JOURNAL OF NORTHEASTERN UNIVERSITY

Volume 27 Issue 01, 2024 ISSN: 1005-3026 https://dbdxxb.cn/ Original Research Paper

ENHANCING INVENTORY EFFICIENCY IN A DUAL-WAREHOUSE SYSTEM: A FLOWER POLLINATION ALGORITHM APPROACH

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Abstract:

This paper explores the application of the Flower Pollination Algorithm (FPA) in optimizing inventory management for a two-warehouse supply chain. The objective is to minimize total inventory costs while meeting demand and adhering to operational constraints. FPA, inspired by the pollination process, is employed to iteratively improve solutions. The study includes problem formulation, algorithm integration, and validation using historical data. Results showcase FPA's effectiveness in enhancing supply chain efficiency and decision-making. This research contributes valuable insights for leveraging soft computing in addressing complexities of inventory optimization in dual-warehouse scenarios.

Keywords: Warehouse, Inflation, Variable holding cost, production cost, Flower Pollination Algorithm

1. Introduction:

In the contemporary landscape of supply chain management, the efficient optimization of inventory has become increasingly paramount for organizations seeking to enhance operational performance and minimize costs. The challenges posed by a two-warehouse supply chain amplify the complexity of inventory management, necessitating innovative approaches for achieving optimal stock levels and distribution strategies. This paper explores the application of soft computing techniques, specifically the Flower Pollination Algorithm (FPA), as a means of addressing the intricacies of inventory optimization within a two-warehouse supply chain framework.

Supply chain dynamics are subject to various uncertainties, including demand fluctuations, lead time variations, and external disruptions. These uncertainties necessitate robust optimization methodologies capable of adapting to changing conditions. Traditional optimization methods often struggle to handle the inherent complexity and dynamic nature of

Submitted: 11/12/2023 **Accepted**: 09/01/2024

supply chain systems, making the application of soft computing techniques increasingly relevant.

Managing inventory across two warehouses adds an additional layer of complexity to the supply chain structure. Balancing stock levels, order fulfillment, and transportation costs between two distinct locations requires sophisticated optimization strategies. This study focuses on the unique challenges posed by dual warehousing systems and aims to devise a solution that enhances overall efficiency.

Soft computing paradigms, such as fuzzy logic, neural networks, and metaheuristic algorithms, have shown promising results in addressing optimization challenges in various domains. These techniques excel in handling imprecision, uncertainty, and non-linearity – characteristics often prevalent in supply chain systems. The integration of soft computing into inventory optimization strategies offers a flexible and adaptive approach to the dynamic nature of supply chains.

The Flower Pollination Algorithm draws inspiration from the natural process of pollination in flowering plants. Mimicking the pollination behavior of flowers, this algorithm has demonstrated effectiveness in solving optimization problems. Its simplicity, efficiency, and ability to explore diverse solution spaces make it a promising candidate for addressing the intricate nature of two-warehouse supply chain inventory optimization.

The remainder of this paper is organized as follows: Section 2 provides a literature review, highlighting existing research in the field of supply chain inventory optimization and the application of soft computing techniques. Section 3 outlines the methodology, detailing the mathematical model and the implementation of the Flower Pollination Algorithm. Section 4 presents the results of the experiments conducted, and Section 5 discusses the findings. Finally, Section 6 concludes the paper, summarizing key contributions and suggesting avenues for future research.

2. Related Work

Supply chain management can be defined as: "Supply chain management is the coordination of production, storage, location and transport between players in the supply chain to achieve the best combination of responsiveness and efficiency for a given market. Many researchers in the inventory system have focused on a product that does not overcome spoilage. However, there are a number of things whose meaning doesn't stay the same over time. The deterioration of these substances plays an important role and cannot be stored for long {Yadav et al. (1-10) Deterioration of an object can be described as deterioration, evaporation, obsolescence and loss of use or restriction of an object, resulting in less inventory consumption than under natural conditions. When raw materials are put in stock as a stock to meet future needs, there may be a deterioration of the items in the arithmetic system which could occur for one or more reasons, etc. Storage conditions, weather or humidity. {Yadav, et al. (11-20)} Inach generally states that management has a warehouse to store the purchased warehouse. However, for various reasons, management may buy or lend more than it can store in the warehouse and call it OW, with an extra number in a rented warehouse called RW near OW or just off it {Yadav, a. al. (21-53)}. Inventory costs (including maintenance costs and depreciation costs) in RW are generally higher than OW costs due to additional costs of running, equipment maintenance, etc. Reducing inventory costs will cost-effectively utilize RW products as quickly as possible. Actual customer service is only provided by OW, and to reduce costs, RW stock is cleaned first. Such arithmetic examples are called two arithmetic examples in the shop {Yadav and swami. (54-61)}.Management of the supply of electronic storage devices and integration of environmental and nerve networks {Yadav and Kumar (62)}. Analysis of seven supply chain management measures to improve inventory of electronic storage devices by submitting a financial burden using GA and PSO and supply chain management analysis to improve inventory and inventory of equipment using genetic computation and model design and chain inventory analysis from bi inventory and economic difficulty in transporting goods by genetic computation {Yadav, AS (63, 64, 65)}. Inventory policies for inventory and inventory needs and miscellaneous inventory costs based on allowable payments and inventory delays An example of depreciation of various types of goods and services and costs by keeping a business loan and inventory model with pricing needs low sensitive, inventory costs versus inflationary business expense loans {Swami, et. al. (66, 67, 68)}. The objectives of the Multiple Objective Genetic Algorithm and PSO, which include the improvement of supply and deficit, inflation and a calculation model based on a genetic calculation of the scarcity and low inflation of PSO {Gupta, et. al. (69, 70)}. An example with two stock depreciation on assets and inventory costs when updating particles and an example with two inventories of property damage and inventory costs in inflation and soft computer techniques {Singh, et. al. (71, 72)}. Delayed control of alcohol supply and particle refinement and green cement supply system and inflation by particle enhancement and electronic inventory system and distribution center by genetic computations {Kumar, et. al. (73, 74.75)}. Depreciation example at two stores and warehouses based on inventory using one genetic stock and one vehicle stock for demand and inflation inventory with two distribution centers using genetic stock {Chauhan and Yadav (76, 77)}. Analysis of marble Improvement of industrial reserves based on genetic technology and improvement of multiple particles {Pandey, et. al. (78)} The white wine industry in supply chain management through nerve networks {Ahlawat, et. al. (79)}. The best policy to import damaged goods immediately and pay for conditional delays under the supervision of two warehouses {Singh, et. al. (80)}.

3. Assumptions:

(I) Relative to the production rate, the unit production cost.

(II) A variable used in decision-making is the pace of production.

(III) It is unacceptable to have shortages.

(IV) A fixed capacity is possessed by the own storehouse.

4. Notations:

H: Total planning prospect.

Rp: Variable production rate.

λ(t): Demand rate is exponentially increasing and represented by $\lambda = \lambda_1 e^{(\sigma+1)t}$, where $0 \leq (\sigma+1)\sigma \leq 1$, $(\sigma+1)$ is a constant inflation rate

W: Fix capacity level of OW

$\boldsymbol{\delta(t)}$:Variable deterioration rate $(\varepsilon+1)(t) = (\varepsilon+1)t$

$\boldsymbol{\gamma(t)}$:Variable deterioration rate $(\mu+1)(t) = (\mu+1)t$ in RW

$\boldsymbol{d}$: Discount rate $(d > a)$

$\boldsymbol{n}$**:** No. of Production cycle during entire horizon H

$\boldsymbol{C_0 + \phi t}$: Variable carrying cost of on item

$\boldsymbol{\mu_0(Rp)}$: Cost of an item's unit manufacture and $\boldsymbol{\mu_0(Rp) = R + \frac{G}{P} + NP}$, where R is substantial cost, N is device or die cost and G is energy and employment cost.

The equation will

$$\frac{dI_{k1}(t)}{dt} + (\varepsilon+1)tI_{k1}(t) = (Rp+1) - \lambda_1 e^{(\sigma+1)t} \quad , \ t_{k1} < t < t_{k1} \qquad (1)$$

$$\frac{dI_{k2}(t)}{dt} + (\mu+1)tI_{k2}(t) = (Rp+1) - \lambda_1 e^{(\sigma+1)t} \quad , \ t_{k1} < t < t_{k2} \quad (2)$$

$$\frac{dI_{k3}(t)}{dt} + (\mu+1)tI_{k3}(t) = -\lambda_1 e^{(\sigma+1)t}, \ t_{k2} < t < t_{k3} \qquad (3)$$

$$\frac{dI_{k4}(t)}{dt} + (\varepsilon+1)tI_{k4}(t) = -\lambda_1 e^{(\sigma+1)t} \quad , \ t_{k3} < t < t_{k4} \qquad (4)$$

$$\frac{dI_{k5}(t)}{dt} + (\varepsilon+1)tI_{i5}(t) = -\lambda_1 e^{(\sigma+1)t} \quad , \ t_{k1} \leq t < t_{k5} \ \ \text{k =1, 2 ....} \qquad (5)$$

$$\frac{dI_{k6}(t)}{dt} \qquad = -\lambda_1 e^{(\sigma+1)t} \qquad , \qquad t_{k4} \leq t < t_{k5} \quad (6)$$

The solution of this equation (1) is

$$I_{k1}(t)e^{\frac{(\varepsilon+1)t^2}{2}} = ((Rp+1)-\lambda_1)t - \frac{\lambda_1(\sigma+1)}{2}t^2 + ((Rp+1)(\varepsilon+1)-\lambda_1((\varepsilon+1) + (\sigma+1)^2))\frac{t^3}{6} + C$$

Put t= (t_{k-1})s

$$I_{k1}(t)e^{\frac{(\varepsilon+1)t^2}{2}} = ((Rp+1)-\lambda_1)(t-t_{k-1}) - \frac{\lambda_1(\sigma+1)}{2}({t^2}_{k-1} - t^2)[(Rp+1)(\varepsilon+1)-\lambda_1((\varepsilon+1) + (\sigma+1)^2)]\left[\frac{{t^3}_{k-1}}{6} - {t^3}_{k-1}\right]$$

$$I_{k1}(t) = [((Rp+1)-\lambda_1)(t-t_{k-1}) + \frac{\lambda_1(\sigma+1)}{2}({t^2}_{k-1} - t^2) + [(Rp+1)(\varepsilon+1) - \lambda_1((\varepsilon+1) + (\sigma+1)^2)]\left[\frac{t^3}{6} - \frac{{t^3}_{k-1}}{6}\right]e^{-\frac{(\varepsilon+1)t^2}{2}} \quad (7)$$

Similarly, the result of $I_{k2}(t)$ will be

$$I_{k2}(t) = [((Rp+1)-\lambda_1)(t-t_{k-1}) + \frac{\lambda_1(\sigma+1)}{2}({t^2}_{k} - t^2) + [(Rp+1)(\varepsilon+1) - \lambda_1((\mu+1) + (\sigma+1)^2)]\left[\frac{t^3}{6} - \frac{{t^3}_{k1}}{6}\right]e^{-\frac{(\mu+1)t^2}{2}} \quad (8)$$

Now result of equation (3) as

$$I_{k3}(t)e^{\frac{(\mu+1)t^2}{2}} = -\lambda_1\left[t + \frac{t^2}{2} + ((\mu+1) + (\sigma+1)^2)\frac{t^3}{6}\right] + C$$

Put t= t_{k3}

$$I_{k3}(t)e^{\frac{(\mu+1){t^2}_3}{2}} = -\lambda_1\left[t_{k3} + \frac{(\sigma+1){t^2}_{k3}}{2} + ((\mu+1) + (\sigma+1)^2)\frac{{t^3}_{k3}}{6}\right] + C'$$

Put $I_{k3}(t_{k3}) = 0$

$$T_{k3}(t) = \left[\lambda_1(t_{k3}-t)\frac{(\sigma+1)}{2}\lambda_1({t^2}_{k3} - t^2) + \left(\frac{(\varepsilon+1)+(\sigma+1)^2}{6}\right)\lambda_1\{{t^3}_{k3} - t^3\}\right]e^{\frac{-(\mu+1)t^2}{2}} \quad (9)$$

So, the result of equation (4) will be

$$T_{k4}(t) = \left[\lambda_1(t_{k4}-t)\frac{(\sigma+1)}{2}\lambda_1({t^2}_{k4} - t^2) + \left(\frac{(\varepsilon+1)+(\sigma+1)^2}{6}\right)\lambda_1\{{t^3}_{k4} - t^3\}\right]e^{-1} \quad (10)$$

Now result of equation of (5)

$$I_{k5}(t)e^{\frac{(\varepsilon+1)t^2}{2}} = We^{\frac{(\varepsilon+1){t^2}_{k1}}{2}}$$

$I_{k5}(t) \;=\; We^{\frac{(\varepsilon+1)}{2}}({t^2}_{k1} - t^2)$ (11)

Now result of equation (6) using boundary condition is

$I_{k6}(t) \;=\; \frac{\lambda_1}{(\sigma+1)}(e^{(\sigma+1)t}{}_{k4} - e^{(\sigma+1)t})$ (12)

Since W is charged put the value of $I_{k1}(t_{k1}) = W$

$$\mathrm{W} \;=\; [((Rp+1)-\lambda_1)(t - t_{k-1}) + \frac{\lambda_1(\sigma+1)}{2}({t^2}_{k-1} - {t^2}_{k1}) + \left[\frac{(Rp+1)(\varepsilon+1)-\lambda_1((\varepsilon+1)+(\sigma+1)^2)}{6}\right][{t^3}_{k1} - {t^3}_{i-1}]e^{-\frac{(\varepsilon+1)t^2}{2}} \qquad (13)$$

We can calculate the worth of W since he has been fined. t_{k1} in terms of t_{k-1}

Now

$$I_{k4}(t) \;=\; \lambda_1(t_{k4} - t) + \frac{\lambda_1(\sigma+1)}{2}({t^4}_{k2} - t^2) + \left(\frac{(\varepsilon+1)+(\sigma+1)^2}{6}\right)\lambda_1\{{t^3}_{k4} - t^3\}e^{-\frac{(\varepsilon+1)t^2}{2}}$$

Put t=t_{k3}

$$I_{k4}(t)_{k3} \;=\; \lambda_1(t_{k4} - t_{k3}) + \frac{\lambda_1(\sigma+1)}{2}({t^2}_{k4} - {t^2}_{k3}) + \left(\frac{(\varepsilon+1)+(\sigma+1)^2}{6}\right)\lambda_1\{{t^3}_{k4} - {t^3}_{k3}\}e^{-\frac{(\varepsilon+1){t^2}_{k3}}{2}}$$

And $I_{k5}(t) \;=\; We^{\frac{(\varepsilon+1)}{2}}({t^2}_{k1} - t^2)$

Put t=t_{k3}

$I_{k5}(t) \;=\; We^{\frac{(\varepsilon+1)}{2}}({t^2}_{k1} - {t^2}_{k3})$

Put $I_{k4}(t_{k3}) = I_{k5}(t_{k3})$

$$\left[\lambda_1(t_{k4} - t_{k3}) + \frac{\lambda_1(\sigma+1)}{2}({t^2}_{k4} - {t^2}_{k3}) + \left(\frac{(\varepsilon+1)+(\sigma+1)^2}{6}\right)\lambda_1\{{t^3}_{k4} - {t^3}_{k3}\}e^{-\frac{(\varepsilon+1){t^2}_{k3}}{2}}\right] = we^{\frac{(\varepsilon+1)}{2}}({t^2}_{k1} - {t^2}_{k3})$$

$$\left[\lambda_1(t_{k4} - t_{k3}) + \frac{\lambda_1(\sigma+1)}{2}({t^2}_{k4} - {t^2}_{k3}) + \left(\frac{(\varepsilon+1)+(\sigma+1)^2}{6}\right)\lambda_1\{{t^3}_{k4} - {t^3}_{k3}\}We^{-\frac{(\varepsilon+1)}{2{t^2}_{k1}}}\right]$$

(14)

$$I_{k2}(t) \;=\; [((Rp+1)-\lambda_1)(t - t_{k-1}) + \frac{\lambda_1(\sigma+1)}{2}({t^2}_{k-1} - t^2) + \left\{\frac{(Rp+1)(\varepsilon+1)-\lambda_1((\mu+1)+(\sigma+1)^2)}{6}\right\}(t^3 - {t^3}_{k-1})]$$

$$I_{k2}(t) = [((Rp+1)-\lambda_1)(t-t_{k1}) + \frac{\lambda_1(\sigma+1)}{2}({t^2}_{k1}-t^2) + [(Rp+1)C - \lambda_1((\varepsilon+1) + (\sigma+1)^2)]\left[\frac{t^3}{6} - \frac{{t^3}_{k-1}}{6}\right]e^{-\frac{(\varepsilon+1)t^2}{2}}$$

Put t = t_{k2}

$$I_{k2}(t_{k2}) = [((Rp+1)-\lambda_1)(t_{k2}-t_{k1}) + \frac{\lambda_1(\sigma+1)}{2}({t^2}_{k1}-{t^2}_{k2}) + [(Rp+1)C - \lambda_1((\varepsilon+1) + (\sigma+1)^2)][{t^3}_{k2}-{t^3}_{k1}]e^{-\frac{(\varepsilon+1){t^2}_{k2}}{2}}$$

$$I_{k3}(t) = [\lambda_1(t_{k3}-t) + \frac{\lambda_1(\sigma+1)}{2}({t^2}_{k3}-t^2) + \left\{\frac{(\varepsilon+1)+(\sigma+1)^2}{6}\right\}\lambda_1({t^3}_{k3}-t^3)]e^{-\frac{(\varepsilon+1)t^2}{2}}$$

Put t = t_{k2}

$$I_{k3}(t) = [\lambda_1(t_{k3}-t_{k2}) + \frac{(\sigma+1)}{2}({t^2}_{k3}-{t^2}_{k2}) + \left\{\frac{(\varepsilon+1)+(\sigma+1)^2}{6}\right\}\lambda_1({t^2}_{k3}-{t^2}_{k2})]e^{-\frac{(\varepsilon+1)t^2}{2}}$$

Put $I_{k3}(t_{k2}) = I_{k2}(t_{k2})$

$$[\lambda_1(t_{k3}-t_{k2}) + \frac{(\sigma+1)\lambda_1}{2}({t^2}_{k3}-{t^2}_{k2}) + \left\{\frac{(\varepsilon+1)+(\sigma+1)^2}{6}\right\}\lambda_1({t^3}_{k3}-{t^3}_{k2})]e^{-\frac{(\varepsilon+1){t^2}_{k2}}{2}}$$

$$=\left[((Rp+1)-\lambda_1)(t_{k2}-t_{k1}) + \frac{\lambda_1(\sigma+1)}{2}({t^2}_{k1}-{t^2}_{k2}) + [(Rp+1)(\varepsilon+1) - \lambda_1((\varepsilon+1) + (\sigma+1)^2)]\ \frac{{t^3}_{k2}-{t^3}_{k1}}{6}\right]e^{\frac{-(\varepsilon+1)t^2}{}}$$

$$=\lambda_1 t_{k3} + \frac{(\sigma+1)}{2}\lambda_1{t^2}_{k3} + \left(\frac{(\varepsilon+1)+(\sigma+1)^2}{6}\right)\lambda_1{t^3}_{k3}$$

$$=-((Rp+1)(\varepsilon+1)-\lambda_1)t_{k1} + (Rp+1)t_{k2} + \frac{\lambda_{1(\sigma+1)}}{2}{t^2}_{k1} - [(Rp+1)(\varepsilon+1) - \lambda_1((\varepsilon+1) + (\sigma+1)^2)]\frac{{t^3}_{k1}}{6} + \frac{(Rp+1)(\varepsilon+1){t^3}_{k2}}{6} \qquad (15)$$

Inventory holding costs for the cycle's current value expressed in RW

$$I_{Rwk} = [C(t_{k-1}) + t\,]e^{-dt_{k-1}}\left[\int_{t_{k1}}^{t_{k2}} I_{k2}(t)e^{-dt}dt + \int_{t_{k2}}^{t_{k3}} I_{k3}(t)e^{-dt}dt\right]$$

$$=[C(t_{k-1})\,]e^{-dt_{k-1}}\left[\int_{t_{k1}}^{t_{k2}} I_{k2}(t)e^{-dt}dt + \int_{t_{k2}}^{t_{k3}} I_{k3}(t)e^{-dt}dt\right] + \phi tC(t_{k-1})e^{-dt_{k-1}}\left[\int_{t_{k1}}^{t_{k2}} T_{k2}(t)e^{-dt}dt + \int^{t_{k3}} T_{k3}(t)e^{-dt}dt\right] \qquad (16)$$

Current inventory holding costs for during the OW cycle

$$I_{owk} = [C(t_{k-1}) + \phi\, t\,]e^{-dt_{k-1}}\left[\int_{t_{k-1}}^{t_{k1}} I_{k1}(t)e^{-dt}dt + \int_{t_{k1}}^{t_{k3}} I_{k5}(t)e^{-dt}dt + \int_{t_{k3}}^{t_{k-1}} I_{k4}(t)e^{-dt}dt\right]$$

$$=C(t_{k-1})e^{-d(t_{k-1})}\left[\int_{t_{k-1}}^{t_{k1}} I_{k1}(t)e^{-dt}dt + \int_{t_{k1}}^{t_{k3}} I_{k5}(t)e^{-d}\ dt + \int_{t_{k3}}^{t_{k4}} I_{k4}(t)e^{-dt}dt\right]$$

$$+\phi t e^{-d(t_{k-1})}\left[\int_{t_{k-1}}^{t_{k1}} I_{k1}(t)e^{-dt}dt + \int_{t_{k1}}^{t_{k3}} I_{k5}(t)e^{-dt}dt + \int_{t_{k3}}^{t_{k4}} I_{k4}(t)e^{-dt}dt\right] \quad (17)$$

Cost of the cycle's present worth setup

$$C_{s,k} = C_{so}e^{((\sigma+1)-d)t_{k-1}},\ k = 1,2,3\ldots\ldots k \quad (18)$$

The cycle's present-value production cost

$$\mathrm{P}C_k\ \ n_0((Rp+1))e^{((\sigma+1)-d)_{tk-1}}\left[\int_{t_{k-1}}^{k1}(Rp+1)e^{-dt}dt + \int_{t_{k-2}}^{k1}(Rp+1)e^{-dt}dt\ +\right]$$
(19)

As a result, the cycle's total variable cost's present value

$$T_{Ck} = I_{RWk} + I_{OWk} + PC_k + C_{sk}\ ,\ \ \mathrm{k=1,2,3\ldots\ldots n} \quad (20)$$

The current value of the system's total variable cost during the course of the planning horizon H is provided by

$$TC_H(n,(Rp+1)) = \sum_{k=1}^{n} TC_k = \sum_{k=1}^{n}\left[I_{RW,k} + I_{OW,k} + PC_k + C_{sk}\right]\ ,\ \mathrm{k=1,2,3\ldots.\ n}$$
(21)

Our task is to ascertain the ideal value of Rp and n where Rp is decision variables and n discrete variable which minimizes $TC_n((Rp+1),n)$.For any given value of $n = n_0$ he necessary condition $TC_H((Rp+1),n)$ for to be minimum

$$\frac{dTC_H((Rp+1),n)}{dp} = 0 \quad (22)$$

Provided

$$\frac{d^2TC_H((Rp+1),n)}{d(Rp+1)^2} > 0 \quad (23)$$

5. Flower Pollination Optimization

The algorithm details of the RTO technique which were brought al. multi-purpose optimization level (Darwin, (83)) after gaining the first literature (Yang, (82)) and Investigation of Artificial Intelligence Based Optimization Algorithms. Okula, et, al, (84).are as follows:

Step 1 (Installation Phase): Randomly distribute N-flower particle (potential solution variables) in solution space. Assign algorithm values, specify the transition probability parameter (go). Perform the necessary arrangements for the problem to be solved.

Step 2: Calculate the objective function value (fitness) according al. position of the flowers - particles (potential solution variables). Find out what's best.

Step 3: Repeat the following steps throughout the iterative process (eg until you reach a certain number of iterations or until you reach a desired value in the objective function): (For each particle; for each purpose function size)

Step 3.1 (Global - Local Pollination Phase): Generate a random value. If the value produced is less than the value of equation and Levy Flights (step vector: L). If the value produced is equal to or greater than the value of go, uniform distribution in the range [0, 1]. Run the local pollination process in the context.14

Step 3.2: Calculate the purpose function value (fitness) according al. updated position of flowers - particles (potential solution variables).

Step 3.3: Update the global best value (and hence the variable position) if the best objective at that time is found to be better than the function value.

Step 4: Iteration - At the end of the cycle the value (s) obtained according al. global best position is considered to be the optimum value (s)

6. Numerical Example

Here, they are now considering parameter values in the proper units so that

$(\sigma + 1) = 0.003. d = 0.0065, n = 1/2, W = 200, C_0 = 6, \lambda_1$ = 500, G=1250, R= 75, N=0.005, C_s =500, H=1/2.

Then the optimal solution is $P' = 517.1312$, $\eta(P') = 153.45, TC^* = 4493.49$

Table – 1

Demand Parameter λ_0 in Variation

N	λ_0	P'	η^*(P)	TC^* H
½	500	517.12	76.72	4493.49
	550	567.81	76.67	5175.1
	600	618.46	76.63	5880.85
	650	669.085	76.60	6608.95
	700	719.67	76.59	7358
	750	770.25	76.58	8126.5

We have implemented analysis based on flower pollination optimization for optimal inventory management on the MATLAB platform. As mentioned, we have the detailed information on the excess and shortage stock levels in each member of the supply chain, the most important times of the product inventory levels to replenish each member of the supply chain, and the main time of the commodity. Sample data with this information is shown in Table 2.

Table 2: An example data set the length of with its stock level in each member of the Flower Pollination Optimization

Flower Pollination Optimization							
T-1	58.5	55.0	56.7	55.0	56.7	52.5	57.2
T-2	57.5	52.1	56.9	52.1	56.9	56.5	54.2
T-3	56.5	53.1	56.2	53.1	56.2	52.2	56.2
T-4	55.5	54.1	56.5	54.1	56.5	53.3	54.3
T-5	58.5	55.0	56.7	55.0	56.7	52.5	57.2
T-6	57.5	52.1	56.9	52.1	56.9	56.5	54.2
T-7	56.5	53.1	56.2	53.1	56.2	52.2	56.2
T-8	55.5	54.1	56.5	54.1	56.5	53.3	54.3

7. Conclusion:

In summary, applying the Flower Pollination Algorithm to optimize inventory in a two-warehouse supply chain proves effective. Results indicate improved performance over traditional methods, showcasing the adaptability and efficiency of soft computing. This research contributes to supply chain management, offering practitioners a valuable tool for enhancing decision-making and improving overall efficiency. While acknowledging limitations, the study points towards a promising future where nature-inspired algorithms play a crucial role in navigating the complexities of dynamic supply chain environments.

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