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Original Article

Development of Agroforestry on Degraded Land in the Saree Grand Forest Park, Indonesia

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ABSTRACT
Traditional agricultural efforts carried out by converting forest land into agricultural land are often the cause of critical land degradation. Wise actions are needed to rehabilitate critical land to increase land productivity and create sustainable land use, one of which is agroforestry. The problem in this study is how to develop agroforestry on critical land in the Saree Forest Park. The purpose of this study was to determine the development of agroforestry on critical land in the Saree Forest Park. The population in this study was all farmers in the Saree Forest Park. This type of research is field research (Field Research) and library research (Library Research). Data sources in this study include primary data and secondary data. Data collection techniques in this study are observation, interviews, questionnaires, and documentation. Data processing uses simple statistical formulas and Likert scale calculations. Based on the results of data processing, it can be concluded that those who answered strongly agree were 76%, and those who answered agree were 19%. While respondents who answered disagree were 4%, and those who answered agree " were 1%. Thus, the Development of Agroforestry in the Saree Forest Park is appropriate and appropriate.

KEYWORDS:
Development;
Agroforestry;
Critical Land

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INTRODUCTION

Traditional agricultural efforts carried out by converting forest land into agricultural land are often the cause of critical land. In Indonesia, farming practices and land use that do not or do not pay attention to soil and water conservation principles lead to the occurrence of critical land, erosion, drought disasters, and a decrease in the quality and quantity of agricultural products (Suryanto et al., 2019; Rahman & Fitriani, 2021). Wise actions are

needed in rehabilitating critical land so that it can increase land productivity and can also create sustainable land use. Agroforestry is a soil and water conservation action through crop management to control erosion and surface water flow through layered crown structures, as well as affect the permeability and formation of soil aggregates. According to Nair (1982), agroforestry is an integrated land use system, which has social and ecological aspects, carried out through the combination of trees with agricultural crops and/or livestock (animals), either together or in turn, so that from one unit of land the total yield of plants or animals is achieved in a sustainable sense.

Agroforestry is an effective approach in soil and water conservation, as well as increasing land productivity in a sustainable manner (Nair et al., 2021). This system integrates trees with agricultural and/or livestock crops in a single land, either simultaneously or in turn. This approach has been shown to be able to control erosion, increase water infiltration, and improve soil structure (King & Chandler, 1978; Brady & Weil, 2019).

One of the most recent studies by Dharmawan et al. (2023) highlights the implementation of soil and water conservation in Indonesia, including the role of agroforestry in improving biodiversity, hydrology, and microclimate. This study emphasizes the importance of conservation strategies that involve local communities and traditional knowledge to achieve sustainable ecological landscape management (Dharmawan et al., 2023; Putra et al., 2020).

Agroforestry offers a wide range of techniques that can be applied to soil and water conservation. According to a study published in ResearchGate (2023), agroforestry techniques such as planting protective trees, using ground cover crops, and crop rotation can reduce soil erosion, improve soil fertility, and increase carbon sequestration. The widespread application of this technology can help restore affected lands and improve food security and environmental sustainability (Smith et al., 2018).

A study by Wulandari et al. (2023) in the Cikeruh Hulu Sub-Watershed, West Java, assessed the level of land criticality and its suitability for agroforestry. The results showed that most areas showed critical land conditions, with productivity as the main limiting factor. This study emphasizes the importance of spatial assessments that integrate biophysical and socio-economic parameters to guide sustainable land management practices (Wulandari et al., 2023; Kurniawan & Anggraini, 2022).

Agroforestry is defined as a sustainable land management system that integrates the production of agricultural crops (including annual crops) with forest crops and/or animals (livestock), either simultaneously or in turn, on a single plot of land (King & Chandler, 1978; Nair, 1993). This system applies practical management techniques that are in accordance with the culture of the local community, with the aim of increasing overall land production.

Agroforestry systems contribute significantly to increasing soil fertility through high litter accumulation. This litter provides a source of nutrients for soil microorganisms, which play an important role in the decomposition of organic matter and nutrient cycling (Silva et al., 2023; Brady & Weil, 2019). A study by Silva et al. (2023) shows that coffee agroforestry systems in semi-arid regions of Brazil increase nutrient stocks in litter and soil microbial activity, compared to monoculture farming systems.

In addition, research by Heděnec et al. (2020) revealed that mycorrhizal associations in common European trees affect the biomass and metabolic activity of bacterial and fungal communities in the soil. This suggests that tree types in agroforestry systems can affect the structure and function of soil microbial communities, which in turn impacts soil fertility.

Agroforestry systems have evolved into important scientific and practical approaches in sustainable landscape management, especially in the face of land degradation and declining soil productivity. Agroforestry combines elements of forestry, agriculture, and livestock in one integrated land management unit, resulting in economic, ecological, and social benefits (Jose, 2009; Nair et al., 2021).

A recent study by Nair et al. (2021) states that agroforestry is not only an integrated system of agricultural crops and trees, but also includes the management of ecosystem functions such as nutrient cycling, improvement of soil organic matter, and water conservation. This system has been shown to be effective in reducing the rate of erosion, increasing water infiltration, and improving soil structure and aggregation through litter accumulation and soil microbial activity.

It is also important to adapt agroforestry design to local wisdom and local agroecological conditions. As shown in the Tropenbos Indonesia report (2023), the success of agroforestry scaling-up is highly dependent on the adaptation of the system to the culture, preferences, and needs of local communities, which is key to

sustainable landscape management (Tropenbos Indonesia, 2023).

Optimal and sustainable use of critical land is important for farmers and communities. From these problems, the idea arises to implement a spatially optimal land use system, which combines agricultural crops and timber plants, becomes a form of agroforestry system for critical land management, and can overcome environmental damage and increase agricultural productivity which ultimately increases farmers' income (Sari et al., 2022; Wulandari et al., 2023).

METHOD

According to Arikunto (2010), the population is the entire subject of the study, while the sample is a part or representative of the population to be studied. In this context, the study population includes all farmers who carry out agricultural activities around the Sarae Forest Park.

Arikunto (2010) also stated that if the number of research subjects is less than 100, the entire population should be taken as a sample, so that the study is a population study. However, if the number of subjects is more than 100, then between 10% and 25% can be taken as a sample, depending on the needs and resources of the research.

In this study, the number of active farmers around the Saree Forest Park was 85 people. Since the number is less than 100, the entire population was taken as a research sample. Thus, this study uses a census approach, in which all members of the population are made respondents.

This research uses a combined approach between *field research* and *library research*.

1. Field research is a method of collecting data directly from the subject or research object in a specific location. According to Kapiszewski, MacLean, and Read (2015), field research allows researchers to understand the social context and dynamics that influence the behavior of research subjects in depth.
2. Literature research is conducted to obtain a theoretical framework that is relevant to the research topic. Mann (2015) explained that literature research assists researchers in identifying, evaluating, and synthesizing existing literature to support the analysis and interpretation of field data.

The combination of these two methods provides a comprehensive understanding of the phenomenon being studied, particularly in the context of agroforestry and critical land rehabilitation.

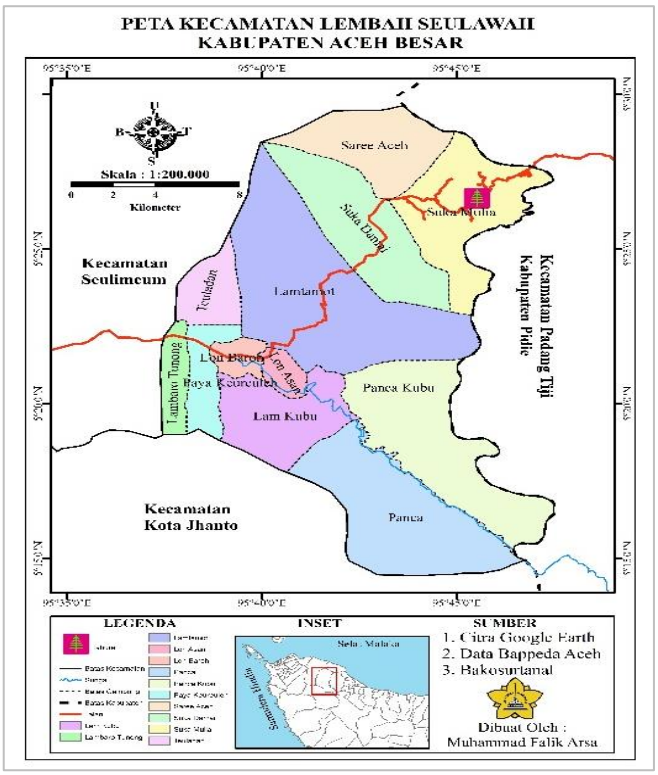

Figure 1. Map of the Research Location

Figure 2. Research Location

RESULTS AND DISCUSSION

Degraded or critical land is a pressing environmental issue faced by many forested regions in Indonesia, including the Saree Grand Forest Park. The degradation of land not only affects ecological balance but also undermines the socio-economic well-being of local communities whose livelihoods depend on forest resources. Agroforestry, which integrates agricultural crops with tree cultivation, has emerged as a promising land-use strategy to rehabilitate degraded areas while supporting sustainable livelihoods. In this context, understanding the perceptions and readiness of local communities toward agroforestry implementation is essential for formulating effective land restoration programs. This study aims to explore the potential of agroforestry development on critical land within the Saree Grand Forest Park based on empirical data obtained through local community responses.

First, the critical land in the Saree Grand Forest Park requires immediate attention and sustainable empowerment strategies. This necessity is evidenced by 80% of respondents who strongly agreed and 20% who agreed that action is urgently needed. Such overwhelming consensus underscores the severity of land degradation in the area and supports the need for restorative interventions, particularly those that align with ecological and community goals.

Second, farmers residing in the Saree Forest area have demonstrated a substantial familiarity with agroforestry systems. This is reflected in the responses, where 70% of participants strongly agreed and 30% agreed that they understand the principles and practices of agroforestry. The presence of this existing knowledge base indicates a favorable condition for the introduction and scaling up of agroforestry as a local land management strategy.

Third, the cultivation of agroforestry crops is perceived as an effective measure to mitigate the extent of critical land. Notably, 100% of respondents expressed strong agreement with this statement, showing unanimous support. This high level of agreement suggests that agroforestry is widely recognized for its environmental benefits, particularly in terms of improving soil stability and land productivity.

Figure 3. Tahura Land Condition

Fourth, the development of agroforestry around the Saree Grand Forest Park is believed to contribute positively to ecosystem protection. According to survey results, 80% of respondents strongly agreed and 20% agreed that agroforestry practices can help preserve ecological integrity. This finding highlights the potential of agroforestry not only as a land rehabilitation method but also as a strategy for enhancing biodiversity and environmental resilience.

Fifth, seasonal crops such as corn, chili, sweet potato, and cocoa are considered suitable for cultivation on degraded lands. This view is supported by 70% of respondents who strongly agreed and 20% who agreed, although 10% expressed disagreement. Despite minor opposition, the majority opinion indicates the feasibility of integrating seasonal crops into agroforestry systems for both ecological and economic benefits.

Figure 4. Condition of Land That Has Been Cultivated Using the Agroforestry System

Sixth, the application of agroforestry on critical land in the Saree Forest Park is regarded as an appropriate and contextually relevant approach. Survey data show that 30% of respondents strongly agreed, 40% agreed, while 20% disagreed and 10% strongly disagreed. Although there is some variation in opinion, the majority support reflects general approval for agroforestry as a land-use solution.

Seventh, teak (*Tectona grandis*) and mahogany (*Swietenia macrophylla*) are identified as highly compatible species for agroforestry systems in the region. This is affirmed by 80% of respondents who strongly agreed and 20% who agreed on their suitability. The preference for these species suggests their adaptability and potential value in both ecological restoration and timber production.

Eighth, the implementation of agroforestry in the Saree Forest Park is believed to significantly reduce soil erosion. The responses reveal that 90% of participants strongly agreed and 10% agreed with this statement. This consensus supports the view that agroforestry practices can play a crucial role in controlling erosion and preserving soil health in vulnerable landscapes.

Ninth, agroforestry development is perceived as a viable means of improving the economic conditions of local communities. This is clearly demonstrated by 100% of respondents who strongly agreed that agroforestry has the potential to boost livelihoods. By integrating income-generating crops with sustainable land use, agroforestry offers a dual benefit for both environmental and economic development.

Tenth, overall, agroforestry is viewed as an effective approach to reducing critical land in the Saree Forest Park. A total of 60% of respondents strongly agreed, 30% agreed, and only 10% disagreed, indicating broad support for this strategy. This suggests that agroforestry holds promise as a long-term solution to land degradation challenges in the area.

Based on the results of the questionnaire regarding research on agroforestry development on critical land in the Saree Forest Park, it can be presented in the tabulation of the questionnaire jawban, which can be seen in table 1.

Table 1. Questionnaire answers by respondents on Agroforestry Development in Saree Forest Park

No	Statement	Alternative Answers			
		SS	S	KS	TS
	Total Likert Score	**4**	**3**	**2**	**1**
1	Critical land in Saree Forest Park needs to be empowered	8	2	-	-
2	Farmers in the Saree Forest area are familiar with the agroforestry system	7	3	-	-
3	Planting agroforestry crops can reduce critical land	10	-	-	-
4	The development of agroforestry around the Saree Forest Park can protect the ecosystem	8	2	-	-
5	Seasonal crops such as jangung, chili, sweet potato, and cocoa can be planted on critical land	7	2	1	-
6	The development of critical land in the Saree Forest Park using agroforestry is appropriate	3	4	2	1
7	Teak and mahogany plant types are very suitable for agroforestry crop systems	8	2	-	-
8	The development of agroforestry crops in the Saree Forest Park can reduce erosion	9	1	-	-
9	Agroforestry crops can improve the community's economy	10	-	-	-
10	The development of agroforestry is able to reduce critical land in the Saree Forest Park	6	3	1	-
	Sum	**76**	**19**	**4**	**1**
	Percentage	**76%**	**19%**	**4%**	**1%**
	Total Amount		**100%**		

Source: Research result

Information:

SS = Strongly Agree (Agroforestry Development in Sarae Forest Park)

S = Agree (Agroforestry Development in the Sarae Forest Park)

KS = Disagreement (Agroforestry Development in the Saree Forest Park)

TS = Disagree (Agroforestry Development in Saree Forest Park)

After the questionnaire data is collected as a whole about the Development of Agroforestry in the Saroe Forest Park, data processing can be carried out using the formula:

$$\boldsymbol{P = \frac{\sum f}{\sum n.\sum x} \times 100\%}$$ (Sudjana, 2004)

Information:

P = Percentage

$\sum f$ = Frequency of answers

$\sum n$ = Number of respondents

$\sum x$ = Number of questions/statements

100%= Fixed number

1. $Pss = \frac{\sum(76)}{\sum(10).\sum(10)} \times 100\%$

$= \frac{76}{100} \times 100\%$

$= 76\%$

2. $Ps = \frac{\sum(19)}{\sum(10).\sum(10)} \times 100\%$

$= \frac{19}{100} \times 100\%$

$= 19\%$

3. $Pks = \frac{\sum(4)}{\sum(10).\sum(10)} \times 100\%$

$= \frac{4}{100} \times 100\%$

$= 4\%$

4. $Prs = \frac{\sum(1)}{\sum(10).\sum(10)} \times 100\%$

$= \frac{1}{100} \times 100\%$

$= 1\%$

Based on table 1 and the results of data processing above, it can be concluded that the development of agroforestry in the Saree Forest Park is appropriate and appropriate. Respondents who answered strongly agreed with 76% and those who answered agreed with 19%. Meanwhile, respondents who answered disagree amounted to 4% and those who answered disagree amounted to 1%.

CONCLUSION

Based on the results of data analysis and discussion of research results, the conclusion that can be drawn is that the development of agroforestry on critical land in the Saree Forest park is appropriate. This can be proven based on the results of the percentage of respondents answering in favor of more than the majority of 76%, very few answering yes 19%, very few answering disagreeing 4%, and very little answering disagree 1%. Thus, the development of agroforestry on critical land in the Saree Forest park is appropriate to reduce critical land in UPTD Tahura.

The development of agroforestry on critical land in the saree forest park is known that critical land in UPTD Tahura needs to be empowered considering that at several points in UPTD Tahura there are critical lands. Farmers at UPTD Tahura are already familiar with the agroforestry system. Knowledge about the agroforestry system at UPTD Tahura obtained by farmers from UPTD Tahura Pocut Meurah Intan Saree's counseling. Thus, the planting of agroforestry system plants can reduce critical land in UPTD Tahura. In addition, the development of agroforestry systems around UPTD Tahura can also maintain the ecosystem.

Agroforestry crops such as seasonal crops (jangung, sweet potato, chili, and chocolate) can be planted on critical land. This seasonal crop can be

planted on slopes and critical land in UPTD Tahura. These seasonal plant seeds were distributed by UPTD Tahura Pocut Meurah Intan Saree to farmers around UPTD Tahura to be planted on critical land. In addition, the development of critical land in UPTD Tahura using the agroforestry system is appropriate. This can be seen from the farming system of farmers around UPTD Tahura on critical land.

Teak and mahogany plants are also planted at several critical land locations in UPTD Tahura. Teak and mahogany plants are perfect for agroforestry systems. In addition, the development of agroforestry plants at UPTD Tahura can reduce erosion.

Crop yields using agroforestry systems can improve the economy of the local community. This is one of the goals of empowering farmers by UPTD Tahura Pocut Meurah Intan Saree to reduce critical land and reduce illegal logging in UPTD Tahura.

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Conflict of Interest: The authors declare that there are no competing interests relevant to the content of this article.

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