A MULTICRITERIA FRAMEWORK FOR EVALUATING FOOD SUPPLIERS: AN AHP-DEMATEL-TOPSIS MODEL TO MANAGE BULLWHIP EFFECT

ABSTRACT

The aim of this paper is to highlight and summarize the main factors found along the food supply chain, which affect the quality of products, taking into consideration the product attributes demanded by consumers. In detail, the paper highlights the complexity involved in the pork supply chain in relation to the Bullwhip Effect in order to obtain quality products.

Keywords: AHP, DEMATEL, TOPSIS, food industry, bullwhip effect.

1. Introduction

Economy of industry growth depends on proper supply of goods and food items to the ultimate consumers at right place, right time, right quantity with right price based on effective prediction or judgement of demand (Perez et al., 2009).

In detail, in Colombia the country's pig industry is facing new challenges. In 2015 Colombia had about 200,000 pig farm sites, with in total 4.6 million pigs. About more than half of the pigs (2.5 million) are held in the most pig dense provinces; Antioquia (1.6 million), Cundinamarca (0.5 million) and Valle del Cauca (0.4 million). One third of the pigs are held in backyard systems and about two third in "technified farms" – or farms producing pigs indoors. The group contains around 20,000 farms having less than ten sows. In 2015, Colombia counted 46,500 technified farms, with a total of 204,500 sows (see Figure 1).

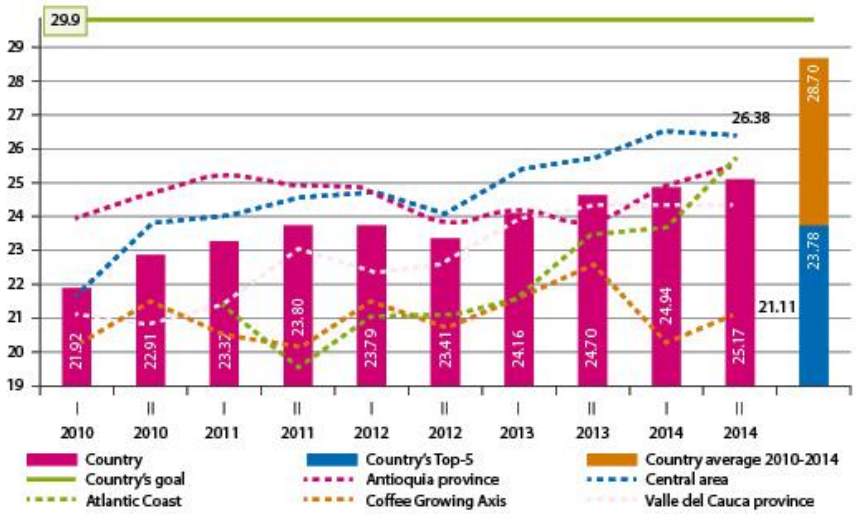

Figure 1: Number of pigs weaned per sow per year in Colombia (source: https://www.pigprogress.net/)

In the last decade, there has been a serious increase in Colombia's pig production. Its pig inventory almost doubled from 2.5 million in 2005 to 4.6 million in 2015. In the most pig dense province Antioquia the pig population almost quadrupled: from 465,000 in 2005 to 1.6 million in 2015.

There is a continuous pressure on cost of production if the sector aims to develop further. Production costs are mainly made up by feed costs. This is shown by a summary of production cost from the Bogotá area. For a pig leaving a farm, feed costs represent 74-78%, followed by labour costs (6-8%), breeding stock costs (4.5-5%), buildings (2.6%) and medication (2.6%).

During the present and coming years there will be serious challenges to overcome. It is evident that by looking at pork production as a chain instead of as individual steps made by different companies, the meat sector can more easily meet the challenge of accurately responding to changing customer demands. Competitive advantage arises from a supply chain creating value for the consumer and this value is dependent on the activities of all partners in the chain.

The failure to predict proper demand by a company leads to fluctuation of demand between supply chain stages. This extends to bullwhip effect, which is a threat for economic growth.

Thus, the aim of the present paper is to propose a multi criteria model based on AHP-DEMATEL-TOPSIS techniques to manage the efficiency of information sharing to reduce the bullwhip effect. Multicriteria approach helps the organisation to alleviate inconsistencies in decision making problems, as argued by several authors (Jayant et al., 2011; Jayant et al., 2014).

2. Literature Review

The bullwhip effect generally refers to the phenomenon where order variability increases as the orders move up streaming the supply chain. It is serious problem for every member of the supply chain (Somashekhar et al., 2013). This effect begins at customers and passes through the chain to producers, which are at the end of the logistic chain. Especially food supply chains are affected by this issue (Ma et al., 2011). Agribusiness industries, including some within the pork industry, have shown that involvement in supply chain management can provide: 1) improved product quality and consistency of supply; 2) improved profitability and efficiency with less price variation; 3) development of new markets or expansion of existing markets; 4) reduced costs through collective business planning and purchasing activities streamlining the chain by removing redundant or unnecessary activities.

3. Hypotheses/Objectives

Supplier selection practices are quite important for companies in the food sector and appears to be the most significant factor for increasing firm competitiveness in a complex food supply chain management. In this respect, companies have to deal with the uncertainty and it is therefore necessary to search for high-committed suppliers decreasing the bullwhip effect. Particularly, we focus on companies processing and distributing pork meat. Hence, according the above-mentioned considerations, this study aims to evaluate the performance of pork suppliers based on a hybrid MCDM approach.

4. Research Design/Methodology

The present study is based on the integration of the Analytic Hierarchy Process (AHP), Decision Making Trial and Evaluation Laboratory (DEMATEL) and the Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS). AHP is applied to determine the criteria and sub-criteria weights. Then, DEMATEL is used to evaluate the interrelations and feedback between decision elements and TOPSIS ranks the pork suppliers with basis on the closeness coefficient.

5. Data/Model Analysis

A decision-making model with 7 criteria, 18 sub-criteria and 4 alternatives (pork suppliers) was designed. The model was developed with the aid of an experts' group from the food sector and studies from the reported literature. Figure 2 shows the proposed decision-making structure.

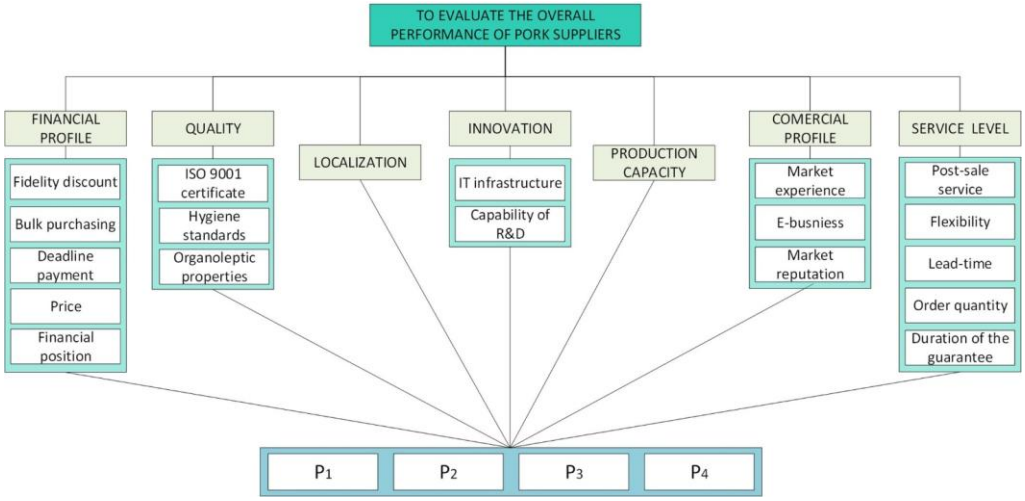

Figure 2: The proposed decision-making structure for evaluating the overall performance of pork suppliers

The results evidence that the most important criteria when assessing the overall performance of pork suppliers from the food sector: SERVICE LEVEL (GW = 19.44%), QUALITY (GW = 18.63%) and FINANCIAL PROFILE (GW = 17.96). The most important sub-criterion was ORGANOLEPTIC PROPERTIES (6.86%) which can be explained by the increasing need of ensuring high quality standards in the food industry. On the other hand, QUALITY was proved to be the most influencing criterion and should be hence taken into account by pork suppliers so that improvement strategies can be effectively created and applied. Finally, after implementing this hybrid method in a set of four suppliers (refer to Fig. 2), it was concluded that P4 is the best supplier with a closeness coefficient of 0.744. Furthermore, weaknesses of each provider were determined in order to facilitate the continuous improvement of supply chains associated with the food industry.

6. Limitations

It is essential to mention that the findings could be associated with the case study. This research study was limited to four pork suppliers in the food industry of Colombia which

may partially explain the outcomes. Future research will consider fuzzy approaches and environmental criteria.

7. Conclusions

The contribution describes the main factors and attributes characterizing the pork supply chain, which are relevant to the quality of the final product as perceived by the consumer. Further research could be done on the effects of the interactions between the factors on pork chain analysis and consumer satisfaction in other countries and not only in Colombia. The paper provides a holistic perspective of the pork supply chain and can be useful for researchers and practitioners involved in the management of pork product quality and new product development.

8. Key References

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