

Comprehensive Analysis of the Stages in the Logistics Chain for Aromatic and Medicinal Plants (PAM) in Northern Morocco

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Abstract

This This paper provides a detailed examination of the critical logistic stages of aromatic and medicinal plants (PAM) in northern Morocco. By adopting a qualitative methodological approach based on case studies and interviews with key stakeholders in the supply chain, each stage from the research phase to the commercialization phase was scrutinized to identify aspects that may hinder total supply chain optimization. The major problems identified include barriers to accessing scientific information, insufficient funding for primary research, seasonal variations, and differences in the quality of raw materials delivered. To address these issues and achieve optimal supply chain configuration, the proposed solutions include the improvement of utilized databases, active management of growing seasons, and investment in transportation infrastructure. The main conclusions indicate that addressing these challenges would optimize the PAM supply chain, contributing to the sustainable and profitable development of this important sector in the Moroccan economy.

Keywords: Aromatic and medicinal plants (PAM), Supply chain, Supply, Quality of raw materials, Transformation.

Introduction

PAMs are one of the important income generating agro-resources in Morocco especially in the northern part of the country with favorable agro-ecological attributes for their production. It is also well recognized for the high level of its bio-diversity density and the variety of plant species with different medicinal and aromatic uses respectively. Nevertheless, as the economic and ecological values of AMPs have already been noted, the supply chain behind stimulating them possesses multifaceted obstacles that meddle with both its efficacy and profit-making capacities.

Thus, the purpose of this article is to describe in detail each of the stages of the PAM logistics chain in Northern Morocco. Every activity starting from the acquisition of knowledge on the plants and collection of the plant samples up to the processing, packaging, transportation and distribution of the plants to the local and international markets will be discussed in detail. As a result of this understanding, attention will be made to focus on the various phases required in the hunt to defining the various challenges that thwart WFP supply chain functionality.

It is necessary to comprehend these difficulties to work out pertinent and efficient strategies so that they can enhance the chain of supply for AMP altogether. This way, main agricultural problems and sustainable, profitable and competitive logistics solutions and concepts supporting the future development of this important sector in the Moroccan economy are the preoccupations of the further work.

This article hence includes a detailed description of the current challenges and future prospects that develop the PAM logistics chain in the northern region of Morocco so as to promote the positive and favorable growth of this promising sector.

1. The Initial Research: Limited Access and Diversity of RTE Products

Studies carried out early on are fundamental to establishing the supply chain of PAM related to medicinal and aromatic plants in northern Morocco. This crucial process's purpose is to select herbaceous plants with medicinal and aromatic qualities for further analysis of their features and possible uses. However, this step proves to have certain difficulties. The detailed and accurate data required for choosing the right AMP can be affected by the lack of access to scientific information and certain information concerning seasonal plants. Such a restriction may be escalated by the lack of the rather unified databases and the fragmentation of the knowledge.

Also, scope and feasibility might be restricted by cost considerations, especially when carrying out initial investigation. Sometimes due to lack of adequate funds to finance the projects

research projects that need funds for field samples, laboratory analysis and special studies may experience some hardships (Barzman et al., 2020). This financial aspect may reduce the size of the projects and possible detailed studies on many of the new developed AMPs. Another major issue is the challenge of getting real time or near real time information on the seasonal supply of plants. Seasonality also affects the APM's operations by applying pressure on the need to receive correct and prompt information. And the situation when real-time information systems are missing increases the probability of production and planning errors which straightly influence a supply chain (Royer-Gaspard, 2021).

The abovementioned challenge rises from the fact that climatic and geographical factors affect growth cycles of plants, making the study more complicated.

Thus, the challenges described in relation to the first stage of research directly affect the choice of the variety of products in the supplies. Lower levels of research could mean that there is little research done on the different RTE varieties that possess characteristics that make them easily marketable. This may also restrict the chances of establishing new varieties that are likely to serve the PAM industry. These restrictions in research are translated to a limited product portfolio, which may affect the competitiveness and overall appeal off the sector on the national and global market.

Therefore, the work of the first link in the PAM supply chain is crucial; however, it is saddled with plenty of challenges. Challenges include but not limited to restricted access to scientific resources, lack of capital and a hard time in getting information on the time of the year that a certain type of plant is available on the ground. Several problems are associated with databases and resources for longer studies, and the coordination of activities to enhance scientific research for their improvements shall be addressed to solve these challenges. These actions will enhance the extent of product research with results making the supply chain for PAMs rich and challenging.

2. Supplier Selection: Consistency of Supply and Quality of Raw Materials

A key process in the management of the AMPs chain is the process of supplier selection to contribute to the successful production and processing of essential compounds resulting from the aromatic and medicinal plants. This step entails the right sourcing and involving the right associates for raw supplies that are good in quality. However, the very characteristics of PAMs and the realities of markets present acute problems at this stage (DU NIGER & CAMEROUN, 2023).

This is the nature of the suppliers and the fact that they are spread geographically across the world presents another challenge. It is possible to find several areas of northern Morocco from which it is possible to source medicinal and fragrant plants, however, this is only possible if alliances can be made with suppliers often in sometimes hard to reach areas. Its management can cause issues such as extended delivery time to the markets and coordination of operations (Prache et al., 2023).

Another issue is that many participants supply low-quality raw materials depending on the market situation. Variations in the quality of plants supplied can also be due to fluctuating climatic conditions, new methods of harvesting and farming practices. Such quality variability is known to have a direct bearing on the stability of production processes and the standard of the final outputs. Ensuring quality of the materials used hence becomes an issue that has to be addressed to uphold on the reputation and customer trust.

The other critical challenge that hampers its efficiency is the task of securing better contracts with suppliers. It has been established that contracts should also cover the quality and quantity of raw materials that would deliver service together with the consideration of the seasonal fluctuation in the supply chain. The following requirements for suppliers may also be difficult to meet especially if demand is very high at certain times in the year. There is always the challenge of trying to get the best terms while at the same time securing the supply chain.

Therefore, to conclusions, one can identify the fact that selecting proper suppliers is critical for APM supply chain. Transportation and location disadvantages, differences in the quality of materials used in production and challenging negotiations of contracts impact issues of supply and quality of finished products. To address such challenges, it is required to have well-defined quality standards, flexibility in mechanisms to address the issues of seasonality and strategic management of the suppliers. Effectively managing the process of selection results in better supply chain continuity and quality of PAM products developed.

3. Production and Transformation: Quality, Efficiency and Management of Seasonal Demand

They are established as the core of the value added logistics chain of medicinal and aromatic plant products (MAP) in Northern Morocco. This is that key stage that involves the actual creation of finished or near finished goods for marketing and sale. Although this phase is certainly not without substantial difficulties due to the criteria of quality, efficiency and the management of demand fluctuations related to the seasons.

The first is the quest to sustain high quality in the process of change. Due to its evaluative nature, PAMs are esteemed for their therapeutic and olfactory attributes, which may be negatively affected by wrong approach to processing it. Thus, maintaining these properties, as well as sanitation and conformity with legal requirements, poses a considerable technical task. Some of the conventional processing methods that are part of the local culture may not produce what is requisite in current quality requirements.

The efficiency in the processing of PAM supply chain is also of significance. Polymer processing techniques need to be refined in order to get as much value out of the raw stock as possible with as little waste produced as is possible. This may entail activities like reduction of initial material losses while processing it, proper usage of water and energy, as well as using the appropriate processing technology currently available. However, there is always the issue of costly adoption or implementation of new technologies and retraining of human resource.

Another difficult task is to plan the sales volumes meeting the seasonal demand. The supply and demand of AMPs change overtime and often varies with the season. Controlling these fluctuations entails planning, whereby the supply is regulated in order to meet the demand during the busy period. It should be noted, however, that planning may be complicated by such factors as shift in the pattern of consumption and climatic factors.

Some of the traditional indigenous processing methods can be enhanced at the commercial scale especially for large volumes. This can cause problems with efficiency, the quality of work, and demand. To counter these challenges, organizations have to deliberate introducing advanced technologies, training the employees and enthusing the organization to adapt itself to flexible management styles. Further, understanding the market trends together with the need to obtain farm produce daily and avoid delays due to seasonality, it will be easier to cooperate with the farmers in the neighboring areas.

In total, the manufacturing and processing phase can be considered as the lifeblood of the PAM supply chain. It can be concluded that a complex and preventive strategy needed to be used in reference to the problem of quality maintenance, an appropriate speed of processing, and fluctuations in the number of passengers during certain periods of the year. The continuation of the modernization of the processing techniques, the application of appropriate high technologies and the cooperation with the regional partners will contribute to the certainty of the quality and effectiveness of this crucial stage.

4. Additional Transformation: Adapting to Markets and the Complexities of Personalization

Some of the varieties, in the PAM supply chain, undergo secondary processing to meet market or customer specifications. Piggyback processing, also referred to as ‘further processing’, covers any operations which add one or many value-added processes to the finished goods like altering the form, state, or packaging of the products. However, since it has to balance regulations, consumers’ tastes and economic rationality, this step is not easy. (Ait Aoudia & Baakel, 2021).

Substantial transformations may be required to accommodate existing products into the markets and consumers’ requirements. For instance, for AMPs, designed for cookery purposes, special cuts or even specific forms, may be necessary for correct application. It may be necessary for a pharmaceutical product to have special dosage forms for better administration of the product. However, extra expenses incurred in terms of labour, equipment and other materials can be attributed to the aspect of customization.

The main difficulty in this stage is the compliance with regulatory standards. Modifications made to the products for instance the packing or the packaging has to measure up to food hygiene as well as health measures. In some cases, it may be required to have test and certification to confirm that the processed products are meeting the set regulatory standards. As a result, failure to conform to legal regulation and possible risks to consumers’ health are the challenges that businesses cannot overlook and must address through compliance expenses.

It is also important to note that, like with the previous frequently cited problem – managing the diversity of processed products – the problem may emerge due to product differentiation. For each of the non-standard types of RTE that it is proposed to produce, it is possible to obtain a new line of products with specific requirements at the stages of production, packaging, and distribution. Thus, managing this diversity tends to increase the supply chain supply of products and alter their flexibility to meet customer needs.

Other concerns involves the ability to control costs, this perhaps can be attributed due to the limitations of funds as per the accepted tender price. The acquisition of labor, some supplies, and equipment becomes more expensive when is being manufactured custom products. Thus, companies have to evaluate implementation of such policy on benefits arising from satisfying particular market needs against costs that come with further processing of the products .(Ould Hamouda, 2022).

Thus, the additional disintegration of the AMP supply chain would be instrumental in transforming products to meet market and consumers' demand. Problems accompanying regulation, differentiation of products, managing diversification and cost aspects pose certain strategic demands. Adhering to all the food safety and health concerns, businesses are left with no choice but to prosecute the extra change's benefits and costs.

5. Supply: Seasonal Management, Uncertainty and Continuity of Production

The main objectives of the supply chain management of aromatic and medical plants products PAM sector in the Laurent and Menzelab district of northern Morocco are to make certain that all the raw materials required for the production are available in the right qualities and quantities. Op cit referring to this important step I which says that nevertheless this step has its challenges and they include the uncertainty of natural resources and the fact that the system may have to take time due to seasonal changes and weather conditions (JARVIS et al., s. d.).

Supply management faces one of the biggest tasks in dealing with the growth and seasons of AMPs. Since many of the PAMs are seasonal plants, then the supply of raw materials may fluctuate with the natural calendar year. Thus, addressing supply management as a critical process emerges as rather important to have the right supply of raw materials when needed. As a result of this, opportunities must be taken to prepare for the various seasons and storage techniques must be determined.

To some extent, the existence of weather conditions averts supply chain procurement and thereby probably causes delays. Disasters, including droughts and floods and storms also affect the growth of the plants and hence the delay of the harvest. These are could have an instant impact on availability of raw material and ergo the capacity of production to carry on. There is always the odd event that never existed on the blueprint of a business plan and contingency plans have to be made.

As for supply, this activity faces another challenge, namely the uncertainty of natural resources. Fluctuations in the status of climatic conditions and the quantity of water resources may also impact the growth of PAM. In estimating the requirements of raw materials, deciding on a quantity that will actually be available is problematic because of this variation and this affects

the production plan as well as stocking of the raw materials. It is necessary to point out that companies need to create tracking and monitoring mechanisms for such situations. (Sheldon et al., 2023).

All in all, it can be concluded that an adequate availability of all the supply chain of the PAM is vital to guarantee an uninterrupted production. Seasonality, climate and volatility of natural resources constitute some of the hardest issues to manage and a lot of effort and planning should be put in to manage these factors. The contingency plans and monitoring instruments are needed to manage the fluctuations in supply by creating the specific strategies for Sourcing Magnez Group companies. Effective supply management which is the main goal of supply management supports supply chain keeping it stable and halting unnecessary production interruptions.

6. Transport: Preservation of Quality, Infrastructure and Costs

Transit in the strategic chain of AMPs of northern Morocco is a mandatory link that plays the role of connection between producers and consumers, providing shipment of products from the places of their production to the markets. However, there are several concerns that are linked to this stage; most of which include the sensitivity of RTE products, poor transport network and higher costs due to quality and standards (Garcia et al., 2019).

A major drawback when it comes to PAM products is that they are quite brittle and are hence difficult to transport. AMPs commonly employ other medicinal and aromatic plants due to their quality; hence, the quality should be preserved through the logistics process. Including, temperature, humidity and handling during transportation are some factors that in a direct way influence the product quality. The process of logistics may look more complicated if there are specific requirements for storage and transportation conditions to preserve goods' quality.

Infrastructure for transportation could be a challenge especially in certain areas that may limit the effectiveness of logistics. PAM can be gathered in areas which are either out of reach or hard to reach, meaning that there are challenges involved in getting the final products to the consumer markets. Some of the challenges include poorly maintained transport networks, poorly developed cold chains, and long transit times which affects the quality of the products and their delivery.

Other risks relate to high costs eligible to quality and safety necessities. Due to the effects of transport on PAM products, stringent safety and quality control have to be observed at every transport stage (BOUSHABA & CHAKOR, 2023). It may also be possible to encounter other costs such as handling costs, packaging costs, and costs related with shipping regulations. That is why healthy profit margins have to be maintained at the expense of these costs by the businesses.

Therefore, the aspect of transportation forms an important link in the APM supply chain as it delivers the goods to the intended customer in good quality. Taking critical precautions to resolve the existing challenges concerning the product's fragility predominant lack of transport systems and expenses linked with quality and safety (Tondel, 2019). For this critical activity to deliver optimal results, the companies need to develop the logistics strategies relevant to PAMs, implement the transport improvements, and partner with logistics providers.

7. Marketing: Visibility, Competition and Distribution Channels

Marketing of products in the market particularly in the global arena is considered as the marketing of aromatic and medicinal plants (AMP) which is one of the stages of the supply chain. However, this step is not without its challenges because there are some obstacles in this step which include; low awareness of the benefits of AMPs, competition which comes as a result of the existence of similar products and identifying the right channels for distributing the products.

A possible implication of this study was that consumers may not readily accept MAPs due to low information about the advantage of such plans. The stimulating and healing characteristics of AMPs are sometimes employed, while narrow-awareness of the advantages of their application could be stated. The awareness agenda has to be underwritten to enlighten consumers about the uses as well as the benefits of PAMs. This awareness might call for advertising, especially to certain groups, and possible indications on the product's package.

Another challenge common to the creation of similar products is competition from similar products. WFP may face competition from other natural herbs, spice and products as those that have quality benefits as this product. Therefore, firms should identify what makes their PAM stand out in the market and deploy account distinctiveness techniques. Depending on chosen product or service these may be quality, geographic provenience, sustainability, and certifications (Chourouk et al., s. d.).

The last but also one of the most significant issues is the identification of the appropriate distribution channels. There are PAMs which might be specially tailored to specific markets, for instance, those industries which are involved in culinary, medical, or cosmetic business. While identifying the proper distribution channels for these markets, it could be needed to strike partnership agreements with the retailers, pharmacies, herbalists, or cosmetic firms. Another factor that can be effective when it comes to expanding the reach the business can also use online distribution platforms.

Summing up, it is impossible to market AMPs without facing some challenges and thus the recommendations are on creating a clear marketing strategy to counter the threats regarding

consumers, competitors, and distribution. There should be enhanced promotion on the products and services offered via marketing and public awareness, the creation and development of differentiation factors in order to result to a distinguished business in the market, and lastly, the consideration of various distribution methods that could help reach the intended target Market. Effective marketing assists in raising awareness about AMPs, and changing the consumers' perception towards products containing AMPs or similar materials.

8. Framework and Legislation: Information, Compliance and Product Safety

Acceptance of the consumer and legislation implementation factors are one of the pivotal links of the MAP products supply chain. This step involves sourcing and presenting information about the product features, its advantages and areas of use, at the same time avoiding violation of the existing rules and norms with reference to human's health and environment. This complex step, though, is not without challenges like how to communicate well with the consumers, the details of the various regulations it has to adhere to, and the requirement to assure quality and safety of the product among others.

The main way to achieve consumer understanding of PAMs, therefore, is appropriate communication with the consumer. The target consumers should be educated on the various product uses, some of which may be healthy, any benefits linked with the products, and the likely risks of consuming the products. This needs to be communicated on the packaging of relevant products and made clearly available in the internet and in outlets that sell products for these diseases. Besides specifications of the dyes that are incompatible with the AMPs, the consumer information file may also contain pieces of advice on when and how the product should be used, possible dosage information and safety measures (MASSON, s. d.).

Moreover, the fulfilment of a number of regulations becomes one of the main issues at this stage. Concerning legislation, the following must be mentioned: PAMs are regulated with regard to their quality, food safety, and environmental protection. Organizations have to make certain that they follow regulations of the country they operate in and the international market regarding their products. This task itself might become quite challenging because of the different legal frameworks to adhere to and is thus often associated with legal counsel and precise quality assurance measures.

It is again important to note that product safety as well as quality is crucial in any organization. Since many AMPs are applied for medicinal and aromatic effects, their quality and purity are critical. As a result, it essential for companies that produces food and goods to employ quality control measures that would help to eliminate contaminants that may be in the foods or goods,

and meet the required standard. For this reason, practical measures on storage, packaging and handling should effectively be controlled to prevent deterioration on quality. (Gagnon, 2020).

Taking all factors into consideration one can conclude that consumer activity, as well as their conformity with the legislation, are critical in the supply chain of AMP. The issues related to communication with consumers, with the focus on such topics as compliance, quality, and risks to the consumer's health also pose certain complexities. PAMs should be accompanied by a clear communication system, Organization should consult attorneys for compliance, and there should be strict quality assurance throughout the PAM supply chain (BENTAHAR & CHADLI, 2022).

Conclusion

This paper has in turn provided an extensive description of each of the upward stages of the Supply Chain for the Aromatic and Medicinal Plants (AMPs) in northern Morocco. By having a closer look at each of the stages of the BSC, the most specific and exceptional issues were singled out and accentuated, which shed light on the fact that there are numerous and vast issues at play when orchestrating and optimizing the logistics' flow in this highly miscellaneous field. However, to have a basis for providing specific prescriptions and suggestions on targeting the improvement and optimization of the AMP supply chain in general, a general appreciation of what lies ahead must be established first.

Setting out the following paradigm, the difficulties which are inherent in each stage of WFP supply chain have been defined: Indeed, there are certain challenges that are characteristic for each of the stages of research, from initial grounding to the final dissemination of the results. However, due to the limitation of information and resource, the variety of products that can be searched might be limited. The quality and negotiation-related aspects here can become a limit to supplier selection. Sustainability in commercial production and processing of these plants require optimization of production and processing respectively. However, costs and degrees of customization may limit further alteration in one way or the other.

Lack of resources and seasonality is a great threat to supply. Transport is influenced by the fact that most of the goods are delicate and the infrastructures, which are available are inadequate. Marketing presents challenges of customer awareness, rivalry and place. Encroachment and compliance have to be communicated properly and many regulations such as quality and safety of the products have to be considered. From this analysis the foundation for the design of focused interventions has been created to which future research will be directed. The mentioned challenges will play the role of the initial platform to investigate different directions of improvement and optimization. They could include application of emerging technologies like AI in process enhancement, involving networks with reliable suppliers for procurement etc, or enhancing the procedures of quality assurance. security to ensure that it provides the quality needed in the products sold in the market.

By discussing supply chain stages for purchasing and utilizing PAMs in Northern Morocco and specifying issues mentioned by the interviewed experts, this paper contains information on the issues that influence the effective supply chain of this industry. This understanding is seen as essential for creating practical and innovative measures for the improvement of the flow of logistics and the increase of competitive industries needed for the development of the regional economy. Further research studies will explore these solutions in more depth primarily with the view of providing prescriptive findings for enhancing the PAM supply chain in the northern regions of Morocco.

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