Evaluation of Agricultural Development Level in Liaoning Province

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Keywords: Traditional agriculture, Modern agriculture, Development level evaluation.

Abstract. China is a big agricultural country. The level of peasants' living standards and the level of agricultural production are directly related to national stability and social development. The transformation of traditional agriculture into modern agriculture is an inevitable choice for building a new socialist countryside. As an important old industrial base of the country, Liaoning Province has the inherent advantages of developing modern agriculture. At First, modern agricultural evaluation theory is expounded; and then analyze and evaluate the modern agricultural development level of the province by using the third agricultural census data of Liaoning Province, It points out the problems existing in the development of modern agriculture in our province, and then puts forward suggestions for promoting the development of modern agriculture in Liaoning Province in This paper.

An Overview of Modern Agriculture Related Theories

Traditional Agriculture

Traditional agriculture means that under the premise of objective nature, the laborer completes agricultural activities through his own human resources, external animal power, and with simple labor tools that do not provide power. Traditional agriculture has many restrictions on the scale of labor and development.

Modern Agriculture

Modern agriculture is no longer confined to the traditional agricultural and aquaculture industries, but also includes the secondary industries such as the production materials industry and the food processing industry, as well as the tertiary industry such as transportation, technology and information services. An industry has expanded to the secondary and tertiary industries.

Comparison between Traditional Agriculture and Modern Agriculture

Operating Objectives. Traditional agriculture aims at maximizing production, and modern agriculture is based on the pursuit of maximizing profits. Traditional agriculture must transform the production target from the maximization of production that satisfies subsistence consumption to the maximization of profit of commodity production to transition to modern agriculture.

The Technical Content. Technological advances in the agricultural sector are achieved through continuous investment in modern agricultural elements that condense advanced technologies. The growth of modern agricultural input and the increase in the content of modern science and technology in agriculture mean a reduction in the labor capacity of the agricultural sector.

Operating Scale. One of the obvious signs of modern agriculture is economies of scale. Only in scale operations, farmers can get rid of the pressure of survival and achieve the goal of maximizing profits.

To Construct the Evaluation System of Modern Agricultural Development Level

Modern agriculture has the characteristics of high output ratio, high mechanization and sustainable development. At the same time, it has the function (or function) of improving land use efficiency and reducing labor intensity. Accordingly, the development of modern agricultural evaluation systems must adhere to the principles of systemic, scientific, versatile, operability and dynamics.
The Basic Idea

Constructing an evaluation index system for modern agriculture requires clear thinking and clear objectives. From the perspective of system composition, the indicator system should basically reflect the basic content and important functions of modern agriculture. Focus on the development level of modern agriculture. In order to facilitate the comparison between domestic and foreign and the comparability of relevant data, a large number of materials and references were consulted, and the internationally representative multi-index comprehensive evaluation method was adopted to evaluate the development level of modern agriculture.

Evaluation content and indicator screening

According to the principles and requirements of modern agricultural development level evaluation, the level of modern agricultural development must be evaluated in terms of agricultural output capacity, agricultural modernization level and modern agricultural development potential.

Output Capacity. Output capacity is the basic requirement for industrial development and an important part of the evaluation of industrial development level. Modern agriculture is the core driving force for agricultural development. The research team selected agricultural labor productivity, land output rate and grain yield as a specific evaluation index of agricultural output capacity.

The Level of Modernization. The level of modernization is the main indicator of the ability of industrial development and innovation. Therefore, the level of agricultural modernization is the core content of the modern agricultural evaluation system. Combining the meaning of modern agriculture and following the basic principles of modern agricultural evaluation system design, the selected agricultural modernization level evaluation indicators include: urbanization rate, urban-rural income ratio, well coverage, greenhouse planting rate, and mechanical arable land rate.

The Development Potential. The development potential is the driving force for the sustainable development of the industry, and it is the source of industrial progress. This paper selects the per capita arable land area, the growth rate of farmers’ income, the growth rate of agricultural machinery and equipment, forest coverage, ponds, reservoir coverage and other indicators to evaluate the potential of modern agriculture in the region.

Evaluation Index Calculation and Evaluation Method

Indicator Calculation

1) Agricultural output capacity

The indicators for evaluating agricultural output capacity include: agricultural labor productivity, land output rate and grain yield, which are positive indicators. The larger the indicator value, the stronger the agricultural output capacity of the region.

Agricultural labor productivity is an evaluation indicator of human cost-benefit. It is the most important indicator for evaluating output capacity. This paper studies the development level of modern agriculture and needs to evaluate the agricultural output capacity. See Equation (1) for calculation.

\[
\text{Agricultural labor productivity} = \frac{\text{Gross agricultural output value}}{\text{Total number of employed people in agriculture}}
\]

Land output rate. Land output is an indicator of resource input efficiency. It is an important indicator for evaluating agricultural output capacity under resource constraints. China is a big agricultural country, but its land resources are limited. Therefore, the land output rate is used as an important indicator for evaluating modern agriculture. See Equation (2) for calculation.

\[
\text{Land output rate} = \frac{\text{Gross agricultural output value}}{\text{Cultivated area}}
\]

Grain yield. Food is an important product of farmland work. China is not only a big agricultural
country, but also a large grain producing country. The grain output per unit of cultivated land is a precise evaluation of the ability to evaluate land output. See (3) for the calculation formula.

\[
Grain yield = \frac{Grain~production}{Cultivated~area}
\] (3)

2) Agricultural modernization level

The indicators for evaluating the level of agricultural modernization include: urbanization rate, urban-rural income ratio, well coverage, greenhouse planting rate, and agricultural machinery equipment coverage. These five indicators are positive indicators. The higher the indicator value, the higher the agricultural modernization water.

Urbanization rate. The degree of urbanization is an important indicator for evaluating the level of regional modernization. Consider the comparability of statistical index calculation and the operability of statistical data collection, and adopt the urbanization rate as the evaluation index. Its calculation formula is shown as (4).

\[
Urbanization~rate = \frac{Urban~population}{Total~population}
\] (4)

The urban-rural income ratio is an indicator of the difference in urban and rural living standards. This indicator is used to analyze the quality of life of employees and to reflect the degree of urbanization of workers in agriculture, forestry, animal husbandry and fishery. The calculation formula is shown in Equation (5).

\[
The~urban–rural~income~ratio = \frac{Per~capita~income~of~farmers}{Per~capita~income~of~urban~population}
\] (5)

Well coverage is the starting point for evaluating agricultural modernization. It reflects the modernization level of cultivated land. See Equation (6) for calculations.

\[
Well~coverage = \frac{Number~of~wells}{Cultivated~area}
\] (6)

Greenhouse planting rate. Greenhouse cultivation is the best way to overcome the impact of harsh climates on agricultural output with modern means. See Equation (7) for calculations.

\[
Greenhouse~planting~rate = \frac{Greenhouse~area}{Cultivated~area}
\] (7)

Mechanical equipment arable rate. The application of machinery and equipment to agricultural development is an organic integration of agriculture and secondary and tertiary industries. The arable land rate of mechanical equipment is an important indicator of the level of agricultural mechanization. See (8) for the calculation formula.

\[
Mechanical~equipment~arable~rate = \frac{Number~of~agricultural~machinery~and~equipment}{Cultivated~area}
\] (8)

3) Modern agricultural development potential

Development potential is the basic guarantee for the survival of an industry. The indicators for evaluating the potential of agricultural development include: per capita cultivated land area, farmers' income growth rate, agricultural machinery and equipment growth rate, forest coverage rate, pond and reservoir coverage. They are also positive indicators. The higher the indicator value indicates that modern agriculture in the region has more development potential.

Per capita cultivated area. The per capita arable land area is a space where agricultural, forestry, animal husbandry, fishery, and laborers can tap their potential. It is an important indicator of the potential of agricultural development. See (9) for the calculation formula.
Per capita cultivated area = \( \frac{\text{Cultivated area}}{\text{Total agricultural population}} \)  \hspace{1cm} (9)

Farmers' income growth rate. The income level is the main indicator for evaluating the living conditions of residents. This paper adopts the growth of per capita income of agricultural, forestry, animal husbandry and fishery employees during the second agricultural census to the third agricultural census, and evaluates the level of modern agricultural development. See (10) for the calculation formula.

\[ \text{Farmer income growth rate} = \frac{\text{Third agricultural census per capita income} - \text{Second agricultural census per capita income}}{\text{Second agricultural census per capita income}} \] \hspace{1cm} (10)

Agricultural machinery and equipment growth rate. The coverage level of agricultural machinery and equipment is an important indicator of agricultural modernization. The growth rate of agricultural machinery and equipment is undoubtedly an appropriate indicator for evaluating the development potential of modern agriculture. The indicators are defined as Equation (11).

\[ \text{Agricultural machinery equipment growth rate} = \frac{\text{Number of mechanical equipment for the third agricultural census}}{\text{Number of mechanical equipment for the second agricultural census}} - 1 \] \hspace{1cm} (11)

Forest cover rate. It reflects the living environment of local residents. The high forest coverage provides local residents with good air quality and living environment, and improves the quality of life and happiness of residents. Provide resources for local economic development, attract talents, and promote regional economic development. See (12) for the calculation formula.

\[ \text{Forest cover rate} = \frac{\text{Forest cover rate}}{\text{Total area of the area}} \] \hspace{1cm} (12)

Reservoir and reservoir coverage. Reservoirs and reservoirs are the most important agricultural, forestry, animal husbandry and fishery resources except cultivated land. Its quantity and area are important resources for the employees to survive. Therefore, the quantity, area and distribution of reservoirs and reservoirs are important resource guarantees for modern agricultural development. See Equation (13).

\[ \text{Reservoir and reservoir coverage} = \frac{\text{Number of reservoirs and reservoirs}}{\text{Total area of the area}} \] \hspace{1cm} (13)

Indicator Scoring Method

The indicators in the indicator system evaluate the development level of modern agriculture from different angles. According to the practice and general knowledge of measurement evaluation, this benchmark value is defined as 60 points. The formula for the scores of each secondary indicator is shown in Equation (14).

\[ \text{The indicator score} = \frac{\text{The calculation formula of the indicator formula}-\text{The national average of the indicator}}{\text{The maximum of the survey}-\text{Minimum}} \times 40 + 60 \] \hspace{1cm} (14)

Index System Construction and Weight Determination

According to the above analysis, modern agriculture gives weights to the first-level indicators in terms of agricultural output capacity, agricultural modernization level and agricultural development.
potential, according to the importance of modern agricultural assessment content: agricultural output capacity weight is 0.4, agricultural modernization level The weight of the modern agricultural development potential is 0.3.

The indicators for evaluating agricultural output capacity are evaluated according to their importance: agricultural yield, land yield and labor productivity, with weight coefficients of 0.5, 0.3, and 0.2 respectively; The indicators of modernization are: urban-rural income ratio, mechanical and equipment arable land rate, well coverage, greenhouse planting rate and urbanization rate. The weight coefficients are: 0.25, 0.2, 0.2, 0.2 and 0.15 respectively; The indicators of development potential are: farmers’ income growth rate, agricultural machinery and equipment growth rate, per capita arable land area, forest coverage rate, and pond and reservoir coverage. The weight coefficients are 0.35, 0.25, 0.2, 0.1 and 0.1 respectively.

The Evaluation Model

According to the research purpose and specific data resources, this paper uses the multi-index comprehensive evaluation method to evaluate the development level of modern agriculture. According to the construction of the index system, the modern agricultural development level assessment system is divided into two levels: the overall model and the sub-model.

Overall model: The overall model of modern agricultural development level is shown in Equation (15). Among them, Z represents the total score of modern agriculture evaluation; W represents the weight score, \( W_i \) is the weight assignment of the i-th modern agricultural assessment content; Y represents the evaluation content score of modern agricultural development level, and \( Y_i \) is the i-th modern agricultural assessment content score.

\[
Z = \sum_i W_i Y_i \tag{15}
\]

Sub-model: The modern agricultural comprehensive evaluation model consists of the agricultural output evaluation model, the agricultural modernization level evaluation model and the modern agricultural development potential evaluation model.

Agricultural output consists of various secondary indicators that constitute agricultural output. For specific models, see (16), where \( Y_1 \) represents the agricultural output score; \( P_1 \) represents the indicators in the agricultural output evaluation index system. Weight assignment, \( P_{1j} \) is the weight of the j-th indicator in the agricultural output evaluation system; \( X_1 \) is the score of each indicator in the agricultural output evaluation system, and \( X_{1j} \) is the score of the j-th indicator in the agricultural output evaluation system.

\[
Y_1 = \sum_j P_{1j} X_{1j} \tag{16}
\]

The agricultural modernization evaluation model is shown in (17), in which \( Y_2 \) represents the agricultural modernization level score; \( P_2 \) represents the weight assignment of each indicator in the agricultural modernization level evaluation system, and \( P_{2j} \) is the j-th indicator in the agricultural modernization level evaluation system. The weight of the weight; \( X_2 \) represents the score of each indicator in the evaluation system of agricultural modernization level, and \( X_{2j} \) is the score of the j-th indicator in the evaluation system of agricultural modernization level.

\[
Y_2 = \sum_j P_{2j} X_{2j} \tag{17}
\]

The evaluation model of modern agricultural development potential can be found in (18), where \( Y_3 \) represents the assessment score of modern agricultural development potential; \( P_3 \) represents the weight assignment of various indicators in the modern agricultural development potential assessment system, and \( P_{3j} \) is the potential of modern agricultural development. The weight of the j-th indicator in the evaluation system; \( X_3 \) represents the score of each indicator in the modern agricultural development potential evaluation system, and \( X_{3j} \) is the score of the j-th indicator in the modern agricultural development potential evaluation system.
\[ Y = \sum P_j X_{3j} \] (18)

**Status Quo of Modern Agriculture Development in Liaoning Province**

According to the standard time stipulated by the agricultural census, the data adopted in this paper is based on the Third agricultural census localities, combined with statistical yearbooks and statistical announcements, but all data are cross-sectional data at the end of 2016. According to the above-mentioned modern agricultural development level evaluation index system, the basic data is collected for analysis. From the comprehensive score point of view: the comprehensive agricultural comprehensive score of Liaoning Province is 67.06 points, which is higher than the national average level (60 points).

Agricultural output capacity. Agricultural output is the basic evaluation index of agricultural development level, which focuses on the efficiency of agricultural input and output. The province's agricultural output score is 65.07 points, which is a medium-level domestic level. Among them, the production labor rate score of 85.81, higher than the domestic leading level, approaching the top level. However, the grain yield is 53.5, which is lower than the national level. The reason is that the geographical location of our province is in the inland high latitude area, the altitude is higher, the temperature is lower, the climate is dry, and the water vapor is difficult to reach, making the crop production slow and long. The grain output has been reduced, and the grain output capacity is below the national average, which objectively reduces the overall evaluation of the province's agricultural output capacity.

The level of agricultural modernization. The level of agricultural modernization is an indicator for comprehensively evaluating the degree of agricultural modernization from the perspectives of agricultural structure and mechanization. The province's agricultural modernization level score is 66.11. The urbanization level (score is 61.45) and greenhouse planting rate (score is 63.7) have just reached the national average, and the well coverage (score is 58.72) and mechanical equipment arable rate (score is 59.93) are lower than the national level, indicating that the degree of agricultural mechanization in the province still needs to be improved. It can be seen that agricultural mechanization is a shortcoming of agricultural modernization in our province.

The province's modern agricultural development potential score is 70.66 points, among them, the growth rate of agricultural machinery equipment is 92.91 points, which shows that the province's efforts in agricultural machinery and equipment have achieved remarkable results. On the other hand, it also shows that the province's agricultural mechanization level is small and the development space is huge. Per capita cultivated land area (66.83 points) and forest coverage rate (63.25 points), the province's land resources are relatively rich, and the development potential is relatively large.

**Countermeasures and Suggestions**

From the analysis point of view, the main problem of agricultural development in Liaoning Province is the problem of farmland output and farmers' income. The main reason for the output of cultivated land is due to land and climatic conditions, while the income problem is related to agricultural output capacity and local income distribution policy. Therefore, the development of modern agriculture in Liaoning Province needs to focus on improving agricultural output capacity and agricultural modernization level from various angles. Based on this, the following suggestions are proposed:

1) The government attaches importance to strengthening policy support.
2) Create a good modern agricultural development environment.
3) Improve the degree of agricultural mechanization according to local conditions.
4) Strengthen international cooperation and learn from foreign experience.
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