farmers' production and operation cost, improve labor productivity and products competitive power in the agricultural cleaner production. However, on the other hand, the spread of the technology and fierce competition in the market will lower farmers' knowledge value, investment profits and the enthusiasm of farmers' investment. If the governments don't pay more attention to agricultural cleaner production, the industry can't attract the investment. Therefore, in order to attract direct investments in agricultural cleaner

production, the local governments should take effective measures and lower the transaction cost. If the technologies are easy to spread, the governments should enhance intellectual property protection. Another way to attract the direct investments in agricultural cleaner production is to expand the demands for cycle means of production and green agricultural products. This is good for not only the direct investments in agricultural cleaner production, but also the environmental improvement of the whole rural areas. Form the scaled agricultural garden and Production Base , and solve the pollution problems of chemical fertilizers 、 pesticide 、 livestock and poultry manure 、 film 、 straw. Resource agricultural cleaner production emphasizes recycle and utilization of agricultural wastes. It encourages extending the agricultural ecological chains and forming industry network by cooperating with relevant industries. Therefore, subjected to the limited natural resources in the areas, the resource agricultural cleaner production is preferred.

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#### THE AUTHOR

**Chen Hong**, School of Economics and Management, Northeast Forestry University. Heilongjiang, 150040, P.R. China.