

Supply chain for Vietnamese agricultural products: A case study of Japanese sweet potatoes in Binh Tan district-Vinh Long province

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Abstract. Vietnam is one of nations which are popular with long tradition of agriculture. With its climate, fertile land and natural conditions, Vietnam is regarded as a land for tropical fruits which are favored in both domestic and export. As the consequence, the Vietnamese agriculture majorly contributes to the national budget and development. However, the supply chains for these fruits are facing problems which lead to the declining of profits. In addition, the supply chain is now becoming a heated issue. In this paper, taking the Japanese sweet potato in Binh Tan district- Vinh Long province as a case study, the supply has been recently outstripped the demand which confronts the farmers. By this reason, this paper supposes the supply chain for this kind of plant with the supply chain network, process design, factory design and facility planning in order to address the present difficulties and control the supply chain to meet the peak demand and achieve the highest profits. Finally, the simulation is applied to check the practical benefits of this thesis.

Key words: Supply chain design, agricultural products, facility planning, supply chain network

I. INTRODUCTION

Vinh Long located in the Mekong Delta, has huge advantages in climate as well as fat soil for planting tropical products such as longans, pomeloes, rambutans and sweet potatoes.... In addition, these products are favored in both domestic and exporting so that the profit can lift up the province budget and enhance the quality of life for the residents. Furthermore, its location is on highway 1A which leads to great benefits in transporting products to many markets in other cities. However, Vinh Long has not had effective supply chain for its agricultural products yet, which lead to many wastes and the farmers have to face with the lost.

For the case of Vinh Long province, there has several kinds of sweet potatoes but the Japanese Purple sweet potatoes were grown up widely with many years experienced, this kind of plant was grown widely throughout this area with 9000 – 10,000 ha but this number has kept declining in recent years. In 2011,

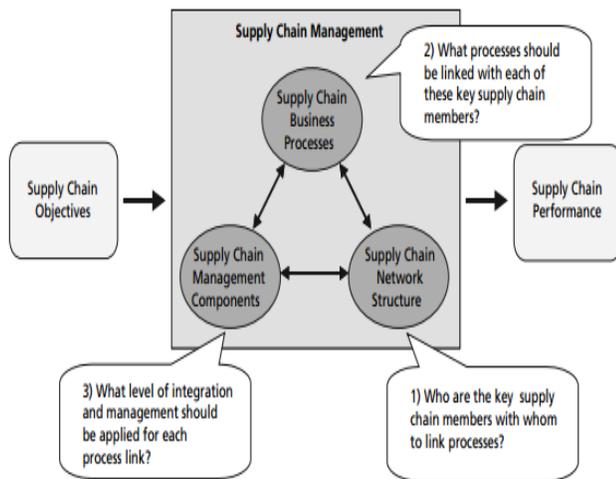
the price of sweet potatoes reached a peak of 1,000,000 VND/ quintal (1 quintal ~ 60 kg) which bring huge revenue for the famers. For this reason, many of them decided to plant sweet potatoes instead of the others. However, until 2012, the price significantly dropped to its trough to 180,000 VND / quintal.

To be more specific, few years ago, the Chinese traders came to Vinh Long and bought large quantities of sweet potatoes with high price. Moreover, they gave the farmers incentives to encourage them keep growing this plant. At that time, this action let the price of sweet potatoes remarkably increase to 800,000VND – 1,000,000 VND / quintal in markets. Without any doubts, the farmers produced huge quantities of sweet potatoes. At that time, their main market was China, but after harvesting, the traders just bought which one had good quality and the rest had no sources to consume. As the result, the farmers had to sell the remaining sweet potatoes in the market with the cheapest price.

There are some crucial factors lead to this situation, the traditional methods in planting sweet potatoes, the lack of information of traders, the unstable supply chain method and probably, the government has not had good way to solve this problem.

II.LITERATURE REVIEW

Figure 13. Key decisions in supply chain management (adapted from Lambert and Cooper, 2000)



According to “Building Agri supply chains: Issues and Guidelines” of Jan van Roekel, the paper draws on the necessity of supply chain model in the development of agricultural products, the benefits of agricultural supply chain affiliation. Furthermore, this paper also provide some basic information about a successful supply chain. Moreover, this also give some strategies to build an effective supply chain and how to develop it. Finally, the author draws an example about the “Thai Lan Agri supply chain project” to emphasize about how it elaborate the supply chain problems, identify the participants of this project and define the ambitions and intentions of these participants. In 2007, the “Agro-Industrial supply chain and management: concepts and application” of Jack G.A.J. van der Vorst, his paper provides the concepts about the importance of supply chain and logistics management. He also illustrates some keys decision for supply chain redesign. This paper gives some example about supply chain management such as pork chain in China, tops fresh vegetables chain in Thailand, the supply chain for beans in Central America, Thai fresh project and the quality management in the dairy supply chain in Brazil in

order to demonstrate how the other countries operate their agricultural supply chain management

Following “Locating plants and warehouses simultaneously model” of Sunil Chopra and Peter Meindl, their paper describe how the facility location impacts to the long-term development of the supply chain management. A good location help us to reduce a huge amount of budget for moving the facilities from this place to another place. Furthermore, this is also a good condition to develop supply chain stably.

According to Sunil, he also emphasized the important role of forecast demand, the suppliers need to use the most appropriate projected method to understand the forecast the demand. As the consequences, they can operate their work to adapt the future demand.

In 2012, “Supply chain simulation and optimization methods” of Siti Norsyahia Othman and Noorfa Haszlinna Mustafa, this paper mainly focuses on the crucial role of simulation model in supply chain management. The paper also claims that using simulation model is the best way to evaluate the supply chain performances in reality and doing simulation should be combined with optimal techniques to get the optimal result.

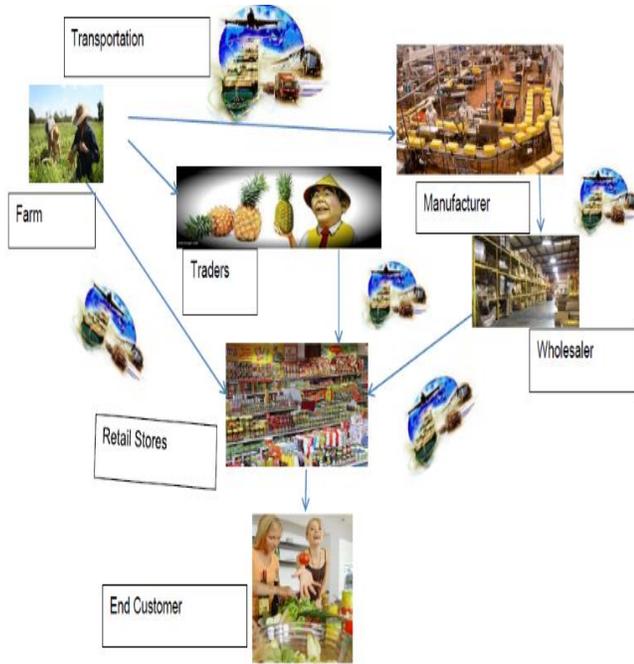
Following “The logistics system for fresh agricultural products in wholesale markets” of Ivan Vanany and Mohammad Arif Rohman, the paper demonstrates the general view in logistics in supply chain, especially for fresh agricultural products. The authors mention about the design of logistics systems included suppliers, retailers, distributors, wholesale markets and customers to show the detail of logistics activities in the wholesale markets.

In 1996, “Supply chain management for perishable product: a case study of dedicated supply chain for banana in UK market” of Natasha Wilson, the paper mentioned the success of many fruit groceries in UK markets due to their high quality cold storage, the in-time delivery and forecasting demand weekly. Furthermore, the good methods of maintain the fresh of fruit during the time from harvesting to selling to customers is the key help them the get the stable demand.

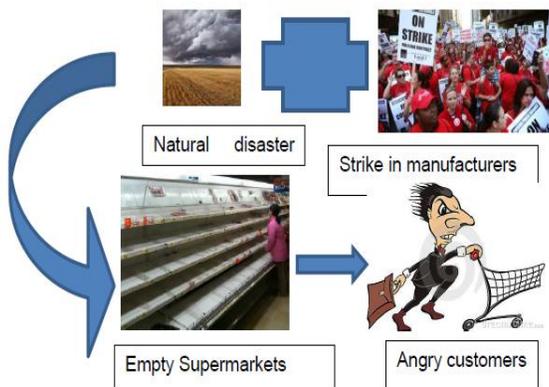
“Importing/ Exporting food products from Viet Nam to Germany and Supply chain management” Uyen Tran of Saimaa University of Applied Science. This paper emphasizes the general import and export food products of Viet Nam and it also provide some benefits in exporting agricultural products from Viet Nam to Germany with the cooperation agreement (Kleber 2011). Furthermore, this paper describe how supply chain for agricultural products work and the result when the supply chain does not work well.

Finally, the author also draw some obstacles in global supply chain management with 4 main risks such as cost risks, quality risks, lead time risks and security risks.

Supply chain of goods



The impacts of bad supply chain

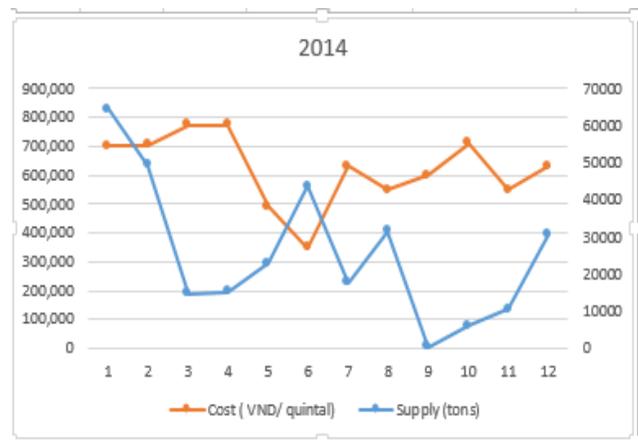


III.SUPPLY FORECASTING AND CAPACITY ESTIMATION

Table 1. Monthly supply of purple sweet potato in 2014

	1	2	3	4	5	6	7	8	9	10	11	12
Supply(tons)	64436	49465	14765	15248	23031	43567	17770	31490	476	6140	10506	30712
Cost(000 VND)	700	705	775	775	490	350	630	550	600	710	550	630

Figure 1. Cost and Supply of purple sweet potato in 2014



(Source: Vinh Long plant protection department)

Table 2.Monthly supply of purple sweet potato in 2015

	1	2	3	4	5	6	7	8	9	10	11	12
Supply	64948	66728	95090	5873	25545	732	2427	4339	8143	5063	16862	50067
Cost(000 VND)	650	810	580	450	490	150	620	525	500	440	850	800

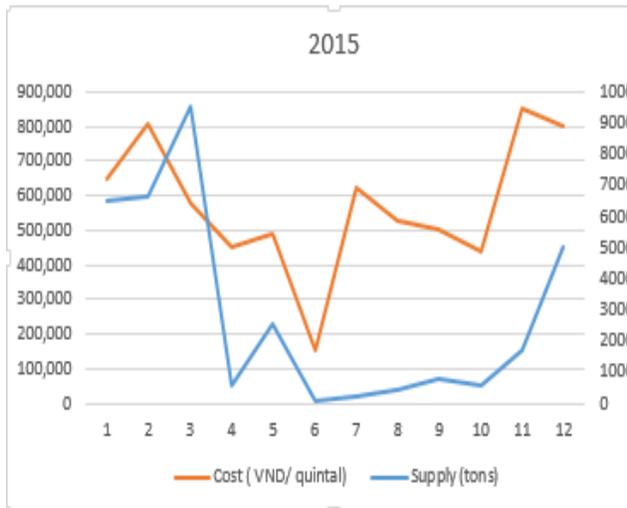


Figure 2. Cost and Supply of purple sweet potato in 2015.

(Source: Vinh Long plant protection department)

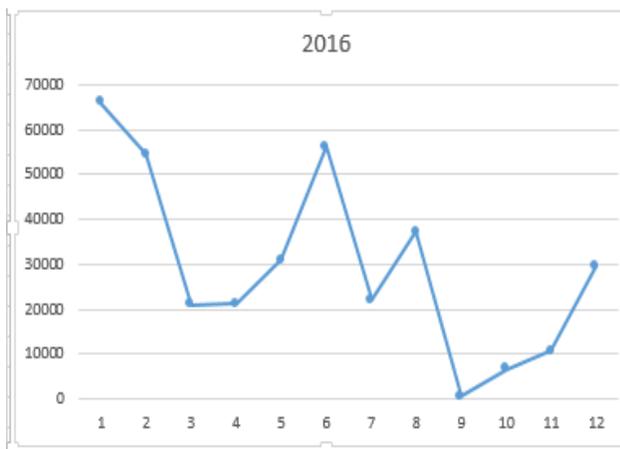


Figure 3. Forecasting of supply in 2016

	1	2	3	4	5	6	7	8	9	10	11	12
Supply(tons)	54982	56015	68716	21223	30875	56141	21963	37242	538	6594	10705	29568

According to the statistics data from Vinh Long plant protection department, the value of supply and cost of purple sweet potatoes is shown in figure 1 and 2.

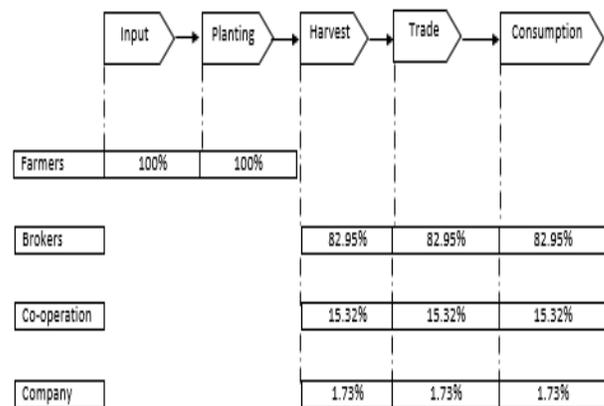
By comparing two factors, we can easily see that there are unreasonable points in some period in 2014

and 2015. For instance, in March, 2014, the price was very high but the supply was very low. Farmers do not know about the markets and the price is decided by brokers so that farmers cannot get the best profit. By this reason, we should do know clearly about the markets and do a forecasting to help the farmers as well as the co-operation or government in Vinh Long province achieve the highest profit.

There are many factors lead to this irrational figure, one of them is that we majorly depend on Chinese brokers and the customers cannot control the price. Furthermore, price is low mainly decided by the season of purple sweet potatoes in China because their supply is also high at that time and it means that the supply is redundant so the price is low.

From the historical data, it demonstrates that using winter method is the best way to forecast for the supply of next period with $\alpha=0.5$, $\beta=0.5$ and $\gamma=0.6$.

Value chain



From the historical data on the internet, news shown that there are 2 co-operation which named Tan Thanh and Thanh Dong and 1 company (Nhat Thanh) in Vinh Long province. The Tan Thanh co-operation provides 200 tonnes of fresh purple sweet potato for the market daily while the Thanh Dong co-operation only provides 300 tonnes for each season (3 seasons each year). The Nhat Thanh company provides 6,000 tonnes for the market each year. Lastly, there are more than 40 purchasing points in Binh Tan districts which accounts for roughly 83% of the production and they all bring the sweet potatoes China market.

The factory is mainly built for the co-operation and company who can help Vinh Long sweet potato reach the other international markets. In this case, the tubers input to factory is about 17.05% but if our research success, this number maybe increase to 30%

IV. SUPPLY CHAIN NETWORK

Distribution network

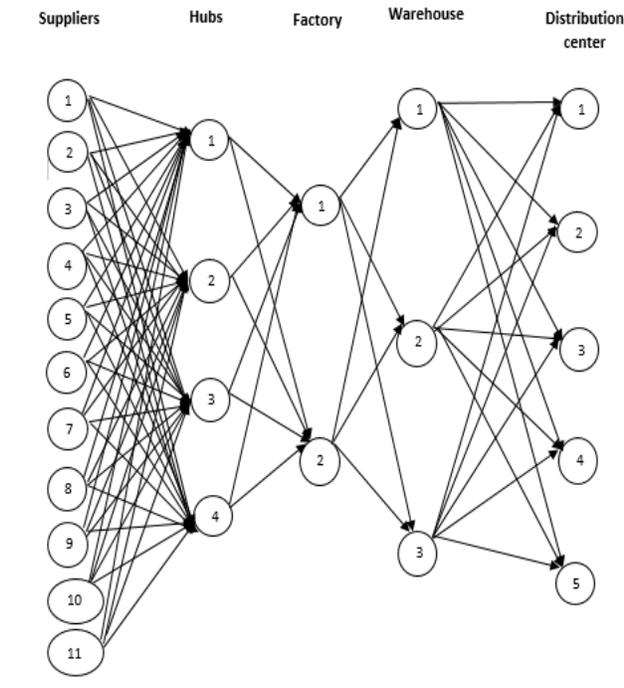
There are 11 suppliers of sweet potato in Vinh Long province which named Tan Thanh, Tan Hung, Thanh Dong, Thanh Trung, Nguyen Van Thanh, My Thuan, Tan Quoi, Tan An Thanh, Tan Luoc, Tan Binh. All of these suppliers produce roughly 300,000 tonnes of tubers each year.

We have 4 candidates for hub locations which named Tan Hung, Tan Thanh, Thanh Dong, Thanh Trung based on their huge suppliers. According to the value chain, 83% production of sweet potatoes is exported to Chinese by the brokers so that the remaining will transported to the hub location candidates.

There are 2 options for factory location (Binh Minh and Hoa Phu industrial zones).

After being processed in the factory, products will be transported to warehouses and we have 3 candidates of warehouses (Tan Thanh, Thanh Dong, Tan Quoi) which are near to the co-operations.

We have 5 distribution centers which are located in contiguous province and big cities of Viet Nam, they are Ha Noi, Hai Phong, Da Nang, Ho Chi Minh and Can Tho.



Model Input

Following input consist of the objective function, the constraints are put into the input of the model:

Input and sets:

- h : number of suppliers/communes
- d : number of potential procurement hub locations
- n : number of potential factory locations
- t : number of potential warehouse locations
- m : number of distribution centers
- S_h : supply capacity at supplier h
- Z_p : potential capacity of procurement hub at site p
- F_p : fixed cost of locating a procurement hub at site p
- K_i : potential capacity of factory at site i
- F_i : fixed cost of locating a factory at site i
- D_j : annual demand of customer j
- W_e : potential capacity of warehouse at site e
- F_e : fixed cost of locating a warehouse at site e
- c_{hp} : cost of shipping one unit from supplier h to procurement hub p
- c_{pi} : cost of shipping one unit from procurement hub p to factory i
- c_{ie} : cost of shipping one unit from factory i to warehouse e
- c_{ej} : cost of shipping one unit from warehouse e to distribution centers j

Decision Variables:

$$y_p \begin{cases} 1 & \text{if we locate a procurement hub candidate at site } p \\ 0 & \text{if not} \end{cases}$$

$$y_i \begin{cases} 1 & \text{if we locate a factory candidate at site } i \\ 0 & \text{if not} \end{cases}$$

$$y_e \begin{cases} 1 & \text{if we locate a warehouse candidate at site } e \\ 0 & \text{if not} \end{cases}$$

x_{hp} : quantity shipped from supplier h to procurement hub p

x_{pi} : quantity shipped from procurement hub p to factory i

x_{ie} : quantity shipped from factory i to warehouse e

x_{ej} : quantity shipped from warehouse e to distribution centers j

$$\begin{aligned} \text{Minimize } & \sum_{p=1}^d F_p y_p + \sum_{i=1}^n F_i y_i + \sum_{e=1}^t F_e y_e \\ & + \sum_{h=1}^l \sum_{p=1}^d c_{hp} x_{hp} + \sum_{p=1}^d \sum_{i=1}^n c_{pi} x_{pi} \\ & + \sum_{i=1}^n \sum_{e=1}^t c_{ie} x_{ie} + \sum_{e=1}^t \sum_{j=1}^m c_{ej} x_{ej} \end{aligned}$$

Constraints:

$$\sum_{p=1}^d x_{hp} \leq S_h, h = 1 \dots l$$

$$\sum_{p=1}^d x_{hp} - \sum_{i=1}^n x_{pi} \geq 0, p = 1 \dots d$$

$$\sum_{i=1}^n x_{pi} \leq Z_p y_p, p = 1 \dots d$$

$$\sum_{i=1}^n x_{pi} - \sum_{e=1}^t x_{ie} \geq 0, i = 1 \dots n$$

$$\sum_{i=1}^n x_{ie} \leq K_i y_i, i = 1 \dots n$$

$$\sum_{e=1}^t x_{ie} - \sum_{j=1}^m x_{ej} \geq 0, e = 1 \dots t$$

$$\sum_{j=1}^m x_{ej} \leq W_e y_e, e = 1 \dots t$$

$$\sum_{j=1}^m x_{ej} = D_j$$

$$x_{hp}, x_{pi}, x_{ie}, x_{ej} \geq 0$$

$$y_p, y_i, y_e \in (0,1)$$

Solution:

Hubs	
Tan Hung	0
Tan Thanh	0
Thanh Dong	1
Thanh Trung	0

Factory	
Hoa Phu	0
Binh Minh	1

Warehouse	
Tan Thanh	0
Thanh Dong	1
Tan Quoi	1

From the result, the hub should be located in Thanh Dong district while the factory is in Binh Minh industrial zone and the warehouses should be opened in Thanh Dong and Tan Quoi districts.

V.PURPLE SWEET POTATO PRODUCTS DESIGN AND OUTPUT ASSUMPTION

Due to the lack of purple sweet potato products in Vietnam, we have to do a research on potential products which can help our exporting markets widely open. Purple sweet potato products are favoured in developed countries such as Japan, Korea, America, Singapore,... because of its health benefits. After doing the research, we realize that there are thousand of sweet potato products over the world but 5 of them are likely stand out:

- Fresh purple sweet potato
- Purple sweet potato powder
- Purple sweet potato noodles
- Purple sweet potato chips
- Purple sweet potato vinegar

Products	Proportion
Fresh sweet potato	44.5%
Powder	17.25%
Noodles	12.75%
Chips	12.75%
Vinegar	12.75%

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