The current condition of agro-industrial supply chain management of public sago product: a case survey of Meranti Islands Regency, Indonesia

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Abstract. Sago-based agroindustry is a mainstay sector that can improve the economy of the Meranti Islands. Lack of data, ineffective communication, and market information related to price, quality, quantity, and the type of product the market wants are causing people in business sago agroindustry to rely on information from intermediary traders. This study aimed to identify and analyze the sago agro-industrial supply chain management. Data were collected by interviews and discussions with stakeholders who have competence in the sago industrial supply chain management. The data was analyzed qualitatively. The results showed that the supply chain management of sago agroindustry consists of sago farmers, traditional traders (toke), sago refinery owners, Harmonis Cooperatives, Individual Distributors, and Companies (PD) in Cirebon and Medan as well as businessmen of household sago processing industries, and local traders. The Sago agroindustry supply chain management in Meranti Island Regency is not efficient and not well managed.

1. Introduction

Sago has the potential to be developed as a raw material industry [1,2]. Sago starch can be processed to produce a wide range of sago products and derivatives [3–5]. Currently, sago starch is relatively widespread in the food industry and manufacture [6]. The multipurpose of sago makes it important because it has the highest starch content [7,8] and is a sustainable source of starch [9]. The development of agro-industry business of sago products has as a provider of employment, source of income of processing entrepreneurs, marketing and sources of foreign exchange acquisition through export activities, as well as sources of income of farmers and other economic actors which are involved in cultivation [10], and become a stimulant of rural economic growth [11].

Meranti Islands Regency is an area whose economic activities are still based on agricultural businesses, with a contribution of 39.80% in 2020. Sago plants are the main contributors to the agricultural sector. Sago plants were found in almost all districts. The area of sago plantations was 51,850 hectares and with a production of 351,967 tons in 2020. Approximately 39,950 hectares (77.05
have a public sago plantation, with a production of 243,710 tons. Therefore, sago plants are most likely to be processed into superior agro-industrial products [12]. The availability of abundant sago raw materials has stimulated the emergence of the sago processing business. Sago agro-industry can produce products that have added value and can be applied in various industries [1]. However, sago processing in Meranti Islands Regency is still limited to food products [13].

Agro-industry development requires supply chain institutions as a business bridge for farmers and industry interests and creates an ideal industrial structure [14]. Stakeholder coordination on these institutional tools is very important, especially the proper supply chain management [15]. The success of a company is not only determined by the capabilities and strengths themselves but the extent of the capabilities and strengths of a company's supply chain. The supply chain concerns the ongoing relationship regarding money, goods, and information. One of the key factors to optimize the supply chain is to create an easy and accurate flow of information between the networks or chains, and the effective and efficient movement of goods that generate maximum satisfaction in consumers [16]. Therefore, the management of the company's network of suppliers, manufacturers, distributors, and retailers by cooperating either directly or indirectly is very important so that customer demands can be met [17–19]. The sago agro-industry supply chain in the Meranti Islands Regency involves two activities, first is processing sago stems (sago tual) by sago refineries to produce semi-finished namely wet sago flour and dry sago flour, both activities process sago flour into food products. Activities at sago mills that produce sago flour, in general, are a legacy business. The management is still simple but still survives.

On the other hand, the lack of information about the quantity and quality of sago consumers want causes the price received by entrepreneurs to be unstable since it relies only on information from intermediary traders. Therefore, the supply chain of public sago needs to be reviewed to provide an overview of sago supply chain management in this region. This study aimed to identify and analyze the public sago agro-industrial supply chain management in the Meranti Islands Regency.

2. Materials and methods
The survey methods were used in the study and were conducted in the three districts in the Meranti Islands Regency, namely Tebing Tinggi Barat, Tebing Tinggi Timur, and Tebing Tinggi districts. Tebing Tinggi Barat district is the center of production of dry sago flour, Tebing Tinggi Timur is the center of production of wet sago flour, and Tebing Tinggi district is the center of production of processed sago flour. The source of data namely primary and secondary data. Data were collected from relevant stakeholders through the spreading of questionnaires, in-depth interviews, and the collection and recording of documents/reports from various sources. Key informants are determined by a purposive method for stakeholders sago agroindustry. To describe the supply chain management was carried out by identification from seed suppliers, sago farmers, tual traders, sago refinery owners, Harmonis Cooperatives, individual distributors, owners of processed sago, traders processed sago. Furthermore, the data were analyzed by descriptive qualitative. Every indication or social condition that occurs in the public sago agro-industry in the Meranti Islands was studied widely and deeply and then made a detailed, systematic, factual, and accurate picture so that an overview of the supply chain model of the public sago in the Meranti Islands.

3. Results and discussion

3.1. Public sago
Meranti Islands Regency is famous for the nickname of Sagu City because it is the center of sago production in Riau Province, where 93.90% of Riau sago comes from Meranti. Sago plants in the region are mostly grown naturally and are a local culture, which is generally hereditary. Sago plants are scattered in almost all districts of the Meranti Islands. The types of sago planted are thorn sago (sago duri), unsalted sago (bemban sago), and rare prickly sago (sago sangka). The most planted is thorn sago
because it is suitable to be planted on the side of the river or in the lowlands and strong against pest attacks [2]. This type of sago thorns has also been released as a superior national variety with the sago variety in the Meranti Island Regency. The most important part of the sago tree is the sago trunk because it contains starch. Starch is obtained from the extraction of sago pith performed at the sago refinery. Communities and companies currently manage sago plantations in the region. About 77.05% of the sago plant area belongs to the community, and only 22.95% belongs to the company. The area and production of folk sago are shown in Figure 1.

![Figure 1. Land area and production of public sago Meranti](image)

The area and production of public sago plantations have increased every year. In 2017 the area of sago plantations was 39,946 hectares then increased to 39,950 hectares (1.18%) in 2020. While production in 2017 amounted to 205,051 tons then increased to 243,710 tons (18.85%) in 2020. This increase occurred because of government policy prioritizing land use to develop sago plantations. The community is also getting smarter in managing its business, especially in setting harvest time, so that the sago tual obtained produces optimal starch. Sago refinery owners in general also have sago plantations. The refinery raw materials (sago tual) for operations come from its plantations but are also purchased from the public sago plantations around the refinery. The equipment used in the public sago refinery is semi-mechanical. Processed sago tual can produce semi-finished products in wet sago flour and dry sago flour [20]. Sago products produced by the public sago refinery were varied because there is no set standard strictly. There are more than 76 public sago refineries, with an installed capacity of about 80-1,500 sago tual per day, and there are more than 300 processors of processed sago products. The use of sago in the Meranti Island Regency is still limited to food products, such as sago noodles, fat sago, sago rendang, sago crackers, and sago cendol [13].

3.2. Supply chain management of public sago

Supply chain management is a system that involves the process of production, delivery, storage, distribution, and sale of products to meet the demand for such products. Supply chain management includes all processes and activities involved in the delivery of the product to the consumer's hands. An efficient operation of the supply chain depends on the full and accurate flow of data related to the products requested from retailers to customers [21]. The management of the supply chain of sago agroindustry products in Meranti is traced from upstream to downstream. Three kinds of flows must be managed in the supply chain, namely the flow of goods, money, and information, to optimize the fulfillment of the needs of entities in the supply chain. 1) the flow of goods from upstream to downstream. 2) flow of money and the like from downstream to upstream, and 3) the flow of information from upstream to downstream or vice versa. Indrajit R E and Djokopranoto R[16] stated the main players in the supply chain are suppliers, manufacturers, distributors, retail outlets, and consumers. In
the Meranti Islands Regency, the supply chain of public sago is included seed suppliers, sago farmers, sago tual traders (toke), sago refineries, cooperatives, distributors, processed sago industries, sago processed traders. Each actor in the public sago agroindustry supply chain performs different activities depending on the inputs owned and the output produced. This supply chain activity is interconnected [11]. The mechanism and supply chain flow of the Meranti public sago agro-industrial products is shown in Figure 2.

**Figure 2.** Mechanism and flow of public sago agro-industrial supply chain management in the Meranti Island Regency

### 3.2.1. Seed suppliers
Suppliers of sago seeds (abut) to farmers are companies, groups, and individuals. There are four sago seed breeders in the Meranti Islands Regency, namely 1) Sejahtera Bersama seed breeder located in Tanjung Village, Tebing Tinggi Barat district, 2) Rumbia Jaya is located in Dedap Village, Tasik Putri Puyu district, 3) Harapan Bersama is located in Renak Village, Merbau Island District, and 4) CV. Eka Cipta Makmur is located in Renak Dungun Village, Merbau Island District. In contrast, the supplier of individual seedlings is the Meranti community that specializes in providing sago seeds. The seed suppliers’ activity starts from retrieving seedlings from sago saplings that grow, are removed, and transferred to the nursery area. After the seedlings are 6-12 months, it is ready for planting.
3.2.2. Sago farmers. Sago farmers are supply chain actors who conduct sago cultivation activities. Sago farmers’ activities start from land clearing, hole digging, sago seed planting, maintenance/insertion, and harvesting. Farmers make pathways for planting sago seedlings. There are three paths in one hectare of land, planted as many as 120 sago seedlings. If sago plantations are inherited (next generation), farmers’ activities are the only insertion and waiting for the harvest. The treatment carried out on sago plants for the first three years is cleaning from the disruptive plant, after which it is left to wait for the harvest period, which is 9 to 12 years. During the harvest period, sago trees are cut down, the trunk and cut into pieces (in the form of tual), with a length of about one meter, then sold to the sago refinery. Some farmers sell sago that has not been harvested in whole stems (not yet cut) on tual traders.

3.2.3. Sago tual merchant (toke). Sago tual traders (toke) buy sago trees from farmers then sell them to the sago refinery. The growth of a firm stem characterizes the ready-to-harvest sago stem and a short crown tip of the leaf, the flower's heart has come out and has a leaf-free stem height of more than 8 m [2]. Sago is cut down and cleaned from leaf fronds by 3–4 workers. Then the sago stem is cut to a size of 1 meter. One sago stem is 9–13 tual, with one tual about 110–120 kg. Sago tual is then arranged like a raft and, through a stream, sent to the sago refinery. Then before processing, sago tual is stored along with the river flow around the refinery to reduce deterioration [22].

A tradition that has been going on for a long time in some sago plantation owners in the Meranti Island Regency is the occurrence of a relationship (Patron-Client) between the toke and the owner of the sago plantation. Toke plays an important role ranging from providing capital, providing basic goods for daily food needs to sago plantation owners, and always giving money loans and doing something that looks good to sago plantation owners, thus making the Client (sago plantation owner) indebted, obediently following the will of toke. Patron (toke) will offer all his services to tie his Client (sago plantation owner). Because of its limitations, the Client does not avoid continuing to rely on patrons (Toke). The sago harvest will be handed over to the toke at a price determined by the toke.

3.2.4. Wet sago entrepreneur (wet sago refinery). Wet sago entrepreneurs (wet sago refineries) are the perpetrators of the supply chain for wet sago. Sago tual processing comes from its plantation and public plantation around the refinery. Sago stored in the stream is lifted using a procrastinator rope. Further activities are stripping sago tual skin, cleavage, destruction, separation of starch (extraction), precipitation, removal, and packaging. The yield of wet sago processing ranges from 30%–35%.

Furthermore, sago starch is packed with simple packaging, using burlap size 50 kg. This wet sago is mostly supplied to the sago refinery located in Batu Pahat through PT. Saweri Gading (as an intermediary merchant) for export to Malaysia. Wet sago is brought to Malaysia by boat, which comes twice a week. Some wet sago is also sold to the community (household entrepreneurs) to be processed into various food products, including sago noodles, vermicelli, sago rendang, and sago fat. The wet sago production center in the Meranti Islands Regency is located in Sungai Tohor Village, Tebing Tinggi Timur District.

3.2.5. Dry sago entrepreneur (dry sago refinery). Dry sago entrepreneurs (dry sago refinery) are supply chain actors for dry sago. The processed sago tual comes from its plantation for 70%, and about 30% comes from the public sago plantation around the refinery. Dry sago processing activities are the same as wet sago, but washing and drying starch is an additional process. Sago starch drying techniques performed by entrepreneurs are diverse. Before drying sago starch through the dewatering stage with a rotary vacuum machine to speed up the drying process of sago starch when dried. Drying is done conventionally under the sun. Some sago refineries have used flash dryers, namely automatic drying machines and ovens, so the drying process is faster and depends on the weather. The yield of dry sago processing ranges from 15%–18%, depending on the diameter of the tual.

Further activities dry sago are packed using burlap sacks covered with plastic size 25 kg and 50 kg to be distributed to Cerebon and Medan. Each sago refinery already has a brand of sago flour produced, so that each package has been listed brand. Sago flour delivery to Cerebon is done 3–4 times a week.
using sea transportation, while delivery to Medan is done once a week. Sago flour produced by the Meranti Island Regency is currently not balanced with the availability of adequate standards, including moisture content, white degrees, and particle size. Widaningrum et al. [23], Indonesian sago starch can excel if quality standards are maintained. Improving product quality can open the door to great opportunities for countries to be competitive internationally.

3.2.6. PT. Saweri Gading. PT. Saweri Gading is a supply chain performer for wet sago. Activities of PT. Saweri Gading, better known as Toke Asiong, collects the production of wet sago and then distributes it to the sago refinery in Batu Pahat, Malaysia. Its function is as an intermediary trader. Cooperation between Toke Asiong and wet sago entrepreneurs in Sungai Tohor Village has been going on for a long time (about 30 years), so if the refinery owner needs capital, then Toke Asiong will give a loan. Delivery of wet sago is done 3-5 times a week by sea transportation. Every month about 1000 tons of wet sago are distributed by PT. Saweri Gading to Malaysia. The delivery of wet sago takes about 4 hours due to the relatively close distance between Sungai Tohor Village to the Port in Batu Pahat, Malaysia.

3.2.7. Harmonis cooperative. Cooperative Harmonis is a supply chain actor for dry sago. The activity of this cooperative is to accommodate the production of dried public sago to facilitate its marketing further. Dried sago flour is brought by sea transportation to Cirebon, West Java, and then dried sago is marketed to trading companies in Cirebon. Sago delivery activities by the Harmonis Cooperative is carried out 3-4 times a month with a ship carrying a capacity of 1,000 tons. Refineries are charged a shipping fee of 4 % of the value of sago delivered.

3.2.8. Individual distributors. Individual distributors are supply chain actors whose activities facilitate the delivery of dried sago originating from sago refineries that do not join the Cooperative Harmonis. Dried sago is collected by distributors (as intermediary traders) to trade companies in Cirebon and Medan through sea transportation. Transportation activities range from 1–2 times per month, with a shipping capacity of 1,000 tons.

3.2.9. Sago processed entrepreneurs (household industry). Sago processed entrepreneurs are supply chain actors who process dry sago flour and wet sago into various food products. In Meranti sago, flour is processed into various food products, including sago rendang, crackers, vermicelli, sago fat, cendol, sago noodles, and simpolet. Sago noodles are processed sago products widely produced by the people of Meranti, especially in the Tebing Tinggi district. The technology is used in semi-mechanical processing, manually using traditional equipment. The workforce involved in this effort is about 2–4 people. The raw material of sago flour used by entrepreneurs to manufacture sago noodles per day ranges from 100–170 kg. Making sago noodles has several stages: 1) Donation, in this process, dry sago flour is moistened with a little water, stirred until it is a dough, formed round, and steamed. 2) Pressing, through thinning with a manual double roll machine, 3) Steaming of the dough that has been separated, 4) Sago sheet feeding done indoors for one night, 5) Cutting sheets, using cutting machines (wheat noodle cutting tools), 6) Packaging, noodles packed into plastic and ready on the market. The resulting sago noodles are still semi-wet raw noodles, so they cannot be stored for long. In ordinary conditions, these sago noodles can last for a week.

3.2.10. Local collector traders processed sago. Local collecting traders are supply chains that conduct activities to collect processed sago flour (sago noodles, sago crackers, fat sago, sago rendang), then distribute it. Processed sago products such as sago noodles produced by The Meranti community, about 70% sold to local collectors and 30% sold to the surrounding community and restaurants that provide sago noodle menu. Local collectors then distribute outside the Meranti Island Regency, including to Pekanbaru, Batam, Java Island, and Singapore.
Based on the research of the flow of goods in managing wet sago, dry sago flour, and processed products, there is no problem. Inventory of goods (logistic) is quite available, and transportation works well in contrast to the flow of money and information that is often problematic, especially about the product's price and its payment. Sago refinery owners are always in a weak position. Traders in Cirebon determine the price of dried sago. So the price of sago is not based on economic estimation but only on information from traders delivered through cooperatives. Payments by merchants are made after the goods are received, and misinformation often occurs, so the withdrawal of payments is inevitable. Misinformation is also the case in wet sago, and wet sago entrepreneurs are in a weak position. The role of toke is very dominant. Implementing Supply Chain Management is important in the company, as it allows for increased effectiveness and efficiency.

4. Conclusion

Stakeholders who play a role in managing the supply chain management of sago agro-industry in Meranti Islands Regency were 1) Wet sago farmers, toal traders (toke), owners of wet sago refineries, PT. Saweri Gading (as an intermediate trader), Sago refinery in Malaysia, owner of sago processed household agro-industry, local collecting merchant. 2) Dried sago farmers, toal traders (toke), owners of dry sago refineries, Harmonious Cooperatives, Individual Distributors, Trading Companies (PD) in Cirebon and Medan, marine vessels (transportation), Owners of sago processed household agroindustry, local collecting traders. Sago agro-industry supply chain management in Meranti Islands has not been efficient and not well managed.

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