DESIGN SUPPLY CHAIN FOR AGRICULTURAL PRODUCTS OF VIETNAM

A CASE STUDY:

SUPPLY CHAIN DESIGN FOR TANGERINE IN DONG THAP PROVINCE

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Abstract: The tangerines fruit in Lai Vung, Dong Thap province of Vietnam is famous for its sweet taste, bright and beautiful color. But the supply chain for this fruit has problem for the past few years which result in price dropping and the farmers no longer want to plan this fruit anymore. This paper will use the production analysis and forecasting, product design, supply chain network, and other optimization tools such as CPLEX to design the new supply chain network for tangerines fruit in order to solve the problem that this fruit is now facing. The data of this paper was collected from the Department of agricultural and rural development in Lai Vung, Dong Thap Province. The output of this paper should be taken into consideration by the local authority to implement and improves the current situation of tangerines. Due to difficulties in collecting data, the marketing research and others issues that this paper could not cover all up and needed more research in further study.

Keywords: supply chain network design, forecasting, CPLEX, product design.

1. INTRODUCTION

Supply chain is not a new term for a successful business, especially in the globalization economy nowadays. The supply chain for agricultural product is also a familiar phrase in developing country such as Vietnam. As for the diverse soil and the climatic conditions of Vietnam, which are favorable for growing fruits, vegetable and flowers on a year-round. But recent years in the domestic market, the selling price of fruit at the time of harvesting is often precarious. There are so many products of the same category at the time of harvest, an average of about 2 months/season, making the regulatory criteria of product sales difficult. The fruit is mostly consumed in fresh form locally and nationally, this leads to the stagnation of fruit, which made the products rotten. In fact, fruit products usually had been harvested even before the time of harvesting. The fruit mostly had not been inspected the quality and food safety. Only a sufficient amount of fresh fruit meets the standard quality. Then, those fruit stored in cold storage with temperature and humidity suitable for each kind of fruit. Notably, in Vietnam, there are only few storage facilities with suitable costs to store fresh fruit and to export at very cold temperature. Also there are so few applications of reservation fresh fruit product in Vietnam. That is why to conduct a supply chain

for agricultural products in Vietnam, is a major job to do right now.

The purpose of this paper is to design the supply chain for the tangerines to balance the output and the price. In order to do that, a fully developed model of supply chain has to be conducted from the beginning: planting, harvesting, gathering, packaging; transportation to supermarket, exporting, and to end-users. This supply chain network may need several models to calculate the factory for pre-processing and packaging the fruits after harvesting. After that, the fruits can be transported to cold warehouse to store. Then the fruit may be carried to domestic's supermarket and retail store for sale. Besides, a small amount of tangerine fruit will go to seaport for exporting to other foreign market such as US, EU, Japan, Hong Kong …

2. LITERATURE REVIEW

2.1 Tangerines

The information from the Scientific Management Division, Department of Agriculture and Rural Development in Dong Thap province, Lai Vung stated that tangerines has a characterized characteristic for its pink colors, large fruit (5 fruits/kg) juicy, and sweet taste. This fruit often used to be displayed during Vietnamese Tet holiday. Lai Vung tangerine has rich nutritional value, in 100g of tangerines consists calcium, phosphorus, vitamin B1, vitamin B2 vitamin C. For that, tangerine is a very healthy fruits for everybody. However, the fruit cannot be stored more than 15 days. Because of that, to export the tangerines, it has to store in cool place to extend the preservation time. But there has not yet any standard storage and not yet any technique for lengthen the freshness for this fruit up to now.

2.2 Supply chain

In the research "The Logistic system for fresh agricultural products in wholesale market", the supply chain structure and configuration for logistics system in wholesale market was showed using product flow model and thread diagram based on SCOR model. Some activities were also depicted for three-business processes area in wholesale market. Besides that, Sunil Chopra and Peter Meindl (2007) pointed out in their work "Supply Chain Management, Strategy, Planning and Operation" that, facility location decisions have a long-term impact on supply chain's performance, because it would be expensive to shut down a facility or move it to another location. The model in this book also helps choosing location of plant and warehouse between different locations that can minimize the total fixed and variable costs.

2.3 Planning and forecasting

The role of Planning and Forecasting is to forecast the demand and to plan in order to adapt the forecasted demand.

According to Sunil Chopra (2007), demand forecast forms the basis of all supply chain planning. It means that, the manager of one supply chain need to understand and choose the most appropriate forecasting method to manage their supply chain effectively. Planning for capacity, production, inventory and pricing – is necessary for the supply chain after demand being forecasted. Russell and Taylor (2011) have stated that the new products and services are the lifeblood of an organization in their work "Operations Management: Creating Value along the Supply Chain". There is a big impact of product design on the market of a business and that is the reason why it needs to be managed effectively. They have also mentioned about technology decision. Technology is another step that influences the cost, speed, quality, and flexibility of operations. The capacity of the firm and later interaction was also decided by technology. A technologist or a decision maker has to consider both aspect and choose the most appropriate and most efficient choice.

2.4 Facilities planning

Tompkins and Associates had mentioned in their book "Facilities planning" (2008) about the important not only in science perspectives but also in strategy perspectives of the facilities planning. The manufacturing facility best supports for production were determined by the facilities planning. The book also indicated facility planning were a wide concept that related to facilities system, facilities layout and material handling system. A good facilities planning can reduce 30 percent waste of operation.

Besides that, the book of Sunil Chopra & Peter Meindl "Supply Chain Management – Strategy, Planning and Operation, 5th edition" indicated how effective the facilities layout upon the operation and the whole supply chain in. The book "Towards effective food chains – models and applications" of Wageningen University and Research center was published in 2010. This book presented the knowledge on management and control the food supply chains. It belonged to the research program which containing design of chain strategies, collaboration efficiencies among chain partners, management of risks in chains, innovative modeling concepts and information technologies. This book figured out the special experience to design the supply chains for agriculture product in this thesis.

2.5 Chitosan in preservation fresh fruits

Chitosan is a biopolymer; produced from shrimp shells. Chitosan exist as solid form, porous, lightweight, and squamous; can be grinded out different sizes. It had white or pale yellow, no taste. Chitosan antimicrobial, inhibiting the activity of a number of bacteria such as E. coli, kills harmful fungi some strawberries, carrots, beans and have a good effect in preserving vegetables have hard exteriors. It is easy to adjust humidity, ventilation air for

food when using Chitosan. Normally, using a package with PE, the amount of oxygen supply is limited; water will be condensed to create an environment for mold to grow. Chitosan film is also quite tough, hard to tear, with durability comparable to some plastics are used as packing. Chitosan membrane slowing downs the process of being intensive horticulture. Fruits after harvest will gradually darken reduce quality and value. Thanks to a package with Chitosan membranes keep fruits fresh longer.

2.6 Irradiation treatment

According to US Food and Drug Administration, fresh fruit irradiation is a technology using ionizing radiation energy to handle products. This technology kills the parasite, fruit fly and extending the shelf life of products. As for exporting fresh fruit to world markets, irradiated product has been proven to bring enormous economic and social benefits. Some country like US has strictly importing rule due to the requirement to have this irradiation treatment for the product that want to enter. Only some register center in Vietnam can perform this irradiation treatment on food product such as VINAGAMMA, An Phu Irradiation Company. Irradiation treatment also help added more value for fruits as well because it extends the freshness of the fruit. An Phu Irradiation Company and VINAGAMMA Center are now capable of implementing this technique to fresh food in order to exporting to foreign country. Exploring a way to apply the irradiation to fresh fruit like tangerine, create the better chance for exporting fresh tangerine fruit to other foreign market such as United State, Japan, EU…

After the tangerines being processed in factory, it should be shipped here to enter the irradiation treatment in order to meet the importing requirement of foreign market and to add more value to the fruit.

3. PRODUCTION ANALYZE AND FORECASTING

3.1 Production analysis

The currents supply chain of the tangerines in Lai Vung, Dong Thap was observed. From the current supply chain, it can be seen that the farmer has to depend a lot on the dealers with 60% production sale to dealers. Only a small amount of fruits can reach the super market as well as end customers. The proportion of each element in the current supply chain of tangerine fruits was shown in figure 3.1
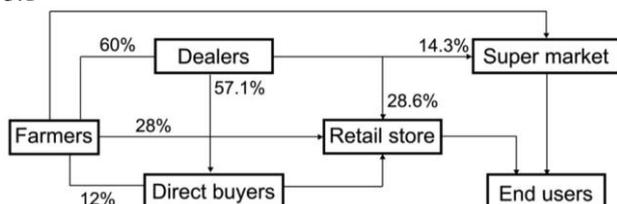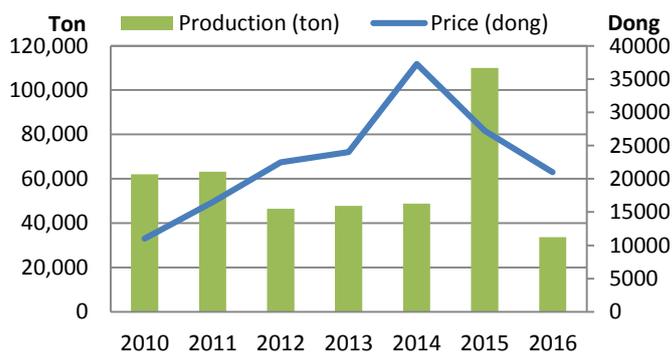

Figure 3.1: The current supply chain of tangerines in

Lai Vung (Source: Departments of Agricultural and Rural development of Lai Vung)

The current supply chain of tangerine also showed the farmers do not have any reliable source to consume their fruit. If the dealers do not buy their fruits, they will have small chance to consume up their production, there for the farmers will lose profit a lot.

The production and the price of tangerine fruit were collected. The figure 3.1 show the relationship between the price and the production of the tangerines fruits for the past 6 years, from 2010 to 2016.

From the chart, the production in 2011 has increased a little bit, and the price also went up showing the growing of the tangerines market. But in 2012, there were natural flood that decreased the production of tangerines a lot, which resulted in increasing price. The production of tangerines continued to rise in 2013 and 2014, so did the price, and with the highest price in 2014 were 37,250 VND. But in 2015, the production had a major jump up in quantity for applying VietGAP technique in planting, resulted in increasing the productivity of tangerines very much. However, the price of tangerine still not increase due to over production of the fruits. Plus, there were several types of tangerine from Hong Kong, Thailand, China on the market with lower price and better quality, which made it hard for tangerine fruit in Lai Vung to compete with. Besides that, based on the current supply chain of tangerine showed in figure 4-1, the farmers have to depend a lot on the dealer to sale their fruit. Those traders also the reason causing the price dropping of tangerine, because they will be the one who buy the tangerine and force the farmers to sale the fruit as low cost when the market demand is low. All of this causes lead to the situation when the production of tangerine grows but the price of the fruit still cannot increase. This is the reason why the farmers do not want to continue planting the fruits anymore, which make the

production decreases a lot in 2016.

Figure 3.1: Lai Vung tangerines production and price from 2010 – 2016

3.2 Forecasting result

The objective of forecasting the production of

tangerines for the year 2017 is that the farmers can estimate the quantity of fruits to be planted and reduce the overproduction scenarios. Applying the forecasting methods "Trend – and seasonality-corrected exponential smoothing (Winter's model)" to calculate the feasible fruits for the farmers to plant in order to meet the demand of markets and not causing overproduction, which once happened in 2015. The forecasting result was showed in the figure 3.2

The chart demonstrates the result of Winter's Model forecasting method.With this forecasting, it can be seen that the production of tangerines has to be increase to fit with the designed supply chain. By doing that, the farmer has to re-planting the tangerines. But due to the price dramatically drop the past few years; the farmers no longer want to plant this fruits. The governments need to encourage farmers to invest in this fruits again to make more benefits and to develop supply chain of agricultural product of Vietnam.
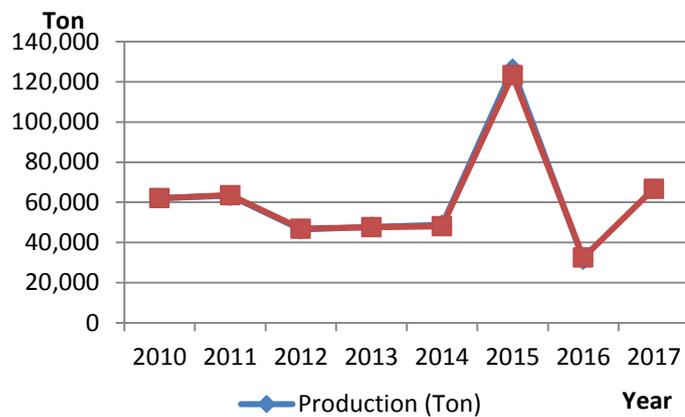

Figure 3.2: Production and the forecasting of tangerine

4. SUPPLY CHAIN NETWORK DESIGN
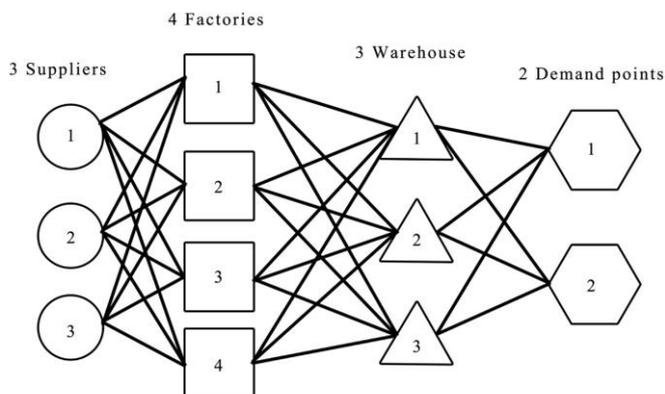### 4.1 General framework

Figure 4.1: The general supply chain network for Lai Vung tangerines

Lai Vung is a district in Dong Thap province. Lai Vung has a very important position, situated between the Tien and Hau rivers, located in the key economic areas in the south of Dong Thap. Lai Vung also adjacent to Sa Dec Industrial Zone and near Tra Noc industrial zone of Can Tho. Long Xuyen city and CanTho city also near this district, which is why Lai Vung is very favorable for attracting investment and development. Lai Vung District is famous for the suitable and fertile soil in planting tangerine, that is why, tangerine is the specialty of this area. There is three wards of Lai Vung grow a lot of this fruits: Long Hau, Tan Phuoc, Tan Thanh. The main supplier of the supply chain will likely take place in those areas.

The aim of designing the supply chain network is to gather all of the production into one place in order to make it easier to manage as well as standardize all of the processing in preservation and packaging fresh tangerine. After that, the transportation of this supply chain will be organize bases on the network that minimize the traveling distance as well as the cost of transportation.

The general supply chain with potential candidate of each component was showed in the figure 5-1. In order to design this supply chain network, the location of the suppliers, factory, and warehouse should be determined. Using the integer programming mathematical model, the optimal location of each function will be achieved.

Components of the supply chain network:
- Supplier: There are 3 supplier candidates with the biggest production of tangerines in Lai Vung, they are: Long Hau, Tan Phuoc, Tan Thanh marked as 1, 2, 3.
- Factory: There are 4 factory candidates which located in Long Hau, Tan Phuoc, Tan Thanh, Tra Kha Industrial park present as 1, 2, 3, 4.
- Warehouse: There are 3 candidates for warehouse location. They are Satra Cold warehouse (Ho Chi Minh City), Amata Industrial Park (Bien Hoa), Song Than Industrial park (Binh Duong).
- Demand Point: The demand points are the 2 biggest city consume tangerines the most: Ho Chi Minh City and Ha Noi Capital.
- Location of suppliers

The suppliers of the fresh tangerines in Lai Vung are the three districts with the biggest planting area of tangerines. The data about the production of those area data showed in table 4.1.

Table 4.1: Candidates for location

Suppliers (location)	Capacity (tones/year)
Long Hau	25,302
Tan Phuoc	14,337
Tan Thanh	6,346

The figure 4.2 also showed the planting area of tangerine in Lai Vung, Dong Thap province. The biggest planting area of tangerines is in Long Hau, Tan Phuoc and Tan Thanh. Those three areas located at the North West of Lai Vung District. These locations near Hau River and Can Tho City, which is a big advantage in developing business. Also its soil has a lot of nutrition, which is suitable for the tangerines fruits to be planted here. There are a lot of farmers grow tangerine in those three area. Some farmer even has 2ha of planting tangerines area with productivity reach 35 – 40 ton/ ha. There is a Co-operative of Lai Vung Tangerine located in Tan Phuoc Ward. Other ward of Lai Vung still plants tangerine but the total production quantity quite low compare to those three area. This is why the supplier of tangerine should be from Long Hau, Tan Phuoc and Tan Thanh ward.

Figure 4.2: The planting area in Lai Vung, Dong thap province.

- Factories:

In Dong Thap, there is Tra Kha Industrial park, which is available to allocate the factory. Still, there are some wide area in Long Hau, Tan Phuoc and Tan Thanh available to build the factory for processing tangerines after harvesting.

- Warehouse

There are two industrial parks in Binh Duong, Bien Hoa that has potential to locate warehouse. Also there is Satra cold warehouse in Ho Chi Minh suitable to store finished products.

- Demand points

Ho Chi Minh City and Ha Noi Capital are considered the biggest market of tangerines. The customer demand and number of potential supermarket are high. There are also many international ports located in these cities, which make it easier to export the fruits foreign market such as US, Japan, EU… Therefore, those two cities are chosen as the demand points for the supply chain network.

4.2 Plans and Warehouse locating model

- Mathematical model

  o Objective equation and several constraints equation were developed to build the model.

$$Min \ \sum_{i=1}^{n} F_i \, y_i + \sum_{h=1}^{l} \sum_{i=1}^{n} c_{hi} \, x_{hi} + \sum_{i=1}^{n} \sum_{e=1}^{t} c_{ie} \, x_{ie} + \sum_{e=1}^{t} \sum_{j=1}^{m} c_{ej} \, x_{ej}$$

Equation 1: Objective function

  o The constraint in equation 2 specifies that the total amount shipped from a supplier cannot exceed the supplier's capacity.

$$\sum_{i=1}^{n} x_{hi} \leq s_h \ for \ h = 1, \dots, l$$

Equation 2: Suppliers capacity constraint

  o The constraint in equation 3 specifies that the amount shipped out of a factory cannot exceed the quantity of raw material received.

$$\sum_{h=1}^{l} x_{hi} - 0.9 \times \sum_{e=1}^{t} x_{ie} \geq 0 \ for \ i = 1, \dots, n$$

Equation 3: Factory shipping constraint

  o The constraint in equation 4 specifies that the amount produced in the factory cannot exceed its capacity.

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

Equation 4: Capacity constraint

  o The constraint in equation 5 specifies that the amount of shipped out of a warehouse cannot exceed the quantity received from the factories.

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

Equation 5: Warehouse shipping constraint

  o The constraint in equation 6 specifies that the amount shipped out of a warehouse cannot exceed its capacity.

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

Equation 6: Warehouse capacity constraint

  o The constraint in equation 7 specifies the amount shipped to a customer must cover the demand.

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

Equation 7: Customer demand constraint

o   The constraint in equation 8 specifies that the total factory, warehouse is equal one.

$$\sum_{i=1}^{n} y_i, y_e = 1$$

Equation 8: Number of factory, warehouse constraint
The Table 5.2 showed the description of each notation used.

Table 4.2: Notation

Notation	Description
M	Number of Demand points
N	Number of potential factory locations
L	Number of suppliers
T	Number of potential warehouse location
D_j	Annual demand from market j
K_i	Potential capacity of factory at site i
S_h	Supply capacity at supplier h
W_e	Potential warehouse capacity at site e
F_i	Fixed cost of locating a factory at site i
c_{hi}	Cost of shipping one unit from supply source h to factory i
c_{ie}	Cost of producing and shipping one unit from factory I to warehouse e
c_{ej}	Cost of shipping one unit from warehouse e to customer j
y_i	=1 if factory is located at site i, 0 otherwise
y_e	=1 if warehouse is located at site e, 0 otherwise
x_{ej}	Quantity shipped from warehouse e to market j
x_{ie}	Quantity shipped from factory at site i to warehouse e
x_{hi}	Quantity shipped from supplier h to factory at site i

Input value

After identify all necessary data and parameters of the model, the software CPLEX is used to solve the mathematical model. The data collected is the distance between each potential component of the supply chain. After that, multiply with the cost for travel to calculate the total cost for each component. The table 4.3 showed cost to travel between each component. The same calculation also applied to the remaining components of the supply chain.

Solution

The solution had showed that the factory should be located in Tan Phuoc district in Lai Vung, Dong Thap Province. From that location, the distance from the factory to irradiation treatment center VINAGAMMA can also be determined. The result showed in the tables 4.4 and 4.4

Table 4.3: Distance from Factory to Irradiation center

Factory/Irradiation center (km)	VINAGAMMA
Tan Phuoc District	186

The location of warehouse indicated in Ho Chi Minh. The table below indicated the result from CPLEX.

Table 4.4: The transportation cost between potential factory and suppliers

Factory/ supplier	Transportation Cost (VND/Ton/ Km)	Long Hau District	Tan Phuoc District	Tan Thanh District
Long Hau district	đ3,333	3333	36667	24000
Tan Phuoc District	đ3,333	36667	3333	16333
Tan Thanh District	đ3,333	24000	16333	3333
Trà Kha industrial park	đ3,333	68000	95000	82333

Table 4.4: Quantity results from CPLEX

QUANTITY RESULT FROM CPLEX		
Factory/supplier (ton)	Tan Phuoc District	
Long Hau district	**25302**	
Tan Phuoc District	**14338**	
Tan Thanh District	**5060**	
Factory/ Warehouse (ton)	Satra (HCM)	
Tan Phuoc District	**40230**	
Warehouse/ Demand point (ton)	HCM	HN
Satra (HCM)	**36000**	**4230**

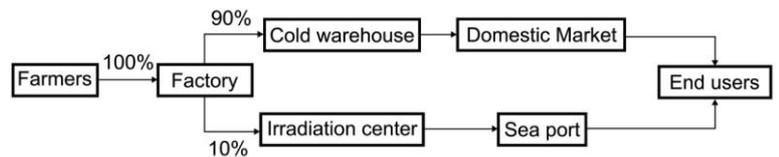From the result, here is the new supply chain network for tangerine fruit.

Figure 4.3: The new supply chain network for tangerine fruit in Lai Vung, Dong Thap

From this network, all of the production of tangerines is gathered in to one place, make it easier to manage the processing for fresh tangerines and standardize the techniques for fresh fruit after harvesting. After that, the fruit may have more chance to enter more type of domestic market like super market, retail store without being transport from difference source as before. Besides that, with the cold storage and the Chitosan shrink-film apply to

help lengthen the preservation time of fresh tangerines, this network offers more chance to export the fresh tangerine fruits to other foreign market such as US, Japan, EU … through sea transportation.

5. FACILITIES PLANNING

All of the tangerines fruits after harvesting will enter the factory for reprocessing and packaging. According to the annual production of tangerines in Lai Vung and the technical requirement, the total workload per day can be estimated. However, the production of tangerine may unstable due to the weather and the farmer planning skill. There is only one season a year for the tangerines, which is winter – spring. This season started at the end of September to next year January or February. From the historical data of production of tangerine for the past few years, the total production of this fruit is about 30,000 – 40,000 ton/year. Therefore, the factory needs to handle the production for two months from January to March. The total quantity of fruit needed processing varies from 30,000 – 40,000 ton for two months. So the total amount the factory need to process is 500-ton fruit per day.

Machine Capacity Determination

After having the daily workload, the machine capacity can be computed by taking the ratio of the Daily Workload to the Total Available Operating Time.

$$Capacity = \frac{Daily\ Workload}{Total\ Available\ Operating\ Time}$$

Equation 1: Machine Capacity calculation

Assume that there is 24-hours available operating time for all workstation.

Output Assumption

Due to lack of practicing in real products, the calculation about the quantities of output cannot be accurate. Based on searching in server fresh tangerines product in market to get the assumption for factory output. Also based on the experience of expert in Food Technology department, fresh tangerine products just needed the primary process, so it did not lead to lost material. Therefore, the amount of product will be the same with material input. This assumption of output also was affected by the production of tangerines. We calculate based on the average of the properties of Lai Vung tangerines. This may has a few changes depend on the planning of the farmer and the weather as well. Following the information, which mentioned in the section above, we calculated the output product in box per day as the table 6-6.

Table 5.1: Output quantity for factory

Product	Input quantities (tones)	Output quantities (tones)	Output/day (Boxes)
Fresh Tangerines	500	450	150,00

The amount of raw material seems larger number than

the output. The supplier resource calculated based on the theory to have the general information. This calculation did not have the validation and checked by any real same situation yet.

Material Handling

The table 5.2 described the material handling for the fresh tangerines. The detail information of each transportation which were used in the factory, it will be describes below.

Table 5.2: Transportation trucks

Type	Weight (Kg)	Load Rating (Kg)	Length (mm)	Width (mm)	Height (mm)
Hand truck	38.5	635	1220	610	320
Platform truck	907	907	1524	760	750

In addition, the aisle width was identified and showed in table 5.3.

Table 5.3 Aisle width requirements

Type of Flow	Aisle Width (m)
Manual Platform truck	1.52
Personnel	0.91
Personnel with doors opening into the aisle from two sides	2.44

The size of the machine used for processing and the total area needed to set up the machine in the factory are also calculated based on the standard machines required.

Workshop layout

Generally, the type of the layout is depending on the production volume and the product variety. In this situation, the workshop has to produce one kinds of products based on the technical requirement. Moreover, the input is not very high. Therefore, the type of workshop's layout is PROCESS LAYOUT.

Advantages:

• High utilization of workstations for the production lines, which need the same functions.

• Low investment for number of machines.

• High flexibility in using relative tools or equipment and workforce.
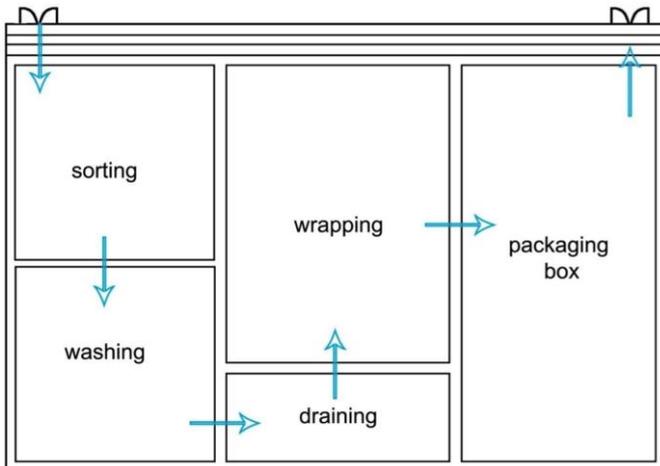
Disadvantages:

• Total production time is longer other types of layout.

• High work in process

• The workers have to be train carefully.

Workshop floor plan

Combining all the results from the previous steps and the recommendation layout from the company that provide the machines for processing the product, the completed workshop layout was developed. The figure below showed in detail the floor plan of the factory and the flow of

processing.

Figure 5.1: Workshop layout

Finished product warehouse:

    The finished product warehouse will be rented the cold warehouse in Ho Chi Minh City, which is specific at Satra cold warehouse. The price for renting the warehouse is 1,454,112,000 vnd/year. The tangerines fruits have only one season a year, it is wasteful to build the warehouse and just can be used for only one or two months. Base on the price calculated, the Satra cold warehouse should be used to stored finish goods after leaving the factory. After that, from the Satra cold warehouse, the finish goods should can be transport to the demand point such as supermarket, for sale. The warehouse is Satra cold warehouse, placed in Thu Duc districts, Ho Chi Minh City. The price for renting the warehouse is 18,000,000 VND/ton/day. Due to the design supply chain, just only 90% of production of tangerine should come to warehouse, another 10% will transport directly to irradiation center for processing and after that shipping directly to the Cat Lai port for exporting to US. This is why to rent the warehouse with the standard operation like Satra cold warehouse is the best solution. Supply chain nowadays have always encouraged business to use the third party logistics in managing warehouse.

6. CONCLUSION

    Lai Vung tangerine is a high potential and special fruit in Lai Vung, Dong Thap province. But the fruit is now not exploited effectively which resulted in the big depreciation of the fruit price. This type of fruits provides not only nutrition but also the beauty to display during Tet holiday. The supply chain network for tangerines fruits has been designed and proposed in this thesis. To obtain the solution, the research proposed to build the supply chain network with one facility for preprocessing fruits and one finished-product warehouse nearby local demand point. The location of factory was suggested at the Tan Phuoc districts in Lai Vung, Dong Thap province. The location of the cold warehouse was also suggested to be at Satra cold warehouse in Thu Duc, Ho Chi Minh City. Because the tangerine has only one season per year, so the factory can only be used for only two months. That is why, this facility can also be used for processing others product that has different season and similar characteristics with the tangerine. This way, the factory will not be wasted and can be rented to get more benefits.

    From the result of this study, further study for the supply chain design of the Vietnam agriculture products needed contribute. The understanding of the customer demand for the tangerines is important for the current supply chain. From this paper, further research to develop the supply chains for Lai Vung tangerines and other tropical fruits in the south of Vietnam could be conducted. Suggestion to do more study on the topic: the implemented model is the deterministic model with uncertainty production, it is highly recommended to develop the model to stochastic model with uncertainty production. Furthermore, market research should be conducted better to understand more about the customer demand.

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