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Exploring a Novel Agricultural Subsidy Model with Sustainable Development: A Chinese Agribusiness in Liaoning Province

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Abstract: To improve the incomes of farmers in China, the Chinese government is paying increased attention to the reform of its agricultural subsidy policy. However, the effectiveness of the subsidy remains insufficient and thus fails to encourage farmers to cultivate their land and develop sustainability. Thus, there is a need for a novel model that will improve the effectiveness and efficiency of subsidies. The proposed novel agricultural subsidy model comprises four major actors: farmers, specialized farmers' cooperatives, agribusiness and government. Furthermore, the subsidy in this novel model would no longer go directly to farmers but to the agribusiness. To develop the model, the empirical data for this study are obtained from a Chinese agribusiness in Liaoning Province that was selected as a benchmark. With this novel model, farmers receive triple rebates: the price received when the rice is initially sold; a share of the profits of the specialized farmers' cooperatives; and a share of the profits of the agribusiness. Accordingly, exploring the optimal subsidy rate for agribusinesses is the critical task of this study, and the results demonstrate that agribusinesses must use the government subsidy policy as the basis for a dynamic subsidy model that ensures the income of farmers and encourages sustainable development.

Keywords: novel agricultural subsidy model; sustainable development; Chinese agribusiness; Liaoning

1. Introduction

The Chinese government's focus on industrialization policy has seriously impacted agriculture. By failing to acknowledge environmental issues, the promotion of agricultural technology leads to the destruction of land and sustainable resources. Moreover, due to rapid urbanization, increasing numbers of farmers are giving up farming to work in the city, leaving large expanses of land to become barren. In fact, the records indicate that there are almost a hundred million acres of fallow fields in southern China. In the northern part of China, approximately 40% of the land is infertile. This situation restricts the development of sustainability. Although government policies have been established to promote agricultural development and increase farmers' income, the results have fallen short of expectations [1]. Beginning in 2004, the Chinese government implemented the three-item subsidies policy (which includes a crop seed subsidy, subsidies to cultivating farmers and general subsidies for agricultural production supplies), which is herein referred to as the traditional subsidy model [2,3]. According to this policy, farmers must sign a contract with the government, under which they receive an annual government subsidy of ¥90 (equal to 15 USD), regardless of whether they cultivate their land. However, farmers who cultivate land that they do not own are not entitled to this subsidy. Hence, this model contains inequities and does not motivate land cultivation.

To promote sustainable development, interventions have been introduced in the agricultural sector by certain global governments that are focused on promoting their respective agricultural sectors [4]. Based on the experiences of the United States, agricultural subsidies are considered a transformative process. Between 1998 and 2004, U.S. farmers received $17 billion annually on average, which is more than the grants for federal temporary assistance for needy families, which averaged $13.6 billion, and the federal aid to postsecondary students, which averaged $16.1 billion [5]. In the recently proposed Thirteen Five Project (2016–2020) (the Thirteen Five Project is a Chinese government project that proposes to improve people's lives by providing stability in a transitional economy. This project includes developments in innovation, coordination, sustainability, opening up and sharing), the Chinese government significantly modified its agricultural subsidy policy to implement the three-item subsidies policy, signaling the support of large-scale producers and operators. Agribusinesses have attempted to adopt the new national policy and thus to seek sustainable development. The novel agricultural subsidy model proposed in this study requires the large-scale development of competitive modern agriculture, which means that agribusinesses must possess sufficient size and capital [6]. In addition, environmental pressures highly influence agribusinesses to engage in reactive internal practices as they develop agricultural sustainability and creativity [4,7].

The key to successfully developing sustainable agriculture is to convince farmers to surrender their direct subsidies from the government and cooperate with agribusinesses. For the farmers, the choice depends on their income, i.e., if the agribusiness can offer a better income than the government subsidy, farmers are willing to collaborate. Many studies have discussed the effects of agricultural subsidies. Chen et al. [8] examined the effects of a government subsidy (including area and price subsidies) on the total cultivated area of crops based on the assumption that a subsidy has both stimulating and inhibiting effects. Wang and Yang [9] examined the relationship between agricultural subsidies and moderate-scale land operations. Furthermore, Zhao et al. [10] argued that the government must distribute a portion of the subsidy to consumers. However, these studies focused on the government and did not consider agribusinesses as the subsidizer subject. When considering agribusinesses as subsidizers, a dilemma is generated whereby the agribusiness must provide an attractive subsidy rate for farmers while simultaneously ensuring sufficient profits to maintain its business operations. It is critical that agribusinesses find an optimal subsidy rate based on the triple rebates (the triple rebate includes three types of revenue to farmers under the proposed model. First, farmers can obtain the initial sale price from specialized farmers' cooperatives; second, farmers can obtain a percentage of the profits from the sales of the specialized farmers' cooperatives; and third, agribusinesses provide a percentage of their total sales to subsidize farmers) to farmers in this model and that they create a dynamic system to comply with government subsidy policies.

Therefore, the objective of this study is to develop a novel agricultural subsidy model to assist agribusinesses as they explore the optimal subsidy rate. This subsidy rate must allow for an increase in the income of farmers and promote the sustainable development of agriculture. To provide a precise guideline for agribusinesses, this study compares the traditional subsidy model (farmers receive the subsidies directly) with the novel model (the subsidies go to the agribusinesses instead of the farmers). The empirical data are obtained from a Chinese agribusiness in the city of Panjin, Liaoning Province that is used as a benchmark. The findings demonstrate that an agribusiness subsidy must use the government subsidy as a base and then build a dynamic subsidy model to respond to adjustments in the government subsidy policy. The remaining part of this study consists of five sections. A comprehensive literature review is provided in the next section. Notations and the proposed novel agricultural subsidy model are presented in Section 3. Section 4 presents the background of the case and the empirical results, and Section 5 discusses the implications. The conclusion, research limitations and suggestions for future studies are discussed in the final section.

2. Literature Review

This section provides a comprehensive review of the literature on agricultural subsidies and sustainable development.

2.1. Agricultural Subsidies

As a result of food shortages and climate change, agriculture is receiving global attention for its role in ensuring the survival of humanity. Governments provide subsidies to encourage farmers to increase productivity and improve their cultivation techniques [11]. However, it is challenging to find a balance between a reasonable agricultural subsidy and farmers' income; indeed, it is a problem analogous to the double-edged sword. Hence, starting in the twentieth century, the European Union focused on exporting grain and agricultural products to reduce the pressure for subsidies. Moreover, several relevant polices underwent significant reforms before being included on the European Union agenda for 2000. This agenda emphasized that the developed policy must ensure that the productivity of the food supply is maintained; the value of agricultural products and competition among them are enhanced; the rural environment is improved; the service industry and agricultural businesses are supported; employment in the new and growing rural economic sector is expanded; reasonable income for farmers is protected; intervention prices from governments are reduced; and compensation is increased from 54 to 63 euros per ton of grain [12].

Regarding the relationship between subsidies and farm performance, Banse et al. [13] revealed that the level of producer subsidies has a negative correlation with the cost of domestic resources in Hungary. Because subsidization ensures a certain return to farmers, they may reduce their cultivation efforts. In the U.S., the aim of agricultural subsidies is to protect farmers from the risks of the industry by ensuring a minimum level of economic growth and stability. Thus, U.S. agricultural subsidies include direct and countercyclical payments [14]. Many other countries have applied the target zone policy to stabilize the market and protect farmers. Chen et al. [15] adopted this concept to investigate the relationship between product purchasing and price subsidy strategies to assess the effect of target zones with different operating strategies. In addition, Turkey separated its subsidy policy into two types of instruments: output-based instruments in the form of deficiency payments for specific crops to increase farm revenue and input support instruments that include subsidies for fuel oil, fertilizer and soil analysis [16].

The Chinese government has long been concerned with its agricultural sector [17]. For example, several practices have been implemented by the government to reduce or eliminate the tax burden on farmers [18]. After joining the World Trade Organization in 2001, China began searching for the optimal process to subsidize farmers who might directly suffer from foreign competition [19]. The Ministry of Finance realized that impacts on the agricultural sector have changed dramatically in terms of direction and quantity, as has the nature of payments to farmers. To address these issues, the government established several policies intended to increase the benefits to the farmer, reversing its centuries-old practice of taxing agriculture [20,21]. In recent years, the government has raised subsidies for the agricultural sector several times to reduce negative impacts on farmers [22]. Accordingly, the records indicate that the largest portion of the subsidies are paid directly to the farmers. There are four types of agricultural subsidies in China: subsidies for grain, inputs, quality seeds and agricultural machinery. The subsidies in grain and inputs account for more than 70% of total subsidies [23].

An increasing number of researchers are focusing on the topic of agricultural subsidies. Previous studies have found significant results from the establishment of new policies and have provided new direction to governments. Gale et al. [21] found that subsidies are spread thinly over a substantial agricultural population and thus have had only a minor impact on rural incomes. Huang et al. [24] and Huang et al. [23] administered a household-level survey to explore the influence of China's subsidy program on household behavior and found that although agricultural subsidies per farm are low, the subsidies per unit of cultivated area and the total budget amount are high and

that all producers received subsidies. Liu [25] conducted an empirical study of a direct food subsidy policy in Shandong Province to analyze the efficiency of policy implementation in different regions. Yi et al. [26] argued that, in general, the grain subsidy policy contributes to improvements in farm households' grain planting areas in liquidity-constrained households. In addition, Ito [27] applied a stochastic frontier output distance function to investigate the rationality of Chinese farmers' crop selection and found strong evidence that the Chinese policy of grain self-sufficiency exemplifies the technical and allocative efficiencies of agricultural production.

Grain production in China is confronting tremendous challenges, including increases in demand, resource constraints and rural labor shortages. These challenges create barriers to the reform and development of the rural economy, for example, by slowing the growth of farmers' income, increasing the need for migrant rural laborers and increasing the outflow of rural resources [28]. Although increased subsidies have a positive and direct effect on farm households by increasing the income of farmers, it may also result in agricultural intensification and thus challenge agricultural sustainability and create or enhance food supply problems [29,30]. In addition, because the use of agricultural land is affected by government policies, its use is supervised to develop regional sustainability [31]. Therefore, there is an essential need to seek sustainable development in the agricultural sector to overcome these challenges. The Chinese government is aggressively reforming the agricultural subsidy policy to promote sustainable development, which entails the simultaneous consideration of environmental issues, land governance, food security and productivity enhancement.

2.2. Sustainable Development

Sustainable development is receiving increased attention in the Chinese agricultural sector. Far-reaching programs have been launched by businesses, governments, social reformers and environmental activists, all of whom have their own interpretation of sustainability and their own ideas about how it should be developed [32]. There has been much debate about the sustainable development of agriculture in the context of policy development due to the diverse characters and characteristics of the agricultural sector, which make it difficult to achieve a consensus in advance of implementation [33,34]. Moreover, previous studies have doubted the feasibility of sustainable development in the Chinese agricultural sector. For example, Brown [35] raised the question, "Who will feed China?" Xu et al. [36] emphasized that the Chinese grain supply might be further undermined by constraints on land and water resources and in the long term by environmental degradation. For these reasons, the Chinese government must consider these concerns as it searches for a way to develop sustainable agriculture.

Sustainable agriculture differs from the traditional approach [37] in that it not only offers sufficient food for an increasing world population while simultaneously preventing harm or risk to the environment but also ensures economic returns for the farmers [38]. Because farmers play an important role in agriculture, enhancing their income is a first step in the development of sustainable agriculture. Thus, the Chinese government proposed a series of policy reforms to the agricultural subsidy in the Thirteen Five Project. Prior studies that investigated the relationship between enhancing the farmers' income and the optimal subsidy policy have offered significant evidence in support of policy reforms. Pan et al. [31] used simulations in cropping patterns, including acreage, cropping locations and management-related environmental impacts, under various policy scenarios for Quzhou County, China. Although the studied subsidy policy ensures farmers' income, it does not encourage water conservation in sustainable crop production and thus may lead to the abandonment of land due to water shortages. Qian et al. [39] indicated that agricultural subsidy policies contribute to increases in the market price of grain as well as to increases in farmers' income.

Overall, the government's agricultural policy is shifting from one of enhancing traditional agricultural productivity to a focus on developing sustainable agriculture. The Thirteen Five Project emphasizes that agribusinesses must advance the development of sustainability to increase farmers' income. However, the majority of current studies only analyze the strengths and weaknesses from the

perspective of government policy development; few studies have adopted the agribusiness perspective of policy implementation. If agribusinesses could offer subsidies when they collect grain from farmers, the motivation for farmers to cooperate with them would be strengthened. With such cooperation, agribusinesses would not only receive subsidies and support from the government due to their enhanced performance but also stand with the farmers in the search for benefits and well-being. Together, these factors play an important role in the successful development of sustainable agriculture.

3. A Novel Agricultural Subsidy Model

To explore the relationship between government subsidies and farmer income, the appropriate mathematical model must be applied. Thus, the relevant notations, income function and proposed analytical procedure are discussed in this section.

3.1. Notations

This study develops a mathematical model to support optimal decision making for agribusinesses. Before formulating the mathematical model, the relevant notations are provided:

P_m: the market price when the farmer sells rice directly to the market
c_m: the unit cost of cultivation without any control by agribusiness
G: the government subsidy per unit of rice
q: the annual productivity of rice
P_h: the acquisition price when the farmer joins the specialized farmers' cooperative; normally, $P_h > P_m$
c_n: the cultivation cost under the novel agricultural model
P_r: the acquisition price based on the price of rice purchased by the agribusiness from the specialized farmers' cooperative (a specialized farmers' cooperative is a cooperative economic organization developed to resolve conflicts between the farmers' small production and the large market.)
P_s: the selling price of rice from the agribusinesses to customers
ω_h: the percentage of the net profit that specialized farmers' cooperatives return to farmers, $\omega_h \in (0,1)$
ω_r: the percentage of net profit that the agribusinesses return to farmers, $\omega_r \in (0,1)$
π_m: the profit of farmers under the traditional subsidy model
π_h: the profit of specialized farmers' cooperatives
π_r: the profit of the agribusiness
π_n: the profit of farmers under the novel agricultural model

3.2. Farmers' Income Function

In the traditional model, the government subsidy is given directly to the farmer. Accordingly, the profit function of the farmer under the traditional model is presented below:

$$\pi_m = (P_m - c_m + G)q. \tag{1}$$

In the novel agricultural model, the government gives the subsidy to the agribusiness. Farmers' income is increased by agribusiness sales. The farmers' profit function under this novel model is as follows:

$$\pi_n = (P_h - c_n)q + \omega_h \pi_h + \omega_r \pi_r. \tag{2}$$

The profits of specialized farmers' cooperatives are defined as follows:

$$\pi_h = (P_r - P_h)q - \omega_h \pi_h. \tag{3}$$

The equation π_h is rewritten as follows:

$$\pi_h = \frac{(P_r - P_h)q}{1 + \omega_h}. \tag{4}$$

The profit of the agribusiness is obtained using the following equation:

$$\pi_r = (P_s - P_r + G)q - \omega_r \pi_r. \tag{5}$$

The equation for π_r is as follows:

$$\pi_r = \frac{(P_s - P_r + G)q}{1 + \omega_r}. \tag{6}$$

Subsequently, adopting the profits of specialized farmers' cooperatives and of the agribusiness associated with the farmers' profit function, the profit of the farmers under the novel agricultural subsidy model is obtained using the following equation:

$$\pi_n = (P_h - c_n)q + \frac{\omega_h(P_r - P_h)q}{1 + \omega_h} + \frac{\omega_r(P_s - P_r + G)q}{1 + \omega_r}, \tag{7}$$

where $P_m < P_h < P_r < P_s$.

3.3. The Proposed Analytical Procedure for Selecting the Optimal Subsidy Rate

Agribusinesses can help to decide how to subsidize farmers' income under different subsidy models. The proposed analytical procedure includes five steps:

(1) Identify the major participants of the different models: the major participants in the traditional subsidy model are farmers and the government, and the distribution of subsidies depends on the area of land under contract with the government. Thus, farmers receive compensation directly from the government. In the novel agricultural subsidy model, in addition to the farmers and the government, the agribusiness and specialized farmers' cooperatives are also participants. In this novel model, the farmers no longer sign a contract with the government; instead, the specialized farmers' cooperatives sign the contract. The cooperatives must associate with the agribusiness to develop agriculture and promote sales. The government gives the subsidies to the agribusiness to maximize performance.

(2) Confirm the agricultural product price in each node: agribusiness research facilitates the acquisition of the market price of a product. For example, the market price P_m, direct purchase price P_h, and indirect purchase price P_r of rice can be obtained from the rice subsidy. A detailed discussion about the collection of data on the price of rice is provided in Section 4.2.

(3) Gather annual productivity and government subsidy data: the annual productivity for rice is obtained from internal agribusiness information. The government subsidy is stated in the relevant policy document.

(4) Identify the farmers' income function: the farmers' income function under different models is obtained through the different subsidy models and survey responses.

(5) Determine the optimal subsidy rate for the agribusiness: the appropriate subsidy for farmers is determined based on farmers' income and requires a comparison between the traditional model and the novel model to explore the effects of the government subsidy, the agribusiness subsidy and the farmers' income. The optimal subsidiary rate for the agribusiness is selected by examining these influences. This ensures that the rate offered provides the optimal income for farmers.

4. Empirical Study

This section discusses the background of the empirical case, the novel agricultural subsidy model, the data collection methodology and empirical results. The case background introduces the Liaoning agribusiness. Data gathering involves a unique cooperative model between farmers, specialized farmers' cooperatives and the agribusiness. Finally, the empirical results provide evidence allowing the agribusiness to select the optimal subsidy rate based on quantitative analysis.

4.1. Case Background

The Liaoning Jin She Yu Nong Supply and Marketing Group (LJSYN) (The LJSYN can also be considered a system of "Gong Xiao She" under the planned economy. This system has decreased due to the market economy transition but still possesses certain infrastructure and government resources in the north of China. For this reason, the LJSYN can obtain government support and launch this novel model in Panjin City.) is an innovative and aggressive agribusiness in Liaoning Province, China (as shown in Figure 1). They adopted a new agricultural subsidy model to enhance the income of farmers and promote sustainable development throughout the agricultural supply chain, particularly focusing on rural areas. The LJSYN, located in Panjing City, was established in 2010 with 11.9 hundred million RMB in capital. The group has ten independent subsidiary companies, seven controlling specialized farmers' cooperatives, five industry associations, four distribution centers, seven agricultural bases and three hundred and thirty-one supermarkets. The principle of the LJSYN is to enhance the quality of life for farmers and to promote its supply and marketing business. In addition, the LJSYN is devoted to the integration of resources along the supply chain to create a unified structure and form an innovative agricultural eco-system.

Figure 1. Liaoning Jin She Yu Nong Supply and Marketing Group.

Recently, the LJSYN completed its business function by building an innovative agricultural production system, a direct sales system with production information and a distribution system. Specialized farmers' cooperatives play an important role in monitoring and guiding farmers, providing a basis for sustainable development. Cooperatives not only mean that farmers no longer cultivate alone, but they also create a known representative brand of local agricultural products, as presented in Figure 2. Although the LJSYN adheres to the rules of the market economy to strengthen the circulation of agricultural products, it continues to have difficulty finding an optimal subsidy rate for enhancing farmers' income. However, the proposed novel agricultural subsidy model of the LJSYN encourages adherence to China's policy reforms and to sustainable development.

Figure 2. Famous rice brand in Liaoning—King of Fong Jing (Yan Fong-47).

4.2. Data Collection

This study adopts the LJSYN as a benchmark agribusiness and uses Yan Fong-47 rice to examine the income of farmers under the novel subsidy model. Yan Fong-47 is a middle–early maturing cultivated variety of round-grained rice. It is characterized by high productivity and high quality and has been certified at the second level according to national quality standards. The cultivating period of this rice is 157.2 days, and the cultivating area is distributed throughout southern Liaoning, Beijing and Tianjin. Figure 3 displays the agricultural subsidy model of Yan Fong-47 rice in Liaoning Province.

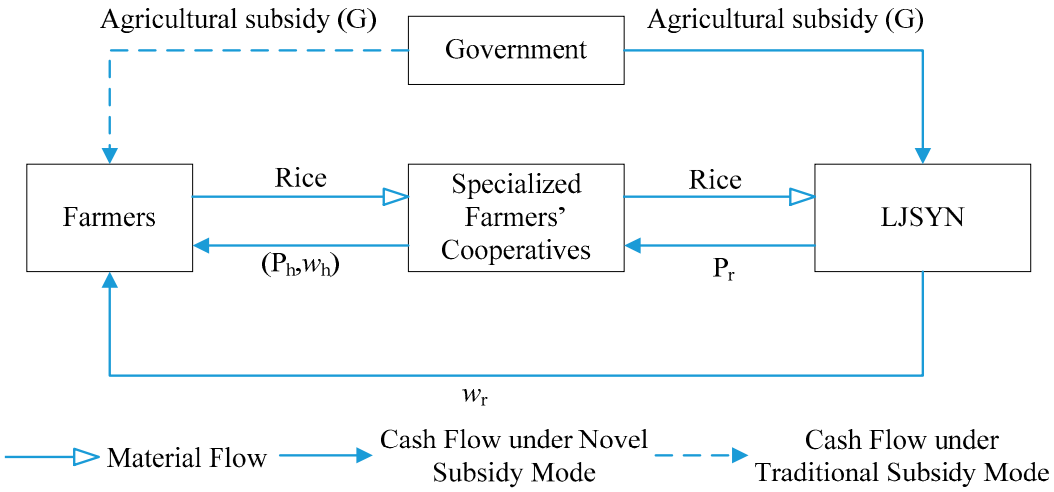

Figure 3. The novel subsidy model of the LJSYN.

In Figure 3, the dotted line indicates that the government directly gives the subsidies to the farmers under the traditional model. Conversely, the solid line represents the novel subsidy model, under which the government gives the subsidy to the LJSYN rather than directly to the farmers. Farmers must sell the rice to the specialized farmers' cooperatives in accordance with signed contracts. The cooperatives use price P_h to purchase the rice. They will then return a portion of the profit ω_h to farmers at the end of the year. The LJSYN purchases the rice at price P_r from the cooperatives, and at the end of year, a percentage of the profit ω_r of the LJSYN is distributed to the farmers. This novel model results in triple rebates for the farmers, which greatly enhances their income and motivates them to be productive.

The data regarding Yan Fong-47 are as follows (2015 data):

(1) If farmers directly sell the rice in the market, the price is ¥1.62 per half-kilogram.
(2) Annual production is 1300 half-kilograms.

(3) The cost to farmers to cultivate the rice without any control by the LJSYN is ¥700 per acre; if each acre can generate 1300 half-kilograms, the cost of cultivation is ¥0.54 per half-kilogram.
(4) After farmers join the specialized farmers' cooperatives, the cooperatives require ¥0.05 to acquire the rice from the farmers, in addition to the purchase price of ¥1.67 per half-kilogram.
(5) The farmers' cultivation cost is ¥300 per acre and ¥0.23 per half-kilogram under the novel model.
(6) The LJSYN's selling price for rice is ¥3 per half-kilogram.
(7) The LJSYN acquires the rice from the specialized farmers' cooperatives. The acquisition price is higher than the market price of ¥0.05. Thus, $\textit{the market price of rice} = \textit{current market price} \times \textit{rice milling yield} = U'3 \times 0.7 = U'2.1$. Accordingly, the acquisition price is ¥2.15 per half-kilogram.
(8) The specialized farmers' cooperatives offer a 25% net profit to farmers.

4.3. Empirical Results

By incorporating the above data into Equations (1) and (7) and creating the diagram using MATLAB R2012a (MathWorks, Natick, MA, USA, 2012), the relationships between the subsidy rate of the LJSYN, the government subsidy and farmers' income under the traditional model become apparent. Within this model, the government distributes the subsidies directly to the farmers, and the agribusiness has no power to intervene or enhance farmers' income through subsidies. The interactions between the agribusiness and farmers are limited. The agribusiness possesses substantial bargaining power when collecting the rice from the farmers, but under the traditional model, the profits of the agribusiness are not shared with the farmers. In other words, the farmers' only income is the government subsidy. Accordingly, under the traditional model, there exists a highly positive relationship between the government subsidy per half-kilogram and the income of the farmer, as shown in Figure 4.

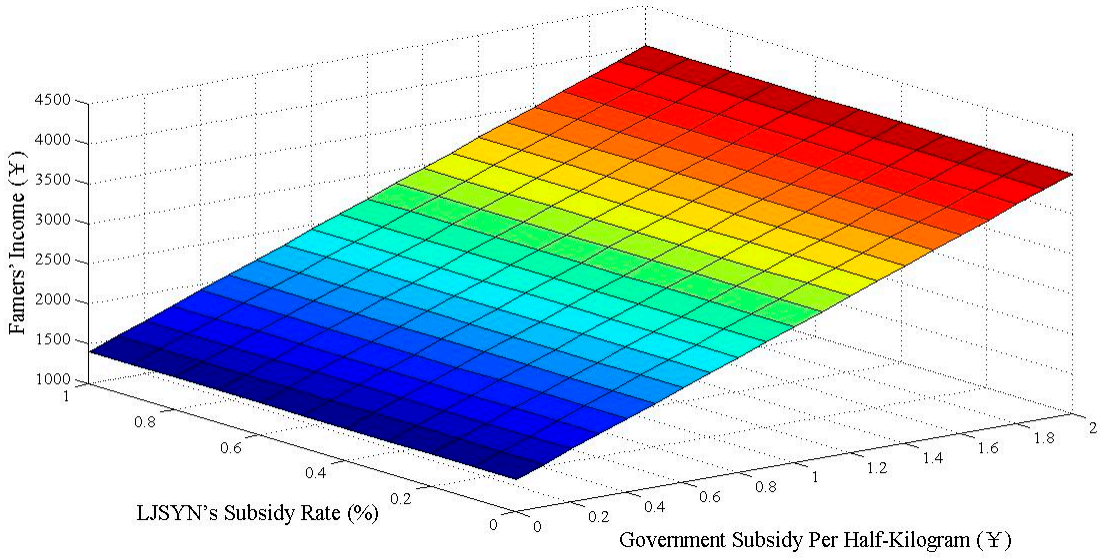

Figure 4. The effect diagram of farmers' income, the LJSYN subsidy rate and government subsidies under the traditional model.

Figure 5 presents the effects of farmers' income, the LJSYN subsidy rate and government subsidies in the novel model. It further indicates that if farmers want to increase their income, they must rely on the subsidy rate of the LJSYN rather than on the government subsidy. Simultaneously, the agribusiness must establish a subsidy rate to reimburse farmers based on the government subsidy. Under the novel model, farmers' income includes the government subsidy and a share of the agribusiness profits. Furthermore, farmers' income is correlated with the LJSYN subsidy rate as the government subsidy

increases. That is, when the government subsidy is maintained at a steady level, the farmers' income is directly proportionate to the agribusiness subsidy rate. When the government subsidy rate increases to a higher level, the farmers' income increases aggressively as the agribusiness subsidy rate also increases. If the government subsidy rate does not increase, the farmers' income is slow to increase.

To clarify the major difference between the traditional model and the novel model, additional comparative analysis is conducted. Figure 6 combines Figures 4 and 5 and represents the integration of the two models. Based on this integration, it is evident that the LJSYN subsidy rate must adjust in response to government subsidy changes to ensure that the farmers' income increases accordingly. In Figure 6, to the left side of the intersection line, the novel model exhibits better performance than the traditional model in enhancing farmers' income. On the right side of the intersection line, the farmers' income in the novel model is less than that in the traditional model. This suggests that agribusiness must establish a break-even point to simultaneously maintain profits and increase farmers' income.

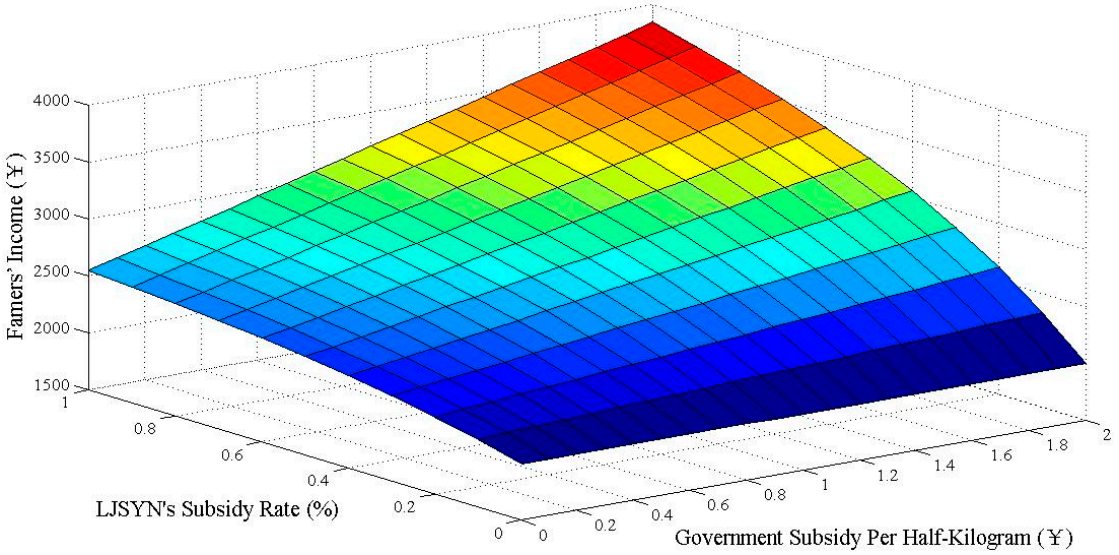

Figure 5. The effect diagram among farmers' income, the LJSYN subsidy rate and government subsidies under the novel model.

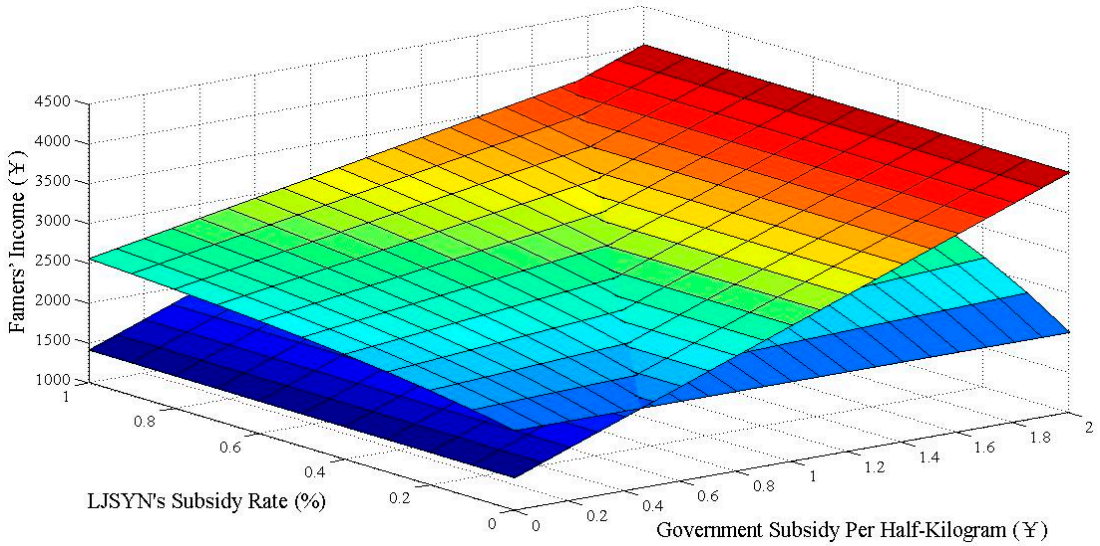

Figure 6. Comparison analysis between the traditional and novel models.

To confirm the optimal subsidy rate of the LJSYN, this study adopts ω_r = 0.1, 0.3, 0.5, 0.7 and 0.9 and compares these values with those of the traditional government subsidy to identify a better alternative for increasing farmers' income. Figure 7 demonstrates that the LJSYN must adjust their subsidy rate consistently with increases in the government subsidy. For example, when the government subsidy is ¥0.58 per half-kilogram, the subsidy rate of the LJSYN cannot be more than 10% below that rate. In other words, the LJSYN must use 10% of its net profit as a rebate for farmers to ensure that farmers' income is better than it was under the traditional subsidy model. When the government subsidy reaches ¥0.82 per half-kilogram, the LJSYN's optimal subsidy rate should be adjusted to 30%. These findings confirm that the novel model provides farmers with better benefits than does the traditional government subsidy. Specifically, the novel model generates triple rebates to farmers.

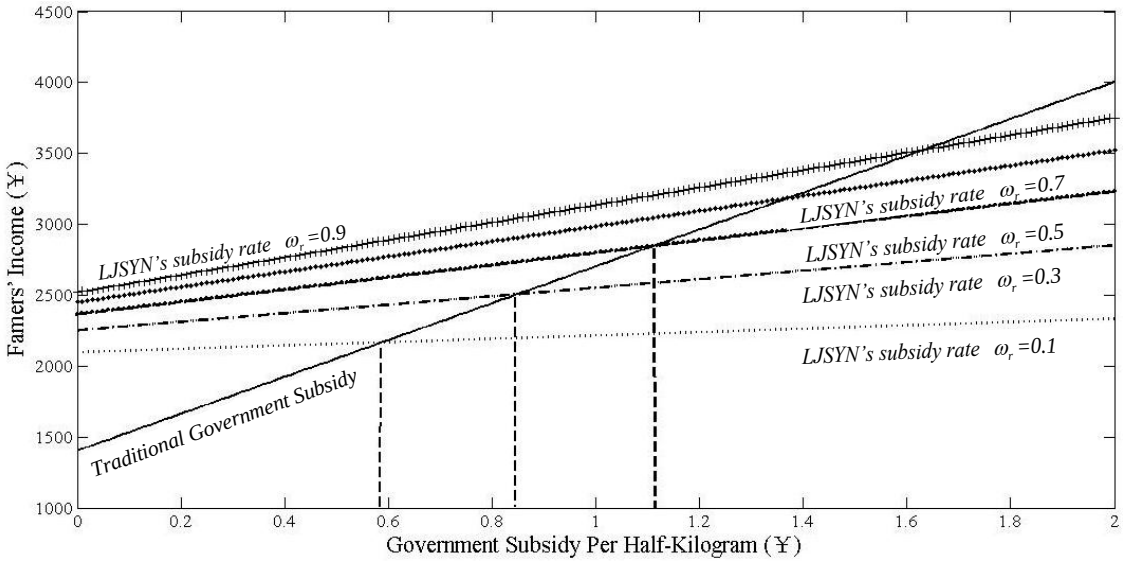

Figure 7. Comparison of the traditional government subsidy with different LJSYN subsidy rates.

5. Implications

Based on the analytical results, the LJSYN can serve as a benchmark agribusiness. Different types of subsidies generate diverse effects for farmers and impact the profits of the agribusiness in different ways [4,17,36]. The proposed novel model presents a type of subsidy intended to improve farmers' income and to enable agribusinesses to launch a sustainable development program. In this model, specialized farmers' cooperatives play a mediating role by monitoring and educating farmers in the cultivation of rice. For example, cooperatives provide non-toxic pesticides at lower costs to their member farmers to improve rice productivity, rice milling yield, and rice quality in the face of land exhaustion and water pollution. Thus, a unique ecological cultivation approach is required in the city of Panjin in Liaoning. Farmers simultaneously cultivate rice and feed river crabs on the same cropland, which means that both rice and river crabs can become popular products nationwide. As a result, the agribusiness can implement higher prices when selling these products in the market, and customers are willing to pay these higher prices to purchase green products. Consequently, the agribusiness can then provide better rebates to the farmers and improve their standard of living. This type of positive cooperative loop generates profits for the agribusiness, cooperatives and farmers; once the loop is sufficiently mature and self-sustainable, government subsidies may no longer be needed.

For agribusinesses to improve performance and enhance sales, farmers must be motivated to be a part of that change. This motivation requires a novel subsidy model that offers a better rebate than the direct government subsidy in order to strengthen farmers' initiative. Although previous studies have discussed the strengths and weaknesses of government subsidies [37–39], there is a lack of research from the agribusiness perspective. Thus, this is the first study to propose a novel subsidy

model to replace the traditional government subsidy model and enhance farmers' income. The novel subsidy model transfers the government subsidy from the farmers to the agribusiness to maximize performance and effects. This is also the first study to model the agricultural subsidy based on China's agricultural subsidy policy. A comparison of the traditional model with the novel model reveals that the two models affect farmers' income differently. In the traditional model, the government issues the subsidy directly to the farmers and thus there is a high positive correlation between farmers' income and the government subsidy at the per half-kilogram level. In the novel model, increases in farmers' income depend on their receipt of the agribusiness subsidy. As the amount of the government subsidy increases, the agribusiness must respond to this increase by adjusting farmers' income. Accordingly, agribusinesses that adopt the novel model must be familiar with the government subsidy policy to promote a dynamic strategy that motivates farmers.

The government must recognize and understand the difference between the traditional model and the novel model because the government subsidy could be eliminated when the novel model matures. In the initial phase of the novel model, the government can assist the agribusiness in the performance of its functions and the implementation of the rebate system, because only a mature system will attract loyal farmers. In addition, specialized farmers' cooperatives must share information with the agribusinesses to enable these businesses to understand the difficulties encountered by farmers during cultivation. To overcome this gap and achieve information transparency, the LJSYN is establishing its own electronic information platform [40] to record all cultivation data, which will then be shared among all group members. This study provides significant insight into agribusiness with respect to sustainable development while also considering farmer subsidies. The role of agribusinesses can be to create value for the customer by maximizing sales and then returning this profit to the farmer. This will encourage farmers to improve their cultivation skills, which will promote sustainable development. In addition, the government should consider this proposed novel model to improve the current subsidy policy based on environmental, social and economic considerations (the triple bottom line).

6. Conclusions

The Chinese government has always been concerned about its agricultural sector and people's livelihoods [41,42]. In the traditional subsidy policy, farmers only needed to sign a contract with the government. Thus, regardless of whether they cultivate the land, farmers can still receive a per acreage subsidy from the government. However, farmers who cultivate rice on land that they do not own cannot receive this subsidy. Although the traditional subsidy model attempts to solve the issue of farmers' income, it lacks the ability to encourage farmers to aggressively cultivate rice. With the external environment rapidly changing, this traditional model is unable to satisfy the needs of farmers and provide a fair subsidy. The new subsidy model aims to support large-scale producers and operators, including large farmers, family farms, specialized farmers' cooperatives, and agricultural social service organizations. This model embodies the "whoever can produce more rice will receive priority subsidy support" concept. In response to the national policy, agribusiness must launch this new model to motivate farmers to adopt sustainable cultivation and to improve farmers' standard of living.

This study assists agribusiness by exploring the optimal subsidy rate to stimulate farmers' initiative, increase their income and encourage sustainable development. The proposed novel model allows for triple rebates. First, the specialized farmers' cooperatives purchase the rice from farmers and pay a one-time price to the farmers; second, a percentage of the cooperatives' profits is rebated to farmers at the end of the year; and third, a percentage of the annual profits of the agribusiness is rebated to the farmers. The purpose of this novel model is to increase the income of farmers. As the government distributes the subsidy to the agribusiness, it confirms the performance of the agribusiness, which forms a positive loop that plays an important role in developing sustainable agriculture. Government subsidies should support this loop until its maturation, at which point

the government can gradually terminate its support until the agribusiness can sustain the entire loop independently.

The findings of this study not only indicate that the novel model has different effects on farmers' income than the traditional subsidy model but also contribute to the development of sustainability by agribusinesses under the triple bottom line considerations. The economic consideration is that farmers should be able to obtain a higher income than that obtained under the traditional subsidy model; the environmental consideration involves the transfer of knowledge regarding sustainable cultivation from specialized farmers' cooperatives to farmers; and finally, farmers become members of the agribusiness, which allows them to afford good-quality necessities for living. With respect to the traditional subsidy model, there is a positive correlation between farmers' income and government subsidies. With respect to the novel model, farmers' income relies primarily on the subsidy from the agribusiness. Hence, the agribusiness must establish a dynamic subsidy model that permits immediate adjustments to the subsidy rate as government policy changes. When farmers engage in sustainable development, they can obtain the necessary support from specialized farmers' cooperatives and the agribusiness to improve cultivation techniques and reduce negative environmental impacts; the traditional subsidy model is unable to accomplish these benefits. Based on the significant findings of this study, the government must consider this novel subsidy model to support the development of agribusiness, and subsequently, agribusiness can use government resources to create a nationwide brand that will enhance farmer well-being.

There are several limitations regarding the content of this study, and several future studies are proposed to address these limitations. Although farmers are considered a low-income group in the Chinese context, certain farmers have their own opinions about [43,44] and reactions to government subsidy policy. This study does not examine that issue but rather explores a novel model for enhancing farmers' income. Accordingly, future studies can examine the differences between farmers when determining the appropriate subsidy type to meet their needs. In the proposed novel model, this study only considers triple rebates. Once additional organizations join the current loop, the subsidy model must be further clarified. Because of these multiple rebates, future studies must develop an optimal model that considers all roles, including those of the agribusiness, specialized farmers' cooperatives, farmers and the government, to maximize subsidy effectiveness. In addition, this study adopts Yan Fong-47 rice as an example to develop the decision-making model for agribusinesses and to explore the subsidy rate; future studies should include all agricultural products to obtain more comprehensive findings. Because subsidy models vary across countries, this case focuses on China, in particular on the institution of specialized farmers' cooperatives. Thus, future studies can apply the concept proposed in this study to other countries for purposes of comparison.

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