MASTER OF INDUSTRIAL AND STRATEGICAL MANAGEMENT

MASTER'S FINAL WORK

DISSERTATION

THE ANALIZE AND OPTIMIZATION OF STOCK MANAGEMENT AT A PORTUGUESE COMPANY IN THE WHOLESALE SECTOR – A CASE STUDY

INÊS MARIA MENDES DA FONSECA

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ABSTRACT

Efficient stock management is the cornerstone of success for businesses operating in today's dynamic and competitive markets. In an era marked by globalization, e-commerce, and supply chain complexities, the ability to optimize stock levels, minimize costs, and meet customer demand is vital. This work investigates into the details of stock management, exploring strategies, tools, and best practices that empower organizations to achieve optimal inventory control. By managing stock costs correctly, companies can make significant savings.

In this study, academic stock management models are applied to a fruit and vegetable distribution and sales company. For reasons of confidentiality, the name of the company cannot be revealed. The main objective of this study is to verify the existence of possible cost savings in stock management in this company.

Two models were used in this study: the ABC model, which aims to organize the company's products into three groups, from the products with the greatest monetary impact on the company to those with the smallest impact. Next, the Economic Order Quantity model is used to define the optimum number of units in each order.

Based on academic methods, and, after the application of the stock management methods mentioned above, this study allowed the company to reduce its stock by around 63.61%, when compared to the cost initially predicted.

Key Words: Food Sector, Stock Management, ABC analysis, EOQ, Total Inventory Cost.

RESUMO

Uma gestão de stocks eficiente é a base do sucesso das empresas que operam nos mercados dinâmicos e competitivos de hoje. Numa era marcada pela globalização, pelo comércio eletrónico e pelas complexidades da cadeia de abastecimento, a capacidade de otimizar os níveis de stock, minimizar os custos e satisfazer a procura dos clientes é fundamental. Deste modo, este trabalho analisa os aspetos da gestão de stocks, explorando estratégias, ferramentas e melhores práticas que permitam às organizações obter um controlo ótimo dos stocks. Ao gerir corretamente os custos de stock, as empresas podem obter poupanças significativas.

Neste estudo, os modelos académicos de gestão de stocks são aplicados a uma empresa de distribuição e venda de frutas e legumes. Por razões de confidencialidade, o nome da empresa não pode ser revelado. O principal objetivo deste estudo é verificar a existência de possíveis economias de custos na gestão de stocks desta empresa.

Neste estudo foram utilizados dois modelos: o modelo ABC, que visa organizar os produtos da empresa em três grupos, desde os produtos com maior impacto financeiro na empresa até aos de menor impacto. De seguida, é utilizado o modelo da Quantidade Económica de Encomenda para definir o número ótimo de unidades em cada encomenda.

Com base em métodos académicos, e após a aplicação dos métodos de gestão de stocks acima referidos, este estudo permitiu à empresa reduzir o seu stock em cerca de 63,61%, face ao custo inicialmente previsto.

Palavras-chave: Sector Alimentar, Gestão de stocks, Análise ABC, QEE, Custo Total de aprovisionamento.

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1. INTRODUCTION

1.1. Context

In the dynamic landscape of the wholesale sector, efficient stock management plays a decisive role in the success of any small company. With the increasing complexity of supply chains and customer demands, maintaining optimal stock levels in a warehouse has become a complex task that requires careful planning and strategic decision making. This work aims to explore the significance of stock level optimization and its impact on enhancing operational efficiency in the context of a small company operating in the wholesale sector.

Effective stock management involves striking the delicate balance between ensuring sufficient stock availability to meet customer demands and minimizing the carrying costs associated with excess inventory. Small companies in the wholesale sector often faces resource constraints and limited storage capacity, making it crucial to optimize stock levels to maximize profitability and customer satisfaction. By employing sophisticated optimization technique, small businesses can achieve improved inventory turnover, reduce costs, and enhance operational agility.

Stock optimization encompasses a comprehensive set of strategies and tactics that enable organizations to strike the right balance between inventory availability and investment. Traditional approaches often lead to excessive stock levels, resulting in increased holding costs, obsolescence, and missed sales opportunities. Conversely, insufficient stock can lead to missed customer orders, delays in order fulfilment, and potential damage to customer loyalty.

Within the scope of stock level optimization, several key factors come into play, such as demand forecasting, lead time management, order frequency, and reorder points. By accurately forecasting demand patterns and analysing historical data, companies can make informed decisions about stock replenishment, ensuring the availability of products when needed while they minimize the risk of overstocking or stockouts. Additionally, by strategically managing lead times and reorganization order frequency, small businesses can optimize their inventory turnover rate, freeing up capital for investment in other critical areas of the business.

This work aims to explore the complexities of a warehouse stock optimization, examining the underlying principles, and methodologies.

1.2. Research objective

The objective of this work is to determine what are the decisive factors in a correct stock management policy. Starting by understanding the different methodologies used in the literature, it will be possible to demonstrate their application in a real case study. For confidentiality reasons the name of the company will be omitted during the study. The purpose of this work is then related to the possible contribution that this small and medium company can make to become more competitive in the market through the reformulation of some stock management policies currently implemented.

A stock classification will be applied according to the analytical data collected, including the ABC analysis seeking to define a stock policy more advantageous to the company to achieve a higher degree of efficiency.

The relevance of this study for the literature is related to the model validation, by using known academic approaches into a company, belonging to a sector with specific needs, where in the end, the main objective is to have additional efficiency gains, by reducing stock costs, when compared to the previous approach used by the company.

1.3. Structure

This study is split into 5 parts. They are: 1. Introduction, where the topic will be introduced. 2. Literature Review, where will be studied what important authors have written about the topic. 3. Methodology, where will be explained how the research will be made. 4. Analysis and discussion of results, where it will be shown and analysed the results of the research. Finally, 5. Conclusion, limitations, and future research, where will be summed up the findings.

The introduction part will give a quick explanation of what the research is about and why it will be important. It also states what the research will try to accomplish. The part of the literature review will present and explain important ideas from other authors that the work is based on and explains how they will be used. After that, the methodology will explain more about what the research will aim to do and how it will do it using specific tools. In this section is characterized the type of research, the

procedure and how the data was collected and processed. In the part of the analysis of the results, the outcomes obtained in the study will be analysed as well as the impact of stock management in this company will be quantified based on the proposed stock management classifications and models. The last part of the report summarizes what was found and addresses about what it could mean, and purpose future research.

2. LITERATURE REVIEW

2.1. Supply Chain Management

Supply Chain Management (SCM) is a complex and multifaceted field that has received significant attention from scholars and practitioners alike. Over the past few decades, numerous studies have been conducted to understand the various aspects of SCM and its impact on organizational performance.

SCM has evolved over time and its origins can be traced back to the early days of trade and commerce. The concept of managing the flow of goods and materials can be seen throughout history, but it was not until the late 20th century, when it was emerged as a distinct discipline. In ancient Egypt, for example, complex supply chains were established to transport and distribute goods like food and building materials for the construction of the pyramids. In the early 20th century, with the rise of industrialization and mass production, companies began to focus on optimizing their internal processes to improve efficiency and reduce costs.

One of the earliest definitions of SCM was proposed by Cooper *et al.* (1997), who defined it as "the systematic coordination of business processes for the purpose of achieving sustainable competitive advantage through the optimization of supply chain effectiveness and efficiency".

Since then, SCM has been studied extensively in a variety of contexts, including manufacturing, service industries, and healthcare. Some of the key themes that have emerged in SCM literature include supply chain integration, collaboration, risk management, sustainability, and technology (Chopra, S., & Meindl, P. (2016)).

Supply chain integration refers to the extent to which the various actors in a supply chain work together to achieve common goals. Collaboration, on the other hand, involves the sharing of information, resources, and risks among supply chain partners. Risk management has become increasingly important in SCM, particularly in the challenge of natural disasters, political instability, and other disruptions that can have significant impacts on the supply chain. Scholars have proposed a variety of risk management frameworks and tools to help organizations identify, assess, and mitigate supply chain risks. Sustainability has also emerged as an important topic in SCM

literature, as organizations seek to reduce their environmental impact and meet the growing demand for socially responsible business practices. Finally, technology has played a significant role in the evolution of SCM, with the emergence of modern technologies that offering new opportunities for supply chain optimization and innovation.

Mentzer, DeWitt, Keebler, Min, Nix, Smith, and Zacharia (2001) argued that SCM encompasses "the systemic, strategic coordination of the traditional business functions and the tactics across these business functions within a particular company and across businesses within the supply chain, for the purposes of improving the long-term performance of the individual companies and the supply chain as a whole." They also identified several key features of effective supply chain management, including:

- **Integration:** SCM involves the integration of multiple business functions, including procurement, production, transportation, and distribution, in order to achieve common goals.
- **Collaboration:** Successful SCM requires collaboration among all members of the supply chain, including suppliers, manufacturers, distributors, and retailers.
- **Information sharing:** Effective SCM relies on the timely and accurate sharing of information among supply chain partners.
- **Performance measurement:** SCM involves the establishment of metrics and performance targets to measure the effectiveness of supply chain operations.
- **Continuous improvement:** Successful SCM requires a commitment to continuous improvement and the use of feedback to identify opportunities for optimization and innovation.

The authors also emphasized the importance of strategic alignment in SCM, noting that organizations must align their supply chain strategy with their overall business strategy to achieve sustainable competitive advantage.

David Simchi-Levi, Philip Kaminsky, and Edith Simchi-Levi *et al* (2007) argue that effective SCM requires a strategic and coordinated approach to managing the various activities involved in the supply chain, including procurement, manufacturing, transportation, and customer service. By optimizing these activities, companies can

achieve a competitive advantage by delivering high-quality products at lower costs and with faster delivery times, which can enhance customer satisfaction and loyalty.

Supply chain management involves managing the flow of goods, services, and information across the entire supply chain, from the sourcing of raw materials to the delivery of finished products to customers. It also involves the coordination and integration of all activities involved in the production and delivery of goods and services, including sourcing, procurement, production, transportation, warehousing, stock management, and customer service (Chopra and Meindl, (2016)). The goal of SCM is to optimize the efficiency of the supply chain, reduce costs, improve product quality, and enhance customer satisfaction. Effective SCM requires collaboration and coordination among all parties involved in the supply chain, including suppliers, manufacturers, distributors, and customers and can help companies improve their competitiveness, reduce waste, and increase profitability (Christopher, M. (2016)).

SCM has become increasingly important in recent years, particularly as companies have globalized their operations and rely on complex networks of suppliers and partners to produce and deliver their products.

Heizer, Render, and Munson (2017) define SCM as the coordination of activities involved in the flow of goods and services from suppliers to customers. It includes managing the movement and capacity of raw materials, work-in-progress stock, and wrapped up products from point of beginning to point of utilization.

Lambert and Enz (2017) argue that the focus of SCM should be on creating value for the customer by integrating the activities of all parties involved in the supply chain. They emphasize the importance of aligning supply chain strategy with the overall business strategy of the company and importance the need for effective communication and collaboration among supply chain partners. Additionally, they emphasize the need for companies to continually monitor and analyse their supply chain performance to identify opportunities for improvement and to mitigate risks. The authors suggest that a customer-centric approach to SCM is essential for companies to remain competitive and successful in today's global marketplace.

Supply chain management also involves the integration and coordination of various functions within a company and among companies in the supply chain, such as marketing, operations, logistics, and information technology. The goal of SCM is to create value for customers by delivering products and services in a timely, cost-effective, and efficient manner while maintaining elevated levels of quality and customer satisfaction.

Recently studies evidence new learnings in SCM area. The paper "A review on reinforcement learning algorithms and applications on supply chain management" of 2022 by Benjamin Rolf, Ilya Jackson, Marcel Müller, Sebastian Lang, Tobias Reggelin & Dmitry Ivanov explores the current state of the art of reinforcement learning in SCM and proposes a classification framework. The authors highlight that decision-making in supply chains is challenged by high complexity, a combination of persistent and discrete forms, coordinates and interdependent operations, dynamics, and adaptability. They argue that the rapidly increasing data availability, computing power, and intelligent algorithms unveil new potentials in adaptive data-driven decision-making.

Reinforcement Learning, a class of machine learning algorithms, is identified as one of the data-driven methods. The review revealed a few critical insights, for example, stock management is the most common application of reinforcement learning in supply chains, as it is a pivotal element of supply chain synchronization, and most reviewed papers address to SCM problems driven by artificial data. The authors suggest that shifting to industry-scale problems will be a crucial challenge in the next years. If this shift is successful, the vision of data-driven decision-making in real-time could become reality, Rolf *et al.* (2022).

2.2. Logistics Management

Logistics management is a critical aspect of supply chain management that involves planning, coordinating, and controlling the movement and storage of goods, services, and information from the point of origin to the point of consumption. It is an essential component of business operations as it ensures that products and services are delivered to customers on time, at the right location, and at the right cost (Douglas M. Lambert, (1996)).

The literature on logistics management covers a broad range of topics, including transportation, stock management, warehousing, distribution, and information management.

Logistics management has a long history that can be traced back to ancient civilizations, these civilizations developed systems to organize the transportation and storage of goods. The need to manage the movement of goods and resources efficiently has always been a crucial aspect of trade and military operations. Throughout history, armies have required careful planning and coordination to ensure the timely delivery of supplies, ammunition, and equipment to troops in the fields. The two World Wars of the 20th century showcased the critical role of logistics in modern war. These conflicts required extensive coordination of resources, transportation, and supply chains on a massive scale. Concepts such as logistics planning, inventory control, and distribution networks were further developed during this time.

The goal of logistics management is to ensure that goods and services are delivered to customers in a timely, efficient, and cost-effective manner. Christopher, M. (2016) emphasizes that the goal of logistics management is to add value to the supply chain by optimizing the flow of goods and information. He argues that logistics managers must balance the conflicting goals of cost reduction and service improvement, and that this requires a deep understanding of customer needs and market trends.

Christopher, M. (2016) also emphasizes the importance of collaboration and integration within the supply chain. He argues that logistics managers must collaborate closely with suppliers, customers, and other stakeholders to ensure that logistics processes are aligned with broader organizational goals. This requires effective communication, trust, and a willingness to share information and resources. The author highlights the strategic importance of logistics management in achieving competitive advantage and delivering value to customers. Christopher emphasizes the need for logistics managers to stay abreast of emerging trends and technologies, and to be flexible and adaptable in the face of changing market conditions.

Both Christopher (2016) and Palmatiwe, Sivadas, Stern, and El-Ansary (2020) recognize that logistics management involves planning, organizing, and controlling the

movement of goods and services from the point of origin to the point of consumption. They also identify transportation management, stock management, warehousing, order processing, and SCM as key functions of logistics management. Overall, both authors acknowledge the importance of logistics management in achieving organizational goals and improving supply chain performance. However, Palmatiwe *et al.* (2020) provide additional insights on emerging trends in logistics management, that includes the increasing use of technology such as automation, artificial intelligence, and blockchain to optimize logistics processes and enhance supply chain visibility; the growing importance of customer-centric logistics, which involves tailoring logistics strategies to meet the specific needs and preferences of different customer segments; the rising importance of sustainability and social responsibility in logistics management, which involves reducing carbon emissions, minimizing waste, and ensuring ethical sourcing practices; and the need to manage risk and uncertainty in logistics, particularly in light of global events such as natural disasters, geopolitical tensions, and pandemics. Palmatiwe *et al.* (2020) also provide a more updated perspective on emerging trends and challenges in logistics management, reflecting changes in the business environment and advancements in technology.

Kain and Verma (2018) highlighted the importance of adopting innovative technologies in logistics management. They argued that with the advent of technologies such as the Internet of Things (IoT), big data analytics, and cloud computing, logistics management has become more efficient and effective. They also discussed how the use of these technologies can help improve supply chain visibility, reduce transportation costs, and enhance customer satisfaction. Furthermore, they also discussed the challenges faced by logistics managers in the current business environment. They identified issues such as rising fuel costs, increasing customer expectations, and changing regulations as some of the key challenges that logistics managers need to address. Overall, Kain and Verma's study emphasized the importance of logistics management in modern business and the need for logistics managers to keep up with emerging technologies to stay competitive in the market.

John J. Coyle (2019) argues that effective logistics management is essential for businesses to meet customer expectations, optimize resources, and achieve profitability. Coyle's approach to logistics management emphasizes the importance of understanding the interrelationships among various logistics activities, such as transportation, stock management, warehousing, and customer service. He also emphasizes the need for effective coordination and collaboration among different stakeholders in the supply chain, such as suppliers, manufacturers, distributors, and customers. Overall, Coyle's work emphasizes the strategic importance of logistics management in achieving business success in a rapidly changing global marketplace. He highlights the importance of developing a comprehensive logistics strategy that aligns with overall business goals and objectives and emphasizes the need for continuous improvement and innovation in logistics management practices.

The following topics are a brief review of some of the key concepts and issues in logistics management:

- Transportation management is a critical aspect of logistics management that involves selecting the best mode of transportation, routing, and scheduling of goods. Effective transportation management can help organizations reduce transportation costs, improve delivery times, and enhance customer satisfaction.
- Stock management involves maintaining the optimal level of inventory to meet customer demand while minimizing inventory holding costs. Effective stock management can help organizations reduce inventory costs, improve cash flow, and ensure the availability of products for customers.
- Warehousing is the process of storing goods in a facility until they are ready for distribution. Effective warehouse management can help organizations improve inventory accuracy, reduce warehouse costs, and improve order fulfilment times.
- Distribution involves the process of delivering goods to customers. Effective distribution management can help organizations improve customer service, reduce delivery times, and minimize transportation costs.

- Information management involves the use of technology and systems to manage logistics data, including transportation schedules, inventory levels, and order information. Effective information management can help organizations improve supply chain visibility, reduce administrative costs, and enhance decision-making.

During the years, there has been a development in the main strategies of logistics management, as lean logistics, green logistics, agile logistics, just-in-time logistics, and outsourcing. Overall, the choice of logistics management functions and strategies depends on the specific needs of the organization and the nature of its logistics operations.

In conclusion, logistics management is a critical aspect of SCM that involves planning, coordinating, and controlling the movement and storage of goods, services, and information. Effective logistics management can help organizations reduce costs, improve delivery times, and enhance customer satisfaction. In the paper "Emergency logistics management—Review and propositions for future research", of 2022, the authors proposed several future research areas related to emergency logistics management, including the design of an ecosystem-aware supply network, emphasizing transportation, inventory, and sourcing policies, to enhance the operational efficiency of a self-organized response system and humanitarian supply networks. They also suggested integrating practitioners' experience in humanitarian logistics and emergency relief management with well-established methods and tools from decision sciences and state-of-the-art information and communication technology (ICT) platforms, Kundu *et al* (2022).

2.2.1. Stock management

Stock management, also known as inventory management, has its roots in the early history of commerce and trade. The concept of managing stock or inventory emerged with the development of complex trading systems and the need to maintain adequate supplies of goods. In ancient times, people engaged in bartering, where goods and services were exchanged directly without the use of currency. Individuals or communities would maintain a stock of goods to facilitate trade and fulfil their basic

needs. The Industrial Revolution in the 18th and 19th centuries brought significant advancements in manufacturing and transportation. With the expansion of factories and the development of railroads, stock management became more crucial to ensure smooth production and distribution processes.

Ballou (2004) defines stocks as the inventory of goods that a company holds for its business operations. These goods can be raw materials, work in progress, finished goods, or supplies. With this, the author defines stock management as the process of planning, organizing, and controlling the flow of goods in and out of a company's inventory. This includes activities such as forecasting demand, setting inventory levels, ordering, and receiving goods, and monitoring stock levels. In addition, it is relevant to explain the definition of this author of safety stocks which is the additional inventory that a company holds to protect against unexpected fluctuations in demand or supply. Safety stocks are used as a buffer to avoid stockouts and ensure customer satisfaction.

Ballou emphasizes the importance of effective stock management in ensuring the smooth functioning of a supply chain. The author notes that stock management decisions can have a significant impact on a company's profitability, and that companies should strive to strike a balance between the costs of holding inventory and the risks of stockouts. He also highlights the role of technology in improving stock management processes, such as the use of stock management software and automated inventory tracking systems.

Stock management refers to the process of overseeing and controlling the flow of goods and materials within a business or organization. It involves managing the stock levels of products or materials to ensure that they are neither overstocked nor understocked, in order to meet customer demand while minimizing costs. Effective stock management involves tracking inventory levels, forecasting demand, ordering new stock when needed, and managing stock movement and storage. The goal of stock management is to ensure that the right products are available at the right time, in the right quantities, and at the right cost.

Stock management has been studied extensively in the field of operations management, with a focus on optimizing inventory levels and reducing costs while

maintaining customer service levels. Several models have been developed to support stock management decision-making, including economic order quantity (EOQ), just-in-time (JIT), and materials requirement planning (MRP).

The EOQ model was developed in the early 20th century and is based on the trade-off between inventory holding costs and ordering costs. The model calculates the optimal order quantity that minimizes the total cost of inventory, considering factors such as the cost of holding inventory, the cost of ordering, and the demand rate.

JIT is a lean manufacturing approach that aims to minimize waste and reduce inventory levels by producing goods only when they are needed. This approach requires a high degree of coordination between suppliers and manufacturers, as materials and components must be delivered just in time for production.

MRP is a computer-based planning and control system that uses data on inventory levels, production schedules, and customer demand to calculate the materials requirements for a given period. The system generates a materials plan that specifies the quantities of each item needed to meet production requirements and maintain inventory levels.

According with Heizer *et al.* (2017) stock management involves the planning, coordination, and control of inventory levels to meet customer demand while minimizing costs and the goal of stock management is to balance the costs of carrying inventory (such as storage and handling costs) with the costs of stockouts (such as lost sales and customer dissatisfaction). Overall, Heizer *et al.* standing the importance of effective stock management for achieving operational efficiency and customer satisfaction.

Vignali, Montanari, Mantovani & Bottani (2017) in their research discussed the importance of effective stock management for business success. They highlighted that stock management is crucial for firms to maintain customer satisfaction, reduce costs, and improve profitability. The authors emphasized the need for businesses to adopt an integrated approach to stock management that considers all stages of the supply chain, from procurement to distribution. They also discuss the key factors that influence stock management practices, including demand forecasting, inventory control, and supplier

relationship management. The authors suggest that firms need to adopt an initiative-taking approach to stock management, regularly reviewing and optimizing their stock levels based on demand patterns and changing market conditions.

Several authors use the same definition. Kyalo *et al.* (2018), for example, had conducted a study on the impact of stock management on the performance of small and medium-sized enterprises (SMEs) in Kenya. In their study, they found that effective stock management is crucial for the success of SMEs. According to Kyalo *et al.* (2018), stock management involves multiple actions to ensure that the right amount of stock is available at the right time to meet customer demand. Effective stock management helps SMEs to minimize stockouts, reduce inventory costs, improve cash flow, and increase profitability. Kyalo *et al.* (2018) identified several strategies that SMEs can use to improve their stock management practices. These strategies include forecasting demand, setting inventory levels, monitoring inventory levels, adopting technology which helps to reduce errors, improve efficiency, and provide real-time visibility into inventory levels.

Recent research has focused on incorporating sustainability considerations into stock management decision-making. This includes incorporating environmental impact assessments into inventory optimization models, as well as developing green SCM practices that promote the use of sustainable materials and reduce waste.

In addition, advances in technology such as the use of RFID (radio-frequency identification) and real-time inventory tracking systems have enabled more accurate and efficient stock management. These technologies allow for real-time tracking of inventory levels and movements, which can improve decision-making and reduce the risk of stockouts.

Overall, stock management remains a critical area of research and practice in operations management, with ongoing efforts to improve efficiency, reduce waste, and promote sustainability.

2.2.2. Demand management

Demand management emerged as a response to economic fluctuations and the need for effective resource allocation. It can be traced back to the early 20th century

when economists began exploring ways to stabilize and manage economic cycles. The Great Depression of the 1930s played a significant role in shaping the understanding of demand management. During this period, widespread unemployment and economic stagnation highlighted the need for interventions to stimulate economic activity. Economists such as John Maynard Keynes developed theories advocating for government intervention in the economy to manage demand. Following World War II, demand management became an integral part of economic policy in many countries. Governments started actively using fiscal and monetary tools to regulate aggregate demand and stabilize their economies. The focus was on achieving full employment, price stability, and sustainable growth.

Demand management refers to the process of planning and controlling the demand for goods or services. The goal of demand management is to ensure that supply and demand are balanced, which can help to reduce inefficiencies and improve profitability.

Demand management involves analysing market trends, customer preferences, and sales data to forecast demand for a particular product or service. Based on this analysis, companies can then adjust their production, pricing, and marketing strategies to meet the expected demand. In addition to forecasting and adjusting supply, demand management can also involve managing demand itself. For example, companies may use promotions or discounts to encourage customers to purchase a product during a slower period or limit the availability of a product during a period of high demand to avoid stockouts.

Peter Drucker believed that demand management was critical to the success of a business, and that companies should focus on understanding and meeting the needs of their customers. He argued that businesses should be proactive in managing demand, rather than simply reacting to changes in the market. He emphasized the importance of market research and customer feedback in developing effective demand management strategies, Drucker, P. (1954).

Rothschild (1990) argues that demand management is critical to the success of any business or economy. He suggests that demand management strategies should be

based on a deep understanding of consumer preferences and behaviour. The author also emphasizes the importance of innovation in developing new products and services that meet changing consumer needs. Rothschild also identifies several challenges facing demand management in the future. These include the increasing complexity of consumer behaviour, the growing importance of technology in shaping demand, and the need for businesses to be more socially and environmentally responsible in their operations.

Ballou (2007) defines demand management as "the process of aligning supply chain capabilities with customer demand patterns to maximize profitability and customer satisfaction."

Ballou's definition of demand management highlights the importance of understanding customer demand patterns and aligning supply chain capabilities to meet those demands in a profitable manner. This involves forecasting demand, setting inventory levels, and coordinating production and logistics activities to ensure that products are delivered to customers in a timely and cost-effective manner. In addition, Ballou emphasizes the need for effective communication and collaboration across the supply chain to ensure that all stakeholders are aligned around the same goals and objectives. By effectively managing demand, companies can optimize their supply chain operations, reduce costs, and improve customer satisfaction.

Richard Thaler, on the other hand, is known for his work in behavioural economics, which looks at how people make decisions and how their behaviour can be influenced by a range of factors. Thaler has argued that demand management should consider the biases and irrationalities that can affect consumer behaviour, Thaler, R. H., & Sunstein, C. R. (2008).

There are however several techniques that helps demand management, as demand forecasting, sales and operations, order promising, capacity planning, stock management, production planning, pricing strategy and marketing strategy. Overall, these techniques are all important components of demand management. By using these techniques effectively, companies can improve their ability to meet customer demand, minimize costs, and maximize profitability.

Overall, demand management strategies involve a combination of pricing, promotions, advertising, product differentiation, forecasting and planning, channel management, and supply chain management. The key is to find the right balance between these strategies to meet customer demand while maximizing profitability.

Demand management is an important aspect of business planning, as it helps companies to optimize their operations and meet the needs of their customers in a timely and efficient manner. Rothschild (1990) highlighted the importance of demand management in today's rapidly changing economy, and the need for businesses and policymakers to stay ahead of the curve in developing effective strategies for managing demand.

2.3. Stock Management Models

Stock management models are frameworks or approaches used by businesses to manage their inventory of goods, products, or materials. These models are designed to optimize inventory levels, minimize costs, and ensure that the right products are available at the right time and in the right quantities.

Stock management models has evolved over time in response to the increasing complexity of supply chains and the need for efficient stock management. The origins of stock management can be traced back to the early days of trade and commerce when merchants recognized the importance of managing inventory levels to ensure adequate supply and meet customer demand. However, the formal development of stock management models began in the mid-20th century with the advent of computer technology and advancements in operations research.

As Ballou (2004) discusses there are diverse types of inventory models, such as the basic Economic Order Quantity (EOQ) model, the production quantity model, and the quantity discount model. Ballou emphasizes the importance of stock management in SCM and highlights that the cost of holding inventory is a significant factor to consider when managing stock. He also explains that stock management should be a collaborative effort between different departments within a company, including finance, operations, and marketing. The author also highlights the importance of inventory classification and segmentation, which involves categorizing inventory items

based on their value, demand, and other characteristics. He explains that different inventory items require different management strategies, and that effective segmentation can help to optimize stock levels and reduce costs.

Kyalo *et al.* (2018) used the term "stock management models" to refer to methods used to manage and control inventory levels. The authors defined stock management models as mathematical models that provide a systematic approach to determine optimal stock levels and ordering policies. These models are used to minimize stock costs while maintaining a desired level of service. Kyalo *et al.* (2018) specifically focused on three commonly used stock management models: Economic Order Quantity (EOQ), Just-In-Time (JIT), and Materials Requirements Planning (MRP). However, there are several different stock management models that businesses can use, including:

- **Just-In-Time (JIT)** - This model involves ordering inventory only when it is needed, reducing the need for large accumulations of goods.
- **Economic Order Quantity (EOQ)** - This model calculates the optimal quantity of goods to order to minimize total inventory costs, considering factors such as order and holding costs.
- **Materials Requirement Planning (MRP)** – this model uses production schedules to determine the necessary materials and inventory levels to meet production requirements.
- **Minimum Stock Level (MSL)** - This model sets a minimum level of inventory that should be kept on hand to ensure that products are always available for customers.
- **ABC Analysis** - This model categorizes inventory into three categories (A, B, and C) based on the value of the items and the frequency of sales, and then manages each category differently.
- **Vendor Managed Inventory (VMI)** - This model involves the supplier managing the inventory levels at the customer's location, reducing the need for the customer to manage their own inventory.

Generally, Kyalo *et al.* (2018) viewed stock management models as important tools for managing inventory levels and controlling costs in manufacturing firms. The

authors highlighted the importance of selecting the appropriate stock management model based on the specific needs and characteristics of the firm, and of regularly reviewing and updating stock management policies to ensure their effectiveness.

Overall, selecting the appropriate stock management model is critical to ensure that a business can maintain adequate inventory levels, minimize costs, and provide quality customer service.

2.3.1. EOQ Model

The Economic Order Quantity (EOQ) model was developed independently by several researchers in the early 1900s, including Ford W. Harris, R.H. Wilson, and F.W. Harris. However, the most widely recognized contribution to the development of the EOQ model is attributed to the work of Ford W. Harris, who first published the basic formula for EOQ in a 1913 article in Factory, The Magazine of Management.

The EOQ model is a mathematical formula used to determine the optimal inventory level that minimizes the total cost of ordering and holding inventory. Kumar (2016) argued that the EOQ model is a powerful tool for determining the optimal inventory level that minimizes the total cost of ordering and holding inventory. Ordering cost includes expenses such as the cost of placing an order, processing paperwork, and receiving and inspecting the product. Carrying cost includes expenses such as storage, handling, insurance, and financing costs (Krajewski *et al.*, 2013; Kumar, 2016; Heizer *et al*., 2017).

The EOQ model takes into account the annual demand, the total amount of product needed over a given period, usually a year; the ordering cost, the cost of placing an order, such as the cost of processing, shipping, and handling; the holding cost, the cost of storing and maintaining inventory, such as storage costs, insurance, and obsolescence; and the lead time, time between placing an order and receiving the goods.

The EOQ model calculates the quantity of a product that should be ordered at one time to minimize the total cost of these two types of costs. The formula for calculating EOQ considers the product's demand, the cost to place an order, and the cost to hold inventory. The formula to calculate the EOQ is (1):

$$Q* = \sqrt{\frac{2DS}{H}} \quad (1)$$

Where:

- D is the annual demand in units
- S is the cost of placing an order
- H is the holding cost per unit

By determining the optimal order quantity, the EOQ model helps companies to achieve a balance between the costs of holding inventory and the costs of ordering and receiving products. This helps to minimize overall logistics costs and increase the efficiency of SCM, Hua *et al.* (2018).

Kumar (2016) also highlighted that the EOQ model intends to answer the following stock management questions:

- How much inventory should be ordered at one time?
- How frequently should orders be placed?
- What is the total cost of ordering and holding inventory?

Ballou (2004), Krajewski *et al.* (2013), Alfares and Ghaithan (2016), and Heizer *et al.* (2017) discuss various concerns regarding the application of the EOQ model in stock management. Some of the main concerns are:

- **Assumptions:** The EOQ model relies on several assumptions, such as constant demand and fixed ordering costs, which may not hold true in real-world situations. Failure to consider these assumptions can lead to inaccurate results.
- **Demand uncertainty:** The EOQ model assumes that demand is known and constant, but demand can be uncertain and variable. This can lead to stockouts or excess inventory if not accounted for.
- **Lead time variability:** The EOQ model assumes a fixed lead time but lead times can vary due to factors such as supplier delays or transportation disruptions. This can impact inventory levels and result in stockouts or excess inventory.
- **Cost components:** The EOQ model considers only two cost components, ordering costs and holding costs. However, other costs such as setup costs,

obsolescence costs, and stockout costs may also be relevant in certain situations.

- **Practical limitations:** The EOQ model may not be practical to apply in certain situations, such as when the inventory item has a short shelf life or when demand is highly variable.

Overall, these concerns highlight the importance of carefully considering the assumptions and limitations of the EOQ model and adapting it as necessary to the specific context and needs of the organization.

Hanafi, Mardin, Asmal, Setiawan & Wijaya, (2019) argued that the traditional EOQ model assumes deterministic demand and lead time, and it does not consider the impact of setup and shortage costs. However, in real-world situations, demand and lead time are often subject to variability, and setup and shortage costs can significantly affect the stock management decision. Therefore, they proposed a modified EOQ model that accounts for these factors and can provide more accurate stock management decisions. The authors conducted a simulation study to compare the performance of the proposed model with the traditional EOQ model and found that the proposed model can reduce the total inventory cost by up to 29.8% compared to the traditional model. They concluded that the proposed model can be a useful tool for companies to improve their stock management practices and reduce inventory costs.

Another topic of interest in the literature has been the extension of the EOQ model to incorporate additional factors, such as stochastic demand and lead times. For instance, a study by Wang and Li (2019) proposed a modified EOQ model that accounts for uncertain demand and lead times and found that the model could improve stock management in a manufacturing setting.

Liao and Li (2021) proposed a modified EOQ model that accounts for the effect of employee incentives on inventory decisions in a supply chain setting. Their study showed that incorporating employee incentives can improve supply chain performance and reduce total costs compared to a traditional EOQ model.

The reorder point (ROP) in the EOQ model represents the level of inventory at which a new order should be placed to avoid stockouts. It is the point at which the

quantity on hand plus the quantity on order reaches a predetermined level, known as the safety stock level. The ROP is calculated by adding the safety stock level to the lead time demand, which is the expected demand during the lead time (the time between placing an order and receiving it).

The studied titled “Economic order quantity determination model: A case study of construction material retailer” by Srayut Kuanmuang and Surapong Intarapak, published in 2023 in the International Journal of Health Sciences, focuses on order processing and stock management for a construction material retailer. The research aimed to reduce cost and lead time for the case study construction material retailer. The objectives were to study the order processing and stock management of the construction material retailer, and to study inventory analysis techniques in decision making to determine the appropriate order quantity. Data was collected from thirty employees through interviews and from the company’s inventory raw material data from January - December 2021. ABC analysis and EOQ were used to calculate quantities for the right order quantity as the high demand. The results showed that using EOQ resulted in a saved cost of 910500.69 baht per year compared to the case study of construction materials retailer’s stock management model. The total cost was reduced from ordering cost and storage because the order quantity was appropriate. Thus, a case study of construction materials retailer has more financial liquidity.

2.3.2. ABC Analyse

The ABC analyse is a technique used to categorize inventory or products into distinct groups based on their value, sales volume, or other criteria. This method is often used in SCM to help companies make better decisions about stock management, procurement, and other logistics activities.

The ABC analysis is a technique used in stock management to categorize items based on their importance to a business. It is believed to have originated in the field of accounting in the early 20th century, where it was used to analyse the financial performance of a business.

The origins of the ABC analysis can be traced back to the work of Italian economist Vilfredo Pareto, who proposed the "Pareto principle" in 1896. The Pareto

principle states that 80% of the effects come from 20% of the causes. Pareto observed that in many situations, a small percentage of items or activities are responsible for a substantial percentage of the overall effect.

The ABC analysis was developed as a way to apply the Pareto principle to stock management. The basic idea is to categorize items into three groups based on their value or importance to the business. The top 20% of items are categorized as "A" items and account for 80% of the inventory value, the next 30% of items are categorized as "B" items and account for 15% of the inventory value, and the remaining 50% of items are categorized as "C" items and account for only 5% of the inventory value. The ABC model categorizes products into three groups, based on their importance to the business:

- **A category:** These are high-value products that have a low sales volume but are critical to the business. These items are often given special attention in terms of stock management, as stockouts can have a significant impact on the company's operations and revenue.
- **B category:** These are medium-value products that have a moderate sales volume. They are important to the business, but not as critical as A. These items are managed with less attention than A, but still require regular monitoring and reordering.
- **C category:** These are low-value products that have a high sales volume. They are often considered "commodity" items and are managed with minimal attention. While these items may not be critical to the business, they still need to be managed to ensure they are always available to customers.

By categorizing inventory in this way, companies can better allocate resources and make more informed decisions about stock management, procurement, and other logistics activities, Hanafi *et al.* (2019).

Hanafi *et al.* (2019) said that ABC analysis method helped companies to identify critical items that needed close attention, the A category. By focusing on these items, the company was able to minimize stockouts and reduce stock holding costs.

Additionally, ABC analysis method enabled the companies to prioritize the procurement of the most important items, which resulted in a more efficient procurement process.

Ballou explains that the ABC analysis is a valuable tool for companies to categorize their inventory based on the items' importance to the business. The ABC analysis helps companies to identify the items that are critical to their operations and to focus their resources and attention on managing those items effectively.

The ABC analysis has since become a widely used technique in stock management and SCM. It has proven to be a useful tool for companies to prioritize their resources and attention, manage inventory levels effectively, and reduce costs associated with stock management.

The paper “ABC Analysis for Inventory Management: Bridging the Gap Between Research and Classroom” by Handanhal Ravinder and Ram B. Misra published in 2014 is a comprehensive study on the ABC analysis as a technique for prioritizing the management of inventory. The authors argue that in today’s world, where businesses and supply chain operate globally and product lives are decreasing rapidly, the ability to deliver the right products quickly to extremely specific markets is crucial for survival. They believe that focusing solely on dollar volume for categorization is misplaced in this context. ABC analysis is a well-established categorization technique base on the Pareto Principle. The authors suggest that modern businesses may carry inventories of a large variety of items – finished goods, spare parts, and raw materials. Sometimes the numbers will run into the thousands. Managing these inventories involves answering, at a minimum, two questions – how much to order and when to order. The paper also discusses how ABC analysis has traditionally been based on the criterion of dollar volume. It operates on the principle that there are a small number of items that account for the bulk of the dollar volume. At the other extreme, a large number of items account for a small share of the dollar volume. In conclusion, the authors recommend incorporating key findings and methods from multiple criteria ABC analysis research into textbook discussions on this topic.

2.3.3. Other Stock Management Models

Besides the EOQ and ABC analyse there are several different stock management models that businesses can use, including Just-In-Time (JIT), Material Requirements Planning (MRP), Kanban System and other systems that provide distinct types of solutions.

Regarding JIT, this model involves ordering inventory only when it is needed, reducing the need for large stockpiles of goods. Basically, the stock is kept at the minimum level necessary to meet immediate production or customer demands. JIT aims to eliminate waste, reduce inventory carrying costs, and improve overall production efficiency by synchronizing production processes with customer demand. There are several benefits of using this system, as the reduction of inventory, the lower production costs, and the shorter lead times, however there are several challenges and concerns at the same time, as the vulnerability of the SC, the dependency of the suppliers and the variability of the demand.

The MRP system is a production planning and inventory control system that manages the ordering and scheduling of raw materials and components based on the production schedule. It helps businesses and manufactures define what is needed, how much is needed, and when materials are needed, and works backward from a production plan for finished goods. MRP converts a plan into a list of requirements for the subassemblies, parts, and raw materials needed to produce a final product within the established schedule. It helps manufacturers ger a grasp of inventory requirements while balancing both supply and demand. It identifies what are the materials, estimate quantities, determines when they will be required meeting the production schedule, and manages delivery timing, with the goal of assembly demands and improving overall productivity.

Kanban is a visual method for controlling production as part of JIT and Lean Manufacturing, as part of a pull system it controls what is produced, in what quantity and when. Its purpose is to ensure that only is produced what the customer is asking for and nothing more than that. It is a system of signals which indicates standard quantity

of production. There are distinct types of kanban, for example, the production kanban, the withdrawal, the square, the signal, the material, and the supplier.

There are however other systems that can help companies to improve their efficiency.

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3. METHODOLOGY

The project will employ an explanatory, bibliographical, and documental methodology. The explanatory aspect aims to elucidate cause and effect relationships based on a theory pertaining to stock management, exploratory research is a study that seeks to answer a question or address a phenomenon. The nature of the entity being considered does not permit a variable to be controlled by the researcher, it cannot be completed in a controlled environment, or most likely, the researcher cannot decide all the impacts on the substance Singh, A. (2021). In the initial phase, comprehensive bibliographical research will be conducted to critically review existing literature and establish a theoretical foundation for the study, covering stock classifications and stock management models, Cooper *et al*. (2018). Subsequently, documental research will be undertaken relying on internal data and documents provided by the company under examination. This may include sales data, cost analysis, product consumption lists, and more. Once the data is gathered, the theoretical models will be applied to the company's data, and the resulting outcomes will be analysed. And interviews were also conducted with the organization's managers. As previously mentioned, the name of the company will remain confidential at the company's request.

In arrange to conduct the bibliographical research, a survey was made of academic articles and book discussions, among other implies of investigate, with the objective of hypothetically establishing stock management. To guarantee the veracity of the data, inner records were given to the organization with respect to monetary operational documentation, the document of records related to products and their purchase values as well as the invoicing associated with them. To get it and get a comprehensive and more thorough see on the operational forms related to stock management, semi-structured interviews were also conducted with one of the managers of the organization. The interviews followed a previously arranged script which can be found in Annex 1.

The company that will be studied, is inserted in the sector of wholesale commerce of fruit and vegetables has more than 30 years of existence and about ten employees.

3.1. Data collection and analysis

The data collection for this paper involved confidential data, since this data is one of the company's competitive factors in the market. The data collected was essentially financial and logistical data on stocks and their organization.

The documental research was executed in the organization's headquarters located in Guarda and was conducted between March and July 2023.

First this research started with an interview where were possible to know all the processes of the company, from its supply to the management of its warehouse. Then the data related to the handling of the merchandise and all the costs involved in the stock management process were analysed, from fixed costs to personnel costs and other variable costs.

3.2. Study questions

Taking into consideration the methodological approaches explained above and the literature review in the previous chapter, it was possible to establish central questions that allowed to develop the topic of stock management optimization.

This project aims to answer two questions:

- What are the most important products for the organization, to optimize resources in stock management?
- Could the application of academically grounded methodologies have beneficial effects in terms of the total cost of stock?

The answers to these questions will be developed in the following chapters, and are based on the literature review, on the analysis of current stock management data and on the application of methodologies implemented by academics.

4. ANALYSIS AND DISCUSSION OF RESULTS

The main objective of this study is to quantify the impact of stock management in a company in the fruit and vegetable trading and distribution sector, to guarantee the optimization of stock management. This analysis will consider all the costs associated with its procurement and storage. The Annex 2 presents a list of the company's best-selling products in 2022.

The analyses presented will be based on the stock management models presented previously in the literature review, the ABC analyse and the EOQ.

4.1. ABC Analyse

In order to identify which are the products that have more impact in the financial value of the company and to determine which are the most important products for the company it was made an analyse ABC showed in a table (Annex 3).

The table to present it has presented the 93 products that this company trade and distribute. After were analysed all the costs associated and the quantities sold to show the total cost in the 2022 as well as the impact of each product in the total cost. Subsequently with this analyse were created and identified the three categories that best fits in this company needs using the ABC analyse.

In 2022 the cost profile of the products commercialized by this company presented a total of € 16 001 774,01. Looking into the needs of the company the three categories were defined, as show in Table I. About 25% of the products that has more impact on the total cost were defined as category A and are equivalent to € 4 001 667,29. The next 40% of products that have more impact were defined as category B and in monetary terms it’s means € 6 517 869,25. The remaining percentage were categorised as C, belonging around € 5 482 237,48 of costs.

Table I ABC Resumé

Class	Number of products	Total cost	% of products	%products value
A	7	€ 4001 667,29	8%	25%
B	19	€ 6 517 869,25	20%	41%
C	67	€ 5 482 237,48	72%	34%
TOTAL	**93**	**€ 16 001 774,01**	**100%**	**100%**

Source: Own elaboration

After this summary and the analysis of this table, it is possible to clearly identify the three categories defined, and the following study will focus on the seven products in category A.

4.2. Total cost

In order to determine the total cost of the stock management operation, the total cost was calculated. The total cost of stock management operations involves several expenses associated with purchasing, storing, and managing inventory throughout the supply chain. The total cost of inventory is the sum of the purchase, the ordering, and holding costs.

According to Christopher, M. (2016), the formula for total inventory cost, which considers both holding (carrying) costs and ordering (setup) costs, typically includes the annual holding cost (H), the annual demand (D), and the order quantity (Q). The formula is as follows:

$$TC = \frac{D}{Q} * S + \frac{Q}{2} * H \quad (2)$$

Where:

- TC represents the total inventory cost over a specific period.
- D represents the annual demand.
- Q represents the order quantity or EOQ.
- S represents the fixed cost or setup cost for each order or replenishment.
- H represents the annual holding or carrying cost per unit of inventory.

The first term (D/Q * S) represents the ordering cost, which is the cost incurred to place orders for a quantity Q over the year. The second term (Q/2 * H) represents the

holding cost, which is the cost associated with carrying or holding inventory over the year.

Holding cost (H) can be represented using the carrying cost per unit of inventory (C) and the average inventory level (I). The relationship between these variables can be expressed as follows:

$$H = C * I \tag{3}$$

Where:

- H represents the annual holding cost.
- C represents the carrying cost per unit of inventory per year.
- I represent the average inventory level over the course of a year.

This formula demonstrates that the holding cost (H) is directly proportional to both the carrying cost per unit of inventory (C) and the average inventory level (I). By calculating the annual holding cost using this formula, it is possible to understand how much it costs to carry or hold a specific quantity of inventory over a year based on the unit carrying cost and the average inventory level.

To determine the different parameters, tables were created and studied for each of them. Table II shows the data used to determine the economic quantity of orders.

Table II Average Quantity per Order

Product	Unit Cost	Total Ordered (kg)	Total Cost in 2022	Number of orders	Average quantity (kg) per order
Banana	€1,08	698 110,09	€ 753 958,90	348	2 006,06
Grapes	€2,10	354 600,42	€744 660,88	386	918,65
Mushrooms	€3,30	164 400,00	€542 518,56	245	671,02
Aubergine	€1,94	277 176,00	€537 721,44	273	1 015,30
Olive	€1,80	271 145,33	€488 060,81	126	2 151,95
Lupin	€1,20	400 130,34	€480 163,49	450	889,18
Pepper	€3,28	140 500,00	€460 840,00	257	546,69

Source: Own elaboration

In the Table III is possible to notice that there are differences in the data that company provided, this means that the quantities ordered have differences to the

quantities sold. In this sense, as there is just one product that do not have differences the formula below was used to determine the clearance of final and initial stocks:

$$Final\ Existences = Order\ Quantity + Initial\ Existences - Sold\ Quantity$$

Table III Stock Differences - calculated vs available

Product	Total Sold	Total Ordered (kg)	Initial Stock 2022 (kg)	Stock measure (kg)	Final Stock 2022 (kg)	Difference in final stocks (kg)
Banana	697110,09	698110,09	1604	2 604	2 300	-304,00
Grapes	354557,42	354600,42	280	323	130	-193,00
Mushrooms	164315,00	164400,00	10	95	-	-95,00
Aubergine	276176,00	277176,00	-	1 000	800	-200,00
Olive	270145,33	271145,33	500	1 500	1 230	-270,00
Lupin	400130,34	400130,34	662	662	330	-332,00
Pepper	140175,00	140500,00	700	1 025	1 025	-

Source: Own elaboration

The stock shortages shown in Table III can be justified by a lack of accuracy in the accounting of flows, by a lax stock system or even by sales that for some reason are not invoiced and are therefore not declared.

To continue the analyse of the total cost the next value to analyse is S, the fixed cost for each order. To study this variable, it was made a sum of all the costs in 2022 and then divided them into the 2085 orders made. In the Table IV are expressed all the resources that were used during the orders, as the human resources, the cost of consumable, the costs that communications had and other costs associated with the energy, cleaning, and the basics.

Table IV Order Fulfilment Costs

Description	Value (€)	Cost by order
Cost of human resources	25 520,72 €	12,24 €
Cost of consumables	8 484,37 €	4,07 €
Communications costs	1 005,85 €	0,48 €
Energy costs	3 328,63 €	1,60 €
Other costs (cleaning, insurance, basic equipment...)	8 191,50 €	3,93 €
Annual total	46 531,07 €	22,32 €

Source: Own elaboration

In order to analyse the annual holding or carrying cost per unit it will be needed to identify the carrying cost per unit of inventory which were already showed in Table II as the unit cost.

Regarding the variable I which represents the average inventory level during 2022 it will be consider the 25%. This decision was made regarding the fact that the company do not have enough data since it misses the warehouse rent, some costs with insurances as well as costs related with warehouse equipment. Besides the company has some inconsistencies when it comes to inventory levels, so an average value used in the literature was considered. The carrying cost percentage is calculated by dividing the total inventory holding cost by the total inventory value and the multiplying by 100. The carrying costs usually run between 20 and 30 percent of the total cost of inventory.

Applying the total cost formula used by Christopher, using the values mentioned above for class A products, we obtained Table V.

Table V Total Cost

Product	D	Q	S	I	C	Total Cost
Banana	697 110,09	2 006,06	€ 22,32	25%	€ 1,08	€8026,03
Grapes	354 557,42	918,65	€ 22,32	25%	€ 2,10	€8854,49
Mushrooms	164 315,00	671,02	€ 22,32	25%	€ 3,30	€5741,65
Aubergine	276 176,00	1 015,30	€ 22,32	25%	€ 1,94	€6316,79
Olive	270 145,33	2 151,95	€ 22,32	25%	€ 1,80	€3285,77
Lupin	400 130,34	889,18	€ 22,32	25%	€ 1,20	€10176,06
Pepper	140 175,00	546,69	€ 22,32	25%	€ 3,28	€5946,36
Total						**€ 48 347,13**

Source: Own elaboration

In order to present the applying the total cost formula (2) to product category A, below is the detailed step for product Banana:

- D - annual demand = 697 110,09
- Q - the order quantity = 2 006,06
- S - fixed cost = € 22,32
- C - the carrying cost per unit of inventory per year = € 1,08
- I - average inventory level over the course of a year = 25%

$$TC = \frac{D}{Q} * S + \frac{Q}{2} * (C * I) = \frac{697\,110{,}99}{2\,006{,}06} * 22{,}32 + \frac{2\,006{,}06}{2} * (1{,}08 * 25\%)$$

$$= \text{€}\ 8\,026{,}03$$

In short, in 2022 this trading and distribution company with all the 7 products of class A, without the stock optimization is possible to observe due to the minimal analysis that the total cost was € 48 347,13 to the products that have more impact on the financial situation of the company.

4.3. Economic order quantity (EOQ)

Economic Order Quantity is a formula used in stock management to determine the optimal order quantity for a product. The primary goal of EOQ is to minimize the total inventory costs, which include holding costs and ordering costs.

The EOQ considers the demand, the ordering cost (the cost incurred each time an order is placed) and the holding cost per unit (the cost of holding or storing one unit

of inventory for a specific time. Christopher, M. (2016) refers that EOQ formula is calculated as follows:

$$EOQ = \sqrt{\frac{2DS}{H}} \quad (4)$$

Where:

- D represents the annual demand
- S represents the fixed cost
- H represents the annual holding or carrying cost per unit of inventory

Table VI Economic Order Quantity

Product	D (kg)	S	I	C	EOQ (kg)	Rounded EOQ (kg)
Banana	697110,09	€ 22,32	25%	€ 1,08	10 735,01	10 735
Grapes	354557,42	€ 22,32	25%	€ 2,10	5 490,31	5 490
Mushrooms	164315,00	€ 22,32	25%	€ 3,30	2 981,57	2 982
Aubergine	276176,00	€ 22,32	25%	€ 1,94	5 041,45	5 041
Olive	270145,33	€ 22,32	25%	€ 1,80	5 176,38	5 176
Lupin	400130,34	€ 22,32	25%	€ 1,20	7 715,61	7 716
Pepper	140175,00	€ 22,32	25%	€ 3,28	2 762,24	2 762

Source: Own elaboration

Going back to the previous example, we will use the Banana to exemplify the application of EOQ formula (4):

$$EOQ = \sqrt{\frac{2DS}{H}} = \sqrt{\frac{2 * (697\ 11{,}09) * 22{,}32}{(0.25) * (1{,}08)}} = 10\ 735{,}01$$

Where:

- D = 697 110,09
- S = 22,32
- H = IC = 0.25*1.08 = 0,27

After found the EOQ it is possible to find the new total costs using the ROP. The ROP is a crucial stock management parameter that helps to determine when to reorder products to ensure that the company do not run out of stock before the next order

arrives. To calculate the ROP after determining the EOQ it will be needed to consider several factors. The optimal time between orders during a year is defined as:

$$T = \frac{EOQ}{D} * 365 \quad (5)$$

To obtain the optimal number of orders placed during a year it will be used the formula:

$$N = \frac{D}{EOQ} \quad (6)$$

In order to avoid stock-outs, the delivery time must be considered and since these products are short-term consumables, the longest delivery time for orders is 2 weeks (LT). It is therefore important that orders arrive at the warehouse when they are needed. In order to place orders, when necessary, the ROP model was used.

$$ROP = d * LT \quad (7)$$

Where:

- d represents the average demand rate for a product.
- LT represents the lead time, which is the time it takes to replenish stock after placing an order.

$$d = \frac{D}{52} \quad (8)$$

In Table VII is represented the ROP for all the seven products in class A however bellow is the example of Banana item:

Order per year (6):

$$N = \frac{D}{EOQ} = \frac{697\ 110{,}09}{10\ 735} = 64{,}94 = 65$$

Lead time between orders (5):

$$T = \frac{EOQ}{D} * 365 = \frac{10\ 735}{697\ 110{,}09} * 365 = 5{,}62 = 6$$

In conclusion, this company for product “banana” if the demand stays stable in the 697 110,99 kg should order 10 735 units 65 times which give a lead time between orders of 6 days.

Average demand:

$$d = \frac{D}{52} = \frac{697\ 110{,}09}{52} = 13\ 405{,}96 = 13\ 406$$

$$ROP = d * LT = 13\,405{,}96 * 2 = 26\,811{,}92 = 26\,812$$

Table VII Reorder Point

Product	D (kg)	Rounded EOQ (kg)	N	T	LT	D (kg)	ROP (kg)
Banana	697 110,09	10 735	65	6	2	13 406	26 812
Grapes	354 557,42	5 490	65	6	2	6 818	13 637
Mushrooms	164 315,00	2 982	55	7	2	3 160	6 320
Aubergine	276 176,00	5 041	55	7	2	5 311	10 622
Olive	270 145,33	5 176	52	7	2	5 195	10 390
Lupin	400 130,34	7 716	52	7	2	7 695	15 390
Pepper	140 175,00	2 762	51	7	2	2 696	5 391

Source: Own elaboration

To conclude this analysis, for this product, there was a weekly demand of 13 406 units and should be authorized a new order when the inventory levels reach 26 812 units.

4.4. Total cost of supply with EOQ

With all these calculations and figuring out what is the ROP for each product of class A it is possible to calculate the total cost based on the EOQ in order to find out what is the savings that is possible to do with this implementation. In the table below it is possible to observe the differences that each product cost will have.

Table VIII Total Cost based on EOQ.

Product	D (kg)	EOQ (kg)	N	T	ROP	TC 2022	TC EOQ
Banana	697 110,09	697 110	65	6	26812	€ 8026,03	€ 2 898,45
Grapes	354 557,42	354 557	65	6	13637	€ 8854,49	€ 2 882,41
Mushrooms	164 315,00	164 315	55	7	6320	€ 5741,65	€ 2 459,79
Aubergine	276 176,00	276 176	55	7	10622	€ 6316,79	€ 2 445,10
Olive	270 145,33	270 145	52	7	10390	€ 3285,77	€ 2 329,37
Lupin	400 130,34	400 130	52	7	15390	€10176,06	€ 2 314,72
Pepper	140 175,00	140 175	51	7	5391	€ 5 946,36	€ 2 265,04
Total						**€48 47,13**	€ 17 594,89

Source: Own elaboration

With this analysis is possible to observe that if the company got a more complexity system of ordering for these 7 products, the savings will be € 30 752,25.

5. CONCLUSION, LIMITATIONS, AND FUTURE RESEARCH

In conclusion, the pursuit of stock optimization is a multifaceted journey that demands an intense understanding of market dynamics, risk management, and operational efficiency. As we navigate this intricate landscape, it becomes abundantly clear that achieving the perfect balance between inventory levels, demand forecasting, and cost containment is both an art and a science.

Stock optimization represents an ongoing process, a continuous quest for improvement that requires adaptability, data-driven insights, and a commitment by the managers of the organization. In the world of finance and commerce, the ability to optimize stock is not merely a competitive advantage; it is the cornerstone of sustainable success in an unpredictable market.

The purpose of this study was to study the existing methodologies in stock management and then apply the two methods studied in a fruit and vegetable marketing and distribution organization.

By applying these methods, it was possible to identify the most important products for the company, which account for a large part of the financial volume invested in the company's stock. Regarding this group of products, the company could manage them more rigorously to have more efficient costs to generate greater profits.

Through the study carried out, it was possible to see that by applying the proposed methods, there could be a significant improvement in costs, thus improving efficiency.

To answer to the first research question “What are the most important products for the organization, to optimize resources in stock management?” It was made an analyse to all the products that the organization has in stock. Were analysed all the 93 products, their unit costs, the units sold and with these data were made an ABC analyse with the value that each product had in the total cost of the year 2022 (Annex 3). After this analysis, the products were categorized into 3 distinct categories and being the category A the one with most impact on the financial of the company these were the products that the study focused on. However, products in categories B

and C are also especially important to customers, because although they do not have as much impact on the company, they also have a significant sales volume.

As an answer to the second question: "Could the application of academically grounded methodologies have beneficial effects in terms of the total cost of stock?" was used an analysis based on the previous analysis of ABC. It was used a methodology based on the stock management, EOQ and then was made a comparison with the first analysis with the organization data and with the optimization of the results. This analysis was based on the stocks, the demand, the orders of the company and were noticed an improvement of 63,61% of the total costs of the company.

In this way, if the company implemented a stock management model like this the improvements on the costs will be highly significant, improving in the same measure, the efficiency of the company. This leaves space for other investments that add value to the company's operation, such as human resources or warehouse systems.

The main limitation of this work is the absence of some analytical or process indicators, since as a small family-run company there are certain elements of the study that are not shown in the company's reports. With the absence of these objects, it was only necessary to make an analysis with the basic elements and it was not possible to make a totally accurate analysis. As so, other limitation of the work is related to the applicability of it since the company has just started to be more rigorous with their numbers in recent years so they are still improving and starting to think about using a stock management model, so there is no certainty about the results that this study can have in practical terms.

For future work, it should be noted that as a fruit distribution and sales company, other stock management methods could be tested. Since the products are likely to have a short shelf life, models such as Just-in-time, could bring benefits to the company's stock levels, to allow for a greater reduction in costs.

To sum up, different stock management methods have been presented throughout the work and, after their application, a significant reduction in the company's costs was noticeable. However, the possibility remains open that there are

stock management models that are better suited to this company. Namely the application of other stock classification methods or the application of a JIT model.

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7. APPENDICES

Annex 1 – Interview to one manager of the company.

1. **What types of customers do you have? (supermarkets/hypermarkets...) (if possible, an approximate number of customers)**

Supermarkets, hypermarkets, mini markets, homes, and wholesale. Around 25 fixed (households; supermarkets; hypermarkets and mini markets) and around 15 to 20 variable who go directly to the warehouse to buy to take back to their shops or fairs and resell.

2. **How big is your warehouse? What is the maximum capacity?**

Warehouse capacity is around 250m2.

3. **What products do you handle?**

All kinds of fruit and vegetables

4. **How is the load handled (are there forklifts in the warehouse, is everything done by hand?)**

There is a forklift, 2 manual pallet trucks and 1 electric one. But the vans are loaded for distribution by hand.

5. **Given the complexity of the cargo, how is it stored? If there are any specifics.**

Preferably the same boxes first and together so that you can organise them in the best feasible way and carry more.

6. **What specific care do you take with the products in stock to preserve their quality?**

They are kept in cold rooms.

7. **Do you have someone in charge of stock management? Do you have any type of system to control it?**

Yes, we have one person in charge. However, we do not have any type of system to control it exactly.

8. **How does the process of ordering products from suppliers' work?**

The person in charge calls the suppliers to place orders and the suppliers call him to offer products and if he needs anything.

9. **How does the customer order process work?**

They call or send an email with their order. Others go directly to the warehouse to buy.

10. How often do you place orders? How many hours a week do you spend on average placing orders?

Usually, orders are taken 3 time per week and the medium time spend is around more or less 3h/4h.

11. What are the main control systems for the periodicity of orders?

The stock in the warehouse.

12. Is there a cost structure for each product?

No. It depends on how the market is.

13. Once you have placed an order, how long does it take for it to arrive?

The order is always placed the day before it is to be delivered and then delivered the following day in the morning/afternoon.

14. Who handles transport from the supplier to your warehouse?

Ourselves, we have 2 trucks of our own.

15. How is the product transported to the customer?

With our distribution vans.

16. Is there a model for prioritising orders?

Orders go together, more than once, but the first stop prioritises the nearest location on the route to be taken that day.

17. How are sales forecasts made? (Example: based on the previous year, with market studies)

In general, we know what each customer is going to spend, but there are weaker times of the year (winter) when sales go down or there may be a less good week for a customer when they buy less from us.

18. How often are prices reviewed?

Prices are review more or less 2 a 3 times per week, depending on the price given by our suppliers.

19. How is made all the process?

When the fresh fruit arrives, it is unloaded from the lorry into the warehouse to pick up the orders. At the end of the day, it is sorted and stored on pallets in the freezer

chambers. The next day when a new load of fruit arrives, the fruit that has been stored in the chambers in our warehouse is removed and orders are placed with that fruit and with the fruit that has just arrived. At the end of the day, the good and rotten fruit is sorted and thrown away, and the remaining fruit is stored again in the freezer chambers. This process is repeated every day.

A new shipment arrives on Tuesdays, Thursdays, and Saturdays, which are our parcel delivery days. We work Monday, Thursday, Friday, and Saturday, with Monday being more about organising things in the warehouse and attending to any customers who come to the warehouse.

20. What aspects could be improved in the future?

Improved facilities have allowed us to better fulfil and deliver orders as well as a significant reduction in work (hours) for us.

Annex 2 – Products List.

#	Code	Product	Unit Cost
1	AB	PINEAPPLE	1,22€
2	ABACA	AVOCADO	2,50€
3	ABO	PUMPKIN	0,60€
4	AG	WATERCRESS	1,30€
5	AIP	CELERY	1,00€
6	AL	GARLIC	0,84€
7	ALF	LETTUCE	1,40€
8	ALHS	DRY GARLIC	1,80€
9	ALP	APRICOT	2,10€
10	AM	PLUM	1,36€
11	AMEN	ALMOND	3,00€
12	ANO	CHERIMOYA	2,38€
13	AZ	OLIVE	1,80€
14	BA	BANANA	1,08€
15	BATC	POTATO	0,50€
16	BD	SWEET POTATO	0,79€
17	BET	BEET	0,70€
18	BR	BROCCOLI	1,37€
19	BRI	Aubergine	1,94€
20	CAST	CHESTNUTS	3,75€
21	CEB	ONION	0,49€
22	CEN	CARROT	0,56€
23	CER	CHERRY	11,00€
24	CLE	CLEMENTINES	1,10€
25	COE	CORIANDER	1,20€
26	COF	CABBAGE	0,77€
27	COG	MUSHROOMS	3,30€
28	CORG	CORGETTE	1,05€
29	CV	"GREEN CALDO"	1,80€
30	DA	APRICOT	1,73€
31	DP	PERSIMMONS	1,86€
32	END	ENDIVIAS	1,37€
33	ER	PEAS	3,23€
34	ES	SPINACH	1,60€
35	FAV	FAVA BEANS	0,66€
36	FEB	WHITE BEANS	1,40€
37	FEC	CATARINO BEANS	1,95€
38	FEF	BLACK BEANS	1,50€

39	FEIM	BUTTER BEANS	1,97€
40	FEL	GREEN BEANS	2,38€
41	FEV	RED BEANS	1,55€
42	FI	FIGS	3,32€
43	FIGSEC	DRIED FIGS	2,91€
44	GEN	GINGER	2,18€
45	GR	GREENS	1,20€
46	GRAO	GRAINS	1,60€
47	HOR	HORTONIQUES	0,65€
48	HORTE	MINT	1,00€
49	KW	KIWI	1,94€
50	LAR	ORANGE	0,67€
51	LI	LEMON	0,60€
52	LIM	LIMES	1,80€
53	MA	APPLE	0,76€
54	MAMAO	PAPAYA	3,30€
55	MAND	CASSAVA	1,40€
56	MAR	PASSION FRUIT	4,72€
57	MEL	WATERMELON	1,40€
58	MEV	MELON	1,50€
59	ML	CANTALOUPE	1,57€
60	MM	QUINCE	0,27€
61	MOR	STRAWBERRY	3,12€
62	NA	TURNIPS	2,50€
63	NAB	TURNIP GREENS	1,50€
64	NEC	NECTARINE	1,53€
65	NES	MEDLARS	2,20€
66	NO	NUTS	1,20€
67	PAP	PAPAYE	3,58€
68	PEP	CUCUMBERS	0,45€
69	PER	PEAR	1,00€
70	PES	PEACH	3,00€
71	PIM	PEPPER	3,28€
72	PP	PEPINO PORT	2,00€
73	RO	POMEGRANATE	1,35€
74	SS	PARSLEY	1,09€
75	TANJ	TANGERINES	1,20€
76	TO	TOMATO	1,21€
77	TRE	LUPIN	1,20€
78	UVA	GRAPES	2,10€
79	MAG	MANGO	3,25€

80	CHOU	CHOU CHOU	1,79€
81	BET23	COZ BEET	0,76€
82	LIX	MADAGASCAR LITCHIS	3,50€
83	CHOU1	CHUCHU	1,70€
84	CLE1	CLEMENVILLE	0,75€
85	CORG1	COURGETTE	1,17€
86	AV	HAZEL	3,00€
87	NO1	NOZ	3,50€
88	PIT	PITAYA	11,80€
89	MIR	MYRTLE	8,00€
90	LEN	LENTILS	1,40€
91	FEIJ	BEET	2,50€
92	MANGE	BASIL	2,15€
93	FIG	FIG	1,80€

Annex 3 – ABC analyse.

#	Code	Product	Unit cost	Total sold	TC	Value (%)	Class
14	Ba	Banana	€1,08	697 110,09	€752 878,90	4,705%	A
78	Uva	Grapes	€2,10	354 557,42	€744 570,58	4,653%	A
27	Cog	Mushrooms	€3,30	164 315,00	€542 238,06	3,389%	A
19	Bri	Aubergine	€1,94	276 176,00	€535 781,44	3,348%	A
13	Az	Olive	€1,80	270 145,33	€486 260,82	3,039%	A
77	Tre	Lupin	€1,20	400 130,34	€480 163,49	3,001%	A
71	Pim	Pepper	€3,28	140 175,00	€459 774,00	2,873%	A
53	Ma	Apple	€0,76	596 021,98	€452 976,70	2,831%	B
2	Abaca	Avocado	€2,50	180 734,32	€451 835,80	2,824%	B
80	Chou	Chou chou	€1,79	250 103,74	€447 685,69	2,798%	B
64	Nec	Nectarine	€1,53	260 422,90	€398 447,04	2,490%	B
76	To	Tomato	€1,21	323 299,10	€391 191,91	2,445%	B
86	Av	Hazel	€3,00	130 170,95	€390 512,85	2,440%	B
26	Cof	Cabbage	€0,77	490 447,00	€377 644,19	2,360%	B
45	Gr	Greens	€1,20	280 294,00	€336 352,80	2,102%	B
23	Cer	Cherry	€11	30 202,42	€332 227,23	2,076%	B
54	Mamao	Papaya	€3,30	100 540,00	€331 767,76	2,073%	B
49	Kw	Kiwi	€1,94	170 003,97	€329 807,70	2,061%	B
61	Mor	Strawberry	€3,12	100 634,15	€313 978,55	1,962%	B
79	Mag	Mango	€3,25	96 603,20	€313 960,87	1,962%	B
69	Per	Pear	€1,00	306 470,92	€306 470,92	1,915%	B
85	Corg1	Courgette	€1,17	250 944,99	€293 605,64	1,835%	B
22	Cen	Carrot	€0,56	521 932,93	€292 282,44	1,827%	B
50	Lar	Orange	€0,67	395 461,14	€264 958,96	1,656%	B
6	Al	Garlic	€0,84	300 310,00	€252 260,40	1,576%	B
51	Li	Lemon	€0,60	400 138,07	€239 901,78	1,499%	B
16	Bd	Sweet potato	€0,79	301 708,00	€238 349,32	1,490%	C
40	Fel	Green beans	€2,38	92 080,00	€219 150,40	1,370%	C
66	No	Nuts	€1,20	180 738,85	€216 886,62	1,355%	C
70	Pes	Peach	€3,00	71 019,00	€213 056,87	1,331%	C
21	Ceb	Onion	€0,49	411 189,96	€201 483,08	1,259%	C
11	Amen	Almond	€3,00	65 381,49	€196 144,47	1,226%	C
28	Corg	Courgette	€1,05	170 962,31	€179 510,43	1,122%	C
15	Batc	Potato	€0,50	356 498,21	€178 249,11	1,114%	C
30	Da	Apricot	€1,73	98 325,92	€170 103,84	1,063%	C
31	Dp	Persimmons	€1,86	90 040,14	€167 474,66	1,047%	C

89	Mir	Myrtle	€8,00	20 070,00	€160 560,00	1,003%	C
52	Lim	Limes	€1,80	89 101,00	€160 381,80	1,002%	C
87	No1	Nut	€3,50	45 038,85	€157 635,98	0,985%	C
65	Nes	Medlars	€2,20	70 563,35	€155 238,82	0,970%	C
3	Abo	Pumpkin	€0,60	256 851,59	€154 146,24	0,963%	C
42	Fi	Figs	€3,32	46 154,30	€153 232,28	0,958%	C
39	Feim	Butter beans	€1,97	76 071,00	€149 859,87	0,937%	C
34	Es	Spinach	€1,60	90 481,00	€144 769,60	0,905%	C
73	Ro	Pomegranate	€1,35	100 185,74	€135 250,75	0,845%	C
58	Mev	Melon	€1,50	86 915,39	€130 373,05	0,815%	C
1	Ab	Pineapple	€1,22	100 264,44	€122 322,62	0,764%	C
75	Tanj	Tangerines	€1,20	99 160,37	€118 997,29	0,744%	C
57	Mel	Watermelon	€1,40	83 970,10	€117 558,14	0,735%	C
88	Pit	Pitaya	€11,80	8 890,80	€104 911,44	0,656%	C
24	Cle	Clementines	€1,10	90 655,00	€99 720,50	0,623%	C
33	Er	Peas	€3,23	30 598,92	€98 834,51	0,618%	C
7	Alf	Lettuce	€1,40	70 580,16	€98 812,22	0,618%	C
10	Am	Plum	€1,36	71 052,66	€96 631,62	0,604%	C
56	Mar	Passion fruit	€4,72	20 042,00	€94 598,24	0,591%	C
17	Bet	Beet	€0,70	130 259,00	€91 178,57	0,570%	C
4	Ag	Watercress	€1,30	65 538,00	€85 199,40	0,532%	C
18	Br	Broccoli	€1,37	60 284,25	€82 589,42	0,516%	C
59	Ml	Cantaloupe	€1,57	50 910,56	€79 929,58	0,500%	C
74	Ss	Parsley	€1,09	70 306,00	€76 633,54	0,479%	C
81	Bet23	Coz beet	€0,76	98 259,00	€74 676,84	0,467%	C
68	Pep	Cucumbers	€0,45	140 378,82	€63 169,58	0,395%	C
62	Na	Turnips	€2,50	20 614,00	€51 535,30	0,322%	C
8	Alhs	Dry garlic	€1,80	24 000,00	€43 199,67	0,270%	C
84	Cle1	Clemenville	€0,75	54 760,30	€41 070,23	0,257%	C
44	Gen	Ginger	€2,18	17 355,00	€37 833,90	0,236%	C
67	Pap	Papaya	€3,58	8 931,01	€31 973,02	0,200%	C
82	Lix	Madagascar litchis	€3,50	8 752,00	€30 634,65	0,191%	C
43	Figsec	Dried figs	€2,91	10 350,00	€30 118,50	0,188%	C
32	End	Endives	€1,37	18 203,00	€24 938,11	0,156%	C
47	Hor	Ortaniques	€0,65	33 700,00	€21 905,66	0,137%	C
72	Pp	Pepino port	€2,00	10 597,00	€21 194,00	0,132%	C
25	Coe	Coriander	€1,20	15 241,00	€18 289,20	0,114%	C
55	Mand	Cassava	€1,40	10 115,00	€14 161,42	0,088%	C

37	Fec	Catarino beans	€1,95	7 000,00	€13 650,00	0,085%	C
63	Nab	Turnip greens	€1,50	8 000,00	€12 000,00	0,075%	C
12	Ano	Cherimoya	€2,38	4 900,57	€11 663,36	0,073%	C
48	Horte	Mint	€1,00	10 000,00	€10 000,00	0,062%	C
83	Chou1	Chuchu	€1,70	5 585,25	€9 494,93	0,059%	C
90	Len	Lentils	€1,40	6 000,00	€8 400,00	0,052%	C
29	Cv	"*Green caldo*"	€1,80	4 500,00	€8 100,00	0,051%	C
41	Fev	Red beans	€1,55	5 000,00	€7 750,00	0,048%	C
91	Feij	Beet	€2,50	3 000,00	€7 500,00	0,047%	C
35	Fav	Fava beans	€0,66	10 800,84	€7 128,55	0,045%	C
38	Fef	Black beans	€1,50	4 500,00	€6 750,00	0,042%	C
20	Cast	Chestnuts	€3,75	1 500,39	€5 626,46	0,035%	C
9	Alp	Apricot	€2,10	2 073,03	€4 353,43	0,027%	C
36	Feb	White beans	€1,40	3 000,00	€4 200,00	0,026%	C
46	Grao	Grains	€1,60	2 500,00	€4 000,00	0,025%	C
93	Fig	Fig	€1,80	2 000,20	€3 600,36	0,022%	C
92	Mange	Basil	€2,15	800,00	€1 720,00	0,011%	C
60	Mm	Quince	€0,27	3 800,24	€1 026,06	0,006%	C
5	Aip	Celery	€1,00	800,00	€800,00	0,005%	C
_	**Total**	**94**	_	**11 716 249,97**	**€16 001 774,01**	**100,000 %**	