Perennial, 2025
Vol. 21 No. 1: 15-23
p-ISSN: 1412-7784

Available Online:
http://dx.doi.org/10.24259/perennial.v21i1.42890
e-ISSN: 2685-6859

VALUE CHAIN ANALYSIS AND MARKET STRUCTURE OF PINE SAP COMMODITY IN COMMUNITY FOREST AREA CASE IN INDONESIA

Analisis Rantai Nilai dan Struktur Pasar Komoditi Getah Pinus di Hutan Kemasyarakatan Cempalagie Indonesia

Andi Mawaddah Zakiyah[1]✉, Makkarennu[2], Ridwan[2]

[1]*Faculty of Agriculture and Forestry, West Sulawesi University, Majene, Indonesia*
[2]*Faculty of Forestry, Hasanuddin University, Makassar, Indonesia*
✉*corresponding author: a.mawaddahzakiyah@unsulbar.ac.id*

ABSTRACT

Community Forestry (HKm) is a scheme that aims to empower local communities and provide access to manage protected/production forest areas. The pine resin commodity is one of the sources of livelihood for the community in the Cempalagie HKm area by utilizing existing access. Value chain analysis is very important to find out the pine resin commodity business actors in the marketing chain from upstream to downstream, namely from raw materials to become a product through qualitative methods with a descriptive approach. The results of the value chain analysis will then show the market structure in the form of market type, number of sellers and buyers, product differentiation, entry barriers, cost structure and conglomeration formed in each chain. The number of respondents was selected as 30 households by census based on respondents who work as pine resin tappers. The results showed that pine resin commodity business actors consisted of tappers, intermediary traders and wholesalers or pine resin processing industries in which the flow of goods, information and money occurred and marketed pine resin and pine resin products in the form of gondorukem, turpentine, alpha pinene and delta carene to international markets, namely India, Vietnam and China.

Keywords: businessman; community forest; market structure; pine sap; value chain.

ABSTRAK

Hutan Kemasyarakatan (HKm) merupakan skema yang bertujuan untuk memberdayakan masyarakat lokal dan memberikan akses dalam mengelola kawasan hutan lindung/produksi. Komoditi getah pinus menjadi salah satu sumber mata pencaharian bagi masyarakat di dalam kawasan HKm Cempalagie dengan memanfaatkan akses yang ada. Analisis rantai nilai menjadi sangat penting untuk mengetahui pelaku usaha komoditi getah pinus yang ada di dalam rantai pemasaran dari hulu hingga ke hilir yaitu dari berbentuk bahan baku hingga menjadi sebuah produk melalui metode kualitatif dengan pendekatan deskriptif. Hasil analisis rantai nilai kemudian akan menunjukkan struktur pasar berupa tipe atau jenis pasar, jumlah penjual dan pembeli, diferensiasi produk, hambatan masuk, struktur biaya serta konglomerasi yang terbentuk di setiap rantai. Jumlah responden dipilih sebanyak 30 kepala keluarga secara sensus berdasarkan responden yang bekerja sebagai petani penyadap getah pinus. Hasil penelitian menunjukkan bahwa pelaku usaha komoditi getah pinus terdiri dari petani penyadap, pedagang pengumpul serta pedagang besar atau industri pengolahan getah pinus yang di dalamnya terjadi proses aliran barang, informasi, dan uang serta memasarkan getah pinus dan produk getah pinus berupa gondorukem, terpentin, alpha pinene dan delta carene sampai ke pasar internasional yaitu negara India, Vietnam dan Cina.

Kata kunci: getah pinus; hutan kemasyarakatan; pelaku usaha; rantai nilai; struktur pasar.

Submitted: 13 January 2025; Accepted: 9 April 2025

A. INTRODUCTION

Community Forest (HKm) is one of the Social Forestry schemes in which the management of the working area applies an agroforestry system. The activity is carried out through providing legal access to local communities, among others, through the HKm program on state forest land which aims to improve community welfare through optimal, fair and sustainable use of forest resources while maintaining the sustainability of forest functions (Puspasari *et al.* 2017). Insusanty *et al.* (2017) argued that Non-Timber Forest Products (NTFPs) are forest resources that have advantages and have been proven to contribute to community welfare through increasing income for the rural poor and are not inferior to Timber Forest Products (HHK) (Pasaribu *et al.* 2021) and provide enormous benefits to communities around the forest (Sisillia *et al.* 2024).

Pinus merkusii is the only pine species that is naturally distributed in the southern equator with an altitude range between 30-1800 masl, but is threatened with extinction because its habitat is starting to be damaged and over-exploited for its wood and sap (Das *et al.* 2017). Pine trees produce NTFPs in the form of sap, which is known that the NTFP harvesting process has been considered an environmentally friendly alternative because it does not damage the forest and humans can preserve biodiversity and ecosystem functions and contribute to the local economy of the community (Atinga 2024).

Pine sap is one of the NTFPs managed by communities around the forest area. Another use of pine trees is to provide raw materials for the pulp industry (Beleko *et al.* 2021). Kencanawati *et al.* (2017) suggest that pine resin is one of the NTFPs obtained by tapping on the trunk of a pine tree that grows in the highlands with a cool climate. Lempang (2017) also suggested that pine resin is one of the NTFPs with commercial value and potential to be developed at this time. Pine sap as a NTFP commodity is very important in the forestry sector and provides benefits in the industrial sector, and NTFPs can maintain forest sustainability because the harvest process can be carried out sustainably without damaging the forest (Mampi *et al.* 2018).

Currently, the flow of pine resin marketing reaches local markets, national markets and even international markets. One of the districts in Indonesia that launched the Community Forest (HKm) social forestry program is Soppeng Regency with its main use aimed at empowering local communities, with the target being protected forest areas and production forests that have not been burdened with management rights or utilization permits, being a source of livelihood for local communities, permits granted to local community groups (Rahmina *et al.* 2011) in which there is the use of NTFPs in the form of pine resin. One of them is managed by the Cempalagie Forest Farmer Group (KTH) which has also reached the international market.

Globalization and regional autonomy as well as increasing human needs bring a logical consequence that the level of competition is getting sharper, both at the regional, national and international levels. Each region is required to further increase its potential in order to improve the economy and competitiveness of the region. Cempalagie HKm is expected to be able to develop through the utilization of forest areas through the HKm scheme by utilizing the potential of existing pine resin. This background indicates the urgency of conducting research on the value chain to identify the actors who participate in the pine resin management chain from the production and distribution process involving input supply, production, transportation or collection, processing, grading and packaging to marketing both for local markets, national markets, to international markets and to find out the market structure formed in each chain.

B. METHODS

This research was conducted in the Cempalagie Community Forest located in Ara Hamlet, Donri-Donri District, Soppeng Regency, South Sulawesi Province, Indonesia. The biggest livelihood of the community in the research location is farmers who focus on several NTFP commodities and one of them is pine resin. This research starts from field observations to data collection through in-depth interviews .

The data collected in this study consisted of primary data and secondary data. Primary data was obtained directly in HKm managed by KTH Cempalagie pine resin tappers by conducting field observations and interviews with stakeholders (community leaders and farmer group members) and the pine resin processing industry in Warehouse 88 Makassar City who can provide information related to this research. Secondary data was obtained through literature sourced from research reports, data from local governments, and other information related to this research.

This research uses a qualitative method with a descriptive approach. Qualitative methods can be interpreted as research that produces descriptive data in the form of speech, writing and behavior of the people observed (Ultavia *et al.* 2023) which will be obtained through interviews and observations in the field. Research through this descriptive approach is a form of research aimed at describing existing phenomena in the form of forms, activities, characteristics, changes and relationships (Linarwati *et al.* 2016).

The population in this study were Cempalagie Forest Group and HKm managers. The selection of respondents for KTH Cempalagie was determined by census with the consideration that the sample set was 30 group members who tapped pine resin. The search for value chain actors was also carried out on pine resin commodity business actors who were determined by purposive sampling with the criteria that the respondents were pine resin value chain actors from Soppeng Regency.

Data collection techniques in this study were carried out using the following techniques:

1. Direct observation technique by collecting data through observation and recording of symptoms that appear on the object of research which is carried out directly at the place and situation carried out by the researcher, namely by direct observation to the pine resin tapping land and observing and identifying the pine resin tapping process carried out.
2. Direct communication techniques (interviews) by collecting data through direct oral or face-to-face contact with respondents, namely members of the pine resin tapping farmer group and other pine resin commodity business actors, namely the pine resin processing industry as a large trader in this chain, through questions and answers with the help of an interview guide.
3. Literature study through the collection of secondary data that supports the research in the form of relevant articles, as well as data on the general condition of the research location in the form of a demographic description, climatic conditions, and the state of human resources from the village office related to the research.
4. Documentation, by taking pictures of various objects to provide a clearer and more detailed picture of the topic or object discussed.

The data that has been collected by observation and interviews in this study is then processed and classified according to the research objectives and then analyzed using qualitative descriptive analysis on each chain and market structure formed. Qualitative data analysis is an analysis based on sentences or descriptions arranged in the form of expanded text, data from interviews and observations are collected in the form of field notes which are grouped according to the objectives to be achieved, namely mapping and identifying the activities of business actors in pine resin management and analyzing the market structure in each chain.

C. RESULTS AND DISCUSSION

Chain Value Pine Sap

The series of activities that occur in a value chain are carried out separately but are highly dependent on each other from raw materials to after-sales handling. The value chain actors in the pine resin commodity in HKm Cempalagie consist of pine resin tappers, intermediary traders, wholesalers and consumers. The pine resin value chain in HKm Cempalagie is presented in Figure 1.

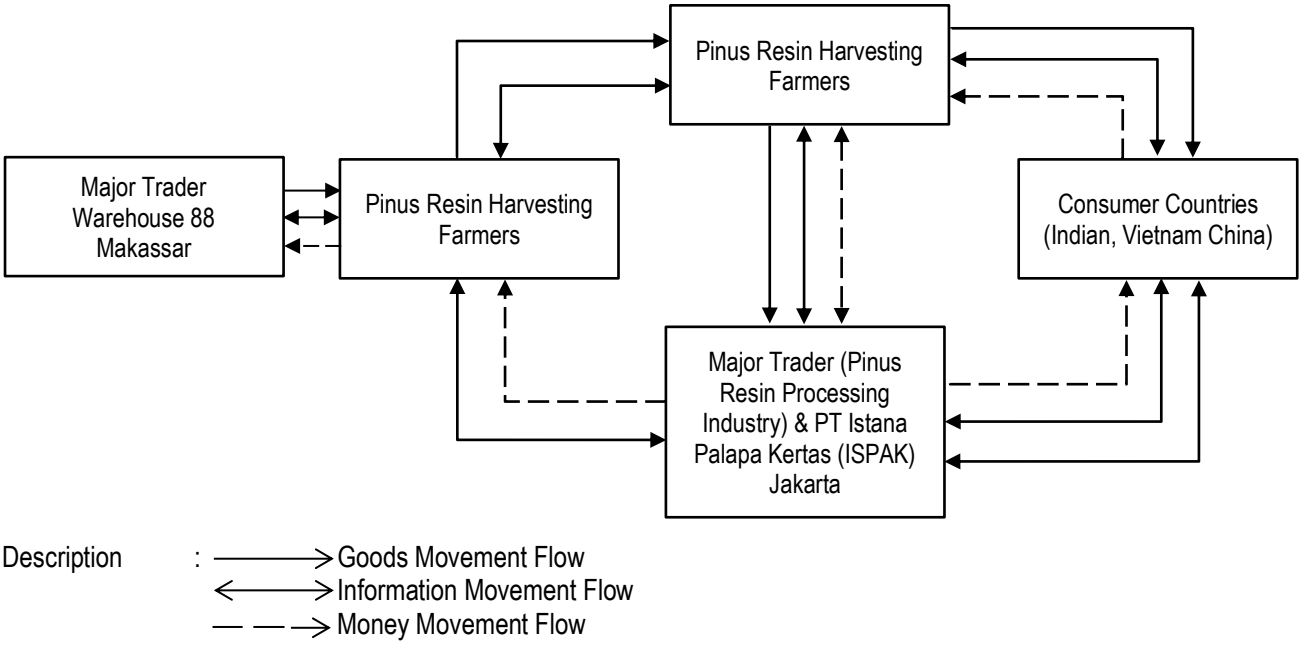

Figure 1. Value chain of pine sap

The figure above shows that the pine resin value chain in HKm Cempalagie shows the flow of movement in the form of goods, information, and money. Starting from the activities and process of tapping pine resin carried out by farmers then collected and purchased directly by the collecting traders, in this case the head of the farmer group, then it will be sold

back to PT Istana Palapa Kertas (ISPAK) Jakarta through Warehouse 88 and resold through the export process to consumer countries namely India, Vietnam and China.

The flow of goods movement (pine resin) starts from farmers to intermediary traders (head of farmer groups), then to large traders, namely Warehouse 88 and then to PT ISPAK and then to the consumer country. The flow of information movement is all interconnected, namely between farmers and collecting traders, then collecting traders with Warehouse 88 and PT ISPAK, as well as the flow of information between Warehouse 88 and PT ISPAK, then between the consumer country and Warehouse 88 and PT ISPAK. The last flow is the movement of money, farmers will receive money directly from the collecting traders, namely the head of the farmer group which is valued at IDR 5,500/kg, then after that the collecting traders will get money from PT ISPAK which is valued at IDR 12,000/kg then marketing activities are carried out again to the consumer country either from Warehouse 88 or PT ISPAK itself so that money from the consumer country goes to Warehouse 88 or PT ISPAK depending on the export activities carried out according to demand.

Business Activity

The research that has been conducted shows that business actors in the pine resin value chain of HKm Cempalagie consist of farmers tapping pine resin, collecting traders, namely the head of the farmer group and large traders, namely Warehouse 88 and PT ISPAK Jakarta. Equipment in the tapping process carried out by KTH Cempalagie is obtained from the assistance of the Directorate General of Social Forestry and Environmental Partnership (PSKL). The activity chain of business actors is presented in Figure 2.

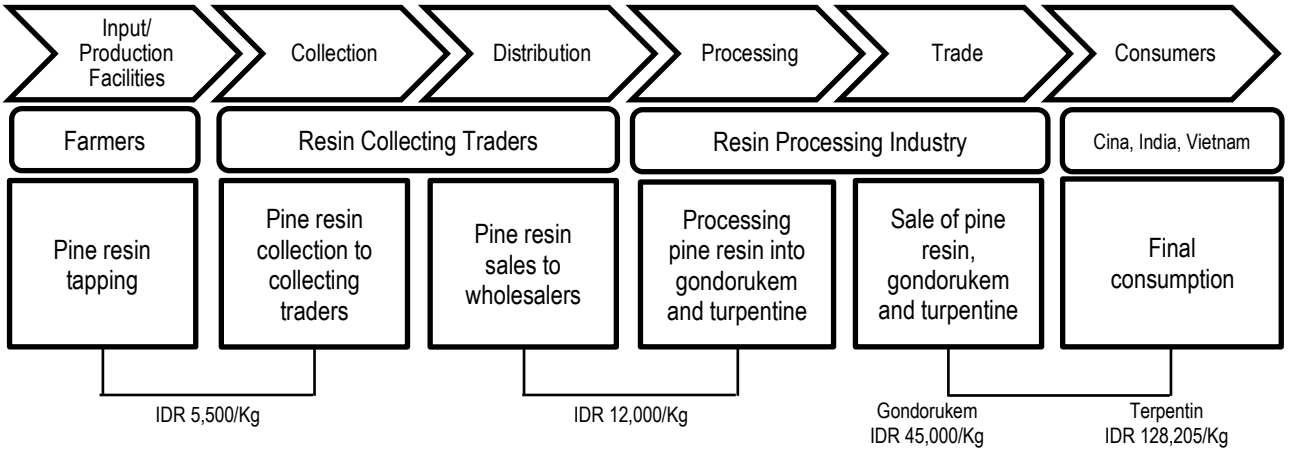

Figure 2. Activity chain of business actors

Pine Sap Tappers

The community as farmers who join the Cempalagie KTH is very dependent on the HKm area in meeting individual and family needs. This is in line with the statement Dewi *et al.* (2018) that the involvement of farmers as communities who live in forest areas and carry out forest management is very important, because the intensity of interaction between forest communities and forests is very high in all regions of Indonesia. Through the HKm scheme, community involvement becomes wider in forest management (Burhanuddin 2021). Since obtaining a Permit for Utilization of Non-Timber Forest Products (IPHHBK) in the form of tapping pine resin, KTH Cempalagie has optimized this utilization, by tapping which is carried out by all group members. Each group member is responsible for the tapping area that has been determined from the start. The intensity of management and the results obtained vary, depending on each individual in carrying out their work. Group members whose land is located in Ara Village require labor to carry the sap during harvest time because the land is located far from the collecting traders, while group members whose land is located in Cempalagie Village do not require labor to carry the sap during harvest time because the land is close to the collecting traders. The activities of pine resin tappers are presented in Figure 3.

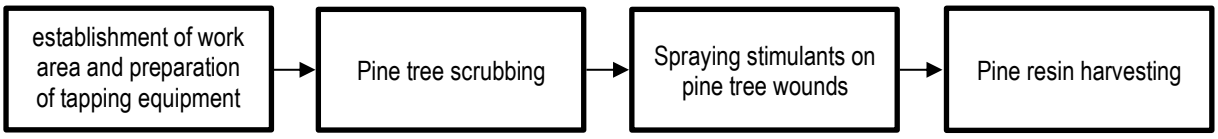

Figure 3. Activities of pine sap tappers

The first activity carried out by farmers in the sap tapping process includes determining the work area, namely by giving each farmer group member one week to tap pine sap according to their ability in turn. When one member has finished tapping for one week, it will then be continued by another member with the same mechanism and continued by the next member, so that the area becomes tapping land permanently until now.

The activity of determining the area is carried out together with the preparation of tools that will be used since the beginning of tapping pine sap until now, namely tapping machetes, buckets, tapping zinc, used plastic bottle containers, hammers and nails. The pine tree tapping process is the next activity. Lempang (2018) and Dahlan *et al.* (2023) stated that the koakan system has been used in Indonesia since the 1975s by forming an inverted U made parallel to the length of the trunk with a depth of 2 cm and a width of 10 cm and a distance from the ground surface of about 20 cm using a tapping tool. The tapping zinc is then nailed or attached to the pine tree and given a cut plastic bottle as a container to collect the sap.

The process of tapping pine sap is then carried out by spraying with sufficient capacity on the wound of the tree that has just been cracked to stimulate the release of sap using a stimulant water solution that has been mixed with nitric acid (HNO_3), sulfuric acid (H_2SO_4) and salt (NaCl). Sulhaji (2020) suggests that the use of these stimulants can increase sap production. The sap ducts that have been cracked will close quickly if not given a stimulant so that the sap production obtained will be low (Ikhsan, 2019). Spraying is done using a sprayer that has been filled with a stimulant solution. Rahmadani (2021) argues that the sprayer must be considered right near the tree wound and pay attention to the spray distance and wind direction so that when sprayed, the stimulant does not spread to other places.

The last activity carried out by farmers is the process of harvesting pine sap in the form of picking up the full sap container, then pouring it into a bucket and doing it once a month. The average time for checking is done by farmers once a week along with the process of renewing wounds and spraying stimulants. The harvesting process requires the labor of three to four people to pour the sap into buckets with a wage of IDR 15,000 per 22 kg, and requires the labor of two to three people to carry the sap to the collecting traders for farmers who have distant land with a wage of IDR 40,000 per pikul (88 kg).

Pine Sap Collector Traders

Rempowatu *et al.* (2018) argued that collecting traders are entities or individuals who have business activities to collect forestry, plantation, agriculture and fishery products and resell these products to industrial business entities or exporters engaged in the sector. Husnarti (2017) also suggests the same thing, that intermediary traders who buy agricultural products from farmers will sell to large traders in the district. The activities of collecting traders are presented in Figure 4.

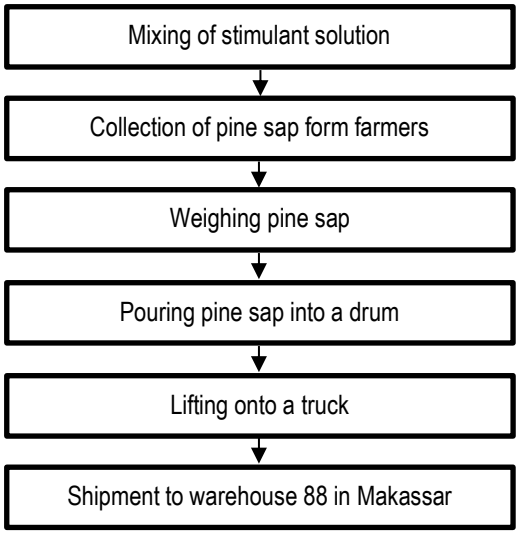

Figure 4. Activity of collecting traders

The collective trader in Cempalagie HKm is the head of the farmer group. This activity has been carried out since the beginning of pine resin utilization in 2016 until now. Activities carried out by the head of the farmer group include mixing a solution of nitric acid (HNO_3), sulfuric acid (H_2SO_4) and salt (NaCl) into water as a stimulant and distributed to all members of the pine resin tappers, collecting all pine resin at harvest time which has been done by 30 farmers, then weighing buckets of pine resin one by one then put into 34 drums and transported to the truck. This work was assisted by the secretary and treasurer of the farmer group. The next activity was to deal directly with Warehouse 88 to send the pine sap

at the beginning of each month. Shipments of pine resin by intermediary traders in one year amounted to 59,840 kg with a selling price of IDR 12,000/kg so that the revenue in one year amounted to IDR 718,080,000.

Pine Sap Wholesalers (Warehouse 88 Makassar City)

Business actors who become large traders in this pine resin value chain are the pine resin processing industry, namely PT ISPAK, which has a warehouse in Makassar city and receives or buys pine resin from eight KTHs spread across South Sulawesi. Sap marketing is carried out depending on the demand of consumer countries, if the demand is in the form of raw materials, it will be directly exported from Warehouse 88 and if the demand is in the form of pine resin that has been processed in the form of final products, it will be exported through PT ISPAK. Activities carried out at Warehouse 88 Makassar City are presented in Figure 5.

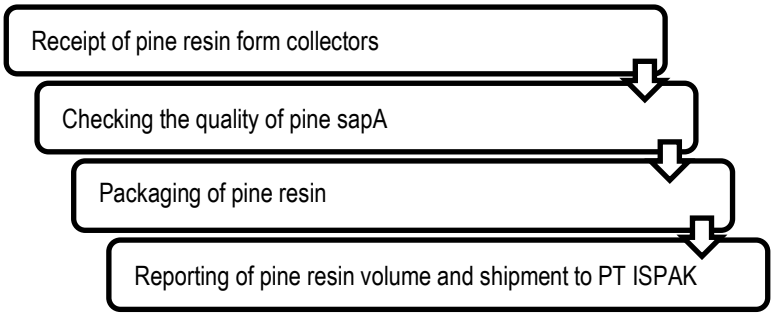

Figure 5. Activities of warehouse wholesaler 88 makassar

Activities carried out at Warehouse 88 include receiving pine resin from collecting traders, then checking the quality (cuality control) by stirring the pine resin using a large log and then lifting it to see the condition of the pine resin containing dirt or not. The next process is in the form of packing into drums if the pine sap that arrives is still in wooden containers or other containers and ensuring how much volume of pine sap is available at Warehouse 88 Makassar and is reported and sent to PT ISPAK as the head office.

Wholesaler PT Istana Palapa Kertas (ISPAK) Jakarta

The activities carried out at PT ISPAK are different from those carried out at Warehouse 88. Since its establishment in 1977, PT ISPAK has continuously strived to create the highest quality products and services in Indonesia by standing tall with a reputation of excellence and is one of the most trusted companies in the country. PT ISPAK is also an authorized agent of Perum Perhutani since 2015 in exporting its products of gondorukem and turpentine. PT ISPAK has acquired expertise in sourcing and delivering forestry resins and derivatives, from Indonesian forests to their long-term partners. The pine sap that has been collected by PT ISPAK will then be processed according to the demand of the consumer country in the form of Gum Rosin, X & WW Grade, Gum Turpentine, AP 80%, Alpha Pinene 95% and Delta 3 Carene 55%. Export activities carried out every month to consumer countries are five containers or equal to 87.5 tons so that in one year, PT ISPAK can export 60 containers or equal to 1,050 tons of pine resin and pine resin products.

Market Structure

The market structure formed in the pine resin commodity value chain of HKm Cempalagie Soppeng Regency consists of the type or type of market, the number of sellers and buyers, product differentiation, entry barriers, cost structure and conglomeration. The first is the number of sellers and buyers in the first chain between farmers and collecting traders, namely the number of collecting traders who buy sap from tapping pine trees from farmers is one person. Collecting traders stand as price determinants and farmers as price recipients worth IDR 5,500/kg of pine sap. Furthermore, in the second chain between collecting traders and large traders (PT ISPAK), the number of companies that buy and sell pine resin is very large and each has the ability to influence the selling price, but KTH Cempalagie chooses to sell pine resin only to PT SPAK. The price setter is PT ISPAK and the price receiver is the intermediary trader with a value of IDR 12,000/kg of pine resin. Furthermore, the third or final chain is between the pine resin processing industry (PT ISPAK) and consumer countries, namely India, Vietnam and China, the number of sellers and the number of buyers is very large and has reached the international market. Consumers are free to choose to buy products from any company and likewise for companies are free to choose any consumer when the price is suitable. Price setters and price takers tend to be balanced for both parties because before carrying out the buying and selling process, a price agreement will be made.

The next market structure is product differentiation, in the first chain between farmers and collecting traders, there is no product differentiation because all farmers only sell raw materials, namely pine resin to collecting traders. Furthermore,

in the second chain between collecting traders and large traders (PT ISPAK), there is product differentiation because in pine resin there can be differences in quality from the amount of garbage or dirt contained in pine resin due to the tapping process. Next is the third or last chain, namely between the pine resin processing industry (PT ISPAK) and the consumer countries, namely India, Vietnam and China, there is product differentiation because each company processes pine resin into certain products. Although the products are the same, the quality can be different according to the quality of pine resin products applicable in Indonesia, namely X (Rex), WW (Water White), WG (Window Glass), N (Nancy), M and so on.

The next market structure is entry barriers, in the first chain between farmers and collecting traders, namely the distance from the location of tapping pine sap to the collecting traders is quite far so that farmers have to walk carrying buckets of sap which is quite heavy. Furthermore, in the second chain between collecting traders and large traders (PT ISPAK) there are no entry barriers because collecting traders only sell sap to one pine sap processing industry, namely PT ISPAK. Furthermore, the third or last chain is between the pine resin processing industry (PT ISPAK) and consumer countries, namely India, Vietnam and China, namely the cost of industrial capital is expensive, the equipment or technology for processing pine resin is quite old or old.

The next market structure is the cost structure, in the first chain between farmers and collecting traders and in the second chain between collecting traders and large traders (PT ISPAK) there is no cost structure. Only in the third or last chain, namely between the pine resin processing industry (PT ISPAK) and consumer countries, namely India, Vietnam and China, PT ISPAK can compete with competitors both domestically and abroad and can be relied upon so that it is asked to be one of the official agents of PT Perhutani.

The last market structure is conglomeration, in the first chain between farmers and collecting traders and in the second chain between collecting traders and large traders (PT ISPAK) there is no conglomeration because in both chains there is only one form of material or product, namely pine resin. Only in the third or last chain, namely between the pine resin processing industry (PT ISPAK), is there conglomeration, which shows that the company produces a variety of different products besides pine resin products, including glass bottles and tools and spare parts.

D. CONCLUSION

The pine resin commodity value chain of HKm Cempalagie consists of several business actors, namely pine resin tappers, intermediary traders who are the head of KTH Cempalagie, large traders, namely Warehouse 88 and PT ISPAK as the pine resin processing industry. The activities carried out by each business actor vary according to their respective duties and responsibilities in the value chain. The market structure formed between farmers and intermediary traders is a monopolistic market, then the market structure formed between intermediary traders and wholesalers (PT ISPAK) is a monopolistic market, and the market structure formed between the pine resin processing industry (PT ISPAK) and consumer countries (India, Vietnam and China) is a perfectly competitive market.

AUTHOR'S DECLARATION

- Conflicts of Interest: None.
- We here by confirm that all the Figures and Tables in the manuscript are ours. Furthermore, any Figures and images, that are not ours, have been included with the necessary permission for republication,which is attached to the manuscript.
- No animal studies are present in the manuscript.
- No human studies are present in the manuscript.
- No potentially identified images or data are present in the manuscript.

REFERENCES

Atinga, E. (2024). The commercialization of NTFPS and conservation of forests: a systematic review for forestry policy. *Forestry Economics Review, 6*(2), 94-121. https://doi.org/10.1108/FER-08-2023-0010.

Beleko, S., Malimbwi, R.E., Mugasha, W.A., Balama, C. & Mpiri, A. (2021). Pine resin productivity at sao hill forest plantation, southern tanzania. *Tanzania Journal of Forestry and Nature Conservation, 90*(1), 82-95.

Burhanuddin. (2021). *Contribution of Non-Timber Forest Products (NTFPs) in Community Forests (HKm) to the Income of Kapita Village Community, Bangkala District, Jeneponto Regency*. Makassar:, Muhammadiyah University.

Dahlan, Yeriana, S., & Tuti, A. (2023). Potensi produksi getah pinus (*Pinus merkusii*) pada kelas diameter batang berbeda menggunakan sistem koakan. *Jurnal Ilmiah Mahasiswa Pertanian, 8*(1), 665-672. https://doi.org/10.17969/jimfp.v8i1.23318.

Das, A.K., Singha, L.B., & Khan, M.L. (2017). Community structure and species diversity of Pinus merkusii Jungh. & de Vriese forest along an altitudinal gradient in Eastern Himalaya, Arunachal Pradesh, India. *Tropical Ecology, 58*(2), 397–408.

Eralita, N., Ayu, P., & Dini N, F. (2020). The effect of reaction temperature in alpha pinene hydration process with amberlyst 36 catalyst. *Jurnal Pengendalian Pencemaran Lingkungan (JPPL), 2*(1), 10-15. https://doi.org/10.35970/jppl.v2i1.136.

Erlangga, D., I. (2020). *Obligations of Business Actors Against Restaurant Consumer Protection According to the Law in Review of the Law on Consumer Protection (Study at Garuda Restaurant Medan)*. Medan: University of North Sumatra.

Halimah, A., S & Muhdiar. (2018). Analysis of rice marketing margin in sibulue district, bone regency. *Journal of Agricultural Technology Education, 4*, 82.

Husnarti. (2017). The role of collecting traders in lima puluh kota regency. *Journal of Agriculture Faperta UMSB, 1*(1), 2-3.

Insusanty, E., Ambar, T.R., & Sri, R.P. (2017). Financial analysis of non-timber forest products (NTFPS) rubber and durian in siak regency. *Journal of Forestry Wahana Forestra, 12*(2), 118-119.

Kencanawati, C.I.P., Ketut, G.S., Suardana, N.G., &Wayan, B.S. (2017). Characterization and preliminary analysis of pinus merkusii sap (pine resin) with variations in heating temperature as an alternative resin in composites. *Proceeding of Annual National Seminar on Mechanical Engineering XVI (SNTTM XVI)*: Surabaya.

Khikmah, U., N., & Herti, U. (2019). Study of the effect of temperature and reaction time on the synthesis of alpha terpineol from turpentine by using trichloroacetic acid catalyst. *Journal of Research and Development, 7*(2), 212-220.

Lempang, M. (2018). Pine sap collection with three tapping systems. *Eboni Technical Info Journal, 15*(1), 5.

Mampi, B., Abdul, H., & Muthmainnah. (2018). Produksi getah pinus (pinus merkusii jung et de vriese) pada berbagai diameter batang menggunakan sistem koakan di desa namo kecamatan kulawi kabupaten sigi. *Jurnal Warta Rimba, 6*(3), 42-48.

Nurmaydha, A., Susinggih, W., & Panji, D. (2017). Productivity analysis in the gondorukem and turpentine production section using the objective matrix (omax) method case study at pgt sukun ponorogo independent business unit of non-timber industry (kbm-ink) perum perhutani unit ii east java. *Journal of Agroindustrial Technology, 1* (1), 43.

Pasaribu, G., Winarni, I., Gusti, R. E. P., Maharani, R., Fernandes, A., Harianja, A. H., Saragih, G. S., Turjaman, M., Tampubolon, A. P., Kuspradini, H., Lukmandaru, G., Njurumana, G. N., Sukito, A., Aswandi, A., & Kholibrina, C. R. (2021). Current challenges and prospects of indonesian non-timber forest products (NTFPs): A Review. *Forests, 12*(12), 1743. https://doi.org/10.3390/f12121743.

Permatasari, S., & Riski, B., R. (2018). *Separation of Turpentine and Gondorukem from Gateh Pinus (Pinus merkusii Jungh. Et de Vriese) by Distillation Method*. Surabaya: Sepuluh November Institute of Technology.

Puspasari, E, *et al.* (2017). Socioeconomic aspects of agroforestry systems in the community forest (hkm) work area of west lampung regency, lampung province. *Journal of Sylva Lestari, 5*(3), 95-103. https://doi.org/10.23960/jsl3595-103.

Rahmadani, R. (2021). Techniques and Productivity of Pine Sap Tapping in KPH Mamasa Tengah. Makassar: Hasanuddin University.

Rahmina, *et al.* (2011). *Procedures for the Development of Community-Based Forest Management Programs within the Framework of Law No. 41/1999*. Jakarta: Sunset Media.

Rempowatu, E. E., Pangemanan, P. A., & Rumagit, G. A. J. (2018). Analisis keuntungan pedagang pengumpul "kelapa kuah" di desa tewasen kecamatan amurang barat. *Agri-Sosio Ekonomi Unsrat, 14*(3), 183-192. https://doi.org/10.35791/agrsosek.14.3.2018.21646.

Shufa, F., F. (2020). *Study of Gum Rosin/Fumaric Acid Mole Ratio and P-Toluene Sulfonic Acid (PTSA) Catalyst Concentration on Fumaric Esterification of Modified Rosin Ester*. Semarang: State University of Semarang.

Siregar, J. (2020). *Extraction of Turpentine Oil from Pine Sap by Microwave Assisted Hydro-Distillation (MAHD) Method. Faculty of Engineering*. Medan: University of North Sumatra.

Sisillia, L., *et al.* (2024). Participatory education on non-timber forest products for communities as an effort to preserve kalimantan forests. *UNDIKMA Devotion Journal, 5* (2), 199.

Sulhaji. (2020). *Production of Pine Sap (Pinus merkusii) in Agroforestry Pattern Community Forests in Tinggimoncong District, Gowa Regency*. Makassar: Muhammadiyah University.

Suranto, Y. (2018). Character and quality of ancient gondorukem discovered in kutoarjo chinatown settlement, purworejo regency. *Jurnal Konservasi Cagar Budaya, 12*(2), 47-60. https://doi.org/10.33374/jurnalkonservasicagarbudaya.v12i2.188.

Ultavia, B., A., *et al.* (2023). Qualitative: understanding the characteristics of research as a methodology. *Journal of Basic Education, 11*(2), 348.