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Retraction

Retracted: Logistics Information Intelligent Platform Based on Dynamic Network Data

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

References

[1] W. Kang, "Logistics Information Intelligent Platform Based on Dynamic Network Data," *Security and Communication Networks*, vol. 2022, Article ID 2288452, 9 pages, 2022.

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Research Article

Logistics Information Intelligent Platform Based on Dynamic Network Data

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In order to reduce the carbon emissions of cold chain logistics and promote the construction of ecological civilization, a logistics distribution path optimization model with the minimum total cost as the objective function under the carbon tax system was proposed. The model comprehensively considers the technical advantages of the Internet of things and the characteristics of cold chain logistics; introduces soft time window, customer satisfaction, and carbon emissions as the main constraint conditions; uses the improved genetic algorithm to solve the mathematical model; uses Matlab to encode; and shows the effectiveness and rationality of the model and algorithm through examples. The experimental results show that: The total cost is 9917.12 yuan, customer satisfaction is 97.07%, carbon emission is 161.06 kg, carbon tax is 5.64 yuan/ton, fixed cost is 600 yuan, transportation cost is 72.72 yuan, refrigeration cost is 8811.73 yuan, cargo damage cost is 427.03 yuan, penalty cost is 0 yuan, The validity of the algorithm and the rationality of the model are verified. When enterprises add a carbon tax constraint, the total cost of cold chain distribution is reduced, and the carbon emission is reduced compared with that without carbon tax. The research can provide a reference for enterprise cold chain logistics distribution decisions.

1. Introduction

The Internet of Things (IOT) is new information carrying structure based on traditional telecommunication networks and Internet system, which enables all independent addressing hosts to establish interconnection and mapping relationships with physical objects. The Internet of Things, also known as the "Universal Connected Applied Internet", can be broadly understood as the expansion and extension network derived from the Internet, which can combine various types of information sensing equipment and network hosts one by one to form a huge and complete network system. Due to the openness and inclusiveness of the Internet space, people or hosts at any time and any place can realize information communication and transmission with the help of the Internet of Things system [1, 2].

Most of the information transmitted by the Internet of Things belongs to the data of perception and recognition. The so-called information perception means that the host of the Internet of Things always maintains a sensitive awareness of the change mode and attribute state of things. Information recognition refers to the data state that the host of the Internet of Things can feel displayed in a special form.

With the continuous development of the concept of sharing economy, the existing management and operation mode of logistics distribution can no longer fully meet the needs of practical application, and some logistics goods will even lag behind transportation, as shown in Figure 1. To avoid the above situation, the traditional blockchain sharing system adopts the most basic distributed storage form. Basic information of delivery users is queried through Ethernet platform, and real-time compilation of logistics transportation orders is realized by using a blockchain host [3]. However, this type of application structure cannot effectively control the cost of logistics distribution, which leads to inaccurate information sharing behavior recorded by the host structure.

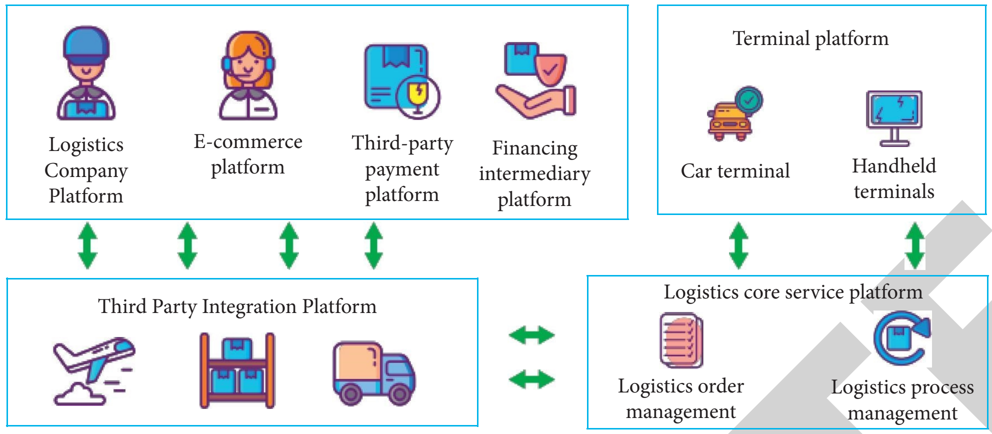

Figure 1: System architecture of intelligent logistics service platform.

2. Literature Review

In view of the abnormal situation of outward logistics, Zhang et al. comprehensively applied multidimensional ontology and intelligent agent technology, and proposed a new abnormal monitoring method of outward logistics. Multidimensional ontology is used to represent abnormal logistics, including positional ontology, social ontology, and dynamic ontology. An intelligent agent is used to independently, flexibly, and synergistically monitor abnormal information of outward logistics [4]. Han et al. adopted the method of empirical research, first proposed relevant theoretical assumptions, designed the corresponding questionnaire and carried out the survey, and studied the key factors affecting the success of information logistics strategy. The results show that key factors include flexibility, comprehensiveness, IT partners, IT strategic positioning, project cooperation, etc. [5]. Xing et al. reasonably analyzed the types of logistics information and discussed in detail the application of regression analysis, prediction, evaluation, and other related information analysis methods and technologies to logistics information analysis and processing [6]. Din et al. studied the analysis of logistics information from the perspective of the circulation process by using fuzzy mathematics, gray system, correlation degree, neural network, principal component analysis, and other methods, and established the corresponding analysis model with strong practicality. W helps logistics enterprises reduce logistics costs, control channels, and improve their market competitiveness [7]. Sun et al. established a logistics information analysis model for the company's logistics information platform, which can be widely used in vehicle scheduling, facility location, customer service analysis, etc., so as to help relevant enterprises design, evaluate, identify and compare logistics strategies, and select the optimal strategy [8]. Zhang et al. deconstructed the composition of regional logistics information resources and believed that transportation information, supply and demand information, market change information, inventory status and inventory strategy information, market forecast information, and policy information of regional logistics market are the main sources of regional logistics information resources [9].

It is well known that fresh produce is difficult to circulate because it is prone to spoilage and spoilage. Among them, the refrigerated transportation rate of aquatic products is only 40%, and that of vegetables and fruits and lean meat is even less, only 15% and 30% respectively [10]. In order to reduce the distribution loss rate of fresh agricultural products, this paper introduces the Internet of Things technology to efficiently manage the whole distribution process during modeling. Internet of Things is an intelligent network integrating RFID radio frequency identification technology, global positioning system, artificial intelligence, and other technologies [11, 12]. It can not only monitor vehicles in real time but also intelligently control the refrigerating temperature of trucks, improve distribution efficiency, stabilize production and marketing relations, and provide complete traceability of carbon footprint.

3. The Research Methods

3.1. The Proposal of Cold Chain Logistics Distribution Mode from the Perspective of Internet of Things and Low Carbon. This essay aims to consider the research on distribution path optimization of cold chain logistics under the constraints of the carbon tax and customer satisfaction with fuzzy time window in the Internet of Things environment and consider the impact of the carbon tax on the objective function while taking the lowest total distribution cost as the objective function. The total cost includes the following aspects: penalty cost, carbon emission cost, fixed cost, transportation cost, cargo damage cost, and cooling cost. The carbon emission cost, including fuel consumption and the amount of CO_2 produced by refrigeration, is obtained by multiplying the carbon tax. The improved genetic algorithm is applied to solve the carbon emission constraint model constructed in this essay for many times to obtain the optimal path, and explore the impact of different carbon taxes on the optimal path, so as to effectively link the development of cold chain logistics with the construction of ecological civilization.

Table 1: Description of parameters and variables.

Parameter	Definition
$N = \{N_0, N_1, \ldots, N_n\}$	Distribution center N_0 and supermarket $\{1, 2, \ldots, n\}$ nodes
$K = \{K_0, K_1, \ldots, K_n\}$	Vehicles are assembled. K vans in total.
d_{ij}	The distance between supermarket i and supermarket j
c_{ij}^k	The cost per kilometer of the kth car from the supermarket to the road $(i, j = \{1, 2, \ldots, n\})$
F	Fixed cost of mobilising unit vehicles (embedded RFID tags)
M_1	Supermarket waiting cost per unit of time
M_2	Supermarket delay cost per unit of time
V	Maximum carrying capacity of vehicle
P_1	Unit value of agricultural products
P_2	Unit cooling costs for agricultural products
q_i	Quantity demanded at the i th supermarket
Q_{ij}	The weight of product left on the vehicle when it leaves supermarket i and goes to supermarket j
t_0^k	The departure time of vehicle k from the distribution center
t_{ij}^k	The time it takes for vehicle k to get from supermarket i to supermarket
t_f^k	The time for vehicle k to complete the last supermarket delivery
t_i^k	The time it takes for vehicle k to get to supermarket i
t_{si}	The time required to serve supermarket i
x_{ij}^k	0,1 variable, indicating that the k th car goes from supermarket i to supermarket j, otherwise $x_{ij}^k = 0$
y_i^k	0,1 variable, indicating that the k th car serves the supermarket i , otherwise $y_i^k = 0$
$[ET_i, LT_i]$	The time window in which supermarket i is expected to be served
$[EET_i, ELT_i]$	The service time window that supermarket i can bear

3.2. To Build a Path Optimization Model Based on the Internet of Things and Low Carbon Perspective

3.2.1. Hypothetical Condition. This essay deals with the optimization of distribution routes from a single logistics center to multiple supermarkets. According to the supermarket order requirements, all vehicles need to depart from the distribution center and return to the distribution center after completion. The vehicles used are of the same model, all trucks with refrigeration and refrigeration equipment, and the distribution logistics center has enough vehicles to complete the distribution task. The demand for fresh agricultural products in each supermarket cannot exceed the maximum carrying capacity, that is, vehicle delivery is not considered [13]. Each supermarket has only one car for delivery, but each car can deliver multiple supermarkets. The demand for fresh agricultural products in supermarkets is constant during the distribution time. The geographical location of supermarkets is known, and the demand and time window are also clear. The speed of all vehicles in the process of driving is constant, and the external temperature is constant.

3.2.2. Description of Main Parameters and Variables. In the process of model construction, parameters and variables are shown in Table 1.

3.2.3. Constraints on the Model. The model established in this paper is to realize the path selection of cold chain logistics distribution from the dual perspectives of the Internet of Things and low carbon. Carbon emissions in distribution mainly come from two aspects, one is the refrigeration of fresh agricultural products, the other is the fuel consumption of vehicles with different loads. If only the lowest carbon emissions as the goal, the quality of fresh agricultural products cannot be guaranteed, therefore, in the modeling process, this essay introduced a fuzzy time window and customer satisfaction [14]. Instead of aiming at the lowest carbon emissions, the distribution network should be designed scientifically on the premise that customer satisfaction meets the expectation of the enterprise, and the overall cost should be minimized as the optimization goal, and the distribution path should be rationally planned.

Fuzzy time window: This paper introduces the time window to blur the expected arrival time of customers, making it closer to the nonrigid requirements of customers on delivery time in reality, so as to better reflect customer satisfaction. Therefore, this essay adopts membership function $s(t_i^k)$ to represent customer satisfaction with time, as shown in formula (1) [15].

$$s\left(t_i^k\right) = \begin{cases} \left(\dfrac{t_i^k - EET_i}{ET_i - EET_i}\right)^{\beta} & t_i^k \in [EET_i, ET_i] \\ 100\% & t_i^k \in [ET_i, LT]_i \\ \left(\dfrac{ELT_i - t_i^k}{ELT_i - LT_i}\right)^{\beta} & t_i^k \in [LT_i, ELT_i] \\ 0 & t_i^k \notin [EET_i, ELT_i] \end{cases} . \quad (1)$$

When the supermarket i provides service in time period $[ET_i, LT_i]$, and $[ET_i, LT_i]$ is the time period expected by supermarket i, the satisfaction is 100%. When you arrive too early or too late, satisfaction begins to decline; When the delivery service starts outside period $[ET_i, LT_i]$, that is $t_i^k \notin [EET_i, ELT_i]$, the customer satisfaction of the supermarket is 0 [16]. The customer satisfaction expected by the distribution center is satisfied with the service within $[Inf_{i\theta}, Sup_{i\theta}]$ time periods. If the service arrives outside this time period, there will be corresponding penalty costs.

In this essay, the time sensitivity coefficient β is 1, that is, the relationship between satisfaction $s(t_i^k)$ and service start time t_i^k is linear.

Customer satisfaction: The customer satisfaction objective function here refers to the supermarket's feelings about the service of the distribution center. In this paper, the total customer satisfaction of the primary path scheme is obtained by weighting customer satisfaction according to the proportion of the amount of fresh agricultural products purchased by each supermarket in the total amount of goods delivered. Its goal is to complete the delivery task with both quality and quantity. Therefore, the objective function of customer satisfaction is expressed as follows:

$$S = \sum_{i=1}^{n} s\left(t_i^k\right) \cdot q_i / \sum_{i}^{n} q_i. \tag{2}$$

Carbon emission cost: This paper attempts to calculate the carbon emission cost of fuel consumption and refrigeration equipment during transportation. The fuel consumption of freight cars is related to the vehicle load, so the fuel consumption per unit distance is set as ρ^* when it is fully loaded and ρ_0 when it is empty. e_0 is the emission coefficient of CO2. Then the carbon emission generated by driving at node (i, j) can be expressed as formula (3) below:

$$E_{ij}^1 = e_0 d_{ij}\left[\rho_0 + \left(\rho^* - \rho_0\right)\frac{Q_{ij}}{V}\right]. \tag{3}$$

The carbon emission generated by refrigeration of freight cars in the process of distribution is also related to the amount of goods carried. Set w as the CO2 generated by refrigeration of freight cars per unit load driven per unit distance, then the carbon emission generated by refrigeration at node (i, j) can be expressed as:

$$E_{ij}^2 = w d_{ij} Q_{ij}. \tag{4}$$

When the delivery truck returns to the distribution center after completing the distribution task, there is no agricultural product on board, that is $Q_{ij} = 0$. In this case, there is no need for refrigeration, and the fuel consumption is the fuel consumption when there is no load. According to formula (3), the carbon emission generated by the vehicle returning to the distribution center is $e_0 d_{ij} \rho_0$[17].

Based on the above analysis, it can be seen that the carbon emission during transportation is $E_{ij} = E_{ij}^1 + E_{ij}^2$ and the carbon tax is c_0 , so the total carbon emission cost C_1 can be expressed as formula (5):

$$C_1 = c_0 \sum_{k=1}^{K}\sum_{i=1}^{n} x_{ij}^k d_{ij}\left\{e_0\left[\rho_0 + \left(\rho^* - \rho_0\right)\frac{Q_{ij}}{V}\right] + wQ_{ij}\right\}. \tag{5}$$

3.2.4. To Build a Model. After comprehensive consideration, the cold chain distribution model from the dual perspective of the Internet of Things and low carbon is as follows:

$$\begin{aligned}
Z = \min\Bigg[& M_1 \sum_{k=1}^{K}\sum_{i=1}^{n} \max\left(Inf_{i\theta} - t_i^k, 0\right) \\
& + M_2 \sum_{k=1}^{K}\sum_{i=1}^{n} \max\left(t_i^k - Sup_{i\theta}, 0\right) \\
& + c_0 \sum_{k=1}^{K}\sum_{i=1}^{n} x_{ij}^k d_{ij}\left\{e_0\left[\rho_0 + \left(\rho^* - \rho_0\right)\frac{Q_{ij}}{V}\right] + wQ_{ij}\right\} \\
& + FK + \sum_{k=1}^{K}\sum_{i=1}^{n} c_{ij}^k x_{ij}^k d_{ij} \\
& + \sum_{k=1}^{K}\sum_{i=1}^{n} y_i^k P_1 q_i\left[1 - e^{-\partial_1\left(t_i^k - t_0^k\right)}\right] \\
& + \sum_{k=1}^{K}\sum_{i=1}^{n} y_i^k P_1 Q_{ij}\left[1 - e^{-\partial_2 t_{si}}\right] \\
& + \sum_{k=1}^{K} P_2 H_{k1}\left(\left(t_f^k - t_0^k\right)\right) + \sum_{k=1}^{K}\sum_{i=1}^{n} P_2 H_{k2} t_{si} y_i^k \Bigg]
\end{aligned}$$

$$s.t. \sum_{k=1}^{K} y_i^k = \begin{cases} 1 & i = 1, 2, \ldots, n \\ K & i = 0 \end{cases}$$

$$\sum_{k=1}^{K}\sum_{i=1}^{n} y_i^k = n, i = 1, 2, \ldots, n; k = 1, 2, \ldots, K$$

$$\sum_{i=1}^{n} y_i^k q_i \le V, k = 1, 2, \ldots, K$$

$$\sum_{j=1}^{n} x_{ij}^k = \sum_{j=1}^{n} x_{ji}^k \le 1, i = 0; k = 1, 2, \ldots, K$$

$$s\left(t_i^k\right) = \begin{cases} \left(\dfrac{t_i^k - EET_i}{ET_i - EET_i}\right)^{\beta} & t_i^k \in \left[EET_i, ET_i\right] \\ 100\% & t_i^k \in \left[ET_i, LT_i\right] \\ \left(\dfrac{ELT_i - t_i^k}{ELT_i - LT_i}\right)^{\beta} & t_i^k \in \left[LT_i, ELT_i\right] \\ 0 & t_i^k \notin \left[EET_i, ELT_i\right]. \end{cases} \tag{6}$$

If the next customer point after vehicle k serves the supermarket i is the supermarket j, then:

$$t_j^k = t_i^k + t_{si} + t_{ij}^k. \tag{7}$$

The objective function Z represents the lowest comprehensive cost. From the left of objective function Z, the first and second items represent the penalty cost in the distribution process, the third item represents the carbon emission cost, the fourth and fifth items represent the vehicle transportation cost, the sixth and seventh items represent the cost of goods damaged in the transportation process, and the last two items represent the refrigeration cost [18]. Constraint function (7) indicates that the distribution center sends out K cars, and each supermarket only has one car for service. Constraint function (8) indicates that every supermarket is served, and there are n supermarkets in total. Constraint function (9) represents the carrying capacity limit of the vehicle. Constraint function (10) indicates that each vehicle must start from the distribution center and finally return to the distribution center. Constraint function (11) represents the start time of fuzzy processing service. Constraint function (12) indicates that the distribution process is continuous and complete.

Penalty cost C_2: It mainly includes the waiting and delay costs of early and late delivery. To ensure the service quality of the distribution center, it is assumed that there will be punishment if you arrive at the supermarket i outside $[Inf_{i\theta}, Sup_{i\theta}]$ time period. Here, θ is 0.85, that is, when customer satisfaction is lower than 0.85, the punishment cost of delivery service will be incurred.

$$C_2 = M_1 \sum_{k=1}^{K} \sum_{i=1}^{n} \max\left(Inf_{i\theta} - t_i^k, 0\right) + M_2 \sum_{k=1}^{K} \sum_{i=1}^{n} \max\left(t_i^k - Sup_{i\theta}, 0\right). \tag{8}$$

Fixed cost C_3: mainly includes the cumulative loss of vehicles and the loss of EQUIPMENT and related software system of RFID radio frequency technology. The calculation formula of fixed cost is as follows (14):

$$C_3 = FK. \tag{9}$$

Transportation cost C_4: mainly includes fuel consumption cost and vehicle maintenance cost, which is usually proportional to vehicle mileage and can be expressed as:

$$C_4 = \sum_{k=1}^{K} \sum_{i=1}^{n} c_{ij}^k x_{ij}^k d_{ij}. \tag{10}$$

Cost of goods damage C_5: The corruption function $D(t) = D_0 e^{-\partial t}$ of fresh agricultural products is established by referring to the exponential speed corruption continuous life cycle function and considering the impact of the Internet of things on the cost of goods damage. It is used to describe the rule of product loss over time. D_0 is the initial quality of the product, ∂ is the spoilage rate of the product, and the cost of cargo damage mainly includes the loss when the door is not opened C_a and the loss when the door is opened during unloading.

$$C_a = \sum_{k=1}^{K} \sum_{i=1}^{n} y_i^k P_1 q_i \left[1 - e^{-\partial_1 \left(t_i^k - t_0^k\right)}\right]$$
$$C_b = \sum_{k=1}^{K} \sum_{i=1}^{n} y_i^k P_1 Q_{ij} \left[1 - e^{-\partial_2 t_{si}}\right]. \tag{11}$$

To sum up, the cost of damage can be:

$$C_5 = \sum_{k=1}^{K} \sum_{i=1}^{n} y_i^k P_1 q_i \left[1 - e^{-\partial_1 \left(t_i^k - t_0^k\right)}\right] + \sum_{k=1}^{K} \sum_{i=1}^{n} y_i^k P_1 Q_{ij} \left[1 - e^{-\partial_2 t_{si}}\right]. \tag{12}$$

Refrigeration cos C_6 t: includes the refrigeration cost incurred by heat exchange when the carriage is closed and after the unloading doors are opened. When the compartment is closed, there will be two factors, namely temperature difference between inside and outside and air leakage of the compartment, which will produce refrigeration cost. The thermal load coefficient of the third compartment when it is closed is H_{k1}, then the refrigeration cost C_d generated during the running of all vehicles can be expressed as:冷成本 C_6 ：

$$C_d = \sum_{k=1}^{K} P_2 H_{k1} \left(\left(t_f^k - t_0^k\right)\right). \tag{13}$$

When the door is opened for unloading, convection is generated with the outside air, forming thermal intrusion. The thermal load coefficient of the kth car when the door is opened is H_{k2}, then the refrigeration cost C_e generated by all the vehicles in the unloading process can be expressed as formula (14):

$$C_e = \sum_{k=1}^{K} \sum_{i=1}^{n} P_2 H_{k2} t_{si} y_i^k. \tag{14}$$

In summary, refrigeration cost C_6 of fresh agricultural products in the whole logistics distribution process is:

$$C_6 = \sum_{k=1}^{K} P_2 H_{k1} \left(\left(t_f^k - t_0^k\right)\right) + \sum_{k=1}^{K} \sum_{i=1}^{n} P_2 H_{k2} t_{si} y_i^k. \tag{15}$$

3.3. Simulation Research on Cold Chain Distribution Path from the Dual Perspective of Internet of Things and Low Carbon

3.3.1. Genetic Algorithm (ga). The research in this essay is a multiobjective optimization problem, which studies the path optimization of cold chain distribution under the dual perspective of the Internet of Things and low carbon. Therefore, a genetic algorithm with robustness and strong global search ability is selected to solve the problem, and its core idea is derived from the principle of "survival of the fittest and survival of the fittest". The adaptability to environmental constraints can be achieved by optimization through elimination and variation. In this essay, the improved genetic algorithm is used for simulation. To achieve the best route distribution with the highest customer satisfaction, the overall cost and the optimal carbon emissions.

3.3.2. Improved Genetic Algorithm Design

(1) Encoding mechanism. In this paper, the vehicle routing problem is studied, and integer coding

method is adopted instead of traditional binary coding method to represent the double helix structure of supermarket and vehicle in the form of chromosomes [19]. The method is as follows: N supermarkets are all arranged as $N = \{N_0, N_1, \ldots, N_n\}$, where supermarket $N_1 \sim N_{k1}$ is allocated to vehicle 1, which satisfies the constraint function of maximum carrying capacity (9) and fuzzy time constraint function (11). The supermarket $N_{k1+1} \sim N_{k2}$ is assigned to vehicle 2, and the service of vehicle 2 to $N_{k1+1} \sim N_{k2}$ still needs to satisfy constraint functions (9) and (11), and so on. In 1~12, for example, integer 12 to service supermarket, supermarket will be 12 full arrangement for, 3, 11, 7, 8, 5, 1, 2, 4, 9, 10, 12 (6), again with the constraint conditions to generate the corresponding vehicle arrangement, 1, 1, 2, 2, 2, 3, 3, 3, 3, 4, 4 (1), Represents the first car serving supermarkets 6, 3 and 11, the second car serving supermarkets 7, 8 and 5, the third car serving supermarkets 1, 2, 4 and 9, and the fourth car serving supermarkets 10 and 12.

(2) Population initialization. In this essay, the effect of population size on algorithm performance is considered comprehensively, and the initial population with random size of 100 is chosen. The number of samples is sufficient, the search results are good, and the calculation amount is not too large, and the convergence speed is fast, which meets our expected requirements.

(3) Fitness function. The fitness function is also called the evaluation function. The fitness function value reflects the probability of an individual being inherited to the next generation. The greater the fitness function value is, the greater the probability will be, and it can be preserved as excellent chromosomes. The fitness function of the first chromosome can be expressed as:

$$f_i = \frac{1}{Z}. \tag{16}$$

(4) Choose a strategy. Pairs of individuals in the population are compared, and those with high fitness function values enter the offspring population, and this operation is repeated until the number of individuals in the population reaches the original size. To ensure that the optimal individuals can be inherited to the next generation, the population with the largest fitness function value in each generation is directly reserved to the next generation, and the rest of the offspring are selected by the above steps. This selection strategy is called the tournament strategy.

(5) Crossover algorithm. The crossover algorithm is the core of the genetic algorithm, which determines the global search ability of genetic algorithm. In this essay, cross operation is carried out by the cyclic cross method. The specific operation process is to first find a cycle of two individuals in the parent generation, and copy the supermarket in the cyclic position of one parent generation to the next generation, and at the same time copy the supermarket in the noncyclic position of the other parent generation to the next generation [20, 21].

(6) Mutation operation. Mutation operation is the process of exchanging some genes in a pair of chromosomes to create a new chromosome. In this essay, in-place variation, exchange variation, and insertion variation were adopted to carry out mutation operation with mutation probability Pm [22].

4. Results' Analysis

(1) The basic case of the example is parameter setting. In this paper, supermarkets within 10 km of Taiyuan city are taken as the distribution object of fresh agricultural products, the intersection of Xizhong Ring Road and South Zhonghuan Street is taken as the origin of coordinates, and the distance between supermarkets and the origin of coordinates represents the corresponding position (X, Y). In addition, a cold chain logistics center is taken as the distribution subject, and the specific data are shown in Table 2

It can be seen from Table 2 that 26.3 tons of agricultural products need to be transported. Now, assuming that the vehicle is traveling at a constant speed, the maximum carrying weight of the vehicle V is 9 tons, the transportation cost per unit distance is 3 yuan/km, the driving speed is 50 km/h, the fixed cost F is 200 yuan/vehicle, and the waiting cost per unit time in the supermarket M_1 is 10 yuan/min. Unit time delay cost M_2 of supermarket is 60 yuan/min. The target satisfaction θ of distribution center is 0.85, the unit value P_1 of agricultural products is 6000 yuan/ton, and the corruption rate of products $\partial_1 = 0.002$, $\partial_1 = 0.003$, unit refrigeration cost P_2 is 1.5 yuan/kCal, thermal load coefficient $H_{k1} = 4944.69$ kCal/h, $H_{k2} = 211.38$ kCal/h, The fuel consumption per unit distance ρ^* is 0.377 L/km when the vehicle is fully loaded, The fuel consumption per unit distance ρ_0 when the vehicle is fully loaded is 0.377 L/km, and the fuel consumption per unit distance when the vehicle is unloaded is 0.165 L/km, CO_2 emission coefficient e_0 is 2.63 kg/L, and the CO_2 w generated by refrigeration per unit load of truck distribution per unit distance is 0.0066 g/(kg·km) [23].

(2) Analysis of simulation results. In this paper, the population size pop is set as 100, the crossover probability is Pc 0.3, the genetic algebra gen is 1500, and the genetic probability is Pm 0.1. The optimal logistics distribution path satisfying the total cost is obtained by analyzing different carbon taxes c_0, as shown in Figure 2.

Table 2: Demand data of supermarket.

Serial number	Location (X, Y)/kilometre	Demand for/Tons	Service time/min	Fuzzy time window[EETi, ETi, LTi, ELTi]
Distribution center0	(6.603, 0.715)	0	0	[5:00, 5:30, 17:00, 17:30]
The supermarket1	(5.702, 2.861)	1.5	20	[5:30, 6:00, 8:00, 9:00]
The supermarket2	(5.466, 4.727)	0.5	10	[7:00, 7:30, 9:00, 9:30]
The supermarket3	(4.093, 3.418)	1.5	20	[5:30, 6:00, 8:00, 8:30]
The supermarket4	(3.750, 2.410)	1.5	20	[6:00, 6:30, 8:20, 9:00]
The supermarket5	(6.667, 5.607)	2	25	[6:10, 6:40, 8:30, 10:00]
The supermarket6	(4.136, 5.435)	2	25	[6:30, 7:00, 9:00, 10:20]
The supermarket7	(2.978, 4.319)	1.8	22	[6:30, 7:20, 9:00, 10:20]
The supermarket8	(5.209, 6.486)	1	15	[7:00, 7:30, 9:00, 10:00]
The supermarket9	(2.913, 2.217)	1	15	[6:40, 7:00, 8:30, 9:30]
The supermarket10	(1669, 4.791)	1	15	[6:30, 7:00, 9:00, 9:40]
The supermarket11	(2.420, 6.808)	1	15	[7:00, 7:30, 9:30, 10:30]
The supermarket超市12	(4.222, 7.537)	0.5	10	[7:00, 7:30, 9:00, 10:00]
The supermarket13	(0.982, 6.379)	0.5	10	[7:00, 7:30, 9:30, 10:30]
The supermarket14	(7.998, 5.027)	1.5	20	[7:00, 7:30, 9:00, 10:00]
The supermarket15	(7.976, 6.443)	2	25	[6:20, 6:50, 8:30, 9:30]
The supermarket16	(6.860, 7.301)	1.5	20	[6:40, 7:00, 8:40, 9:30]
The supermarket17	(6.002, 6.400)	1.5	20	[6:40, 7:00, 8:40, 9:30]
The supermarket18	(7.032, 5.113)	0.5	10	[7:00, 7:50, 9:00, 10:00]
The supermarket19	(4.822, 2.646)	2.5	30	[6:00, 6:30, 8:30, 9:301]
The supermarket20	(6.212, 2.110)	1	15	[7:00, 7:50, 9:00, 10:00]

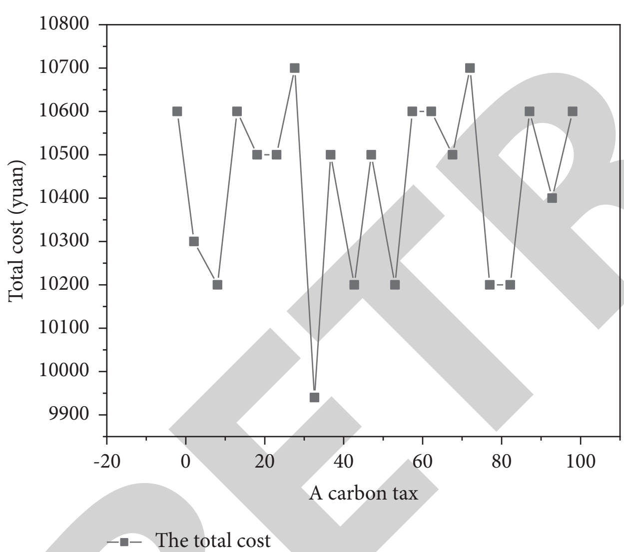

Figure 2: Total cost of carbon tax at 0–100 yuan/ton.

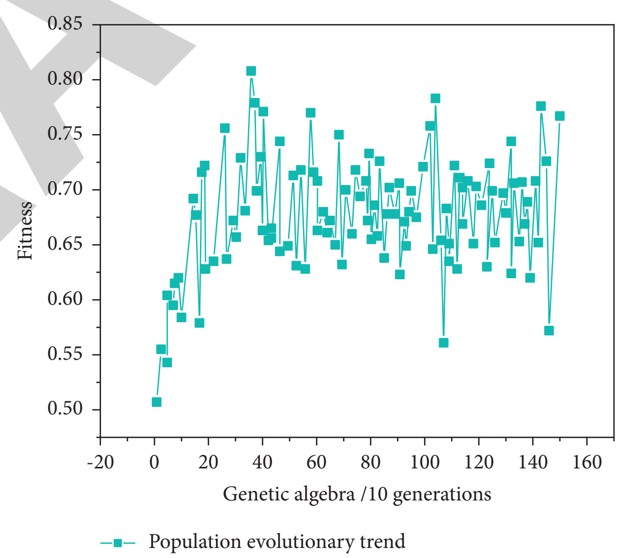

Figure 3: Evolution trend of the population with a carbon tax of 35 yuan/ton.

As can be seen from Figure 2, when the carbon tax is between 0 and 100 yuan/ton, the total cost fluctuates within a certain range without a straight rise due to the increase of tax, which indicates that the carbon tax is a reasonable range that enterprises can bear within this range. Compared with the total cost when the carbon tax is 0, only the total cost when the carbon tax is 30 yuan, 65 yuan, 75 yuan, and 100 yuan/ton exceeds the total cost when the carbon tax is 0, and the total cost of the remaining carbon tax is not greater than the total cost when the carbon tax is 0, indicating that the government is effectively binding to impose the carbon tax on enterprises [24].

In this article, the distribution scheme with the lowest carbon emission and the lowest total cost, that is, the carbon tax is 35 yuan/ton, is selected for detailed explanation. The specific simulation results are shown in Figure 3. At 1400 generation, the algorithm approximates the optimal solution and draws the geographical location map of distribution center and supermarkets according to the data in Table 2. 0 represents the distribution center and data 1–20 represents the location of each supermarket, as shown in Figure 4 [25].

The optimal path can be obtained by decoding according to the optimal solution, as shown in Table 3. The path of this scheme is plotted with Matlab software to obtain the optimal transportation path, as shown in Figure 5.

To sum up, the optimal solution of this paper is: The total cost is 9917.12 yuan, customer satisfaction is 97.07%, carbon

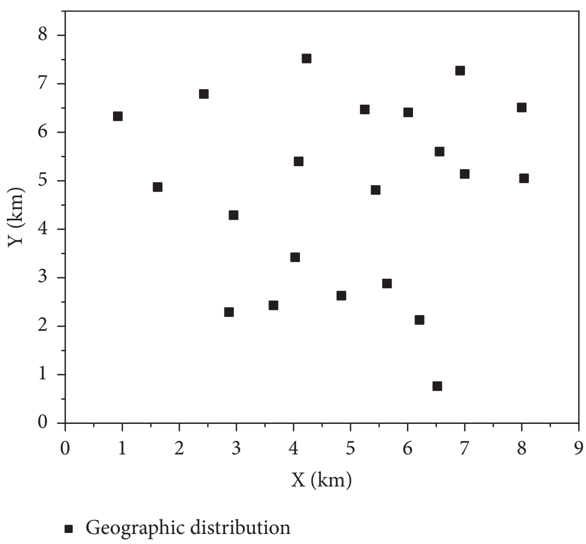

Figure 4: Distribution of distribution centers and supermarkets.

Table 3: The best transportation route when carbon tax is 35 yuan/ton.

The vehicle number	Route sequence from distribution center to supermarkets
1	0⟶9⟶4⟶3⟶19⟶1⟶20⟶0
2	0⟶6⟶7⟶10⟶13⟶11⟶12⟶8⟶2⟶0
3	0⟶5⟶17⟶16⟶15⟶14⟶18⟶0

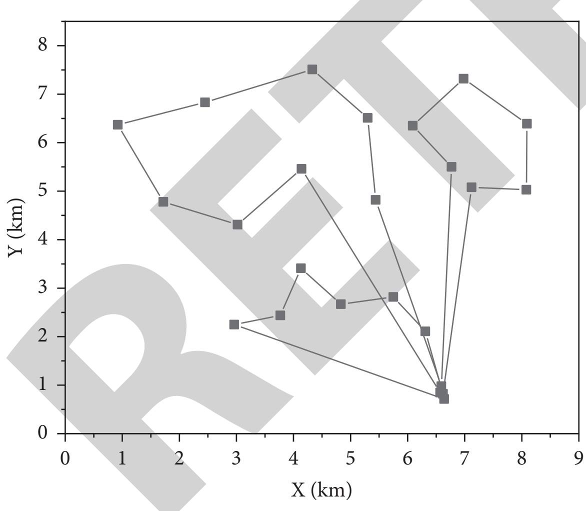

Figure 5: Schematic diagram of optimal transportation route.

emission is 161.06 kg, carbon tax is 5.64 yuan/ton, fixed cost is 600 yuan, transportation cost is 72.72 yuan, refrigeration cost is 8811.73 yuan, cargo damage cost is 427.03 yuan. The penalty cost is 0 yuan, and the distribution path is shown in Figure 5. In this paper, the improved genetic algorithm adopts different carbon tax solving models for many times, aiming at the minimum total cost and the customer satisfaction most suitable for enterprise expectations, and obtains the optimal solution, which verifies the effectiveness of the algorithm and the rationality of the model.

5. Conclusion

With the popularization of 5G technology, the cold chain distribution mode in the Internet of Things environment will further mature and develop, and promote the intelligence and information of fresh agricultural products distribution. In this essay, in the construction of the model, consider customer satisfaction and carbon emissions, balancing the interests of the enterprise and customer, from the distribution of the punishment cost, carbon cost, transportation cost, vehicle fixed cost, cost of refrigeration and damage cost six aspects to consider the total cost of investment, and with the improved genetic algorithm on Matlab software for cold-chain distribution under different carbon tax path optimization. It is concluded that the addition of carbon tax not only does not increase the total cost of the enterprise, but effectively restricts the carbon emissions of the enterprise, thus reducing the total cost input of the enterprise. At the same time, it conforms to the development concept of green ecology, and provides decision-making reference for the enterprise in the planning of cold chain logistics distribution path. In future studies, the closed-loop cold chain distribution of receiving goods can be considered at the same time of delivery to improve work efficiency, energy conservation, and emission reduction, and strive to achieve low-carbon logistics.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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