Design of a Performance Measurement Model in Cassava Agroindustry Supply Chain Management

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Abstract— *The purpose of this study was to determine the mechanism of supply chain and the pattern of cassava of agroindustry supply chain flow and analyze the relationship between the components of SCM and the impact on supply chain activity improvement and agroindustry performance. Sample of research were producers of agroindustry local food of cassava as much of 106 respondents were taken by simple random sampling. The data analyzed by qualitative and quantitative analysis. Qualitative analysis used to describe the mechanism and pattern of cassava of agroindustry supply chain flow and principles of SCM. While quantitative analysis used to analyze the components, SCM activity improvement and agroindustry performance by using a structural equation model. The results showed that the mechanism of cassava agroindustry supply chain is the creation of collaboration and coordination among supply chain actors ranging from farmer, processor, distributor and consumer.*

Keywords— Agroindustry, Cassava, Local Food, Supply Chain Management, Structural Equation Models.

I. INTRODUCTION

Supply chain management (SCM) have been presented by many researchers, which mostly defined as synonym for logistics, and supply chain (SC) control. SCM is the designing and management of all activities involved in sourcing and purchasing, transformation, and all logistics management activities (Aramyan, Lansink, Vorst, Kooten, 2007). It linked the relationship between the buyers, the sellers, and relationship with its network partners i.e. middlemen, suppliers, transportation and customers (L. Condrațchi, 2014). The cassava industry is an essential processing industry that supports food security in many countries, and the development of agro-industry based on local commodities, especially based on cassava, is encouraged to support food security (Timaboot, Suthikarnnarunai, 2017). Cassava supply chain refers to the coordination and management of all activities involved in the production and delivery of cassava and cassava-based products to customers (Chinyophiro, 2012). Cassava supply chain starts from the raw material (cassava roots) which are cultivated by the farmers. They can be supplied directly by the farmers or from the middleman who collected cassava roots from the farmers and supplied to the manufacturing (D. Slavic & A Jambrišak, 2011). These studies aimed to maintain the competitive advantage of the cassava supply chain and improve overall performance. The cassava supply chain is an important component of the cassava industry, and improving its performance can contribute to the development of local commodity-based agro-industry, especially cassava-based, to support food security (Timisela, Leatemia, Polnaya, Breemer, 2017). Most of cassava studies in Thailand are to improve the production yield, enhance the supply chain efficiency, reduce total cost, increase the percentage of starch content, have the resistance to pests and diseases, etc.

TABLE 1
LITERATURE REVIEW ON SUPPLY CHAIN PERFORMANCE MEASURES

Author	Sector	Customer Responsiveness	Efficiency	Flexibility	Other	Number of Indicators
Eppen (1979)	Steel Production		X			1
Hannus (1991)	Manufacturing		X	X		3
Lee & Ballington (1992)	Manufacturing		X			1
Berry and Naim (1996)	Manufacturing	X		X	X	4
Murphy et d. (1996)	Different Industries		X		X	35
Beamon (1998)	Manufacturing	X	X	X	X	16
Beamon (1999)	Manufacturing	X	X	X	X	33
Li & O'Brien (1999)	Manufacturing	X	X	X	X	11
Talluri et al.	Manufacturing	X	X		X	9
Van der Vorst (2000)	Food	X	X	X	X	8
Gunasekarn (2001)	Not Specified	X	X	X	X	43
Thonemann & Bradley (2002)	Manufacturing	X	X			2
Korpela et a. (2002)	Not Specified	X	X	X		3
Lai et al. (2002)	Transport	X	X	X	X	4
Talluri & Baker (2002)	Manufacturing	X	X	X	X	15
Person & Olhager (2002)	Manufacturing	X	X	X	X	7
Claro et al. (2003)	Horticulture		X	X		2
Gunaekaoa (2004)	Different Industries	X	X	X	X	45

Most of the problems resulted from there are no collaboration in the supply chain which they made the problems occur repeatedly. Many problems that found today need more improvement, and it is the burden to the supply chain. The purpose of this study is to review the previous studies on the SCM contexts by applying to cassava supply chain focuses on the case study in Thailand with the objective to improve the performance of the supply chain in order to sustain the advantage for the future competition (A. P. Utami and A. Kusumawardhani, 2021). It involves various study on SCM such as collaborate among all parties in the supply chain, select the strategy, manage the cost by using financial management concept, inventory management, use software & technology in managing the supply chain, use green logistics in order to reduce cost and able to sustain the competitive advantage to the future (Timisela, Leatemia, Polnaya, Breemer, 2017).

II. CASSAVA SUPPLY CHAIN

Cassava is cultivated in many tropical countries situated in the equatorial belt. The best time to harvest cassava is about 7-18 months after planting [33]. However, harvesting can be any time between six months to two years. Cassava can grow and produce dependable yields in places while other crops will not grow or produce well. It can tolerate drought and grow on soils with low nutrient capacity. Many countries in the world have demands and uses of cassava differently depend on their needs. The farmers' perceptions of cassava cultivation and the results showed that the farmers' reasons for growing cassava are (1) ease of growing (2) good price (3) ease of selling and (4) ability to grow on poor soils (Van der vorst, Da Silva, Trienekens, 2007).

The general approach to supply chain development can be summarized in 6 basic concepts:

2.1 Bottom up approach:

Vertical co-operation initiatives typically come from potential chain partners who are attempting to overcome specific obstacles or to solve specific management problems and who discover the power of chain leveraged solutions. Generally these will be at least two private companies who form contiguous links in a potential supply chain. Before setting up a supply chain project it is necessary to ascertain whether the proposed chain affiliation is commercially, technically, and politically feasible. These

three issues strongly relate to the position of the business within its environment and the competitive advantage. Porter (1980, 1985) recognizes five forces that determine the competitive position and strength of a company: its suppliers, substitutes, new entrants, rivals and customers. Three generic strategies that can be derived from this are: cost leadership, differentiation and focus. A Value Chain Analysis can be used to assess the commercial and technical feasibility of the proposed chain relationship within the selected strategy. An appropriate tool to assess the political feasibility of a chain project is conducting a socio-economic impact analysis. Especially in emerging or transition economies, local governments can be worried or suspicious about the impact of new competitive partnerships upon the existing market order. Potential employment generation or losses, increased competition with local (state-owned) companies, and other effects need to be estimated in advance. Self-evidently, the impact analysis should be combined with a stakeholder perception analysis on basis of the assumption "perception is reality and opinion is truth".

2.2 Demand oriented agri supply chain development:

Customer demands should be the starting point for each new agri-supply chain design. Only those products that respond to consumer demands with faster, cheaper, better solutions, will be sustainable over the long term.

2.3 Public-private partnerships:

The team of stakeholders that co-operate in a pilot project should ideally consist of not only representatives from the business community but also from universities and research institute. Depending upon the project, Ministries of Agriculture and Commerce, Food and Drug Administration and public agencies may also be actively involved. The private and public partners work together on the development and application of chain knowledge aiming at resolving bottlenecks in the chain and in developing a learning environment to facilitate education and training on these issues.

2.4 Learning by doing:

It is important to work with partners on their worksite i.e. fields, warehouses, processing plants and offices. The hands-on experiences should be an integrated part of the overall knowledge management system, which includes knowledge development, knowledge dissemination, knowledge use and knowledge storage. The practical experiences that are generated within the chain can be supported by tailor made training courses in each of the supply chain development fields: chain differentiation (e.g. category management training), integral chain quality assurance (e.g. HACCP training), and chain process realignment or chain optimization (logistical training).

2.5 Strengthening chain knowledge infrastructure:

A critical success factor for supply chain competitiveness is knowledge infrastructure—in particular infrastructure that is able to support production, processing and trade at each level of the supply chain in an integrated way. Tailor-made training and education modules can be developed and added to existing educational programs (e.g. at MBA level). This means a vital structure in which the private sector and public knowledge infrastructure co-operate effectively and continuously in the field of chain knowledge.

2.6 Synergy and progressive alignment:

Knowledge development is accelerated through the process of gaining initial market acceptance. Winning early operational successes helps lock in partner commitments. In practice we see various stakeholders making individual efforts to effectuate supply chain performance improvements. At various levels of the upstream and downstream supply chain stakeholders work on quality and safety issue. Coordinated efforts between seed companies that successfully organizes training in the field of good agricultural practices and integrated pest management, and a retailer that sets up a certification program for safe and organic vegetables, can have a spin -off that is bigger than the individual separate pilots. The co-operation allows the retailer to communicate product specifications directly to the growers and guarantee the sales of the quality produce and the seed company on its turn can teach and monitor the correct farming practices and pre-harvest intervals and improve it seed sales. ACC-like organizations can contribute to supply chain knowledge system innovation by systematically gathering the case based information in a toolkit and provide this expertise for other future supply chain projects.

III. SUPPLY CHAIN AGROINDUSTRY OF CASSAVA

The spects of the study were structurally organized covering target the supply chain, supply chain structure, resources, chain management, business process chain and supply chain performance. By studying these aspects, the researcher could find out the chain supply phenomenon and propose the best development ideas.

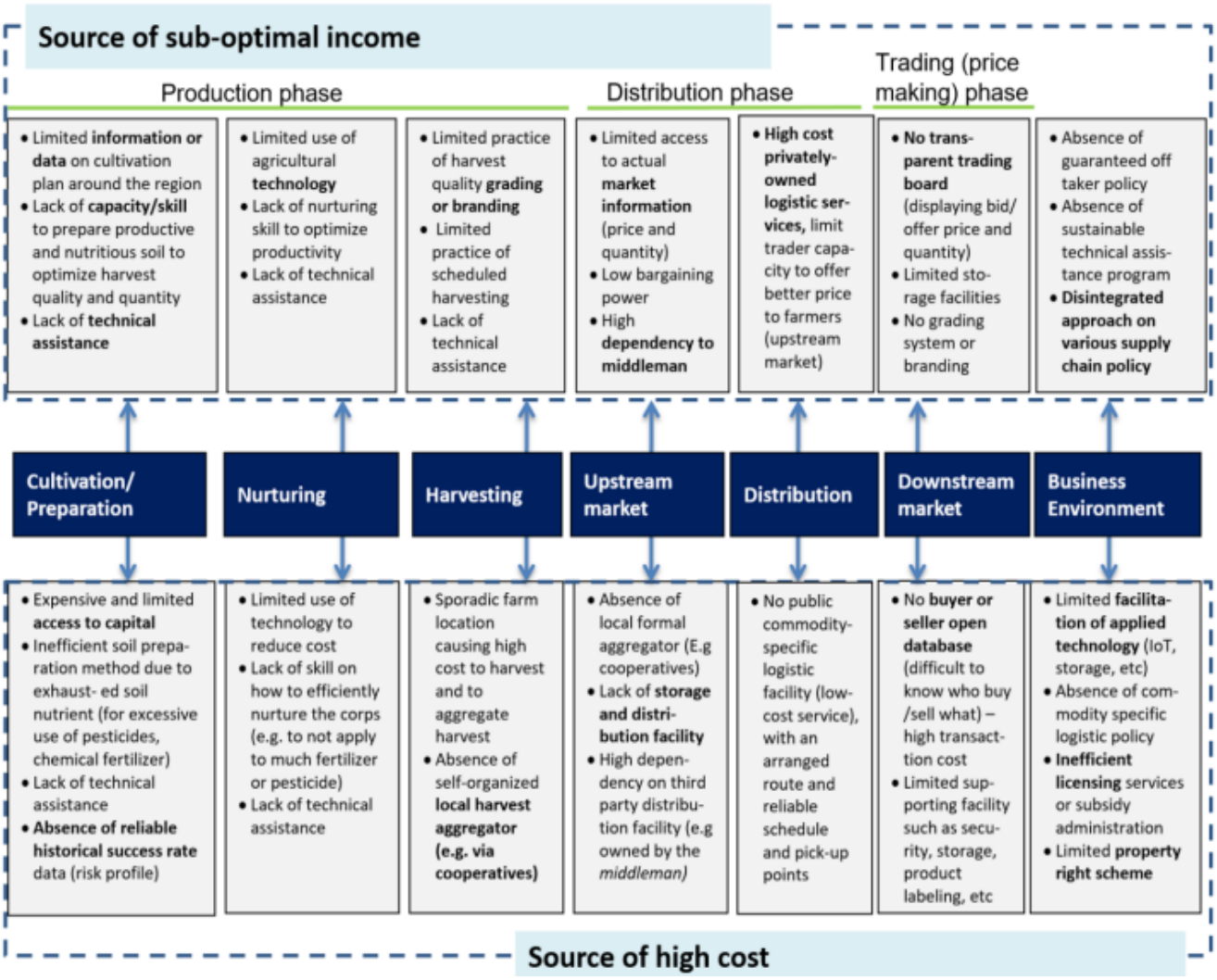

FIGURE 1: Summary of the General Supply Chain Problems

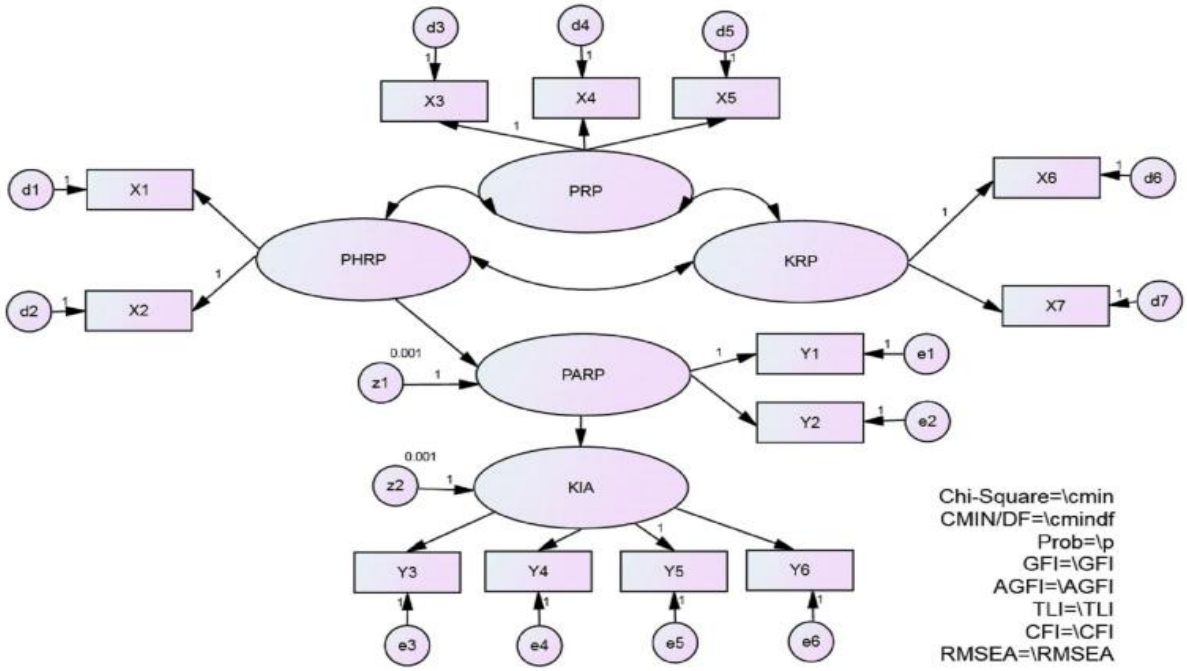

FIGURE 2: The Conceptualization of Structural Equation Models (SEM) of SCM Agroindustry

Description:

X1 = coherence or fusion; X2 = the proximity of the area; X3 = integrity of service customers and suppliers, X4 = dissemination of information; X5 = the speed of communication and supply chain; X6 = quality and service, X7 = operations and distribution; Y1 = integrity and synergy principles of supply chain management, Y2 = improved management of agro-industry input-output; Y3 = increase product diversification and relative efficiency of agro-industry, Y4 = increasing of profitability of agro-industry; and Y5 = increased performance of agroindustry product marketing; Y6 = increase value of SCM actors.

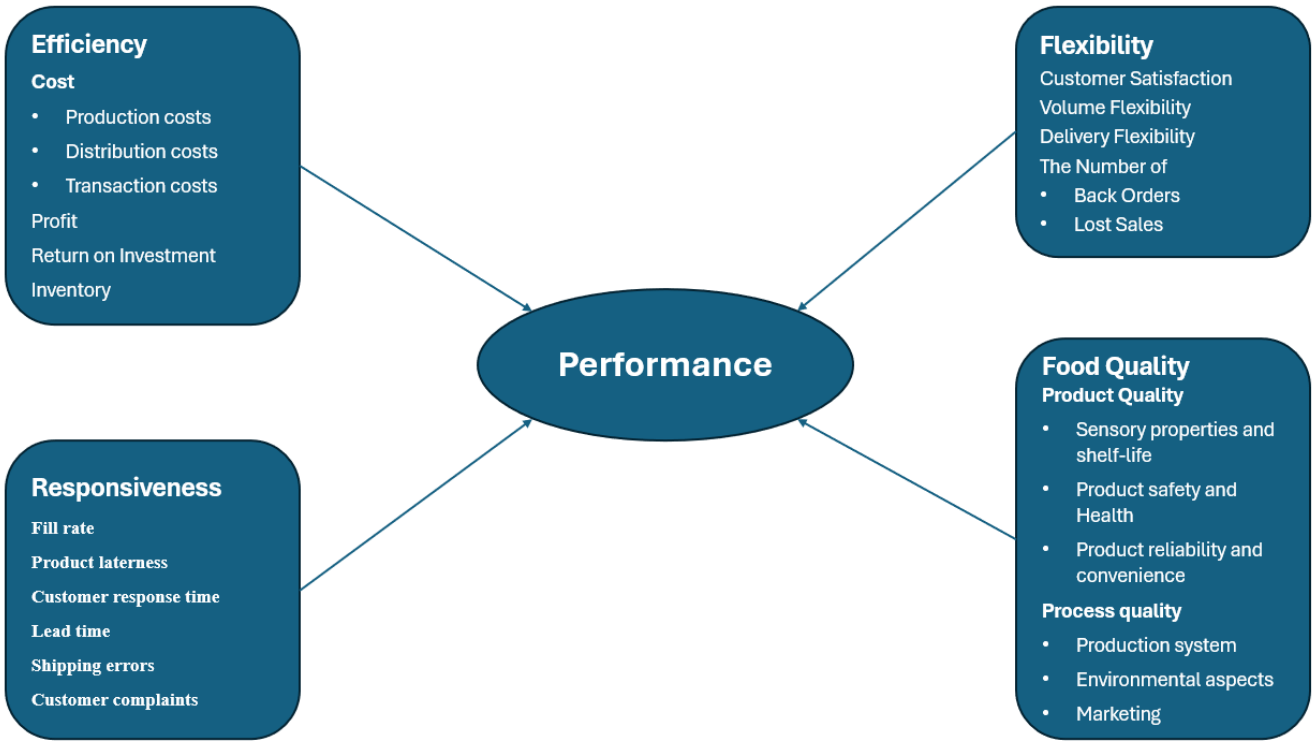

FIGURE 3: Conceptual Framework of Agri-Food Supply Chain Performance Indicators

There was a study on the presence of market and production risks which they resulted in farmers temporarily changing the market in which they sell their cassava and diversifying into other crops. As it regards production risks faced, pest attacks are the most outstanding. Traders like the farmers, are prone to market risks, poor storage and generally post-harvest handling constitute a significant source of risk for traders as any changes in market demand results in either build up in stocks requiring additional storage and increased risk for spoilage, while reduced demand in the market equally results in longer storage time and by extension increased risk of spoilage (Xanthavanij, Amornsawadwatana, 2019).

IV. DISCUSSION AND RECOMMENDATION

Many studies in the scope of SCM with the objectives to improve the efficiency of the supply chain by applying SCM contexts study i.e. define framework, having performance measurements, apply strategy concept, financial management, collaboration, and sustainable competitive advantage to the future competition. From the study, it is found that many problems in the cassava supply chain needed more analysis and improvement. Presently, there are no benchmarks to be used as tools to help the related party cope with the supply chain problems. Most problems occur regularly and no systematic solution planning by not allow the problems to occur repeatedly. One of the major problems in the cassava supply chain is the fluctuation of the cassava price, they are so volatile that the farmers may switch to cultivate other kind of agriculture products when cassava price is low.

The main reasons are the payoff return to the farmers which resulted from Thai farmers are poor. They can't afford with the low price of cassava for the extended period, they have to switch to cultivate other agriculture products that generate better return. Another crucial problem of cassava supply chain is the short shelf life of cassava roots since they are the perishable products. Many experts try to keep and extend the shelf life of cassava roots to prolong the cassava use to be available for the longer period. Moreover, most of the problems that found in the cassava supply chain in Thailand are the lower efficiency of cassava production, lesser yield in cassava plantation and low percentage of starch content. All of these problems can be

improved if there are the collaboration among all parties consist of the government sector, technician expert, academic expert, manufacturers, farmers, etc.

They should have the organization/association that will oversee/monitor the operation of the cassava supply chain, and ready to provide the support to the farmers & related parties once they have the problems. This association will delay/relax he farmers from switching to cultivate other agriculture products, by provide the support the farmers to keep on cultivating the cassava. Furthermore, it also needs the decision support tools that will be used to help them justify the cassava supply chain situation. It has to encourage the farmers to harvest and sell the cassava roots on the high percentage of starch content, by not having the early harvest on the young cassava in order to have better percentage of starch content and selling price. Financial management is very important issue for cassava supply chain, especially in Thailand since the competition of cassava not only compete with the players in the same industry, but they also have to compete with other substitute agriculture products especially with corn. The related parties in the supply chain have to manage the cost with effectiveness and efficient, otherwise, they will lose the competition ability. By setting high efficiency on performance measurement i.e. KPIs, SCOR model, suitable strategy, or use the technology to help in managing the supply chain, etc., these will allow the related party in the supply chain to have the ability to compete in the market.

The price of cassava and its products depended on demand and supply in the supply chain. The price was fluctuated from time to time, and there are many factors that affected the price. Most studies are intended to improve the production efficiency, the plantation yields, and find the reasons to support whether cassava was well harvested by the farmers in the world. Some study on the presence of market and production risks which they resulted in farmers temporarily changing the market in which they will cultivate or switch to other agriculture product. As it regards production risks faced, pest attacks are the most outstanding. Traders like the farmers, are prone to market risks, poor storage especially on postharvest handling constitute a significant source of risk for traders as any changes in market demand results in either build up in stocks requiring additional storage and increased risk for spoilage.

V. CONCLUSION

The study on this paper on the SCM context by apply to cassava supply chain, it allows the related parties in supply chain to analyze the markets and competitions, in order to have the competitive advantage over other competitors in the industry and other competitors in the related industries. This study, it will be able to apply to other country's cassava supply chain, by not specific only in Thailand. Moreover, the researcher hopes that this study will be used as the groundwork to other researchers who interested to study in cassava or other agriculture products. They can apply by using some concept from this study; the factors that affect the performance of the supply chain are addressed and know how to improve the efficiency to the supply chain.

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