Global Journal of Modeling and Intelligent Computing (GJMIC)

Vol. 2, No. 2, July, 2022 ISSN: 2767-1917

OPTIMAL REPLENISHMENT POLICY FOR A GREEN INVENTORY MODEL WITH PRICE AND GREEN SENSITIVE DEMAND UNDER RELIABILITY

S. R. Singh, Department of Mathematics, Chaudhary Charan Singh University, India (shivrajpundir@gmail.com)
Ummeferva, Chaudhary Charan Singh University, India (zaidiumme08@gmail.com)

ABSTRACT

Green Movement is becoming the buzzword of today's business world. Businesses all across the globe are establishing green plans and aiming to create a low-carbon environment. Retailing is as ancient as business; it serves as a crucial point of contact between producers and customers, and it is the retailer's obligation to provide green items and encourage green consumption. In this paper an inventory model is formulated with retail investment in green operations under the effect of inflation and variable holding cost. The effect of the reliability on the production system has been studied. Demand is taken selling price and green level dependent. Shortages are taken partially backlogged type with fixed backlogging rate. The main intention of this paper is to find optimal replenishment time so that the profit will be maximised. The numerical analysis has been also done to verify the initiated paper. Finally, a sensitivity analysis is also made for different parameters to obtain some useful observations.

Keywords: Price and green sensitive demand; Variable holding cost; Inflation; Deterioration; Carbon tax; Green retailing.

1. INTRODUCTION

Green retailing is a strategy for running any type of retail firm using environmentally friendly procedures, such as turning product packaging into one that is recyclable. Other techniques, such solar panel usage green retailing may also be defined as employing energy-efficient lighting. Green retailing is a green management strategy that emphasises providing products and services to by maintaining environmental safety for the customer. It includes several methods and procedures for distribution and sales that don't cause damage to the environment. Green retailing improves the industry chain by removing wastes that improve the effectiveness of manufacturing and distribution. The notion includes the manner that products are transported, the type of energy utilised, and product packaging. For the thing Instead of using plastic bags for packing, a number of environmentally friendly items like paper bags can be employed. In place of fossil fuel-dependent automobiles, carts, organic transit vehicles, and battery-powered vehicles can be employed for transportation. The pieces of this mode of transportation are recyclable, and it emits no poisonous or dangerous substances. Solar panels and light emitting diode (LED) bulbs are the examples of materials that may be utilised to save energy.

Demand is assumed to be either time-dependent or constant in the inventory model. In actuality, however, demand is heavily influenced by selling price and level of greening. When the selling price drops, the demand changes. Customers today are also very conscious about the environment. In order to purchase green items, customers are willing to spend extra. Additionally, the selling price is linearly related to the greening level.
Deterioration is defined as decay, damage or spoilage of items and its effect cannot be ignored in an inventory model. In our reality, a large portion of the things like vegetables, fish, organic products, blossoms, meds, food grains, decayed after a scheduled time period. Hence, in an inventory system, deterioration rate of items per unit time have a very important role.

Inventory has a time value and an investment period while it is in storage. Prior to now, the impact of inflation was rarely taken into account in comparison or inventory network studies. It has to do with the notion that judgments about inventory control will not be considerably impacted by inflation. This idea is unfounded because an investment period's correlation with a company's resource is strong. The notion of inflation must be prioritised when anticipating and making long-term investments.

2. LITERATURE REVIEW

The number of studies on the greening inventory model is rising daily. A short life cycle degrading product recycle in green supply chain inventory control system is provided by Chung and Wee (2011). They have demonstrated that key variables influencing decision-making in a green supply chain inventory control system include new technological development, remanufacturing ratios, and system holding costs. New replacement guidelines for degrading commodities in the green supply chain are provided in 2012 by Sazvar et al. A green supply chain model with product remanufacturing in a volume-flexible context was examined by Singh and Singh in 2013. Mutingi (2014) define key performance indicators for green supply chains, pinpoint causal relationships among critical elements of a typical supply chain, and create a dynamic simulation model for developing suitable green policies and strategies when switching from reverse logistics to green supply chains. Dem & Singh (2015) take into account a multi-item integrated production inventory system. This paradigm is built on the idea of a vendor-managed strategy with a green manufacturing approach. To minimise overall costs, a non-linear issue is posed and solved using a genetic algorithm. Huang et al. (2016) looked into a supply chain for green products that had a number of suppliers, a single producer, and several retailers. To examine the effects of product line design, supplier selection, transportation mode selection, and pricing strategies on revenues and greenhouse gas emissions, a game-theoretic model is set up. In a scenario where the vendor allows the buyer a legal payment delay and sends the usable goods to the buyer lot by lot, Saxena (2017) et al. studied a green supply chain inventory model for integrated creation of new goods and remanufacturing of redeemable returned goods. In addition, Yadav et al. (2018) provide a green supply chain management of the automotive sector using an inventory model with distribution centres utilising Particle Swarm Optimization. Rani et al. (2019) offer a fuzzy inventory model for goods that are depreciating in a supply chain that is environmentally friendly and has a demand that is carbon conscious. Daryanto & Wee (2020) provide an integrated supply chain inventory model for items with a poor quality that are decaying and have an influence on the environment, especially the supply chain's carbon footprint. A certain amount of faulty products are created by a defective production process. Green practises are included by Jemai et al. (2020) into the design of a dynamic supply chain management in the healthcare industry to lower carbon emissions, assure green platelet collection and delivery, and lower the total costs of a dynamic green supply chain. For the first time, Mishra et al. (2021) investigate sustainable inventory management under a greenhouse farm's controllable carbon emissions. In this work, a linear and non-linear price-dependent demand with a carbon cap and tax-regulated sustainable inventory management for a buyer is investigated. Yadav et al. (2021) gives reduction of waste and carbon emission through the selection of items with cross-price elasticity of demand to form a sustainable supply chain with preservation technology. In a green supply chain, Rani et al. (2022) looked at a fuzzy inventory model for decaying new and reconditioned commodities with cannibalization. Guan et al. (2022) provide an inventory management optimization of a green supply chain using the IPSO-BPNN algorithm.

Buzacott (1975) first developed an inventory model on inflation. Wee et al. (2005), Lo et al (2007), Kuo-Lung et al.(2011), Pal et al. (2014), have considered an inventory model for deteriorating items under inflationary environment. Rezezedeh et al. (2016) looked into the accuracy of an economic production quantity model in an inefficient production system under inflationary conditions. Rastogi & Singh (2018) found the effects of inflation on a production inventory model for degrading products with a selling price-dependent consumption rate and shortage .Tayal et al. (2019) developed a storage model with two tiers for things that were degrading, demand that was stock-dependent and partial backlogs using both rental warehouses. Shaikh et al. (2020) looked at an EPQ model for a depreciating good with a partial trade credit policy for dependability and demand that are reliant on price. Shah et al. (2021) provide an economic production model for degrading goods under credit financing where demand relies on stock exhibited. The model includes dependability and inflation. Application of the Artificial Neural Network with Multithreading inside an Inventory Model under Uncertainty and Inflation was studied by Sarkar et al. in 2022
Manufacturing companies try to manufacture more reliable products in the current, highly competitive marketing environment. As a result, they frequently check to see if the products they make are perfect or not. In this work, we have described this type production problem, and the impact of system dependability has been covered. In 2014 Sarkar et al. (2014) gives an an EMQ model with price and time dependent demand under the effect of reliability and inflation Further Mahapatra (2017) also provides an inventory model for products that decay, with demand that is time and reliability dependent and partial backorder. Imperfect production inventory model was developed by

Shah & Vaghela (2018) for time and effort dependent demand with inflation and maximum reliability. In 2020 Adak & Mahaptra find the impact of reliability on multi-item inventory system with shortages and partial backlog incorporating time dependent demand and deterioration.

2.1 Research gap

Table 1. Recent research works in the inventory literature

Authors	**Demand**	**Inflation**	**Reliability**	**Holding cost**	**Carbon tax**	**Shortage**
Sarkar et al. (2014)	Price and time dependent	Yes	Yes	Constant	No	No
Rajoria, et al. (2015)	Power Demand Pattern	Yes	No	Constant	No	Partial backlogging
Singh et al (2016)	Stock dependent demand	No	No	Constant	No	Partial backlogging
Kumar and Rajput (2016)	Ramp type demand	Yes	No	Constant	No	Partial backlogging
Tripathi and Aneja (2017)	Stock dependent demand	No	No	Time dependent	No	No
Rahdar et al. (2018)	Uncertain	No	No	Constant	No	No
Mahapatra et al. (2019)	reliability and advertisement dependent	Yes	No	Reliant	No	No
Rastogi & Singh (2019)	Price sensitive demand	No	No	Time dependent	No	Partial backlogging
LA San-Jose et al. (2020)	Time and price sensitive	No	No	Constant	No	Fully backordered
Kumar et al. (2020)	Advertisement, time and selling price dependent	Yes	No	Constant	No	No
Das et. al (2021)	Price dependent	No	Yes	Constant	No	No
Halim et al (2021)	Non-Linear price and stock dependent	No	No	Constant	No	No
Adak & Mahapatra (2022)	Advertisement and reliability dependent	No	Yes	Reliability depnedent	No	Partial backlogging
Padiyar et al. (2022)	Exponential and triangular type	Yes	No	Constant	No	No
This paper	Price and green sensitive demand	Yes	Yes	Time dependent	Yes	Partial backlogging

At the present time, people are becoming more aware of the need to protect the environment from pollution produced by humans. Therefore demand is depend on greening level of the product. Inventory has a time value and an investment period while it is in storage. Prior to now, the impact of inflation was rarely taken into account in comparison or inventory network studies. In this paper an EPQ model for deteriorating items with price and green sensitive demand under the effect of inflation and reliability.

The difference between the work done and the work of this paper can be understood through the Table 1. Many researchers have developed inventory models very effectively in different conditions, but very few researchers have been able to develop the model with green sensitivity demand, carbon tax and reliability.

3. NOTATIONS & ASSUMPTIONS

3.1 Notations

Parameter	Description
$q(\tau)$	Inventory level at any time τ
c_h	Holding cost ($/unit) and it is assumed as $c_h = g + h\tau$
c_s	Shortage cost($/unit)
c_l	Lost sale cost($/unit)
P	Production rate(unit)
A	Ordering cost($/unit)
Q_r	Selling price($/unit)
Q_p	Purchasing cost($/unit)
a_v	Variable carbon emission per holding inventory
θ	Deterioration rate(constant)
c_d	Deterioration cost($/unit)
a_f	Fixed carbon emission of holding inventory
r	Inflation rate(0<r<1) (Constant)
γ	Excess progressive tariff per unit carbon emission
r_e	Reliability rate to produce good items(%)
k	Backlogging rate(0<k<1)
R	Maximum Backorder Quantity
T	Total Cycle Time
Decision variable	
f	Green degree
τ_1	Time at which the inventory level reaches at maximum.
τ_2	Time at which the inventory level vanishes
Objective	
TP	**Total profit**

3.2 Assumptions

The proposed model is based on the following assumptions:

i. Now a days people are becoming more aware about environment, therefore demand is taken as dependent on greening level of the manufactured goods and selling price i.e.
ii. $D = D_0 + \delta f - \mu Q_r$
iii. Inflationary environment has been considered
iv. Shortages are allowed with constant partial backlogging rate.
v. This model takes deterioration into account and rate of deterioration is assumed as constant.
vi. The holding cost is linearly dependent on time
vii. Purchasing cost of manufactured goods depends on greening degree. Purchasing cost is defined as $Q_p = q_1 + q_2 f$ where q_1 is the initial price and q_2 is the green sensitive price.
viii. Selling price is defined as $Q_r = mQ_p$, where m>1 is the mark up as based on Q_p.
ix. To improve the green degree of the product, a retailer spends some development costs.
x. The development cost is chosen as $\kappa f^2, f > 0$ is the green degree of the product.

4. MATHEMATICAL MODEL

Initially the production starts at τ=0. From the time τ =0 to τ = τ_1 the model undergoes production as well as occurring demand and deterioration. At the time τ = τ_1 the production stop. During the time period [τ_1, τ_2], the inventory level is affected due to demand and deterioration and at the time $\tau = \tau_2$ the inventory level reaches zero. From the time $\tau = \tau_2$ to $\tau = T$ shortages are occur. Therefore the governing equations are given by:

$$q'(\tau) = r_e P - (D_0 + \delta f - \mu Q_r) - \theta q(\tau),\ \ 0 < \tau < \tau_1 \quad (1)$$
$$q'(\tau) = -(D_0 + \delta f - \mu Q_r) - \theta q(\tau),\ \ \tau_1 < \tau < \tau_2 \quad (2)$$
$$q'(\tau) = -k(D_0 + \delta f - \mu Q_r),\ \ \tau_2 < \tau < T \quad (3)$$

Solving the equations (4.1), (4.2) and (4.3), with the help of boundary condition q(0)=0 and q(T)=0, we get

$$q(\tau) = \frac{[r_e P - (D_0 + \delta f - \mu Q_r)]}{\theta e^{\theta\tau}}\left(e^{\theta\tau} - 1\right), 0 < \tau < \tau_1 \quad (4)$$
$$q(\tau) = \frac{D_0 + \delta f - \mu Q_r}{\theta}\left(e^{\theta(\tau_2 - \tau)} - 1\right),\ \ \tau_1 < \tau < \tau_2 \quad (5)$$
$$q(\tau) = k(D_0 + \delta f - \mu Q_r)(T - \tau_2),\ \ \tau_2 < \tau < T \quad (6)$$

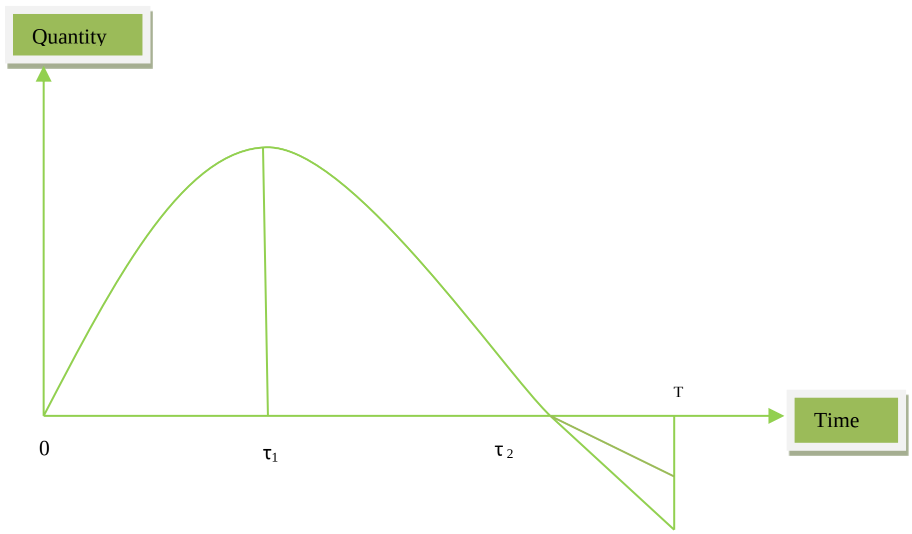

Figure 1: Inventory level versus time

Now, the following factors are used to compute the inventory's total cost:

(1) **Ordering Cost:** The retailer has to spend some money to process the order depending on the type of material, the quantity ordered, and the source of the supplier. Let A be the order cost per cycle. Then

$$oc = \frac{A}{T} \quad (7)$$

(2) **Holding cost:** The expense of keeping goods in the warehouse from the time they are received until all of the things are sold is known as holding cost. If the holding cost per unit time is c_h, then the total holding cost for storing the items in the warehouse will be

$$HC = \int_0^{\tau_1} (g + h\tau)e^{-r\tau} q(\tau)d\tau + \int_{\tau_1}^{\tau_2} (g + h\tau)e^{-r\tau} q(\tau)d\tau$$

$$HC = \frac{(D_0 + \delta f - \mu Q_r)}{\theta}\left[\frac{g}{r}\left(e^{-r\tau_2} - e^{-r\tau_1}\right) - \frac{g}{r+\theta}\left(e^{-r\tau_2} - e^{\theta(\tau_2 - \tau_1) - r\tau_1}\right) - h\left(\frac{1}{r+\theta}\left(\tau_2 e^{-r\tau_2} - \tau_1 e^{\theta(\tau_2-\tau_1) - r\tau_1}\right) - \frac{1}{(r+\theta)^2}\left(e^{-r\tau_2} - e^{\theta(\tau_2-\tau_1) - r\tau_1}\right)\right) + h\left(\frac{e^{-r\tau_2}}{r^2}(r\tau_2 + 1) + \frac{e^{-r\tau_1}}{r^2}(r\tau_1 + 1)\right)\right] \quad (8)$$

(3) **Deterioration cost:** Deterioration is a natural phenomenon which occurs in many edible items. If the deterioration cost per unit time is c_d, then the total deterioration cost will b2

$$DC = c_d\left[\int_0^{\tau_1} \theta e^{-r\tau} q(\tau)d\tau + \int_{\tau_1}^{\tau_2} \theta e^{-r\tau} q(\tau)d\tau\right]$$

$$= c_d\left[\left(r_eP - (D_0 + \delta f - \mu Q_r)\right)\left(\frac{1}{r+\theta}\left(e^{-(r+\theta)\tau_1} - 1\right) - \frac{1}{r}\left(e^{-r\tau_1} - 1\right)\right) + (D_0 + \delta f - \mu Q_r)\left(\frac{e^{-r\tau_2} - e^{-r\tau_1}}{r} - \frac{1}{r+\theta}\left(e^{-r\tau_2} - e^{-(r+\theta)\tau_1 - \theta\tau_2}\right)\right)\right] \quad (9)$$

(4) **Shortage Cost:** Shortage cost from the time τ_2 to T is given by

$$SC = -c_s\int_{\tau_2}^{T} e^{-r\tau}\, q(\tau)d\tau$$

$$= -c_s\left[k(D_0 + \delta f - \mu Q_r)\left(\frac{e^{-r\tau_2}}{r}(T - \tau_2) + \frac{1}{r^2}\left(e^{-rT} - e^{-r\tau_2}\right)\right) + \frac{R}{r}\left(e^{-rT} - e^{-r\tau_2}\right)\right] \quad (10)$$

(5) **Lost sale cost:** Lost sale cost from the time τ_2 to T is given by

$$LSC = c_l(1-k)\int_{\tau_2}^{T} e^{-r\tau}\,(D_0 + \delta f - \mu Q_r)d\tau$$

$$= \frac{c_l(1-k)(D_0 + \delta f - \mu Q_r)}{r}\left(e^{-r\tau_2} - e^{-rT}\right) \quad (11)$$

(6) Retailer earns some revenues by selling the manufactured goods. Here sales revenue is

$$SR = (m-1)(D_0 + \delta f - \mu Q_r)(q_1 + q_2 f)T \quad (12)$$

(7) Retailer has to spend some expenses to upgrade the worth of the manufactured goods and it is dependent on the greening level of the product. Here development cost is

$$DC = \kappa f^2 \quad (13)$$

(8) Nowadays, some costs are imposed for harming the environment. So, retailer has to spent some costs due to carbon emission. Here carbon tax is

$$CT = \left(a_v\tau_1 P + a_f\right)\gamma \quad (14)$$

Hence, the total profit is defined as follows:

$$TP = \frac{1}{T}\Bigg[(m-1)(D_0 + \delta f - \mu Q_r)(q_1 + q_2 f)T - A - \frac{(D_0 + \delta f - \mu Q_r)}{\theta}\Bigg[\frac{g}{r}\left(e^{-r\tau_2} - e^{-r\tau_1}\right) - \frac{g}{r+\theta}\left(e^{-r\tau_2} - e^{\theta(\tau_2-\tau_1) - r\tau_1}\right) - h\left(\frac{1}{r+\theta}\left(\tau_2 e^{-r\tau_2} - \tau_1 e^{\theta(\tau_2-\tau_1) - r\tau_1}\right) - \frac{1}{(r+\theta)^2}\left(e^{-r\tau_2} - e^{\theta(\tau_2-\tau_1) - r\tau_1}\right)\right) + h\left(\frac{e^{-r\tau_2}}{r^2}(r\tau_2 + 1) + \frac{e^{-r\tau_1}}{r^2}(r\tau_1 + 1)\right)\Bigg] - c_d\left[\left(r_eP - (D_0 + \delta f - \mu Q_r)\right)\left(\frac{1}{r+\theta}\left(e^{-(r+\theta)\tau_1} - 1\right) - \frac{1}{r}\left(e^{-r\tau_1} - 1\right)\right) + (D_0 + \delta f - \mu Q_r)\left(\frac{e^{-r\tau_2} - e^{-r\tau_1}}{r} - \frac{1}{r+\theta}\left(e^{-r\tau_2} - e^{-(r+\theta)\tau_1 - \theta\tau_2}\right)\right)\right] - \frac{c_l(1-k)(D_0 + \delta f - \mu s)}{r}\left(e^{-r\tau_2} - e^{-rT}\right) - \kappa f^2 - \left(a_v\tau_1 P + a_f\right)\gamma\Bigg] \quad (15)$$

5. NUMERICAL EXAMPLE

Ordering cost A = 100, Production cost = 225, Deterioration rate θ = 0.9, Demand parameter D_0=100, Variable carbon emission per holding inventory a_v=2, Fixed carbon emission of holding inventory a_f=1.5, Excess progressive tariff per unit carbon emission γ=1.5, α = 4, β = 0.3, Mark up m =3, location parameter of holding cost g = 5, Shape parameter of holding cost h = 0.9, c_s = 25, c_l = 42, c_d = 3, Inflation rate r = 0.01, f= 0.03, Reliability parameter r_e = 0.9, Initial price q_1 =2, Green sensitive price q_2 = 6.5, δ = 4, μ = 0.3, Total cycle time =4.

By using the MATHEMATICA software we obtain an optimal solution as
TP = 3276.48, τ_1 =1.15675 months, τ_2 = 3.29504 months, f = 28.2681

6. SENSITIVITY ANALYSIS

A sensitivity analysis is carried out using the numerical example from the preceding section to examine the impact of under- and overestimating the parameters on the values of the total profit per unit time (TP), the greening level of the product (f), and the time pointsτ_1, τ_2. Table displays the related computational outcomes.
We obtained the following insights from Table:

- ✓ When the ordering cost A increases, total profit decreases while time points τ_1, $\tau_2$and greening level f has no effect.
- ✓ When the production cost P increases, greening level f increases, while time τ_1, τ_2 and total profit decrease.
- ✓ As the deterioration rate θ increases, total profit and greening level f decrease, whereas the time τ_1 increases.
- ✓ When the demand parameter D_0 increases, total profit and greening level f increase. While the time τ_1 also increases.
- ✓ When the reliability parameter r_e increases, greening level increases, while the total profit decreases.
- ✓ When the inflation parameter r increases, total profit and greening level f increase while the time τ_1, τ_2 decrease.
- ✓ When the shortage cost parameter c_s and the lost sale parameter c_l increase, total profit and greening level f increase.
- ✓ When the location parameter of holding cost g and shape parameter of holding cost h increases, greening level increases, while the time τ_1, τ_2 and total profit decrease.
- ✓ When the variable carbon emission per holding inventory a_v increases, greening level increases, while the time τ_1, τ_2 and total profit decrease.

Table 2: Sensitivity Analysis

Parameter	% change	Value	τ_1	τ_2	f	Total Profit
A=100	+10	110	1.532	3.62034	27.6518	3306.36
	+05	105	1.532	3.62034	27.6518	3307.61
	-05	95	1.532	3.62034	27.6518	3310.11
	-10	90	1.532	3.62034	27.6518	3311.36
P=210	+10	231	1.05136	3.20413	28.438	3266.51
	+05	220.5	1.24911	3.37488	28.118	3284.92
	-05	199.5	2.00296	4.03183	26.8581	3342.11
	-10	189	-	-	-	3861.08
θ =0.9	+10	0.99	1.6663	3.63808	27.5206	3282.46
	+05	0.945	1.59362	3.62262	27.5969	3295.16
	-05	0.855	1.47857	3.6289	27.6899	3323.58
	-10	0.81	1.4314	3.64687	27.7143	3339.37
D_0=100	+10	110	-	-	-	4116.09
	+05	105	1.99059	4.02098	28.2305	3738.86
	-05	95	1.21587	3.34613	26.8208	2911.08
	-10	90	0.97543	3.13875	25.8567	2542.53
r_e=0.9	+10	0.99	1.18144	3.31637	28.2281	3284.08
	+05	0.945	1.32991	3.44485	27.9857	3295.07
	-05	0.855	1.83484	3.88454	27.1436	3327.01
	-10	0.81	-	-	-	3565.31
r =0.01	+10	0.011	1.522	3.61038	27.6648	3310.27
	+05	0.0105	1.52698	3.61534	27.6583	3309.57
	-05	0.0095	1.53707	3.62537	27.6451	3308.16
	-10	0.009	1.54217	3.63044	27.6384	3307.46
c_s=25	+10	27.5	1.53576	3.62418	27.6457	3308.8

	+05	26.25	1.53389	3.62227	27.6487	3308.83
	-05	23.75	1.5301	3.61839	27.6548	3308.89
	-10	22.5	1.52818	3.61643	27.6579	3308.92
c_l=42	+10	46.2	-	-	-	3602.42
	+05	44.1	1.85232	3.94056	27.12	3303.56
	-05	39.9	1.29789	3.37472	27.9926	3320.47
	-10	37.8	1.1114	3.16933	28.2225	3337.03
g = 5	+10	5.5	1.39391	3.4378	27.9517	3270.99
	+05	5.25	1.45974	3.52592	27.8072	3289.46
	-05	4.75	1.6118	3.72195	27.4838	3329.26
	-10	4.5	1.70051	3.8319	27.3012	3350.74
h =0.9	+10	0.99	1.44041	3.51588	27.8324	3297.11
	+05	0.945	1.48415	3.56603	27.7459	3302.86
	-05	0.855	1.58477	3.67958	27.5487	3315.14
	-10	0.81	1.64349	3.74474	27.4348	3321.74
a_v=2	+10	2.2	1.33376	3.44819	27.9794	3286.84
	+05	2.1	1.42874	3.53059	27.823	3297.21
	-05	1.9	1.64518	3.71891	27.4629	3321.36
	-10	1.8	-	-	-	-
a_f= 1.5	+10	1.65	1.532	3.62034	27.6518	3308.8
	+05	1.575	1.532	3.62034	27.6518	3308.83
	-05	1.425	1.532	3.62034	27.6518	3308.89
	-10	1.35	1.532	3.62034	27.6518	3308.92

7. CONCLUSION

This paper develops a green inventory model with price and green sensitive demand under the effect of inflation and reliability. This study gives a comprehensive understanding of the effects of a green degree on customers' decisions to buy sustainable inventory. These effects will help to increase consumers' knowledge of environmental issues in their day-to-day social interactions, and as more consumers pick items with high environmental standards, suppliers are compelled to provide such goods, which will lower GHG emissions, including CO_2. This outcome clarifies how an appropriate green investment might reduce the environment's rising carbon emissions. Long-term, these improvements will contribute to the restoration of the climate and have other beneficial effects, such as enhancing human health. The main objective of this paper is to optimize the total profit. The important results were obtained using this model is that optimum total profit function is concave and as the inflation rate increases the profit will be decrease.

For further research the model can be extended for multi item inventory system with different type of demand as stochastic demand, freshness dependent demand etc. This research can also be extended by taking partial trade credit.

REFERENCES

Adak, S., & Mahapatra, G. S. (2020). Effect of reliability on multi-item inventory system with shortages and partial backlog incorporating time dependent demand and deterioration. *Annals of Operations Research*, 1-21.

Adak, S., & Mahapatra, G. S. (2022). Effect of reliability on varying demand and holding cost on inventory system incorporating probabilistic deterioration. *Journal of Industrial & Management Optimization*, *18*(1), 173.

Buzacott, J. A. (1975). Economic order quantities with inflation. *Journal of the Operational Research Society*, *26*(3), 553-558.

Chung, C. J., & Wee, H. M. (2011). Short life-cycle deteriorating product remanufacturing in a green supply chain inventory control system. *International Journal of Production Economics*, *129*(1), 195-203.

Daryanto, Y., & Wee, H. (2020). Three-Echelon green supply chain inventory decision for imperfect quality deteriorating items. *Operations and Supply Chain Management: An International Journal*, *14*(1), 26-38.

Das, S., Khan, M. A. A., Mahmoud, E. E., Abdel-Aty, A. H., Abualnaja, K. M., & Shaikh, A. A. (2021). A production inventory model with partial trade credit policy and reliability. *Alexandria Engineering Journal*, *60*(1), 1325-1338.

Dem, H., & Singh, S. R. (2015). Joint replenishment modelling of a multi–item system with greening policy and volume flexibility. *International Journal of Operational Research*, *22*(2), 148-166

Guan, Y., Huang, Y., & Qin, H. (2022). Inventory Management Optimization of Green Supply Chain Using IPSO-BPNN Algorithm under the Artificial Intelligence. *Wireless Communications and Mobile Computing*, *2022*.

Huang, Y., Wang, K., Zhang, T., & Pang, C. (2016). Green supply chain coo///rdination with greenhouse gases emissions management: a game-theoretic approach. *Journal of Cleaner Production*, *112*, 2004-2014.

Halim, M. A., Paul, A., Mahmoud, M., Alshahrani, B., Alazzawi, A. Y., & Ismail, G. M. (2021). An overtime production inventory model for deteriorating items with nonlinear price and stock dependent demand. *Alexandria Engineering Journal*, *60*(3), 2779-2786.

Jemai, J., Do Chung, B., & Sarkar, B. (2020). Environmental effect for a complex green supply-chain management to control waste: A sustainable approach. *Journal of cleaner production*, *277*, 122919

Kumar, S., & Rajput, U. S. (2016). A probabilistic inventory model for deteriorating items with ramp type demand rate under inflation. *American Journal of Operational Research*, *6*(1), 16-31.

Kumar, M., Chauhan, A., Singh, S. J., & Sahni, M. (2020). An Inventory Model on Preservation Technology with Trade Credits under Demand Rate Dependent on Advertisement, Time and Selling Price. *Accounting and Finance*, *8*(3), 65-74.

Kuo-Lung, H., Yung-Fu, H., & Li-Chiao, L. (2011). An inventory model for deteriorating items with stock-dependent selling rate and partial backlogging under inflation. *African Journal of Business Management*, *5*(10), 3834-3843.

Lo, S. T., Wee, H. M., & Huang, W. C. (2007). An integrated production-inventory model with imperfect production processes and Weibull distribution deterioration under inflation. *International Journal of Production Economics*, *106*(1), 248-260.

Mahapatra, G. S., Adak, S., Mandal, T. K., & Pal, S. (2017). Inventory model for deteriorating items with time and reliability dependent demand and partial backorder. *International Journal of Operational Research*, *29*(3), 344-359

Mahapatra, G. S., Adak, S., & Kaladhar, K. (2019). A fuzzy inventory model with three parameter Weibull deterioration with reliant holding cost and demand incorporating reliability. *Journal of Intelligent & Fuzzy Systems*, *36*(6), 5731-5744.

Mishra, U., Wu, J. Z., & Sarkar, B. (2021). Optimum sustainable inventory management with backorder and deterioration under controllable carbon emissions. *Journal of Cleaner Production*, *279*, 123699.

Mutingi, M. (2014). The impact of reverse logistics in green supply chain management: a system dynamics analysis. *International Journal of Industrial and Systems Engineering*, *17*(2), 186-201

Padiyar, S. V. S., Kuraie, V. C., Bhagat, N., Singh, S. R., & Chaudhary, R. (2022). An integrated inventory model for imperfect production process having preservation facilities under fuzzy and inflationary environment. *International Journal of Mathematical Modelling and Numerical Optimisation*, *12*(3), 252-286.

Pal, S., Mahapatra, G. S., & Samanta, G. P. (2014). An inventory model of price and stock dependent demand rate with deterioration under inflation and delay in payment. *International Journal of System Assurance Engineering and Management*, *5*(4), 591-601.

Rani, S., Ali, R., & Agarwal, A. (2019). Fuzzy inventory model for deteriorating items in a green supply chain with carbon concerned demand. *Opsearch, 56*(1), 91-122.

Rani, S., Ali, R., & Agarwal, A. (2022). Fuzzy inventory model for new and refurbished deteriorating items with cannibalisation in green supply chain. *International Journal of Systems Science: Operations & Logistics*, *9*(1), 22-38.

Rajoria, Y. K., Saini, S., & Singh, S. R. (2015). EOQ model for decaying items with power demand, partial backlogging and inflation. *Int J Appl Eng Res*, *10*(9), 22861-22874.

Rahdar, M., Wang, L., & Hu, G. (2018). A tri-level optimization model for inventory control with uncertain demand and lead time. *International Journal of Production Economics*, *195*, 96-105.

Rastogi, M., & Singh, S. R. (2018). A production inventory model for deteriorating products with selling price dependent consumption rate and shortages under inflationary environment. *International Journal of Procurement Management*, *11*(1), 36-52.

Rastogi, M., & Singh, S. R. (2019). An inventory system for varying deteriorating pharmaceutical items with price-sensitive demand and variable holding cost under partial backlogging in healthcare industries. *Sādhanā*, *44*(4), 1-10.

Rezezedeh, B., Mirzazadeh, A., & Mohammadi, M. (2016). An EPQ model with reliability in an imperfect production system at the presence of two sale policies of prepayment and delay in payment. *International Journal of Operational Research*, *27*(4), 530-551.

San-José, L. A., Sicilia, J., González-De-la-Rosa, M., & Febles-Acosta, J. (2020). Best pricing and optimal policy for an inventory system under time-and-price-dependent demand and backordering. *Annals of Operations Research*, *286*(1), 351-369.

Sarkar, B., Mandal, P., & Sarkar, S. (2014). An EMQ model with price and time dependent demand under the effect of reliability and inflation. *Applied Mathematics and Computation*, *231*, 414-421.

Sarkar, A., Guchhait, R., & Sarkar, B. (2022). Application of the Artificial Neural Network with Multithreading Within an Inventory Model Under Uncertainty and Inflation. *International Journal of Fuzzy Systems*, 1-15.

Saxena, N., Singh, S. R., & Sana, S. S. (2017). A green supply chain model of vendor and buyer for remanufacturing. *RAIRO-Operations Research*, *51*(4), 1133-1150.

Sazvar, Z., Al-e, S. M. J. M., Baboli, A., Jokar, M. R. A., & Botta-Genoulaz, V. (2012). New replenishment policy for deterioration items in green supply chain. In *IIE Annual Conference. Proceedings* (p. 1). Institute of Industrial and Systems Engineers (IISE).

Shah, N. H., & Vaghela, C. R. (2018). Imperfect production inventory model for time and effort dependent demand under inflation and maximum reliability. *International Journal of Systems Science: Operations & Logistics*, *5*(1), 60-68.

Shah, N. H., Rabari, K., & Patel, E. Economic Production Model With Reliability And Inflation For Deteriorating Items Under Credit Financing When Demand Depends On Stock Displayed.

Shaikh, A. A., Cárdenas-Barrón, L. E., Manna, A. K., & Cespedes-Mota, A. (2020). An economic production quantity (EPQ) model for a deteriorating item with partial trade credit policy for price dependent demand under inflation and reliability. *Yugoslav Journal of Operations Research*, *31*(2)), 139-151.

Singh, S. R., & Singh, N. (2013). Green supply chain model with product remanufacturing under volume flexible environment. *Procedia Technology*, *10*, 216-226.

Singh, S., Khurana, D., & Tayal, S. (2016). An economic order quantity model for deteriorating products having stock dependent demand with trade credit period and preservation technology. *Uncertain Supply Chain Management*, *4*(1), 29-42.

Tayal, S., Singh, S. R., & Attri, A. K. (2019). Two levels of storage model for deteriorating items, stock dependent demand and partial backlogging with both rented warehouses. *International Journal of Process Management and Benchmarking*, *9*(4), 485-498.

Tripathi, R. P., & Aneja, S. (2017). Inventory models for stock-dependent demand and time varying holding cost under different trade credits. *Yugoslav Journal of Operations Research*, *28*(1).

Wee, H. M., Yu, J. C., & Law, S. T. (2005). Two-warehouse inventory model with partial backordering and Weibull distribution deterioration under inflation. *Journal of the Chinese Institute of industrial engineers*, *22*(6), 451-462.

Yadav, A. S., Swami, A., & Ahlawat, N. (2018). A Green supply chain management of Auto industry for inventory model with distribution centers using Particle Swarm Optimization. *Self organizology*, *5*(3-4), 10-18.

Yadav, D., Kumari, R., Kumar, N., & Sarkar, B. (2021). Reduction of waste and carbon emission through the selection of items with cross-price elasticity of demand to form a sustainable supply chain with preservation technology. *Journal of Cleaner Production*, *297*, 12629