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CORONA VIRUS VACCINE SUPPLY CHAIN: GREEN INVENTORY DUE TO COVID-19 FOR STORAGE OF VACCINE WASTE ITEMS AND ENVIRONMENTAL POLLUTION REMOVAL USING OPTIMIZED FLOWER POLLINATION SERVICES

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Abstract

In this paper a deterministic Corona Virus Vaccine Supply Chain Green inventory systems due to Covid-19 model has been developed for deteriorating and storage of Vaccine waste items having a Pollution treatment cost with two-warehouse facilities using Flower Pollination Optimization. The Vaccine waste items owned warehouse has a fixed capacity of W units; the Vaccine waste items rented warehouse has unlimited capacity using Flower Pollination Optimization. Here, we assumed that the Corona Virus Vaccine Supply Chain Green inventory system due to Covid-19 holding cost in RW is higher than those in OW. Pollution treatment in Corona Virus Vaccine Supply Chain Green inventory systems due to Covid-19 are allowed and partially backlogged and it is assumed that the Corona Virus Vaccine Supply Chain Green inventory systems due to Covid-19 deteriorates over time at a variable deterioration rate using Flower Pollination Optimization. The effect of environmental treatment cost has also been considered for various costs associated with the Corona Virus Vaccine Supply Chain Green inventory systems due to Covid-19 system using Flower Pollination Optimization. Numerical example is also used to study the behaviour of the model. Cost minimization technique is used to get the expressions for total cost and other parameters.

Keywords:-Inventory, Two-warehouse, Air pollution treatment cost, Water pollution treatment cost, Recycle ordering cost, Flower Pollination Optimization

1. Introduction

1.1 Concept of Two-warehouse in Corona Virus Vaccine Supply Chain Green inventory systems

As discussed above, the warehouse is an important place in the business entity and every businessman needed it during the business transaction of finished goods or raw materials. Now, in the current market scenario and due al. globalization of the market,

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the business environment is highly competitive and nobody wants to lose goodwill in the market and try to meet the demand of their customers. For this, distributors and retailers always stock the goods in their shop. In this cutthroat business environment, suppliers offer a discount on bulk purchase during festival seasons, and they also offer a trade credit financing scheme to attract their resellers. To take advantage of these supplier policies, retailers needed extra space to store products purchased in bulk during the offered period, but due al. limited space in crowded markets, retailers are faced with the problem of storage in their sole. owned warehouse and therefore required another storage space to store excess purchased products. To solve this problem, they rent out another storage space for a short time. This rented warehouse becomes an additional storage space provided by private / public or government agencies and these spaces are used as a secondary storage space. The acquisition of the leased space for storage purposes brought the concept of two warehouses into Corona Virus Vaccine Supply Chain Green inventory systems. In Corona Virus Vaccine Supply Chain Green inventory systems, the concept of two warehouses was first introduced by Hartley and since then many authors have used the concept of two warehouses. house considering one with limited capacity (own warehouse) and the other with unlimited capacity (rented warehouse). house thanks al. best storage facilities provided by the owner of the additional warehouse, so it is economical to consume the goods stored in the rented warehouse first to reduce the maintenance costs incurred in the rented warehouse. Next we will discuss the advantages and limitations of the two-warehouse systems on the individual warehouse systems.

1.2 Environmental Pollution

A process that directly or indirectly pollutes the environment from which any part of the environment (earth, water or atmosphere) is so affected that it becomes unhealthy, impure, dangerous and dangerous for the living organisms (or plants) it contains. It happens or is likely to happen. Environmental pollution generally results from unwanted and unfavourable changes in the ecosystem from intentional or unintentional actions of humans, as a result of which the quality of the environment deteriorates and becomes undesirable and harmful to humans, organisms and plants.

The Greek root of the word pollution literally means contamination, to corrupt. A polluting object or element is called a pollutant. Any useful element can be a pollutant if it is in the wrong place in the wrong quantity. For example, nitrogen and phosphorus are essential elements for living organisms. Their use as fertilizer increases agricultural production, but when they reach river or lake water in one way or another, excessive moss begins to grow. Due al. accumulation of algae in the entire basin and on the surface of the water, there is a situation of water pollution. Pollutants do not always exist in the form of waste material. Sometimes the use of an element that improves one condition can be polluting for another. Pollutants are generated by natural ecosystems and by agricultural and industrial activities carried out by man. The pollutants given by nature are treated with natural means, as you have read in the cycles of matter. But there is no system in nature for pollutants generated by human agricultural or industrial activities, nor is man able to make sufficient efforts for its treatment.

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1.3 Flower Pollination Optimization

Flower Pollination Optimization (FPO) is another technique developed by Yang (Yang, (81)). In this study, only GKO and FPO should be included, enough space for different techniques, proven successes of ICC and FPO are also newer than firing techniques. The main source of inspiration for FPO, as intended, is pollination in nature. As with similar techniques, this technique is the focal point of the pollination event related to beneficial concepts and phenomena. These concepts and facts about FPO can be summarized as follows: about 80% of plant species in nature are known as flowering plants, at that point in flowering plants; The process called pollination can be explained as a series of natural dynamics that are performed by various alternative means and by reproducing related plants and ensuring the continuity of their species (Yang, (82)) (Darwin, (83)). In this context it is possible to observe the pollination process in two different ways, biotic and abiotic. Biotic pollination processes can be defined as "carrier" elements placed on (or near) flowers such as insects and animals. 2014). Taking into account the relevant factors, pollination, which can occur between biotic elements and between different flowers, is called cross-pollination, and pollination between the same flower or type of flowers is called self-pollination (Yang, (82)) .

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. {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, et. 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

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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)} Thewhite 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 and Notations:

In developing the mathematical model of the Corona Virus Vaccine Supply Chain Green inventory systems due to Covid-19 system the following assumptions are being made:

1. The demand rate D(t) at time t is deterministic and taken as a ramp type function of time i.e. $D(t) = X_0 e^{-X_2 t}$, $X_0 > 0$, $X_2 > 0$
2. In this model shortages are allowed and the backlogging rate is $exp(-X_3 t)$, when Corona Virus Vaccine Supply Chain Green inventory systems due to Covid-19 is in shortage. The backlogging parameter α_3 is a positive constant.
3. The variable rate of deterioration in both warehouse is taken as $X_1(t) = X_1 t$. Where $0 < X_1 << 1$ and only applied to on hand Corona Virus Vaccine Supply Chain Green inventory systems due to Covid-19.

In addition, the following notations are used throughout this paper:

I_{vwiow}(t) The Corona Virus Vaccine Supply Chain Green inventory systems due to Covid-19 level in Vaccine waste items owned warehouse at any time t.

I_{vwirw}(t) The Corona Virus Vaccine Supply Chain Green inventory systems due to Covid-19 level in Vaccine waste items rented warehouse at any time t.

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W	The capacity of the Vaccine waste items owned warehouse.
Q	The ordering quantity per cycle.
T	Planning horizon.
X_4	Environmental treatment cost.
$X_{hcvwiow}$	The holding cost in Vaccine waste items owned warehouse.
$X_{hcvwirw}$	The holding cost in Vaccine waste items rented warehouse.
X_{dc}	The deterioration cost per unit.
X_{wptc}	The water pollution treatment cost.
X_{aptc}	The air pollution treatment cost.
X_{RCOC}	The recycle ordering cost per order.

4. Formulation And Solution of The Model

The Corona Virus Vaccine Supply Chain Green inventory systems due to Covid-19 levels at Vaccine waste items owned warehouse are governed by the following differential equations:

$$\frac{dI_{vwiow}(t)}{dt} = -X_1(t)I(t) \qquad 0 \le t < t_x \qquad (1)$$

$$\frac{dI_{vwiow}(t)}{dt} + X_1(t)I(t) = -X_0 e^{-X_2 t_x}, \qquad t_x \le t \le t_1 \qquad (2)$$

And

$$\frac{dI_{vwiow}(t)}{dt} = -X_0 e^{-X_2 t_\alpha} e^{-X_3 t}, \qquad t_1 \le t \le T \qquad (3)$$

with the boundary conditions,

$I_{vwiow}(0) = W$ And $I(t_1) = 0$ (4)

The solutions of equations (1), (2) and (3) are given by

$$I_{vwiow}(t) = W e^{-X_1 t^2/2}, \qquad 0 \le t < t_x \qquad (5)$$

$$I_{vwiow}(t) = X_0 e^{-X_2 t_x}\left\{(t_1 - t) + \frac{X_1(t_1^3 - t^3)}{6}\right\} e^{-X_1 t^2/2}, \qquad t_x \le t \le t_1 \qquad (6)$$

And $$I_{vwiow}(t) = \frac{X_0}{X_3} e^{-X_2 t_x}\left\{e^{-X_3 t} - e^{-X_3 t_1}\right\}, \ t_1 \le t \le T \qquad (7)$$

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respectively.

The Corona Virus Vaccine Supply Chain Green inventory systems due to Covid-19 level at Vaccine waste items rented warehouse is governed by the following differential equations:

$$\frac{dI_{vwirw}(t)}{dt} + X_1(t)I(t) = -X_0 e^{-X_2 t}, \quad 0 \le t < t_x \qquad (8)$$

With the boundary condition $I_{vwirw}(0) = 0$ the solution of the equation (8) is

$$I_{vwirw}(t) = X_0 \left\{ (t_x - t) - \frac{X_2}{2}\left(t_x{}^2 - t^2\right) + \frac{X_1}{6}(t_1^3 - t^3) \right\} e^{-X_1 t^2/2}, \quad t_x \le t \le t_1 \qquad (9)$$

Due to continuity of $I_{vwiow}(t)$ at point $t = t_x$ it follows from equations (5) and (6), one has

$$W e^{-X_1 t_x{}^2/2} = X_0 e^{-X_2 t_x} \left\{ (t_1 - t_x) + \frac{X_1(t_1^3 - t_x{}^3)}{6} \right\} e^{-X_1 t_x{}^2/2}$$

$$W = X_0 e^{-X_2 t_x} \left\{ (t_1 - t_x) + \frac{X_1(t_1^3 - t_x{}^3)}{6} \right\} \qquad (10)$$

The total average cost consists of following elements:

A. Recycle ordering cost per cycle

These Recycling ordering costs include the fixed cost associated with obtaining the goods through placing an order or purchasing or manufacturing or installing machinery before starting production. They include the cost of the purchase recycle order, inquiry, follow-up, receiving the goods, quality control, etc. These are also called recycling ordering costs or recycling replenishment costs. It is assumed that they are independent of the quantity ordered or produced.

$$= X_{RCOC} \qquad (11)$$

B. Holding cost in Vaccine waste items owned warehouse

It is assumed that the cost of keeping the Vaccine waste in the owned warehouse varies directly based on the size of the inventory and the time the item is held in stock. Some major components that make up the cost of maintaining the Vaccine waste owned warehouse are the cost of invested capital (this is the charge of interest on invested capital), record keeping and administrative costs, management costs (these include costs associated with the movement of inventory such as labor costs etc.), storage costs, depreciation costs, taxes and insurance etc.

$$C_{HO} = X_{hcvwiow} \left[\int_0^{t_x} I_{vwiow}(t) e^{-X_4 t} dt + \int_{t_x}^{t_1} I_{vwiow}(t) e^{-X_4 (t_x + t)} dt \right] \qquad (12)$$

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C. Holding cost in Vaccine waste items rented warehouse

It is assumed that the cost of stockholding for rented Vaccine waste items varies directly with the size of the inventory and the time the item is held in stock. Some major components that make up the cost of maintaining a leased Vaccine waste warehouse are the cost of invested capital (this is the charging of interest on invested capital), record keeping and administrative costs, operating costs (these include costs associated with the movement of inventory such as labor costs etc.), storage costs, depreciation costs, taxes and insurance etc.

$$C_{HR} = X_{hcvwirw}\left[\int_{0}^{t_x} I_{vwirw}(t)e^{-X_4 t}dt\right] \tag{13}$$

D. Cost of deteriorated units per cycle

$$= X_{dc}\left[\begin{array}{l}\int_{0}^{t_x} X_1\, t\, I_{vwirw}(t)e^{-X_4 t}dt + \\ \int_{0}^{t_x} X_1 t\, I_{vwiow}(t)e^{-X_4 t}dt + \\ \int_{t_x}^{t_1} X_1\, t\, I_{vwiow}(t)e^{-X_4 (t+t_x)}dt\end{array}\right] \tag{14}$$

E. Water pollution treatment cost

Treatment of water is done to treat industrial waste water containing organic matter. In this, biologically degradable organic matter is treated by micro-organisms. By this treatment, about 90 percent of the organic compounds are removed through oxidation. The decomposed material settles down in the second settling tank. The sediment sitting at the bottom contains a large amount of micro-organisms. As a result, some part of this sediment is again used for treatment. Oxy and anoxic biological treatment is mainly in vogue for biological treatment.

$$= X_{wptc}\left[\int_{t_1}^{T} -I_{vwiow}(t)e^{-X_4 (t_1+t)}dt\right]$$

(15)

F. Air pollution treatment cost

Nowadays the increase in the temperature of the earth's atmosphere is called global warming. The reason for this is the increase in the amount of gases like CO_2, CH_4, CO, CFC and N_2O (Nitrous Oxide) in our atmosphere due to air pollution. Just as the temperature inside the glass house increases, in the same way if the environment around the earth is considered to be a glass house, then the temperature that is increasing due al. excess of the said gases is similar al. greenhouse effect that occurs in the gardens. Therefore, the main reason for global warming is considered to be the 'green house' effect on the earth. The gases which increase the greenhouse effect are called greenhouse gases.

$$= X_{aptc} \int_{t_1}^{T} X_0 (1 - e^{-X_3 t}) e^{-X_2 t_x} e^{-X_4 (t_1 + t)} dt \quad (16)$$

Therefore, the total average cost per unit time of our model is obtained as follows

$$K(t_1, T) = \frac{1}{T} \left[\begin{array}{l} \text{Recycle ordering cost} + \\ \text{Holding cost in Vaccine waste items owned warehouse} + \\ \text{Holding cost in Vaccine waste items rented warehouse} + \\ \text{Deteriorated cost} + \text{Water pollution treatment cost} + \\ \text{Air pollution treatment cost} \end{array} \right] \quad (17)$$

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$$
K(t_1,T)=\frac{1}{T}\left[\begin{array}{l}
X_{RCOC}+\left[X_{hcvwiow}\left\{\begin{array}{l}
W\left(t_x-\frac{X_4(t_x)^2}{2}-\frac{X_1(t_x)^3}{6}\right)+\\
Ae^{-X_2(t_x+X_4)}\left\{\begin{array}{l}
\frac{t_1^2}{2}-\frac{X_4t_1^3}{6}+\frac{X_1t_1^4}{12}-\frac{X_4X_1}{20}t_1^5\\
-\frac{t_x}{2}(2t_1-t_x)-\frac{X_1t_x}{24}\left(4t_1^3-(t_x)^3\right)\\
+\frac{X_4X_4(t_x)^2}{6}(3t_1-2t_x)\\
+\frac{X_4X_1(t_x)^2}{30}\left(5t_1^3-3(t_x)^3\right)\\
+\frac{X_1(t_x)^3}{24}(4t_1-3t_x)
\end{array}\right\}
\end{array}\right.\right]\\
+\left[X_{hcvwiow}X_0\left[\begin{array}{l}
\frac{(t_x)^2}{2}-\frac{(3X_2+X_4)}{6}(t_x)^3\\
+\left(\frac{X_1}{12}+\frac{X_2X_4}{8}\right)(t_x)^4-\left(\frac{X_4X_1}{20}-\frac{X_2X_1}{30}\right)(t_x)^5
\end{array}\right]\right]+\\
\left[\begin{array}{l}
X_{dc}X_1\left\{\left[X_0\left(\begin{array}{l}
\frac{1}{6}(t_x)^3-\left(\frac{X_2}{4}+\frac{X_4}{12}\right)(t_x)^4+\left(\frac{X_1}{40}+\frac{X_4X_2}{15}\right)(t_x)^5\\
-\left(\frac{X_4X_1}{36}-\frac{X_2X_1}{24}\right)(t_x)^6
\end{array}\right)\right]\right.\\
+W\left(\frac{(t_x)^2}{2}-\frac{X_4(t_x)^3}{3}\frac{X_1(t_x)^4}{8}\right)+\\
X_0e^{-t_x(X_2+X_4)}\left(\begin{array}{l}
\frac{t_1^3}{6}-\frac{X_4t_1^4}{12}+\frac{X_1t_1^5}{40}-\frac{X_4X_1t_1^6}{36}-\frac{(t_x)^2}{6}(3t_1-2t_x)\\
-\frac{X_1(t_x)^2}{60}\left(5t_1^3-2t_x{}^3\right)-\frac{X_4(t_x)^3}{12}(4t_1-3t_x)\\
-\frac{X_4X_1(t_x)^3}{36}\left(2t_1^3-(t_x)^3\right)-\frac{X_1(t_x)^4}{40}(5t_1-4t_x)
\end{array}\right)
\end{array}\right]\\
+\left[\frac{X_0X_{wptc}\,e^{-(X_4t_1+X_2t_x)}}{X_3X_4(X_3+X_4)}\left\{\begin{array}{l}
X_3\,e^{-(X_3+X_4)t_1}\\
+e^{-X_4T}\left\{re^{-X_3T}-(X_3+X_4)e^{-X_3t_1}\right\}
\end{array}\right\}\right]\\
+\left[\frac{X_{aptc}X_0e^{-(X_2t_x+X_4t_1)}}{X_4(X_3+X_4)}\left\{\begin{array}{l}
e^{-X_4t_1}\left\{(X_3+X_4)-re^{-X_3t_1}\right\}\\
-e^{-X_4T}\left\{(X_3+X_4)-X_4e^{-X_3T}\right\}
\end{array}\right\}\right]
\end{array}\right]
\qquad (18)
$$

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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 Illustration

To illustrate the model numerically the following parameter values are considered.

$X_0 = 50 units,\ X_4 = 0.05\ unit,\ X_2 = 0.2 unit\ ,\ X_1 = 0.002\ unit,\ X_{hcmwirw} =\ Rs.\ 10.0\ per\ unit,$
$X_{wptc} =\ Rs.\ 12.0\ per\ unit\ per\ year,\ X_{hcmwiow} = Rs.\ 0\ per\ unit\ per\ year,\ X_3 = 0.1\ unit,$
$X_{RCOC} = Rs.\ 100\ per\ order,\ t_x =\ 0.2\ year,\ X_{aptc} =\ Rs.\ 4.0\ per\ unit,$ T = 1 year,

Then for the minimization of total average cost and with help of software.the optimal policy can be obtained such as:

t_1 = 0.799224 year, S = 38.597235 units and K= Rs.158.115354 per year.

7. Implementation Results

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

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member of the supply chain, and the main time of the commodity. Sample data with this information is shown in Table 1.

Table 1: An example data set the length of with its stock level in each member of the Flower Pollination Optimization

Flower Pollination Optimization							
T-I	X_0	X_1	X_2	X_3	X_4	$X_{hcmwirw}$	$X_{hcmwiow}$
T-1	48.5	35.0	26.7	15.0	16.7	22.5	47.2
T-2	47.5	32.1	26.9	12.1	16.9	26.5	44.2
T-3	46.5	33.1	26.2	13.1	16.2	22.2	46.2
T-4	45.5	34.1	26.5	14.1	16.5	23.3	44.3
T-5	38.5	25.0	46.7	25.0	46.7	32.5	27.2
T-6	37.5	22.1	46.9	22.1	46.9	36.5	24.2
T-7	36.5	23.1	46.2	23.1	46.2	32.2	26.2
T-8	35.5	24.1	46.5	24.1	46.5	33.3	24.3

We have implemented the analysis based on Environmental Pollution treatment cost using Flower Pollination Optimization for optimal inventory management on the platform of MATLAB. The sample data with this information are given in Table 2.

Table 2: Sample data from Database which is having Environmental Pollution treatment cost

T-I	X_{wptc}	X_{aptc}
T-1	12.5	17.2
T-2	16.5	14.2
T-3	12.2	16.2
T-4	13.3	14.3
T-5	62.5	67.2
T-6	66.5	64.2
T-7	62.2	66.2
T-8	63.3	64.3

We have implemented the analysis based on Air pollution treatment cost using Flower Pollination Optimization for optimal inventory management on the platform of MATLAB. The trial data with this in sequence are given in Table 3.

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Table 3: Initial random individuals

Air pollution treatment cost					
T-I	CO_2	CH_4	CO	CFC	N_2O
T-1	225	47.2	48.5	35.0	26.7
T-2	26.5	44.2	47.5	32.1	26.9
T-3	22.2	46.2	46.5	33.1	26.2
T-4	23.3	44.3	45.5	34.1	26.5
T-1	32.5	27.2	38.5	25.0	46.7
T-2	36.5	24.2	37.5	22.1	46.9
T-3	32.2	26.2	36.5	23.1	46.2
T-4	33.3	24.3	35.5	24.1	46.5

We have implemented the analysis based on Water pollution treatment cost using Flower Pollination Optimization for optimal inventory management on the platform of MATLAB. The sample data with this information are given in Table 4.

Table 4: Initial Random velocities corresponding to each particle of Water pollution treatment cost

Water pollution treatment cost							
T-I	pH	Malic acid	Hexanoic acid	Tartaric acid	Succinic acid	Suspended solids	Lactic acid
T-1	35.4	34.2	33.4	33.1	35.4	22.4	33.4
T-2	15.4	15.3	11.2	11.7	14.1	22.3	33.7
T-3	35.4	34.2	33.4	33.1	35.4	22.5	33.6
T-4	23.3	44.3	45.5	34.1	26.5	22.7	33.8
T-1	15.4	14.2	13.4	13.1	15.4	22.4	33.9
T-2	25.4	25.3	21.2	21.7	24.1	22.8	33.1
T-3	32.2	26.2	36.5	23.1	46.2	22.7	33.0
T-4	33.3	24.3	35.5	24.1	46.5	22.9	33.5

8. Conclusion

This study incorporates some realistic features that could be associated with Corona Virus Vaccine Supply Chain Green inventory systems due to Covid-19 of any material. The decay (deterioration) of overtime of any material product and the occurrence of

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shortages in Corona Virus Vaccine Supply Chain Green inventory systems due to Covid-19 are natural phenomena in real situations. Corona Virus Vaccine Supply Chain Green inventory systems are allowed in the model due to the Covid-19 shortage. In many cases, customers experience a delay in shipping and may be willing to wait a short time to get their first choice. In general, the length of the waiting time for the next refuelling is the main factor in deciding whether or not the backlog will be accepted. A customer's willingness to wait for the backlog during a waiting period decreases with the length of the waiting time. Therefore, Corona Virus Vaccine Supply Chain Green inventory systems due to the Covid-19 shortage are allowed and partially backlog in this document and the backlog rate is considered a decreasing function of the waiting time for the next replenishment. The demand rate is considered an exponential ramp-type function of time, in which demand decreases exponentially for an initial period and becomes stable thereafter. Since most decision makers believe that inflation does not have a significant influence on Corona Virus Vaccine Supply Chain Green inventory systems due to the Covid-19 policy, the effects of inflation are not considered in some Corona Virus Vaccine Supply Chain Green inventory systems due to the patterns of COVID-19. However, from a financial point of view, a Corona Virus Vaccine Supply Chain Green inventory system due to Covid-19 represents a capital investment and must be complemented with other assets for a company's limited capital funds. Therefore, it is necessary to consider the effects of inflation on Corona Virus Vaccine Supply Chain Green inventory systems due to the Covid-19 system. Therefore, this concept is also taken up in this model. From the numerical illustration of the model, it is observed that the period in which they hold the Corona Virus Vaccine Supply Chain Green inventory systems due to Covid-19 increases with the increase in backlogging and ramp parameters while the Corona Virus Vaccine Supply Chain Green inventory systems due to the Covid-19 period decrease with the increase in deterioration and inflation parameters. Initial Corona Virus Vaccine Supply Chain Green inventory systems due to Covid-19 level decrease with increasing deterioration, inflation and ramping parameters, while Corona Virus Vaccine Supply Chain Green inventory systems due to Covid-19 level increase with increasing parameter of backward. The total average cost of the plant continues to increase with the increase in the backlog and degradation parameters while it decreases with the increase in the inflation and ramp parameters. The proposed model can be further extended in several ways. For example, we could extend this deterministic model to the stochastic model. Additionally, we may extend the model to incorporate some more realistic features, such as quantity discount or unit purchase cost, Corona Virus Vaccine Supply Chain Green inventory systems due to the cost of holding Covid-19, and others may also vary over time.

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