Supply Chain Analysis of Chayote in Semarang Regency, Central Java Province, Indonesia

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Abstract. This study aim was to analyze the supply chain performance of chayote vegetable in Semarang, Central Java Province, Indonesia. The survey was conducted from April to July 2019. The analytical method used was descriptive quantitative, namely research by describing the conditions in the field from several individuals interviewed directly. Respondents were determined purposively on farmer respondents and snowball sampling for marketing institutions. The results showed that the supply chain of chayote vegetables at the research location had clear market targets however there were problems in optimizing supply chain targets, namely information on prices at the farm level, knowledge of good quality. The measurement of supply chain performance was categorized quite efficiently based on the marketing efficiency approach by calculating the income margin and the farmer's share.

1. Introduction
Trade liberalization has shifted the paradigm of agriculture from production-driven agriculture to market-driven [1]. Supply chain is a concept deemed suitable for market-driven agriculture because it is creating a system and responsive to the changing needs of the consumers. Supply chains are principally concerned with the flow of products and information from farmers to customers. Integrated supply chain activities include three aspects, namely: (1) sources; (2) the production process, and (3) the product delivery process [2]. Integrated supply chains are enabling organizations to reduce inventory and costs, add product value, extend resources, accelerate time to market, and retain customers. Included in the supply chain are input suppliers, farmers, processors, transporters, collectors, wholesalers, retailers, and end consumers. This interaction also relates to transportation, information, scheduling, credit transfers, and cash and raw material transfers between the parties involved [3]. Good integration and coordination between members of the supply chain is the main key in the product marketing process. The real measure of supply chain success is how well activities coordinate across the supply chain to create value for consumers, while increasing the profitability of every link in the supply chain.

Agricultural products marketing is still challenged with inherent problems like dominance of small-scale farmers, fragmented distribution, absence of scale economies, low level of processing, inadequacy of marketing infrastructure etc. With market-driven agriculture, it is known that commercial organizations that have greater access to capital and higher land ownership can realize greater profits from trade. The development of horticultural commodities tends to be hampered due to the poor arrangement of the distribution system where there is a large price difference between the selling price at the producer level and the purchase price at the consumer level [4]. In marketing channels which are
usually through many parties, farmers often face price uncertainty [5]. This is because small scale farmers do not have distribution facilities [6].

Semarang Regency is a cluster for developing vegetable commodities. The needs for vegetables will continue to increase along with the increase in population and purchasing power. Chayote (*Sechiumedule (Jacq.) Sw*) is a creeping-soft plant containing a lot of water and often found in sub-tropical to tropical countries. Chayote is one of the horticultural products that have a high demand in both local and export markets. In Central Java, the number of chayote production in 2017 was 225.815 tons [7]. The interesting thing from this study is that Chayote in Semarang is cultivated on a small scale but has export orientation. Improving supply chain performance is very important in increasing the competitiveness of agricultural industries to meet global demand. The purpose of this research was to find a description of the model and supply chain performance in chayote production in Semarang Regency.

2. Materials and Methods

The study was conducted in April - July 2019 in Semarang Regency through survey. Purposive sampling was used to determine respondents at the farm level and snowball sampling was used to determine respondents of marketing institutions. The number of chayote farmer respondents were 20 people. Traders respondents consisted of 8 middlemen, 10 collecting traders, 20 retailers, 6 wholesalers, 4 small industrial consumers and 20 consumers.

Chayote supply chain models were analyzed descriptively using the development of supply chain methods for horticultural products that follow [8] modified process framework. The aspects of this framework were covering the objectives of supply chain, supply chain structure, resources, chain management, business process chains, and supply chain performance. Marketing efficiency was analyzed by calculating marketing margins, farmers’ share, and marketing efficiency. Marketing margin, share, and efficiency were calculated using the formula below [9]:

\[ MP = Pr - Pf \]

MP = Marketing Margin  
Pr = Price at the retail level (consumer)  
Pf = Price at the producer level.

Farmers’ share analysis (FS) was used to compare the portion farmers receive from prices at the consumer level. The farmers share and marketing efficiency have been calculated respectively by using the following formula [10].

\[ Sf = \frac{Pf}{Pr} \times 100\% \]

Sf = the share received by farmers (%),  
Pf = Prices at the farm level (IDR), and  
Pr = Prices at the retail level (IDR)

3. Results and Discussion

3.1. Overview of the Chayote Supply Chain in Semarang Regency

Chayote consumers came from Semarang, Salatiga, and Jakarta. The sale of chayote starts from farmers, middlemen (village traders), traders in the market, wholesaler, and retailers.

3.1.1. Farmer

Farmers have important role in the supply chain because the quality, quantity, and continuity of chayote was highly determined by chayote farmers. Farmers carried out cultivation activities starting from land management, planting, replanting, weeding, irrigation, fertilizing, harvesting, and sorting. Majority farmers produced large sized chayote containing 3-5 fruits per kg, and some of them produce small sized chayote containing 10-12 pieces per kg, depending on consumer demand. The yield of this production can be adjusted based on the time of harvest. Large sized chayote was harvested every 7-12 days, whereas small sized was harvested every 3-6 days. Average sales of chayote was 405 kg at IDR 1540 per kg. Farmers rarely sell their produce directly to the market, there are always middlemen or regular middlemen who take the chayote directly from the farm.
3.1.2. Middlemen
Middlemen are members of the supply chain that conduct direct transactions with farmers and other marketing institutions in the market. The market destination in this study are Jetis Agribusiness Sub Terminal (STA) as a wholesale market in Semarang Regency, Bandungan Market, Sumowono Market and other markets around Jetis STA. The middlemen buy chayotes from farmers and sell them to collectors in the market or large traders with a price range of IDR 2000 - IDR 2700 and the average purchase transaction is 425 kg. This price depends on quality, availability, and the size of the chayote purchased. The middleman is also able to serve retail purchases by setting a different price from the wholesale price.

3.1.3. Collectors
Collectors are traders who buy chayotes from middlemen and sell them at STA Jetis and other markets. These collectors usually buy chayotes from several middlemen with an average purchase per day ranging from 200-500 kg, then sell them to retailers, culinary traders, and household consumers. The selling price for wholesale transactions is cheaper (IDR 2362).

3.1.4. Wholesalers
Wholesalers are supply chain institutions that obtain chayote from middlemen or collectors and serve markets far from STA Jetis, including markets in Salatiga City, Semarang City, Pati, Rembang, Boyolali and even Jakarta. The range of purchase is between 1-2 tons with price range between IDR 2200 - IDR 3000 per kg and resale them with prices ranging from IDR 3400 - IDR 4000.

3.1.5. Retailers
Retailers are supply chain institutions that obtain chayote from intermediaries or collectors and serve consumers in the markets around STA Jetis including the Bandungan market, Sumowono market and other local markets outside Semarang Regency. The number of retailer purchases ranges from 10-30 kg at a price of IDR 2100 - IDR 4000 per kg and resold at a price of IDR 4000 - IDR 5300 per kg.

3.1.6. Culinary and End-Consumers
Culinary consumers are those who consume chayote for the culinary business and the end-consumers of chayote are household consumers. Culinary consumers average purchase is 7.17 kg and household consumers of 0.85 kg with an average purchase price of IDR 4550 per kg.

3.2. Relationship Structure of Supply Chain Members
Chayote's supply chain relationship structure was analyzed based on the members that make up the supply chain and the role of each member. Supply chain members are agency actors involved in product flow, financial flow and information flow from producers (farmers) to end consumers. There are 5 chayote supply chain channels in Semarang Regency. The structure of the chayote supply chain also involves traders from outside the city.

3.3. Chain and Network Management
Chain and network management describe the decision process taken by supply chain members including partner selection, contractual systems for supply chain members, government support, and collaboration between members that influence supply chain resources [11].

3.3.1. Partner selection
Partner selection is the process of choosing partners who can work together and provide mutual benefits. Chayote farmers choose partners who have a smooth financial flow. Farmers prefer middlemen who are able to pay upfront or pay in cash. Chayote farmers already have subscription merchants (middleman) to sell their products to. Middlemen will also choose partners they already know well to facilitate the resolution of various problems such as financial problems. Collector traders do not have special criteria
in choosing partners, customers who come to him will always be served. But the priority will be given
to its customers, especially regular customers who always make payments smoothly.

3.3.2. Contractual Agreement
The contractual agreement explains the matters that have been mutually agreed between the parties who are cooperating both formally and informally. A contractual agreement provides an overview of the responsibilities and limitations that must be imposed by the collaborating parties and can be valid for a long period of time. Chayote farmers and institutions in the supply chain usually do not have written contracts or agreements. Verbal agreements were made to deal about price, quantity, quality and delivery period.

3.3.3. Transaction System
Most of the transactions between farmer and buyer are done by cash payment. Cash transactions are preferred because of rapid capital turnover. However, there are also non-cash transactions, where traders take chayotes in advance and pay after the chayotes are sold. The payment system with a certain period of time is widely used by large traders, this aims to ensure product availability at the next delivery time.

3.3.4. Government Policy Support
Policy support by the government at this time has been done to improve supply chain management. Agribusiness Sub Terminal (STA) is one of the government support which makes it easy for supply chain actors to conduct transactions. In addition, transportation facilities and infrastructure to remote villages where chayote is produced is also getting better. This is very beneficial for supply chain actors, considering that agricultural products are perishable.

3.4. Supply Chain Resources
Resources in the supply chain are needed to support, develop, and streamline all activities that take place in the chayote supply chain in Semarang Regency. Resources are owned by supply chain members and play role in all activities. This study discusses physical resources, technological resources, and capital resources.

Physical resources owned by chayote farmers are varying size of land. Most farmers (90%) cultivate on their own land, and the rest rent land. The average area of land planted with chayote is 495 m². In addition, farmers also have equipment used in the cultivation of chayote, such as hoes, machetes, hand-sprayers, rakes, sacks, and sickles.

Physical resources owned by middlemen include transport pick-up vehicles, warehouses, and scales. There are several village traders who also do chayote gourd cultivation. Physical resources of cultivation equipment as supporting infrastructure owned by middlemen are the same as equipment owned by other chayote farmers. Middlemen need more physical resources to carry out marketing activities such as scales and transport vehicles. Physical resources owned by wholesalers are similar to market collectors, the difference is that market collectors have a warehouse in the form of a kiosk at STA.

Technology resources that have been applied are the adoption of organic cultivation. Human resources in the chayote supply chain involve relevant parties who interact with each other resulting in the flow of products, information, and money. Supply chain human resources consist of farmers, middlemen, wholesalers, farm workers, STA employees, extension agents. Farmers are the most important chain resource. Farmers as subjects in producing have a level of expertise that is good enough to produce chayote. The activities carried out by middlemen are still relatively carried out by those who are assisted by their families. While for wholesalers, the activities carried out involve transport workers, sorters, truck or truck drivers, warehouse guards, administrative staff.

Capital resources are important requirement for chayote farming or the buying and selling process. Farmers need capital for land management, buy inputs, and pay harvesting labor. These activities cannot be delayed so that they need money in the meantime. Farmers’ capital is obtained from of middlemen, while most of the capital owned by middlemen is obtained from wholesalers. Capital can be in the form
inputs like seeds or fertilizer. Capital owned by supply chain members includes their own capital, credit assistance from certain institutions such as farmer groups, cooperatives, or banks.

Most of the farmers owned capital is their own capital. But, they are member of farmer groups, they can access capital from their groups. Majority middlemen rely on their own capital in conducting their business activities. Meanwhile, wholesalers that have large-scale businesses collaborate with cooperatives and banks in the business activities they do.

3.5. Distribution Pattern

The distribution pattern in the chayote supply chain illustrates the flow of products, financial flows, and information flows that occur between chain members. The product flow of chayote in Semarang Regency is Jetis Agribusiness Sub Terminal (STA). The products from farmers are bought by middlemen, then the middlemen sell to PPP, PB and PR in Jetis STA. Then they sell it to local markets around STA and outside the region.

![Pattern](image)

VMT = village merchant traders; MT = merchant trader; W = wholesalers; R = retailer;

Figure 1. Chayote Distribution Channel in Semarang Regency

The existence of institutions in the distribution chain of pumpkin is considered very important for the smooth flow of products from producers to consumers and the flow of money from consumers to consumers. For farmers, the process of delivering products to consumers is very important, especially for those who do not have direct access to markets or end consumers. The involvement of marketing institutions will certainly lead to price differences [12, 13]. The financial flow starts from wholesalers to village merchant traders and merchant traders. VMT then flow the money to farmers. Farmers themselves get capital from payments every harvest period.

The flow of information that occurs between supply chain members is demand, price, seed type, fertilizer rates, cultivation techniques, and application of technology. Information about prices occurs flows from VTM and to farmers. The information about demand and availability of chayote is not that clear. The lack of information regarding the quantity of chayote available in the market causes fluctuations in prices. Information regarding technology in chayote is also lacking. The government has role in the flow of information, especially regarding cultivation management. Suppliers who have product knowledge, including end use by consumers, and are also sensitive to market demand will be able to respond more quickly to changes in consumer preferences and maintain marketing excellence [12].
3.6. Supply Chain Performance
A supply chain encompasses all activities associated with the flow and transformation of goods and services from the raw material stage to the end user (customer), as well as the associated information flows. The supply chain also integrated group of process to source, make, and deliver product. [13]. Supply chain performance analysis in this study was conducted using only operational efficiency approaches such as marketing margin analysis, farmers’ share analysis, and profit and cost ratio analysis.

3.6.1. Marketing margin
Marketing margin was analyzed to determine the difference in income received by each marketing agents in flowing products to end consumers. Marketing margin is the difference between the purchase price of the product paid by the end-consumer and the selling price from the producer. Marketing margins reflect the costs incurred by each member of the supply chain and the profit that each member of the supply chain receives in return for the contribution made. The amount of marketing margin is different between each marketing institution because each marketing institution carries out different marketing activities or functions. Analysis of distribution and cost margins is shown in Table I.

| No | Supply Chain Members            | I     | II    | III   | IV    | V     |
|----|--------------------------------|-------|-------|-------|-------|-------|
| 1  | Farmers                        | 1540  | 1540  | 1540  | 1540  | 1540  |
| 2  | Village merchant traders        | 1540  | 1540  | 1540  | 1540  | 1540  |
|    | Purchase price                 | 171   | 171   | 170   | 171   | 170   |
|    | Distribution cost              | 585   | 585   | 585   | 585   | 585   |
|    | Profit                         | 414   | 414   | 415   | 414   | 415   |
|    | Selling price                  | 2125  | 2125  | 2125  | 2125  | 2125  |
| 3  | Merchant trader                 | 0     | 2125  | 2125  | 2125  | 0     |
|    | Purchase price                 | 0     | 170   | 172   | 172   | 0     |
|    | Distribution cost              | 0     | 750   | 750   | 750   | 0     |
|    | Profit                         | 0     | 580   | 578   | 578   | 0     |
|    | Selling price                  | 0     | 2875  | 2875  | 2875  | 0     |
| 4  | Pedagangbesar                  | 0     | 0     | 2875  | 0     | 2125  |
|    | Purchase price                 | 0     | 0     | 168   | 0     | 168   |
|    | Distribution cost              | 0     | 0     | 375   | 0     | 1125  |
|    | Distribution margin            | 0     | 0     | 207   | 0     | 957   |
|    | Profit                         | 0     | 0     | 3250  | 0     | 3250  |
| 5  | Retailer                       | 0     | 0     | 2125  | 2875  | 3250  |
|    | Purchase price                 | 0     | 0     | 135   | 102   | 102   |
|    | Distribution cost              | 0     | 0     | 2425  | 1675  | 1300  |
|    | Distribution margin            | 0     | 0     | 2290  | 1573  | 1198  |
|    | Profit                         | 0     | 0     | 4550  | 4550  | 4550  |
| 6  | Consumer                       | 2125  | 2875  | 4550  | 4550  | 4550  |

Table 1. Analysis of chayote’s margin and distribution costs in Semarang Regency
Overall, the chayote marketing channel in Semarang Regency has an uneven R/C Ratio in each marketing channel, this indicates the difference in marketing costs borne by each member of the supply chain and different profits at each end of the marketing channel. Table 1 illustrates the five marketing patterns that have a profit and cost ratio of more than one, this indicates that there is an efficiency in spending costs for activities in the supply chain.

3.6.2. Supply Chain Efficiency
Supply chain efficiency is a measure of a business process in a supply chain. Efficiency measurement is a tool to see the level of efficiency of the supply chain. The measurement used in this study was farmer's share.

Table 2. Distribution Margin and Farmer's Share in the Chayote supply chain in Semarang Regency

| Pattern | Supply Chain Institutions | Farmer's Selling Price (IDR/kg) | Consumer Purchase Price (IDR/kg) | Distribution margin | Farmer's Share (%) |
|---------|---------------------------|---------------------------------|----------------------------------|---------------------|-------------------|
| I       | F–VMT–C                   | 1540                            | 2125                             | 585                 | 72.47             |
| II      | F–VTM–MT–C               | 1540                            | 2875                             | 1335                | 53.57             |
| III     | F–VTM–MT–W–R–C           | 1540                            | 4550                             | 4135                | 9.12              |
| IV      | F–VTM–MT–R–C             | 1540                            | 4550                             | 3010                | 33.85             |
| V       | F–VTM–R–C                | 1540                            | 4550                             | 3010                | 33.85             |

Note: F = farmer; VMT = village merchant traders; MT = merchant trader; W = wholesalers; R = Retailer; C = consumer

Based on Table 2, it is known that the longer supply chain, the smaller the percentage of the farmer's share. Producers as the most meritorious party and bear the greatest risk of failure in the process of product distribution, should have a greater portion of prices owned by producers [14]. Based on this opinion, the distribution patterns that have been efficient are on patterns I and II.

4. Conclusion
Based on the results of the study, it can be concluded as follows:
1. The condition of the chayote supply chain in Sumowono District was well underway. But there are problems in optimizing supply chain goals. Management and supply chain networks have not gone well, one of which is a contractual agreement between an unwritten marketing agency. In supply chain resources, it is found that capital is still a main obstacle for traders. Business processes are constrained due to slow financial flow and the flow of price information change rapidly, as changes in the availability of goods on the market.
2. Supply chain performance was already good and efficient, seen from the value of marketing margins and farmer's share. Marketing channel patterns 1 and 2 are more efficient than marketing channels 3, 4 and 5.

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