



Sustainable Economic Development through Downstream Frankincense (Styrax Benzoin) Production in an Effort to Increase Farmers' Income in North Sumatra

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ABSTRACT

This study analyzes the potential of a frankincense downstreaming program as a strategy to increase community income in North Sumatra, the world's largest frankincense-producing province. Data on frankincense production and exports from North Sumatra for the 2020-2024 period show significant dominance in the global market, yet the added value received by farmers remains relatively low. This paper identifies the obstacles faced by farmers, such as limited access to processing technology, price fluctuations, and a lack of downstream infrastructure. Through a review of data from the Statistics Indonesia (BPS), the Ministry of Trade, and the North Sumatra Plantation Office, as well as a literature review related to sustainable economic development programs, this study proposes a downstreaming solution that focuses on the diversification of frankincense derivative products, increasing farmer human resource capacity, and an active government role in creating a conducive industrial ecosystem.

INTRODUCTION

North Sumatra, a province in western Indonesia, is known as the world's largest producer of frankincense (*Styrax benzoin*). Frankincense is a multipurpose plantation commodity with high economic value, used in the cosmetics, perfume, pharmaceutical, cigarette raw materials, and even religious rituals. The presence of frankincense trees has become an integral part of the economic and social life of communities in several districts, particularly in North Tapanuli, Humbang Hasundutan, Toba, Dairi, Papak Bharat and Central Tapanuli. The community's economic dependence on this commodity is very high, making price fluctuations and challenges in the value chain crucial issues affecting their well-being. Frankincense resin is a typical commodity of North Sumatra with high economic value. Currently, frankincense forest management faces challenges, such as a lack of market information, unstable frankincense resin prices, and the lack of intensive frankincense tree cultivation (Marjenah, 2024). In its journey, the use of frankincense as a tradable commodity has been going on since the 17th century and the impact of the frankincense trade has been clearly felt by local farmers and traders.

Frankincense production has high economic value and is used as a raw material for the perfume, pharmaceutical, cosmetic, soap, and cigarette industries. Frankincense needs to be developed to increase farmers' income, so that it needs to be managed in a sustainable manner. Frankincense forest management is part of the culture and knowledge of local communities. Frankincense forests have social, economic, and ecological benefits. On average, farmers earn an income of IDR 13,233,500/year (60.69% of total income) as found (Sitompul, 2011) from frankincense, indicating that to develop frankincense forests, it is necessary to reduce internal weaknesses and utilize or optimize opportunities through strategies: intensifying extension activities, establishing farmer groups and/or cooperatives, monitoring the frankincense resin marketing system, intensive farming systems, and the use of superior frankincense seeds.

Through forest management, frankincense has been able to make a significant contribution to the household economy of frankincense farmers, amounting to 70%-75%. This includes several regencies in North Sumatra Province (Affandi, 2002). However, until now, the management and processing of frankincense by the community is still traditional and has not been touched by many development efforts. Despite holding the title as the largest frankincense exporter, ironically, the added value received by frankincense farmers at the upstream level is still minimal. Most frankincense is exported in the form of raw or semi-processed materials, so the potential for increasing income through diversification of derivative products (downstream) has not been optimally developed. This condition creates a disparity between large production volumes and the unequal welfare of farmers. The Indonesian government, through various strategic policies, is increasingly promoting downstream programs in various industrial sectors, including plantation commodities.

THEORETICAL REVIEW

Characteristics of Frankincense (Styrax benzoin) as a Leading Commodity of North Sumatra

Frankincense is an aromatic resin obtained from the bark of trees of the *Styrax* genus. The quality and type of frankincense vary depending on the species and growing location. Frankincense from North Sumatra, particularly *Styrax benzoin* Dryand, is renowned for its high quality and distinctive aroma, making it a favorite on the global market. Indonesia's frankincense plantation potential is generally a top priority internationally. Non-timber forest products, such as frankincense resin, are tapped from frankincense trees (Simanjuntak, 2012). North Sumatra, a region with frankincense potential, has long been known as a major producer and exporter of frankincense worldwide. This plant thrives in the forests of Sumatra, particularly in the North Tapanuli and Humbang Hasundutan regions of North Sumatra. According to data from the North Sumatra Department of Animal Husbandry and Plantations, frankincense production in 2021 reached 8,845 tons across 23,172 hectares of land. The economic value of this production is estimated at IDR 2.65 trillion at the farmer level. Indonesian frankincense is exported to various countries, including India, China, Japan, Malaysia, the United Arab Emirates, Taiwan, and France. Known internationally as benzoin, frankincense is commonly used in the perfume, cosmetics, and pharmaceutical industries, as well as as a food and beverage preservative. Frankincense trees begin to produce resin after about 10 years of age. The tapping process involves making small wounds in the tree trunk using a special tool. The resulting resin then hardens and is collected after 4-5 months.

One of the potentials that can be utilized from village forests is Non-Timber Forest Products (NTFPs), which are the potential of village forests that are commonly and commonly utilized by communities traditionally, but have not been utilized optimally. According to FAO, NTFP commodities can be grouped into five purposes, namely, food and derivative products, ornamental plants, wild animals and their products, non-timber building materials, and bioorganic materials. Meanwhile, for the economy, namely regarding use and market analysis, NTFPs are divided into three categories, namely subsistence level (for own consumption), local use level (semi-commercial), and commercial (Desyanti, (Indonesia B. , 2023)et. al., 2023). Communities living around forest areas have a very high dependence on forest products to meet their living needs. One type of forest product utilized by the community is non-timber forest products (NTFPs), which are utilized by obtaining the economic value of the NTFPs obtained and their contribution to household income.

Frankincense plants are large, with a trunk diameter of around 60-100 cm and a height of 20-40 meters. They are usually found in natural forests and grow in groups or mixed with other plants, and are distributed across various countries, including Southeast Asia, such as Malaysia, Thailand, Indonesia, and Laos. In Indonesia, they are distributed on the island of Sumatra, especially in central North Sumatra (the Toba plateau), West Java, and West Kalimantan. In North Sumatra, they are distributed in the northern Tapanuli region (North

Tapanuli, Humbang Hasundutan, Toba, and Samosir), Dairi, and Pakpak Bharat. The distribution of frankincense trees is estimated to account for almost 67% of the area of frankincense plantations in Indonesia. The product or part of the frankincense plant that is widely used in various fields is the resin produced by the bark of the frankincense tree (Manurung and Sitorus, 2021). In the North Tapanuli region, local communities still cultivate frankincense plants in a very traditional manner, generally inherited from their ancestors. Two types of frankincense are found throughout North Sumatra: Toba frankincense (*Styrax sumatrana* J.J.SM) and Durame frankincense (*Styrax benzoin*). Both species belong to the Ebenales order, Styraceae family, and *Styrax* genus (Harahap, 2018).

Data from the North Sumatra Statistics Agency (BPS) shows an increase in land and frankincense production for several regencies in North Sumatra (Saputra, 2025). North Tapanuli Regency is the region with the largest land area and also contributes to production, so it has great potential to be used as a production center and development of frankincense plants in North Sumatra Province. For Humbang Hasundutan Regency itself, which is one of the expansion areas of North Tapanuli Regency, the distribution of frankincense plants. In the agricultural/plantation sector, frankincense or the term for the farming community called haminjon is a superior regional commodity for Humbang Hasundutan Regency from the agricultural/plantation sector. In this case, more than 60 percent of Humbang Hasundutan residents, North Sumatra, work in the frankincense plantation sector with an estimated transaction value of IDR 2.1 billion per week. (Nurjannah, 2017), frankincense is the main source of livelihood.

The Concept of Downstreaming as Sustainable Economic Development

The downstreaming process is an effort to reduce the export of raw materials and instead encourage domestic industries to utilize these materials because it increases domestic added value and creates jobs. It is one of the government's programs and policies (Matondang, et. al., 2024). It is hoped (Agung and Adi, 2022) that this will result in the creation of a strong manufacturing industry structure and, in turn, export volume, benefiting the national economy by minimizing imports through empowering the long-term utilization of mineral resources (Deddy, Adriyanto and Navalino, 2023).

To address this issue, Indonesia has adopted a downstreaming strategy. Downstreaming is the process of processing raw natural resources into finished or semi-finished products with higher added value. Through downstreaming, Indonesia can increase state revenue, create jobs, stimulate economic growth, and reduce dependence on raw material exports. Downstreaming refers to efforts to increase the added value of a commodity through further processing into finished or semi-finished products. This concept is crucial for sustainable economic development because it can reduce dependence on raw material exports, create economic diversification, and increase domestic income. In the agricultural context, downstreaming involves technological innovation, supply chain management, and market development.



Figure 1. Frankincense (*Styrax benzoin*) Production
Frankincense Processing Process

The industrial process of frankincense processing involves several stages, from tapping the sap of the frankincense tree, processing it into resin, and finally utilizing the final product. Frankincense, which is the dried sap or resin from the *Styrax* tree, is used in various industries such as pharmaceuticals, perfumery, and even clove cigarettes. The processing process involves several stages, starting with Sap Tapping. The sap of the frankincense tree, specifically the *Styrax benzoin* and *Styrax paralleloneurus* species, is tapped by making incisions in the bark. The resulting sap hardens and collects around the incisions, both inside and outside the bark. The collected sap is then separated from the bark and other impurities.

The next stage is Sap Processing. The collected frankincense sap is then further processed to produce a product ready for use. This processing can involve cleaning, drying, and sorting the sap based on quality. Some processes also involve extraction with solvents such as acetone to improve quality and meet specific standards. In the product usage stage, frankincense, processed into resin, is used in various industries. The pharmaceutical industry uses frankincense as a raw material for medicines and other health products. The fragrance industry uses frankincense as an aroma binder to make perfumes last longer.

In some regions, frankincense is also used as an ingredient in clove cigarettes and as an air freshener, as shown in the following table:

Table 1. Stages of Frankincense Management Frankincense (*Styrax benzoin*)

No	Types of Stages	Process
1	Tapping	<ul style="list-style-type: none"> - <i>Styrax benzoin</i> and <i>Styrax paralleloneurus</i> are tapped for their sap by making incisions in the tree bark. - The sap that flows out hardens and collects around the incision, both inside and outside the tree bark. - The collected sap is then separated from the tree bark and other debris.
2	Implementation	<ul style="list-style-type: none"> - The collected frankincense resin is then further processed to produce a product ready for use.

		<ul style="list-style-type: none"> - This processing can involve cleaning, drying, and sorting the resin based on its quality. - Some processing also involves extraction with solvents such as acetone to improve quality and meet certain standards.
3	Consumption	<ul style="list-style-type: none"> - Frankincense, processed into resin, is used in various industries. - The pharmaceutical industry uses frankincense as a raw material for medicines and other health products. - The fragrance industry uses frankincense as an aroma binder to make perfumes last longer. - In some regions, frankincense is also used as an ingredient in clove cigarettes and as an air freshener.

The industrial processing of frankincense not only provides economic benefits for farmers and surrounding communities but also contributes to various industrial sectors. Proper frankincense processing and proper utilization can increase the added value of this product and positively impact the economy.

Benefits of the Agricultural Commodity Downstreaming Program

The Indonesian government has outlined various policies and programs to encourage downstreaming, including through the Ministry of Industry, the Ministry of Trade, and the Ministry of Agriculture. These policies include fiscal incentives, industrial estate development, human resource training, and market access facilitation. The downstreaming policy is a strategic step to strengthen efforts to increase added value and productivity, while supporting economic stability. The downstreaming policy, in this case, encompasses two sectors simultaneously: minerals and food (plantations, agriculture, and fisheries), which complement each other while still prioritizing the resulting derivative products and the availability of raw material sources (Affandi, et.al. 2023). The downstreaming policy to support economic stability and increase added value and productivity can be achieved through downstreaming food and downstreaming minerals and coal (minerba). Going forward, policy synergy needs to be continuously strengthened to strengthen downstreaming and support Indonesia's transformation into a developed nation, including through improving production factors, strengthening regulatory and institutional aspects, and strengthening trade and promotional cooperation (Indonesia B., 2023). Therefore, it is important to examine how this policy can be adapted to the frankincense sector. Downstream processing offers significant benefits for Indonesia, both economically, socially, and environmentally. Some of the main benefits of downstream processing include:

Table 2. Downstream Aim

No	Aim	Description
1	Increasing the Added Value of Natural Resources	Downstream processing produces products with a significantly higher sales value than the raw materials. For example, nickel ore processed into stainless steel or lithium batteries has a sales value tens or even hundreds of times higher. This increased added value directly impacts state revenue and foreign exchange earnings.
2	Economic Diversification	Downstreaming encourages the development of a more diverse processing industry, thereby reducing dependence on the commodity sector. By having a strong downstream industry, Indonesia can mitigate the risk of commodity price fluctuations and strengthen national economic resilience.
3	Job Creation	The downstream industry requires a larger and more diverse workforce than the extractive sector. From factory workers to technicians to technologists, downstreaming opens up extensive job opportunities for Indonesians, thereby reducing unemployment.
4	Technology Development and Innovation	Downstreaming encourages investment in technological research and development to improve efficiency and product quality. With advanced technology, Indonesia can produce downstream products that are competitive in the global market.
5	Strengthening Domestic Industry	Downstreaming encourages the growth of a competitive national industry. By producing its own downstream products, Indonesia can reduce its dependence on imports and increase economic independence.
6	Environmental Conservation	Sustainable downstream processing can encourage more environmentally friendly natural resource management practices. By reducing raw material exports and processing them domestically, Indonesia can mitigate negative environmental impacts, such as deforestation and pollution.

Some of the main challenges to downstreaming in Indonesia include limited supporting infrastructure, such as transportation and technology, which can hinder the development of downstream industries. Limited human resources with the quality or ability of skilled workers and technological experts. This includes dependence on foreign investment, which will certainly create the risk of dependency and economic instability. Commodity price fluctuations: unstable commodity prices can affect the profitability of downstream industries, including the support and role of banking and all parties carrying out activities to collect and distribute funds from the community for the economic development of a country (Simbolon et al., 2024) as well as being an important party in the creation of new capital (Simbolon et al., 2024)

When commodity prices fall, downstream industries can experience losses, including global competition from other countries that are also developing downstream industries, which can be a challenge for Indonesia. To win this competition, Indonesia needs to improve the quality and competitiveness of its downstream products.

Indonesia itself has experienced success in downstreaming. There have been a number of successes in the downstreaming of several commodities. Some examples of successful downstreaming in Indonesia include the Palm Oil Industry: Indonesia is the world's largest palm oil producer. Through downstreaming, Indonesia has succeeded in developing a downstream palm oil industry that produces various derivative products such as cooking oil, biodiesel, oleochemicals, and processed food products. In the Nickel Industry, Indonesia has the world's largest nickel reserves. Nickel downstreaming has produced products such as stainless steel, lithium batteries, and electric vehicle components. The development of this downstream nickel industry has driven economic growth and created jobs in nickel-producing regions. Similarly, in the Cocoa Industry, Indonesia is one of the world's largest cocoa producers. Cocoa downstreaming has produced high-quality chocolate products that are in demand in the international market. In the Fisheries Industry, Indonesia has great fisheries potential. Fisheries downstreaming has produced processed fish products such as canned fish, fish crackers, and surimi.

METHODOLOGY

This study, with the topic of downstreaming, aims to increase product added value, create jobs, and encourage sustainable economic growth. In the context of North Sumatran frankincense, the downstreaming program is not merely an option but a necessity to optimize economic potential and increase community income sustainably. Therefore, it is necessary to analyze the urgency and potential of the downstreaming program for frankincense production in North Sumatra. Qualitative methods as a means of analysis in the literature study by managing and analyzing data sourced from scientific research results and other literature references (Simbolon, et al., 2023) is the pattern used to achieve the objectives of this study itself. The main focus is to identify obstacles faced by farmers, explore downstreaming opportunities through diversification of derivative products, and formulate recommendations for sustainable policies and programs to increase community income. Data will be obtained from relevant secondary sources, such as the North Sumatra Central Statistics Agency (BPS), the Plantation Service or the Ministry of Trade, Bank Indonesia, and other data sources. Data analysis is conducted descriptively to describe production trends, exports, and the general condition of the frankincense industry. Literature studies and policy analysis are used to evaluate existing downstreaming programs and formulate recommendations. The focus of the analysis is how the data reflects the urgency and potential of downstreaming in increasing community income.

RESULTS

Potential for Developing Indonesian Frankincense as the World's Largest Exporter

Indonesia holds the status of king of frankincense exports, commonly known as *Styrax Benzoin* gum, also known as benzoin gum. Based on data as of April 11, 2025, Indonesia was the largest frankincense exporting country with 1,216 shipments, followed by India with 177 shipments, and Singapore ranked third with 101 shipments. There are 160 suppliers in Indonesia exporting frankincense to 178 buyers worldwide. From October 2023 to September 2024, there were 62 active frankincense exporters in Indonesia. Three companies dominate frankincense exports: CV Aroma Co, PT Java Agro Timber Investama, and PT Karimun Kencana Aromatics. These three companies contribute 54 percent of Indonesia's total frankincense exports. The value of frankincense exports was previously revealed by the Chairman of the National Economic Council, Luhut Binsar Pandjaitan. He intends to encourage the downstreaming of frankincense due to its high economic potential. Our frankincense exports in 2024 are projected to reach 43,000 tons, valued at over US\$52 million (Rp847.6 billion, assuming an exchange rate of Rp16,299 per US dollar). Research on the presence of frankincense in Indonesia as an opportunity to strengthen the national economy, conducted by the Center for International Forestry and Agroforestry Research (CIFOR-ICRAF) in 2004, stated that Indonesian frankincense, specifically North Sumatran frankincense, is a non-timber forest product in Asia. Their findings stated that frankincense contributed 30-45 percent of household income to the people of North Sumatra at that time.

Table 3. Frankincense Planted Area and Production in North Sumatra 2020-2023

No	Province / Regency / City	Total Land Area (Ha) and Production (tons) of Frankincense Plants ((<i>Styrax benzoin</i>) in North Sumatra in years							
		2020		2021		2022		2023	
		Area	Pro d	Area	Pro d	Area	Pro d	Area	Pro d
1	Tapanuli Utara	16.22	4.07	16.2	4.15	16.250	4.20	16.26	4.28
		3	3	31	1		1	8	9
2	Humbang Hasundutan	4.927	3.41	4.93	3.48	4.947	3.57	4.975	3.78
			8	5	5		2		6
3	Toba	500	384	509	438	523	441	537	486
4	Dairi	143	42	144	48	143	48	144	50
5	Pakpak Bharat	1.338	681	1.33	712	1.350	694	1.380	803
				8					
6	Tapanuli Tengah	14	6	15	11	15,40	11	18	17
	North Province	23.14	8.60	23.17	8.84	23.228,	8.96	23.32	9.43
		6	4	2	5	4	7	2	1

Source : North Sumatra Statistics Agency

The destination areas for Indonesian frankincense are selling well in China, France, Bangladesh, Egypt, and India, according to data from the Central Statistics Agency (BPS), which is widely used by a number of luxury brands in the world as a raw material for their perfumes, including Louis Vuitton and Gucci, as conveyed by Vice President Gibran, who said that many people underestimate the potential of frankincense and consider it only for shamanic purposes, even though its value is equivalent to nickel (CBNCIndonesia, 2025). BPS data revealed that the volume of frankincense exports in 2024 reached 43,069 tons, a slight decrease compared to the volume in 2023 which was 45,505 tons. However, the export value increased to US\$ 52 million (2024) from the previous US\$ 49 million (2023). In these export destination countries, the sap or resin produced from the *Styrax benzoin* plant is widely used in the cosmetics, food and medical industries. In the world of anesthesia and medicine, frankincense is used as an adhesive to protect wounds, especially used to increase the adhesion of surgical tape and bandages. Likewise, it is used in religious rituals in other countries in Asia and Europe.

Production and Export Potential of Frankincense (*Styrax benzoin*) from North Sumatra

North Sumatra has long been the backbone of global frankincense production. Data from the Central Statistics Agency (BPS) shows that frankincense production in this province consistently contributes the largest share of total national production. In the world of trade, marketing efficiency is essential. Marketing is considered efficient if it meets two requirements: the ability to deliver products from producers to consumers at the lowest possible cost and the ability to distribute them fairly to all parties involved in the production and marketing of these products (Sudiono, 2021). Marketing efficiency can be observed and determined by examining the length of the frankincense marketing channel. The longer the marketing channel, the more marketing institutions involved, resulting in lower marketing efficiency. Furthermore, efficiency can be measured by the margins, costs, and profits received by each marketing institution within the marketing agency.

Based on the data above, it can be seen that North Sumatra's frankincense production. Land area increases by approximately 55–70 hectares per year, indicating limited expansion or intensification by farmers and farmer groups. In terms of export value, North Sumatra is a Major Producer. North Sumatra is said to be the main contributor to Indonesia's frankincense volume (estimated at >80–90%) based on national production. North Sumatra's dominance is also reflected in export data. Frankincense from North Sumatra province is a mainstay export commodity that reaches various countries in Asia, Europe, and America. The push to develop the downstream frankincense industry could be a major leap for the regional economy. While Indonesia has previously only sold raw resin, now opportunities open up to process it into finished products such as exclusive perfumes, essential oils, natural cosmetics, or premium medical ingredients. This downstream industry step can also create new jobs in the processing and research sectors, while opening up new investment opportunities. The government does have a crucial role in providing supporting infrastructure and regulations, but

business actors and investors are also required to act quickly and boldly seize opportunities. Frankincense is a clear example of Indonesia's invaluable biodiversity and its immense potential as an exporter of high-value products. This potential can be tapped not only by large corporations but also by innovative SMEs, cooperatives, and startups.



Figure 2. Frankincense trees or plants grow abundantly in the highlands of North Sumatra

Source: <https://jurnal.unimed.ac.id/2012>

Sustainability Analysis of Downstream (Styrax benzoin) Processing as a Solution to Increase Income and Economic Growth Opportunity

Frankincense production has high economic value and is used as a raw material for the perfume, pharmaceutical, cosmetic, soap, and cigarette industries. Frankincense needs to be developed to increase farmers' income, so it needs to be managed properly. Frankincense forest management is part of the culture and knowledge of the local community. Frankincense forests have social, economic, and ecological benefits. On average, farmers earn Rp 13,233,500 per year (60.69% of total income), according to findings (Sitompul, 2011) from frankincense shows that to develop frankincense forests it is necessary to reduce internal weaknesses and utilize or optimize opportunities through strategies: intensifying extension activities, forming farmer groups and/or cooperatives, monitoring the frankincense resin marketing system, intensive farming systems and the use of superior frankincense seeds.

The downstreaming program offers a strategic solution to overcome the above obstacles. The concept is to transform raw frankincense into products with higher sales value, thereby increasing the income of farmers and surrounding communities. The potential of North Sumatra's frankincense, which has three varieties, needs to be developed, especially for downstream product applications such as raw materials for medicines, perfumes, and health products such as lotions, soaps, shampoos, and so on. Future potential also exists for applications as a food additive for the food industry, such as the use of flavors for the

chocolate and syrup industries. Several local industries in Central Java produce cigarettes known as klembak menyan, which are commonly used to reduce stress. The mixture of these cigarettes is tobacco, a large amount of benzoin resin, and cloves. This potential is very worthy of development, as demand increases annually, but its economic value is limited to raw materials. Utilization as downstream products includes perfumes, cosmetics, and health products. The development of downstream products still requires in-depth scientific studies (Ridwansyah, 2025), including the diversification process of Derivative Products: Frankincense has great potential for processing.

Table 4. The Potential of Processed Frankincense in the Downstream Process

No	Processed form	Field of allocation for processed production
1	Frankincense Essential Oil	Perfume, cosmetics, and aromatherapy industry
2	Processed Frankincense Resin	Raw materials for pharmaceuticals, paints, and specialty adhesives
3	Innovative Products	Herbal drinks, supplements, or food products containing frankincense extract

Challenges as obstacles faced by farmers

Despite being the largest producers, frankincense farmers in North Sumatra still face various obstacles that hinder their income and well-being. Market Price Fluctuations: Frankincense prices are highly dependent on global market demand and are often unstable, making farmers' incomes uncertain. Limited Access to Processing Technology: The majority of farmers still rely on traditional methods for harvesting and initial processing, resulting in variable product quality and a lack of high-value derivative products. Lack of Knowledge about Product Diversification: Farmers are poorly educated about the potential of frankincense derivative products (e.g., essential oils, processed resins, pharmaceutical derivatives) that can provide significant added value. Access to Capital and Marketing: Constrained access to financial institutions and extensive marketing networks often leads farmers to rely on middlemen with low profit margins. Inadequate Infrastructure: Road conditions and collection facilities in frankincense-producing areas often do not support efficient distribution. Regulation and Data Protection: Although not immediately visible, data related to farmers, land, and production is potentially vulnerable if there is a lack of adequate data protection in plantation information systems.

Some of the main challenges to downstreaming in Indonesia include limited supporting infrastructure, such as transportation and technology, which can hinder the development of downstream industries. Limited human resources with the quality or ability of skilled workers and technological experts. This includes dependence on foreign investment, which will certainly create the risk of dependency and economic instability. Commodity price fluctuations: unstable commodity prices can affect the profitability of downstream industries. When commodity prices fall, downstream industries can experience losses, including global competition from other countries that are also developing downstream industries, which can be a challenge for Indonesia. To win this competition,

Indonesia needs to improve the quality and competitiveness of its downstream products.

The role of the government as the main driving force

Indonesia it self has experienced success in downstreaming. There are a number of successes in the downstreaming of several commodities. Some examples of successful downstreaming in Indonesia include the Palm Oil Industry Indonesia is the largest palm oil producer in the world. Through downstreaming, Indonesia has succeeded in developing the downstream palm oil industry that produces various derivative products such as cooking oil, biodiesel, oleochemicals, and processed food products. In the Nickel Industry, Indonesia has the largest nickel reserves in the world. Nickel downstreaming has produced products such as stainless steel, lithium batteries, and electric vehicle components. The development of this nickel downstream industry has driven economic growth and created jobs in nickel-producing regions. Likewise in the Cocoa Industry, Indonesia is one of the largest cocoa producers in the world. Cocoa downstreaming has produced high-quality chocolate products that are in demand in the international market. In the Fisheries Industry, Indonesia has great fisheries potential. Fisheries downstreaming has produced processed fish products such as canned fish, fish crackers, and surimi. The role of the Government is to guarantee and provide policies in:

Tabel 5. The role of the Government is to guarantee and provide policies

No	field	Government Efforts
1	Technology and Innovation	Requires investment in research and advanced processing technology. The solution is partnerships with universities and research institutions, as well as incentives for technology investors.
2	Development of Small and Medium-Scale Processing Industries	Encourage the formation of cooperatives or MSMEs focused on frankincense processing at the local level, so that added value remains local.
3	Human Resource Capacity Building	Training for farmers on improved harvesting techniques, initial processing, quality management, and entrepreneurship and marketing of processed products.
4	Market Access Facilitation	Supporting frankincense farmers and MSMEs to access broader domestic and international markets, both through e-commerce platforms and participation in trade fairs.
5	The Government's Role in the Downstream Ecosystem	The government, through the North Sumatra Plantation Office, the Ministry of Trade, and other relevant institutions, plays a crucial role in:

6	Formulating Pro-Downstream Policies	Providing fiscal incentives, simplifying licensing, and regulations that support investment in the downstream frankincense sector.
7	Infrastructure Provision	Building or improving processing facilities, warehouses, and road access.
8	Research and Development (R&D) Facilitation	Supporting research to create new derivative products and improve processing efficiency.
9	Building Industrial Networks	Connecting farmers with investors, processing industries, and downstream buyers.
10	Quality and Standardization	Processed products must meet international quality and safety standards to compete in the global market. The solution is coaching and certification for MSMEs processing frankincense
11	Marketing	Building brand awareness and distribution networks for processed frankincense products. The solution is integrated promotion, participation in international exhibitions, and utilization of digital platforms
12	Environmental Sustainability	Processing processes must be environmentally friendly and not damage the frankincense tree ecosystem. The solution is the implementation of sustainable agricultural practices and green processing technologies.
13	Data Protection	In implementing downstream programs involving data systems (e.g., farmer data, production data, transaction data), it is necessary to ensure a robust cyber law framework and personal data protection mechanisms in accordance with the PDP Law No. 27 of 2022. This is crucial to maintain farmer trust and prevent data misuse

CONCLUSIONS AND RECOMMENDATIONS

Frankincense production has high economic value and is used as a raw material for the perfume, pharmaceutical, cosmetic, soap, and cigarette industries. Frankincense needs to be developed to increase farmers' incomes, which requires advanced beekeeping. Frankincense forest management is part of the culture and knowledge of local communities. Frankincense forests have social, economic, and ecological benefits, so further development is needed, including efforts to intensify extension activities, establish farmer groups and/or cooperatives, monitor the frankincense resin marketing system, develop an intensive farming system, and use superior frankincense seeds, among other efforts.

The downstreaming program for frankincense production in North Sumatra is a strategic and essential step to increase community income and achieve sustainable economic development. With its status as the world's largest

frankincense producer, North Sumatra has strong capital to optimize the added value of this commodity. Challenges faced by farmers, such as limited technology and market access, can be overcome through product diversification, increased human resource capacity, and government support for the industrial ecosystem. Therefore it is necessary to take actions or steps such as. Strengthening Regulations and Policies: The North Sumatra Provincial Government and the General Elections Commission (KPU) can collaborate in developing regulations supporting downstream processing, including protecting the personal data of farmers and business actors. Investment in Research and Development (R&D) and Innovation: Encouraging collaboration between universities, research institutions, and industry to develop efficient frankincense processing technology and create new derivative products. Development of Frankincense Industry Centers: Establishing dedicated frankincense processing areas with complete facilities and good accessibility. Sustainable Mentoring Program: Providing technical training, business management, and access to capital for frankincense farmers and MSMEs processing frankincense in a sustainable manner. Aggressive Marketing and Branding: Building the image of "North Sumatra Frankincense" as a high-quality product in domestic and international markets. Implementing Data Protection: Ensuring that every information system used in the frankincense downstream value chain implements data protection standards.

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