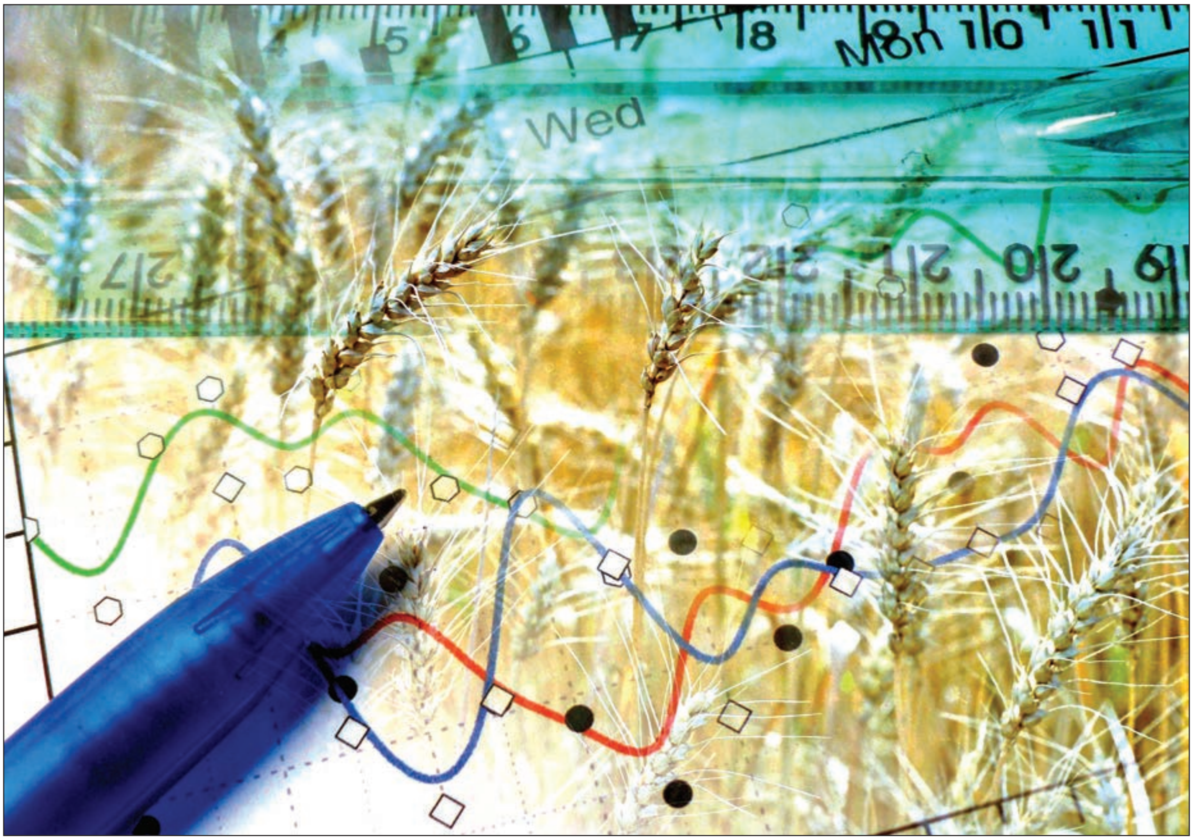

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Applicable Inventory Control Models for Agricultural Business Managers: Issues and Concerns

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ABSTRACT

This study examined inventory control models highlighting the fundamental issues and concerns for shaping agri-business prowess. Inventory control is the centre stage of entrepreneurial existence, survival, growth and sustainability. Inventory was considered a road map that gives direction to a new business for making decisions about management of cash, raw materials, finished goods and receivables. It was revealed that the risks associated with daily business deliveries are high. The production cost control measures are the sole responsibility of business managers. One critical cost of production is investment in raw materials supplies, work-in-process and processed or finished products that are still waiting in the warehouse. If this investment becomes excessive, it will lead to high costs of capital costs, operating costs and decreased production efficiency when two much space is used for inventory. The study concluded that in a customer-oriented inventory, the decision to add an item to stock was usually based on the number of calls for that item. It was recommended that in a producer-oriented inventory, economic issues are vital in deciding whether to stock an item or to produce.

Key words: Economic lot size, inventory, model, production batch size and re-order point

INTRODUCTION

Inventory is stores of goods and stocks. In value addition or processing farm factories, inventory is called stock keeping items that are held at storage level. Usually, the farm stock keeping items consists of raw materials, work-in- process, finished or value added products and supplies. By keeping inventories, certain level of control must be exercised. Control is an element of managerial tasks that involves the measurement and correction of the performance of subordinates to make sure that the objectives of the farm and the plans devised to attain them are accomplished efficiently and economically. It also involves setting standards, measuring the performance against standards, feedback of results and correcting deviations from standards. Usually, farm managers develop a plan specifying the desired levels of their investment. Because of environmental factors, however, actual performance generally does not confirm to plan performance and managers must exercise inventory control.

Hornby *et al*. (2010) defined inventory as a written list of all the objects, furniture, etc in a particular building and/or of all the goods in a shop. The stock will be disposed of over the next 12 weeks. This implies that there should be inventory control model to enable one to compare stock taking in the in the past periods with the present. Control is ability to make do with what you want or desire. Inventory management is used to describe the inflow and outflow of inventory in an organization. A rational farm manager must pay particular attention to inventory management and control because inventories play a significance role in organized farm systems.

According to Koutsoyiannis (1983), a model is a simplified representation of a real situation. A model includes the main features of the situation, it is designed to describe. It can be constructed at different levels of aggregation, details and sophistication depending on the purpose it is meant to achieve. The author further maintained that a good model should be able to analyze and predict. Thus, the validity of a model may be judged on several criteria such as its predictive power, the consistency and realism of its assumptions, the extent of the information load it provides, its generality and its simplicity.

Abstract mathematical model of an inventory process have contributed to the state of the art. Dvoretzky *et al.* (1952), Arrow and Karlin (1958) and Moran (1959) looked at this development from purely an economic sense of minimizing costs within constraints on availability of stock to satisfy demand. The other was pragmatic (Magee, 1958) in which one had to show how to measure demand, for example, rather than merely assuming. Whitin (1953) was the first significant attempt to bridge the gap between the two approaches.

Robert (1978) revealed that the first successful inventory application was implemented for spare parts inventories in large companies, where demand from a large population is based primarily on need rather than promotion. There is no important substitutability of one item for another since the costs and lead times are known with sufficient accuracy. The author further stated that the inventory management of an enterprise involves three important different level of systems, viz; firstly, is the processing of transactions and maintenance of files. The important inventory files shows current stock on hand, stock due in from the sources on open orders and stock due to customers when it becomes available. The record of any given stocked item includes various data such as cost, lead time, unit of measure and source, etc. The second level systems involve the decision rules for answering questions such as when to order to replenish stock and how much to order. The third level systems provides management with simulations of alternative strategic choices among decision rules and alternative tactical choices of policy in the rules chosen, to guide annual budgeting of the policy to be followed in the coming year.

Vander Weide and Maier (1985) revealed that inventory is a typical characteristic of working capital of any company balance sheet. Deducing from this and imagining a farmer that conducts a simple agri-business, it buys raw materials for cash, processes them into finished goods and then sells these goods on credit. If you draw up a balance sheet at the beginning of the process, you see cash. If you delay a little, you find cash replaced by inventories of raw materials and, still later, by inventories of finished goods. When the goods are sold, the inventories give way to accounts receivables and finally when the customers pay their bills, the agri-business firm draws out its profit and replenishes the cash balance. We can see that cash was transformed into inventory, then into receivables and back into cash again. But these assets have different degrees of risk and liquidity. You can't pay bills with inventory or with receivables, you must pay with cash. Thus, working capital is inventory plus account receivables minus account payable.

Brealey and Myers (2003) pointed out that every manufacturer experiences a steady demand from customers. By so engaging, there are two costs of holding an inventory of the finished goods and other related inputs. First, there is the carrying cost such as the cost of the capital that is tied up in the inventory, the cost of the ware house space, etc. The second type of cost is the order cost. Each order involves fixed handling expense and delivery charges. The author concluded that the two costs are the kernel of the inventory problem. An increase in order size increases the average number of processed goods in inventory and therefore, the carrying cost rises.

Baruah (2011) simply defined business to means the state of being busy. This implies that agri-business includes not only those that farm the land but also the people and firms that provide the inputs (for example, seed, chemicals, credit, etc.), process the output (for example, milk, grain, meat, etc.), manufacture the food products (for example, ice cream, bread, breakfast cereals, etc) and transport and sell the food products to consumers (for example, restaurants and supermarkets). The author further emphasized that agri-business system has undergone a rapid transformation as new industries have evolved and traditional farming operations have grown larger and more specialized. To accomplish this, there is always a relative interrelationship between the households (consumers) business firms, factor market and product market. To sustain these relationships, agri-business managers must be guided by the dynamics of inventory control models on daily basis.

The broad objective of the study was to examine the applicable inventory control models and fundamental issues and concerns for shaping agricultural businesses. The specific objectives include; application of inventory models to empirical studies, estimates of costs and returns of poultry production and inventory, ascertain the perception of poultry farmers on inventory and constraints of poultry production and inventory.

INVENTORIES

Why inventories?:

- The fundamental reason for carrying inventories is that it is physically impossible and economically impractical for each farm stock items to arrive exactly where it is needed and when it is needed. Even where, it is physically possible, the cost involved would be prohibitively expensive. For example, supplying fertilizers for integrated farm implies that the farm must make provision for extra fertilizers in its supply of raw materials inventory for use when they are in need. Thus, it is better to keep inventory to avoid high expenses
- Inventories are necessary when there is a favourable return on investment implying that farm managers should consider the Marginal Efficiency of Capital (MEC). This concept holds that a farm should invest in those materials that provide a greater return than capital costs. An investment alternative should be accepted because its MEC is greater than capital cost while, investment alternatives should be rejected if MEC is less than capital cost:
- One primary inventory function is to decouple or break apart, successive stages of production. That is, when they break operations apart so that one operation's supply is independent of another's supply. The decoupling function serves two basic purposes
    - Inventories are necessary to reduce the dependencies among successive stages of production so that breakdown of material shortages or other production fluctuations at one stage do not cause later stages of operations to shut down
    - A second purpose of decoupling through inventories is to let one farm unit schedule its operations independently of another. For example, in fertilizer factory, fertilizer production blending can be schedule separately from bag or sack production. Likewise, in automobile manufacturing, engine build-up can be schedule separately from seat assembly
- Inventories are necessary because it may buffer to reduce uncertainty, i.e., if demand is higher and the farm wants high returns on investment, inventory is necessary
- Inventory can be used to assist in leveling production. In this case, farm inputs such as fertilizers can be made during slack demand periods and used in peak demand period

- Inventory reduces materials handing cost. This is particularly true of intermittent system since they involve less automation of material handling than continuous system. Parts can be accumulated and inventoried in boxes or baskets and transported by hand-jerk dollier or fork-lift trucks much more economically than they can be carried by hand
- It allows production of family of parts (assembling and inventory)
- With bulk purchase, quantity discounts can be arranged, thus, providing another cost advantage of inventories, i.e., where a firm practices economies of scale at a least cost
- Merchandising farm firm often use inventories for customers displays. Since retail customers often base their purchase on displayed goods; the retail trader often use inventory in this way
- Inventories may be necessary based on the farm firms' willingness to do so

Dynamic inventory concepts:

- Minimum inventory is also called minimum stock, i.e., the level below which inventory should not be allowed to fall. If it does, it will result in stock out leading to production stoppage. But usually, there should be a buffer stock to reduce uncertainty
- Re-order quantity is the quantity that is most economic to order. It equates the cost of ordering with cost of storage of products or materials
- Procurement or lead time is the time lag between date of placing an order and actual date of receiving the order
- Consumption rate (usage rate) is the rate at which materials are used in each production run. It is assumed to be uniform over a long period of time
- Carrying cost is the cost per unit per year
- Reorder point is the point at which reorder quantity has been placed. Thus:

$$\text{Reorder point} = \text{Minimum inventory}+(\text{lead time}\times\text{usage})$$

or:

$$\text{Reorder point} = \text{Average daily usage}\times\text{lead time}+\text{buffer or safety stock}$$

- Average inventory is:

$$\frac{\text{Total of minimum inventory}+\text{Maximum inventory}}{2}$$

  It is both the function of minimum inventory and reorder quantity. It application ignores the use of consumption rate and lead time because it prefer a more analogical approach on the part of the farm firm
- Maximum inventory is the stock level calculated as the maximum desirable for a farm firm to hold. It is the level above which stock should not be normally allowed to rise. It takes into account the consumption rate, lead time and the reorder quantity
- Safety or buffer stocks are stock allowance to cover errors in forecasting the lead time. It is, therefore, designed to absorb random variations in demand

MATERIALS AND METHODS

Underlying assumptions guiding farm business inventory environment: According to Raymond (1931), inventory model is based on the dynamism of environmental assumptions that the entire quantity ordered is delivered as one lot. The model assumes that the stock on hand rises from the minimum to have the entire lot quantity on hand at the beginning of each cycle. Material is delivered from the start of the production run over a period of time that is long enough for some part of the material to be consumed (issued, sold) before the entire quantity has been delivered.

In line with the above, usages will continue at a consistent rate for an indefinite time, so that there will be more replenishments of the same quantity implying that stock on hand will be diminishing. Also, usage will continue at known or forecast rates which vary from period to period (Wagner and Whitin, 1958). It was further stated that usage will continue until there is an unexpected need to write off any stock that remains on hand (Brown, 1971). Inventory is being controlled at one point (in a stockroom or in raw materials), demand is deterministic and at a constant known rate per year, no stock outs are allowed, lead time is constant and independent of demand and the purchase cost per unit is fixed.

DETERMINISTIC INVENTORY MODELS

For model development and discussion, the following notations were used:

D = Annual demand in units
Q = Quantity ordered, i.e., Economic Order Quantity (EOQ)
*Q = Optimal order quantity

Note that:

- Economic lot size = Q or EOQ:

$$EOQ = \sqrt{\frac{2BC}{E}}$$

Where:
B = Ordering cost per order
C = Consumption rate per annum
E = Carrying cost per unit per year

- Production batch size = *Q or optimal order quantity

Therefore:

$$^{*}Q = \sqrt{\frac{2RcP}{CH(1-\frac{r}{p})}}$$

Where:
R = Consumption rate
CP = Cost of preparation or set up cost

CH = Cost of holding
r = Rate of use per week
p = Production rate

Empirical 1: The sort goods department of large farm super stores sells 500 units per month of a certain tomatoes paste. The unit cost of the paste to the store is 0.50 k and the cost of placing an order is estimated to be ₦200. The store uses an inventory carrying cost of 17% of the cost of inventory on per unit per year basis:

$$EOQ = \sqrt{\frac{2BC}{E}}$$

Where:
R = 500
C = 6,000 (500×12)
B = 200
E = Unit price (%), i.e., 17% of 50 k = 0.085 per unit per year

$$\sqrt{\frac{2\times 200\times 600}{0.085}} = 5{,}314 \text{ units}$$

$$\text{Re-order point (ROP)} = \text{Minimum inventory}+(R\times L) = 0+500\times 1 = 500 \text{ units}$$

or:

$$\text{ROP} = \text{Average daily usage}\times(\text{Lead time}+\text{Buffer stock}) = \text{Minimum inventory}+(\text{Lead time}\times \text{Usage})$$

Brealey and Myers (2003) re-affirm these findings stating that an increase in order size increases the average number of processed goods in inventory leading to a rise in the carrying cost.

Empirical 2: Some items manufactured by a farm firm are delivered in lots of 1,500 units. The rate of use is uniform and equals to 375 units per week. The procurement rate is 2 weeks. Given that the minimum inventory is 200 units, calculate:

- Maximum inventory
- Recorder point
- Average inventory
- X = 1,500
- C = 275
- Lead time = 2 weeks
- Minimum inventory = 200 units

Therefore:

- Maximum inventory = 200+1,500 = 1,700
- Average inventory = 200+1,700/2 = 950 units
- Recorder point = 200+(2×375) = 950

These results confirms Robert (1978) which states that the record of any given stocked item includes various data such as cost, lead time, unit of measure, source, etc. it also involve the decision rules for answering questions such as when to order to replenish stock and how much to order.

Empirical 3: Agri-business soap manufacturer make several different detergent using the same equipment for the types. It cost ₦1,000 to clean the equipments and prepare it for a run for a given detergents. A particular detergent has a determined demand rate of 100 tons month^{-1}. The variable production cost is ₦200 and the business uses an average carrying charges of 17% per annum. What is the optimum quantity to produce per run if stock outs are not allowed per run?

Solution:

$$Q_0 = \sqrt{\frac{2rCp}{CH(1-\frac{r}{p})}}$$

Substitute the following into the above model to arrive at the optimum quantity to produce per run if stock outs are not allowed.

R = 100
CP = ₦1,000
CH = ₦200
P = $12\times100 = 1,200$
r = $17\%\times100 = 17$

BATCH MODEL: QUANTITY DISCOUNT

When demand is certain, delivery would be instantaneous, i.e., no stock outs and quantity can vary giving room for quantity discount. In quantity discount, both quantities and prices are quoted differently. At different level, we have different prices and different Economic Order Quantity (EOQ) which involves Total Cost (TC):

$$TC = \frac{c}{x}B + \frac{x}{2}E + PC$$

where, PC is variation in price.

Empirical 4: Agri-business company purchases a part, that is, sacks which are a component of one of the assemblies (fertilizers) it manufactures. This is used at uniform rate throughout the year. The supplier delivered the entry lot at a time. The manufacturer finds it necessary to take the following pattern when finding the economic lot size. The consumption rate per year C = 25,000 units. The cost of placing and receiving an order B = ₦10. Cost of carrying one unit of inventory for one year E = 20%. The unit purchase price and the unit purchase for the different quantity are given below:

Lot size	Unit price
1-1,999	₦1.00
2,000-4,999	₦0.50 k
5,000 and above	₦0.30 k

Calculate:

- What is the economic lot size at each price?
- In what lot size world the manufacturer purchase the parts?
- What annual cost would the lot size generate?

Solution:

- Given:

C = 25,000 units
B = ₦10
E = 20% per unit per year

$$\text{EOQ} = \sqrt{\frac{2BC}{E}}$$

$$\text{EOQ ₦1} = \sqrt{\frac{2\times 10\times 25{,}000}{0.20\times 1}} = \sqrt{\frac{500{,}000}{0.2}} = 1{,}581.14 \text{ units at ₦1}$$

$$\text{EOQ 50 k} = \sqrt{\frac{2\times 10\times 25{,}000}{0.20\times 0.5}} = \sqrt{\frac{500{,}000}{0.1}} = 2{,}236.07 \text{ units}$$

$$\text{EOQ 30 k} = \sqrt{\frac{2\times 10\times 25{,}000}{0.20\times 0.3}} = \sqrt{\frac{500{,}000}{0.06}} = 2{,}886.75 \text{ units}$$

Therefore, we have two EOQ values falling within the valid price, i.e., 1,581.14 units and 2,236.07 units:

- $\text{TC} = \frac{c}{x}B + \frac{x}{2}E + PC$

$$\text{TC₦1} = \frac{25{,}000}{1{,}581.14}\times 10 + \frac{1{,}581.14}{2}\times 0.2\times 1 + 1\times 25{,}000 = \text{₦}25{,}316.13$$

$$\text{TC50 k} = \frac{25{,}000}{2{,}236.07}\times 10 + \frac{2{,}236.07}{2}\times 0.2\times 0.5 + 0.5\times 25{,}000 = \text{₦}12{,}723.16$$

$$\text{TC30 k} = \frac{25{,}000}{2{,}886.75}\times 10 + \frac{2{,}886.75}{2}\times 0.2\times 0.3 + 0.3\times 25{,}000 = \text{₦}7{,}673.20$$

From the results of empirical 4, the firm should purchase 2,886.75 lot sizes at 30 k in order to take advantage of price discount at the total cost of ₦7,673.20. This implies that the principles of economies of scale must be practiced while keeping inventory.

Empirical 5: A company produces goods with a variety. Annual sales anticipated are 10,000 units. With a discount in price; less than 800 units attracts ₦10.00 per unit; 800 units through 2,499 units attracts ₦9.90 per units, 2,500 and above units attracts ₦9.80 per unit. If the cost of ordering is ₦100.00 and the carrying cost is 0.18% of the price paid, Calculate?

- What is the optimum number of units to order each year time?
- What is the total cost of this order size?

Solution:

C = 10,000
B = ₦100
E = 0.18×p
p = ₦10, ₦9.90 and ₦9.80

$$\text{EOQ} = \sqrt{\frac{2BC}{E}}$$

$$\text{EOQ}_{10} = \sqrt{\frac{2\times 10{,}000\times 100}{0.18\times 10}} = 1054.09 \text{ units}$$

$$\text{EOQ}_{9.90} = 1059.40 \text{ units}$$

$$\text{EOQ}_{9.80} = 1064.79 \text{ units}$$

Therefore, only one EOQ falls within the valid price range, i.e., 1,059.40 units.

- $$\text{TC} = \frac{c}{x}B + \frac{x}{2}E + PC$$

$$\text{TC EOQ} = \frac{10{,}000}{1{,}059.4}\times 100 + \frac{1{,}059.4}{2}\times 0.18\times 9.9 + 10{,}000\times 9.9 = ₦100{,}887.83$$

TC at price break:

$$\text{TC ₦10} = \frac{10{,}000}{1{,}059.09}\times 100 + \frac{1{,}059.09}{2}\times 0.18\times 10 + 10{,}000\times 10 = ₦101{,}897.39$$

$$\text{TC ₦9.90} = \frac{10{,}000}{1{,}059.40}\times 100 + \frac{1{,}059.40}{2}\times 0.18\times 9.9 + 10{,}000\times 9.9 = ₦100{,}887.87$$

$$TC\ ₦9.80 = \frac{10,000}{1,064.79} \times 100 + \frac{1,064.79}{2} \times 0.18 \times 9.80 + 10,000 \times 9.80 = ₦99,878.29$$

We can, now, conclude that the company should purchase in lot size of 1,064.79 units to take advantage of the discount at the total cost of ₦99,878.29.

RE-ORDER POINT AND SAFETY STOCK MODEL

- The Re-order point is defined as:

$$\text{Buffer or safety stock} + (\text{average daily usage}) \times (\text{lead time})$$

So, what must a farm firm do to provide for stock outs? The calculation for the reorder point must be adjusted to provide for stock out, resulting in the above equation of adding buffer or safety stock to it:

- Safety stock refers to extra inventory held as a buffer or protection against the possibility of stock out. The larger inventory of safety stock, the larger will be the inventory carrying costs. On the other hand, safety stock will decrease stock out costs
- The decision as to how much safety stock to engage in order to minimize total costs of any farm firm is not an easy one. One best way of doing it is the use of probabilities

Here, we have to utilize the probability approaches by analyzing past inventory records in order that a probability percentage can be assigned to the various qualities of usage during the reorder period, e.g., $0 \leq \text{prob.} \leq 1$.

Empirical 6: Bauchi water treatment plant at Gubi purchased 100 kg of lime from a wholesaler, Sea Enterprises Ltd. in Bauchi for the use in the water treatment processes. The number of bags used per day varies with the water consumption and past records have yielded the following data:

Usage during past recorded periods (bags)	No. of times quantity of lime used
225	9
300	20
375	15
450	3
525	2
600	1

The normal lead time was 15 days and the average usage per day is 25 bags. Inventory carrying cost ₦2 bag^{-1} $year^{-1}$ and being out of stock necessitates buying from the Bauchi market at an excess price of ₦5 bag^{-1}. The optimum number of order per year is 15. As a management consultant, you have to recommend the safety stock. What reorder point would you recommend?

Solution:

- Lead time (Lt) = 15 days
- Average usage per day or daily consumption (c) = 25 bags
- EOQ or No. of order (C/t) = 15
- Stock out cost = ₦5

Carrying charges or inventory carrying cost of ₦2 implies that any stock or item in inventory attracts a cost no matter the size or quantity. A stock out cost ₦5 and a carrying cost of ₦2 shows that it is economical to keep inventory, that is, inventory can be undertaken to take advantage of price increase, that is, when price changes is unfavourable.

Level of safety stock	Usage during past recorded periods	No lime	Probability $0 \leq p \leq 1$	Expected consumption or expected demand
	225	9	0.18	40.5
	300	20	0.40	120.0
0	375	15	0.30	112.5
75	450	3	0.06	27.0
150	525	2	0.04	21.0
225	600	1	0.02	12.0
			1.00	333.0

Stock out will start at 375 usage date because expected demand of 333 units falls within this period; hence, we start it with 0 values:

- Average usage during lead time = C×Lt or D×Lt = 25×15 = 375 units

Therefore:

- At 0 safety stock:

$$TC_0 = [(75\times0.06\times₦5)+(150\times0.04\times₦5)+(225\times0.02\times₦5)]\times15+0\times₦2$$
$$= (22.5+30+22.5)\times15 = ₦1,125.00$$

- Cost of holding 75 safety stock:

$$TC_{75} = [(75\times0.04\times₦5)+(150\times0.02\times₦5)]\times15+75\times₦2 = ₦600.00$$

- Cost of holding 150 safety stock:

$$TC_{150} = [(75\times0.02\times₦5)\times15+150\times₦2 = ₦412.50$$

According to Empirical 6, various stocks out levels were computed. However, an order of 525 kg, i.e., 375+150 (safety stock) at the total cost of ₦412.50 was feasible, economical and recommended signifying that an average usage during a lead time of 375 units was at a minimum cost of ₦412.50. Brealey and Myers (2003) however, agrees that as the warehouse increases its order size, the number of the orders falls, so that the order cost declines.

Empirical 7: Given the following data for the Nadabo farms, compute the reorder point and determine the level of safety stock the company should maintain if the following information is given.

- EOQ at 100 order per year
- Average usage (C) per day was 4 units
- Average reorder point was 25 give that; inventory cost or cost of storing one unit per year was ₦5; cost of being out of stock per unit per time was ₦20.00

Level of safety stock	Usage during reorder periods	Probability of occurrence
	25	0.05
	50	0.10
	75	0.15
0	100	0.25
25	125	0.20
50	150	0.15
75	175	0.70

Solution:

- EOQ = 10
- C = 4
- Lead time = 25
- Storing cost = ₦5
- Cost of out of stock = ₦20

$$\text{Average usage} = C \times Lt = 4 \times 25 = 100$$

- Cost of holding 0 safety stock:

$$TC_0 = [(25\times0.02\times₦20)+(50\times0.15\times₦20)+(75\times0.40\times₦20)]\times10+0\times₦5 = ₦4{,}000.00$$

- Cost of holding 25 safety stock:

$$TC_{25} = [(25\times0.15\times₦20)+(50\times0.10\times₦20)]\times10+25\times₦5 = ₦1{,}875.00$$

- Cost of holding 50 safety stock:

$$TC_{50} = [(25\times0.10\times₦20)]\times10+50\times₦5 = ₦750.00$$

- Cost of holding 75 safety stock:

$$TC_{75} = [(25\times0\times₦20)]\times10+75\times₦5 = [(0\times20)]\times10\times75\times5 = ₦375.00$$

We, therefore, recommend that the farm maintain safety stock of 75 units to minimize total cost at ₦375.00 or an order of 175 units be placed. That is; 100+75 (safety stock) at TC of ₦375.00.

- Reorder point = Minimum inventory+(Lt×C)

$$= 75+(25\times4) = 175 \text{ units}$$

According to Table 1, the total production cost was ₦1,104,667.52 while, the total revenue was ₦1,759,388. The analysis showed that the poultry (broilers and layers) producers earned ₦654,720.48 as realizable net profit. This wouldn't have been possible without inventory and stock taking controls. Maduekwe *et al.* (2008) in a feasibility survey of 1000 broiler birds, confirms a total variable cost and total fixed cost of ₦470,525 and ₦238,055 representing 66 and 34% of the total cost (₦708,580). The author further agrees with this findings that a net present worth of ₦3,066,447 was positively reported showing that it is feasible and sustainablefor an enterprise to maintain inventory.

According to Table 2, majority (33.93%) of the respondents discloses loses from mortality, disease outbreak (26.79%), weather condition (14.29%), 10.71% for untimely vaccination and breaking of egg product. This indicates that mortality and disease outbreak constitutes the main problem reported to be the major causes of losses by poultry farmers through inventory in the study area.

Table 1: Costs and returns of poultry production and inventory

Variables	Average amount (₦)	Cost (%)
Variable costs		
Cost of feed	725,109	65.64
Cost of labour	68,800	6.22
Cost of chicks	254,567.2	23.04
Cost of medication	9930	0.90
Cost of transportation	4958	0.45
Water management	22,432	2.03
Consultation/phone calls	4607	0.42
Fixed costs		
Depreciation on Assets	14,264.34	1.30
Total cost	1,104,667.52	100.00
Returns		
Sales of matured broilers	425,004	
Sales of spent layers	68,576	
Sales of eggs	1,260,590	
Sales of empty feed bags	3,154	
Sales of manure	2,054	
Total Returns	1,759,388	
Net farm income	654,720.48	

Table 2: Perception of poultry farmers on inventory

Perception	Frequency	Percentage
Egg breakage	6	10.71
Mortality	19	33.93
Weather	8	14.29
Stress	2	3.57
Disease outbreak	15	26.79
Untimely vaccine failures	6	10.71
Total	56*	100.00

*Multiple responces

Table 3: Constraints of poultry production and inventory

Problems militating inventory	Frequency	Percentage
Mortality	30	31.58
Poor supervision	9	9.47
Time constraint	7	7.37
Weather	11	11.58
Disease outbreak	8	8.42
Unskilled personnel	20	21.05
Improper data recording	10	10.51
Total	95*	100.00

*Multiple responces

Table 3 disclosed that 31.58% of the respondents have problem of mortality, 21.05% or the respondents faced problem of unskilled personnel, 11.58% of the respondents faced weather problem (extremely cold or hot), 10.51% of the respondents face improper data recording problem, 9.47% of the respondents faced poor supervision problem, 8.42% of the respondents face problem of disease outbreak and 7.37% faced the problem of time constraint. This indicates that the major problem of keeping inventory by the farmers was mortality. Another study stated that the major causes of mortality are professional error and mishaps in poultry production and inventory.

CONCLUSION

Business managers maintain inventories because it is an investment that translates into capital formation and profit. The empirical findings disclosed that in keeping farm inventory and stocking, the total production cost was ₦1,104,667.52 while, the total revenue was ₦1,759,388 implying that the producers earned ₦654,720.48 as realizable net profit. The major constraint mortality rate at 33.93%. It was, therefore, recommended that when carrying costs are high, the factory should hold a smaller inventory of the fertilizers and replenish it more often. Also, when order costs are high, the factory should hold a larger inventory and replace order less frequently.

REFERENCES

Arrow, K.J. and S. Karlin, 1958. Studies in the Mathematical Theory of Inventory and Production. Stanford University Press, Stanford, CA., USA., ISBN-13: 9780804705417, Pages: 340.

Baruah, B.K., 2011. Agribusiness management, its meaning, nature and scope, types of management tasks and responsibilities. http://assamagribusiness.nic.in/agriclinics/agribusiness%20management.pdf

Brealey, R.M. and S.C. Myers, 2003. Principles of Corporate Finance. 7th Edn., McGraw-Hill/Irwin, New York, USA., Pages: 1071.

Brown, R.G., 1971. Economic order quantities for materials subject to engineering changes. Prod. Invent. Manage., 12: 89-91.

Dvoretzky, A., J. Kiefer and J. Wolfowitz, 1952. The inventory problem: I. Case of known distributions of demand. Econ. Soc., 20: 187-222.

Hornby, A.S., J. Turnbull, D. Lea, D. Parkinson and P. Phillips *et al*., 2010. Oxford Advanced Learner's Dictionary. 8th Edn., Oxford University Press, Oxford, UK., ISBN-13: 978-0194799126, Pages: 1888.

Koutsoyiannis, A., 1983. Modern Microeconomics. 2nd Edn., Macmillan Press Limited, Hong Kong, China, Pages: 581.

Maduekwe, I.M., D.A. Okpanachi and D.O.K. Okoroafor, 2008. Economic analysis of broiler production in gwagwalada, federal capital territory, Nigeria: Implication for entrepreneurship development in a developing economy. Int. J. Entrepreneurship Stud., 1: 134-145.

Magee, J.F., 1958. Production Planning and Inventory Control. McGraw-Hill, New York, USA.

Moran, P.A.P., 1959. The Theory of Storage. Methuen and Co. Ltd., London, UK.

Raymond, F.E., 1931. Quantity and Economy in Manufacture. 1st Edn., McGraw-Hill, New York, USA., Pages: 375.

Robert, G.B., 1978. Inventory Control. In: Handbook of Operations Research: Foundations and Fundamentals, Moder, J.J. and S.E. Elmaghraby (Eds.). Van Nostrand Reinhold, UK., ISBN-13: 9780442245955, pp: 173-212.

Vander Weide, J.H. and S.F. Maier, 1985. Managing Corporate Liquidity: An Introduction to Working Capital Management. John Wiley and Sons Inc., New York, USA., ISBN-13: 9780471877707, Pages: 307.

Wagner, H.M. and T.M. Whitin, 1958. Dynamic version of the economic lot size model. Manage. Sci., 5: 89-96.

Whitin, T.M., 1953. The Theory of Inventory Management. 2nd Edn., Princeton University Press, Princeton, New Jersey.