

Adaptation Strategies of Clove Farmers in Facing Climate Change in Taliabu Barat Sub-district Taliabu Island District North Maluku Province

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Abstract

Climate change is one of the natural phenomena that has a considerable impact on agriculture. This study aims to find out (1) Clove Plant Productivity in Kramat Village, West Taliabu District, Taliabu Island Regency, North Maluku Province (2) Adaptation Strategies Carried out by Clove Farmers in Kramat Village, West Taliabu District, Taliabu Island Regency, North Maluku Province. The determination of the research location was carried out purely with the consideration that Kramat Village is one of the clove producers that has unstable climatic conditions and threatens the productivity of cloves which is the main source of livelihood for farmers. The number of clove farmer respondents was 36 farmers. The data analysis used was a descriptive-qualitative analysis with a Likert scale. The results of the study showed that the productivity of clove plants in Kramat Village, West Taliabu District, Taliabu Island Regency, was only 106.60 kg/ha/year. This low productivity is caused by climatic variations in high rainfall that occurred in Kramat Village, West Taliabu District with a range of 1811.9-5118.8 mm/year. The adaptation strategies carried out by clove farmers in the face of climate change that occurred in Kramat Village, West Taliabu District, Taliabu Island Regency, are the use of extension services, changes in planting time, the use of fertilizers, the selection of resistant varieties, the clearing of ground cover, the formation of farmer groups to share knowledge, business diversification, the use of more efficient irrigation technology, the application of agroforestry, and the adoption of crop insurance.

Keywords: *climate change, productivity, cloves, adaptation strategies.*

INTRODUCTION

Indonesia is a tropical agricultural country that is famous for its diverse agricultural sector, the existence of land owned by Indonesia has made it an agricultural center that is rich in commodities in various fields, ranging from the production of rice, corn, coffee, oil palm, to spices such as cloves, Indonesia is one of the countries with very diverse agricultural potential and high competitiveness (Nasikh, *et al.*, 2023).

Climate change is a global natural phenomenon triggered by world warming due to heat energy that is not able to escape completely, where world warming means the phenomenon of increasing the average temperature of the earth's atmosphere, oceans and land as a whole, which results in an increase in the intensity of extreme climate events El-Nino and La-Nina and seasonal irregularities (Subagyo, *et al.*, 2014). Meanwhile, the Earth's climate is constantly changing, but climate change in the past took place naturally, while now it is caused by human activities, such as increasing concentrations of greenhouse gases in the atmosphere and the use of fossil fuels (coal, oil, and natural gas) as well as emissions of carbon dioxide, methane, and nitrogen oxides that accelerate the increase in Earth's temperature (Hartono, 2023). Climate change is now a global issue that is widely discussed, because its impacts have been felt in various aspects of human life, including economic losses due to natural disasters, increased health risks, and environmental damage (Antarissubhi, *et al.*, 2023).

Clove is a spice derived from the dried flowers of the clove tree (*Syzygium aromaticum* L.). The clove tree is an *original* Indonesian plant that grows in tropical areas, especially in Maluku, North Maluku and surrounding areas. However, clove plants are vulnerable to weather fluctuations caused by climate change, the result of this climate change can hamper the growth, production and quality of cloves. Seasonal uncertainty and extreme weather changes can result in decreased productivity, threatening farmers' income and the sustainability of the clove industry in Indonesia including in the West Taliabu District.

Table 1 Clove Production Data of West Taliabu District, Taliabu Island Regency

Year	Production (tons)
2019	13.750
2020	11.250
2021	8.750
2022	6.250
2023	2.150

Source: BPS Kecamatan Taliabu Barat 2023, processed 2024

The table of clove production data in West Taliabu District, Taliabu Island Regency, above shows a significant downward trend from 2019 to 2023. In 2019, clove production reached 13,750 tons, but then dropped to 11,250 tons in 2020, then to 8,750 tons in 2021, and 6,250 tons in 2022, then the highest peak decline occurred in 2023 at 2,150 tons. This decline can be caused by various factors, one of which is due to not maximizing the use of inputs such as seeds, fertilizers, pesticides and technology, but the most dominant is climate change caused by high rainfall, air temperature and length of sunlight.

Kramat Village, West Taliabu Sub-district, Taliabu Island District, North Maluku Province, is located in the eastern part of Indonesia and is known for its significant clove production, making it one of the leading commodities and a major source of income for local farmers; however, the area is vulnerable to climate change impacts. The impacts of climate change on clove farming in Kramat Village can be significant, including increased temperature and rainfall variability that disrupt the growth cycle and productivity of cloves. Higher temperatures and irregular rainfall patterns can affect the flowering period and yield of cloves. In addition, heavy rainfall poses a threat to farmers as it can slow plant growth and affect harvesting factors, thereby lowering their productivity and income. Climate change also results in substantial losses, with farmers having to deal with unstable weather conditions that often lead to crop failure, making it important to develop appropriate adaptation strategies to prevent the problems posed by climate change.

Based on the description above, it is the basis of the author's consideration to conduct research with the title "Adaptation Strategy of Clove Farmers in Facing Climate Change in West Taliabu District, Taliabu Island Regency, North Maluku Province", this study aims to determine the productivity of cloves due to climate change that is detrimental to farmers and develop appropriate adaptation strategies to overcome climate change problems.

METHOD

The population of this study were all clove farmers in Kramat Village, West Taliabu Sub-district, which amounted to 200 people. The sample is part of the number and characteristics of the population (Sugiyono, 2013). The sampling technique in this study was determined using *Simple Random Sampling* of 36 respondents determined based on the Slovin formula with an error rate of 15%. Data collection techniques were carried out by observation, interviews, literature study, and documentation. **The data analysis used in this research is:**

1. Analysis to answer objective one, how the productivity of clove farmers using the formula to calculate productivity according to Soekartawi (1994).

$$\text{Productivity} = \frac{\text{Hasil Produksi (kg)}}{\text{Luas Lahan (ha)}} = \frac{Q}{A} = \frac{\text{Quantity (kg)}}{\text{Area (kg)}}$$

Description:

Productivity = Productivity

Total Production (Q) = Annual clove production (kg)

Land Area (A) = Clove land area (ha).

2. The analysis to answer objective two, the adaptation strategy carried out by farmers is a qualitative descriptive analysis using a 5-point research scale, in analyzing data on farmers' adaptation strategies in dealing with climate change in Kramat Village, West Taliabu District, Taliabu Island Regency can be seen in table 2.

Table 2 Likert Scale Model

No.	Description	Score
1	Doing (M)	5
2	Often Do (SM)	4
3	Sometimes Doing (KM)	3
4	Rarely Do (JM)	2
5	Did Not Do (TM)	1

Each strategy is measured using a Likert scale (1-5). The data obtained is ordinal data that cannot be operated arithmetically, so the data needs to be transformed into interval data using the *Method of Succesive Interval* approach (Hays, 1976). The criteria classification uses the following formula:

$$Z = \frac{A-B}{K}$$

Description:

Z= Class Interval

A= Highest score

B= Low Value

K= Number of Classes

Based on this formula, the class interval can be calculated as follows:

$$Z = \frac{5-1}{3} = 1.33$$

The results of the interval Z = 1.33 then obtained the following categorization:

1.00-2.33 = Low

2.34-3.67 = Fair



3.68-5.00 = High

RESULTS AND DISCUSSION

Clove Crop Productivity

1. Land Area

There are three groups of farmers based on the area of land cultivated, namely the broad farmer group has a land area (>2 ha), the medium farmer group has a land area (0.5-2 ha), the narrow farmer group has a land area (<0.5 ha). The following is data on farmer respondents based on land area can be seen in table 3.

Table 3 Land Area of Clove Farmer Respondents in Kramat Village, West Taliabu Sub-district, Taliabu Island Regency

No.	Land Area (ha)	Number (Farmers)	Percentage (%)
1	<0,5	0	0
2	0,5-2	33	91,67
3	>2	3	8,33
	Total	36	100

Source: Primary Data, 2024

Table 3 based on the respondent's land area shows that the average majority of farmers from all respondents with the largest land area is dominated by the medium farmer group totaling 33 people with a percentage of 91.67 percent of the total sample, followed by a large farmer group land area with a percentage of 8.33 or 3 people. This shows that clove farmers have adequate land area for clove farming and support the potential for sustainable and productive agricultural development.

2. Fertilizer

Fertilizers used by farmer respondents in Kramat Village The following data on fertilizer use by clove farmers can be seen in table 4.

Table 4 Fertilizer Use of Clove Farmer Respondents in Kramat Village, West Taliabu Sub-district, Taliabu Island Regency

No.	Land Area (ha)	Total (Farmer)	Inorganic Fertilizer (Urea kg/ha)	Organic Fertilizer (Herbafarm liter/ha)
1	<0,5	0	0	0
2	0,5-2	33	420	30

3	>2	3	70	0
	Fertilizer kg/ha	36	490	30

Source: Primary Data, 2024

Table 4 shows that farmers with a land area of 0.5-2 hectares (33 farmers) use 470 kg/ha of urea inorganic fertilizer, while farmers with more than 2 hectares (3 farmers) use 70 kg/ha. Total fertilizer use reached 490 kg/ha/year. In addition, farmers with 0.5-2 hectares of land also use 30 liters/ha of HerbaFarm organic fertilizer. According to Sutanto and Prasetyo (2021), the optimal dose of urea fertilizer for clove crops ranges from 200-300 kg/ha/year. The use of fertilizer by farmers with 0.5-2 hectares of land is close to this figure, indicating that the dose used is high enough to meet the needs of clove plants. In contrast, farmers with more than 2 hectares of land use lower doses than recommended, indicating the need for adjustment for better efficiency.

3. Labor

The following is data on the use of labor of respondents of clove farmers in Kramat Village can be seen in table 5.

Table 5 Labor Use of Clove Farmer Respondents in Kramat Village, West Taliabu Sub-district, Taliabu Island Regency

No.	Land Area (ha)	Total (Farmer)	Production (kg/ha/year)	Number of Power work	Cost Wages kg/year
1	<0,5	0	0	0	0
2	0,5-2	33	2.047	36	51.175.000
3	>2	3	590	4	14.750.000
	Labor/ha	36	2.637	36	65.925.000

Source: Primary Data, 2024

Table 5 shows that the labor use of respondents of clove farmers in Kramat Village consists of 36, where 32 workers come from farmers with a medium land area of 0.5-2 and produce a production of 2,047 kg/year with a wage of Rp.51,175,000. While the other 4 people produced 590 kg/year with a wage cost of Rp.14,750,000. This shows the amount of expenditure used by farmers to pay the cost of labor which further impacts on economic losses for farmers because they have to continue to pay the wages of labor used even though the production obtained is low. This research is in line with Mulyadi 2016, that the success of the business can

be seen from the amount of output (*output*) and labor is one of the important production factors in farming because it can affect the amount of costs incurred in farming.

Productivity

The following is data on the productivity of clove plants in Kramat Village, West Taliabu Sub-district, as shown in Table 6.

Table 6 Productivity of Clove Crops in Kramat Village, West Taliabu Sub-district, Taliabu Island District, North Maluku Province

No.	Category Land (ha)	Land Area (ha)	Total Farmer (Soul)	Production (kg/year)	Productivity (kg/ha/year)
1	<0.5 (Narrow)	0	0	0	0
2	0.5-2 (Medium)	43	33	2.047	47,60
3	>2 (Broad)	10	3	590	59
	Productivity kg/ha	53	36	2.637	106,60

Source: Primary Data, 2024

Table 6 shows that clove farmer respondents in Kramat Village, West Taliabu Sub-district, Taliabu Island Regency have variations in land area owned but show low productivity. A total of 33 farmer respondents have a land area of 0.5-2 ha with a total production of 2,047 kg/year and productivity of 47.60 kg/ha/year. In contrast, there were 3 farmers with a land area of >2 ha with a total production of 590 kg/year and productivity of only 59 kg/ha/year. This data illustrates that an increase in land area does not automatically increase productivity, indicating that there are other factors that affect yields. The productivity of the clove crop in Kramat Village is low when compared to the productivity of the national clove crop in 2023, which reached 402 kg/ha/year (Siagian, 2023). This figure shows that clove productivity in Kramat Village is still far from the national average productivity with a very significant difference. This low productivity indicates a serious challenge in clove cultivation practices.

Adaptation Strategies by Clove Farmers

Adaptation strategies in this study include steps and efforts taken by farmers in overcoming the impacts of climate change that refer to adaptation strategies according to Khanal *et al*, (2018), where in his research confirmed several strategies or efforts that can be used by farmers in overcoming the impacts of climate change including the use of extension

services, changes in planting time, the use of fertilizers, the formation of farmer groups to share knowledge, business diversification, the use of more efficient irrigation technology, the application of agroforestry and the adoption of crop insurance. These strategies are expected to reduce the vulnerability of clove farmers to economic and environmental risks caused by climate instability, especially rainfall, and maintain the sustainability of productivity and adaptability of clove crops in Kramat Village, West Taliabu District in the long term.

Table 7 Adaptation Strategies of Clove Farmers in Facing Climate Change

No .	Adaptation Strategy	Answer Scale					Average Total Score	Category
		M	SM	KM	JM	TM		
1	Utilization of extension services	12	0	0	0	24	2,33	Low
2	Change in planting time	0	0	0	0	36	1	Low
3	Fertilizer use	20	0	0	0	16	3,22	Simply
4	Selection of climate-resilient varieties	36	0	0	0	0	5	High
5	Ground cover clearance	25	0	11	0	0	4,38	High
6	Formation of farmer groups to share knowledge	0	0	0	0	36	1	Low
7	Business diversification	25	0	11	0	0	4,38	High
8	Use of more efficient irrigation technology	0	0	0	0	36	1	Low
9	Application of agroforestry	14	0	0	0	22	2,55	Simply
10	Crop Insurance Adoption	0	0	0	0	36	1	Low

Source: Primary Data, 2024

Table 7 shows the results of the questionnaire with clove farmers regarding adaptation strategies in the face of climate change to increase productivity and adaptability and sustainability of clove farming in Kramat Village as follows

1. Utilization of Extension Services shows that 12 respondents stated that they implemented the utilization of extension services by attending training and counseling conducted by the local Agriculture Office while 22 other respondents stated that they



did not, the average score reached 2.33 and fell into the low category. The lack of access to extension services from the local government needs to be improved. Research by Munawar et al. (2023) emphasized the important role of government agencies in addressing farmers' problems through well-managed extension services. Extension services are important to deliver agricultural information so that farmers can manage their businesses well and increase productivity. Therefore, evaluation and improvement of the existing system is necessary.

2. Changes in planting time, shows that 36 respondents stated that they did not apply the strategy of changing planting time with an average value of 1 and fell into the low category. This is due to the unique characteristics of clove crops that differ significantly from annual crops. Research by Nurhayati (2018) shows that cloves are perennial plants that can last for tens or even hundreds of years. These characteristics make the strategy of changing planting time irrelevant for clove farmers, as planting time is determined by land and seed readiness, not by the seasonal calendar.
3. The use of fertilizers, as many as 20 respondents stated that they did and 16 others stated that they did not with an average of 3.22 in the sufficient category. This shows that respondents' awareness of the importance of fertilization to produce optimal clove production is quite good. The fertilizers used by clove farmer respondents in Kramat Village consist of two types, namely inorganic urea fertilizer and herbafarm organic fertilizer. The fertilizer is applied by scattering urea fertilizer around the clove tree and spraying Herbafarm liquid organic fertilizer. The application of urea fertilizer aims to increase soil fertility around the clove roots, thereby increasing the absorption of nutrients by plants. Meanwhile, farmers with medium land use Herbafarm fertilizer to avoid chemical contamination, aiming to increase the vegetative and generative growth of plants as well as resistance to pests and diseases. The combination of the two types of fertilizers is expected to significantly increase clove productivity and fruit quality. Research by Rahma et al. (2020) supports that applying fertilizers in accordance with soil fertility and plant needs can result in better production.
4. Selection of Climate Resistant Varieties shows that 36 respondents stated that they implemented a strategy of selecting types of clove varieties that are more resistant to climate change with an average score of 5 with a high category. This effort is carried out by replacing clove plants that are old or attacked by pests or diseases or die with new plants, namely climate-resistant varieties of cloves which aim to restore production and adaptability of cloves in a sustainable manner. Replacing old or infested and dead clove





plants is a strategic step in facing the challenges of climate change, indicating that this strategy is implemented effectively and is included in the high category. Adaptation through the development of more resistant varieties is important to increase productivity and adaptability of cloves in a sustainable manner. Clove farmers developed the zansibar variety, one of the superior varieties derived from the afo cloves of Ternate Island, known worldwide as zanzibar cloves. This variety has wide adaptability to various environmental conditions, high production levels, and good quality, characterized by fast growth, many branches, and medium-sized dense flowers (Soenarsih et al., 2023).

5. Opening of soil cover to anticipate inundation due to rainfall where as many as 25 respondents said they did it and 11 others said they sometimes did it with an average value of 4.38 and included in the high category. This strategy is carried out by opening and cleaning the cover or soil barrier from dry leaves from clove plants by rotating, this effort is commonly called clove farmers in Kramat Village by the name Roda. Riyanto, et al. (2022), emphasized that tillage practices such as clearing ground cover and loosening can increase water infiltration and reduce inundation on farmland. These techniques help improve soil aeration and support optimal root growth, but need to be done carefully to avoid erosion and long-term soil structure disturbance.
6. The formation of Farmer Groups for Knowledge Sharing showed that 36 farmer respondents stated that they did not carry out and implement this adaptation strategy with an average score of 1 and fell into the low category, this was due to several things including the lack of knowledge among farmers about these strategies and the limitations of adequate resources in this case social and financial capital. A total of 36 farmer respondents stated that capital was the main factor hindering the implementation of this adaptation strategy. Capital is needed to finance operational activities, procurement of shared equipment and capacity building of members. This is in line with research conducted by Prasetyo and Awaludin (2021), confirming that social and financial capital has a significant role in the formation and strengthening of farmer groups, the availability of capital is not only important for group initiation but also plays a crucial role in maintaining the sustainability of farmer groups.
7. Business Diversification, 23 respondents have done it and 13 have not done it with an average score of 4.38 and falls into the high category. This shows a positive response to climate change adaptation where this practice not only helps reduce the risk of economic losses caused by unpredictable fluctuations in weather conditions, but also expands farmers' sources of income. Diversification by farmers includes planting food crops,





vegetables, chili, and fruits, as well as raising chickens and fishing to meet daily needs, and producing local processed foods from food crops; this aims to reduce dependence on one main crop and earn side income. This adaptation strategy is in line with Hidayat's (2023) opinion, which states that business diversification has a positive impact on reducing risk, increasing farmers' income, and strengthening local food security. Meanwhile, the 12 respondents who did not diversify admitted that they were limited by capital and skills, so they only focused on clove farming.

8. The use of more efficient irrigation technology shows that 36 clove farmer respondents admitted that they did not carry out this adaptation strategy with an average score of 1 and fell into the low category. This is due to the respondents' limited information and finances in providing and buying or using the technology. Because the implementation of this strategy requires considerable costs, especially if it is used for clove plants that have long planting distances and large farms. This is in line with the findings of research conducted by Harsono and Sari (2022), which confirms that limited access to information and financial resources is often a major obstacle for farmers in adopting new technologies and adaptation strategies needed to increase productivity and farm sustainability, in addition to high costs and lack of knowledge affecting farmers' ability to implement advanced technology.
9. Agroforestry implementation, as many as 14 respondents said they did, with an average value of 2.55, which means it is in the moderate category. Agroforestry is a land management system that combines agricultural crops with forestry crops. Efforts to improve the sustainability of agricultural land are carried out by maintaining protective plants around clove crops, such as large hardwood and dense-rooted trees that can be used as raw materials for cooking firewood, reflecting awareness of the importance of tree integrity in agricultural systems. The aim of this practice is to reduce soil erosion, increase biodiversity and diversify income from forest products, as well as reduce expenditure on fuel oil and gas. Clove farmers implement agroforestry with valuable shade crops, such as fire wood and building boards, but 22 farmers do not do so due to lack of knowledge and resources. The results of Lestari and Pramono's (2014) research show that agroforestry can provide benefits for farmers, improve soil structure, and protect against atmospheric changes.
10. Adoption of Crop Insurance shows that the farm insurance strategy as many as 36 respondents claimed not to have carried out this strategy with an average score of 1 and in the low category. This is due to the crop insurance program that has not been provided



by the local government, all respondents claimed to be given information by the local government on how to get farm insurance by submitting a request proposal but until now there has been no reply from the local government regarding the proposal that has been submitted. This is in line with the research proposed by (Prasetyo, *et al.* 2021) asserting that limited access and slow response from government programs are often the main obstacles in the adoption of agricultural insurance. Uncertainty and shortcomings in the provision of insurance programs hinder farmers' efforts to reduce the risks of climate change to clove farming.

CONCLUSION

Based on the analysis and discussion of this research, it can be concluded that the productivity of clove plants in Kramat Village, West Taliabu Sub-district, Taliabu Island Regency, is 106.60 kg/ha/year.

Adaptation strategies carried out by clove farmers in the face of climate change are the utilization of extension services, changes in planting time, use of fertilizers, selection of resistant varieties, clearing ground cover, formation of farmer groups to share knowledge, business diversification, use of more efficient irrigation technology, application of agroforestry, and adoption of crop insurance.

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