Article **Journal of Microfinance Planning and Control**
December 2022, Vol.8 No.22 33-39

Inventory program in a storage plant warehouse with financial methodology physical control of inventories

Programa de inventarios en almacén de planta forrajera con metodología financial physical control of inventories

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DOI: 10.35429/JMPC.2022.22.8.33.39 Received: July 20, 2022; Accepted: December 30, 2022

Abstract

The purpose of this is to publicize the results obtained as an Innovation Project, during the research and implementation of the methodology entitled "Financial Physical Control of inventories" developed within the Albagran Forage Plant in its Raw Materials Warehouse, which presented problems in handling them given the characteristics of being perishable material and the costs associated with the procurement and storage of these; derived from the above, the aforementioned methodology consisting of 4 phases was implemented, after analysis: Detailed classification; tracing and mapping; Auditable Control and Self-management. This resulted in the calculation of purchases of raw materials, focused on production needs, being demonstrated in financial terms, the reduction of costs for purchases, storage and losses.

Methodology, Procurement and storage, Raw materials, Purchasing

Resumen

La presente tiene como objeto dar a conocer los resultados obtenidos como Proyecto de Innovación, durante la investigación e implementación de la metodología titulada “Financial Physical Control of inventories” como una alternativa de solución a la problemática en el manejo de inventarios dentro de la Planta Forrajera Albagran en su Almacén de Materias primas, la cual presentaba dificultades en el manejo de las mismas dadas las características de ser material perecedero y a los costos asociados con la procura y almacenamiento de estos; derivado de lo anterior se implementó , previo análisis, la metodología antes citada que consta de 4 fases: Clasificación pormenorizada; trazo y mapeo; Control y Autogestión auditable. Ello dio como resultado el cálculo de compras de materias primas, enfocado en las necesidades de producción, quedando demostrado en términos financieros, la reducción de costos por compras, almacenaje y mermas.

Metodología, Procura y almacenamiento, Materias primas, Compras

Citation: BLEN, Erick, HUESCA, Laura and GUTIÉRREZ, Francisco. Inventory program in a storage plant warehouse with financial methodology physical control of inventories. Journal of Microfinance Planning and Control. 2022. 8-22:33-39.

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Introduction

Forrajera Albagran S.A. de C.V. Is a company with more than 25 years of experience dedicated to the production of balanced feed for cattle, pigs, horses, sheep, poultry and pets. As well as the distribution of raw materials whose objective is to provide the livestock producer with food that will help him to reduce costs in their production processes. It also sells basic raw materials for the nutrition of sheep, sheep and horses, as well as medicines and agricultural implements.

This plant stores different products for the production of its feed, such as: palm kernel meal, coffee husks, biscuit paste, wheat bran, millrun salt, soybean paste, urea, pericarp, forage oats or barley, whole wheat, chicken meal, orthophosphate, phosphoric rock, sodium bicarbonate, corn gluten, among others. The above mentioned are the ones that have the highest participation in the production and which represent purchases of high volumes (tons per week) for all these products the company has two storage warehouses which are commonly called by the staff of the organisation; "Bodega de café" and "Bodega de sal".

The company has experienced failures in its purchasing management system, as it is not adapted to the production needs of the company. It has a main warehouse where most of the finished products and some raw materials are stored, as well as two other warehouses for raw materials, which lack an optimal arrangement due to the volume of purchases, which is greater than required for some products.

It has perishable raw materials, most of which the purchasing department acquires quantities greater than the storage capacity of the plant, due to the price discounted by volume of purchase, without taking into account that this excessive storage incurs higher procurement costs due to the perishable characteristics of the product, as this is exposed to decomposition, payments not contemplated from external warehouses or exposure to the elements of the materials.

Similarly, it makes certain purchases of various raw materials for testing different food formulas for cattle, sheep, pigs, horses, poultry and pets, but these are not usually successful and the materials that were used for these products remain in storage causing a financial loss in the purchase of these.

As a result of the above, the need arises to implement an inventory management model for the raw materials warehouse adapted to the production needs of the Albagran Forrajera.

With this objective in mind, the following research objective was proposed: To design a work model (operational programme) that allows the management of raw materials in the warehouse of Forrajera Albagran S.A. De C.V., adapting the premises suggested in the Methodology for financial physical control of inventories.

It is important to point out that this research focuses specifically on the raw materials warehouse, given that this is the one with the highest costs due to shrinkage and storage, without ignoring the fact that the finished products warehouse or the products in process warehouse have similar problems to those already mentioned.

The appropriate classification of the materials in the raw materials warehouse of the Albagran S.A. de C.V. forage company. It served to prioritise the products that have a high rotation in the production of this, as well as to classify the articles according to their importance, pointing out the articles that represent a higher percentage of the total consumption in relation to the required production.

By using statistical tools such as exponential smoothing to analyse the forecasts of raw material outflows from the warehouse, information was obtained regarding the frequency of purchases in order not to exceed the plant's procurement capacity and also to maintain a stock that can satisfy the needs both in production and in the sale of raw materials.

ISSN: 2444-5037

With the distribution of materials, in the stage called mapping, in the warehouses, an adequate control of them was obtained, in physical and financial terms, due to the fact that it is easy to identify the position, quantity and handling of the raw materials within the warehouse, bringing as a final result the reduction of costs due to wastage. This research is the result of the link between the ITSMT and the company, with the aim of innovating its processes and technologies. In this case, the active participation of a student of the Professional Residency Programme is a key element for the achievement of this research. In this case, the active participation of a student from the Professional Residency Programme was a key element in achieving this goal, demonstrating the application of the knowledge acquired during her academic training, as well as opening the link for future collaborations and research with the aforementioned company.

Methodology applied

As a result of the observation and analysis of inventories (available financial information provided by Albagran personnel) and the different problems for the control of inventories of perishable items, arising in different companies dedicated to the sale of edible products, this project proposes the use of a method of organisation and inventory control that allows the existence and location of the inventory to be known physically at all times, in such a way that this allows both physical and financial control to be exercised. It also proposes the use of Information and Communication Technologies to make this a self-manageable and auditable model at any time required.

The inventory control model proposes a problem for warehouses (inventories) with products that have the particularity that, due to their use in the production area, their rotation is fast and precise in aspects of immediacy of departure of raw materials according to their periodicity of arrival (Blen, 2019), for which the methodology suggests the following steps:

- Detailed classification.
- Tracing and mapping.
- Control.
- Auditable self-management.

The aforementioned steps are the result of a series of already established techniques adapted to the needs of this type of inventories, this methodology takes up statistical tools of simple cost analysis, as well as basic quality tools, which allow real-time control of costs, rotation, location and supply of products (Blen, 2019).

The products found within the warehouses of the Albagran S.A. de C.V. forrajera Albagran S.A. de C.V. They are finished products of fodder and raw materials for the production of the same, we started with the classification of raw materials that are used for production using the ABC method under the criterion of participation, being A the products with the highest frequency of occupation in production meaning that they are the products with a considerably high volume for production, B a with less frequency and type C materials with very low participation within the plant but not the least important.

Classification and prioritisation

According to the materials used for the production of finished products, the products with the highest inventory turnover are prioritised, regardless of the selling price, as indicated by the ABC methodology, since the aim of this method is to classify in detail the turnover time in order to subsequently analyse the financial impact.

	Description	Required	% part.
A	Calcium carbonate	469.166	19.9 %
A	Sorghum	456.082	19.3 %
A	Palm kernel meal	344.466	14.6 %
B	Soybean meal	304.316	12.9 %
B	Bran	249.115	10.5 %
B	Mill run salt	182.182	7.7 %
B	Pericarp	155.789	6.6 %
B	Urea	92.188	3.9 %
C	Oats	29.953	1.2 %
C	Meat meal	22.389	0.9 %
C	Coffee husk	15.124	0.6 %
C	Orthophosphate	13.753	0.5 %
C	Chicken meal	6.727	0.2 %
C	Wheat	6.045	0.2 %
C	Phosphate rock	5.337	0.2 %
	Total, required	2,352.641	100 %

Table 1 Raw Material Requirements
Source: Own elaboration

ISSN: 2444-5037

As illustrated in the table above, the amounts of demand that these materials have for production are indicated, it is worth noting that the items called type C represent 50% of the total products and their percentage of participation is less than 5%, the products classified as B and A are the remaining 30% and 20% respectively.

It is important to mention that products such as whole yellow corn, polished rice, molasses, corn chaff, citrus, biscuit paste, DDG 27%, are some of the few in the plant that have their own special warehouse for each one due to their high demand in production.

The monthly participation of each product is important, this will serve to establish the prioritisation of storage, as this will be based on demand in order to ensure the product that has the highest participation in production, which are shown below.

Product	Annual sale (Bulk)	Total cost	Total price	Profit
Tropical steer	76,404	$ 9,610,954.08	$ 13,382,640.00	$ 3,771,685.92
Fattening cattle	54,948	$ 8,108,841.84	$ 9,687,454.80	$ 1,578,612.96
Cattle 18% Cow 18% Dairy	31,332	$ 5,227,405.08	$ 6,444,622.32	$ 1,217,217.24
Dairy alba plus 16	25,008	$ 3,869,704.32	$ 4,756,070.16	$ 886,365.84
Fattening pellet w/corn	20,436	$ 2,888,627.28	$ 3,670,049.52	$ 781,422.24
Steer 16% Calf 16	10,860	$ 1,675,719.84	$ 2,069,673.60	$ 393,953.76
Calf 16% Calf 16	9,312	$ 1,447,842.48	$ 1,783,252.56	$ 335,410.08
Dairy Gavat	5,844	$ 1,378,028.76	$ 1,690,585.92	$ 312,557.16
Feed type AM	14,172	$ 3,808,430.64	$ 4,083,480.00	$ 275,049.36
Calf 16% pellet	5,424	$ 845,112.00	$ 1,116,360.00	$ 271,248.00
Albahorse 13% multiparticulates	7,680	$ 1,652,806.20	$ 1,923,162.24	$ 270,356.04
Pig finisher C/racto	11,976	$ 808,133.76	$ 1,037,290.20	$ 229,156.44
Dairy Albagran 14	8,712	$ 1,311,000.36	$ 1,498,911.60	$ 187,911.24
Pig growth ProPlus palm	5,868	$ 464,786.28	$ 596,656.92	$ 131,870.64
Albahorse 12% pellet	3,768	$ 732,472.08	$ 779,184.00	$ 46,711.92
Total, sold	291,744	$ 43,829,865.00	$ 54,519,393.84	$ 10,689,528.84

Table 2 Top selling products
Source: Own elaboration

The Top 15 of Forrajera Albagran is made up of the above products, which are the ones that have the greatest share in the sales of the plant, these figures were obtained from annual sales July 2018 - July 2019.

Forecasting and mapping

The simple exponential smoothing method (Hillier, 2006) (sometimes called Brown's simple exponential smoothing) which tries to find the equation of the line that fits the data, with more weight on recent observations and less weight on observations from the distant past, was used to calculate the demand, this method has two smoothing equations, the first finds an estimate for the trend line interpretation, while the second estimates the trend line dependent one. Each equation has its own smoothing constant and therefore the forecaster must find the optimal values for each (Keat & Young, 2011).

This method of calculation is used because it does not require a large amount of historical data, because it is an exponential model, it is more accurate, and it is flexible because it gives importance to the most recent or oldest demand.

The exponential smoothing method is implemented as a forecasting tool in which the forecast is based on a weighted average of current and past values, it is appropriate as the data does not trend but moves around an average value, it does not exhibit significant trend, cyclical or seasonal effects, it is easy to apply and provides a high level of accuracy for short-range forecasts, and it requires minimal data which makes it ideal when forecasts are required.

Goodwin (2010) describes the exponential smoothing method as a way of forecasting the demand for a product over a given period. It estimates that demand will be equal to the historical average for a period, giving greater weighting to values closer in time. In addition, it takes into account the current forecast error in the following forecasts.

For the raw materials to be used in the production of Albagran fodder, it is calculated using the following formula:

Equation 1 Exponential smoothing

$$F_t = F_{t-1} + \alpha(A_{t-1} - F_{t-1}) \quad (1)$$

With this method, the solver tool is used to obtain a more accurate α and a forecast that is closer to reality, within the simple exponential smoothing exercise, a storage buffer is obtained.

Once the storage buffer is established, it is added to the forecast month in order to establish the monthly storage forecast for each of the raw material products to be used in production.

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Average monthly purchase forecast			
Product	**Volume**	**% warehouse**	**% cumulative**
Sorghum	123.8	18.297	18.3
Calcium carbonate	108.2	15.992	34.3
Palm kernel meal	100.4	14.839	49.1
Bran	99.2	14.662	63.8
Soybean meal	53	7.833	71.6
Coffee husks	49.9	7.375	79.0
Mill run salt	40.9	6.045	85.0
Pericarp	36.6	5.409	90.5
Urea	32.8	4.848	95.3
Oats	9.2	1.360	96.7
Meat meal	8.3	1.227	97.9
Phosphate rock	6.5	0.961	98.8
Wheat	4.4	0.650	99.5
Chicken meal	2.3	0.340	99.8
Orthophosphate	1.1	0.163	100.0
Total, stored	**676.6**	**100**	

Table 3 Prioritised storage forecast
Source: Own elaboration

In the table above it can be seen that the maximum storage forecast is 676.6 tonnes for the month in question, all this taking into account that due to some eventuality there may be an excess production of some product or due to the bulk sale of raw materials.

Taking into account that the plant's two raw material storage warehouses, the "coffee warehouse" and the "salt warehouse" have a capacity of 450 tonnes and 300 tonnes respectively.

Once the quantities of raw materials to be stored have been defined, and following the logic of production prioritisation (from the most demanded to the least demanded), they should be stowed in a linear manner, allowing the continuous flow of the product, as well as the shape of the stowages to be two tonnes for reasons of space and using a system of first in, first out system, in order to avoid losses in the inventory of raw materials.

The plant has two storage warehouses which store both raw materials and finished products. The above diagram shows the coffee warehouse with dimensions of 15.08m x 10.30m and a height of 5m.

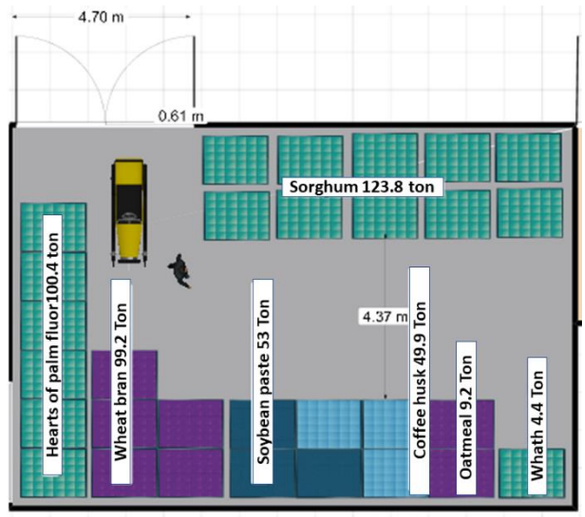

Figure 1 Proposed distribution
Source: Own elaboration with Sketchup software.

Conclusion

Many of Albagran's cost overruns originated in the excessive purchase of raw materials, as there was a surplus of them and considering their perishable nature, this resulted in losses due to wastage, together with a low turnover. In addition, it was not possible to ensure the quality of the product, due to the conditions of the raw material.

In addition to an obvious financial loss due to shrinkage, this also resulted in a drop in sales volumes as it was not possible to offer a reliable product to the customer, as this had repercussions on the finished products.

This methodology has brought improvements in two direct areas, physical storage and financial control. In relation to physical storage, it has been arranged as shown in Illustration 1, in such a way that the location and volume available in the company's warehouse is physically known.

On the other hand, in financial terms, the application of this model allows us to know on the one hand the amount of inventory we have, which must coincide with what physically exists, and on the other hand, by eliminating excessive purchases, we have made better use of the company's financial resources, buying only what is required.

ISSN: 2444-5037

Figure 2 Current physical storage
Source: Own elaboration

In addition to the above, it is important to point out that the company has only implemented three of the four stages of the aforementioned methodology, because although it is true that it has statistical and documentary controls of the operations related to the warehouse, for the fourth stage consisting of self-management and that this in turn is auditable, it requires investment in the development of software and information technologies in general, for the optimal functioning of the methodology, although the latter is not limiting in relation to the results currently shown by the use of the methodology.

An example of the positive results that the application of this method has brought about is shown below, taking the coffee husk raw material as a reference:

Weekly Coffee husk						
Unit cost Tonne ($)	Q	MP amount ($)	MP + Transport ($)	Cost x ton ($)	Transport ($)	Total cost ($)
1,800.00	26	46,800.00	47,200.00	1,815.38	400.00	188,800.00
1,800.00	13	23,400.00	23,800.00	1,830.77	400.00	95,200.00

Table 4 Comparative sales analysis
Source: Own elaboration

As we can see in the table above, the use of the method brings with it a reduction in costs, saving the company approximately $ 93,600.00 in the purchase of the input "coffee husk", reducing the volume from 26 to 13 tonnes, i.e., reducing the purchase by 50% and in addition the storage needs.

It should be noted that one of the main characteristics of this input is that it is prone to decomposition or infestation by pests, if it is not handled properly, i.e., if its storage does not comply with optimal lighting and humidity conditions, therefore, maintaining a high inventory increases the risk of decomposition and/or infestation by pests.

As can be seen, the objective of the research was met, since a forecasting system was designed for raw material purchases in the company, adapted to the production needs of the company, taking better advantage of the application of financial resources, as well as the company's infrastructure.

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ISSN: 2444-5037