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Clove commodity issues in productivity improvement and sustainability based on policy elements in Indonesia

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ABSTRACT

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The role of the clove industry in Indonesia's economy is crucial, as it makes a substantial contribution to the GDP and export figures. Despite experiencing growth overall, clove farmers face various challenges such as price fluctuations, climate change impacts, and limited market access. By analyzing data spanning from 2014 to 2021, this research anticipates a continuous increase in production levels but foresees a decrease in export numbers. Proposed policy measures include providing financial assistance, promoting education, enhancing infrastructure, developing markets, and ensuring environmental sustainability. It is crucial to focus on credit availability, incentives, and subsidies, while also improving agricultural education, infrastructure, and sustainable farming methods. A comprehensive approach across eight key policy areas is necessary to strengthen the clove industry in Indonesia. By addressing these challenges holistically, the clove sector can look forward to a resilient and sustainable future, maintaining its importance in the country's economic landscape.

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1. Introduction

The agricultural sector, including the plantation subsector, is the largest contributor to Indonesia's GDP. In 2018, the plantation subsector was the highest contributor to the GDP of the agriculture, livestock, hunting and agricultural services sector, amounting to 35% of total GDP (Direktorat Jenderal Perkebunan, 2021). Clove is one of the main plantation commodities in Indonesia (Siringoringo et al., 2023), which has great potential to be developed. However, clove farmers are faced with several challenges that affect their efforts in developing markets. Some of the challenges faced by clove farmers are, firstly, the selling price of cloves tends to fluctuate, which can affect farmers' income. Although clove prices are rising, these price fluctuations are still a problem for farmers. Second, erratic weather conditions, such as high rainfall or crop failure due to certain climatic conditions, can have a negative impact on clove productivity and farmers' yields. Third, traditional post-harvest management can lead to low productivity and quality of cloves. This is also one of the factors causing fluctuations in national clove productivity. Fourth, some farmers have begun to switch to other crops due to the challenges faced in clove cultivation. Dependence on one commodity can be an economic risk for farmers. Fifth, the lack of market access and adequate

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infrastructure is also an obstacle in developing markets for farmers' clove products. This can affect the distribution and marketing of crops. These complexities faced by clove farmers require implementable, data-driven government policies.

Statistical data related to the area and production of cloves in Indonesia based on the status of cultivation (smallholder, state, private) and related provinces show that the area of clove plantations cultivated by smallholders has the largest contribution to clove production in Indonesia from 2018 to 2020 (Septiani et al., 2023). North Sulawesi Province is recorded as the region with the largest area of clove crops in Indonesia, with the number of clove crops in this region reaching 75,665 hectares in 2018. Maluku has been the largest clove producing province in Indonesia since 2015 with an average contribution of 15.37%. Indonesia's clove productivity tends to fluctuate during the 2014-2020 period with an average growth rate of 1.74% per year. In 2015, clove productivity reached the highest level of 441 kg/ha of dried flowers, while the lowest productivity occurred in 2017 with a productivity of 345 kg/ha. The development of clove export value also fluctuated, but in 2018 it experienced a very significant increase of 252%, with Indonesia importing 13.37 thousand tons of cloves with a value of 105.65 million USD in the same year (Direktorat Jenderal Perkebunan, 2021). The data-based problems in the clove industry in Indonesia include a narrow area of clove plantations per farmer, old clove plants with low productivity due to traditional post-harvest management. This results in fluctuations in national clove productivity, one of which is caused by a climate that does not support the development of production. In addition, the use of cultivation (Riptanti et al., 2019) and post-harvest techniques (Bangulzai et al., 2022; Faidah Azuz & Aylee Christine Alamsyah Sheyoputri, 2017) that still do not use technological innovation (Kasmi et al., 2022) is also an obstacle in increasing clove productivity.

Solutions to improve the productivity and sustainability of clove farmers in Indonesia can therefore involve several strategic measures. First, farm input management needs to be improved to increase clove productivity (Lawalata et al., 2023; Morais et al., 2023), which could include the use of modern technology in cultivation and post-harvest. A sustainable approach to improving infrastructure and market access for clove farmers, so that farmers can obtain a fair price for their crops. The government can also provide training and mentoring to farmers to implement more efficient and sustainable farming practices (Nunes et al., 2021; Tennhardt et al., 2023; Weltin et al., 2021). Research and development of improved clove varieties can also help improve productivity and yield quality. A combined scope of technical efforts, market approaches, and government support can be a solution to improve the condition of the clove industry in Indonesia. Government support for the clove industry in Indonesia is reflected in potential policies that can be identified through eight key elements, namely financial support (L. Liu et al., 2020; Zhou et al., 2020), education and training (Bravo Lucas et al., 2022; Torrejón et al., 2022), agricultural infrastructure (Huang et al., 2021; Kaushik, 2024; M. Liu & Ji, 2020; Mazibuko & Antwi, 2019), market development (Binh et al., 2023; Ibrahim & Ali, 2021; Nugroho, 2021), environmental sustainability (Cho et al., 2023; Kasayanond et al., 2019; Yue et al., 2020), regulation and quality standards (McCannon, 2019; Nidhi Pandey et al., 2022; Walsh, 2021; WHO, 2018), food safety and health (Osaili et al., 2021), and farmer participation in decision-making (Boza et al., 2024; Khayatinejad Aggonbad et al., 2022; Mwambi et al., 2020). The theoretical foundations that can be used to detail and direct these policies include public economic theory to understand the financial support element, Economic Development Theory (Chang, 2011; Hammer & Pivo, 2017; Schumpeter, 2021) to look at the impact of education and training policies, and agricultural infrastructure on economic growth. Market and market development theory (Bicen & Hunt, 2012; Thorpe, 2022) is relevant to examine government efforts to develop markets for clove products. Meanwhile, environmental sustainability theory (Han, 2021; Stern, 2018) can guide policy development that considers the environmental impacts of clove production. Regulatory and quality standards theory (Brooks et al., 2021; Culot et al., 2021) are needed to design policies that improve product quality and maintain consumer safety. Food safety and health (De Brún et al., 2020; Patrick et al., 2022) policy aspects can be explained through related theories, and participation and decision-making theories provide a framework for involving farmers in the policy process. Reference to these theories can assist in designing comprehensive and effective policies to support the sustainable growth of the clove industry in Indonesia.

2. Methods

This study uses descriptive research methods (Creswell & Creswell, 2018) to describe the condition of the clove industry in Indonesia, as well as identify challenges and potential solutions faced by farmers based on relevant theories. The main data sources were obtained in the form of secondary data, namely 1) Indonesian Plantation Statistics 2018-2020 from the Directorate General of Plantations (Direktorat Jenderal Perkebunan, 2021), 2) Clove Outlook 2022-2026 (Pusat Data & Sistem Informasi Pertanian, 2022), Pusdatin, Ministry of Agriculture of the Republic of Indonesia which is summarized as a data collection process. Presentation of data collection results is done through visualization of statistical data related to area, production, and export of cloves. The analysis used through policy analysis is limited to coverage of eight key elements, namely financial support, education and training, agricultural infrastructure, market development, environmental sustainability, regulations and quality standards, food safety and health, and farmer participation in decision-making. The key elements are based on theoretical references and achievement targets and have standardized indicators. With this approach, the research is expected to provide a comprehensive picture of the problems and potential solutions in the clove industry, with a strong data base and detailing the impact of current, theory-based policies.

3. Results

Indonesia, as the largest clove producer, recorded an increase in clove production from 133,604 tons in 2020 to an estimated 151,710 tons in 2022, an increase of 10.22%. National productivity reached 442 kg/ha with a total area of 580.44 thousand ha, dominated by smallholder plantations (573.17 thousand ha). Clove production is growing steadily, reaching 140,012 tons in 2022 with a projected average annual growth of 1.95% until 2026 (Pusat Data & Sistem Informasi Pertanian, 2022). The positive trend reflects the stability of cloves over the period. Tonnage production projections show an increase to 151,560 tons in 2026. Indonesia's clove production not only fulfills domestic needs, it also meets export needs and is one of Indonesia's leading commodities in the global market. According to data from the Central Statistics Agency (BPS), the total volume of national clove exports during the January-December 2021 period amounted to 20.14 thousand tons. This volume decreased by 57.84% compared to exports in the same period in 2020, which amounted to 47.77 thousand tons. The total value of national clove exports also decreased by 45.58%, from US\$176.54 thousand in 2020 to US\$96.08 thousand in 2021. The projected net export volume of cloves for the period 2022-2026 shows significant fluctuations. In 2022, the net export volume of cloves reached 37,413 tons (Pusat Data & Sistem Informasi Pertanian, 2022). However, the projections show a decline in the following years. In 2023, there is a decline of 2.16%, resulting in a net export volume of 36,604 tons. This negative trend continues with a 7.46% decline in 2024, reaching a volume of 33,875 tons. In 2025, a further decline of 3.73% results in a net export volume of 32,610 tons. The 2026 projection shows a drastic decline of 35.91%, resulting in a significant net export volume of 20,901 tons. The average growth over the period is -12.31%, reflecting the challenges and dynamics that the clove export sector may face in the coming years. This projection analysis provides an overview of the significant changes in the net export volume of cloves over the projection period. The main destination countries for the country's clove exports include India, United Arab Emirates, Singapore, China, Bangladesh, Pakistan and Saudi Arabia. In 2020, clove exports to India reached 28.49% or 5.74 thousand tons. Meanwhile, the United Arab Emirates absorbed 11.47 percent and Singapore absorbed 7.76 percent. Based on the province, Maluku is the center province of cloves, namely 20.73 thousand tons (average 2017-2021). Then South Sulawesi with production followed by West Java with 8,403 tons, Central Java with 7,269 tons, Aceh with 5,513 tons, and East Nusa Tenggara with 3,576 tons (Pusat Data & Sistem Informasi Pertanian, 2022).

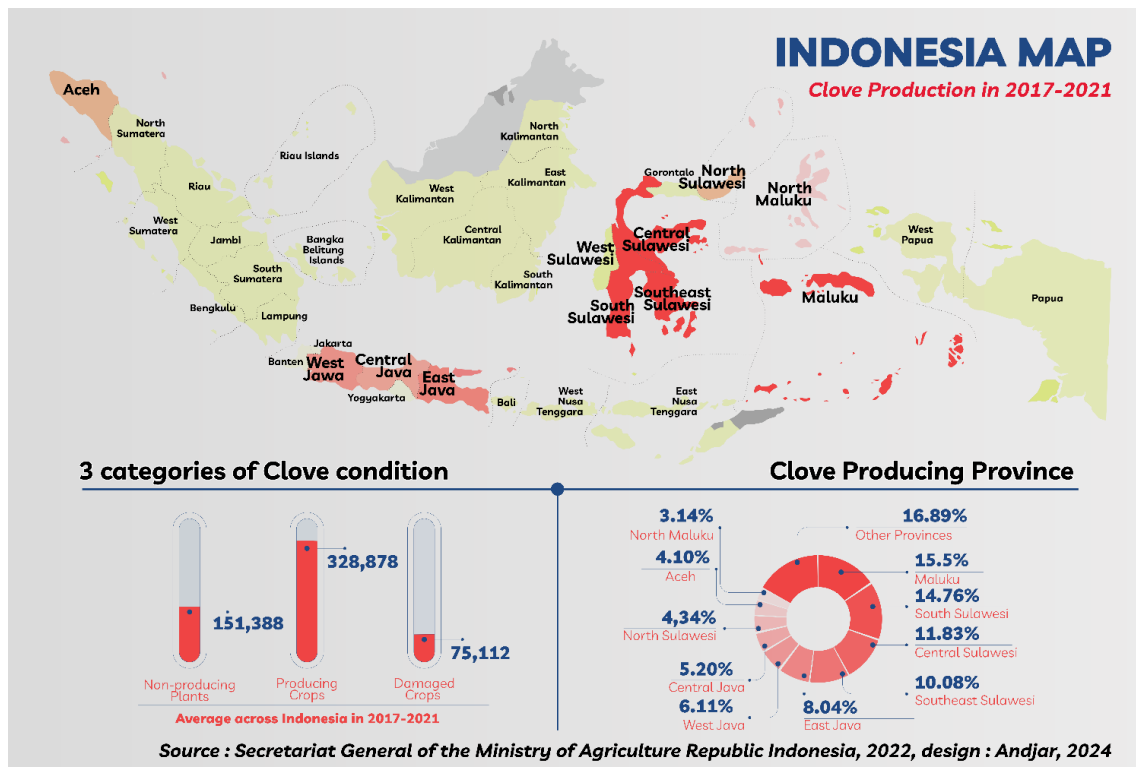


Fig. 1. Clove Production in Indonesia

In the projected timeframe of 2022-2026 (Pusat Data & Sistem Informasi Pertanian, 2022), the clove production and export industry experienced significant dynamics. In 2022, total production reached 140,012 tons, with net exports of 37,413 tons and domestic consumption of around 102,599 tons. The following year, despite a 2.16% decline in net clove exports to 36,604 tons, production and consumption rose by 5.74% and 108,488 tons, respectively. In 2024, clove production reached 146,251 tons, but net exports decreased by 7.46% to 33,875 tons, while domestic consumption rose to 112,376 tons. The growth trend continued in 2025, with production reaching 149,813 tons, net exports of 32,610 tons, and consumption of 117,203 tons. In 2026, production reached 151,556 tons, but net exports decreased significantly by 35.91%, reaching 20,901 tons, while domestic consumption increased to 130,655 tons. Average growth over this period reached 6.27%, reflecting the complexity

and variation in the dynamics of the clove industry, which is influenced by production, export and consumption factors. From 2017 to 2021 (Fig. 1), clove production in different provinces in Indonesia shows significant variations. Maluku Province is the largest contributor to clove production with an average of 20,732 tons, accounting for about 15.50% of the total national production. It is followed by South Sulawesi with an average of 19,732 tons or 14.76% of total production. Central Sulawesi also showed a significant contribution, increasing from 5,324 tons in 2017 to 20,309 tons in 2021 (Direktorat Jenderal Perkebunan, 2021). Meanwhile, some provinces such as North Sulawesi and North Maluku experienced greater fluctuations, with production tending to rise and fall significantly. Although Aceh has shown steady growth from year to year, clove production in the province is relatively small compared to other provinces. The process of production growth and fluctuation in these provinces may be influenced by several factors, including climatic conditions, agricultural techniques, and government policies in each region. It should be noted that several provinces classified as "Other Provinces" also contributed a considerable amount, reaching an average of 22,591 tons or about 16.89% of the total national production (Direktorat Jenderal Perkebunan, 2021).

Table 1
Clove Production in Indonesia in 2014-2021

Year	Indonesia Clove Area	Production Development	Non-producing Plants	Producing Crops	Damaged Crops
2014	510.175	122.134	121.222	312.118	76.833
2015	535.694	139.641	135.365	316.300	84.027
2016	545.026	139.611	138.002	327.591	79.432
2017	559.566	113.178	154.664	327.795	77.107
2018	569.052	131.014	169.544	327.337	72.170
2019	573.873	140.797	167.214	335.526	71.132
2020	575.813	145.984	163.325	340.830	71.658
2021	573.836	137.642	161.771	343.524	68.534

Source : (Direktorat Jenderal Perkebunan, 2021)

From 2014 to 2021 (Table 1), the area under cloves in Indonesia has increased significantly, rising from 510,175 hectares in 2014 to 573,836 hectares in 2021. Despite fluctuations, clove production reached its highest peak in 2020 with 145,984 tons. Analysis of crop composition shows that immature crops tend to decrease over time. On the other hand, the mature crop experienced variations, reaching its highest point in 2019 with an area of 335,526 hectares. Damaged crops also show variations, with a decline in 2021 to 68,534 hectares. In the same year, clove production decreased to 137,642 tons, reflecting the complex dynamics of the clove industry in Indonesia (Direktorat Jenderal Perkebunan, 2021). Such changes may reflect certain challenges or factors that affect the production and condition of the clove crop in Indonesia.

4. Discuss

The first policy element is financial support (table 3), which includes the availability of credit for clove farmers. In the framework of public economic theory, the financial support aspect is considered important in supporting economic growth. With the estimated production of cloves continuing to increase (Table 2), reaching 151,556 tons in 2026 with an average growth of 1.95%, then the projected volume of net exports of cloves in 2022-2026 shows significant challenges in terms of a fairly drastic decline from 2022 to 2026, as well as an average consumption growth of 6.27% (Pusat Data & Sistem Informasi Pertanian, 2022), it appears that domestic demand for cloves is increasing over time, so increasing access to credit for clove farmers is a key indicator of the success of this policy. In addition, the government's financial incentive program is also a policy element that can strengthen the financial position of clove farmers. This program is expected to provide an additional stimulus to encourage growth in the agricultural sector, especially in clove cultivation. Furthermore, farmers' access to subsidy programs is also an integral part of this policy strategy. By subsidizing farmers, the government can provide additional financial support, which can improve the welfare and competitiveness of clove farmers. Thus, this policy aims to create a conducive economic environment and support sustainable growth in the agricultural sector, particularly in clove production.

The next second policy element is education and training (Table 3), which aims to improve the knowledge and skills of clove farmers. In the context of Economic Development Theory (Schumpeter, 2021), education and training are considered key factors that can influence economic growth. The main indicator to measure the success of this policy is the level of farmer participation in the training. This increased participation is expected to create more skilled and knowledgeable clove farmers, able to face technical and managerial challenges in clove cultivation. In addition, the availability of formal education programs is also an important element, which can provide a broader knowledge (Zhang et al., 2020) base to farmers. These programs are expected to improve their understanding of important aspects of farm management, including sustainable practices. In addition, training in modern farming techniques is another focus of this policy. Through the application of more efficient and innovative farming techniques, clove farmers can improve the productivity and quality of their crops. Thus, this education and training policy seeks to create more competent clove farmers who are able to cope with the changing dynamics in the agricultural sector.

Table 2
Indonesian Clove Production, Net Export and Consumption Projections 2022-2026

No.	Year	Year Production (Ton)	Net Export (Ton)	Consumption (Ton)
1	2022	37.413	102.599	140.012
2	2023	36.604	108.488	145.092
3	2024	33.875	112.376	146.251
4	2025	32.610	117.203	149.813
5	2026	20.901	130.655	151.556

Source : (Pusat Data dan Sistem Informasi Pertanian, 2022)

The third element is agricultural infrastructure (Table 3), which includes the availability of transportation infrastructure, access to clean water and irrigation, and the availability of electricity in agricultural locations. In the perspective of Economic Development Theory (Chang, 2011; Schumpeter, 2021), infrastructure is considered a key factor that can increase the productivity of the agricultural sector. The main indicator of the success of this policy is the increased access to transportation and irrigation in agricultural areas. With the increased availability of transportation, clove farmers can be more efficient in the distribution and marketing of their crops. In addition, improved access to irrigation will provide important support in water management for agriculture, increasing crop yields and resilience to dry seasons. Policy (Goebel & Rajamani, 2021) success is also linked to access to clean water and irrigation, which provide the basis for sustainable agricultural systems. This policy aims to ensure agricultural growth by providing access to transportation, clean water, irrigation, and electricity, crucial for modern agricultural activities.

Table 3
Policy Elements in Clove Productivity and Sustainability

No.	Policy Elements	Indicator	Theory Reference	Target Achievement
1.	Financial Support	Availability of credit for clove farmers	Public Economic Theory:	Increased farmer access to credit for cloves.
2.		Government financial incentive programs	Understanding aspects of financial support in supporting economic growth	
3.		Farmer access to subsidy programs	Economic Development Theory:	
4.	Education and Training	Farmer participation rate in training	Assessing the impact of education and training on economic growth.	Increased farmer participation in training
5.		Availability of formal education programs	Economic Development Theory:	
6.		Training in modern farming techniques	Assess the role of infrastructure in increasing the productivity of the agricultural sector.	
7.	Agricultural Infrastructure	Availability of transportation infrastructure	Market Development Theory:	Improved access to transportation and irrigation in agricultural areas
8.		Access to clean water and irrigation	Examine market development and distribution strategies for agricultural products.	
9.		Availability of electricity at farm sites	Environmental Sustainability Theory: Assess the impact of agriculture on the environment and efforts to maintain sustainability.	
10.	Market Development	Availability of local and international market access	Regulation and Quality Standards Theory: Analyze the impact of regulations on product quality and consumer safety.	Increased access to local and international markets.
11.		Product promotion and marketing programs	Food Safety and Health Theory:	
12.		Farmer involvement in the supply chain	Assess efforts to maintain food safety and farmer health.	
13.	Environmental Sustainability	Implementation of sustainable agricultural practices	Participation and Decision-Making Theory: Understand the importance of farmer participation in policy development.	Increased implementation of sustainable practices.
14.		Natural resource conservation program		
15.		Availability of environmental certification		
16.	Regulations and Quality Standards	Farmer compliance with regulations and standards		Increased farmer compliance with regulations.
17.		Availability of farmer compliance incentives		
18.		Food safety practices in cultivation		
19.	Food Safety and Health	Implementation of sanitation standards in production		Improved food safety and farmer health.
20.		Level of participation in agricultural policy		
21.		Involvement in farmer organizations		
22.	Farmer Participation in Decision-Making	Consultation process in decision-making		Increased farmer participation in clove-related decision-making.

Source: Analysis Results, 2024

The fourth element is market development (Table 3), which focuses on the availability of local and international market access for agricultural products, based on market development theory (Thorpe, 2022). The main indicator of the success of this policy is increased market access, both at the local and international levels, for agricultural products, such as cloves. Enhanced market access offers clove farmers better pricing opportunities. Product promotion and marketing programs boost visibility and value, while farmer involvement in distribution enhances market access and product quality. This engagement can also create better relationships between producers and consumers, supporting economic growth at the local level. This market development policy aims to create a healthy and sustainable market ecosystem for agricultural products (Yu et al., 2020), such as cloves, by improving market access, through promotion and marketing programs, and farmer involvement in the supply chain.

The fifth element is environmental sustainability (Table 3), which focuses on the implementation of sustainable agricultural practices, grounded in environmental sustainability theory (Dentoni et al., 2017; Stern, 2018). Success is gauged by increased adoption of sustainable practices, notably in clove cultivation, mitigating agriculture's environmental impact and fostering economic sustainability. Natural resource conservation, supported by governmental programs, ensures prudent land and water

management. Environmental certification incentivizes sustainable practices, enhancing product reputation globally. This policy aims to create a balanced, environmentally-conscious agricultural landscape, particularly in clove production. This environmental sustainability policy aims to achieve a balance between economic growth and environmental sustainability through improved sustainable agricultural (Rawung et al., 2018) practices, natural resource conservation programs, and the availability of environmental certification.

The sixth element is regulation and quality standards (Table 3), which emphasizes farmers' compliance with certain regulations and standards. In the context of the regulation and quality standards theory (Nidhi Pandey et al., 2022; WHO, 2018), it is important to analyze the impact of regulations on product quality and consumer safety. The main indicator of the success of this policy is the increase in farmers' compliance with applicable regulations. With increased compliance, it is expected that the quality of products, such as cloves, can be maintained in accordance with established standards, thus providing safety and trust to consumers. The availability of farmer compliance incentives is also an important factor in this policy, as it can provide extra encouragement for farmers to comply with the regulations in force. Thus, this regulation and quality standards policy aims to create an enabling environment for farmers to comply with regulations, improve product quality, and maintain consumer safety.

The seventh element is food safety and health (Table 3), which focuses on food safety practices in cultivation, grounded in food safety and health theory (Prasetyo, 2018; Thompson et al., 2016). Success hinges on enhancing food safety and farmers' health, particularly in clove cultivation. Emphasis on food safety practices and sanitation standards aims to ensure product quality and minimize contamination risks. These efforts safeguard farmers' well-being and elevate agricultural product standards, aligning with the policy's objective of fostering a safe and healthy farming environment.

The last policy element is farmer participation in decision-making (Table 3), which focuses on the level of farmer participation in agricultural policy, based on the theory of participation and decision-making (Mwambi et al., 2020). The main indicator of the success of this policy is the increased participation of farmers in decision-making related to cloves. Involvement in farmer organizations is one of the focuses of this policy, whereby strengthening the role and organization of farmers, they can have a stronger voice in the decision-making process related to agriculture, including clove-related policies. In addition, the consultation process in decision-making is an important aspect in ensuring inclusive participation of farmers. By involving farmers in the consultation stage, the resulting policies can reflect their needs and aspirations, supporting the growth of the agricultural sector holistically. Therefore, this farmer participation in decision-making policy aims to strengthen the role of farmers in the decision-making process, open space for involvement in farmer organizations, and improve the consultation process to achieve more inclusive and sustainable policies.

5. Conclusion

Indonesia as the largest clove producer is experiencing stable production growth but faces challenges in the volume of net clove exports that decline significantly in the projected years 2022-2026, while production dynamics in various provinces reflect the complexity of climatic factors, agricultural techniques, and government policies. Meanwhile, from a policy perspective, the successful implementation of various policy elements, ranging from financial support, education and training, agricultural infrastructure, market development, environmental sustainability, regulations and quality standards, to farmer participation in decision-making, is crucial to achieving sustainable economic growth and maintaining the competitiveness of cloves as a leading commodity in the global market.

To improve the performance of the clove sector in Indonesia, several strategic recommendations need to be implemented. Firstly, there is a need to increase access to credit and financial incentives for clove farmers to support the growth of the agricultural sector. Second, education and training programs need to be strengthened to improve farmers' knowledge and skills, with a focus on modern farming techniques. Third, agricultural infrastructure, especially transport, irrigation and electricity, needs to be improved to support efficiency and productivity. Fourth, expansion of market access, through promotion, marketing, and farmer involvement in the supply chain, will open wider opportunities in local and international markets. Fifth, there is a need to increase awareness and implementation of sustainable agricultural practices with natural resource conservation programs and environmental certification. Sixth, increased compliance with regulations and quality standards can ensure product safety and quality. Seventh, farmer participation needs to be strengthened through strong farmer organizations and inclusive consultation in decision-making. Thus, these measures are expected to improve the competitiveness of the clove sector, ensure sustainable economic growth, and maintain environmental sustainability.

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