RESEARCH-ARTICLE

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Green Logistics Discovery Strategy of Agricultural Products Under Low Carbon Economy

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Abstract

This article starts from the perspective of low-carbon economy, reviews literature on green logistics evaluation in recent years, and combines the current development status of agricultural product logistics in Linyi City. Using literature induction method, a green logistics evaluation index system for agricultural products in Linyi City is established. Using the Analytic Hierarchy Process, evaluate the development of green logistics for agricultural products in Linyi City, analyze the influencing factors of green logistics for agricultural products in Linyi City, and finally propose corresponding countermeasures based on the indicator system.

CCS Concepts

• **Applied computing**; • **Computers in other domains**; • **Agriculture**;

Keywords

Linyi City, Low Carbon Economy, Agricultural Product Logistics, Green Logistics

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1 Introduction

Nowadays, the ecological environment is being damaged and deteriorating, and the low-carbon economy is highly valued. China is increasingly emphasizing environmental protection and gradually integrating environmental protection concepts into various industries. The report of the 20th National Congress of the Communist Party of China fully elaborated on "promoting green development and promoting harmonious coexistence between humans and nature", which mentioned that "promoting green and low-carbon economic and social development is a key link to achieving high-quality development" (Xi, 2022). All industries should take "green" as their future development direction and take the path of green and sustainable development. Although the logistics industry has continuously achieved good results, it is undeniable that there have been some problems of environmental pollution and resource waste (Wang & Li, 2021). As the "logistics capital of China", Linyi's traditional agricultural product logistics management has led to problems such as social resource waste and environmental pollution, making it difficult to adapt to the needs of low-carbon economic development (Chen et al., 2020).

2 Current Situation of Agricultural Product Logistics Development in Linyi City

2.1 Overview of Linyi City

Linyi is a major agricultural city and an important production base for grain, vegetables, and oil materials in Shandong Province (Linyi Statistical Bureau, 2023). The orchard area is 1.396 million mu, and the fruit output is 3.144 million tons. The area of vegetables and edible fungi is 2.108 million mu, and the output is 8.254 million tons. The grain area is 9.675 million mu, and the total output is 4.18 million tons. As shown in Table 1.

2.2 Strong Government Support and Introduction of Multiple Policies

In recent years, Linyi City has the "county-village" three-level distribution network has basically taken shape. The average annual number of shuttle buses dispatched is more than 17,000, and the number of parcels for "sending parcels to the countryside" and "bringing goods to the city" exceeds 27.8 million and 220,000 tons respectively, driving an increase in the income of the masses by more than 3.6 million yuan and a cost reduction for enterprises by more than 5 million yuan.

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Table 1: Statistical Table of the Output of Major Agricultural Products in Linyi City in 2022

Product Name	Unit	Output	Growth (%)
Fruit	10,000 tons	314.4	3.5
Vegetables and Edible Fungi	10,000 tons	825.4	4.4
Grain	10,000 tons	418	0.4

Data Source: Linyi Statistical Yearbook 2022

Current Situation of Agricultural Product Logistics Development in Linyi City

2.2.1 Large-scale Logistics Industry and Leading Development Level. Linyi City is the "Logistics Capital of China". Linyi City has more than 1,120 various commodity markets and has become the largest wholesale market cluster in the northern part of the Yangtze River. There are more than 14,000 logistics enterprises and business households in Linyi City, including more than 3,300 various logistics enterprises and more than 2,000 dedicated lines. The overall spatial layout of logistics presents an axial radiation pattern relying on the rapid transportation network and railway lines (Zhou & Huang, 2022).

2.3 Continuous Improvement of Logistics Infrastructure and Diversified Logistics Investment

The transportation investment in Linyi City has been increasing every year, and the urban road infrastructure has become more and more perfect, creating good conditions for the development of green logistics. The railway network, with the Beijing-Shanghai and Rizhao-Dongying expressways as the main trunk lines, runs through the whole territory from north to south and connects major cities across the country, providing strong support for the prosperity and development of the logistics industry. Every year, the transportation volume and turnover volume of highways, railways, and waterways in Linyi City are constantly increasing, reflecting the rapid growth of the city's logistics demand and the continuous rapid development of the logistics industry.

2.4 Problems Faced by the Development of Green Agricultural Product Logistics in Linyi City

2.4.1 Backward Agricultural Product Logistics Technology. Agricultural products are perishable. Most of the current transportation in Linyi City adopts normal temperature transportation, lacking professional equipment and teams, unable to effectively control the temperature and humidity during transportation, resulting in increased cargo losses and logistics costs.

2.4.2 Logistics Links Falling Short of Green Standards. The basic work of agricultural product logistics includes processes such as agricultural product processing, packaging, and transportation. Although there are a variety of agricultural products sold in Linyi City, most of these products are raw materials without any processing and packaging. Therefore, the prices and freshness of these products will decline, making them unable to enter the high-end market and obtain greater profits.

2.4.3 Lack of Talents with Green Logistics Awareness. The current employees in the agricultural product logistics industry in Linyi City generally have not received professional training and lack awareness of green logistics. There is a shortage of agricultural product logistics talents, and it is difficult to introduce professional talents graduated from colleges and universities, resulting in inexperienced employees, imperfect work, and low work efficiency, unable to meet the standards of green logistics.

2.4.4 Inadequate Government Supervision. The government does not pay sufficient attention, and the implementation of policies is not in place. There is no formal logistics company to provide relevant technical support for customers, resulting in various problems during cargo transportation, such as imperfect equipment and non-optimal routes, leading to quality problems of agricultural products and resource waste.

3 Evaluation and Analysis of the Development of Green Agricultural Product Logistics in Linyi City

3.1 Selection of Evaluation Indicators for Green Agricultural Product Logistics

The agricultural product logistics in Linyi City is in a stage of vigorous development, and achieving "green" development has become an inevitable choice for the development of agricultural product logistics in Linyi CityThe author draws on the research results of outstanding domestic scholars, selects indicators that meet the conditions according to the actual situation in Linyi City, and then conducts expert scoring on the screened results to determine the final first-level and second-level indicators.

3.1.1 Government Factors. (1) Quantity of green logistics policies. Under the background of national policies, the Linyi municipal government has conscientiously implemented various policies related to green logistics and made detailed plans for them.

(2) Training of green logistics knowledge. Relevant employees have relatively little knowledge of green logistics, and the government should carry out relevant training and popularize green logistics knowledge.

(3) Fiscal expenditure on transportation. Improve traffic conditions and build "green" highways to ensure the quality of agricultural products.

3.1.2 Environmental Protection Factors. (1) Usage rate of green packaging. Whether the packaging materials choose recyclable and reusable materials.

Table 2: Evaluation Indicator System of Green Agricultural Product Logistics in Linyi City under the Low-carbon Economy

Target Layer	First-level Indicators	Second-level Indicators
Evaluation Indicator System of Green Agricultural Product Logistics in Linyi City	Government Factors A1	Quantity of Green Logistics Policies A11
		Training of Green Logistics Knowledge A12
		Fiscal Expenditure on Transportation A13
	Environmental Protection Factors A2	Usage Rate of Green Packaging A21
		Waste Emissions A22
		Recycling Utilization Rate of Waste A23
	Resource Factors A3	Situation of Transportation Facilities A31
		Quantity of Logistics Talents A32
		Resource Consumption Rate A33
	Technical Factors A4	Level of Logistics Informatization A41
		Advancedness of Logistics Equipment A42
		Standardization Degree of Logistics A43

Table 3: Comparison Scale Table

Factor i Compared with Factor j	Quantitative Value
Equally important	1
Slightly important	3
Strongly important	5
Extremely important	7
Intermediate values of two adjacent judgments	2, 4, 6, 8

(2) Waste emissions. During transportation, vehicle exhaust emissions, garbage generated in the agricultural product market, and waste generated during the processing of agricultural products will all cause pollution to the environment.

(3) Recycling utilization rate of waste. From picking to transportation, waste will be generated in each link, and the treatment and recycling of waste will also have an impact on the environment.

3.1.3 Resource Factors. (1) Situation of transportation facilities. Whether the route planning is reasonable and whether the transportation facilities are complete during the transportation of agricultural products.

(2) Quantity of logistics talents. Whether the logistics planning is reasonable, whether the logistics-related talents choose the optimal route, and whether there are talents who master the green logistics technology of agricultural products.

(3) Resource consumption rate. The resource consumption situation during transportation.

3.1.4 Technical Factors. (1) Level of logistics informatization. Whether there is a perfect logistics information system, whether the buyer and the seller can share information and communicate at any time.

(2) Advancedness of logistics equipment. Whether the logistics equipment can meet the standards of green agricultural product logistics.

(3) Standardization degree of logistics. Whether a scientific agricultural product logistics system can be established and whether the quality of agricultural products can be guaranteed.

3.2 Evaluation and Analysis of Green Agricultural Product Logistics in Linyi City

3.2.1 Analytic Hierarchy Process (First-level Indicators). In the 1970s, American operations researchers proposed the Analytic Hierarchy Process (AHP). This method decomposes the elements related to decision-making into multiple levels such as goals, criteria, and schemes, and conducts qualitative and quantitative analysis on this basis, which has very wide practicability.

Construction of judgment matrix

In the application of the Analytic Hierarchy Process, the data of the judgment matrix needs to be constructed through the expert scoring method. Experts score the relative importance of N indicators at the same level, and the relative importance ratio scale is selected between 1 and 9. This article conducts a questionnaire survey on 8 experts and scholars, including 5 associate professors in the field of logistics in the School of Management of Wuhan College and 3 relevant experts from the logistics industry association. According to the calculation of the expert scoring table data, the following matrix is obtained.

3.2.2 Analytic Hierarchy Process (Second-level Indicators). (1) Judgment matrix

(2)According to the steps of the Analytic Hierarchy Process, the weights of each indicator of green agricultural product logistics in Linyi City can be obtained, and the overall ranking is as follows:

(3) Sort the above data to obtain the importance degree of the influencing factors for the indicators.

Using the Analytic Hierarchy Process, an indicator system for green agricultural product logistics under the low-carbon economy

Table 4: Column Normalization

Government Factors	Quantity of Green Logistics Policies	Training of Green Logistics Knowledge	Fiscal Expenditure on Transportation
Quantity of Green Logistics Policies	1	1/3	1/2
Training of Green Logistics Knowledge	3	1	2
Fiscal Expenditure on Transportation	2	1/2	1
Environmental Protection Factors	Usage Rate of Green Packaging	Waste Emissions	Recycling Utilization Rate of Waste
Usage Rate of Green Packaging	1	1/3	1/4
Waste Emissions	3	1	1/2
Recycling Utilization Rate of Waste	4	2	1
Resource Factors	Situation of Transportation Facilities	Quantity of Logistics Talents	Resource Consumption Rate
Situation of Transportation Facilities	1	1/4	1/2
Quantity of Logistics Talents	4	1	1/5
Resource Consumption Rate	2	5	1
Technical Factors	Level of Logistics Informatization	Advancedness of Logistics Equipment	Standardization Degree of Logistics
Level of Logistics Informatization	1	1/2	3
Advancedness of Logistics Equipment	2	1	4
Standardization Degree of Logistics	1/3	1/4	1

Table 5: Weights of Influencing Factors

Indicator	Weight
Quantity of Green Logistics Policies	0.163
Training of Green Logistics Knowledge	0.523
Fiscal Expenditure on Transportation	0.297
Usage Rate of Green Packaging	0.122
Waste Emissions	0.317
Recycling Utilization Rate of Waste	0.551
Situation of Transportation Facilities	0.159
Quantity of Logistics Talents	0.283
Resource Consumption Rate	0.557
Level of Logistics Informatization	0.320
Advancedness of Logistics Equipment	0.556
Standardization Degree of Logistics	0.122

is constructed. Through the above data analysis, the influencing factors of green agricultural product logistics under the low-carbon economy are explored.

3.3 Analysis of Influencing Factors of Green Agricultural Product Logistics in Linyi City

3.3.1 Resource Consumption Rate. Linyi City has a relatively high density of traffic routes. In the early stage, for the development of agriculture, highway planning and construction were carried out. However, with urban development and transformation, many highway routes have not been effectively optimized, resulting in many

Table 6: Hierarchical Overall Ranking of Influencing Factors

Indicator	Importance Degree	Ranking
Resource Consumption Rate	0.557	1
Advancedness of Logistics Equipment	0.556	2
Recycling Utilization Rate of Waste	0.551	3
Training of Green Logistics Knowledge	0.523	4
Level of Logistics Informatization	0.320	5
Waste Emissions	0.317	6
Fiscal Expenditure on Transportation	0.297	7
Quantity of Logistics Talents	0.283	8
Quantity of Green Logistics Policies	0.163	9
Situation of Transportation Facilities	0.159	10
Usage Rate of Green Packaging	0.122	11
Standardization Degree of Logistics	0.122	11

From the above data, it can be concluded that the resource consumption rate, the advancedness of logistics equipment, and the recycling utilization rate of waste are the three main factors affecting green agricultural product logistics under the low-carbon economy; the training of green logistics knowledge, the level of logistics informatization, and the waste emissions are three secondary important factors.

agricultural product transportation routes not being the optimal routes. This makes agricultural products take longer during transportation, generate more exhaust gas, have a greater impact on the environment, and also cause product losses, resulting in greater resource losses. Linyi City needs to focus on solving problems such as imperfect transportation facilities, serious resource waste, and a lack of logistics talents.

3.3.2 Advancedness of Logistics Equipment. Logistics equipment plays a guiding role in the development of green agricultural product logistics. The popularity of green agricultural product logistics technology in Linyi City is still not high. Now, under the impact of the big data era, various entities have begun to participate in the e-commerce industry. From this, we can find that although e-commerce technology is the most widely used logistics technology by farmers, compared with processing enterprises and wholesale and retail merchants, it still has no advantage. Therefore, most farmers still choose traditional sales methods. In Linyi City, the application of modern logistics technologies such as GPS and RFID is not yet mature and cannot meet the needs of modern logistics development and needs to be strengthened and improved.

3.3.3 Recycling Utilization Rate of Waste. The fundamental of the development of green agricultural product logistics is to conform to the environmental protection concept. The attention paid to the establishment of a waste recycling system is low, which leads to environmental pollution.

4 Countermeasures and Suggestions for Promoting the Development of Green Agricultural Product Logistics in Linyi City

4.1 Improving the Construction of Green Agricultural Product Logistics Facilities

Currently, the logistics facilities in Linyi City are not perfect and have serious aging problems. Although the introduction of equipment requires a large amount of upfront capital investment, the return rate is high. The government should increase support, promote the development of green logistics from a strategic perspective, organically connect transportation yards and warehousing planning, and prevent redundant construction to avoid waste.

4.2 Increasing the Degree of Logistics Greening

Increase the scale of agricultural product processing. In terms of raw materials, conduct management and control, classify raw materials according to quality, and process high-quality agricultural products to enter the high-end market. Introduce advanced equipment during the processing to reduce losses and improve quality. Currently, the enterprises in Linyi City have not formed a scale, and each has different standards. They should form an economy of scale, cooperate with each other, improve efficiency, improve the quality of agricultural products, and enhance competitiveness.

4.3 Cultivating Green Logistics Talents

Establish a sound logistics talent introduction system, strengthen the introduction of talents, offer relevant majors and courses in colleges and universities. Relevant majors and courses should focus on teaching theoretical knowledge, combine theory with practice, and pay attention to the cultivation of students' practical abilities to cultivate green logistics talents for agricultural products.

4.4 Establishing a Perfect System

The government should vigorously support relevant logistics technology companies, ensure the good application of logistics technology in the transportation process, focus on technological innovation, and optimize aspects such as transportation temperature, humidity, and routes to ensure the quality of agricultural products and reduce resource waste.

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