TECHNICAL REPORT 2024

Perigi Project of Sustainable Community Based Reforestation and Enterprise (SCORE), CIFOR-UNSRI-NIFoS Action Research

Center of Excellence Peatland and Mangrove Conservation and Productivity Improvement (CoE PLACE)

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Foreword

Indonesia is one of the countries in the world that has extensive peatlands. Indonesian government has made several important commitments toward protection and restoration of peatlands. Paludiculture, the cultivation of biomass on wet peatlands can be a viable restoration option. The agroforestry technique contributes to peat formation (increase the carbon stock) while producing commodities such as food, fibre, bioenergy, and other Non-Timber Forest Products (NTFPs). There are already practices of low-impact agriculture on shallow peatlands. Respecting this type of traditional knowledge in combination with new technologies of paludiculture systems, a resilient and sustainable peatland use model can be designed. However, much research is to be carried out to know if these systems are feasible to protect peat soil against degradation and if they deliver socio-economic benefits to the communities.

In Perigi Village, Pangkalan Lampam District, Ogan Komering Ilir Regency, South Sumatra, CoE Place UNSRI has been conducting action research on the restoration of damaged peatlands using a climate-smart agro-silvo-fishery method since 2018 in accordance with the LoA from CIFOR. The actions taken have had a beneficial effect. By extending the Memorandum of Understanding that was signed on August 18, 2023, UNSRI and CIFOR have decided to continue their collaboration. The Unsri team began using the agrosilvofishery approach last year, extending 12 acres with 11 farmers.

Since two last year tree and fruit plant planting was done involving 11 farmers. Planting activities have gone smoothly as planned, but the long dry conditions in 2024 have caused many plants get burn to death. This report is the technical report of the activities carried out in the year of 2024.

Palembang, January 2025

Prof. Dr. Rujito Agus Suwignyo
Director of CoE Place

Contents

I. INTRODUCTION

Peatlands are terrestrial wetland ecosystems in which waterlogged conditions prevent plant material from fully decomposing. Consequently, the production of organic matter exceeds its decomposition, which results in a net accumulation of peat. Ecosystems around peatlands are generally areas between 2 large rivers so that overflowing river water can inundate the area for a long period of time. The existence of this ecosystem causes peatlands to be mapped based on the Peat Hydrological Unit (KHG). The area of peatlands in Indonesia is around 14.91 million ha, spread over Sumatra 6.44 million ha (43 %), Kalimantan 4.78 million ha (32 %), and Papua 3.69 million ha (25%). Indonesia's peatlands are estimated to cover half of all peatland areas throughout the tropics and are equivalent to 84% of peatlands in Southeast Asia. South Sumatra province has a peatland area of 1.28 million ha, 0.78 million ha of which is degraded peat covered with grasses and scrub. The occurrence of fires on peatlands that always occur during extreme dry season weather conditions causes the need for an integrated and sustainable management of peatland ecosystems. This problem is always repeated and becomes a very serious problem in South Sumatra Province.

Moreover, it can be seen that the root of the problem of peatland fires is related to meeting the needs of daily life. Exploitation of the environment by not thinking about its carrying capacity causes environmental sustainability to be neglected. This phenomenon should make us more aware to correct socio-ecological thought patterns and actions so far while still paying attention to the socio-ecological future of peatlands through actions that will be useful to the people in the areas. This action is important because the environmental problems that arise are the product of the interaction between humans and nature/environment. Since peatland fires are also related to many dimensions of people's life, it is important to formulate a comprehensive strategy to save the future of the environment.

Realizing the urgency to act, Indonesia has made several important commitments toward protection and restoration of peatlands. Agroforestry and paludiculture, the cultivation of biomass on wet peatlands can be a viable restoration option. These techniques contribute to peat formation (increase the carbon stock) while producing commodities such as food, fibre, bioenergy, and other Non-Timber Forest Products (NTFPs). There are already best practices of low-impact agriculture on shallow peatlands. Respecting this type of traditional knowledge in combination with new technologies of agroforestry and paludiculture systems, a resilient and sustainable peatland use model can be designed. However, much research is to be carried out to know if these systems are feasible to protect peat soil against degradation and if they deliver socio-economic benefits to the communities.

For supporting Indonesia Policy in protection and restoration of peatlands, since 2018 CIFOR, UNSRI and partners have been carrying out research on restoration of heavily degraded peatlands using ***Climate Smart Agrosilvofishery*** approach on a demonstration plot of 3 ha located in Perigi Village, Pangkalan Lampam District, Ogan Komering Ilir Regency in South Sumatra. The activities carried out have shown positive results, such as: trees planted have shown good health and growth, agricultural productivity (paddy yield and pinapple) enhanced, the community has actively participated in implementing the program, the community has participated in protecting the land from fires during the dry season, etc.

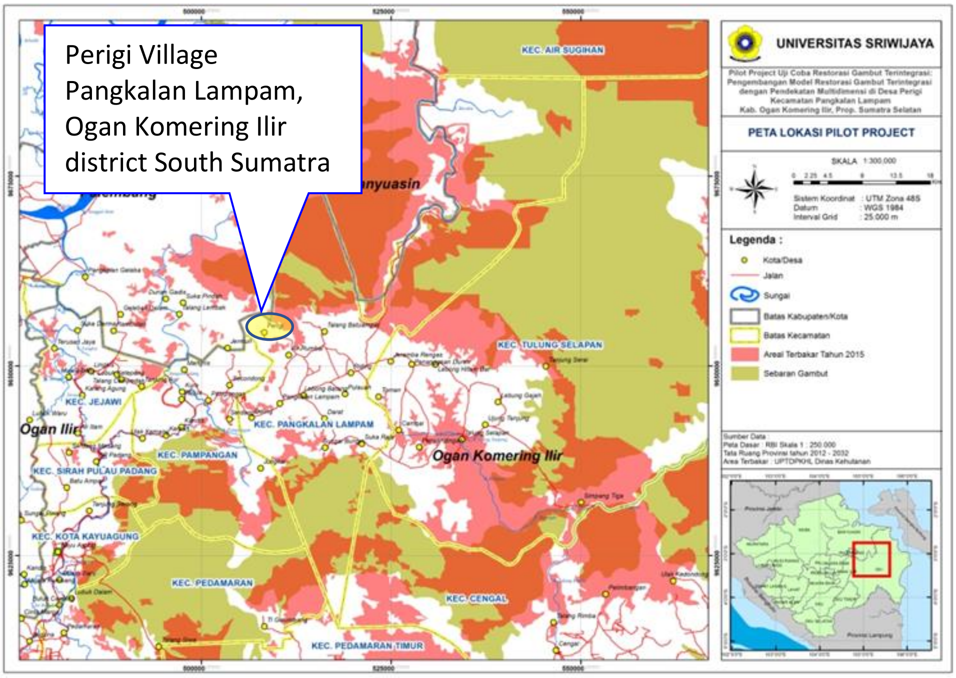


Figure 1.1. Map of the location of peat restoration activities in Perigi Village, Pangkalan Lampam District, Ogan Komering Ilir Regency, South Sumatra Province

Perigi village is located in Pangkalan Lampam subdistrict in Ogan Komering Ilir district South Sumatra Province (Figure 1.1). Peatlands in Perigi village can be classified as degraded, with diminished hydrological, production, and ecological functions. Deterioration of their chemical, physical and biological properties has decreased their productivity, with some areas becoming unproductive. The people in Perigi village have long used timber from trees covering the peatlands and practiced ‘sonor’ shifting cultivation in growing rice. This village is one of the locations in South Sumatra Province which is suspected as a source of hotspots during peatland fires. It will take about 2.5 hours from Palembang to Perigi Village, and during the rainy season it is better to use a 4 wheel drive car.

In 2015, Indonesia experienced a very long dry season and in South Sumatra there have been more than 23,000 hot spots. Sonor rice cultivation is the predominant rice cultivation system in Perigi village, which farmers practice during the long dry season when peatlands become very dry. With this system, farmers prepare land for rice cultivation by burning vegetation above the soil. They consider burning more effective as it reduces land preparation costs and provides a nutrient source for their rice crops. After burning, farmers broadcast rice seeds, and usually harvest the resulting rice crops in February-March. As farmers usually apply this system only once a year, and carry out no crop maintenance from sowing to harvest, their rice production is very low, with average productivity of 1–2 tons per ha. For this reason, in 2016 the Government planned to develop an area of 865 ha of rice fields in Perigi Village, and at that time it was developed around 562.7 ha. The trial of peatland restoration has been done in this area using the strategy of agrosilvofishery since 2018.

Throughout 2022, CIFOR and partners continued monitoring the growth of trees and crops, and scaled up the plots by expanding an additional 10 ha of land, making the demonstration plots become 13 ha in total, located on the same landscape. Employing a combination of participatory and field based action research approaches and various research strategies such as household surveys, focus group discussions and informal meetings, we learned that farmers expressed their interest in participating in our approach. Farmers were selected to take part in the adoption of agro-silvo-fishery models and were invited to select tree species to be planted. Farmers are expected to benefit from the plants they grow as the choice is based on their wishes. Restored peatlands are expected to contribute to reducing greehouse gas emissions while producing a variety of socio-economic and environmental benefits to rural communities.

The activities carried out have shown positive impacts after 5 years collaboration. UNSRI and CIFOR have agreed to continue the collabarotion by extending the MoU signed by both parties on August 18, 2023. Starting 2 last year, the Unsri team has been continued to implement the ***Climate Smart Agrosilvofishery*** method with expanding 12 ha involving 11 farmers. The overall aim of this research is to restore degraded peatlands through participatory action research and climate-smart agrosilvofishery approaches to generating multiple social, economic and environmental benefits.

The specific objective of the research for 2024 is to assess the feasibility of the agrosilvofishery model by developing, testing and modifying farmers' income models, and by conducting the following key and relevant activities:

1. To promote a model farmer practicing agrosilvofishery through controlled and intensified forest, agriculture and fishery practices (a description of the model is presented in Annex 1). The 2024 planned activities include designing and setting up the land model (land preparation, *caren* building) and fishery, soil-water analysis and soil preparation, maintaining land and ponds etc.
2. To conduct the following specific studies:
    - observing and analyzing **fire-post paddy production** and its relationship with different variables (i.e. burned areas, various planting techniques, use of paddy varieties).
    - analyzing **market potential** for agrosilvofishery products (main forest tree species) based on a literature review and making a **comparative study on income models** across different climate-smart agricultural contexts in South Sumatra peatland. This will build the basis for 2025 market survey.
    - assessing **fish cultivation and production** in terms of species (e.g. native and introduced species) and pellet formula (e.g. ingredients) and assessing fish cultivation feasibility.
3. To provide participating farmers with **technical guidance** on peat farming cultivation, crop maintenance and harvesting and post-harvest/processing. **Sub-activities** include:
    - conducting farmer training in priority topics (e.g. fish cultivation, climate-smart farming practices such as biochar production, fish cultivation, cultivation, and maintenance of Liberica coffee, processing and marketing of pineapple) and

- supervising the field teams working closely with farmers doing farming activities including cultivation, enrichment and maintenance of planted trees, crops, established ponds and fishes as part of adoption of agroforestry/agrosilvofishery models.

4. To identify **windows of opportunity** for provincial (South Sumatra) and district (Ogan Komering Ilir and other districts, whenever relevant) policies relevant to peat restoration, and **engage key actors** in advancing research lessons, findings and recommendations from Perigi agrosilvofishery model.
5. To produce **scientific papers**, news articles, briefs or infographics based on research findings; and to disseminate key research findings to relevant stakeholders at village, district, provincial and national and international levels through appropriate forums.

In the end of 2024, we report our ***Climate Smart Agrosilvofishery*** research which is to conduct participatory action research on restoration of degraded peatland for multiple economic and environmental values such as agri-food, fish, timber and other materials. This report is the technical report of the activities carried out in the year of 2024.

II. RESULT OF THE ACTIVITIES IN THE YEAR OF 2023

2.1. To promote a model farmer practicing agrosilvofishery through controlled and intensified forest, agriculture and fishery practices

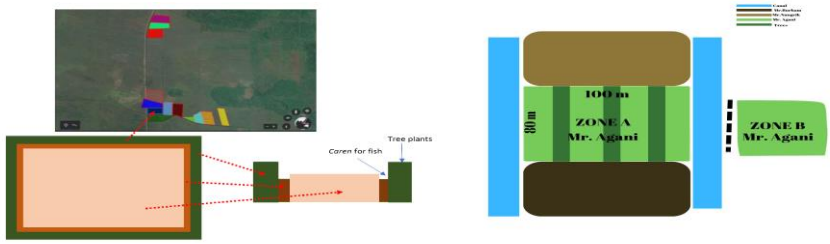
1. Background

Peatland is one of the most fragile ecosystems, and the utilization of peatland in the agricultural sector might be seriously considered so as not to cause peatland degradation. Peatland not only have ecological functions but also economic functions, where most local communities depend on them as their livelihood. The combination of both factions is needed in peatland management to reach both ecological and economic benefits. COE PLACE, Universitas Sriwijaya has committed to realizing peatland sustainability through Peatland restoration using the agrosilvofishery method involving 11 farmers in Perigi village has been implemented since 2022. The agrosilvofishery demonstration plot activities carried out in Perigi village have not provided satisfactory results. Even though there are already trees and fruit plants growing, the impact on improving farmers' income cannot yet be revealed. Breakthroughs are needed by improving land management and improving the combination of rice, pineapple, vegetable and fish cultivation. Fish farming patterns will also be improved. Through this improvement, it is hoped that farmers' income can be clearly calculated. The agrosilvofishery model that will be implemented can be seen in Figure 2.1. To carry out these activities, one farmer will be elected as a role model for neighboring farmers and beyond, based on criteria and indicators for how he has been active, enthusiastic and motivated to do farming practices and land management during past years. The farmer's land will be improved based on a design as illustrated in Figure 2. The planting system will be carried out using a semi-intensive cultivation method.

2. Demoplot Design

a. Demoplot Location

The demoplot is located on one of local farmers' plot (named Pak Agani), next to Pak Nungcik and Pak Burhan's lands as illustrated in dark blue. Mr. Agani's plot consists of 2 zones, namely zone A and Zone B. The demoplot will be established in Zone A which has a land size of 100 m long and 80m wide so that the total area is 8000m2. There are water canals with a width of 3m and a depth of 5m on the right and left of the land (zone A). The land has been planted with several tree species such as Jelutung (*Dyera lowi*), Belangeran (*Shorea belangeran*), Tamanu (*Colaphylum inophyllum*) and fruit trees. Mr. Agani was elected as a model farmer or collaborative partner due to his ability to preserve and protect the plants from fire.



(A) (B)

Figure 2.1. Location and Mapping of Demoplot

b. Agroforestry Model Design

The design of the agrosilvofishery model to be implemented in Perigi consists of three main components, namely (1) the *pematang* area for horticulture crop cultivation, (2) the fish cultivation area, and (3) the rice farming+ tree cultivation area. The *pematang* d area (part D) will be made around the demo plot area with a total circumference of 360 m with an pematang height of 5-6 meters, and weight 2-3 m. The *pematang* area will be used to experiment with various horticultural crops such as vegetables and pineapples. Furthermore, to overcome the problem of water management in the dry and rainy seasons, a water inlet (part C) and 2 levels of outlets (Part A and B) will be constructed. The inlet is made to introduce water from the canal into the demoplot, then the water will be accumulated into a reservoir (part E). The reservoir (part E) will have depth 2m. The reservoir is made to prevent drought during the dry season. The higher outlet (part A) is made to release excessive water during the rainy season to prevent rice plants and trees from being submerged. The optimal water level will be at the outlet of part B. Fish cultivation will be done in section F and fish ponds will be established with a depth of 1 m and a width of 3 surrounding the demoplot. In addition, soil properties (pH, Nitrogen, Phosphorus, Potassium, etc.) and water properties (pH, DOC, DO, etc.) will also be measured before giving treatment Measurements of abiotic factors such as rainfall, humidity, temperature, water level are also needed as supporting factors.

Figure 2.2. Agrosylfofishery Model Design in Perigi

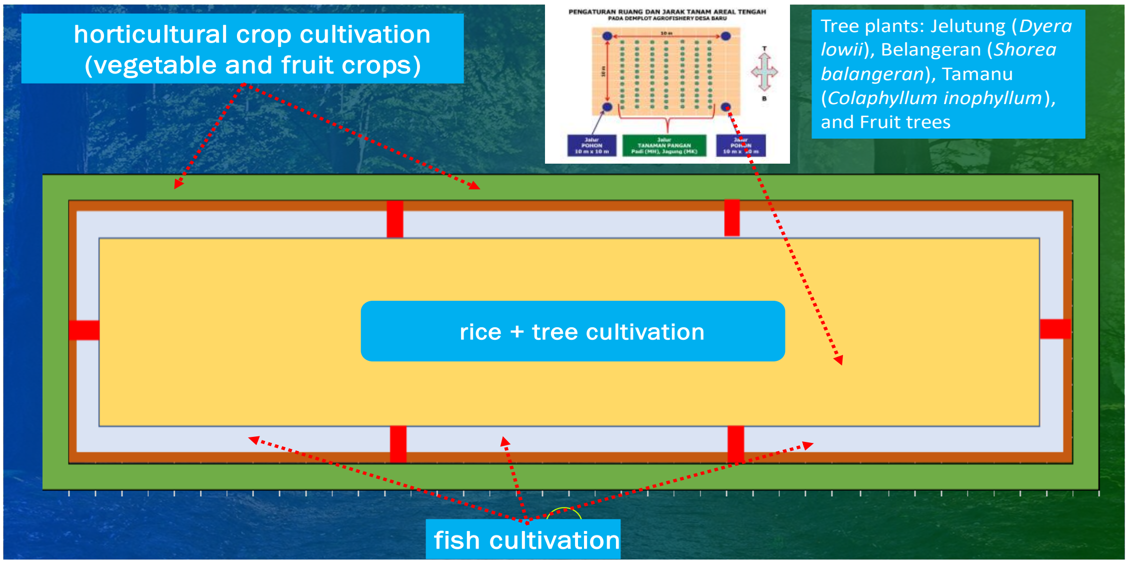


Figure 2.3. Detail Design of Perigi Agrosylfofishery Model

Tabel 2.1. Dimensions, Area and Volume of Land Components of Pak Agani Agrosilvofishery in Perigi Village

No.	Components	Dimensions (m)			Area (m^2)	Volume (m^3)	Note
		P	L	Q			
1.	**Total land area**	100	80		8.000		
2.	**Pematang**(Function: horticultural plant cultivation)						
	Up side	100	3	2	300	525	
	Down side	100	3	2	300	525	
	Left side	97	3	2	291	509	
	Right side	97	3	2	291	509	
3.	**Caren**(Function: Fish Cultivation)						
	Up side	97	3	2	291	582	
	Down side	97	3	2	291	582	
	Left side	94	3	2	282	564	
	Right side	94	3	2	282	564	

4.	**Pematang Foot**(Function: strengthening the edges of the caren and embankment so that they don't slide easily)						
	Up side	97	2		194		1 meter top and bottom, left and right
	Down side	97	2		194		
	Left side	91	2		182		
	Right side	91	2		182		
5.	**Ricefield** (Function in the rainy season for rice fields, in the dry season for corn, between forest plants and extant fruit)						
	Main land	92	72		6.624		
	Planted with rice/corn				5.000		

3. Result

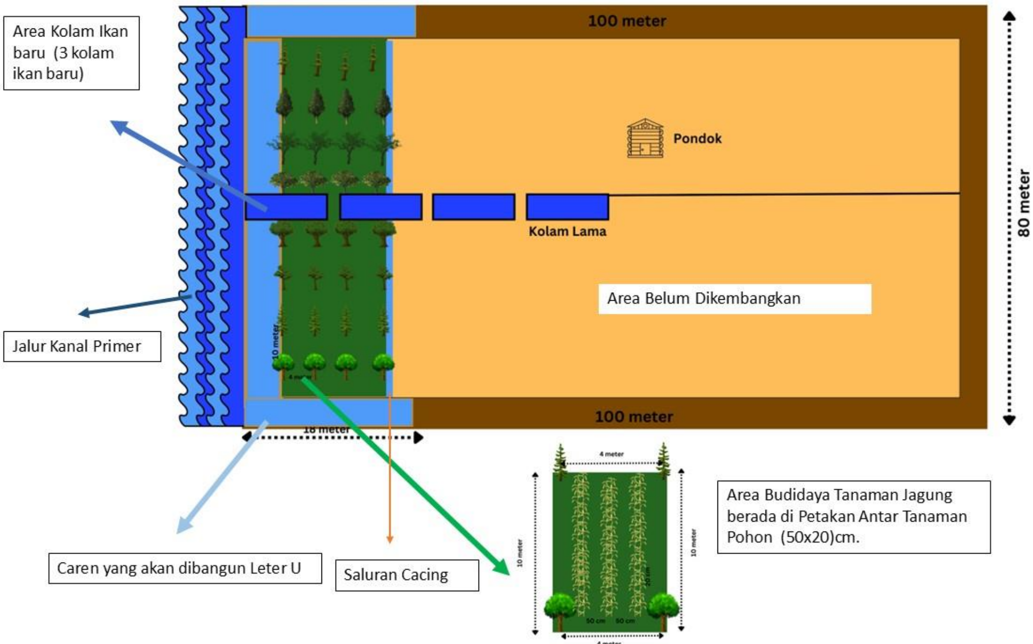


Figure 2.4. The Adjustment of Agrosylfofishery Model Design in Perigi

The adjustment of the Agrosylfofishery Model was determined due to our limitation of sources after our field study visit on September 2024. The schema of the adjustment is shown in the figure above. The schema was established on the field size of 80x100m. In 2024, the area has been developing size 10 x 80 m where there 3 new fish pond (fish cultivation), agrosilvo area, and irrigation canal (saluran cacing).

Agrosilvo area was established that purposed to do crop cultivation activities. This area is susceptible to floods in rainy seasons and dried in dry season. To overcome this issue, some aspects need to be considered like crop selection (adaptive to floods and dried), crop rotation, soil and water management. Irrigation canal was established to maintain the water during dry season. The water sources is from premier canal, flow to irrigation canal through water inlet. With the schema, it can maintain soil moisture and water availability for the plant. During the rainy season, the local community, utilizes their land to do rice cultivation, they also use local varieties without any land management. In contrast, in dry season, the local community can't do any crop cultivation, hence the peatland is drying, and the water level is very low. During long dry season, the peatland is susceptible to fire, then causes peatfire.

Through this schema, we try to utilize peatland, as a cultivation area in the dry season. We established corn/maize cultivation area in agrosilvo area (4x10m area). The maize cultivation was conducted at the end of September 2024, and involved 5 farmers (Pak Nungcik, Pak Agani,Pak Mattuci, Pak Marham, and Pak Mattudin). Some treatments were also applied such as line spacing (50x20cm, 60x20cm, and 70x20cm), and ameliorant application (Dolomite and without Dolomite) as part of small research. This research aims to figure out the best line spacing compared to both ameliorant applications (Dolomite and without Dolomite. In addition, based on this research, it can increase land productivity which can increase the local community’s income. Doing maize cultivation in dry season indirectly can make the farmers protect the peatland from fire.

Based on the schema, we also expanded the fish pond, by establishing the three new fish ponds in the current fish pond. The size of fish ponds is 1x 3 meters with 1.2m depth. The construction was built by woven bamboo, it’s important to prevent landslides. On the fish pond, we also use net to protect from the otter’s attack happened last year.

2.2. To conduct the specific studies

1. To conduct the specific studies observing and analyzing fire-post paddy production and its relationship with different variables (i.e. burned areas, various planting techniques, use of paddy varieties).

A trial of paddy farming was conducted on the land of sample farmers post land fire occurrence in November 2023. The farmers were introduced to three different planting methods: broadcasting, direct seeding, and transplanting. Additionally, three rice cultivars—Inpari 22, Inpari 32, and Inpari 48—were recommended for the farmers to cultivate. The harvest was carried out in February of 2024. Plant samples were gathered from each farmer's sample plot. Plant samples from non-participant farmers with previously burned land were also collected. The parameters of growth and yield then were evaluated as given below.

A. Rice Growth Evaluation

Based on the results, it was found that all three planting systems resulted in significantly lower plant populations compared to the traditional *sonor* method practiced by non-participant farmers, as given in Figure 2.5.a. The sample plants from the non-participant plot had the lowest plant height and the fewest number of tillers, as shown in Figures 2.5.b and 2.5.c. An excessively high population would lead to increased competition among plants, which would result in somewhat slower plant growth.

Plant length parameter did not show apparent differences among different planting systems. The highest plant length was obtained from transplanting treatment in previously burned land with 107.00 cm, while the lowest plant was from a non-participant plot with 81.56 cm. Compared to rice plants planted on unburned land, those planted on burned land yield many more tillers. The most tiller number was resulted from direct seeding treatment in burned land with 16 tillers per hill, and the least number was from the non-participant plot with 6.11 tillers.

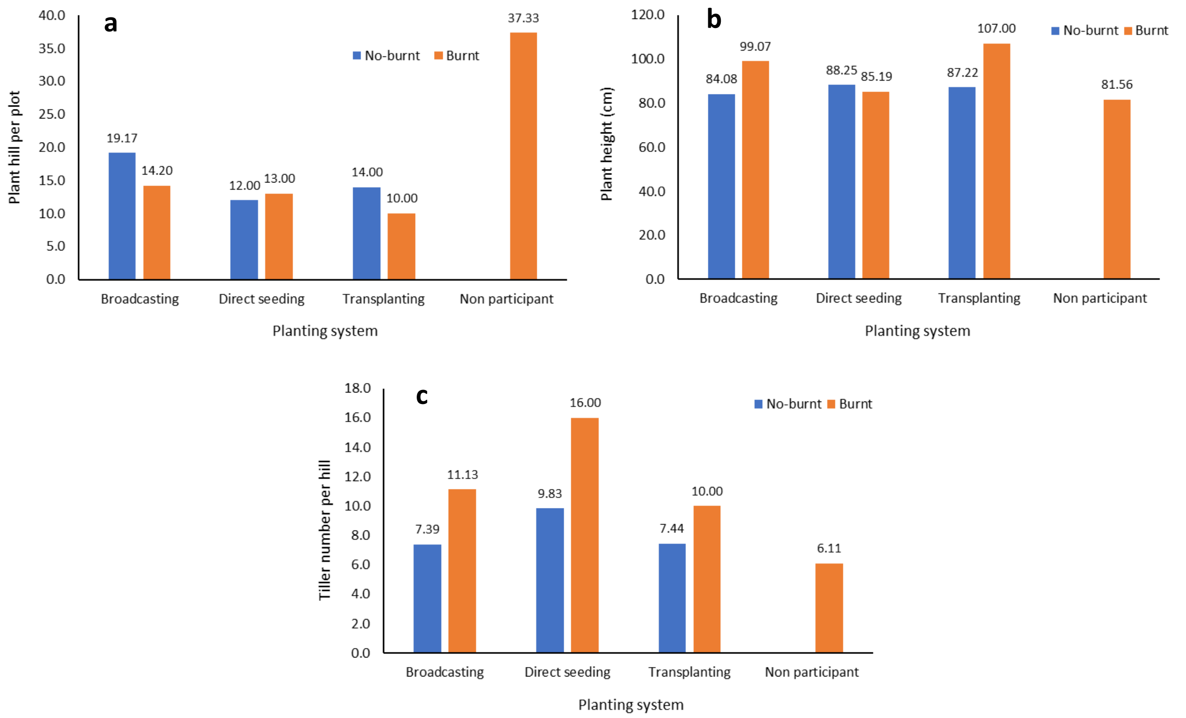


Figure 2.5. The effect of different planting systems on plant hill per plot (a), plant height (b), and tiller number (c) of rice plants

Plant height is one of the growth parameters that is closely related to plant genetics, and it was evidenced by Figure 2.6.a, where the plant height of the Inpari 48 cultivar was comparatively higher than that of other cultivars used by sample farmers. Even when planted on the non-burned land, Inpari 48 still resulted in higher length compared to other cultivars. While the cultivar used in the non-participant plot was unknown, it was relatively similar in height to Inpari 22 and Inpari 32.

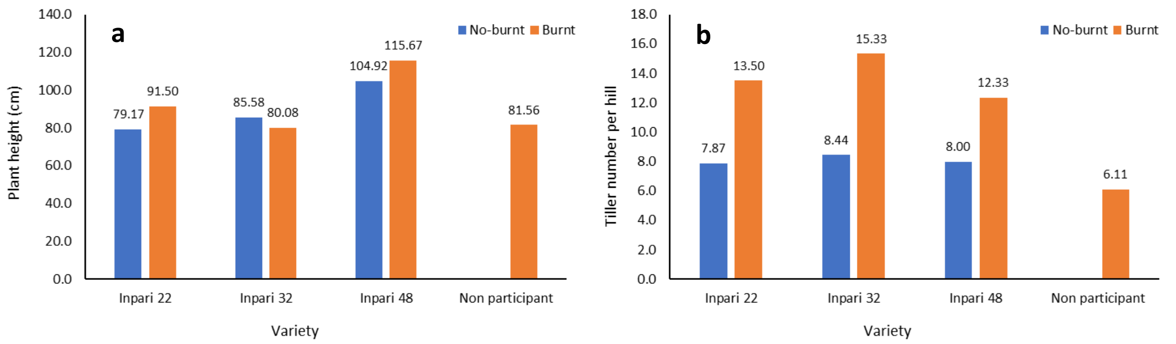


Figure 2.6. Plant height (a) and tiller number (b) of different rice cultivars

In contrast, the result on tiller number showed that all plants from previously burned land in sample farmers' plots had significantly higher tiller numbers compared to those from non-burned land. The most tiller number was resulted from Inpari 32 cultivated in previously burned land with 15.33 tillers. While rice plants from non-participant plots had the least tiller number, it only had a slightly lower tiller number than other cultivars planted on non-burned land with 6.11 tillers (Figure 2.6.b).

From the evaluation on growth parameters, it was concluded that the improvement of planting systems increased plant growth despite the comparatively lower populations due to less competition among plants. Only plant length showed a variation between rice cultivars, but the number of tillers was more likely to be affected by environmental factors. Since the burned soil made nutrients more easily absorbed by the plants, rice plants grown on previously burned land showed better growth than those grown on non-burned land. Although this appears to be beneficial for plant growth, the benefits will only last temporarily. Burning land and soil will have long-term detrimental effects, including the loss of organic matter, a reduction in the soil's ability to retain water, and the emission of carbon that fuels climate change.

B. Rice Production Evaluation

Rice plants cultivated on post-burned land performed higher on yield parameters, which is consistent with the findings on rice growth. According to Figure 2.7.a and 2.7.b, the direct seeding planting system produced the largest number of panicles (17 per hill) and spikelet weight (36.71 g) per hill. Even while the results of all planting systems on non-burned land were not as good as those on previously burned land, they were still higher than those from the non-participant plot. As seen in Figure 2.7.c, the non-participant plot likewise yielded the largest percentage of empty grain, at 21.74%. The percentage of empty grain was lower on previously burned land, with the exception of the broadcasting system, where the percentages of burned and non-burned land were roughly equal at 18.07 and 16.73 percent, respectively.

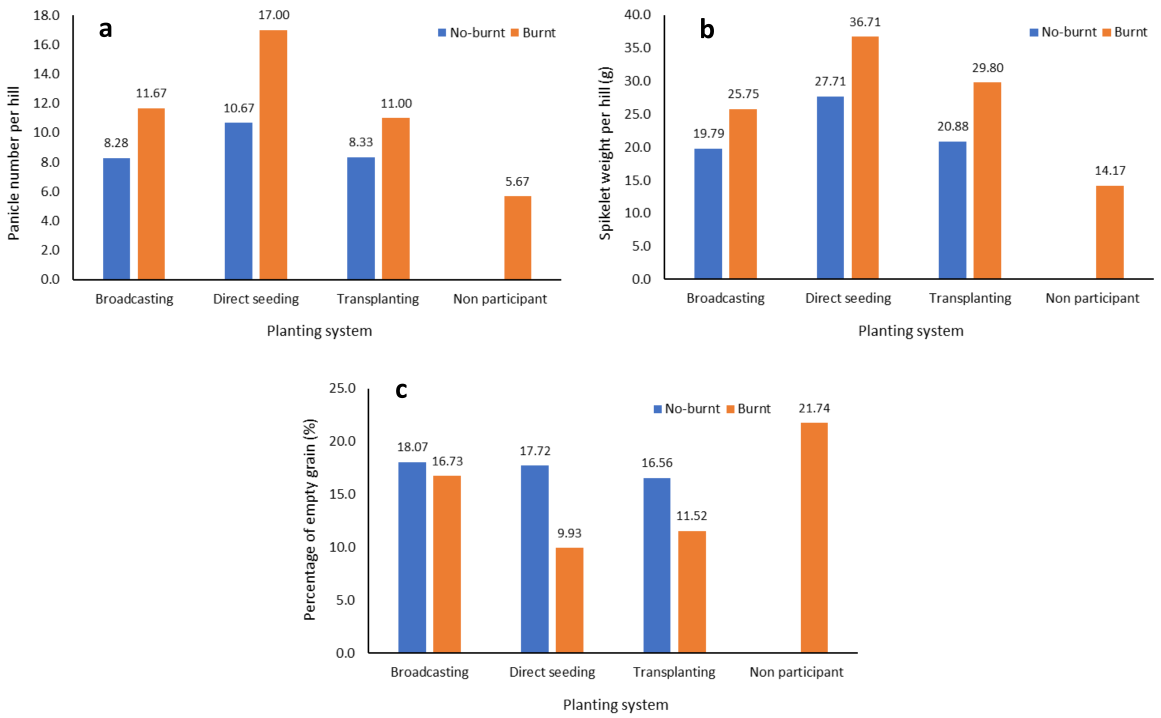


Figure 2.7. The effect of different planting systems on panicle number per hill (a), spikelet weight per hill (b), and percentage of empty grains (c) of rice plants

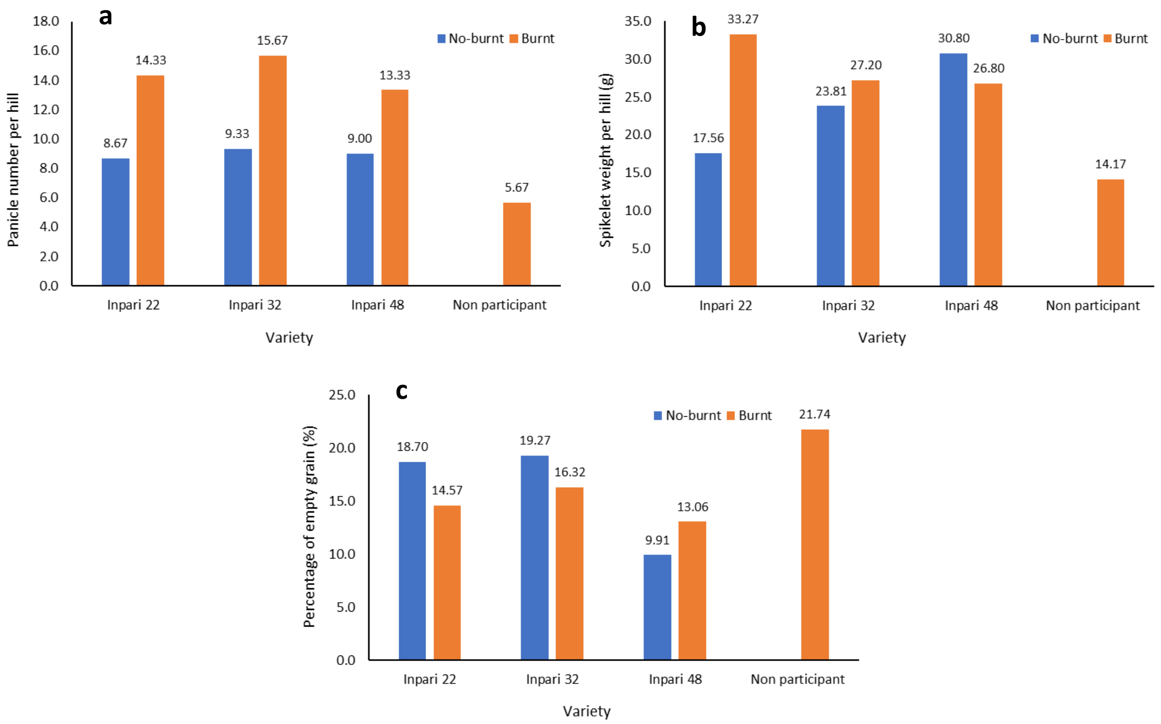


Figure 2.8. Panicle number per hill (a), spikelet weight per hill (b) and percentage of empty grains (c) of different rice cultivars

The highest number of panicles was resulted from Inpari 32 cultivar in previously burned land with 15.67 panicles as seen from Figure 2.8.a. Inpari 22 yielded the highest spikelet weight per hill in post-burned land with 33.27 g (Figure 2.8.b). Previously burned land generally produced higher spikelet weight per hill compared to non-burned land regardless of the cultivars used. However, Inpari 48 cultivated in non-burned land produced higher spikelet weight compared to that in the post-burned land with 30.80 g and 26.80 g, respectively. This was due to the higher percentage of empty grains resulted from Inpari 48 in post-burned land with 13.06% compared to the non-burned land with only 9.91% (Figure 2.8.c). However, from all the cultivars used, Inpari 32 resulted the highest percentage of empty grain with 19.27%.

Based on the data collected, estimated rice productivity then was calculated as given in Figure 2.9. The improvement of planting systems has successfully increased productivity compared to the non-participant plot with traditional *sonor* system where it resulted the lowest productivity with only 0.63 ton/ha (Figure 2.9.a). The highest productivity was resulted from post-burned land with direct seeding system with 4.76 ton/ha. The use of transplanting system showed very positive result where the productivity almost similar between non- and post-burned land with 2.88 and 2.99 ton/ha, respectively.

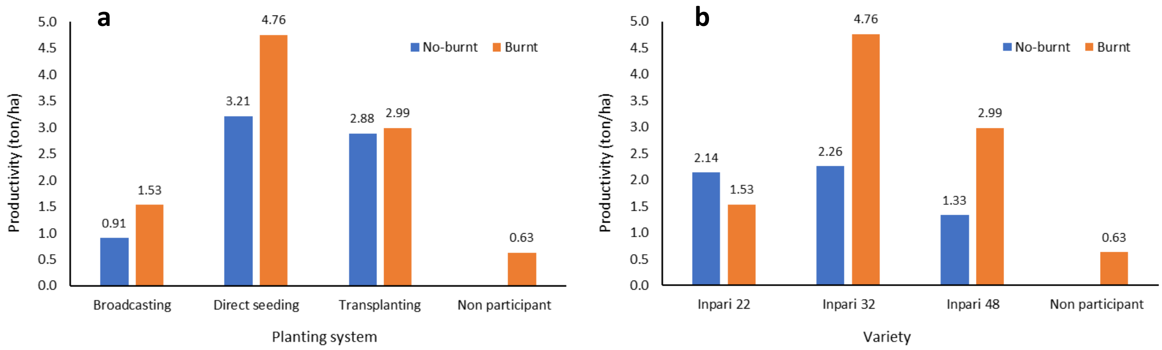


Figure 2.9. Estimated rice productivity in different planting systems (a) and cultivars (b)

Inpari 32 cultivated in post-burned land produced the highest productivity with 4.76 ton/ha (Figure 2.9.b). While the use of Inpari 32 and Inpari 48 still did not increase productivity in non-burned land compared to that in post-burned land, the use of Inpari 22 in non-burned land (2.14 ton/ha) was higher than in post-burned land (1.53 ton/ha). All cultivars used regardless of land condition resulted in higher productivity compared to the non-participant plot. This indicated that even without land burning, the use of proper planting system and high yielding cultivar can increase rice production. This result can be used as the recommendation for rice farmers in Perigi area to avoid land burning for rice planting preparation.

2.To conduct the specific studies analyzing market potential for agrosilvofishery products (main forest tree species) based on a literature review and making a comparative study on income models across different climate-smart agricultural contexts in South Sumatra peatland. This will build the basis for 2025 market survey.

a. Introduction

Peatland restoration in South Sumatra has been carried out since 2016, when the government of Indonesia established the Peatland Restoration Agency (PRA) based on the Presidential Regulation of the Republic of Indonesia Number 1 of 2016 [1]. Not all types of peatlands can be managed productively to meet the needs of human's life. Peatlands with a thickness of less than 3 meters can be used for productive activities, while those with a thickness of more than 3 meters are only used for conservation purposes [2]. Therefore, apart from being a source of livelihood for the surrounding community, peatlands also have the function of providing ecosystem services such as biodiversity conservation, water regulation, and carbon storage [3]. Almost 70.3% of the peatland area in South Sumatra is categorized as degraded peatland out of the total peatland area of 1,287,899 ha [4]. This peatland degradation is generally caused by illegal logging, land conversion, agricultural activities, canal construction, and recurrent fires [1,5–7]. The impact of peatland degradation is not only experienced by the surrounding community but also by the wider community. Degraded peatlands will experience a decline in function, both physically, environmentally, economically, and socially. Loss of local people's livelihoods, flooding in the rainy season, drought in the dry season, and health problems caused by smoke from fires are some of the impacts that can be felt by the community [8,9].

Logging activities, drainage, fires, conversion to plantations and expansion of small-holder dominated mosaic landscape have rapidly increased in peatland areas since the 1980's [10]. These destructive activities not only disturb the ecosystem functions, but affect gas fluxes between peatland areas and atmosphere. In addition to reducing the amount of biomass contained by living vegetation, activities in peatland areas cause changes in water table level, which affect peat decomposition and carbon fluxes from peat [11]. Indirectly, degradation of peatland ecosystems makes them more vulnerable to yearly fire activity [12]

[13]and increases the risk of periodical severe fire episodes that release high quantities of carbon into the atmosphere [14] [15].

In recent years, climate change has emerged as one of the most pressing challenges facing humanity, with its effects being felt keenly in agricultural regions worldwide. South Sumatra, a province in Indonesia characterized by its extensive peatland areas, stands at the intersection of this global crisis and the imperative for sustainable agricultural practices. As climate-smart agriculture gains traction as a promising solution to mitigate greenhouse gas emissions, adapt to changing climatic conditions, and ensure food security, understanding its impact on income generation becomes crucial, particularly in regions like South Sumatra where agricultural livelihoods are deeply intertwined with the environment.

Nestled within the expanse of South Sumatra's peatland, Perigi Village stands as a microcosm of the intricate challenges and opportunities inherent in agricultural landscapes grappling with the impacts of climate change. As global temperatures rise and extreme weather events become more frequent, the imperative for adopting climate-smart agricultural practices becomes increasingly pronounced, particularly in regions where livelihoods are deeply intertwined with the natural environment.

This paper embarks on a comparative journey to unravel the income models associated with diverse climate-smart agricultural practices within Perigi Village and compared to existing models in Ganesha Mukti, Muara Sugihan, situated amidst the verdant tapestry of South Sumatra's peatland. Through meticulous examination and analysis, this study aims to shed light on the economic viability and resilience of various agricultural approaches, offering insights that are invaluable for sustainable development initiatives in the region.

The significance of this research lies in its potential to inform decision-making processes at multiple levels, from local community planning to regional agricultural policies. Crucially, this comparative analysis will delve into income streams, types of activities, types of commodities, estimates of farmer income, workload and the money value of time that underpin income models in Perigi Village's agricultural landscape. As the global community strives to address the intertwined challenges of climate change, food security, and rural development, studies such as this serve as beacons of knowledge, illuminating pathways towards a more resilient and prosperous future for agricultural communities in Perigi Village and beyond. By fostering dialogue, collaboration, and innovation, we aspire to pave the way for transformative change that ensures the well-being of both people and planet in South Sumatra's peatland landscape.

b. Objectives

The objectives of a comparative study on income models across different climate-smart agricultural practices or contexts in South Sumatra peatland are as follows

1. Analyze the market potential for agrosilvofishery products (particularly main forestry trees), based on a literature review (2024)
2. Conduct a comparative study of incomes between Perigi Village with the existing models in Sepucuk Village and Saleh-Sugihan or Sugihan-Sungai Lumpur Villages (2024).
3. Conduct a survey in Perigi village market and beyond (2025) (a) Analyze the market potential for agrosilvofishery products in Perigi Village market, (b) Analyze the sustainability of income streams, types of activities, types of commodities, estimates of farmer income, workload and the money value of time required by farmers to look after the land.

c. Research Framework

A research framework, as depicted in Figure 2.10., guides the implementing steps for this study. For 2024, activities will be focused on a literature review assessing the market potential of agroforestry products, which will establish a base for market survey planned to be conducted in 2025. Another activity in 2024 is to make a comparative assessment of incomes from other models in other villages. A household analysis which is another key component of the research framework is planned to be conducted whenever appropriate.

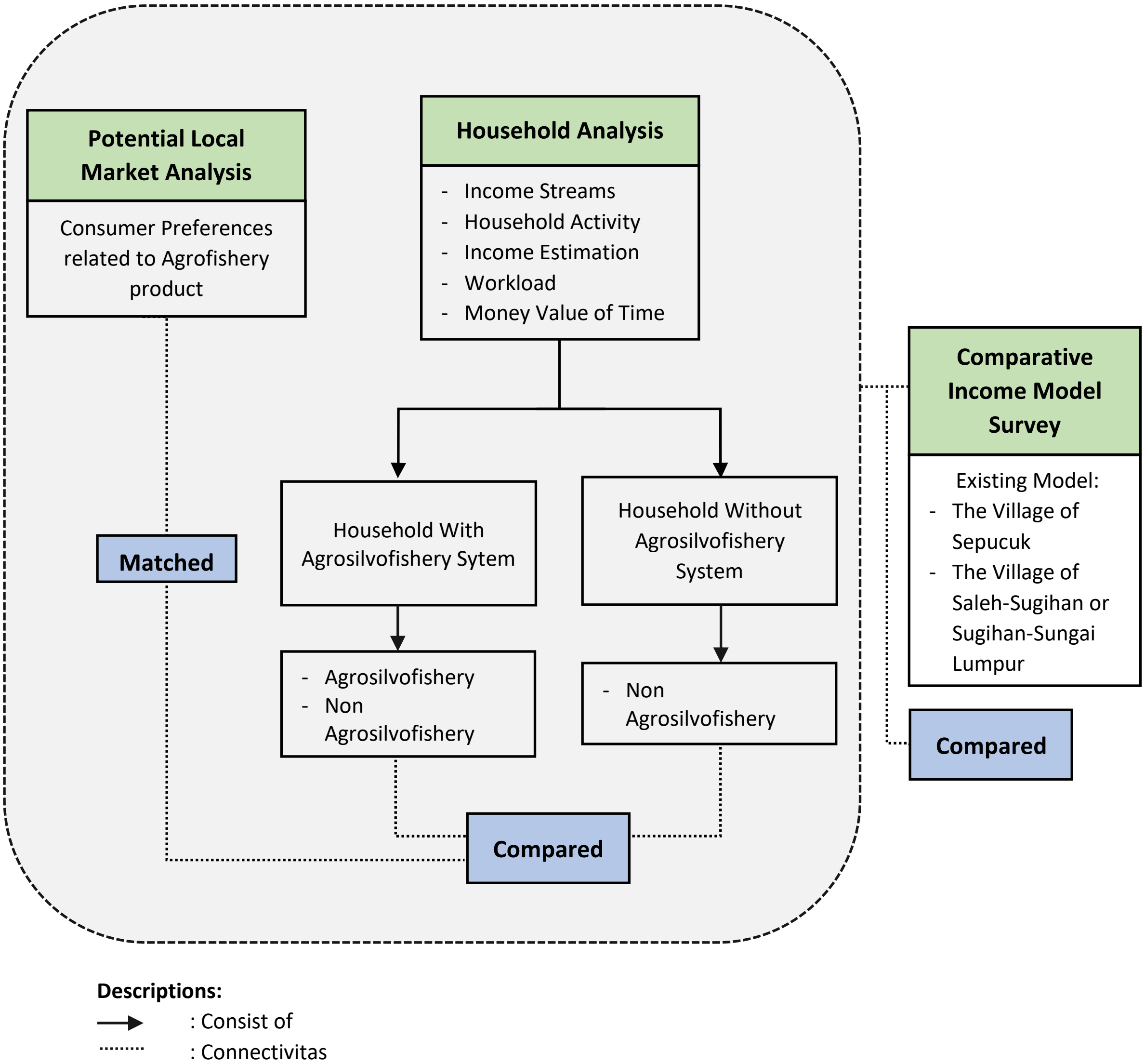


Figure 2.10. Research Framework

c. Research Method

The method used in **A Comparative study on income models** uses the **survey method**, with the following details:

1. Activity Plan

Literature reviews on the market potential of agroforestry products (particularly forestry trees) and comparative studies assessing income from different models will be carried out from July to September 2024. The latter will focus on the village of Perigi, Sepucuk village and Saleh-Sugihan or Sugihan-Sungai Lumpur.

2. Protocol and Target Respondents

a. Potential Local Market Survey:

Following up the literature review conducted in 2024, a survey is to be conducted in 2025 to assess the potential of local markets in Perigi village and beyond for agroforestry products and to assess market supply and demand for food crops and forestry trees produced as part of agrosilvofishery-based integrated peat restoration program. The target respondents include traders and consumers who are in markets around the village. Additional interviews are also planned for a wider scope of market analysis. Data are collected through interviewing traders and consumers, based on guided questionnaires.

b. Comparative Income Model Survey:

This survey will be conducted to assess comparative values and potential indicators for income models applied in 3 different villages, namely (1) Pilot Project Climate Smart Agrosilvofishery, Perigi Village, (2) Land4Life Program, Peatland management and restoration plans of Peat Hydrological Units Saleh-Sugihan and Sugihan-Sungai Lumpur (Banyuasin District, South Sumatera Province). The target respondents include farming households managing land-based agroforestry model. Data are collected through interviewing respondents, based on guided questionnaires.

e. Research Step

1. Systematic Literature Review Methodology

Conducting a systematic literature review (SLR) requires a structured and transparent approach to identify, assess, and synthesize relevant literature. Here are the best steps or methods to conduct an SLR:

Determining the Research Question (Research Question). The first step in SLR is to formulate a clear and specific research question. This question will serve as the basis for selecting relevant literature. The technique often used is PICO (Population, Intervention, Comparison, Outcome) to help formulate focused questions.

Creating a Review Protocol. The SLR protocol must include search strategies, inclusion and exclusion criteria, and the analysis methods to be used. This protocol helps improve transparency and reduce bias. Some elements that must be included: (1) Database used (such as: Scopus, Web of Science, Google Scholar), (2) Search keywords (including synonym and its combination), (3) Inclusion/exclusion criteria (based in year publication, study type, it's relevance)

Conducting Literature Search. Using various scientific databases to conduct a comprehensive search according to the established protocols. This search must be carried out systematically by recording the search results and extracting data.

Literature Selection Based on Inclusion and Exclusion Criteria The literature found must be filtered through two stages: Title and abstract selection: Selecting studies that are relevant to the research question based on their titles and abstracts. Full text selection: After the initial selection, the full text of the filtered articles will be read to ensure their relevance.

Data Extraction. After the relevant studies are selected, perform data extraction. This extraction includes important information from the studies, such as: Research method used, The population studied, Main findings, Study implications

Assessing the Quality of the Study. A critical assessment of the quality of the selected studies is necessary to evaluate the validity of the findings. Some tools that can be used to assess the quality of studies are VOS Viewer, N-VIVO, or the PRISMA checklist.

Synthesizing Findings There are two main methods for synthesizing the results from the reviewed literature: (1) Narrative synthesis: Combining and analysing findings from various studies descriptively, emphasizing patterns, themes, or key differences., (2) Quantitative synthesis (meta-analysis): If possible, statistically combine the results to provide a more general conclusion.

Reporting and Publication The SLR results are reported following reporting guidelines such as PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses), which includes a flow diagram to show the study selection process, as well as tables to show the extracted data.

2. Comparative Study of Incomes Models.

Conduct a comparative study of incomes between Perigi Village with the existing models in Saleh-Sugihan or Sugihan-Sungai Lumpur Villages (2024). In this two area, there are Land4Life Activities. Land4Lives or Land for Life is a 5-year action-research activity aimed at strengthening gender-sensitive landscape governance, climate-resilient livelihoods, and food security. This activity is a collaboration between the Government of Indonesia and the Government of Canada and is carried out by ICRAF Indonesia along with its partners. The target is that rural communities, especially vulnerable groups including small farmers, women, and girls, will have the capacity and resilience to face the impacts of climate change.

f. RESULT

1. The Market Potential For Agrosilvofishery Products (Particularly Main Forestry Trees), Based On A Literature Review

1.1. Protocol

a. Creating a Review Protocol.

The SLR protocol must include search strategies, inclusion and exclusion criteria, and the analysis methods to be used. This protocol helps improve transparency and reduce bias. Some elements that must be included:

(1) Database used (For example: Scopus, Web of Science, Google Scholar). On this SLR, we used google scholar as databased sourced.

(2) We used keywords: Agroforestry, Potential, market, product, agroforestry product, market potential, demand, supply, pricing, and economic analysis, (3) Inclusion/exclusion criteria for year 2014-2024, with no limitation on number of articles that can be extracted.

Research Question: What is the market potential for agroforestry products?

Scope: This review will focus on the market potential of agroforestry products, including factors influencing demand, supply, and pricing.

b. Conducting Literature Search.

Using various scientific databases to conduct a comprehensive search according to the established protocols. This search must be carried out systematically by recording the search results and extracting data. We used, Google Scholar by considering that all articles published by various journals and publishers will be indexed in Google Scholar.

c. Literature Selection Based on Inclusion and Exclusion Criteria

The literature found must be filtered through two stages: Title and abstract selection: Selecting studies that are relevant to the research question based on their titles and abstracts. Full text selection: After the initial selection, the full text of the filtered articles will be read to ensure their relevance. For This step we used Publish and Perish to extract the article in each keywords.

d. Data Extraction.

After the relevant studies are selected, perform data extraction. This extraction includes important information from the studies, such as: Research method used, , Main findings, Study implications. We used tabulation for getting information related to : Research method used, The population studied, Main findings, Study implications as seen on Attachment 1.

1.2. Findings

a. Main Findings

1. Demand Factors

Consumer Preferences: Growing consumer awareness of environmental sustainability and health benefits has increased demand for agroforestry products.

Market Segmentation: Targeting specific market segments, such as organic food consumers, health-conscious individuals, and niche markets, can enhance market potential.

2. Supply Factors

Production Challenges: Factors limiting production include limited access to land, technology, and financial resources.

Value Chain Analysis: Identifying bottlenecks and inefficiencies in the value chain can help improve supply and reduce costs.

3. Pricing Factors

Cost Structure: Production costs, including labour, land, and inputs, influence pricing.

Market Dynamics: Supply and demand dynamics, as well as competition, play a significant role in determining prices.

4. Market Potential

Global Trends: Increasing urbanization and rising incomes are driving demand for agroforestry products, particularly in developing countries.

Regional Variations: Market potential varies across regions due to differences in consumer preferences, production conditions, and government policies.

b. Policy Implications

Governments can play a crucial role in promoting agroforestry by providing incentives, supporting research and development, and improving infrastructure.

Future Research: Further research is needed to explore the long-term sustainability of agroforestry markets, as well as the potential for value-added products and new markets.

c. Conclusion

Agroforestry products offer significant market potential, driven by growing consumer demand and global trends. However, realizing this potential requires addressing production challenges, improving value chains, and understanding regional market dynamics. By addressing these factors, agroforestry can contribute to sustainable livelihoods and environmental conservation

1.3. Assessing the Quality of the Study.

A critical assessment of the quality of the selected studies is necessary to evaluate the validity of the findings. Some tools that can be used to assess the quality of studies are VOS Viewer, NVIVO, or the PRISMA checklist. Altough we can used some program, but for this section we used VOS Viewer to exctract the path among the article. Figure 2.11 explains the relation among each cluster and keyword, and Figure 2.12. explains the number of research studies based on clusters and years. Figures 2.13 to 2.29 also explain the possible connections of keywords in each cluster formed from the analysis results. Based on the analysis results, many paths are shown to be formed, indicating the relationships between keywords found in previous research.

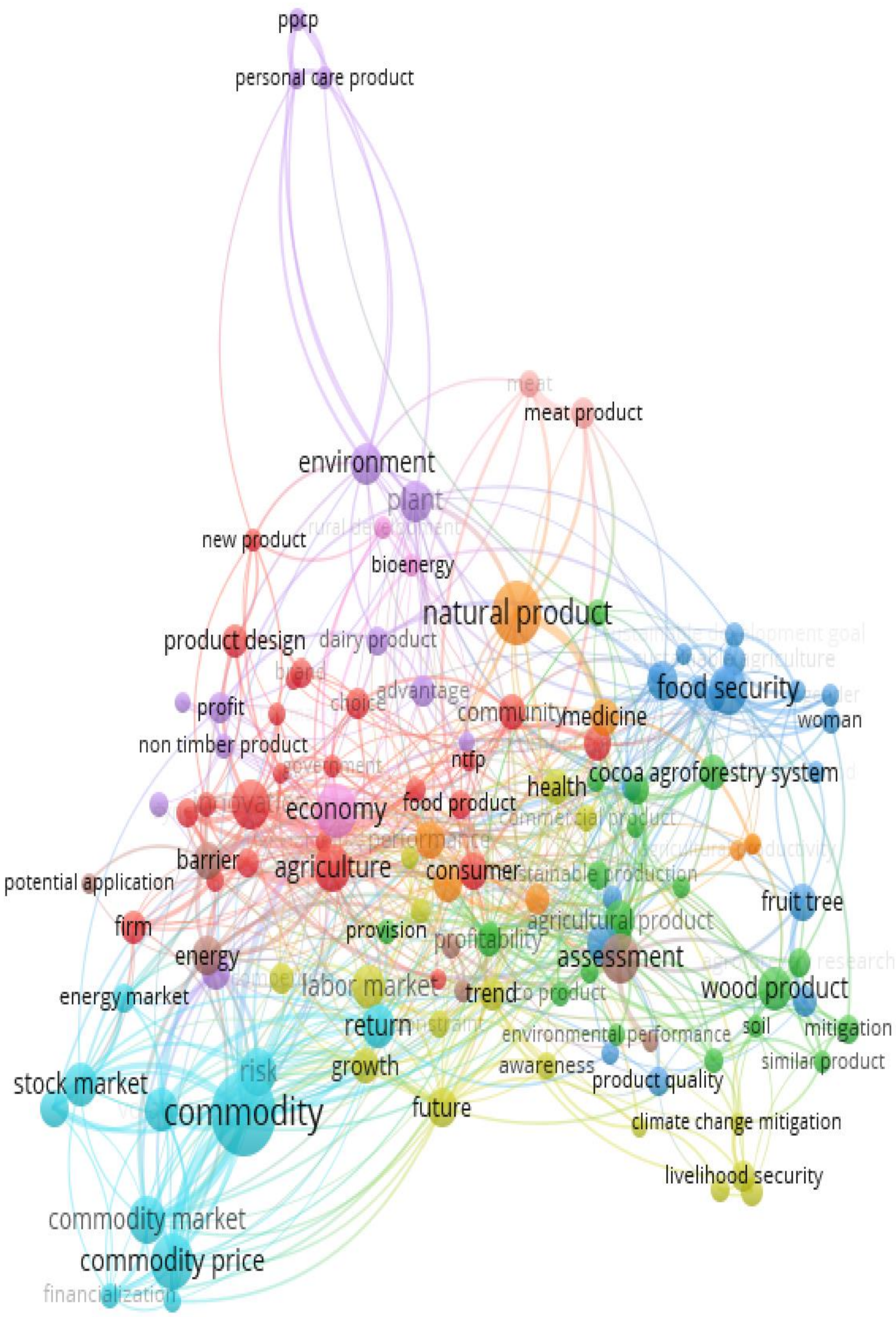


Figure 2.11. General Map from the VOS Viewer Analysis Based on Cluster

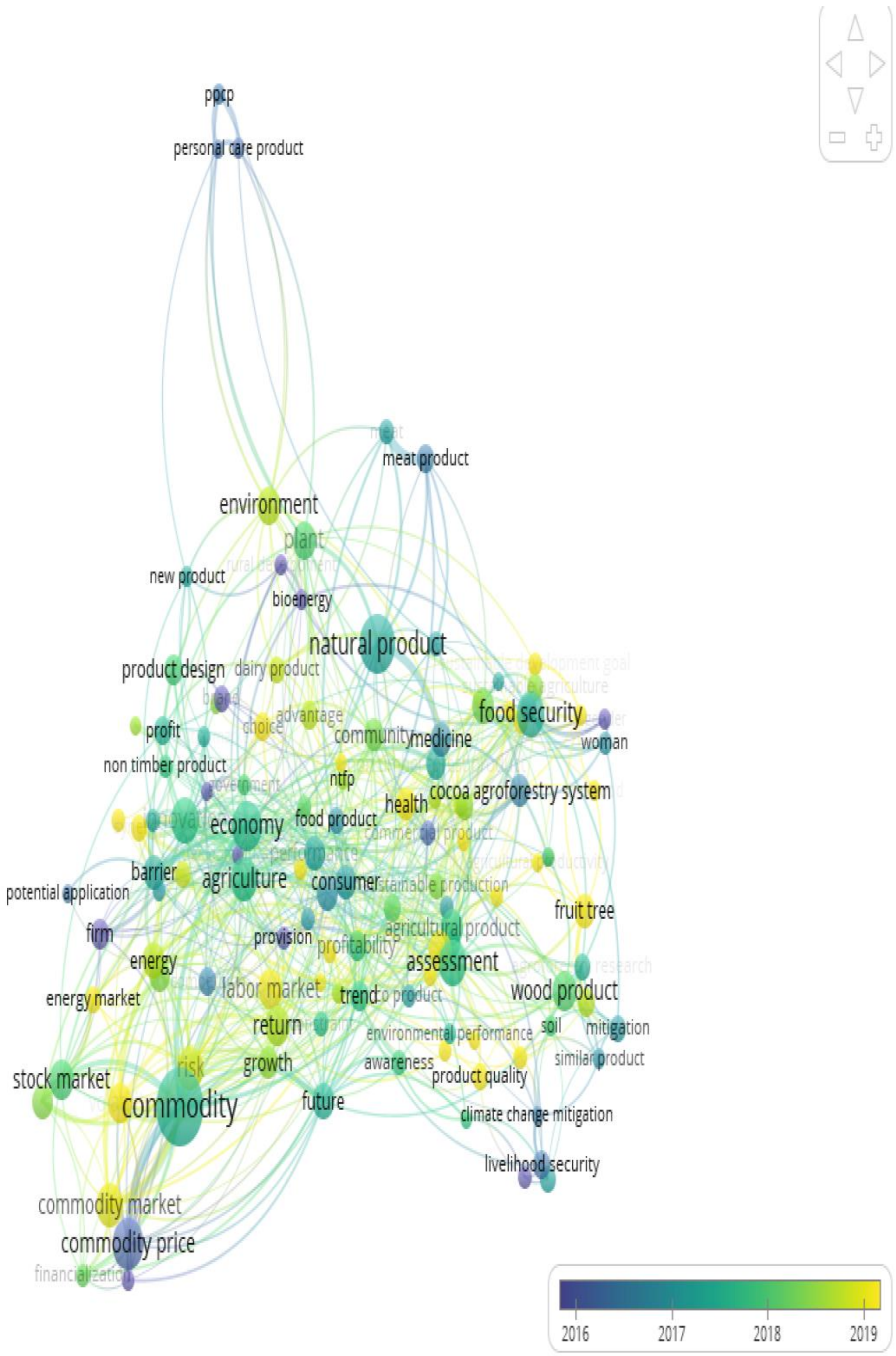


Figure 2.12. General Map from the VOS Viewer Analysis Based on years

Table 2.2. The keywords generated in each cluster are based on the results of the VOS Viewer analysis.

CLUSTER									
1	2	3	4	5	6	7	8	9	10
Agriculture	Agriculture product	agroforestry development	awareness	advantage	commodity	agricultural productivity	agroforestry residue	bioenergy	meat
Brand	Agroforestry Research	agroforestry farmer	carbon sequestratio n	agricultural sustainability	commodity futures market	firewood	agroforestry residue potential	economy	meat product
Choice	Carbon	agroforestry landscape	climate change mitigation	agroforestry waste	commodity market	market access	assessment	rural developm ent	
Community	Co-product	biodiversity	commercial product	dairy product	commodity price	medicine	barrier		
Consumer	Cocoa	cacao	competition	environment	energy market	natural product	energy		
Evolution	cocoa agroforestry system	commercializati on	constraint	non timber product	financial market	performance	final product		
Firm	Combination	consumption	environment al benefit	personal care product	financializatio n	producer	potential application		
Food Product	Economic performance	food security	environment al service	pharmaceutic al	return	vegetable			
Forestry	environment al impact	fruit tree	future	plant	risk				
Governme nt	environment al performance	fuelwood	growth	ppcp	stock market				
Innovation	mitigation	gender	health	profit	volatility				

CLUSTER									
1	2	3	4	5	6	7	8	9	10
Market Power	monoculture	main product	labor market	smallholder agroforestry system					
New product	non food product	nutrition	livelihood security	uncertainty					
Non Timber Forest Product (NTFP)	oil palm	processing	potential impact						
Potential benefit	oil palm agroforestry	product quality	success						
Potential Market	profitability	smallholder farmer	trend						
Premium price	provision	supply chain							
Product Design	similar product	sustainable agriculture							
Smallholder	soil	sustainable development goal							
Synergy	sustainable production	woman							
Tree Domestication	wood product								
Value Added									

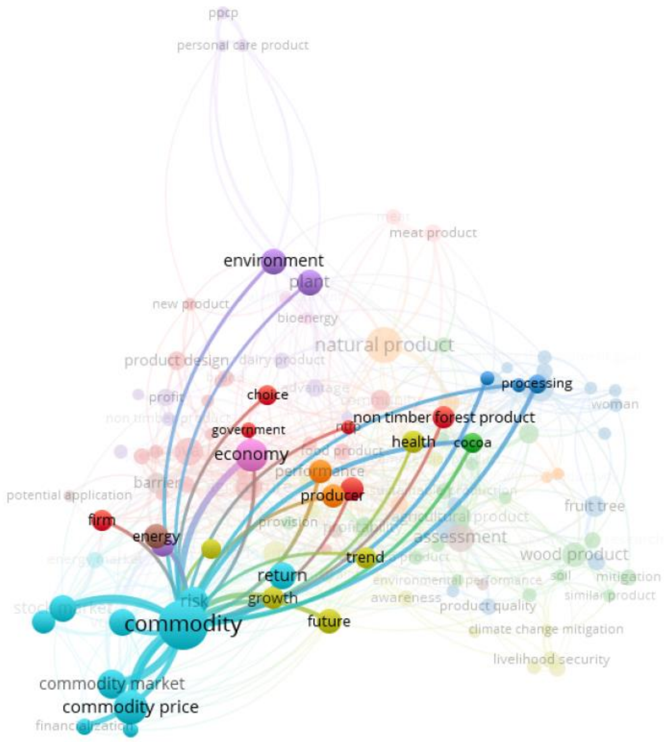


Figure 2.13. Commodity Cluster from the VOS Viewer Analysis

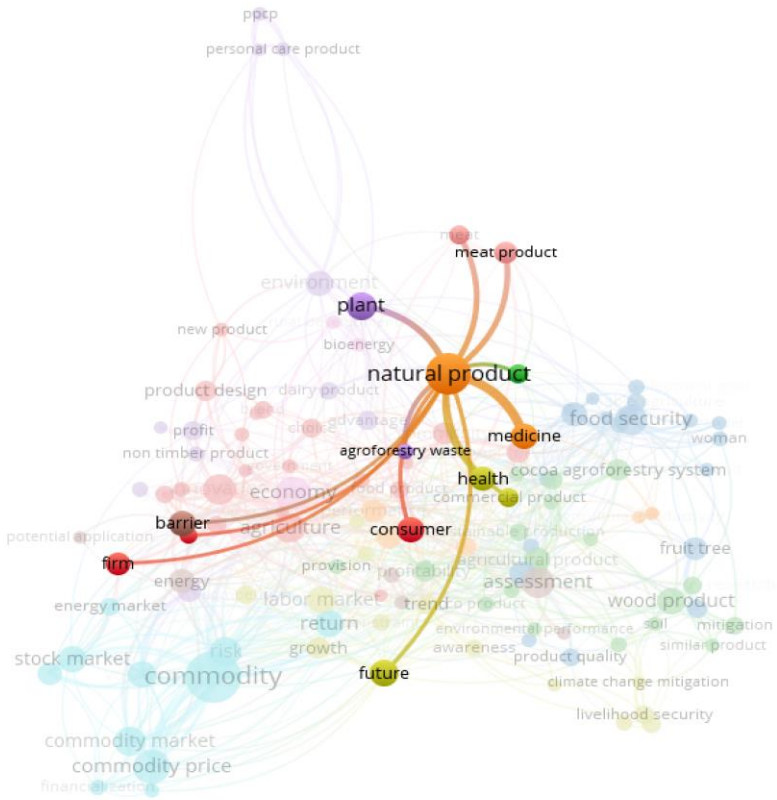


Figure 2.14. Natural Product Cluster from the VOS Viewer Analysis

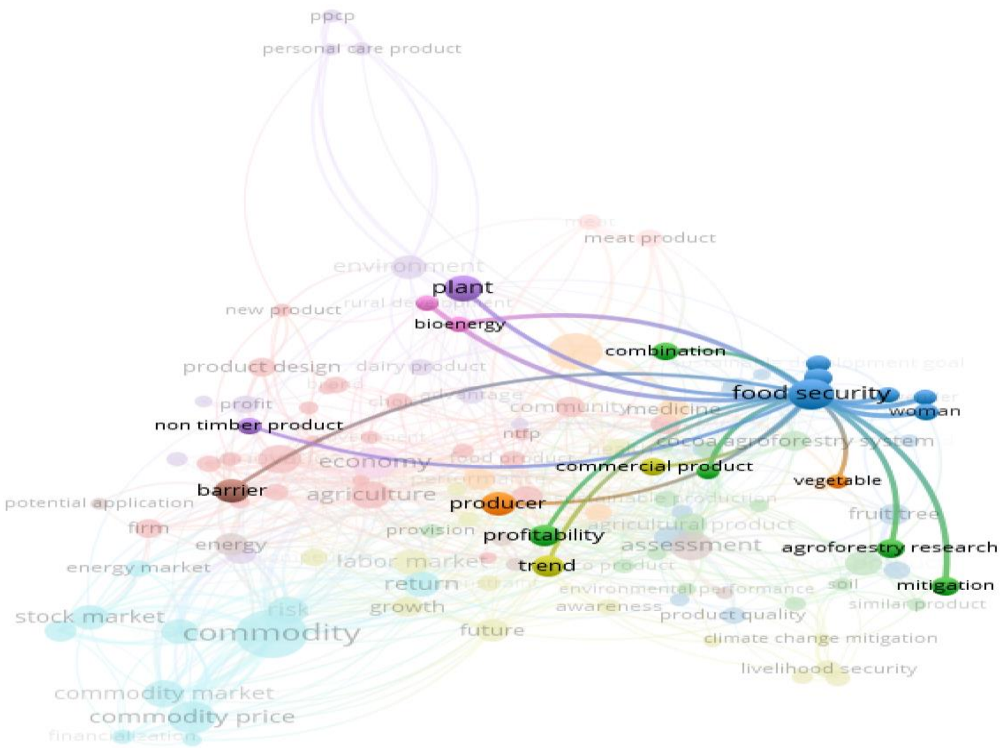


Figure 2.15. Food Security Cluster from the VOS Viewer Analysis

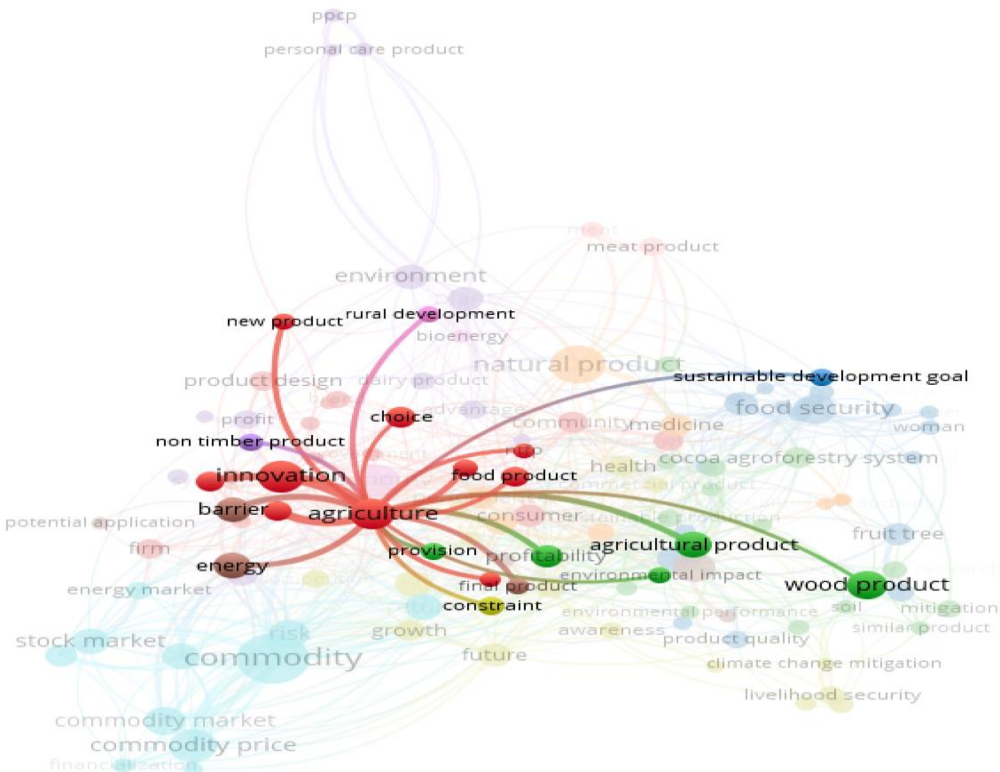


Figure2.16. Agriculture Cluster from the VOS Viewer Analysis

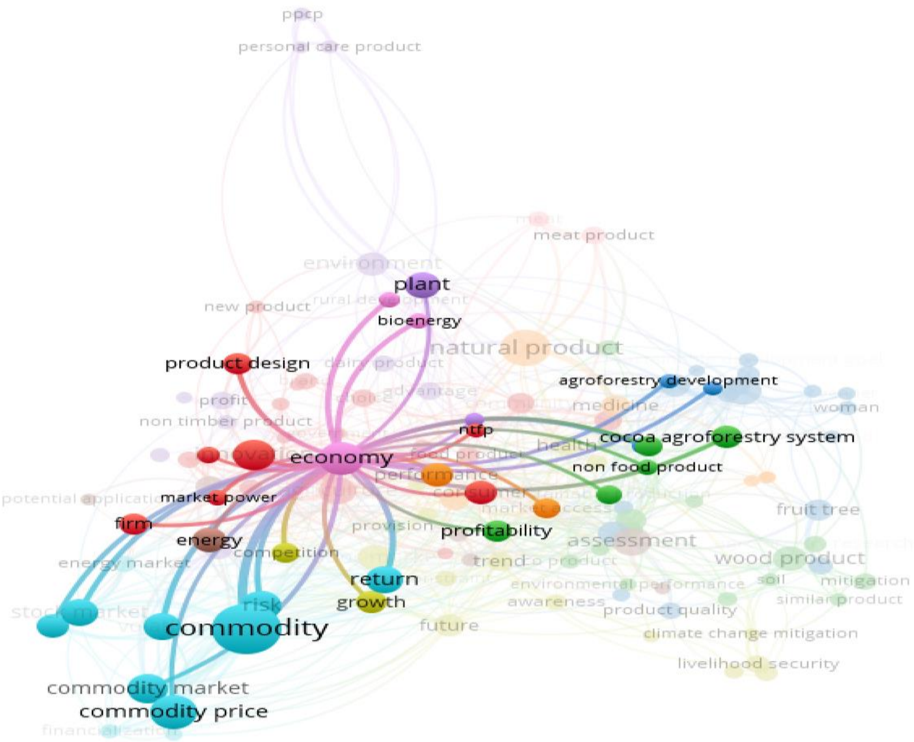


Figure 2.17. Economy Cluster from the VOS Viewer Analysis

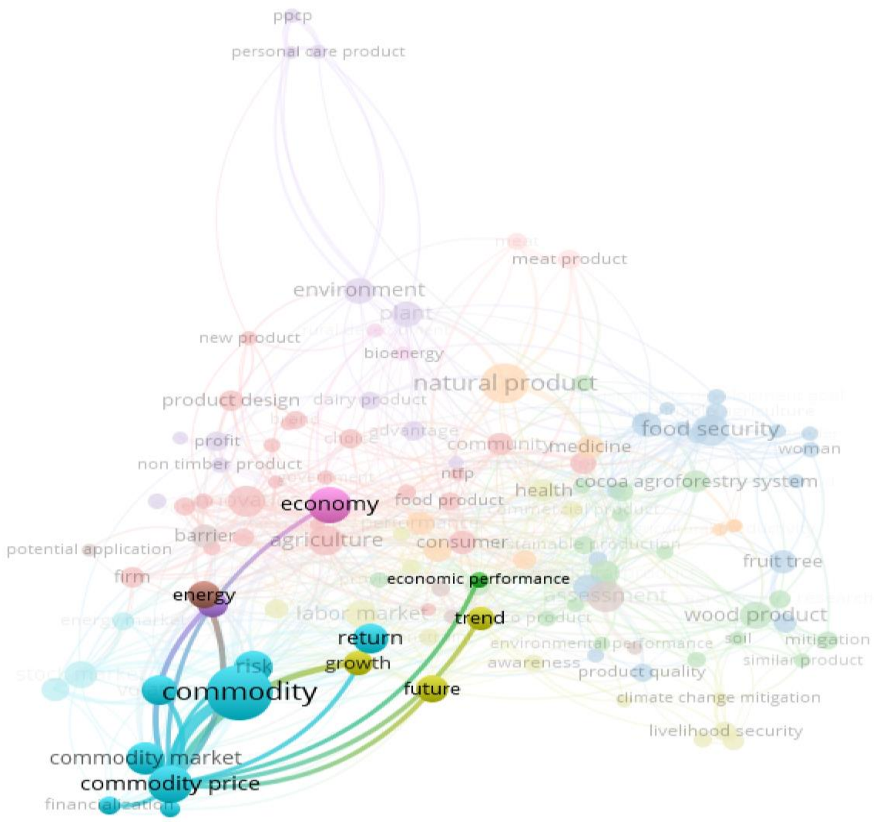


Figure 2.18. Commodity Price Cluster from the VOS Viewer Analysis

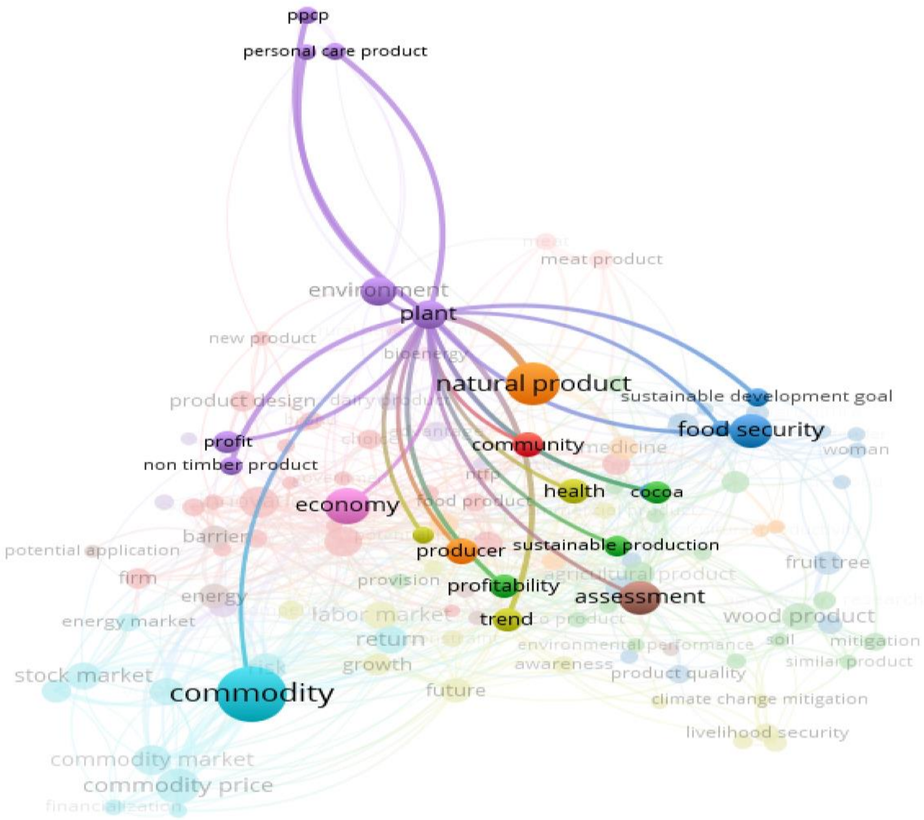


Figure 2.19. Plant Cluster from the VOS Viewer Analysis

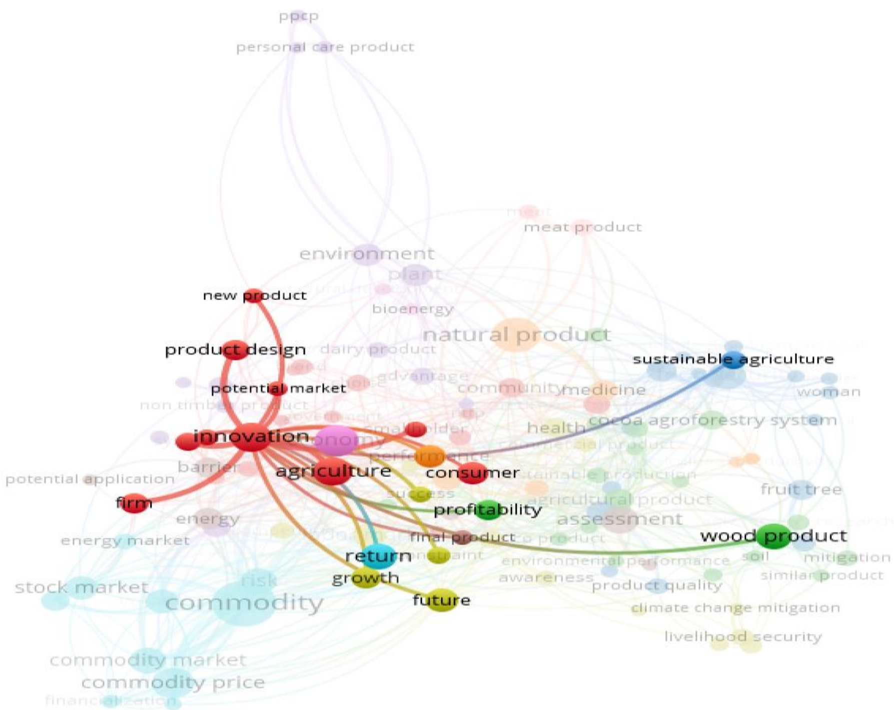


Figure 2.20. Innovation Cluster from the VOS Viewer Analysis

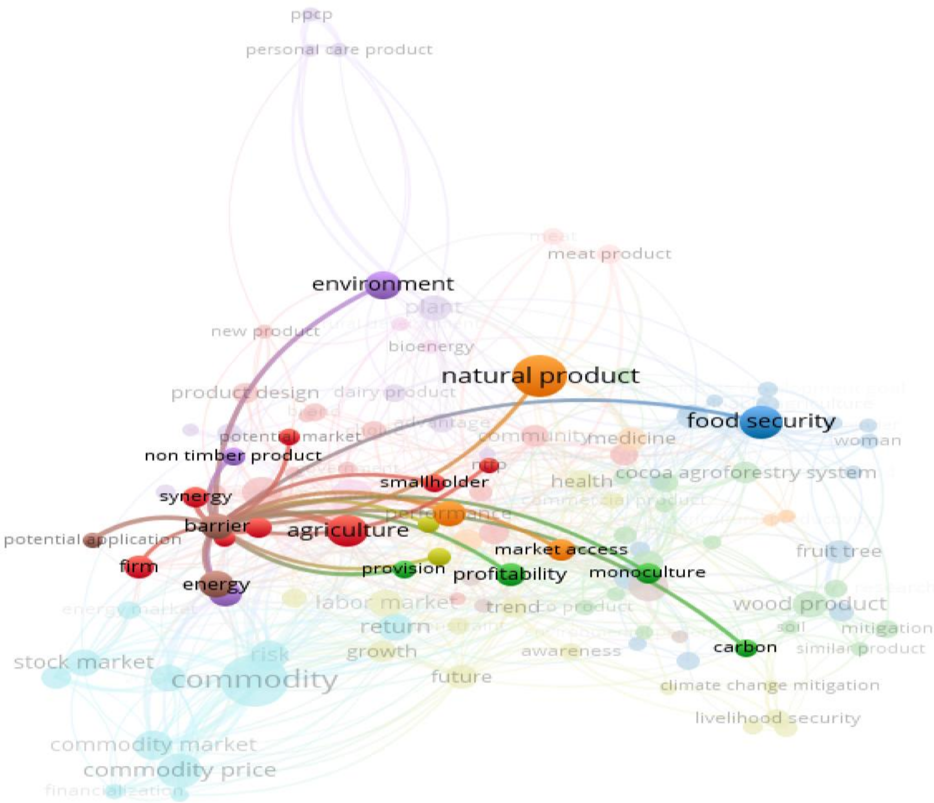


Figure 2.21. Barrier Cluster from the VOS Viewer Analysis

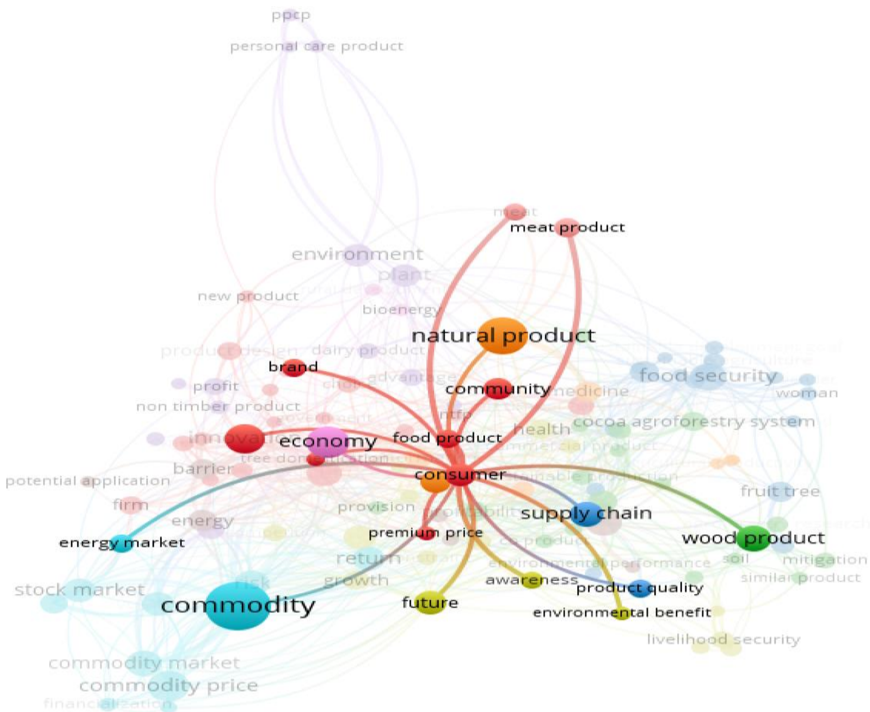


Figure2.22. Consumer Cluster from the VOS Viewer Analysis

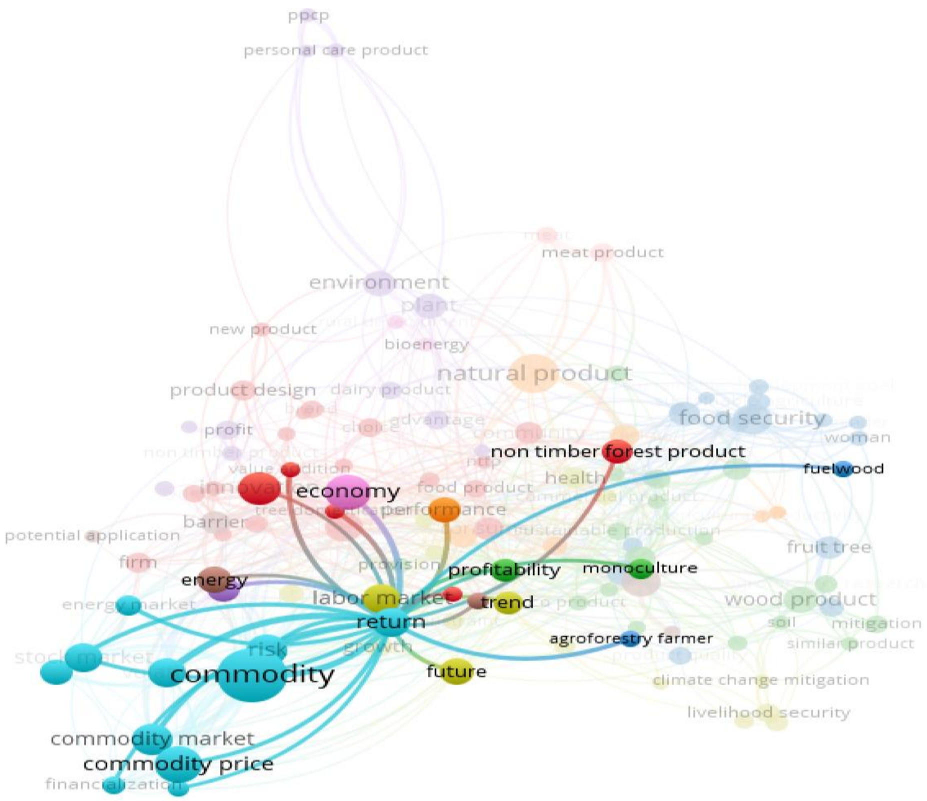


Figure 2.23. Return Cluster from the VOS Viewer Analysis

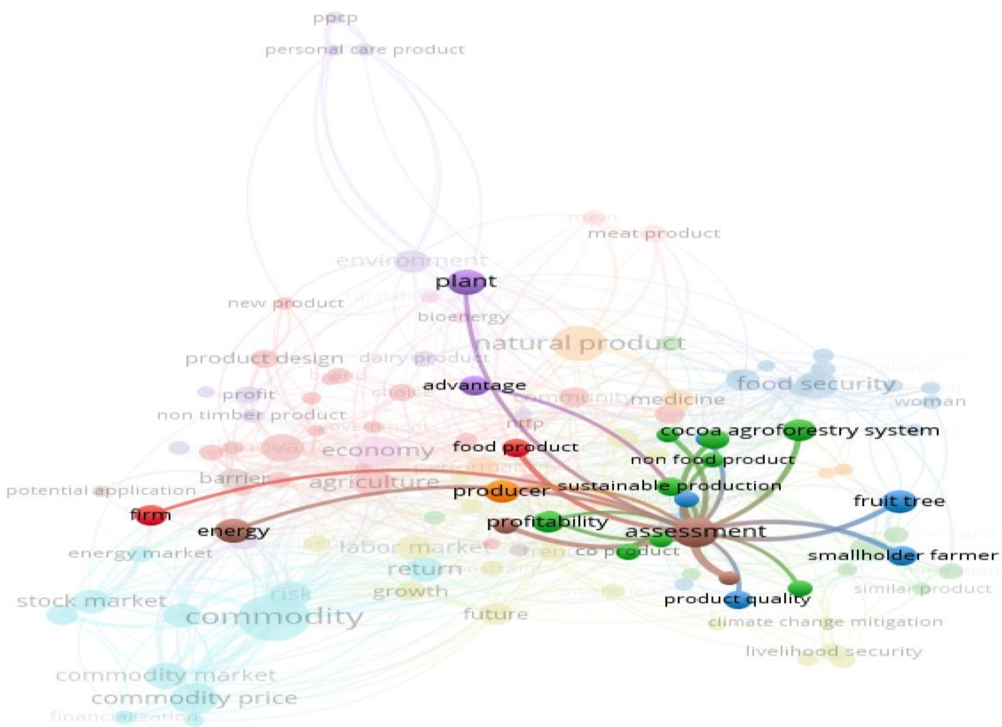


Figure 2.24. Assessment Cluster from the VOS Viewer Analysis

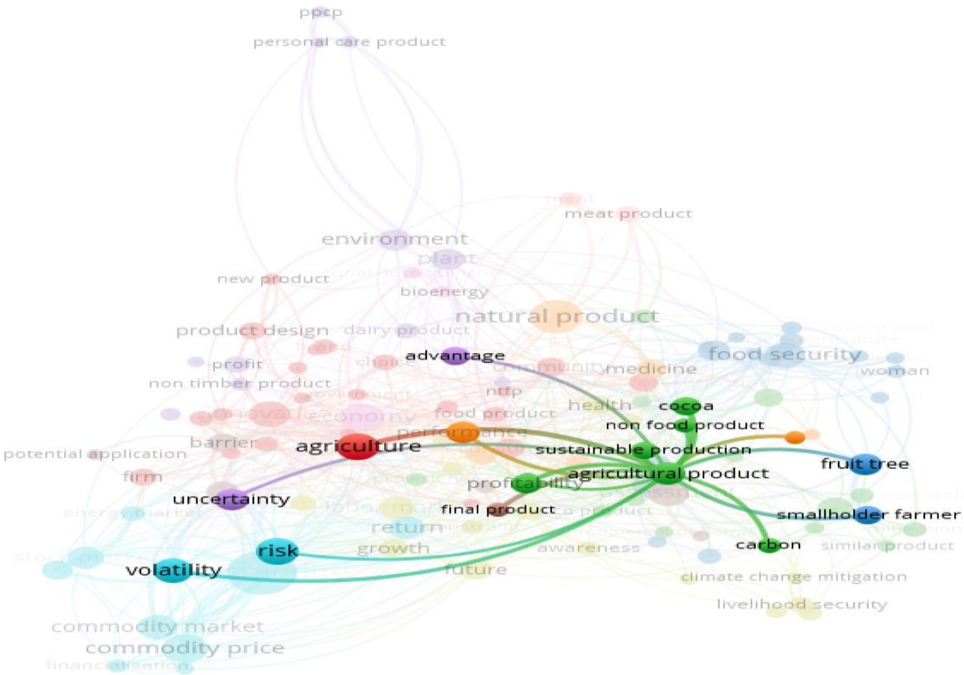


Figure 2.25. Agriculture Product Cluster from the VOS Viewer Analysis

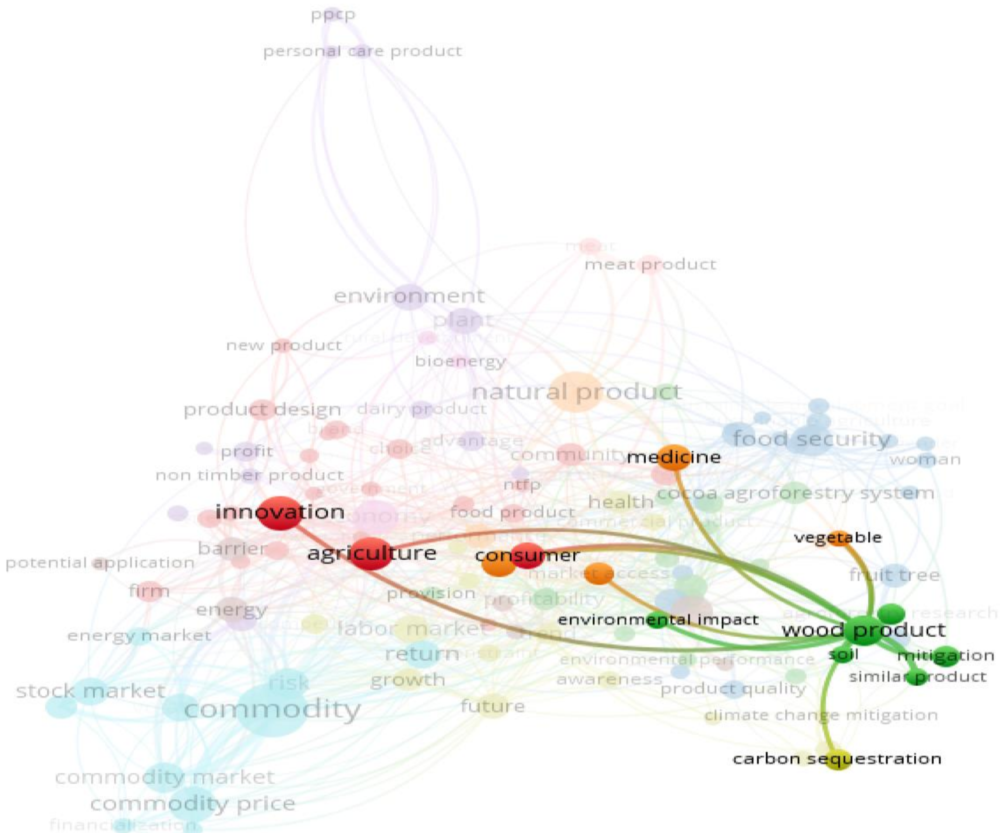


Figure 2.26. Wood Product Cluster from the VOS Viewer Analysis

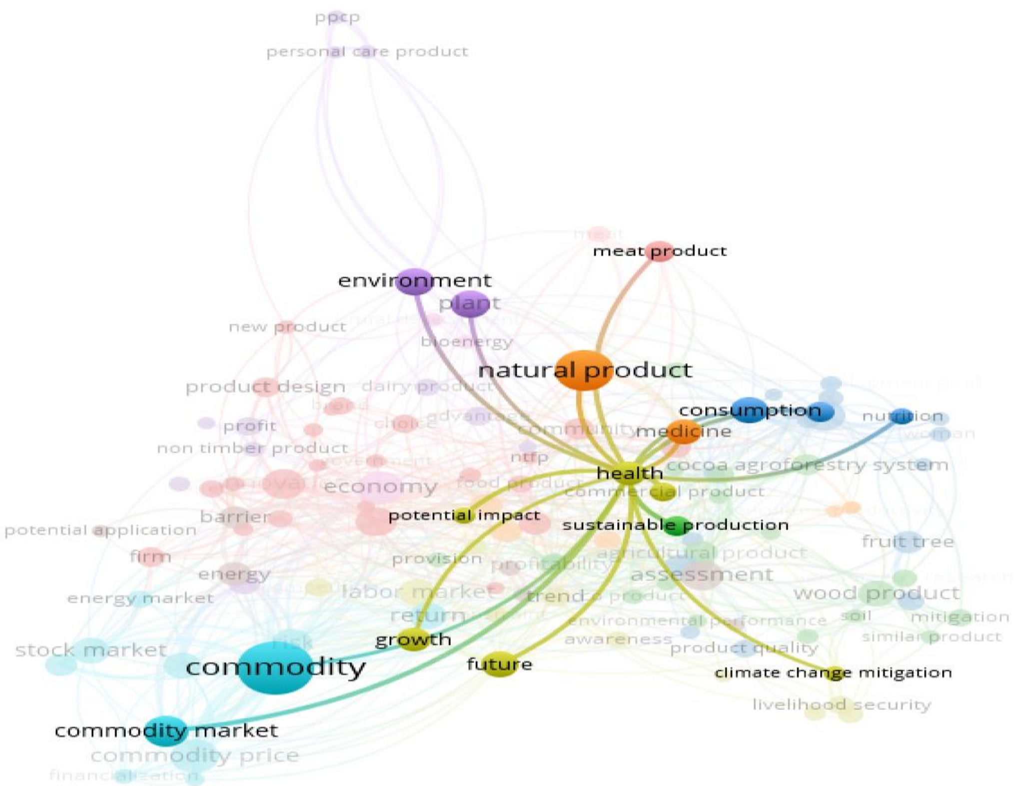


Figure 2.27. Health Cluster from the VOS Viewer Analysis

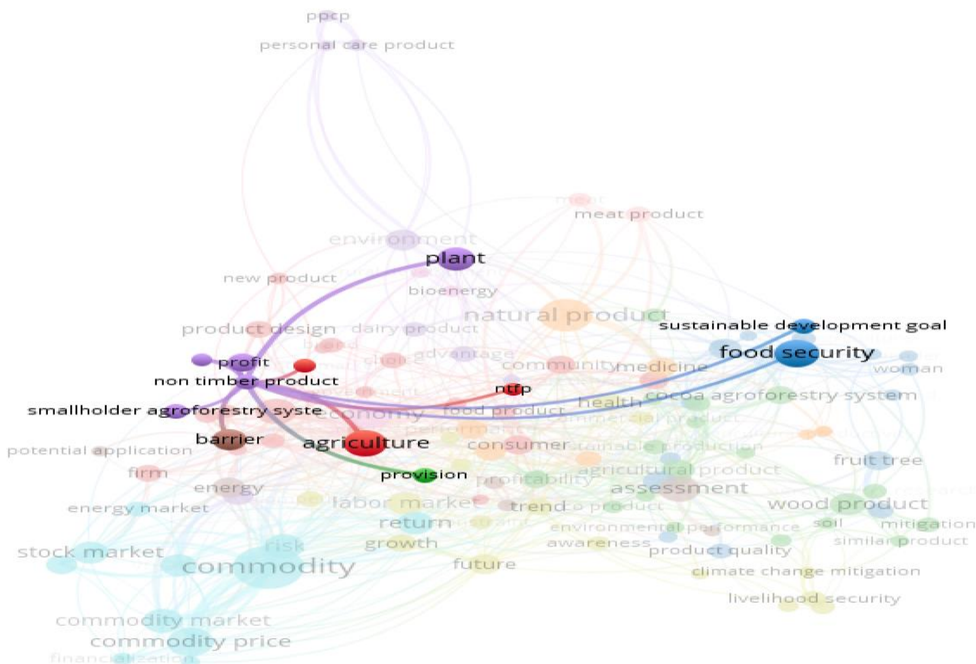


Figure 2.28. Non Timber Product Cluster from the VOS Viewer Analysis

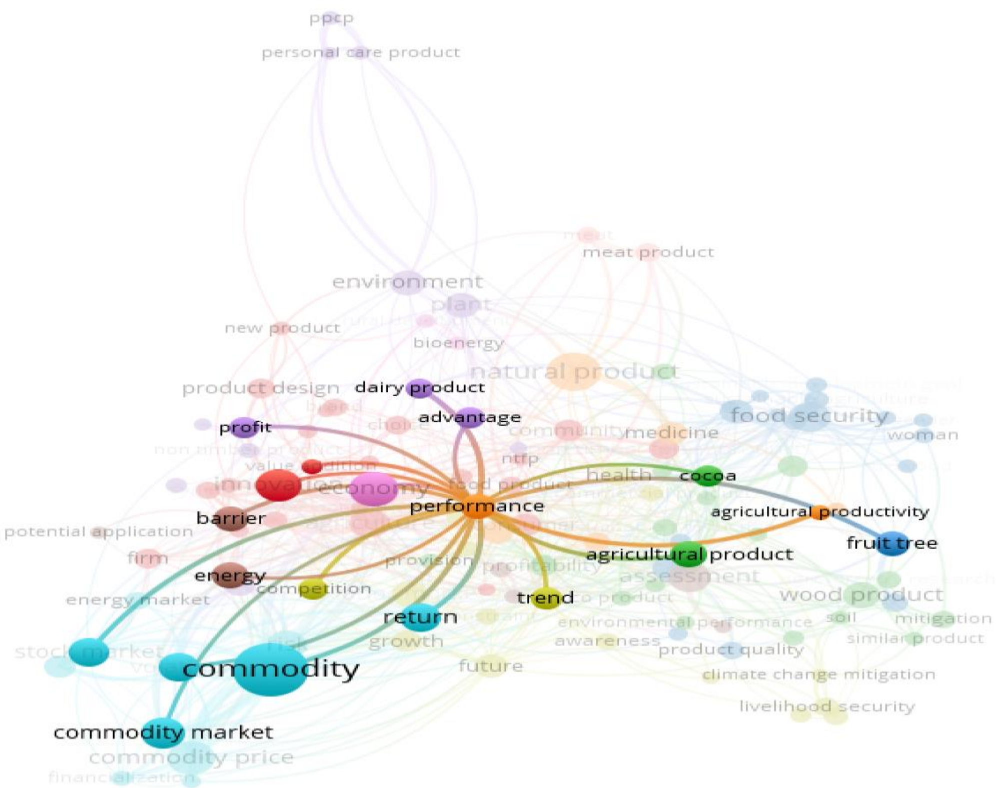


Figure 2.29. Performance Cluster from the VOS Viewer Analysis

Agroforestry products show significant market potential, with growing demand for various crops, livestock, and tree products, this finding also related to [16; 17]. Market participation is influenced by factors such as farm size, education, credit access, and extension services. The transition from wildcrafting to intentional cultivation of specialty forest products offers financial and environmental benefits, with medicinal herbs like ginseng garnering particular interest. [18] stated the same finding. Domestication of non-timber tree products (NTTPs) is often farmer-driven, responding to subsistence and income needs [19]. However, challenges persist, including small-scale production, insufficient services to farmers, and the need for secure land tenure [17;18]. To realize the full market potential of agroforestry products, emphasis should be placed on improving extension services, credit facilities, and agroforestry training, as supported by [16; 18].

The market potential for agroforestry products is as follows: Small-scale production and insufficient service to farmers from the village-level agriculture collection centre and cooperatives are major constraints to effective and efficient market chain development and management [17, 20]. Fuel supply, fruit production, vegetable production, and protein supplementary sources are important contributions of the homestead agroforestry system to rural livelihoods [20]. Potential consumers appear willing to pay a higher price for attractive agroforestry products, with direct selling at local or farmers' markets, fairs, or short supply chains being beneficial for reaching groups interested in and committed to sustainable products [21]. Expanding markets for agroforestry products and increasing support by extension workers are reported as available opportunities, but poor pricing policies, inadequate market information, and poor transport as well as handling and storage facilities hinder the marketing of agroforestry products [22]. Based on The National Agroforestry Policy, the agrogoresty policy aimed to address issues related to quality planting material, tree insurance, restrictions on transit and harvesting, and marketing of agroforestry produce to support the full potential of agroforestry in the economic development of the country [23].

c. Discussion

Agrosilvofishery systems integrate agriculture, forestry, and fishery practices, promoting sustainable land use and resource management. Benefits: These systems enhance biodiversity, improve soil health, and provide multiple income streams for farmers.

a. Key Findings from Literature Review

- Growing Demand: (1) Increasing consumer awareness of environmental sustainability is driving demand for agroforestry products, (2) Specific market segments, such as organic and health-conscious consumers, are particularly interested in agroforestry products.
- Production Challenges: (1) Limited access to land, technology, and financial resources restrict production capabilities, (2) Identifying bottlenecks in the value chain can help improve supply and reduce costs.
- Pricing Factors: (1) Production costs (labor, land, inputs) directly influence pricing strategies, (2) Market dynamics, including supply and demand fluctuations, play a significant role in determining prices.

b. Market Segmentation

- Target Markets: (1) Local Markets: Emphasis on direct selling at farmers' markets can enhance farmer income, (2) Niche Markets: Opportunities exist for specialty products such as medicinal herbs and organic produce.

c. Opportunities for Growth

- Policy Support: Governments can promote agroforestry by providing incentives, improving infrastructure, and supporting research and development.
- Consumer Preferences: Consumers are increasingly willing to pay premium prices for sustainably sourced products, indicating a favorable market environment for agrosilvofishery products.
- Value Addition: Enhancing value chains through processing and marketing strategies can significantly increase profitability for farmers.

d. Challenges and Recommendations

- Market Access: (1) Farmers often face barriers in accessing markets due to inadequate information and infrastructure. (2) Recommendation: Establish cooperatives to strengthen market presence and bargaining power.
- Training and Capacity Building: (1) Farmers require training on sustainable practices and market trends to maximize their production potential. (2) Recommendation: Implement training programs focused on agroforestry techniques and market integration.

e. Potential Agroforestry Commodities with Market Potential

1. Main Forestry Trees

- Timber Products: High demand for sustainable timber for construction and furniture.
- Non-Timber Forest Products (NTFPs): Includes fruits, nuts, and medicinal plants that can be marketed locally and internationally.

2. Agrosilvofishery Products

- Fish and Aquatic Plants: Integration of fish farming with forestry and agricultural practices can enhance income and provide diverse products.

3. Medicinal Plants and Herbs

- Herbal Remedies: Increasing consumer interest in natural and organic health products creates a market for medicinal plants.

4. Fruits and Nuts

- Tropical Fruits: Products like durian, rambutan, and other exotic fruits have growing demand in local and export markets.
- Nuts: Products such as cashews and walnuts can provide significant income due to their popularity and health benefits.

5. Specialty Crops

- Organic Produce: Growing market for organically grown vegetables and fruits, appealing to health-conscious consumers.
- Value-Added Products: Processed foods, jams, and juices derived from agroforestry produce can attract premium prices.

6. Bioenergy Products

- Biomass: Use of agroforestry residues for bioenergy production is gaining traction as a renewable energy source.

7. Sustainable Wood Products

- Eco-Friendly Furniture: Demand for sustainably sourced furniture and decor items is increasing, providing opportunities for agroforestry businesses.

8. Agroforestry-Based Livestock Feed

- Fodder Trees: Trees that provide fodder for livestock can enhance livestock productivity and contribute to food security.

The market potential for agrosilvofishery products, particularly main forestry trees, is promising due to rising consumer demand for sustainable and environmentally friendly products. However, addressing production challenges and enhancing market access through policy support and farmer education are essential steps to fully realize this potential. By leveraging these insights, stakeholders can develop strategies that not only increase profitability for farmers but also contribute to sustainable land management and environmental conservation. These commodities not only have market potential but also contribute to sustainable practices within agroforestry systems. By focusing on these products, farmers can enhance their income while promoting environmental sustainability.

1.4. Closing Remarks

Agroforestry products have significant market potential, with growing demand for crops, livestock, and tree products. Factors influencing market participation include farm size, education, credit access, and extension services. The transition from wildcrafting to intentional cultivation offers financial and environmental benefits, particularly medicinal herbs like ginseng. Domestication of non-timber tree products is often farmer-driven, but challenges persist, such as small-scale production and insufficient services. To realize the full market potential, focus should be on improving extension services, credit facilities, and agroforestry training. Addressing issues like quality planting material, tree insurance, and marketing can support agroforestry's full potential in economic development.

2. Comparative Income Model Survey

2.1. Description of the Physical and Ecological Conditions of the Village

a. Geographic and topographic characteristics of the village

The Land4Life ICRAF project visited for the benchmarking study is located in Ganesha Mukti Village. Geographically, this village is located in the Muara Sugihan District, Banyuasin Regency, South Sumatra Province. The Muara Sugihan District is located in a delta locally known as the Left Sugihan Delta because it is situated on the left side of the Sugihan River when traveling towards the river's estuary. On the right side of the Sugihan River, there is the Right Sugihan Delta, which administratively belongs to the Ogan Komering Ilir Regency.

The Muara Sugihan District, where Ganesha Mukti Village is located, lies between two major rivers that flow into the eastern coast of Sumatra (Bangka Strait), namely the Saleh River to the north and the Sugihan River to the south. Overall, Muara Sugihan District is a swamp area influenced by the tidal movements of the sea, hence it is known as a tidal area. The low topography causes most of this area to be frequently flooded by tidal waters, making it suitable for rice fields. The presence of water management infrastructure can regulate water levels according to the needs of the plants.

Desa Ganesha Mukti also has the same conditions as most villages in the Muara Sugihan District. In accordance with its topographical conditions, this village has been opened since 1981 as a general transmigration location sponsored by the government with a focus on food crops. Currently, this village has developed into a village that is considered successful in food production, particularly rice. This is evident from the entire tidal rice fields in this village, which are utilized for food production at least twice a year. Its productivity is also classified as high, exceeding 5 tons/ha of dry unhusked rice (GKP).

b. Initial condition of the peatland ecosystem in each village.

The Land4Life project site in Ganesha Mukti Village is located in a reclaimed tidal swamp area. The reclamation process is carried out by building a water management network on the tidal swamp land, resulting in tidal rice fields with a tidal irrigation network that relies on two main water sources. During the rainy season, water comes from high rainfall and there is an excess of water (flooding), so the water management system functions to remove the excess water (drainage). In the dry season, water comes from the high tide that enters the rice fields and is then retained (water retention) according to the water needs of the plants. The water management in the tidal reclaimed rice fields still follows the original pattern and no modifications are visible yet. Some water management infrastructure, such as sluice gates, appear to have just been rehabilitated. The secondary channel (SPD) appears shallow and is overgrown with aquatic plants, but water can still flow through it. The tertiary channels are in a similar condition, but they still convey water from the secondary channel to the rice fields and vice versa. The P3A (Water User Farmers Association) group exists and is active, but there are no contributions (IPAIR) to fund the operation and maintenance (OM) of the network. OP is carried out through mutual cooperation. Major maintenance such as sluice gate repairs is proposed to government institutions and funded by the regional or national budget.

The ecological threats that have occurred include saltwater intrusion during the dry season. If the sluice gate cannot be closed, then saltwater will enter the rice fields. This affects the decrease in rice productivity in the next planting season. Productivity dropped to 2.25 tons of GKP/ha from the normal productivity of 6-7 tons of GKP/ha. The rice fields have been utilized quite optimally. The entire rice fields (LU1 and LU2) have been cultivated with seasonal crop farming. Economically, farmers have already engaged in commercial crop cultivation. This means that cultivation is not only done with a production (supply) approach, but has also started to pay attention to demand, for example, there are already farmers planting red rice because there is demand.

At the beginning of the settlement of residents in this village through a government-sponsored transmigration program, peat soil with a depth of about 100cm was found based on information from the first generation who came to this village and the surrounding villages. Peatland with a peat layer depth of 100cm falls between shallow peat and medium peat. Although peat soil is considered fertile due to its richness in organic matter, land productivity is initially low because of the high soil acidity. Along with the natural flushing process through the ebb and flow of seawater, soil acidity decreases and land productivity gradually increases.

In line with the leaching process that reduces the acidity of peat soil, local farmers carry out intensive land cultivation at the beginning of each planting season. Intensive land cultivation, accompanied by the addition of dolomite and other organic materials, gradually depletes the peat layer present in the rice fields. So now peat soil is no longer found in the rice fields.

Thin peat soil with a depth of <30 cm can still be found in yard areas. This thin peat soil still remains in the yard because most of the yard is only used for mixed gardens where the soil is not intensively cultivated. This thin peat soil can be restored by maintaining its presence through the cultivation of various types of short-lived horticulture such as long beans, cucumbers, eggplants, and others. This horticultural cultivation is combined with the planting of various types of tree-shaped fruits chosen by the community, such as mangosteen, durian, jackfruit, and others.

2.2. Peat Restoration Process

a. Stages of peat restoration carried out

The thin layer of peat soil remaining in the yard area averages 0.25 ha (50m x 50m). Initially, it was suspected that the peat layer in the yard was the same as in the rice field. But because the yard land is not intensively cultivated, the peat soil still remains in this yard land, but its depth is only about 30cm and it falls into the category of shallow peat. However, the condition of the peat soil in this yard cannot be said to have experienced degradation. Although thin, the peat soil can be said to be still intact, so no restoration action is needed.

The activities carried out in the Land4Life project by ICRAF are more focused on utilizing peatland home gardens to be beneficial for the community. Its utilization is more directed towards types of food crops and horticulture, including fruit trees, to meet the family's needs that have not been part of household consumption. The target is to meet the subsistence needs of households for vegetables, fruits, and spices, as is commonly done by farming households in fulfilling their staple food (rice) needs, which are set aside from the harvest.

Planting vegetables, fruits, and spices does not require intensive land cultivation like the land preparation for rice fields. But its utilization can prevent the reduction of peatland or the conversion of peatland in the yard to other uses. This has a positive impact on the existence of the tidal agriculture ecosystem, which was previously a peat ecosystem.

b. The role of local actors, the government, and supporting institutions

Because the business land has been fully utilized, farmers' attention needs to be directed to the relatively large yard land (0.25 ha including the house and partly a storage warehouse). The yard land has not been fully utilized because it is usually used as a drying area. When farmers sell all their produce at harvest time, the use of the yard as a drying floor is no longer necessary. Farmers can optimize the use of yard land for the production of various types of plants, especially to meet their own needs such as various types of vegetables and fruits. The utilization of this yard land is part of the Land4life activities carried out by the women's farmer group (KWT) in partnership with ICRAF. KWT members are active, diligent, knowledgeable in cultivating various plants, and enthusiastic about attending extension sessions. This then becomes the basic capital in the implementation and success of the Land4life activities in this village.

The basic capital mentioned above is then reinforced by the presence of informal leaders in the village. Informal leaders, often referred to as figures, play an important role in encouraging community activities. In the Land4Life activities, the selection of leaders is very important because these activities are carried out participatively. The figure plays a role in encouraging community participation from the awareness stage to the implementation (adoption). The figure chosen as a partner in the activity is quite appropriate because he is experienced as a village head, forward-thinking, possesses a sociopreneurial spirit, and is willing to sacrifice by providing the necessary facilities to initiate the activity.

The success of the activities evaluated on an interim basis is also supported by good communication between the initiators and the implementers of the activities in the field. In addition, the process was initiated with a democratic decision-making approach, so it did not come across as top-down. In the implementation of the activities, the community appeared enthusiastic in carrying them out. These factors serve as reinforcement for the successful implementation of activities towards achieving the goals.

2.2. Current Situation Overview

a. Description of Peat Restoration Objectives

Peat restoration is the process of restoring peat ecosystems that have been damaged by human activities, such as drying, burning, or converting land into agricultural and plantation areas. The main goal is to restore the ecological function of peat as a natural water and carbon store, which plays an important role in reducing the risk of floods, droughts, and reducing greenhouse gas emissions to support climate change mitigation. In addition, this restoration aims to preserve biodiversity by protecting the habitat of typical peat species and supporting the welfare of local communities through the sustainable use of resources, such as non-timber forest products (NTFP). These efforts are also designed to prevent land fires by improving hydrological balance, thereby reducing the vulnerability of peat to fire. Peat restoration is not only focused on environmental aspects, but also prioritizes the empowerment of local communities to create sustainable and inclusive solutions**.** The following Table 2.3. is a brief description of the goals of peat restoration.

Table 2.3. Comparison of Restoration Objectives in Ganesha Mukti Village and Perigi Village

Aspects	Restoration Objectives in Ganesha Mukti Village	Restoration Objectives in Perigi Village
Gender-Based Management	Increase women's participation in peat ecosystem management.	Introducing environmentally friendly ecosystem-based land use.
Capacity Building and Community Participation	Increasing community capacity in sustainable practices.	Engaging the community in intensive practices without burning.
Spatial Design	Integrating the local economy with the sustainability of peat ecosystems.	Integrating the agriculture, forestry, and fisheries sectors through full spatial planning.
Land Management Practices	Improve environmentally friendly land management practices.	Eliminate the practice of burning through intensive cultivation methods.

Utilization of Local Resources	Commodity Diversification to improve people's welfare.	Diversification of high-value commodities to increase income.
Climate Change Mitigation	Reducing carbon emissions through awareness and adaptive practices.	Reduce greenhouse gas emissions through ecosystem restoration.

A comparison of restoration goals in Ganesha Mukti Village and Perigi Village shows a specific and contextual approach to the challenges faced by each village in an effort to restore peat ecosystems. Each village has different focuses and priorities according to the socio-economic characteristics, ecology, and needs of the local community. In terms of gender-based management, Ganesha Mukti Village focuses on increasing women's participation in peat ecosystem management. It aims to empower women as agents of change in environmental conservation and local resource management. Meanwhile, Perigi Village focuses on introducing the concept of environmentally friendly ecosystem-based land use, which also involves women as an integral part of the community. In terms of capacity building and community participation, Ganesha Mukti Village seeks to improve community skills in sustainable land management practices, by instilling awareness of the importance of peat ecosystem sustainability. In contrast, Perigi Village places an emphasis on intensive practices without burning, which aims to reduce negative environmental impacts and increase community productivity.

In terms of spatial design, Ganesha Mukti Village prioritizes the integration of the local economy with the sustainability of peat ecosystems. This strategy aims to create a harmonious relationship between resource utilization and environmental conservation. Perigi Village, on the other hand, highlights a full spatial plan that integrates the agriculture, forestry, and fisheries sectors to maximize the potential of the land while maintaining the ecological function of the peat. In land management practices, Ganesha Mukti Village emphasizes the application of environmentally friendly practices, such as agroforestry and the use of organic fertilizers, to increase productivity while preserving the ecosystem. In comparison, Perigi Village targets the elimination of land burning practices by encouraging intensive cultivation methods, which are more sustainable and safe for the environment. In terms of the use of local resources, Ganesha Village and Perigi Village both diversify high-value commodities such as pineapples and various fruits which can be the main strategy to increase community income and optimize land use.

Finally, in terms of climate change mitigation, the two villages share the same goal of reducing carbon emissions, although their approaches are different. Ganesha Mukti Village focuses on increasing public awareness and adaptive practices that support ecosystem sustainability. Meanwhile, Perigi Village focuses more on ecosystem restoration as a strategic step to significantly reduce greenhouse gas emissions. Overall, this comparison shows that the two villages have complementary approaches in supporting sustainable peat restoration, taking into account the local conditions and potential of each region. This community-based approach is an important model in achieving successful peat restoration in Indonesia.

2. Programs/Activities carried out in achieving goals.

2.1. Programs and Activities in Ganesha Mukti Village

The programs and activities carried out in Ganesha Mukti Village have a focused focus on achieving various strategic goals in peat ecosystem restoration. Every aspect of the program is designed with the local needs of the community in mind, environmental sustainability, and community empowerment. The following is a Table 2.4. describing the programs that have been implemented in achieving the goals.

Table 2.4. Description of Programs/Activities in Ganesha Mukti Village

Aspects	Purpose	Programs/Activities
Gender-Based Management	Increase women's participation in peat ecosystem management.	Yard land management training for women; enabling KWT from production to marketing
Capacity Building and Community Participation	Increasing community capacity in sustainable practices.	Sustainable land management and decision-making training. A joint experimental garden is provided.
Spatial Design	Integrating the local economy with the sustainability of peat ecosystems.	Integration of the local economy through the management of environmentally friendly resources.

Land Management Practices	Improve environmentally friendly land management practices.	Application of agroforestry techniques such as fruit crops (Durian, Mango) and the use of organic fertilizers
Utilization of Local Resources	Diversification of commodities to improve people's welfare.	Development of high-value commodities such as durian and various fruits.
Climate Change Mitigation	Reducing carbon emissions through awareness and adaptive practices.	Public education related to carbon emission reduction and environmentally friendly practices by not burning land

The program aims to increase women's participation in the management of peat ecosystems, given their important role in managing household and community resources. To achieve this goal, special yard land management training for women is carried out, providing them with skills in optimizing the use of yards for productive activities. In addition, the Farmer Women Group (KWT) is activated as a driving force for community-based economic activities. KWT is not only trained in production aspects but also in marketing strategies, ensuring local products can compete in a wider market. This step not only strengthens the role of women in the local economy but also contributes to the sustainability of peat ecosystems through environmentally friendly practices.

In an effort to increase community capacity, Ganesha Mukti Village held a sustainable land management training program. The training covered various technical aspects, such as how to improve soil fertility without damaging peat ecosystems, and strategies for maintaining long-term productivity. One of the important initiatives in this program is the provision of joint experimental gardens. The garden serves as a field laboratory where the community can directly apply the knowledge they have gained during training. This initiative is designed to encourage active community participation while having a real impact on increasing productivity and sustainability of peatlands.

Ganesha Mukti Village also focuses on the integration between the local economy and the sustainability of peat ecosystems through inclusive spatial design. This program aims to ensure that all economic activities carried out by the community are in line with the principles of sustainability. One of the main approaches is environmentally friendly resource management. Thus, the use of resources is regulated in such a way that it not only supports the economic activities of the community but also preserves the ecological function of peat as a carbon store and water absorber.

Improving environmentally friendly land management practices is one of the top priorities. The village applies agroforestry techniques, which integrate productive crops such as durian and mango with other trees to support the sustainability of the ecosystem. These techniques help improve soil quality, increase biodiversity, and provide additional economic benefits to the community. In addition, the use of organic fertilizers was also introduced as a safer alternative for the environment compared to chemical fertilizers. This approach not only supports the preservation of peat ecosystems but also increases the community's agricultural yield in the long term.

Diversification of high-value commodities is the main strategy in improving the welfare of local communities. Ganesha Mukti Village focuses on the development of crops with high economic value, such as durian and various other fruits, which have good market demand. This program provides the community with the opportunity to increase income while maintaining environmental sustainability. With this approach, the community is invited to use local resources wisely without having to damage the peat ecosystem.

In terms of climate change mitigation, Ganesha Mukti Village is committed to reducing carbon emissions through an education-based approach and adaptive practices. One of the main activities is public education about the importance of reducing carbon emissions and their impact on the environment. The program also emphasizes the application of environmentally friendly practices, such as not burning land for land clearing or management. This education aims to change the mindset of the community to be more concerned about environmental conservation and its impact on global climate change.

Through this combination of comprehensive programs, Ganesha Mukti Village seeks to be a model in peat restoration that not only focuses on environmental restoration but also empowers local communities to create long-term sustainability. The strategy implemented in these villages reflects the importance of a holistic approach that integrates social, economic, and environmental aspects in support of national peatland restoration goals.

2.2. Programs and Activities in Perigi Village

The program in Perigi Village aims to introduce environmentally friendly ecosystem-based land use by involving women in the management of local natural resources. One of the activities is the introduction of local ecosystem-based management which includes the fisheries, forestry, and agriculture sectors. Women are involved in this activity because they have an important role in maintaining the balance of the ecosystem and optimizing the resources in their environment even though they are not in the form of farmer women groups. This program is designed to increase women's awareness and capacity to contribute to environmental sustainability through an ecosystem-based approach (Table 2.5.)

Table 2.5. Brief Description of Programs and Activities in Perigi Village

Aspects	Purpose	Programs/Activities
Gender-Based Management	Introducing environmentally friendly ecosystem-based land use	Introduction to local ecosystem-based management such as fisheries, forestry, and agriculture.
Capacity Building and Community Participation	Engaging the community in intensive practices without burning.	Intensive hands-on training on no-burn and commodity diversification.
Spatial Design	Integrating the agriculture, forestry, and fisheries sectors through full spatial planning.	The application of full spatial planning for agriculture, forestry, and fisheries (wanaminatani).
Land Management Practices	Eliminate the practice of burning through intensive cultivation methods.	The use of intensive cultivation methods without fire.
Utilization of Local Resources	Diversification of high-value commodities to increase income.	Diversification of high-value commodities such as fruit crops.
Climate Change Mitigation	Reduce greenhouse gas emissions through ecosystem restoration.	Peat restoration with no-burn cultivation techniques.

Perigi Village prioritizes community involvement in intensive practices without burning as an environmentally friendly alternative to clearing or managing land. Through the training provided, the community is taught practical and effective techniques to replace the burning method that has been often used. In addition, commodity diversification activities are an important part of this program, where people are introduced to ways to grow various high-value commodities to increase their income without having to damage the ecosystem.

In this aspect, the main goal is to integrate the agriculture, forestry, and fisheries sectors through full spatial planning. Activities that support the achievement of this goal involve the application of integrated spatial planning to support various productive activities in one area in harmony. For example, wanamina tani (integration of forestry and fisheries) is one form of implementation in the field. This approach ensures that land use supports various sectors in a sustainable manner without compromising the ecological function of peatlands.

Perigi Village is committed to eliminating the practice of land burning by encouraging intensive cultivation methods without fire. This method provides a solution that is not only environmentally friendly but also more efficient in the long run. The community is trained to manage land using intensive techniques, such as the use of modern tools that support the agricultural process without having to burn the land first. This program not only reduces carbon emissions but also improves the community's agricultural yields.

The utilization of local resources in Perigi Village is directed to the diversification of high-value commodities, such as fruit crops that have great market potential. This activity aims to improve the welfare of the community by optimizing local resources. The community is invited to make the most of their land through the cultivation of commodities such as pineapples, durians, and various other horticultural crops that not only provide economic benefits but also support the preservation of peat ecosystems.

To support climate change mitigation, Perigi Village prioritizes peat restoration programs through no-burn cultivation techniques. This activity not only reduces greenhouse gas emissions but also restores peat's ecological function as a carbon store and water absorber. The community is given an understanding of the importance of maintaining peat ecosystems and is involved in long-term sustainability-oriented restoration practices.

The programs and activities carried out in Perigi Village show integrative efforts in integrating ecological, social, and economic aspects. This approach not only supports the preservation of peat ecosystems but also improves the welfare of local communities through the empowerment and implementation of sustainable practices. This strategy can be a relevant model for other regions that face similar challenges in managing peat ecosystems.

b. Differences in Programs/Activities in Ganesha Mukti Village and Perigi Village

Gender-based management programs are one of the main focuses in Ganesha Mukti Village. Women's participation is encouraged through yard land management training designed specifically for women. In addition, the Farmer Women Group (KWT) is activated as a driving force for the local economy, starting from production to marketing of local resource-based products. In contrast, in Perigi Village, there is no explicit focus on gender-based management. The program in this village emphasizes community participation in general without special discrimination for women, with a collective approach to land management. Ganesha Mukti Village held a sustainable land management training equipped with a joint experimental garden. The garden serves as a field laboratory, where the community can directly apply the knowledge they have gained during training. This approach allows for more in-depth, practice-based learning. Meanwhile, in Perigi Village, community capacity building is carried out through training on no-burn cultivation practices and commodity diversification. While education remains a key component, no experimental garden facilities have been reported as part of the program.

The program in Ganesha Mukti Village is more prominent in terms of spatial design that integrates the local economy with the sustainability of peat ecosystems. Resources are arranged in such a way as to support the economic activities of the community without sacrificing the ecological function of peatlands. In contrast, the program in Perigi Village focuses more on technical land management practices without developing a strategically integrated spatial design. In Ganesha Mukti Village, agroforestry techniques are applied to integrate productive crops such as durian and mango with other trees, supporting biodiversity while providing economic benefits. The use of organic fertilizers was also introduced as a more environmentally friendly alternative. In Perigi Village, land management is more oriented towards disaster risk control, such as the application of no-burn farming techniques to reduce the risk of peat fires, without a special emphasis on agroforestry integration.

Ganesha Mukti Village utilizes local resources with a focus on diversifying high-value commodities such as durian and other fruits that have good market potential. In Perigi Village, diversification is also carried out, but it is more directed to local commodities such as swamp rice and horticultural crops to support the needs of the local community In climate change mitigation, Ganesha Mukti Village emphasizes community education related to carbon emission reduction and adaptive practices, such as no-burn management and the use of organic fertilizers. In Perigi Village, the focus of mitigation is more directed to water management that functions to maintain the peat water level, thereby reducing the risk of carbon oxidation and fire.

c. Village Restoration Achievement Indicators

c.1. Success indicators

The Table 2.6 descibe the distribution of the Saleh Sugihan KHG Sub-Landscape in South Sumatra Province.

Table 2.6. Distribution of KHG Saleh Sugihan Sub-Landscape

ID SL	Sub Bentang Lahan	Luas (Ha)	ESSupply	ESDemand	ESBalance	FSVA_mean	FSVA_komp	flood_mean	drought_mean	Desa	Kecamatan
1	Lindung Berkanal_AIR KUMBANG	2	3.08	0.10	2.98	73.32	73	0.21	0.34	SEBOKOR	AIR KUMBANG
2	Lindung Berkanal_AIR SUGIHAN	3	2.58	0.88	1.69	73.32	73	0.27	0.36	BUKIT BATU	AIR SUGIHAN
3	Lindung Berkanal_MUARA PADANG	41,101	1.90	2.13	-0.23	73.31	73	0.45	0.45	KARANG ANYAR; MUARA PADANG	MUARA PADANG
4	Lindung Berkanal_MUARA SUGIHAN	17,890	2.59	0.31	2.28	72.39	73	0.03	0.12	DAYA MURNI; GANESHA MUKTI; GILIRANG; JURU TARO; KUALA SUGIHAN; SIDO MAKMUR	MUARA SUGIHAN
5	Lindung Berkanal_PANGKALAN LAPAM	4,990	2.64	0.23	2.41	65.16	65	0.04	0.14	BUKIT BATU; PERIGI; RAMBAI; RIDING	PANGKALAN LAPAM
6	Lindung Berkanal_RAMBUTAN	3,643	1.80	2.31	-0.51	63.05	63	0.49	0.46	BARU; DURIAN GADIS; PELAJAU; SIJU; SUKA PINDAH	RAMBUTAN
7	Lindung Nonkanal_AIR KUMBANG	6	1.94	1.37	0.57	63.20	63	0.30	0.21	SEBOKOR	AIR KUMBANG
9	Lindung Nonkanal_MUARA PADANG	21,511	2.15	0.06	2.08	63.06	63	0.23	0.16	KARANG ANYAR	MUARA PADANG
10	Lindung Nonkanal_MUARA SUGIHAN	9,017	1.78	0.01	1.76	63.07	63	0.33	0.23	GILIRANG; JURU TARO; KUALA SUGIHAN	MUARA SUGIHAN
11	Lindung Nonkanal_PANGKALAN LAPAM	9,384	2.46	0.00	2.46	65.07	65	0.00	0.00	BUKIT BATU; PERIGI; RAMBAI; RIDING; SUNGGUTAN	PANGKALAN LAPAM
12	Lindung Nonkanal_RAMBUTAN	7,166	2.14	0.00	2.14	80.75	81	0.03	0.02	BARU; SIJU; SUKA PINDAH	RAMBUTAN
13	Budidaya Berkanal_AIR KUMBANG	2	2.46	0.00	2.46	71.70	72	0.00	0.00	SEBOKOR	AIR KUMBANG
14	Budidaya Berkanal_AIR SUGIHAN	106	2.90	0.00	2.90	71.70	72	0.18	0.13	JADI MULYA; MARGA TANI; NUSANTARA; PANGKALAN DAMAI; RENGAS ABANG; SUKA MULYA; SUNGAI BATANG; TIRTA MULYA	AIR SUGIHAN
15	Budidaya Berkanal_MUARA PADANG	24,729	1.79	0.00	1.79	80.75	81	0.01	0.01	AIR GADING; DAYA MAKMUR; DAYA UTAMA; KARANG ANYAR; MARGA SUGIHAN; MARGO MULYO 20; MUARA PADANG; PURWODADI; SIDO MULYO 18; SIDOMULYO 20; SIDOREJO; SUMBER MAKMUR; TANJUNG BARU; TIRTA JAYA; TIRTO RAHARJO	MUARA PADANG
16	Budidaya Berkanal_MUARA SUGIHAN	42,063	2.41	0.40	2.01	80.77	81	0.09	0.28	ARGO MULYO; BERINGIN AGUNG; CENDANA; DAYA BANGUN HARJO; DAYA KESUMA; DAYA MURNI; GANESHA MUKTI; GILIRANG; INDRAPURA; JALUR MULYA; KUALA SUGIHAN; MARGO MULYO 16; MARGO RUKUN; MEKAR JAYA; REJO SARI; SIDO MAKMUR; SUGIH WARAS; SUMBER MULYO; TIMBUL JAYA; TIRTA MULYO; TIRTO HARJO	MUARA SUGIHAN
17	Budidaya Berkanal_PANGKALAN LAPAM	1,131	2.98	0.11	2.87	76.24	72	0.00	0.00	AIR RUMBAI; PERIGI; RAMBAI	PANGKALAN LAPAM
18	Budidaya Berkanal_RAMBUTAN	1,738	2.97	0.65	2.32	71.70	72	0.23	0.13	BARU; DURIAN GADIS; PELAJAU; SIJU; SUKA PINDAH	RAMBUTAN
19	Budidaya Nonkanal_AIR KUMBANG	7	2.29	0.10	2.19	80.76	81	0.01	0.08	SEBOKOR	AIR KUMBANG
21	Budidaya Nonkanal_MUARA PADANG	220	2.76	0.22	2.55	76.30	76	0.02	0.10	KARANG ANYAR; MUARA PADANG	MUARA PADANG
22	Budidaya Nonkanal_MUARA SUGIHAN	11	1.84	0.00	1.83	76.28	76	0.28	0.17	JURU TARO; KUALA SUGIHAN; MEKAR JAYA	MUARA SUGIHAN
23	Budidaya Nonkanal_PANGKALAN LAPAM	3,446	2.19	0.01	2.18	76.28	76	0.27	0.17	AIR RUMBAI; BUKIT BATU; PERIGI; RAMBAI; RAWA TENAM; RIDING; SUNGGUTAN	PANGKALAN LAPAM
24	Budidaya Nonkanal_RAMBUTAN	548	2.96	0.34	2.62	76.28	76	0.05	0.11	SIJU; BARU	RAMBUTAN

A comparison between Pangkalan Lampam District (Perigi Village) and Muara Sugihan District (Ganesha Mukti) shows significant differences in ecosystem conditions and peatland management potential. The following are comparative indicators between the two sub-districts:

1. **ESSupply (Ecosystem Service Supply)**

   The ESSupply indicator shows the capacity of peatlands to provide ecosystem services such as carbon storage, water cycle regulation, and biodiversity support. In Pangkalan Lampam District, the ESSupply value on protected land such as the Beranal Protected Land is relatively good, with a value range of 2.64, indicating a fairly adequate ecosystem capacity. Meanwhile, in Muara Sugihan District, ESSupply indicators on some lands such as Non-Canal Protection and Farming tend to be lower, with values of 0.78 and 2.41, indicating a more limited supply of ecosystem services due to intensive land-use pressures.

2. **ESBalance (Ecosystem Balance)**

   ESBalance reflects the balance between the supply and demand for ecosystem services, where higher values indicate better ecosystem stability. Pangkalan Lampam District has a fairly stable ESBalance value on Protected Land (2.41) and Cultivated Orchids (2.87), indicating a well-functioning ecosystem. On the other hand, Muara Sugihan District showed a low ESBalance value, especially in a large area of Anal Cultivation (0.40). This imbalance indicates high pressure on peatlands in the region, which requires further restoration interventions.

3. **FSVA_mean (Water Service Availability)**

   FSVA_mean demonstrated the availability of water services in peatlands, which are critical to supporting agricultural, forestry, and fisheries activities. Muara Sugihan District has a very high FSVA_mean value on Coral Cultivation land (80.75 to 81), reflecting great potential to support water-based productive activities. In Pangkalan Lampam District, the FSVA_mean value varied between 55.16 to 76.24, indicating that the water capacity was quite good but not as optimal as Muara Sugihan.

4. **Flood_mean (Flood Risk)**

   Flood_mean reflects the flood risk on each sub-landscape. Pangkalan Lampam District has a low flood risk value, with a value range of 0.14 to 0.17 on Protected Land for Canal and Canal Cultivation. This shows that this region has quite good flood mitigation. In Muara Sugihan District, the risk of flooding is higher, especially on canal cultivation land, with a value of 0.28, indicating the need for water system improvements to reduce this risk.

5. **Drought_mean (Drought Risk)**

   Drought_mean shows the level of drought risk that affects land productivity. Pangkalan Lampam District again showed good performance with a low risk of drought, ranging from 0.11 to 0.14. On the other hand, Muara Sugihan District faces a higher risk of drought on some lands, such as Canal Cultivation, with a value of 0.28. This risk of drought can affect the sustainability of productivity in the region and requires better water management.

6. **Carbon Emission Reduction Rate**

   The reduction in carbon emissions occurs if the peat water level is successfully maintained at a certain height (at least 40 cm below the surface). Villages that adopt a no-burn cultivation pattern have a significant contribution to reducing carbon emissions. The rate of carbon emission reduction in Ganesha Mukti Village is relatively better than that of Perigi Village. The practice of no-burn cultivation that has begun to be implemented also contributes to the reduction of greenhouse gas emissions. On the other hand, Perigi Village faces challenges in reducing carbon emissions due to high ecosystem pressure due to the large amount of land that is still burned. In addition, higher drought risks require more intensive water management to minimize carbon emissions from degraded peatlands.

7. **Vegetation Recovery Rate**

   Vegetation restoration in Perigi Village showed better results due to the stability of the ecosystem that supports the regrowth of peat-typical vegetation. With a relatively small but stable protected land area, vegetation restoration in Perigi Village is more focused and measurable. A good ESBalance indicator (2.41) indicates a high potential for revegetation involving typical plants such as jelutung and ramin. On the other hand, Ganesha Mukti Village faces obstacles in vegetation recovery due to low ecosystem stability and higher drought risk. Although the region has optimal water availability (FSVA_mean 81), the pressure on peatlands due to intensive cultivation practices makes the revegetation process difficult. These challenges require strategic interventions, such as mass planting of native vegetation and better management of water systems, to accelerate vegetation recovery in the region.

c.2. Success Indicators from Socio-Economic Aspects

Indicators of restoration achievement from **socio-economic aspects** include various dimensions that reflect the social and economic impacts of environmental restoration activities, both for local communities and for their economic sustainability. In the context of ecosystem restoration, socio-economic aspects aim to create positive changes, such as increased welfare, employment, and active community participation in natural resource management. Here on Table 2.7. are some indicators of restoration achievement from the social aspect used to evaluate the success of restoration projects:

Table 2.7. Brief Description of Social Aspects Supporting the Success of Restoration Activities

Social Aspect Indicators	**Description**	**Measurement Examples**
Improving Community Skills and Knowledge	Assess the number of people who are trained and gain knowledge in environmental management.	All farmers get the same opportunity to improve the skills and knowledge of the community
Community Participation in Restoration Projects	Measure the level of community involvement in restoration activities, both men and women.	All farmers are involved in the activity, but only about 30% of farmers actively and routinely carry out restoration activities in the peatland of Perigi Village
Strengthening Stakeholder Networks and Collaboration	Assess the partnerships formed between communities, governments, and the private sector in ecosystem restoration.	Since there have been CSA practice activities in peatland restoration efforts in Perigi Village, a community of agrosilvofishery farmers has now begun to be formed. However, for networks outside the group, it is currently being tried to be built, while strengthening the internal of farmers.

Improving community skills and knowledge is a very important social indicator in ecosystem restoration projects. Community involvement in natural resource management must be based on adequate knowledge of sustainability principles and appropriate restoration techniques. In this context, training and extension programs play a central role in improving the ability of communities to manage their ecosystems in an environmentally friendly way. For example, in peatland restoration projects, farmers need to be trained on greener agricultural practices, such as agrosilvofishery, which integrates agriculture, forestry, and fisheries. With better knowledge, farmers can use natural resources more efficiently, increase production yields, and maintain ecosystem balance at the same time. This training program should be accessible to all members of the community, especially farmers, so that they get the same opportunity to develop their skills and knowledge.

The second social indicator is community participation in restoration projects. Ecosystem restoration cannot be effective without the active involvement of local communities, both in the planning, implementation, and monitoring stages. This participation includes different levels of involvement, ranging from passive (e.g., simply supporting activities) to active (e.g., regularly participating in restoration activities or contributing thoughts). In the peatland restoration project in Perigi Village, although all farmers are involved in the activity, only about 30% of the farmers participate actively and regularly. This shows that despite the collective awareness of the importance of restoration, there are still challenges in encouraging the full participation of all members of the community. One of the factors influencing active participation is a deep understanding of the long-term benefits of restoration, both in the form of increased agricultural yields and environmental conservation. Therefore, to increase participation, it is crucial to continue to educate the public about the concrete benefits of restoration.

The last social indicator that is no less important is the strengthening of networks and collaboration between stakeholders, which include the community, the government, and the private sector. This collaboration creates synergies that can strengthen the sustainability of restoration projects. In many cases, successful restoration projects require the support and involvement of various parties, both in terms of funding, policy, and technical expertise. In Perigi Village, for example, the implementation of CSA (Climate-Smart Agriculture) in peatland restoration has formed a community of agrosilvofishery farmers who support each other in sustainable agricultural activities. The community also creates opportunities to forge partnerships with various other parties, such as government agencies that can provide policy support or the private sector that can provide market access for environmentally friendly agricultural products. However, network strengthening does not only occur within community groups, but must also involve cooperation with stakeholders outside the community. By strengthening partnerships between communities, governments, and the private sector, restoration projects can gain broader and sustainable support, both in terms of resources and supportive policies.

Furthermore, the economic aspects of ecosystem restoration focus on how the project provides tangible economic benefits to local communities, improves their well-being, and promotes long-term economic sustainability. Economic indicators that are often used in measuring the success of restoration projects include increased income, job creation, access to financing, increased markets for sustainable products, and diversification of revenue sources. Table 2.8 is a further explanation of these indicators as well as examples of relevant measurements.

Table 2.8. Brief Description of Economic Aspects Supporting the Success of Restoration Activities

Economic Aspect Indicators	**Description**	**Measurement Examples**
Increased Revenue	Measure changes in the income of people involved in restoration, both from products and services.	Around 30% of farmers get additional income from the sale of agricultural products such as pineapples and rhizomes. However, 100% of farmers benefit from rice cultivation with a yield between 15-1000kg/cultivated area that is not marketed. This can indirectly reduce rice purchases by Rp. 70,000 - Rp. 3,500,000/year
Job Creation	Assess the number of jobs created thanks to restoration projects and the sustainability of the local economy.	No jobs have been created from CSA practices in Perigi Village
Access to Financing	Assess increasing public access to financing to support sustainable economic activities.	100% of farmers get access to financing in the form of subsidies for agricultural production facilities from NIFOS and Cifor
Increasing the Market for Sustainable Products	Measure increased access to the market for products produced by the community after restoration.	There has not been a significant increase in the market, because there are only about 30% of farmers who market agricultural products.

Diversification of Revenue Sources	Assess the extent to which communities have succeeded in diversifying their sources of income through restoration activities.	As many as 30% of farmers diversify their income through the sale of pineapples and rhizome crops.

The ecosystem restoration project in Perigi Village provides a clear picture of how economic indicators can be used to assess the impact of restoration on community welfare. While not all indicators showed optimal results, such as job creation and increased markets for sustainable products, other indicators such as increased income, access to financing, and diversification of income sources showed positive results. This shows that ecosystem restoration has the potential to improve the quality of life of the community, although there are still challenges to be overcome. Going forward, it is important to continue to support farmers in accessing wider markets, creating more job opportunities, and strengthening access to financing and training to support economic sustainability.

2.4. Determinants of Successful Village Success

a. Factors Supporting the Success of CSA Practice

Climate-Smart Agriculture (CSA) is an agricultural approach that aims to increase agricultural resilience to climate change, reduce negative impacts on the environment, and increase food production in a sustainable manner. The success of the implementation of CSA depends on three main aspects, namely technical, social, and economic aspects. These three aspects are interrelated and play an important role in creating an agricultural system that is resilient to climate change and able to provide long-term benefits for farmers, communities, and the environment. From a technical point of view, the right technology and efficient management of natural resources are key to overcoming the challenge of climate change. Technical aspects are a key factor in the success of Climate-Smart Agriculture (CSA) because the right technology and efficient management of natural resources can increase productivity, reduce losses, and increase agricultural resilience to climate change. This aspect includes the use of innovative technologies, efficient management of natural resources, and the application of methods that allow agricultural systems to adapt to changing climatic conditions. In this context, the technical aspect is not only about the adoption of advanced technologies, but also about how they can be integrated into everyday agricultural practices to improve resilience, efficiency, and sustainability. The technology used in CSA helps farmers manage climate change risks, optimize the use of natural resources, and improve the quality and quantity of agricultural products. Therefore, investment in technology and the development of adequate technical support systems is essential for the long-term success of CSA practice. The following Table 2.9. is a brief description related to the success factors on the technical aspect

Table 2.9. Brief Description of the Supporting Factors for the Success of CSA Practice in Technical Aspects

Aspects	Factor	Explanation
Technical Factors	Innovative Agricultural Technology	The use of efficient technology, such as drainage systems for irrigation, the use of drones and sensors for land monitoring, and the use of superior seedlings that are resistant to climate change.
	Natural Resource Management	Efficient water and soil management, including soil conservation techniques such as agroforestry and the use of renewable energy in agricultural processes.
	Resilience to Climate Change	The use of crop varieties that are resistant to drought, floods, or extreme temperatures, as well as the application of agricultural techniques that are more adaptive to climate fluctuations and soil conditions.
	Risk Management and Resilience	Systems to monitor and respond to climate change risks (e.g., early warning of natural disasters) and the implementation of strategies to mitigate losses due to extreme weather.
	Geographic Information System (GIS)	The use of GIS to map land and manage land use efficiently, as well as to monitor soil and vegetation conditions more accurately and data-based.

	Agricultural Infrastructure	Provision of supporting infrastructure such as efficient irrigation, post-harvest processing facilities, and transportation to support the sustainability and marketing of agricultural products.

From a social perspective, community involvement, effective counseling, and awareness of climate change are critical in ensuring the success of the CSA program. The social aspect plays an equally crucial role in determining the success of this climate-smart agricultural practice. In this context, the success of CSA depends not only on the application of technology and financial capital, but also on the extent to which communities, especially farmers, can adopt and adapt to more climate-friendly agricultural practices. The active involvement of the community, especially farmers, in the planning and implementation of CSA practices is a key factor determining the success of the program. In many cases, the success of new technologies or practices in agriculture depends not solely on technical innovation, but on the extent to which farmers understand the benefits and their ability to implement those technologies in their social and environmental contexts. Therefore, community participation in decision-making is very important.

If farmers are involved in determining the choice of technology to implement and benefit from CSA programs, they are more likely to support and implement them. Conversely, if they feel that the decision was made without involving them, they may be hesitant to adopt the new practice. Therefore, it is important to engage farmers in an inclusive and participatory dialogue, by providing a space for them to share experiences, challenges, and solutions that are appropriate to their local conditions.

This involvement also contributes to a sense of ownership towards the CSA program, which increases the likelihood of the program's long-term sustainability. For example, if farmers are involved in selecting crop varieties that are more resilient to climate change or in designing technology-based irrigation systems, they will feel more responsible and motivated to care for and manage those technologies. The following is a brief description related to the social aspect (Table2.10).

Table 2.10. Brief Description of the Supporting Factors for the Success of CSA Practice in Social Aspects

Aspects	**Factor**	**Explanation**
Social Factors	Community Involvement and Participation	Active participation of farmers and communities in the planning, implementation, and maintenance of CSA practices. This increases the sense of ownership and successful implementation of the new technique.
	Counseling and Education	Training and counseling programs to improve farmers' understanding of climate change, CSA techniques, and their benefits for agricultural sustainability and food security based on scientific evidence.
	Awareness and Adaptation to Climate Change	The level of public awareness about the impact of climate change and the importance of adaptation actions. Education programs that increase farmers' understanding of climate change risks are essential.
	Social Justice and Access to Resources	CSA programs should be inclusive and ensure that farmers from different backgrounds (e.g., women, young farmers, or marginalized groups) have equitable access to technology, training, and markets.

Economically, access to financing, economic value creation, and supportive incentives are essential to drive CSA adoption and improve farmers' welfare. One of the main factors that determine the success of CSA implementation is the economic aspect. Without adequate financial support, CSA practices are difficult to widely adopt by farmers, especially in areas with limited resources. Access to financing is one of the key factors. Sufficient financing, such as microcredit, subsidies for green agricultural tools, or climate change-based agricultural insurance, allows farmers to invest in new, more efficient and climate-friendly technologies. Without access to financing, many farmers may struggle to adopt climate-smart farming techniques that require high upfront costs. Furthermore, the creation of economic value through the practice of CSA can increase farmers' income. For example, by adopting climate-resistant crop varieties or efficient irrigation systems, farmers can increase agricultural yields despite facing extreme weather. In addition, sustainable agricultural products, such as organic products, can open up new markets at better prices, increasing farmers' profits. A supportive business model and market are also important. Developing a market for products produced with CSA techniques, such as climate-friendly product certification, can open up access to a wider and profitable market. With stable market access and competitive prices, farmers will be more motivated to adopt CSA in the long term.

Overall, the economic aspect plays an important role in ensuring the sustainability of CSA. Access to financing, economic value creation, and supportive markets can reduce financial barriers and strengthen incentives for farmers to switch to more climate-friendly farming practices, so that CSAs can be widely implemented and provide sustainable benefits. The Table 2.11 is a brief summary related to the economic aspect.

Table 2.11. Brief Description of the Supporting Factors for the Success of CSA Practice in Economic Aspects

Aspects	Factor	Explanation
Economic Factors	Access to Financing and Investment	Adequate financing to support the adoption of new technologies, such as microcredit for farmers, subsidies for agricultural tools, or investments in infrastructure that supports CSAs.
	Economic Value Creation	Increase farmers' income through more efficient and sustainable CSA practices, including through organic products or agricultural products that are more resistant to market fluctuations.
	Business Model and Market	Develop sustainable business models and access to markets for agricultural products that use CSA techniques. This includes certification of climate-friendly products or organic farming.

	Incentives and Subsidies	Provision of financial incentives for farmers who adopt CSA practices, such as subsidies for the purchase of organic fertilizers, environmentally friendly agricultural equipment, or climate change-based agricultural insurance.
	Job Creation	This program opens up new job opportunities in the sustainable agriculture sector and related industries such as agricultural product processing.

The integration of these three factors with an inclusive and holistic approach will ensure the sustainability and long-term success of CSA.

b. Successful Village Case Study: Best Practices Applied in Ganesha Mukti Village, Then Compared to Perigi Village

Climate-smart agricultural practices (CSA) are implemented with the aim of helping farmers manage natural resources more efficiently, increase land productivity, and mitigate the impact of climate change. In this context, each village has different challenges and approaches in implementing CSA practices. The following table presents a comparison between the two villages involved in the **CSA practice project**, namely **Perigi Village** and **Ganesha Mukti Village (in the Land4lives project),** from various technical aspects that are important in the successful implementation of CSA. Factors such as **innovative agricultural technology, natural resource management, resilience to climate change,** and **agricultural infrastructure** are the main focus in assessing the readiness and challenges faced by the two villages in improving their food security. Here is a detailed comparison based on the technical factors that exist in each village (Table 2.12).

Table 2.12. Comparison of Technical Factors in CSA Practice in Ganesha Mukti Village and Perigi Village

Aspects	Factor	Perigi Village	Ganesha Mukti Village
Technical Factors	Innovative Agricultural Technology	CSA practices that focus on the concept of agrosilvofishery have applied several technologies, namely by using superior seeds/seedlings that are resistant to land with high PH, regulating planting patterns that adapt to the climate, but do not have a good land irrigation system.	CSA Practice Focuses on improving life and food security, so it focuses on the use of cultivation technology and techniques, especially the drainage system has been running for a long time in Ganesha Mukti Village
	Natural Resource Management	It is regularly monitored by the research team from UNSRI, especially the PH of Water, PH of the Land and the estimated planting time as well as the supervision of land clearing without burning.	It is regularly monitored by the research team related to soil PH, as well as supervision of land clearing without burning.
	Resilience to Climate Change	The use of plant varieties that are resistant to drought, floods, or extreme temperatures; Application of more adaptive agricultural techniques to peatlands; selection of varieties/types of fish suitable for cultivation on peatlands after through peat water management techniques.	Introduction to climate change challenges, selection of planting varieties, planting time, land management before planting, drainage system management.

	Risk Management and Resilience	The existence of fire-aware communities around the well village area; The formation of a team to monitor fires in the dry season to prevent peatland fires.	Introduction to climate change challenges, selection of planting varieties, planting time, land management before planting, drainage system management, agroforestry and soil conservation.
	Geographic Information System (GIS)	The use of GIS to map land and manage land use efficiently, as well as to monitor soil and vegetation conditions more accurately and data-based.	The use of GIS to map land and manage land use efficiently, as well as to monitor soil and vegetation conditions. more accurately and data-driven.
	Agricultural Infrastructure	There are water canals around the agricultural area in Perigi village, the sluice gates around the canal have not been built much so it is difficult to regulate the drainage system on agricultural land; road access that is still small (only for two-wheeled vehicle users) is even only connected to small bridges, which is an obstacle to carrying out agricultural and post-harvest activities on the land; In addition to two-wheeled vehicles, access to the land can be done using boats, but if the dry season is slightly hampered because there are many roots of aquatic plants.	There are various kinds of drainage channels that have been connected to each farmer's land, so that there are no obstacles in the irrigation system, land access to the land can be passed by two- and four-wheeled vehicles, besides that it can also be passed by waterways using ketek boats, so that post-harvest activities can be easier to market.

Overall, Ganesha Mukti Village has better infrastructure, especially in water management and road access, which supports the successful practice of CSA and food security. Perigi Village, despite having implemented several innovative techniques in agriculture, still faces challenges related to irrigation and accessibility that can hinder the efficiency and sustainability of agricultural production.

Furthermore, social aspects are important factors in the successful implementation of climate-smart agriculture (CSA) practices, as community involvement, awareness of climate change, and access to education and resources greatly affect the effectiveness of the program. Farmers' involvement in the agricultural process, both in terms of land management, technology application, and climate change adaptation efforts, will determine the sustainability and success of the CSA program. In addition, efforts to create social justice in access to resources, as well as ensuring the active participation of various groups, including women and marginalized groups, are crucial aspects in creating inclusive and sustainable agricultural systems.

The following Table 2.13. compares two villages involved in CSA practice, namely Perigi Village and Ganesha Mukti Village, based on social factors that affect the implementation of CSA practice. The factors discussed include community involvement and participation, counseling and education, awareness of climate change, and social justice in access to resources. By looking at this comparison, we can understand the difference in the social readiness of the two villages in supporting the success of the CSA program.

Table 2.13. Comparison of Social Factors in CSA Practice in Ganesha Mukti Village and Perigi Village

Aspects	Factor	Perigi Village	Ganesha Mukti Village
Social Factors	Community Involvement and Participation	Farmer involvement and participation are quite high if there is supervision in the field, but if not, farmer involvement and participation tend to be low. Only about 30% of the total farmers are always active in agricultural activities on the land; The background of farmers and the environment who are not the type of farmers in groups and are active in community group activities.	The involvement and participation of farmers is quite high with the presence or absence of supervision from the research group, as can be seen from the activities in kitchen garden activities, vegetable banks and the number of farmers who attend training and education activities.
	Counseling and Education	Counseling and education activities are not scheduled on a monthly basis. However, field monitoring is continuously carried out virtually.	Counseling and education activities are carried out regularly for 3-5 days every month with different materials and practices. Counseling and education activities are also recorded using digital attendance so that each participant has their own data related to how many counseling/education activities have been followed.

	Awareness and Adaptation to Climate Change	Climate change awareness and adaptation are still low. So far, farmers have only carried out farming activities with the direction of the research team, there has been no initiative of their own. For example, fire monitoring activities in the dry season will not run without direction from the research team.	Farmers' awareness and adaptation to climate change is quite high, there has been initiative and creativity of farmers in carrying out climate change adaptation activities, for example by carrying out organic and sustainable agricultural activities.
	Social Justice and Access to Resources	CSA practice activities are inclusive but all members are dominated by male farmers with consideration as a driver of labor within the family/outside the family to carry out agricultural activities.	CSA's practice activities are inclusive but prioritize women farmers and girls to be involved because Land4lives' activities target gender equality in meeting food needs.

The comparison between Perigi Village and Ganesha Mukti Village shows significant differences in social aspects that can affect the success of CSA practice. Ganesha Mukti Village shows a higher level of involvement, awareness, and participation from the community, as well as the implementation of more structured counseling and education. Meanwhile, Perigi Village still faces challenges in terms of low farmer involvement and limited awareness related to climate change. More inclusive initiatives, such as prioritizing the role of women in Ganesha Mukti Village, are also a positive factor in creating a fairer social and economic balance.

Economic aspects play a very important role in determining the success and sustainability of climate-smart agriculture (CSA) practices. Factors such as access to financing, economic value creation, business model development, and job creation will affect the competitiveness and economic stability of farmers involved in the CSA program. To support farmers in adopting sustainable farming techniques, they need access to financial resources, stable markets, and opportunities to increase income.

The following Table 2.14 compares two villages involved in CSA practice, namely Perigi Village and Ganesha Mukti Village, in terms of economic aspects that affect the success of CSA practice. The factors analyzed include access to financing and investment, economic value creation, business and market models, incentives and subsidies, and job creation. By looking at this comparison, we can understand the challenges and economic opportunities faced by both villages in their efforts to improve their food security and climate resilience.

Table 2.14. Comparison of Economic Factors in CSA Practice in Ganesha Mukti Village and Perigi Village

Aspects	Factor	Perigi Village	Ganesha Mukti Village
Economic Factors	Access to Financing and Investment	During the project, access to financing and investment is sourced from NIFOS - Cifor. There is no other source of financing and investment besides this.	During the project, access to financing and investment is sourced from global affairs, ICRAF. There is also support from the district and provincial governments that contribute. In addition, ICRAF also helps to map potential access to financing that farmers may be able to access after the land4lives project activities are completed.
	Economic Value Creation	Increasing farmers' income through farming activities with the concept of agrosilvofishery. However, not many agricultural products have been obtained due to natural disasters such as forest fires, floods and failure to harvest fishery products due to human disturbances.	Increase farmers' incomes through more efficient and sustainable CSA practices; including through organic products or agricultural products that are more resistant to market fluctuations; Mobilizing food security activities through yard planting activities and kitchen

			gardens that are worked together.
	Business Model and Market	Developing access to markets in the surrounding area. However, not many agricultural products have been marketed. So far, the types of products marketed are fruit plants, food and rhizomes; A sustainable business model has not been formed due to the lack of community participation in agricultural activities.	Developing sustainable business models and market access for agricultural products that use CSA techniques by producing organic farming; Build a market from a small scale and reachable.
	Incentives and Subsidies	There are no incentives yet, but there are seed subsidies.	There are no incentives yet, but there are seed subsidies.
	Job Creation	So far, there has been no job creation in Perigi Village.	The land4lives program opens up new job opportunities, namely mobile vegetable traders and creates additional income for household scales.

A comparison of economic aspects between **Perigi Village** and **Ganesha Mukti** Village shows that **Ganesha Mukti** Village has **advantages** in terms of economic sustainability and **access to** more diversified financing, as well as **clearer job creation**. Meanwhile, **Perigi Village** still faces major challenges, especially related to **limited market access** and its vulnerability to **natural disasters.** However, by strengthening economic aspects, especially in terms of **sustainable business models** and **access to financing**, both villages can strengthen their economies to support sustainable food security.

3. Income Model

Our study's main goal was to find sustainable and feasible agroforestry business models as essential components of Indonesia's integrated approach to peatland management, restoration, and conservation. Based on results studies field carried out , found a number of difference stages activities and management agroforestry land in Ganesha Mukti Village, Muara Sugihan and Perigi Village , Pangkalan Lamp .

3.1. Description of the Income Model in Perigi Village and Ganesha Mukti Village

a. Description of farmers' sources of income.

Activities carried out in Land4Life project by ICRAF more nature utilization land yard peat to be empowered use for society. Its utilization more directed to types plant food and horticulture including tree fruits For fulfil need family who have been This No become part from consumption household. The goal is fulfillment the need of food security to vegetables, fruits and spices as usual done by farmer in fulfill the need food staple (rice) is set aside from results harvest . With an income model like this , then the farmers of Ganesha Mukti Village received main income from rice fields in LU1 and LU 2 area. The entire rice fields (LU1 and LU2) have been cultivated with seasonal crop farming. Economically, farmers have already engaged in commercial crop cultivation. This means that cultivation is not only done with a production (supply) approach, but has also started to pay attention to demand, for example, there are already farmers planting red rice because there is demand. Planting vegetables , fruits and spices No need processing intensive land as processing land For rice fields. But its utilization can prevent decrease peatland or change of function in the yard the become other uses. This is positive impact to existence ecosystem former tidal farming is ecosystem peat.

This is different from peatland management activities in Perigi Village. All peatland restoration activities are focused on medium peatlands, which have so far only been used for sonor rice where land clearing is done by burning. During the program, farmers participating in the activities in Perigi Village appeared to have succeeded in building a strong economic foundation through efforts to diversify community income sources based on the principles of sustainability and peat ecosystem restoration. By integrating environmentally friendly economic activities, this village can become a model for village development that is not only economically independent but also contributes to environmental conservation.

One of the main pillars of Perigi Village's income comes from non-timber forest products obtained from restored peat areas. By the efforts to maintain this ecosystem, the community can harvest high-quality peat pineapples, harvest fish, and various medicinal plants that are planted. These results not only have high economic value but are also a symbol of the success of preserving peat forests that remain productive without damaging nature.

Perigi Sustainable agroforestry practices that combine pineapple cultivation and various types of vegetables intercropped on peatlands. This method not only increases land productivity, but also helps maintain soil fertility and ecosystem stability. The intercropping approach allows communities to manage land efficiently while maintaining environmental sustainability. Although until now, the products produced are mostly still used to meet household subsystem needs.

Table 2.15. General Description of Peatland Management Activities in Perigi Village and Ganesha Mukti Village.

Type of Land	**Income Source**			
	Perigi Village		**Ganesha Mukti Village**	
	Plant Type	**Plant Condition**	**Plant Type**	**Plant Condition**
Main Land	Rubber	productive plants	Rice Farming	productive plants
Forestry Land	Rice Farming	productive plants	coconut	productive plants
	Introduction of Forest Plants and Fruit Plants	the plants have not yet produced	Introduction to Fruit Plants	the plants have not yet produced
	Introduction of Vegetable Plants	productive plants	Tuber plant	productive plants
	Introduction of Horticultural Plants (Pineapple)	productive plants		
	Fishery	the plants have not yet produced		
Home Yard	-	-	Introduction of Vegetable and Horticultural Plants	productive plants

b. Income Model Schema Comparison

In Ganesha Mukti Village, management of peatland carried out in areas that are spread out and separated in several location, so that demand a more approach segmented in planning and management. While that, in Perigi Village, the land managed to concentrate at one area, allowing implementation of management strategies more integrated efficient and coordinated For preservation ecosystem as well as optimization results economy .

Table 2.16. Peatland Agroforestry Income Model

Village	Peatland Profile	Peatland Agroforestry Income Model					
		Income Model		Type			
				Tree	Crop	Rice	Fishery
Ganesha	Shallow Peatland	Model A	Peatland management is carried out in separate areas.	LU 2: Coconut Tree, Fruit Tree, and Tuber Plants	Yard: Vegetable and Horticultural Plants	LU 1: Rice Farming	-
Perigi	Medium Peatland	Model B	Peatland managed centrally in one area				
			B1. Nungcik	The Jelutong Blangeran Mango	Spinach, Pineapple, sweet potato, long beans, liltte tomatoes ,	Rice and Zea Mays Farming	Catfish and kissing gouramy
			B2. Agani	The Jelutong Tamanu Soussop Liberica Coffee Avocado	Spinach, Kasambah , Pineapple, sweet potato, long beans, bitter melon, lemongrass, sweet pumpkin, eggplant, Cassava	Rice and Zea Mays Farming	Catfish and kissing gouramy
			B3. Matcuci	The Jelutong, Blangeran Mango, Jackfruit, Liberica Coffee	Pineapple,	Rice and Zea Mays Farming	Catfish

			B4. Marham	The tamanu, Blangeran , Mango, Jackfruit, Orange, Soursop Liberica Coffee,	Pineapple, aromatic ginger, red galangal, lemongrass	Rice and Zea Mays Farming	
			B5. Sarman	The tamanu, Blangeran , Mango, Jackfruit, Orange, Soursop Liberica Coffee,	Pineapple, aromatic ginger, red galangal, lemongrass	Rice and Zea Mays Farming	Catfish
			B5. M. Aji	The Jelutong, Mango, Orange, Jackfruit , Rambutan, Manila sapodilla	Pineapple	Rice Farming	
			B6. Joni Saputra	The Jelutong, Blangeran, Tamanu, Orange, Pinang		Rice Farming	
			B7. Darwin	The Jelutong, Blangeran , Orange, Mango, Liberica Coffee, Palm Oil	Pineapples	Rice Farming	
			B8. Matudin	The Jelutong, Blangeran, Jackfruit, Mango,		Rice and Zea Mays Farming	
			B9. Robinson	The Jelutong, Blangeran, Orange, Mango, Liberica Coffee,	Pineapples , Vegetables	Rice Farming	
			B10. Matudin	The Jelutong, Orange, Jackfruit, Mango		Rice Farming	
			B11. Burhan	The Jelutong, Manila sapodilla		Rice Farming	

Success or failure farmer in manage peatland is greatly influenced also by various factors that include commodities, water management, market access, support external, and income diversification. Analysis to factors that difference between Ganesha Mukti and Perigi Income Models presented in Table 2.16**:**

1. Crop Choice. The success of the income model is based on on choice For plant commodity worth tall and friendly peat , such as fruits , pineapples, and areca nut, which are capable grow optimally in the ecosystem peat . On the other hand , the income model is lacking succeed still depends on the plant less traditional suitable For condition peat, so that produce productivity low and yield the harvest that is not stable .
2. Water Management. The development of income models is also influenced by capable managing hydrology land peat with good, take care ideal soil water content for growth plant without damage structure land . Meanwhile, farmers who fail to deal with the problem of poor water control, causing the land to become too dry or flooded, thus having a negative impact on agricultural output.
3. Market Access. The development of income models also needs to be supported by having a strong market network, allowing them to sell their crops at competitive prices. On the other hand, not on limited market access, making it difficult for them to market products at reasonable prices or find consistent buyers.
4. Support Systems. The development of income models are often supported by access to training and technical guidance from government or non-governmental organizations (NGOs). On the other hand, unsuccessful farmers generally do not have access to such training or support, which hinders skills improvement and innovation in their farming.
5. Revenue Streams. Diversification of income is one of the factors for the success of developing an income model. The income model, which relies solely on a monoculture system, makes them vulnerable to market price fluctuations and uncertain environmental conditions.

By understanding the differences in these factors, appropriate strategies can be developed to help farmers who have not yet successfully adapted to peatland conditions, while improving their welfare through sustainable agriculture.

Table 2.17. Comparison between Genesha Mukti dan Perigi Income Model

Factors	**Ganesha Mukti Income Model**	**Perigi Income Model**
Area	Concentrated in one area	Separeted area
Access to the Area	Easy access	Difficult access
Crop Choice	High-value, peat-friendly crops (coconut, fruit tree, areca nuts)	High-value, peat-friendly crops (jelutunng, Blangeran, Fruit Tree, pinenapple)
Water Management	Effective hydrology management	Poor water control
Market Access	Well-established market linkages	Limited market access
Support System	Access to government/NGO training	Minimum support
Revenue Streams	Monocropping and intercroping systems	Intercropping systems
Land Maintenance	Frequently	Infrequently

Table 2.18. Brief Overview of Achievements Income in Perigi Village

No.	Land Owner	Activity	Amount production	Unit	In the market or No	The quantity sold , if there is something for sale	Current market price (Rp)	Revenue (Rp/year)	Total Revenue (Rp/Year)	Place Sale
1	**H. Nungcik**	Water Spinach Harvest	1	kg	On the market	1.00	6,000.00	6,000.00	**1,521,000.00**	Perigi Village Community
		Pineapple Harvest	1	Unit	consumption Alone			-		
		Sweet potato	0.5	kg	consumption Alone			-		
		Peanut	1	kg	On the market	1.00	5,000.00	5,000.00		Perigi Village Community
		Just eat raw vegetables	1	ounce	consumption Alone			-		
		Pineapple	15	Unit	On the market	15.00	75,000.00	1,125,000.00		Perigi Village Community
		Rice Harvest	300	kg	consumption Alone			-		
		Planting Corn			Crop failure			-		
		Harvest pineapples	77	Unit	marketed	77.00	5,000.00	385,000.00		cake craftsmen in Pangkalan Lampam sub-district
		Fish Pond Preparation								
2	**Agani**	Plant rice			Not yet harvested				**246,000.00**	
		Planting soursop	1	Unit	Not yet harvest					
		coffee planting	12	Unit	Not yet harvest					
		stitching mango	1	Unit	Not yet harvest					

		Planting seed cashew nut			Not yet harvest					
		Transplanting rice and sticky rice								
		harvest kasamba	3	Unit	consumption Alone					
		harvest peanut long	0.5	kg	consumption Alone					
		Plant bitter melon			Not yet harvest					
		sweet potato harvest	2	kg	consumption Alone					
		Rice Harvest	30	kg	consumption Alone					
		Pineapple harvest	39	Unit	marketed	39.00	4,000.00	156,000.00		
		Plant Water Spinach			Not yet harvest					
		Plant Corn			Crop failure					
		Plant rice Talang (Local rice)								
		Plant cassava	10	unit						
		Harvesting kale	20	Unit	for personal consumption and marketed to neighbors	10.00	3,000.00	30,000.00		neighbor around
		Plant taro	30	Unit						
		Plant rice								
		Plant beans vegetable								
		Plant citronella								
		Harvest 1 mango	1	Unit	consumption Alone					
		harvest gourd	3	Unit	consumption Alone					
		Eggplant harvest	5	Unit	consumption Alone					
		harvest peanut long	4		marketed	4.00	15,000.00	60,000.00		
3	**Matcuci**	Pineapple harvest	6	Unit	consumption Alone				**800,000.00**	

		Rice Harvest	250	kg	consumption Alone					
		Plant liberica coffee			Not Yet Harvested					
		Pineapple harvest	7	Unit	consumption Alone					
		harvest 16 pineapples	16	unit	marketed	16.00	50,000.00	800,000.00		for sale neighbors who have a celebration
		Plant Corn			Crop failure					
		Spread the seeds paddy			Not Yet Harvested					
		preparation fish pond			Not Yet Harvested					
4	**Marham**	Pineapple harvest	30	Unit	not consumed alone and shared with neighbors				**7,977,000.00**	
		Rice Harvest	300	kg	consumption Alone					
		Harvesting galangal red	960	kg	marketed	960.00	2,500.00	2,400,000.00		collector level village
		Plant liberica coffee			Not Yet Harvested					
		Aromatic ginger	24	kg	marketed	24.00	15,000.00	360,000.00		collector level village
		Galangal Leaves	24	Unit	marketed	20.00	2,000.00	40,000.00		collector level village
		Laos	5	kg	marketed	5.00	10,000.00	50,000.00		collector level village
		Plant Corn			Crop failure					
		Lemongrass harvest	493	kg	marketed	493.00	4,000.00	1,972,000.00		collector level village
		Harvest 50 pineapples	365	Unit	marketed	365.00	5,000.00	1,825,000.00		seller cake in the sub-district base lamp
		plant paddy with method the boat			Not Yet Harvested					
		plant Laos 12 kg eggs			Not Yet Harvested					

		Harvesting galangal red	38	kg	marketed	38.00	35,000.00	1,330,000.00		collector level village
5	**Sarman**	Pineapple harvest	5	Unit					-	
		Rice Harvest	200	kg						
		Plant liberica coffee			Not Yet Harvested					
		Plant Corn			Crop failure					
		preparation fish pond								
6	**Burhan**	Weeding grass plant paddy							-	
		Planting rice / sowing paddy								
		Rice Harvest	150	kg	not / consumed Alone					
7	**Mr. Aji**	Rice Harvest	200	kg	not / consumed Alone				-	
		slash use machine grass								
		Planting rice								
8	**Joni Saputra**	Rice Harvest	180	kg	not / consumed Alone					
		Planting rice								
9	**Darwin**	Plant palm oil	43	Unit					**120,000.00**	
		Rice Harvest	140	kg	not / consumed Alone					
		Plant liberica coffee			Not Yet Harvested					
		pineapple harvest	19	Unit	for personal consumption and sharing with neighbors/relatives					
		pineapple harvest	24	Unit	marketed	24.00	5,000.00	120,000.00		relatives who have celebration

10	**Matudin**	Rice Harvest	180	kg	not / consumed Alone				-	
		Plant liberica coffee			Not Yet Harvested					
		plant corn								
		pineapple harvest	19	Unit	not / consumed Alone					
11	**Robinson**	Rice Harvest	1000	kg	not / consumed Alone				-	
		Plant liberica coffee								
		Spread the seeds paddy								
		pineapple harvest	5	Unit	for personal consumption and sharing with neighbors					
		Corn harvest vegetable			for personal consumption and sharing with neighbors					

Table 2.19. Initial Identification of Food Security and Commercial Plant related to Model Income

Commodity	Food security	Business Prospect
Rice	*	
Catfish	*	*
Kissing gouramy	*	*
Pineapple	*	*
Spinach	*	*
Sweet potato	*	
Long beans	*	*
Liltte tomatoes	*	
Bitter melon	*	
Sweet pumpkin	*	
Eggplant	*	
Cassava	*	
Aromatic ginger		*
Red galangal		*
Lemongrass		*

The Table 2.19 highlights the initial identification of food security and business prospects for commodities cultivated under the agrosilvofishery model. It provides insight into the dual-purpose role of these commodities in ensuring household food availability and generating income through market opportunities.

Food Security Commodities

Certain commodities, such as rice, cassava, and sweet potato, are pivotal for food security. These staples form the backbone of household sustenance, ensuring a steady food supply. Additionally, vegetables like spinach, long beans, and eggplant contribute to a diversified and nutritious diet. The inclusion of crops like little tomatoes, bitter melon, and sweet pumpkin further enhances dietary variety, supporting overall health.

Business Prospect Commodities

Several commodities show significant market potential, indicating their value as income-generating crops. Pineapple, catfish, and kissing gouramy stand out for their high commercial demand, offering profitable opportunities for smallholder farmers. Medicinal and aromatic plants such as aromatic ginger, red galangal, and lemongrass also present lucrative prospects, especially given the increasing consumer preference for natural and organic products.

Dual-Purpose Commodities

Certain commodities, including pineapple, catfish, and long beans, serve a dual purpose, addressing both food security and business needs. These crops are particularly strategic for smallholders, as they ensure subsistence while providing a pathway to economic resilience through market participation.

This assessment underscores the potential of the agrosilvofishery model to integrate food security and income generation. It aligns well with sustainable development goals by enhancing livelihoods, promoting biodiversity, and supporting community resilience in peatland areas.

3.2. Obstacles in integrate restoration peat with income improvement

Management sustainable peat in Ganseha Mukti Village has give contribution significant to improvement welfare public local . Various efforts to restore and utilize peat ecosystems integrated with local economic strategies have brought measurable positive impacts on the socio-economic life of the village.

One of the important achievements is the success of the restoration program in reducing household expenditure by 40% in the last three years , as revealed by field survey data in 2024. This decrease in expenditure cannot be separated from the efficiency of peatland utilization for daily needs, such as the utilization of yard land as vegetable and fruit fields, as well as more productive and cost-effective agricultural management with the use of organic pesticides and herbicides produced by farmers themselves.

In the economic sector, the contribution of restoration is also seen in increasing market access for local products . Partnership support with women's farmer groups and government institutions has opened up wider opportunities for marketing peat-based products, such as vegetables and fruits. This partnership allows local products to gain added value and higher competitiveness. Partnerships with women's farmer groups also encourage an increase in the added value of peat-based products produced.

In addition, good peat management efforts have succeeded in reducing the risk of land fires , which were previously a major threat to the community. The reduction in land fire incidents not only keeps the environment safe but also reduces the burden of socio-economic costs that are often borne by the community, such as agricultural losses, health problems due to smoke, and damage to village infrastructure.

Overall, the appropriate peat management steps have brought about real positive changes, making Ganseha Mukti Village a model for a sustainable peat village that is able to create synergy between environmental conservation and improving the economic welfare of its people.

At the same time, the development of income models in Perigi Village still requires a lot of attention. Perigi Village faces a major challenge in reducing dependence on unsustainable practices as a source of community income. Although various restoration efforts have been introduced, the sustainability of the village economy is still not fully integrated with the preservation of the peat ecosystem.

One of the biggest challenges is the ongoing practice of land clearing by burning . Although some farmers have committed to not using this method, land burning is still carried out by some local residents as a quick and cheap way to clear subsistence agricultural land. This practice not only damages fragile peat ecosystems but also increases the risk of forest fires that harm communities and the environment.

On the other hand, the people of Perigi Village still face a lack of economic alternatives. Limited skills training, lack of access to business capital, and low support for peat-based business development are the main obstacles in creating more sustainable sources of income.

These barriers are further compounded by several other factors:

1. Lack of technical and financial support for income diversification makes it difficult for communities to shift to more environmentally friendly economic activities.
2. The absence of economic incentives to encourage active participation in restoration activities makes many residents reluctant to get involved because they do not see the direct benefits they can gain.
3. The conflict of interest between short-term economic needs and long-term ecosystem preservation is a dilemma that continues to be faced by communities. Income instability encourages them to continue to rely on conventional practices despite their damaging impacts on the environment.

To overcome these challenges, a holistic approach is needed that includes providing economic incentives, skills training, access to capital, and increasing community awareness of the long-term benefits of healthy peat ecosystems. With the right support, Perigi Village has great potential to transform into an economically independent village while also becoming a pioneer in sustainable peat ecosystem conservation.

3.4. Closing

Key Findings Related Revenue Model Effectiveness from Restoration Peat is (1) Restoration integrated peat with activity economy sustainable give impact positive to income and welfare community , (2) Support holistic and inclusive policies active public is factor key success of the revenue model , (3) Need compiled and designed integrated programs and activities , starting from from coaching beginning , mentoring , development business in a way Keep going continuous and sustainable .

Implications for Development Policy Restoration Peat in the Future is (1) Policy restoration must designed For support diversification economy local through training , access to capital, and incentives, (2) Restoration programs need approach based on public with focus on strengthening local capacity, (3) Work The same cross sectors (government , NGOs, and private) must reinforced For support sustainability economy and ecology .

2.2.3. To conduct the specific studies assessing fish cultivation and production in terms of species (e.g. native and introduced species) and pellet formula (e.g. ingredients) and assessing fish cultivation feasibility.

A. **Fish Cultivation of Native Species and Introduced Species**

The fish cultivation trial used 2 species of fish, namely native fish species, namely kissing gouramy fish, and introduced fish, namely catfish. There are 3 locations for the trial, namely at Pak H. Nungcik's location with (Mr. H. Nungcik, Mr. Matcuci and Mr. Sarman), at Mr. Matudin's location (Mr. Matudin, Mr. Robinson and Mr. Darwin), and at Mr. Agani's location. Grouping is done with the aim of making it easier to control and is also expected to prevent the presence of pests, namely otters.

Stages of fish cultivation include:

1. Pond preparation and Repairing

Preparatory activities for fish farming include cleaning ponds and repairing existing ponds. This improvement aims to ensure that the pond is ready for use when fish are stocked. The following is documentation of the fish pond preparation stages (Figure 2.30).

Figure 2.30. Pond Preparation and Repairing

Liming is done to increase the pH of the water. The pH of the water at the experimental field location before liming was measured was 4, and when liming was carried out the pH of the water increased, namely 6 as shown in the following picture. pH level need to be paid attention to while using this system. It is recommended to use a porous pool during the rainy season to avoid problems with the water quality. Lime is used in peat-swamp ponds, according to several studies, to raise and maintain the water's pH. Liming neutralizes acidity in pond soil and water, improves alkalinity and hardness of water, and kills disease vectors in soil (Figure 2.31).

(a) pH Before lime application (b) pH after lime application

Figure 2.31. the pH of the water

Common materials used are calcitic lime ($CaCO_3$), dolomitic lime ($CaMgCO_3$), hydrated lime ($Ca(OH)_2$) and quicklime (CaO). Dolomite lime has been reported used on tidal marsh soil at a dosage of 1.2 kg/m^2 for growing catfish (Umari etal 2017). Liming materials made from *P. canaliculata* shells might be used as a substitute for lime in catfish swamp ponds with dosage of 0.6 kg/m^2 (Jubaedah et al 2019).

2. Fish Stocking and Rearing of Fish Culture

There are 2 types of fish stocked, namely catfish and kissing gouramy fish. For the amounts according to the following Table 2.20.

Table 2.20. Fish Stocking and Rearing of Fish Culture

No	**Location of pond**	**Fish Type and Number Fish Seed**		**Note**
		Kissing Gouramy	**Catfish**	
1	H. Nungcik Pond Location			
	H. Nungcik (7 Fishnet)	2,000	2,500	
	Pak Matcuci (4 Fishnet)	-	2,000	
	Pak Sarman (4 Fishnet)	-	2,000	
2	Agani Pond Location			
	Agani (7 Fishnet)	2,000	2,500	
3	Matudin Pond Location			
	Matudin	-	-	Still in development
	Robinson			Still in development
	Darwin			Still in development

B. Fish stocking activities

Fish farming activities that must be carried out regularly are providing food and monitoring water quality, especially water pH. Feeding is done twice a day. The amount of feed given is adjusted to the fish's needs (Figure 2.32). Fish stocking involves introducing fish fingerlings or juvenile fish into a body of water, such as ponds, lakes, or tanks, to cultivate them for aquaculture purposes. This step is crucial to ensure the sustainability of fish farming operations. The process typically involves careful planning, including selecting the appropriate fish species, determining the stocking density, and ensuring the water conditions are suitable for the fish to thrive. The accompanying picture (referred to in the text) likely illustrates the stocking process, showing the method used to introduce the fish into the water.

Figure 2.32. Fish stocking activities can be seen in the following picture

2.3. To provide participating farmers with technical guidance on peat farming cultivation, crop maintenance and harvesting and post-harvest/processing.

2.3.1. Conducting farmer training in priority topics (e.g. fish cultivation, climate-smart farming practices such as biochar production, fish cultivation, cultivation, and maintenance of Liberica coffee, processing and marketing of pineapple)

a. Disseminate key research findings to relevant stakeholders at village, district, provincial and national and international level through appropriate forums

On a 12-hectare demonstration plot in Perigi Village, Pangkalan Lampam District, Ogan Komering Ilir Regency, South Sumatra, UNSRI and CIFOR has been conducting research on the regeneration of severely damaged peatlands using a climate-smart agrosilvofishery approach. Positive outcomes have resulted from the activities that were conducted, including the following: increased agricultural productivity (paddy yield and pineapple), healthy and growing trees, active community participation in program implementation, fire protection during the dry season, and more. We found that farmers were interested in participating in our approach by combining participatory and field-based action research methodologies with a variety of research techniques, including focus groups, informal meetings, and household surveys. Farmers were asked to select which tree species to plant after being selected to take part in the implementation of peatland sustainability models. Because the selection is based on their suggetions, farmers are expected to gain from the plants they grow. In addition to offering a variety of social and environmental advantages to rural communities, restored peatlands are anticipated to contribute to the reduction of greenhouse gas emissions. An essential part of Indonesia's response to climate change is the preservation and repair of peatlands. The UNSRI will establish the groundwork for developing science and technology, regulations, and international cooperation to ensure a harmonious life for peatlands and the people who live in them.

Peatlands have great potential. for the development of semi corn because The land is vast and not yet fully utilized. Some the peatlands in Perigi are still located under the natural secondary forest and about 75% of the peatland that has been utilized for various agricultural activities.


Figure 2.33. Dissemination at village level

b. **Training the farmers in relation to agrosilvofishery based peatland restoration and aquaculture techniques under peatland condition**

b.1. Introduction

Currently, the implementation of agrosilvofishery-based peatland restoration activities in Perigi Village only involves 11 farmers. This activity is a trial of the agrosilvofishery model which requires a good understanding for farmers who take part in this program. The success of this program will greatly determine the sustainability of the program and the expansion of its implementation. Based on the existing experiences, farmers participating in the activity gave various responses. Farmers' activeness in managing their land is not the same. For this reason, training activities are needed to increase farmers' understanding and it is hoped that this will increase activities on the land so that land productivity will increase. The increase in land productivity will be positively correlated with an increase in farmer income. Training activities were carried out on August 24 2024, at Pak Nungcik's Land, Perigi village (Figure 2.34).

b.2. Maize Field Study

Peatlands have great potential. for the development of semi corn because The land is vast and not yet fully utilized. Some the peatlands in Perigi are still located under the natural secondary forest and about 75% of the peatland that has been utilized for various agricultural activities.

Corn is a food crop besides rice that has a good content of carbohydrates and protein for the body, strong resilience, and relatively strong adaptability to the environment, making it highly potential for development in various soil characteristics found in Indonesia. Corn plants grow optimally in land with sandy loam soil with good water drainage or soil conditions that are not waterlogged with neutral soil pH, where the acidity level of the soil with that pH has high natural nutrient availability. For that reason, an evaluation of peatland is necessary to obtain data on the characteristics of peatland to be adjusted for the development of corn commodities.

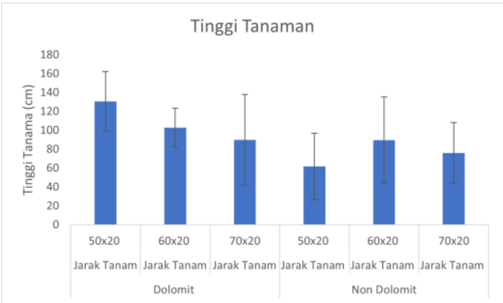
Figure 2.34. Dissemination at village level

b.3. Result

Maize field study was conducted in the end of Sepetember until November 2024 in Desa Perigi, Pangkalan lampam, Ogan Komering Ilir, South Sumatera. There are two faktor, first factor is line spacing (50x20cm, 60x20cm, and 70x20cm), and ameliorant application (Dolomite and without Dolomite). There are five farmers who involved in this study as replication. The plant was monitored from the vegetative stages until the generative stages. The parameters was measured such as plant height, number of leaves, number of corncobs, length of corncob, number of seed per corncob, weight of corncob with cornhusk, weight of corncob without cornhusk, and weight of seed per corncob.

Plant Height

Based on plant height data on Figure 2.35., it showed that line spacing in dolomite treatment, line spacing 50x20 cm had the highest plant height (130cm) followed by line spacing 60x20cm (100cm) , and 70x20cm (90cm), In addition, on non-Dolomite treatment, line spacing, 60x20 cm has the highest plant height followed by line spacing 70x20cm and 50x20cm. Treatment with Dolomite has the highest plant height (130cm) compared to non dolomite (80 cm). In addition, line spacing 50x20cm (100 cm) and 60x20cm (100 cm)was not significantly different and line spacing 70x20cm (80 cm)has the lowest of plant height.



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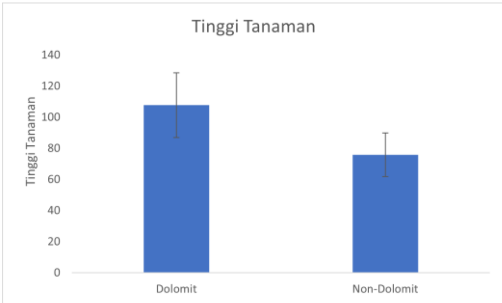

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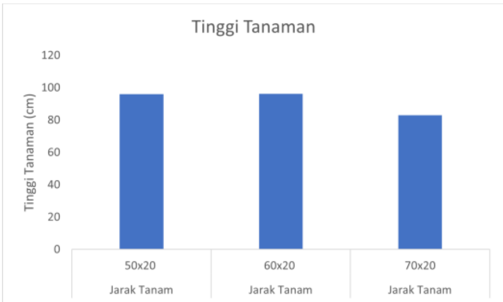
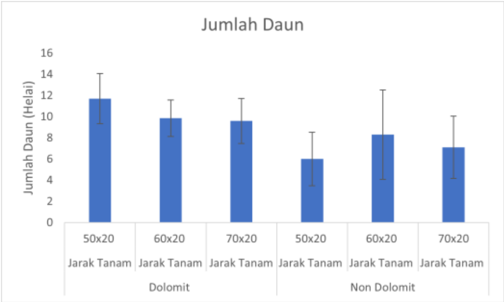


(C)

Figure 2.35. Plant Height

B. Number of Leaves

Based on the number of leaves data on Figure 2.36., it showed that line spacing in dolomite treatment, line spacing 50x20 cm had the highest plant height (12) followed by line spacing 60x20cm (10) , and 70x20cm (10cm) was not significantly different, In addition, on non-Dolomite treatment, line spacing, 60x20 cm (8) has the highest plant height followed by line spacing 70x20cm (8) and 50x20cm (4). Treatment with Dolomite has the highest plant height (130cm) compared to non-dolomite (80 cm). In addition, line spacing 50x20cm (9) and 60x20cm (9)was not significantly different and line spacing 70x20cm (8)has the lowest of plant height.



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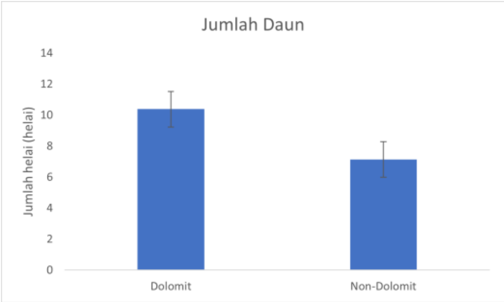

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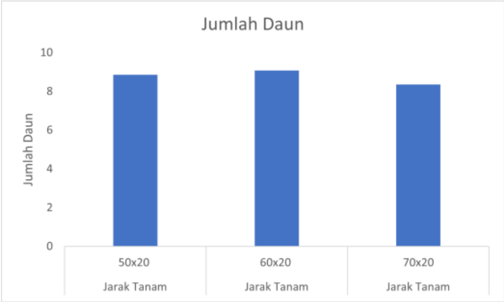
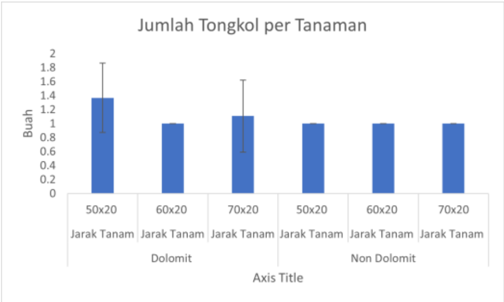


(C)

Figure 2.36. Number of Leaves

C. Number of Corn Cobs

Based on the number of corncob on Figure 2.37., it showed that line spacing in dolomite treatment, line spacing 50x20 cm had the highest plant height (1,3) followed by line spacing 70x20cm (1,1) , and 70x20cm (1cm) was not significantly different, In addition, on non-Dolomite treatment, line spacing has a similar number of corncobs was 1. Treatment with Dolomite has the highest plant height (1,2) compared to non-dolomite (1) but is not significantly different. In addition, line spacing 50x20cm (1,2 corncob) followed by 60x20cm (9) line spacing 70x20cm (8) height. All these line spacing treatment was not significantly different in all treatments



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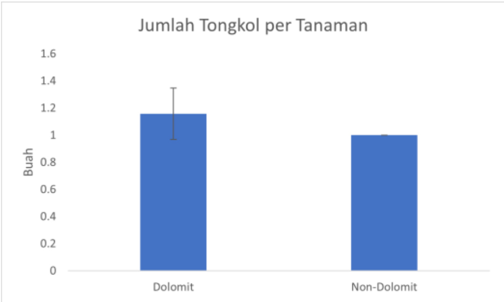

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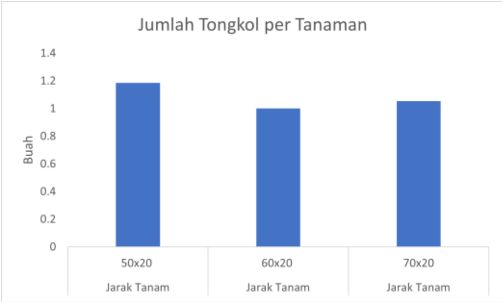
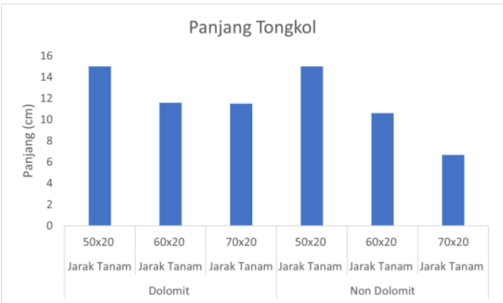


(C)

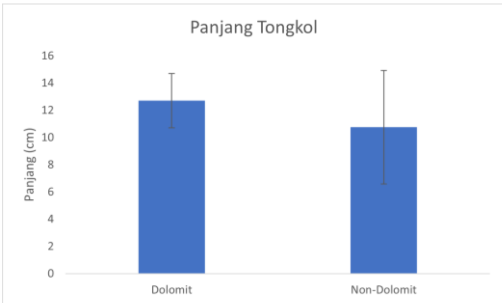
Figure 2.37. Number of Corn Cobs

D. Length of Corn Cobs

Based on the number of corncob on Figure 2.38., it showed that line spacing in dolomite treatment, line spacing 50x20 cm had the highest length of corncob (1,3) followed by line spacing 70x20cm (1,1), and 70x20cm (1cm) was not significantly different, In addition, on non-Dolomite treatment, line spacing has a similar number of corncobs was 1. Treatment with Dolomite has the highest plant height (1,2) compared to non-dolomite (1) but is not significantly different. In addition, line spacing 50x20cm (9) and 60x20cm (9)was not significantly different and line spacing 70x20cm (8) had the lowest of length of corncobs.



(A)



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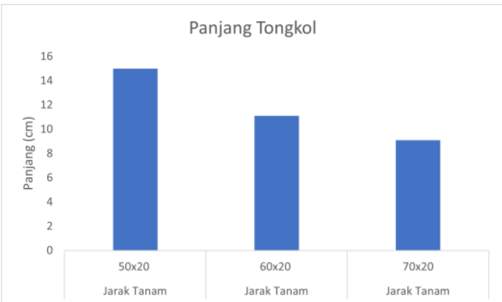
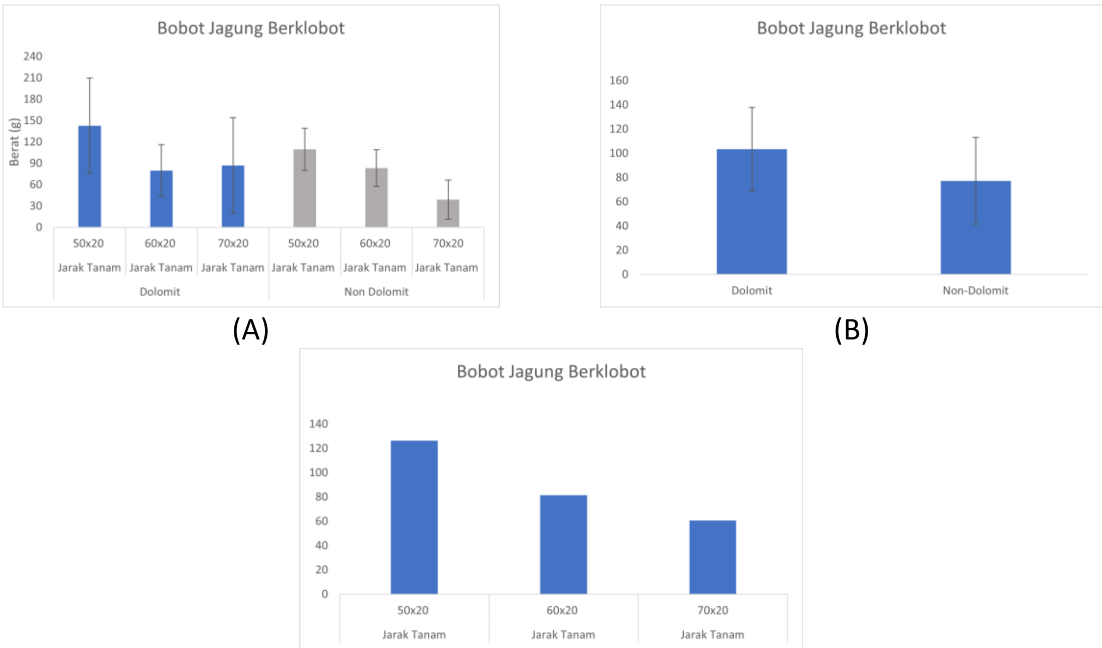


(C)

Figure 2.38 . Length of Corn Cobs

E. Weight of Corn Cobs with cornhusk

Based on the weight of the corncob on Figure 2.39., it showed that line spacing in dolomite treatment, line spacing 50x20 cm had the weight of corncob (130g) followed by line spacing 70x20cm (90g) , and 60x20cm (70g). In addition, on non-Dolomite treatment, line spacing 50x20 cm has the highest (100g) followed by line spacing 60x20cm (80g) and 70x20cm (40g). Treatment with Dolomite has the highest plant height (100g) compared to non-dolomite (80g) but not significantly different. In addition, line spacing 50x20cm (130g) and 60x20cm (80g)was not significantly different and line spacing 70x20cm (60g) has the lowest of weight of corncobs with cornhusk.

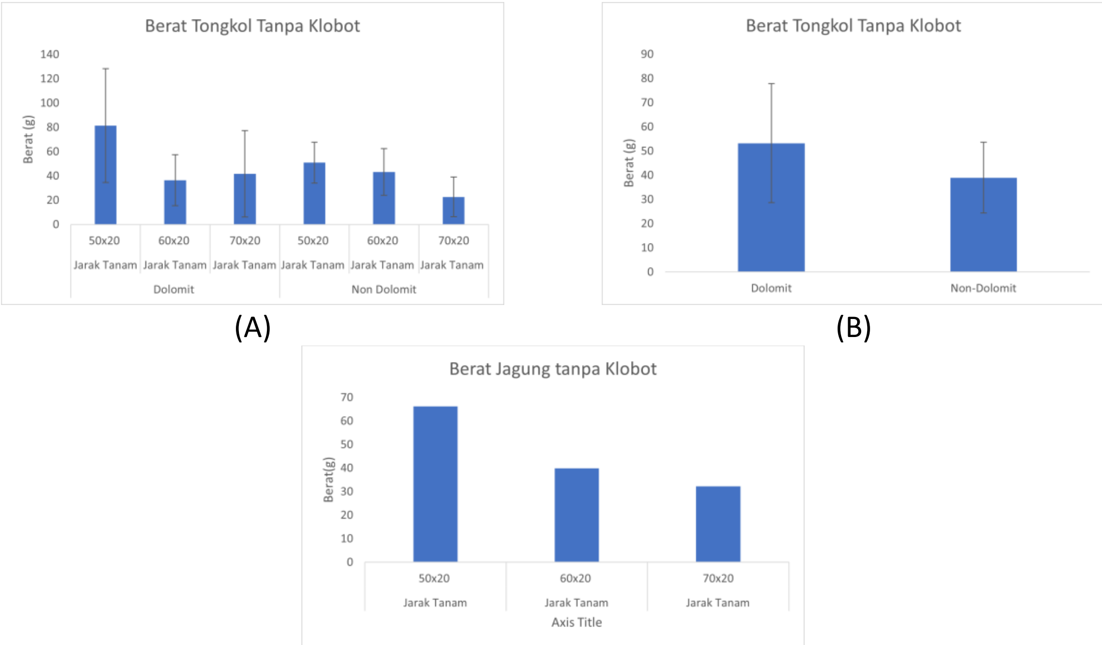


C

Figure 2.39 . Weight of Corn Cobs with cornhusk

F. Weight of Corn Cobs without Cornhusk

Based on the weight of the corncob on Figure 2.40., it showed that line spacing in dolomite treatment, line spacing 50x20 cm had the weight of corncob without cornhusk (80g) followed by line spacing 70x20cm (50g) , and 60x20cm (60g). In addition, on non-Dolomite treatment, line spacing 50x20 cm has the highest (50g) followed by line spacing 60x20cm (40g) and 70x20cm (20g). Treatment with Dolomite has the highest plant height (55g) compared to non-dolomite (40g) but not significantly different. In addition, line spacing 50x20cm (65g) and 60x20cm (40g)was not significantly different and line spacing 70x20cm (30g)has the lowest of weight of corncobs without cornhusk.



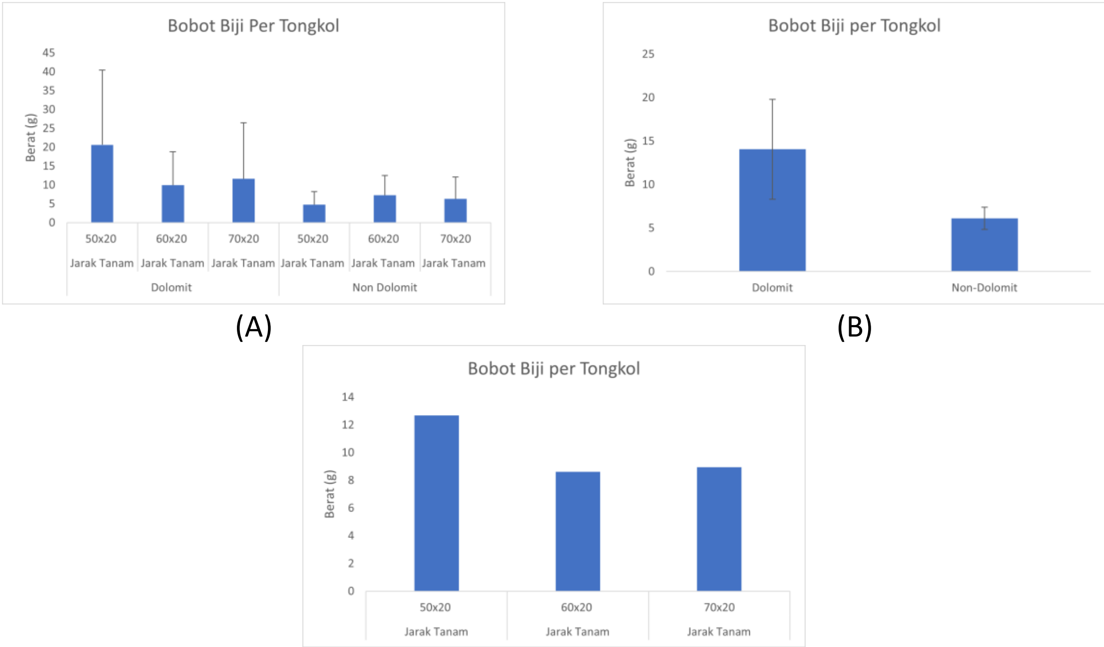
(A) (B)

(C)

Figure 2.40. Weight of Corn Cobs without Cornhusk

G. Weight of Seed per Corncobs

Based on the weight of seed per corncob on Figure 2.41., it showed that line spacing in dolomite treatment, line spacing 50x20 cm had the weight seed per corncob (20g) followed by line spacing 70x20cm (13g) , and 60x20cm (10g). In addition, on non-Dolomite treatment, line spacing 60x20 cm has the highest (8g) followed by line spacing 70x20cm (7g) and 50x20cm (5g). Treatment with Dolomite has the highest weight seed per conrcobs (14g) compared to non-dolomite (5g) but not significantly different. In addition, line spacing 50x20cm (13g) and 70x20cm (9g)was not significantly different and line spacing 60x20cm (8g)has the lowest of weigh of seed per corncobs.



(C)

Figure 2.41 . Weight of Seed per Corncobs

c. Farmer Meeting Innovative Smart Practices for Sustainable Climate Management in Peatlands

On December 24, 2024, a Farmer Meeting event themed "Innovative Smart Practices for Sustainable Climate Management in Peatlands" was held at The Zuri Palembang Hotel. This event lasted for one day, from 09:00 to 15:30 WIB, involving participants consisting of 10 to 11 local farmers, an academic team from Sriwijaya University (UNSRI), and researchers from the Center for International Forestry Research (CIFOR).

This training aims to build farmers' capacity to implement innovative and climate-friendly peatland management practices. The material presented includes sustainable hydrological management, the selection of commodities suitable for peat characteristics, and strategies for mitigating the impacts of climate change in the peat agriculture sector.

Through this activity, participants are encouraged to adopt a smart approach that not only increases agricultural productivity but also preserves the fragile peatland ecosystem. Collaboration between farmers, academics, and researchers is expected to strengthen the implementation of sustainable agriculture based on innovation and adaptation to climate change. Farmers Meeting aims to increase understanding farmer participant to practice management peat intelligent climate through the process of sharing experience and knowledge and strengthen commitment to front

- Identifying innovative farmer practices that characterize climate-smart farmers
- Taking inventory potential land farmers and improvement strategies productivity land
- Strengthen commitment management peat based on agrosilvofishery model

Figure 2.41. Meeting Documentation

Expected results :

- Identified practices innovative farmer intelligent climate and options solution together to problem / challenge main management land peat
- Inventory potential land farmers and improvement strategies productivity land

Strengthening return commitment For management peat with the agroforestry model, which is characterized by attitudes, behaviors and practices that reflect friendly farming environment , worthy in a way economic and social.

A farmer meeting was held also with the agenda of discussing the management of the peatland agrosilvofishery model, land potential inventory, farmer institutional development, and commitment to fire management and prevention. This meeting was attended by mentored farmers, representatives from UNSRI, and CIFOR. Some conclusion from the meeting are:

1. Peatland Agrosilvofishery Model

The farmers shared their experiences and challenges they faced, such as:

- Mr. H. Aji suggested the use of the IP 200 (Rice-Corn) planting pattern which is carried out simultaneously to avoid pest attacks, compared to the Rice-Rice pattern which is disrupted by water source problems.
- Mr. Agani proposed the creation of longer mounds for planting fruit plants and road access, as well as ditches between forest plants for adaptation to the rainy season.
- Several farmers emphasized the importance of cleaning canals and using mini tractors to increase land processing efficiency.
- From the trial results, turmeric plants showed poor results, while lemongrass plants remained productive.

2. Land Potential Inventory

Farmers are aware that different land conditions require adaptation of planting times. Prediction of flood and dry season times is recommended for better planting planning. Farmers are also advised to plant flood-resistant dryland rice, followed by corn as a second crop planted simultaneously to avoid pests. The importance of installing monitoring wells to monitor waterlogging is also discussed.

3. Strengthening Farmer Institutions and Capacity

Some farmers have joined farmer groups, but activities are still not active. For this reason, it was agreed that there is a need for cooperation between farmers, including experience sharing sessions and trials on small plots of land before being implemented widely. Better management of farmer groups is expected to increase the cohesiveness and effectiveness of land management.

4. Farmer Commitment in Land Management

As a mitigation measure after the previous year's fire, it is planned to replace plants affected by the fire. Each farmer is given the freedom to choose the type of replacement tree according to the needs of their land, including fruit trees and forest trees planted alternately to prevent fires. The planting plan will be carried out in stages starting in April.

This meeting confirmed the joint commitment of farmers, UNSRI, and CIFOR in developing an agrosilvofishery model that is not only economically sustainable but also environmentally friendly, with the hope that this success can inspire other villages.

Table 2.21. Farmers Meeting Agenda

No	Program	Process, PiC
Morning snack		
1	Opening	UNSRI
2	Agrosilvofishery model land peat	Exposure short highlight concept , principle sustainability and implementation until moment This Technique/media: presentation , brochure and manual PIC: UNSRI
	Discussion group	Farmer participant identify (a) **challenges** main issues faced , (2) proposals **the solution** and (3) **practices innovative** and sustainable (both existing and applied and also plan to front) which characterizes agriculture intelligent climate Technique/media: post-it and flip chart paper PIC: CIFOR & UNSRI
Lunchbreak		
3	Inventory potential land	Participating farmers recognize their own **land designs** , types of forest trees, fruit trees and food crops, and identify current and future crop potential. Technique/media: drawing design of each farmer's plot along with plant printed in A3 size , post-it PIC: CIFOR & UNSRI
Afternoon snack		
4	Strengthening and developing	Guided by the facilitator, participating farmers identify (a) important elements or components for strengthening farmer

No	Program	Process, PiC
	farmer institutions and capacities	institutions and (b) topics for increasing capacity (training) and forms of support, (c) access to resources, e.g. seeds, seedlings, fertilizers, etc. Technique/media: post-it and flip chart paper PIC: CIFOR & UNSRI
	Strengthen commitment farmer For agrosilvofishery model management land peat Well	With referring to the letter agreement cooperation between farmers and UNSRI, farmers participant do reflection to activities that have been in progress during this , and identify agrosilvofishery model management land peat Technique/media: Copy sheet letter respective agreements PIC: CIFOR & UNSRI

C. Replacement of Dead Plants

1. Identification of live plants on each farmer's plot consisting of fruit plants and forest plants and proposal for replanting dead plants

The replanting activity begins by identifying dead or poorly growing plants and replacing them with new seedlings. Seedling selection is based on the farmer's preferences and plants with a high survival rate, particularly those that can adapt to peatland conditions, such as high moisture and acidity. The goal is to ensure optimal growth while supporting the long-term economic and environmental sustainability for the farmers.

Table 2.22. Replacement of Dead Plants

Petani	# Live plants		# Replacement plants		Proposes replacement plants					
	Forest tree	Fruit tree	Forest tree	Fruit tree	Fruit tree	Number of plants		Forest tree	Number of plants	
Agani	95	103	30	22	Jeruk Manis	10	22	Jelutung	15	30
					Jeruk Kunci	5		Belangeran	15	
					Mangga	7				
Burhan	15	3	110	122	Mangga	122	122	Jelutung	110	110
Darwin	75	32	50	93	Mangga Apel	83	93	Jelutung	50	50
					Jeruk	10				
Joni Saputra	7	8	118	117	Mangga Manalagi	117	117	Jelutung	100	118
								Belangeran	18	
M Aji	13	14	112	111	Mangga	111	111	Jelutung	100	112
								Belangeran	12	
Marham	58	74	67	51	Mangga	31	51	Jelutung	67	67
					Jeruk	20				
Matcuci	106	41	19	84	Mangga	84	84	Jelutung	19	19
Matudin	60	46	65	79	Mangga	79	79	Jelutung	65	65
Robinson	16	45	109	80	Mangga	80	80	Jelutung	59	109
								Belangeran	50	
Sarman	109	123	16	2	Mangga	2	2	Jelutung	16	16
Nungcik	165	51	85	199	Mangga	199	199	Jelutung	85	85
Total			781	960	Total		960			781

2. Recapitulation number of plants proposed for replanting and their prices. Additional total amount of 10% for fruit plants and 30% for forest plants to prevent plants from dying during the shipping and planting process.

The preparation for the seedling replanting activity begins with the construction of ridges on each farmer's land. Ridges play an essential role in land management, serving to slow water flow, reduce the risk of soil erosion, and provide an ideal place for planting new crops. The ridge construction process is carried out gradually, adapting to field conditions. Currently, water levels in most areas remain high, and a significant portion of the land is still planted with rice. Therefore, land preparation is conducted carefully to avoid disturbing the growing rice crops while ensuring that the constructed ridges meet agronomic needs and match the land's characteristics.

The delivery of seedlings is carried out gradually, adjusted to the progress of ridge construction completed on each plot of land. This approach ensures that the delivered seedlings can be planted immediately on the prepared ridges, minimizing the risk of damage or quality degradation due to delays in planting. Additionally, the gradual delivery allows for better coordination between farmers and the implementation team, ensuring the planting process runs efficiently and according to the planned schedule.

The condition of the seedlings to be used consists of two types: fruit tree seedlings and forest tree seedlings. Fruit tree seedlings have a height of approximately 40-50 cm, while forest tree seedlings have a height of about 15-20 cm. This difference in height reflects the characteristics of each type of seedling, tailored to their specific planting needs and purposes. Fruit tree seedlings typically require more intensive care to support their growth, while forest tree seedlings are designed to be more adaptive to diverse environmental conditions.

2.3.2. Supervising the field teams working closely with farmers doing farming activities including cultivation, enrichment and maintenance of planted trees, crops, established ponds and fishes as part of adoption of agroforestry/agrosilvofishery models.

The replanting of fruit tree and forest tree seedlings on peatland using ridges is carried out in a planned and careful manner to ensure successful plant growth. The process begins with selecting healthy seedlings that meet specific criteria, such as height and root conditions, to ensure optimal adaptation to the peatland environment.

The seedlings are planted on pre-prepared ridges, which function to reduce waterlogging, improve drainage, and provide a stable planting area. After planting, initial watering is performed to maintain soil moisture and ensure good contact between the seedling roots and the planting medium. Additionally, planting distances are optimally arranged to ensure each seedling has sufficient space to grow without competition.

Regular monitoring is conducted to ensure the seedlings grow well, including applying additional fertilizers if necessary and controlling pests and diseases. Through this method, fruit tree seedlings are expected to provide long-term economic benefits, while forest tree seedlings contribute to the preservation of the peatland ecosystem.

2.3.2. Supervising the field teams working closely with farmers doing farming activities including cultivation, enrichment and maintenance of planted trees, crops, established ponds and fishes as part of adoption of agroforestry/agrosilvofishery models.

Supervising field teams in collaboration with farmers is essential for the successful implementation of agroforestry and agrosilvofishery models. This supervision encompasses several key activities:

1. **Cultivation**: Guiding teams in preparing the land, selecting appropriate tree and crop species, and employing sustainable planting techniques to ensure optimal growth.
2. **Enrichment**: Overseeing the introduction of additional plant species to enhance biodiversity, improve soil fertility, and increase overall system productivity.
3. **Maintenance of Planted Trees and Crops**: Ensuring regular care through pruning, fertilization, pest management, and monitoring plant health to promote vigorous growth and high yields.
4. **Establishment and Maintenance of Ponds and Fish Stocks**: Supervising the construction of ponds, selection of suitable fish species, and ongoing management practices such as feeding, water quality monitoring, and harvesting to integrate aquaculture into the farming system.

Effective supervision in these areas not only enhances productivity but also fosters the adoption of sustainable practices among farmers, contributing to the long-term success of agroforestry and agrosilvofishery initiatives.

(a) Cultivation

(b) Enrichment

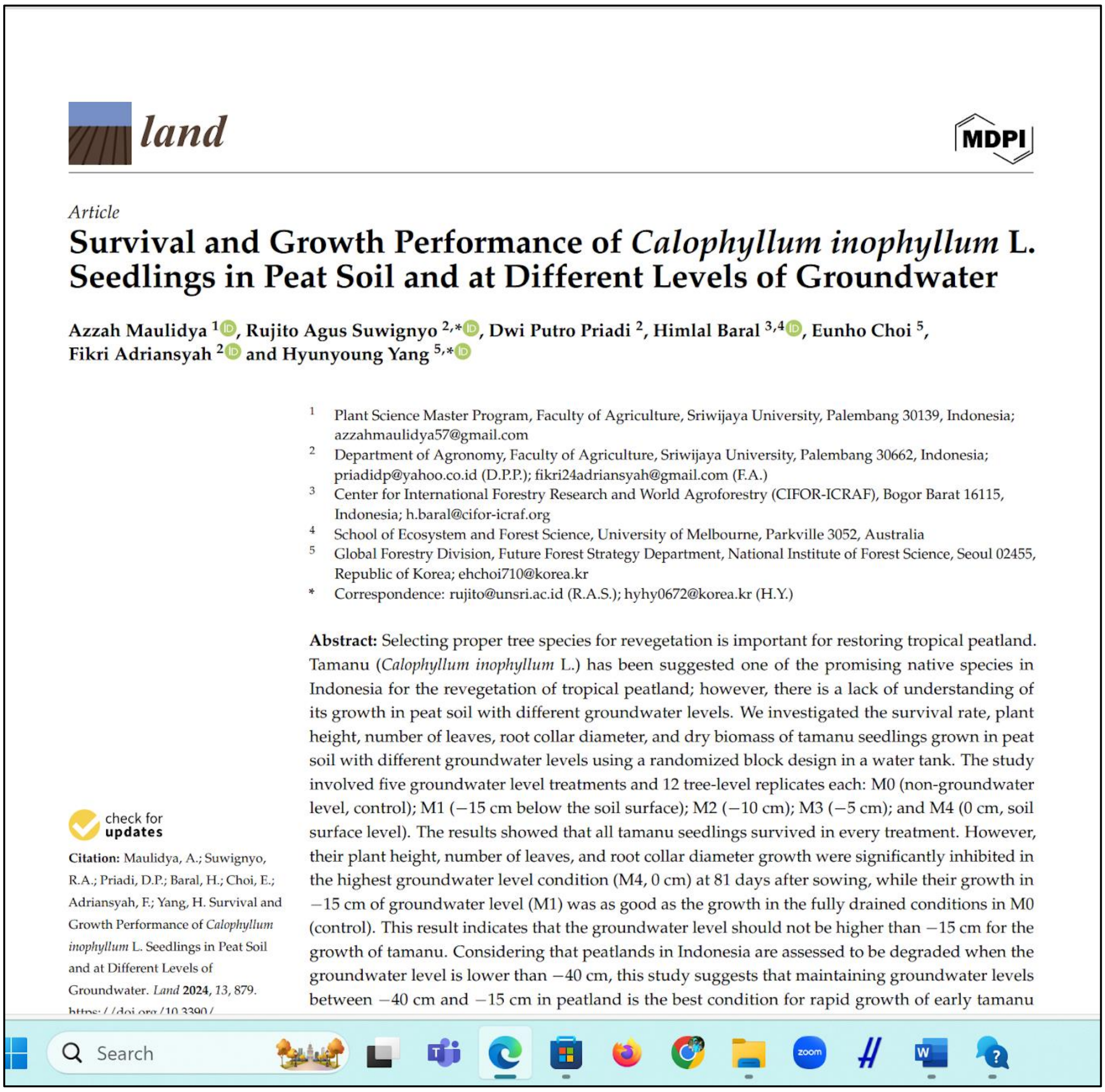
(c) Maintenance of Planted Trees and Crops

(d) Establishment and Maintenance of Ponds and Fish Stocks

Figure 2.42. Supervising field teams in collaboration with farmers

2.4. To produce scientific papers, news articles, briefs or infographics based on research findings; and to disseminate key research findings to relevant stakeholders at village, district, provincial and national and international levels through appropriate forums

1. Azzah Mualidya, Rujito A. Suwignyo, Dwi Putro Priadi, Himlal Baral, Eunho Choi, Fikri Adriansyah, and Hyunyoung Yang. 2024. *Land* 2024, *13*(6), 879; https://doi.org/10.3390/land13060879.



land MDPI

Article

Survival and Growth Performance of *Calophyllum inophyllum* L. Seedlings in Peat Soil and at Different Levels of Groundwater

Azzah Maulidya [1], Rujito Agus Suwignyo [2,*], Dwi Putro Priadi [2], Himlal Baral [3,4], Eunho Choi [5], Fikri Adriansyah [2] and Hyunyoung Yang [5,*]

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check for updates

Citation: Maulidya, A.; Suwignyo, R.A.; Priadi, D.P.; Baral, H.; Choi, E.; Adriansyah, F.; Yang, H. Survival and Growth Performance of *Calophyllum inophyllum* L. Seedlings in Peat Soil and at Different Levels of Groundwater. *Land* **2024**, *13*, 879. https://doi.org/10.3390/

Abstract: Selecting proper tree species for revegetation is important for restoring tropical peatland. Tamanu (*Calophyllum inophyllum* L.) has been suggested one of the promising native species in Indonesia for the revegetation of tropical peatland; however, there is a lack of understanding of its growth in peat soil with different groundwater levels. We investigated the survival rate, plant height, number of leaves, root collar diameter, and dry biomass of tamanu seedlings grown in peat soil with different groundwater levels using a randomized block design in a water tank. The study involved five groundwater level treatments and 12 tree-level replicates each: M0 (non-groundwater level, control); M1 (−15 cm below the soil surface); M2 (−10 cm); M3 (−5 cm); and M4 (0 cm, soil surface level). The results showed that all tamanu seedlings survived in every treatment. However, their plant height, number of leaves, and root collar diameter growth were significantly inhibited in the highest groundwater level condition (M4, 0 cm) at 81 days after sowing, while their growth in −15 cm of groundwater level (M1) was as good as the growth in the fully drained conditions in M0 (control). This result indicates that the groundwater level should not be higher than −15 cm for the growth of tamanu. Considering that peatlands in Indonesia are assessed to be degraded when the groundwater level is lower than −40 cm, this study suggests that maintaining groundwater levels between −40 cm and −15 cm in peatland is the best condition for rapid growth of early tamanu

Search

Figure 2.42. Publication on *Land* **2024**, *13*(6), 879; **https://doi.org/10.3390/land13060879**

2. Erizal Sodikin, Irmawati, Rujito A. Suwignyo, Entis S. Halimi, Marudut Tampubolon, A-Ram Yang, Hyunyoung Yang, and Himlal Baral. Growth and biomass production of purun (*Lepironia articulata Retz. Domin*) in degraded peatlands due to periodical stem cutting. *Sustainability* 2024, *16*(20), 8896; https://doi.org/10.3390/su16208896

sustainability MDPI

Article

Growth and Biomass Yield of Grey Sedge (*Lepironia articulata* Retz. Domin) under Different Shoot-Cutting Intervals in a Tropical Peatland

Erizal Sodikin [1,2], Irmawati Irmawati [1,2], Rujito A. Suwignyo [1,2,*], Entis S. Halimi [1], Marudut Tampubolon [3], A-Ram Yang [4], Hyunyoung Yang [4,*] and Himlal Baral [5,6]

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Abstract: Grey sedge (*Lepironia articulata* Retz. Domin) is a plant endemic to tropical peatlands and is widely used as a handicraft and biodegradable product that brings income to local farmers. However, its habitat has been decreasing due to peatland degradation, which has forced local farmers to harvest *L. articulata* repeatedly in the same habitat. To examine the effects of repeated shoot cutting at different time intervals on *L. articulata* growth and biomass yield, a mesocosm experiment was conducted from June 2019 to March 2020 in a tropical peatland in Perigi village, Ogan Ilir District, South Sumatra, Indonesia, using a randomized block design with four treatments and three replicates. The treatments were as follows: P1 (cutting every 1 month), P2 (cutting every 2 months), P3 (cutting every 3 months), and P4 (cutting at 6-months). The results showed that P1 significantly reduced monthly shoot height, shoot diameter, shoot number, dry biomass, cumulative shoot number, and cumulative dry biomass. In contrast, considering *L. articulata*'s regenerative growth, the growth and cumulative biomass yield of P3 (1453.5 ± 518.4 g m^{-2}) were as good as those of P4. These

Citation: Sodikin, E.; Irmawati, I.; Suwignyo, R.A.; Halimi, E.S.; Tampubolon, M.; Yang, A.-R.; Yang, H.; Baral, H. Growth and Biomass Yield of Grey Sedge (*Lepironia articulata* Retz. Domin) under Different Shoot-Cutting Intervals in a Tropical Peatland.

Figure 2.43. Publication on *Sustainability* **2024**, *16*(20), 8896; **https://doi.org/10.3390/su16208896**

3. Exploring The Future of Aquaculture Development in The Peatlands of South Sumatra: Opportunities and Challenges. Mohamad Amin, Marini Wijayanti. . It has been submitted to Philippine Journal of Fisheries, alamtnya https://www.nfrdi.da.gov.ph/tpjf/index.php (D6b)

Exploring The Future of Aquaculture Development in The Peatlands of South Sumatra: Opportunities and Challenges

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Abstract: Peatlands play a critical role in the global carbon cycle and mitigation of climate change and provide a range of additional advantages for humans: flood control, food, and cultural and livelihoods' opportunities. They support a diverse range of ecosystems and rare and endangered plant and animal species. The prospect of farming fish in peatlands is highly promising. Empowering indigenous farmers can be accomplished by use of native species (for example, 'snakehead' (*Channa* striata), 'kissing gourami' (*Helostoma temminckii*), 'snakeskin gourami' (*Trichopodus pectoralis*), 'climbing perch' (*Anabas testudineus*), and 'gurami' (*Osphronemus goramy*) and introduced (two types of catfish: *Pangasius hypotalmus* and *Clarias gariepenus*; and *Oreochromis niloticus* ('nile tilapia'). Fish-farming technology can focus on drainage and irrigation systems to manage groundwater levels, as well as soil ameliorants. Empowerment of indigenous farmers can be achieved through the cultivation of fish as well as water management in peat restoration. The capacity of cultured fish species to survive in peat water should be featured during their selection. Aquaculture systems can be used to domesticate or cultivate a variety of consumable and ornamental fish that are naturally prevalent in peatland settings. Pond systems, pen culture and 'beje' (artificial ponds) are some aquaculture technology systems that may be implemented in peatlands. To effectively expand aquaculture on peatland, the capacity of local communities and field supervisors must be built.

Keywords: aquaculture; native species; peatland; Indonesia

Figure 2.44. Draft Article with the Title Opportunities and Challenges. Mohamad Amin, Marini Wijayanti. . It has been submitted to Philippine Journal of Fisheries, alamtnya https://www.nfrdi.da.gov.ph/tpjf/index.php

III. ACTIVITIES PROPOSED FOR FURTHER IMPROVEMENT IN 2025

I. Background

The agrosilvofishery method has been applied in Perigi Village to support peatland restoration and improve the welfare of local communities. Although it shows positive results, various technical, socio-economic, and vegetation challenges still need to be overcome to optimize the benefits of this method. Therefore, further, more in-depth research is needed to develop an adaptive and sustainable agrosilvofishery model.

II. Research Objectives

1. Develop a technical model of agrosilvofishery that is adaptive to the conditions of the peat ecosystem in Perigi Village.
2. Analyze the socio-economic impacts of the application of the agrosilvofishery method on local communities.
3. Evaluate and identify the optimal types of vegetation to be developed on peatlands, including fruit forest plants, horticulture, and vegetables.

III. Research Methodology

Agrosilvofishery Model Design:

- Combination of utilization of embankment areas for horticulture, water areas for fish farming, and integrated agricultural zones for food crops and fruit trees.
- Simulation of water management models to maintain soil moisture and prevent drought.

A. Technical Aspects

Technical Data Collection: (1) Monitoring soil moisture, water quality, and crop and fish productivity, and (2) Evaluation of the effectiveness of irrigation systems and canals.

B. Socio-Economic Aspects (Sosek)

Social Survey: (1) Interviews and focus group discussions (FGD) with farmers and local communities, and (2) Analysis of community perceptions of the benefits and challenges of implementing the agrosilvofishery method. Economic Analysis: (1) Data collection of production costs, income, and profitability of the agrosilvofishery method, and (2) Market study to identify potential commodities with high economic value.

C. Vegetation Aspect

Plant Identification and Selection: (1) Fruit Forest Plants: Jelutung (Dyera lowii), Belangeran (Shorea belangeran), Durian (Durio zibethinus), Mango (Mangifera indica),etc, and (2) Vegetable and Horticultural Plants: Spinach, kale, chili, pineapple, and watermelon, etc. Field Experiments: (1) Determination of planting patterns, planting distances, and crop rotation, and (2) Trial of ameliorant use (e.g. dolomite) to increase soil productivity, (3) Monitoring and Evaluation, (4) Observation of plant growth, productivity, and resistance to peatland conditions.

IV. Variables and Indicators

1. Technical: Soil moisture level, water quality, fish and plant productivity.
2. Socio-Economic:Farmer income, community participation, social dynamics.
3. Vegetation: Plant growth rate, harvest yield, disease resistance.

V. Main Research Activities

1. Design and Implementation of Agrosilvofishery Model: Development and testing of various combinations of plants, fish, and irrigation patterns.
2. Farmer Training: Training on peat-based agricultural techniques, fish farming, and crop processing.
3. Market Analysis: Identification of local and regional market needs for agrosilvofishery products.
4. Dissemination of Research Results: Presentation of research results to local and national stakeholders.

VI. Expected Outputs

1. Adaptive and sustainable agrosilvofishery model.
2. Policy recommendations to support the development of agrosilvofishery methods in peatlands.

3. Improving the welfare of local communities through diversification of income sources.
4. Scientific publications related to agrosilvofishery-based peatland restoration.

With this 2025 research plan, it is expected that real contributions to the development of sustainable solutions for peatland restoration and the welfare of local communities can be realized.We also proposed for the next collaboration by: (a) Involving more researcher in the project, (2) Continuing in writing joint proposal for getting more funding, Joint research and increasing publication, (3) Involving more scientific meeting for collaboration and promotion, and (4) Disseminating and scaling up to others area

IV. CLOSING REMARK

4.1. Conclusion

The activities undertaken in 2024 under the CIFOR-UNSRI-NIFoS SCORE Project have demonstrated promising results in advancing the agrosilvofishery model as a viable solution for peatland restoration. Key achievements include:

1. **Development and Implementation of Agrosilvofishery Models**: The project successfully expanded demonstration plots to 12 hectares, involving 11 farmers, integrating agroforestry, agriculture, and aquaculture practices. Improved design and adaptive measures, such as enhanced water management, have addressed challenges related to prolonged dry seasons and flooding.
2. **Community Engagement and Capacity Building**: Farmers actively participated in cultivation, maintenance, and sustainable practices, fostering a sense of ownership. Training on agrosilvofishery techniques has empowered farmers to enhance productivity and income potential.
3. **Environmental and Socio-Economic Benefits**: Initial results indicate improved soil health, biodiversity enhancement, and reduced risk of peatland fires. Economic benefits through diversified income streams from fish, crops, and timber products are becoming evident.

4.2. Policy and Program Implications

1. **Strengthening Policy Support**:
    - Promote agrosilvofishery models as a strategic component of regional and national peatland restoration programs.
    - Provide financial incentives and technical assistance to encourage adoption among smallholder farmers.
2. **Scaling Up the Model**:
    - Expand demonstration plots and replicate successful practices in other peatland areas.
    - Integrate agrosilvofishery models into provincial development plans to address broader restoration and livelihood challenges.

3. **Enhancing Market Access**:
    - Develop value chains and cooperatives to improve market access for agrosilvofishery products.
    - Facilitate market studies to identify potential demand and ensure fair pricing for farmers.
4. **Research and Monitoring**:
    - Conduct ongoing research to refine agrosilvofishery practices and assess long-term impacts on peatland health and farmer livelihoods.
    - Implement robust monitoring systems to track ecological and economic outcomes.
5. **Community Empowerment**:
    - Strengthen training programs focused on sustainable practices and entrepreneurship.
    - Foster community-led initiatives to ensure the sustainability of the agrosilvofishery approach.

The achievements in 2024 underline the potential of agrosilvofishery models to address complex environmental and socio-economic challenges in peatland areas. Continued collaboration among stakeholders, enhanced policy frameworks, and community-driven efforts will be critical to scaling and sustaining these outcomes in the years ahead.

Acknowledgement

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REFERENCES

1. Dohong A, Aziz A A and Dargusch P 2017 A review of the drivers of tropical peatland degradation in South-East Asia Land use policy 69 349–60
2. Agus F and Subiksa I G M 2008 Lahan Gambut : Potensi untuk Pertanian dan Aspek Lingkungan (Bogor, Indonesia: Balai Penelitian Tanah dan World Agroforestry Centre (ICRAF))
3. Tonks A J, Aplin P, Beriro D J, Cooper H, Evers S and Vane C H 2017 Geoderma Impacts of conversion of tropical peat swamp forest to oil palm plantation on peat organic chemistry , physical properties and carbon stocks Geoderma 289 36–45
4. Wahyunto, Ritung S, Nugroho K, Sulaeman Y, Hikmatullah, Tafakresnanto C, Suparto and Sukarman 2013 Atlas of Degraded Peatlands in Sumatra Island Agric. Res. Dev. Agency Minist. Agric. (In Bahasa)
5. Dohong A and Aziz A A 2018 A Review of Techniques for Effective Tropical Peatland Restoration
6. Ritzema H, Limin S, Kusin K, Jauhiainen J and Wösten H 2014 Canal Blocking Strategies for Hydrological Restoration of Degraded Tropical Peatlands in Central Kalimantan , Indonesia Catena 114 11–20
7. Carmenta R, Zabala A, Daeli W and Phelps J 2017 Perceptions across scales of governance and the Indonesian peatland fi res Glob. Environ. Chang. 46 50–9
8. Lestari S, Winarno B and Premono B T 2018 Peatland Degradation and Restoration Efforts for Community Empowerment and Economic Improvement : Case of Ogan Komering Ilir, South Sumatra Proceeding of National Seminar 2018 "Merawat Asa Restorasi Gambut, Pencegahan Kebakaran dan Peningkatan Kesejahteraan Masyarakat" ed E Martin, H L Tata, L Syaufina and M Rahmat (Palembang: Balai Penelitian dan Pengembangan Lingkungan Hidup dan Kehutanan Palembang) pp 199–206
9. Thornton S A, Setiana E, Yoyo K, Harrison M E, Page S E and Upton C 2020 Towards biocultural approaches to peatland conservation : The case for fish and livelihoods in Indonesia Environ. Sci. Policy 114 341–51
10. Silvius, M., and H. Diemont. 2007. Deforestation and degradation of peatlands. Peatlands International 2: 32–34.
11. Jauhiainen, J., S. Limin, H. Silvennoinen, and H. Vasander. 2008. Carbon dioxide and methane fluxes in drained tropical peat before and after hydrological restoration. Ecology 89: 3503– 3514.
12. Cochrane, M.A. 2001. Synergistic interactions between habitat fragmentation and fire in evergreen tropical forests. Conservation Biology 15: 1515–1521.
13. Siegert, F., G. Ruecker, A. Hinrichs, and A.A. Hoffmann. 2001. Increased damage from fires in logged forests during droughts caused by El Nino. Nature 414: 437–440.
14. Page, S.E., F. Siegert, J. Rieley, H.-D.V. Boehm, A. Jaya, and S. Limin. 2002. The amount of carbon released from peat and forest fires in Indonesia during 1997. Nature 420: 61–65.

15. Heil, A., B. Langmann, and E. Aldrian. 2006. Indonesian peat and vegetation fire emissions: Study on factors influencing largescale smoke haze pollution using a regional atmospheric chemistry model. Mitigation and Adaptation Strategies for Global Change 12: 113–133.

Attachment 1. Market Potential for Agroforestry Product Main Literature Review References

Paper	DOI	Abstract summary	Main findings	Policy recommendations
S. M. Amatya, I. Nuberg, E. Cedamon, K. K. Shrestha, B. H. Pandit, P. Aulia, M. Joshi and B. Dhakal Participatory market chain appraisal for the full range of agroforestry products including market trends and growing markets Banko Janakari, 2018; 27(2): 32-45	http://doi.org/10.3126/banko.v27i2.21221	Participatory market chain analysis identified constraints and factors affecting the market potential for agroforestry products in Nepal.	- Small-scale production and insufficient support services for farmers from local agriculture collection centers and cooperatives are major constraints to effective and efficient agroforestry product market chain development and management. - Increased awareness of agroforestry practices among local resource persons/groups, as well as supportive institutions and policies, are the main factors driving increased production of agroforestry products. - The paper concludes by identifying the key controlling factors in the agroforestry business.	Not mentioned (the abstract does not explicitly state any policy recommendations made by the authors)
Basamba, T. A., Kiiza, B., Mayanja, C., Nakileza, B., Matsiko, F., Nyende, P., & Kukunda, E. B. (2012). Linking markets to smallholder agro-forestry farmers as a strategy for poverty alleviation in the tropics. *Journal of Agricultural Science and Technology. B*, *2*(3B), 29.		Factors like farm size, household size, education, credit access, and extension services positively impact smallholder agroforestry farmers' market participation.	- Farm size, household size, education level, access to credit, and extension visits had positive and significant effects on farmer participation in agro-forestry product markets. - Older age of the farmer had a negative and significant effect on their participation in agro-forestry product markets. - Improving extension services, providing more credit to farmers, and increasing agro-forestry training were recommended to enhance farmer	Improve the quality and coverage of extension services for farmers, extend credit facilities to farmers, and intensify agro-forestry training for farmers in order to enhance the participation of smallholder agro-forestry farmers in agricultural product markets.

Paper	DOI	Abstract summary	Main findings	Policy recommendations
			participation in agro-forestry product markets.	
Teel, W. S., Buck, L. E., & Josiah, J. (1998, October). From wildcrafting to intentional cultivation: The potential for producing specialty forest products in agroforestry systems in temperate North America. In *North American Conference on Enterprise Development Through Agroforestry: Farming the Agroforest for Specialty Products, Minneapolis, MN* (pp. 7-24).		The paper discusses the potential for producing specialty forest products in agroforestry systems in temperate North America.	- The transition from wildcrafting to intentionally producing non-timber forest products in agroforestry systems requires increased management, labor, and other inputs, as well as entrepreneurial skills. - Landowners whose livelihoods are not solely dependent on agricultural and natural resources production appear to be more innovative in managing special forest products. - Landscapes in transition, such as those experiencing agricultural land abandonment, forest fragmentation, and urban/rural fringe formation, provide environments for innovations in agroforestry practice and the production of specialty forest products.	Not mentioned (the abstract does not contain any explicit policy recommendations from the authors)

Paper	DOI	Abstract summary	Main findings	Policy recommendations
Fereday, N., Gordon, A., & Oji, G. (1997). Domestic market potential for tree products from farms and rural communities: Experience from Cameroon (Vol. 13). Natural Resources Institute. ISBN 0859544893. Greenwich Academic Literature Archive - Domestic market potential for tree products from farms and rural communities: Experience from Cameroon		The domestic market potential for non-timber tree products from farms and rural communities in Cameroon appears to be growing, with increasing demand matched by increasing supply.	- The domestic markets for the non-timber tree products (NTTPs) studied were well-developed and competitive, despite some issues with information access for farmers. - There was increasing demand for the NTTPs, which was being met by increasing supply. - The domestication of NTTPs was driven by farmers, in response to products becoming scarce in the forest and being important for both subsistence and income.	Not mentioned (the abstract does not explicitly state any policy recommendations made by the authors)
Reddy, E. V. (2011). Constraints in marketing of agroforestry produce in India. Indian Forester, 2011, Vol. 137, No. 6, 669-677 ref. 14		Constraints in marketing of agroforestry products in India include lack of farmer knowledge, infrastructure, and value addition.	- Small-scale farmers face constraints in marketing agroforestry products due to lack of market knowledge and technical expertise. - Government and NGOs can play a crucial role in providing training to farmers to address these constraints. - Organizing small farmers into groups and societies can help them overcome the constraints they face in marketing their agroforestry products.	1. Government and non-governmental organizations should provide training to farmers on cultivating and trading agroforestry products. 2. Develop rural enterprises by organizing small farmers into groups and societies to help them obtain quality planting materials and market their produce. 3. The government should develop infrastructure in villages to promote agroforestry produce. 4. Provide training to farmers on value addition methods to help them earn greater profits from their agroforestry produce.

Paper	DOI	Abstract summary	Main findings	Policy recommendations
Magsi, H. A. B. I. B. U. L. L. A. H., Lohano, H. D., & Mirani, Z. U. (2014). Marketing system and structure for agroforestry products in Sindh, Pakistan. Eur Acad Res, 2(7), 9509-9522.		Agroforestry products in Sindh, Pakistan have market potential, but farmers receive lower returns compared to middlemen.	- The main agroforestry products are timber, mining-timber, and firewood. - Agroforestry generates additional income for farmers and provides environmental benefits by improving soil conditions. - Farmers receive lower returns compared to the high marketing margins taken by middlemen in the agroforestry supply chain.	Not mentioned (the abstract does not mention any policy recommendations made by the authors)
Islam, K. K., Fujiwara, T., Tani, M., & Sato, N. (2014). Marketing of agroforestry products in Bangladesh: a value chain analysis. American Journal of Agriculture and Forestry, 2(4), 135.		The market potential for agroforestry products in Bangladesh is limited by the involvement of many intermediaries in the value chain, reducing farmers' access to fair prices.	- The study found that the value chain for agroforestry products and timber in Bangladesh involves many intermediaries, which leads to increased value addition and higher marketing margins. - Farmers have a poor relationship with the intermediaries, and the lack of farmer organizations limits their ability to freely and fairly access local markets to sell their products. - The study concludes that there is a need to establish farmer cooperatives to reduce the number of intermediaries in the value chain, allowing farmers to get fairer prices for their products, and to harmonize and execute marketing legislation.	1. Establish farmer cooperatives to reduce the number of intermediaries in the agroforestry value chain and help farmers get fair prices for their products. 2. Harmonize and execute marketing legislation to further support farmers in getting fair prices.

Paper	DOI	Abstract summary	Main findings	Policy recommendations
Atreya, K., Subedi, B. P., Ghimire, P. L., Khanal, S. C., Charmakar, S., & Adhikari, R. (2021). Agroforestry for mountain development: Prospects, challenges and ways forward in Nepal. Archives of Agriculture and Environmental Science, 6(1), 87-99.		Nepal has high potential for agroforestry but faces socioeconomic, institutional, and knowledge challenges that need to be addressed to unlock the market potential.	- Nepal has enormous agroecological diversity, suitable land availability, traditional knowledge, and prospects for adapting new technologies and developing markets for agroforestry. - However, agroforestry value chains face challenges including socio-economic constraints, institutional barriers, and inadequate scientific knowledge and expertise. - The paper suggests ways forward to promote agroforestry and a business model to achieve untapped potentials for enhancing income, employment, food security, and sustainable land use.	1) Increase investment to educate farmers on the science and ecosystem services of agroforestry 2) Facilitate the development of agroforestry-based enterprises by identifying priority products and value chains, and connecting producers to markets 3) Incorporate traditional agroforestry knowledge into modern science, focusing on socio-ecological resilience and adaptive management
Szerb, B., Horváth, J., & Szente, V. (2020). Consumer perception of Hungarian agroforestry products–results of a Q-methodology attitude research study. Studies in Agricultural Economics, 122(3), 124-131.	https://doi.org/10.7896/j.2077	The study identifies different consumer segments interested in Hungarian agroforestry products and their preferred purchasing channels.	- The study identified four main consumer groups based on their attitudes towards agroforestry products: "Alternative, Green Consumers", "Inquisitive Consumers", "Busy Consumers", and a fourth group. - The "Alternative, Green Consumers" are committed to sustainable products and would be interested in agroforestry products. - The "Inquisitive Consumers" are interested in learning about the products they purchase and are willing to pay more for agroforestry products.	1. Offer loyalty discounts and product tastings to attract and retain regular customers. 2. Emphasize the sustainability and environmental benefits of agroforestry products, as consumers are willing to pay higher prices for these. 3. Highlight the lower ecological footprint of agroforestry products compared to conventional agriculture. 4. Engage directly with consumers, as they are eager to be informed about the products and their origins by the producers themselves.

Paper	DOI	Abstract summary	Main findings	Policy recommendations
Nair, P. R., Rao, M. R., & Buck, L. E. (Eds.). (2004). New Vistas in Agroforestry: A Compendium for 1st World Congress of Agroforestry, 2004 (Vol. 1). Springer Science & Business Media.		This compendium covers a wide range of topics related to agroforestry, including systems, practices, biological and ecological issues, economics, marketing, and knowledge integration, but does not specifically address market potential for agroforestry products.	Not mentioned (the abstract does not appear to present any specific findings or conclusions from a study)	Not mentioned (the abstract does not contain any explicit policy recommendations or suggestions for decision-makers)
Leakey, R., Tchoundjeu, Z., Schreckenberg, K., Simons, T., Shackleton, S., Mander, M., ... & Sullivan, C. (2006). Trees and markets for agroforestry tree products: targeting poverty reduction and enhanced livelihoods. World agroforestry into the future, 11-22.		Agroforestry tree domestication and commercialization of agroforestry tree products can enhance livelihoods for poor farmers in the tropics.	- Agroforestry tree domestication driven by farmers and markets has been an important international initiative since the early 1990s. - A participatory approach to tree improvement, in addition to traditional methods, is an important strategy for achieving key Millennium Development Goals like eradicating poverty and hunger and promoting social equity. - Significant progress has been made in domesticating indigenous fruits and nuts in Cameroon and Nigeria, using an approach focused on 'ideotypes' and understanding tree-to-tree variation in commercially important traits.	Not mentioned (the abstract does not explicitly state any specific policy recommendations made by the authors)

Paper	DOI	Abstract summary	Main findings	Policy recommendations
Ramachandran Nair, P. K., Mohan Kumar, B., & Nair, V. D. (2009). Agroforestry as a strategy for carbon sequestration. Journal of plant nutrition and soil science, 172(1), 10-23.	DOI: 10.1002/jpln.200800030	Agroforestry has potential for carbon sequestration, but the market potential for agroforestry products is not discussed.	- The current global area under agroforestry systems is estimated to be 1,023 million ha. - There is substantial potential to expand agroforestry by converting unproductive or degraded lands. - The carbon sequestration potential of agroforestry systems depends on site-specific biological, climatic, soil, and management factors. - The profitability of agroforestry-based carbon sequestration projects depends on carbon market prices, revenue from other products, and monitoring costs.	Not mentioned (the abstract does not explicitly state any specific policy recommendations made by the authors)
Leakey, R. R., Tchoundjeu, Z., Schreckenberg, K., Shackleton, S. E., & Shackleton, C. M. (2005). Agroforestry tree products (AFTPs): targeting poverty reduction and enhanced livelihoods. International Journal of Agricultural Sustainability, 3(1), 1-23.	1473-5903/05/010001-23 $20.00/	Agroforestry tree domestication and commercialization of agroforestry tree products can promote enhanced livelihoods for poor farmers.	- Agroforestry tree domestication emerged as a farmer-driven, market-led process that became an international initiative. - A participatory approach to tree improvement, involving farmers, is an important strategy for achieving development goals like reducing poverty and promoting sustainability. - Significant progress has been made in domesticating indigenous fruit and nut trees in parts of Africa, with farmers developing new cultivars based on an understanding of desirable traits.	Not mentioned (the abstract does not mention any specific policy recommendations made by the authors)

Paper	DOI	Abstract summary	Main findings	Policy recommendations
Leakey, R., & Van Damme, P. (2014). The role of tree domestication in green market product value chain development. *Forests, Trees and Livelihoods*, *23*(1-2), 116-126.		Agroforestry tree domestication creates business and employment opportunities for smallholder farmers in developing countries by enhancing economic returns through value chain development of green market products.	- Tree domestication enhances economic returns for smallholder farmers by enabling them to meet the increasing demands of global markets for higher quality, more uniform, and consistently available products. - Tree domestication enables smallholder farmers to develop new cultivars and market their products, both food and non-food, in local and regional markets, creating new business and employment opportunities. - Tree domestication and agroforestry can enhance food security by improving the yields of modern crop varieties, thereby closing the yield gap between potential and actual yields.	Not mentioned (the abstract does not provide any specific policy recommendations made by the authors)
Alavalapati, J., Nair, P. K. R., & Barkin, D. (2001). Socioeconomic and institutional perspectives of agroforestry. World forests, markets and policies, 71-83.		Agroforestry systems have potential for economic and environmental sustainability, but require target-specific policies and incentives to address socioeconomic and institutional factors.	- Agroforestry systems (AFS) have the potential to improve economic and environmental sustainability in the tropics and temperate regions. - Non-market benefits of AFS, such as protective and environmental values, option values, value-added opportunities, and spin-off values, should be considered in their valuation. - Well-defined property rights and their effective enforcement are important for ensuring long-term investment, improving economic efficiency, and promoting distributional equity in AFS.	1. Implement target-specific agroforestry policies to ensure equitable distribution of benefits within society. 2. Consider both market-based and non-market benefits (e.g., environmental, option values) when evaluating the value of agroforestry systems. 3. Develop innovative incentive mechanisms that account for the non-market benefits of agroforestry systems to promote their optimal production. 4. Ensure well-defined and effectively

Paper	DOI	Abstract summary	Main findings	Policy recommendations
				enforced property rights to encourage long-term investment, improve economic efficiency, and promote distributional equity.
Roshetko, J. M., Nugraha, E., Tukan, J. C. M., Manurung, G., Fay, C., & Van Noordwijk, M. (2007). Agroforestry for livelihood enhancement and enterprise development. In *ACIAR PROCEEDINGS* (Vol. 126, p. 137). ACIAR; 1998.		Agroforestry systems offer opportunities to enhance farmer incomes through market-oriented production, but require addressing technical factors like quality germplasm, tree management, and market linkages.	- Agroforestry can provide social, economic, and environmental benefits when integrating trees into agricultural landscapes. - Many areas have not yet developed market-oriented agroforestry systems, and several factors may hinder the development of smallholder agroforestry. - Improving smallholder access to quality germplasm and building farmers' technical skills in tree propagation and nursery management are key factors in developing successful smallholder agroforestry.	Not mentioned (the abstract does not provide any specific policy recommendations made by the authors)

Paper	DOI	Abstract summary	Main findings	Policy recommendations
Leakey, R., & Van Damme, P. (2014). The role of tree domestication in green market product value chain development. Forests, Trees and Livelihoods, 23(1-2), 116-126.		Agroforestry tree domestication can provide new market opportunities for smallholder farmers in Africa through sustainable production and marketing of non-timber forest products.	- Agroforestry tree domestication has made significant progress in Africa over the past 20 years, providing new tree crop varieties for various industries. - Local farmers, in collaboration with research institutes, are developing improved tree crop cultivars, leading to benefits from processing and marketing these products in local, regional, and international markets. - Agroforestry can indirectly improve food security by enhancing the production environment for crops, thereby reducing the yield gap between potential and actual yields.	Not mentioned (the abstract does not contain any explicit policy recommendations made by the authors)
Roshetko, J. M., Snelder, D. J., Lasco, R. D., & Van Noordwijk, M. (2008). Future challenge: a paradigm shift in the forestry sector. Smallholder tree growing for rural development and environmental services: lessons from Asia, 453-485.		Smallholder agroforestry systems have potential to contribute to sustainable forest management and rural livelihoods, but require enabling conditions, institutional support, and market-oriented strategies.	- A paradigm shift is needed in the forestry sector to recognize the importance of smallholder tree-based (agroforestry) systems in achieving sustainable forest management. - Smallholder agroforestry systems have the potential to contribute to both sustainable forest management and rural livelihoods. - Enabling conditions, institutional and policy support, and market-oriented strategies are needed to strengthen the development and productivity of smallholder agroforestry systems.	Not mentioned (the abstract does not explicitly state any specific policy recommendations made by the authors)

Paper	DOI	Abstract summary	Main findings	Policy recommendations
Nair, P. K. R., & Garrity, D. (2012). Agroforestry research and development: the way forward. Agroforestry-the future of global land use, 9, 285-311.		The paper discusses the evolution of agroforestry research and development, but does not specifically address the market potential for agroforestry products.	- Agroforestry research has evolved from an inductive, observational approach to a more deductive, experimental approach. - Agroforestry research has expanded to focus on environmental issues and ecosystem services, in addition to the initial focus on biophysical interactions. - The vast potential of agroforestry to address land management challenges has been well recognized, as a result of the research and development efforts over the past three decades.	Not mentioned (the abstract does not contain any explicit policy recommendations or recommendations for decision-makers)
Gupta, J., Kumari, M., Mishra, A., Akram, M., & Thakur, I. S. (2022). Agro-forestry waste management-A review. Chemosphere, 287, 132321.		The paper reviews the management strategies and sustainability assessment of agroforestry waste, which has potential market value in biofuel, fertilizers, and other products.	- Current methods of agroforestry waste management have disadvantages. - Effective management of agroforestry waste is needed to obtain economic and environmental benefits. - Using appropriate pretreatment technologies can improve the valorization of agroforestry waste and overcome barriers to its utilization.	Not mentioned (the abstract does not provide any specific policy recommendations made by the authors)
Moreno, G., Aviron, S., Berg, S., Crous-Duran, J., Franca, A., de Jalón, S. G., ... & Burgess, P. J. (2018). Agroforestry systems of high nature and cultural value in Europe: provision of commercial goods and other ecosystem services. Agroforestry systems, 92, 877-891.		HNCV agroforestry systems in Europe provide a range of commercial goods and ecosystem services, but translating their positive impacts into market prices	- HNCV agroforestry systems in Europe generally enhance biodiversity and regulating ecosystem services compared to conventional agriculture and forestry. - These systems can reduce fire risk, increase carbon sequestration, moderate the microclimate, and reduce soil	Not mentioned (the abstract does not explicitly state any specific policy recommendations made by the authors)

Paper	DOI	Abstract summary	Main findings	Policy recommendations
		remains a challenge.	erosion and nutrient leaching compared to conventional practices. - Many HNCV agroforestry systems continue to provide multiple commercial goods, including woody and non-woody plant products as well as high-quality livestock and game.	
Beer, J., Harvey, C. A., Ibrahim, M. A., Harmand, J. M., Somarriba, E., & Jiménez Otárola, F. (2003). Servicios ambientales de los sistemas agroforestales. Agroforestería en las Américas Volumen 10, números 37-38 (2003), páginas 80-87.		Agroforestry systems provide environmental services like soil fertility, water conservation, and carbon capture, but their market potential is limited by lack of economic analyses.	- Agroforestry systems (AFS) provide important environmental service functions, including maintenance of soil fertility, water conservation, carbon capture, and biodiversity conservation. - These service functions complement the products that AFS provide, but farmers are rarely rewarded for them. - More research is needed on potential trade-offs between the different service functions and the negative effects on traditional products/uses of AFS when the tree component is increased.	Not mentioned (the abstract does not explicitly state any specific policy recommendations made by the authors)
Leakey, R. R. (2001). Win: Win landuse strategies for Africa: 1. Building on experience with agroforests in Asia and Latin America. The International Forestry Review, 1-10.		Agroforestry provides economic and environmental benefits, and offers opportunities for income generation and poverty reduction in Africa.	- A win-win land use strategy must provide both economic and environmental benefits, with enhanced livelihoods for the poor and provision of global commodities. - The paper examines opportunities for African farmers to produce income-generating non-timber forest products through agroforestry and domestication of indigenous tree species. - The paper provides recommendations	Not mentioned (the abstract does not provide any specific policy recommendations)

Paper	DOI	Abstract summary	Main findings	Policy recommendations
			for further research and development to encourage sustainable land use based on tree crops, and suggests a role for the industrial sector in agroforestry development.	
Niesten, E. (2005). A New Agenda for Forest Conservation and Poverty Reduction: Making Markets Work for Low-Income Producers by Sara J. Scherr, Andy White & David Kaimowitz (2004), x+ 160 pp., Forest Trends, Washington, DC, USA. ISBN 0 9713606 6 9 (pbk), unpriced [also available at http://www. forest-trends. org/]. Oryx, 39(1), 102-103.		Community-based forestry and innovative policies/partnerships have potential to contribute to sustainable development and poverty reduction through market opportunities for low-income producers.	- Community-based forestry has significant untapped potential to contribute to sustainable development and poverty reduction. - The paper aims to identify promising market opportunities for local community producers in developing countries. - The paper presents a framework for identifying promising market niches and proposes strategies to realize the potential of community-based forestry.	Not mentioned (the abstract does not provide any specific policy recommendations made by the authors)
Sereke, F., Graves, A. R., Dux, D., Palma, J. H., & Herzog, F. (2015). Innovative agroecosystem goods and services: key profitability drivers in Swiss agroforestry. Agronomy for sustainable development, 35, 759-770.		Agroforestry practices that incorporate innovative marketing of products and payments for ecosystem services can be more profitable than conventional farming.	- Agroforestry systems that combine trees and crops can be more productive than growing them separately. - Many agroforestry practices, especially those involving innovative marketing or payments for ecosystem services, can be more profitable than conventional agricultural systems. - Incorporating the concept of ecosystem services can help support the design of multifunctional agriculture and	1. Applying the concept of ecosystem services to support multifunctional agriculture and increase payments for these services. 2. Improving collaboration between scientists and farmers to develop productive agroforestry practices.

Paper	DOI	Abstract summary	Main findings	Policy recommendations
			increase the willingness to pay for the services provided by agroforestry systems.	
Foresta, H. D. (2013). Advancing agroforestry on the policy agenda–a guide for decision-makers. H. Foresta.		The paper discusses the importance of recognizing the value of agroforestry and trees on farmland to improve policies and support livelihoods, but does not directly address market potential.	- The study found that 46% of agricultural land globally has more than 10% tree cover, equivalent to 25% of the global forest area. - The lack of recognition of the extent of trees on agricultural land has negatively impacted the livelihoods of poor farmers. - While there is growing local recognition of the environmental, social, and economic value of trees in agroforestry systems, this is not yet recognized by development projects and donors.	Not mentioned (the abstract does not provide any specific policy recommendations made by the authors)
Sheppard, J. P., Chamberlain, J., Agúndez, D., Bhattacharya, P., Chirwa, P. W., Gontcharov, A., ... & Mutke, S. (2020). Sustainable forest management beyond the timber-oriented status quo: transitioning to co-production of timber and non-wood forest products—a global perspective. Current Forestry Reports, 6(1), 26-40.		This book provides a global synthesis of the potential and challenges associated with the use and marketing of non-timber forest products.	Not mentioned (the abstract does not contain any information about the main findings or conclusions of the study)	Not mentioned (the abstract does not contain any information about policy recommendations made by the authors)

Paper	DOI	Abstract summary	Main findings	Policy recommendations
Neumann, R. P., & Hirsch, E. (2000). Commercialisation of non-timber forest products: review and analysis of research.		This paper reviews and analyzes research on the commercialization of non-timber forest products, but does not directly address the market potential for agroforestry products.	- Forest and resource tenure can affect how resources are managed and utilized, and be affected by changes in value due to commercialization. - There are differing views on the environmental impacts of NTFP commercialization, with some suggesting it is less damaging than timber harvesting, while others believe it can lead to the decline of valuable products and harm the ecosystem. - The economic importance of NTFPs, especially for the poor, is recognized, but the potential impacts of their commercialization require further study and understanding.	Not mentioned (the abstract does not provide any specific policy recommendations made by the authors)
Plotkin, M., & Famolare, L. (Eds.). (1992). Sustainable harvest and marketing of rain forest products.		Rainforest products have economic potential but may not be a complete solution for forest protection.	- Tropical rainforests are underutilized sources of new plant products that could be further developed. - Increased use of tropical forest products has the potential to benefit human inhabitants of the rainforest. - However, non-timber forest products may not be a complete solution or "panacea" for rainforest conservation and development.	Not mentioned (the abstract does not contain any explicit policy recommendations made by the authors)
Budowski, G. (1993). The scope and potential of agroforestry in Central America. Agroforestry Systems, 23, 121-131.		Agroforestry practices can provide benefits in the form of produce and services to	Not mentioned (the abstract does not present any specific "main findings" or results from a study)	Not mentioned (the abstract does not contain any policy recommendations or suggestions for decision-makers)

Paper	DOI	Abstract summary	Main findings	Policy recommendations
		improve or sustain the environment.		
Porro, R., Miller, R. P., Tito, M. R., Donovan, J. A., Vivan, J. L., Trancoso, R., ... & Gonçalves, A. L. (2012). Agroforestry in the Amazon region: a pathway for balancing conservation and development. Agroforestry-The future of global land use, 391-428.		Agroforestry in the Amazon can balance conservation and development through a "multichain" approach to established and secondary markets.	- Agroforestry practices can provide a pathway to balance conservation and development in the Amazon region. - A "multichain" approach, focusing on both established and secondary markets, can help agroforestry move beyond subsistence and generate income for Amazon farmers. - Stronger policy support for agroforestry, recognizing both its economic and environmental benefits, can help combine environmental and livelihood benefits through agroforestry strategies.	1) Policymakers should give agroforestry a stronger policy identity that recognizes its ability to provide both economic benefits and ecosystem services, and use international environmental agreements as a framework to promote and disseminate agroforestry strategies. 2) Policymakers should set policies related to agroforestry as a cohesive whole, using agroforestry as a common thread to link initiatives addressing poverty, hunger, deforestation, emissions, and climate change. 3) Agroforestry can be an effective strategy to bridge gaps between different policies and link environmental opportunities with economic realities, while also enhancing the livelihoods of smallholders, traditional communities, and indigenous peoples in the Amazon region.

Paper	DOI	Abstract summary	Main findings	Policy recommendations
Fanish, S. A., & Priya, R. S. (2012). Review on benefits of agro forestry system.		Agroforestry has many potential benefits, including increased productivity, soil improvement, and environmental services, but the market potential is not directly addressed.	- Agroforestry systems can increase livelihood security and resilience to climate change. - Agroforestry is seen as a key strategy to increase forest cover in India. - Agroforestry systems have the potential to enhance productivity, improve soil fertility and conservation, regulate microclimate, sequester carbon, and produce bioenergy and biofuels.	Not mentioned (the abstract does not explicitly state any specific policy recommendations made by the authors)
Josiah, S. J., St-Pierre, R., Brott, H., & Brandle, J. (2004). Productive conservation: Diversifying farm enterprises by producing specialty woody products in agroforestry systems. Journal of Sustainable Agriculture, 23(3), 93-108.		Agroforestry systems can produce commercially valuable specialty forest products for niche markets.	- Producers in the North American Midwest and Great Plains are interested in growing alternative crops like specialty forest products for niche food, medicinal, decorative floral, and handicraft markets. - Many of these commercially valuable specialty forest products can be produced in agroforestry systems like windbreaks and buffers, providing environmental and financial benefits. - The study summarized data on the selection, production, performance, prices, and markets for small fruits and woody decorative florals in Nebraska and Saskatchewan.	Not mentioned (the abstract does not contain any policy recommendations made by the authors)
Maas, B., Thomas, E., Ocampo-Ariza, C., Vansynghel, J., Steffan-Dewenter, I., & Tscharntke, T. (2020). Transforming tropical agroforestry towards high socio-ecological standards. *Trends in Ecology & Evolution*, *35*(12), 1049-1052.		Growing demand for sustainable tropical agroforestry products like coffee and cocoa presents	- Growing demand for more sustainable tropical commodities is changing the global market for agroforestry products like coffee and cocoa. - Transforming mass production of cash crops towards	Not mentioned (the abstract does not provide any specific policy recommendations or recommendations for decision-makers)

Paper	DOI	Abstract summary	Main findings	Policy recommendations
		both challenges and opportunities.	higher socio-ecological standards includes both challenges and novel opportunities to protect ecosystem services and human well-being.	
Scherr, S. J. (1999). The economic context for agroforestry development: evidence from Central America and the Caribbean. Outlook on agriculture, 28(3), 163-170.		The economic context, including changing product and factor markets, is important for understanding the potential for agroforestry development.	- Agroforestry can provide significant economic benefits through household use or sale of tree products, positive effects on companion crops or animals, and improved environmental conditions. - Many development initiatives ignore the regional economic context for agroforestry, including the effects of changing product and factor markets on the choice of species and management practices.	Not mentioned (the abstract does not mention any policy recommendations)
Arnold, M., & Townson, J. (1998). Assessing the potential of forest product activities to contribute to rural incomes in Africa. Natural Resources perspective No. 37. ODI. Nopember 1998.		The paper discusses the potential and limitations of forest product activities to contribute to rural incomes in Africa.	- Many rural households in Africa rely on forest product activities, but much of this involvement is in low-return activities that serve as a safety net. - Expansion of forest product activities is likely to focus on a limited number of products and services with growing demand as rural and urban areas develop. - Intervention strategies should distinguish between those engaged in forest product activities out of necessity versus market opportunities, and focus on helping those in declining activities move to other more rewarding fields.	1. Differentiate interventions for those engaged in forest product activities out of necessity versus those responding to market demands. 2. Help those in declining forest product activities transition to other more promising livelihoods rather than trying to increase productivity in their current work. 3. Tailor support for sustainable forest product activities to the different stages of enterprise development. 4. Consider the declining prospects for some forest products, the growing demand

Paper	DOI	Abstract summary	Main findings	Policy recommendations
				for a limited number of commercially valuable products, and the need to maintain forests as a buffer resource during hardship when managing forest resources. 5. Avoid committing communities to institutional arrangements that they will be unable to sustain as reliance on forest products declines.
UBinam, J. N., Oduol, J., Place, F., & Kalinganire, A. (2015). Unlocking Market Potential of Agroforestry Products Among Smallholder Farmers in the Sahelian and Sudanian Ecozone Countries of West Africa. Small-scale forestry, 14, 507-529.		Agroforestry products hold great potential for income generation and poverty reduction among smallholder farmers in West Africa.	- Market participation and selling decisions by agroforestry farmers are influenced by predisposing, facilitating, and reinforcing factors. - Even in areas with poor transportation infrastructure, other interventions to strengthen value chains and market integration can lead to successful market participation by agroforestry farmers. - Improving value chains and market integration can be successful in increasing agroforestry market participation, even where transportation is costly.	Not mentioned (the abstract does not explicitly state any policy recommendations made by the authors)

Paper	DOI	Abstract summary	Main findings	Policy recommendations
Swallow, B., Boffa, J. M., & Scherr, S. J. (2006). The potential for agroforestry to contribute to the conservation and enhancement of landscape biodiversity. World agroforestry into the future. World Agroforestry Centre (ICRAF), Nairobi, 95-101.		Agroforestry can contribute to the conservation and enhancement of landscape biodiversity, but the biodiversity benefits depend on the specific agroforestry system.	- Agroforestry generally produces higher biodiversity benefits than monoculture crop production, but the biodiversity value varies across different agroforestry systems. - Agroforestry is most beneficial for biodiversity when part of an integrated land use approach, but diverse agroforestry systems may become less diverse under high population pressure. - Important knowledge gaps remain on how to design agroforestry and tree domestication to maximize positive impacts on wild biodiversity.	Not mentioned (the abstract does not contain any explicit policy recommendations or recommendations for decision-makers)
Pham, T. T., Nguyen, D. T., Đào Thi, L. C., & Hoàng, T. L. (2020). Preparing Vietnam for new rules on international market: Preparing Vietnam for new rules on international market (Vol. 257). CIFOR.		Deforestation-free production will be a requirement for the global market, and Vietnam's agroforestry industry needs to adapt to this new trend to maintain market share.	- Deforestation-free production will be a requirement of the global market from now through 2030, with over 1,000 financial institutions and 600 multinational companies pledging to produce and supply zero-deforestation agricultural products. - 92 domestic and foreign companies in Vietnam across 21 industries have committed to achieving zero deforestation by 2020. - However, Vietnamese businesses are not yet prepared to adapt their supply chains to meet these new zero-deforestation requirements, and without further support and planning, the Vietnamese agroforestry industry is at risk of losing significant market share.	1) The Vietnamese government should develop a legal framework to support and monitor companies that commit to deforestation-free production. 2) The government should build the capacity of stakeholders (e.g. businesses) to respond to the new international market requirements on deforestation-free products. 3) Vietnam needs to conduct further research and long-term planning to ensure its agroforestry industry can remain competitive and avoid major economic losses.

Paper	DOI	Abstract summary	Main findings	Policy recommendations
El Tahir, B. A., & Vishwanath, A. (2015). Market and value chain analyses of marketable natural products from agroforestry systems in Eastern Sudan. Journal of Geoscience and Environment Protection, 3(9), 57-73.	https://doi.org/10.4236/GEP.2015.39006	The study identifies gum arabic, honey, fodder, and other agroforestry products as having high market potential in Eastern Sudan.	- Eight natural products were identified as having the greatest opportunities for enterprise development, with gum Arabic being the highest ranked. - The gum Arabic value chain is dominated by a few traders who capture a disproportionately high share of the benefits, with producers receiving only 20% of the end market price. - Key constraints to the growth of the gum Arabic industry include poor land security, unfair pricing, taxes and levies, and lack of finance and skills, but opportunities exist in fair trade, organic, and environmentally sustainable markets.	Not mentioned (the abstract does not explicitly state any policy recommendations made by the authors)
Banana, A. Y. (1996). Non-timber forest products marketing: field testing of the marketing information system methodology. Domestication and commercialization of non-timber forest products, 218.		The paper discusses marketing information systems for non-timber forest products in agroforestry systems.	Not mentioned (the abstract does not contain any information about the main findings or results of the study)	Not mentioned (the abstract does not mention any policy recommendations or recommendations for decision-makers)
Nair, P. R., Nair, V. D., Kumar, B. M., & Showalter, J. M. (2010). Carbon sequestration in agroforestry systems. Advances in agronomy, 108, 237-307.	https://doi.org/10.1016/S0065-2113(10)08005-3	Agroforestry systems have high potential for carbon sequestration, but assessing and realizing this potential requires considerable effort.	- Agroforestry systems have significant potential for carbon sequestration, but this potential is not well-studied. - Agroforestry systems can reduce the need for agrochemical inputs while maintaining productivity, through mechanisms like nutrient cycling and nitrogen fixation. -	Not mentioned (the abstract does not contain any explicit policy recommendations made by the authors)

Paper	DOI	Abstract summary	Main findings	Policy recommendations
			Agroforestry systems, with their emphasis on multipurpose trees, can store more carbon than conventional forestry systems because less of the photosynthetic output is removed.	
Leakey, R. R. (2014). The role of trees in agroecology and sustainable agriculture in the tropics. Annual review of phytopathology, 52(1), 113-133.	https://doi.org/10.1146/annurev-phyto-102313-045838	Agroforestry with nitrogen-fixing trees and indigenous tree species can provide marketable products and restore degraded land.	- Diversifying with nitrogen-fixing trees and cultivating indigenous tree species can restore soil fertility, agroecosystem functions, and provide income. - Agroforestry systems with shade trees can provide habitat for wildlife that helps reduce herbivores and pathogens. - Agroforestry systems can provide productive, environmentally friendly farming that improves food security, nutrition, and poverty alleviation while also supporting wildlife.	Not mentioned (the abstract does not provide any specific policy recommendations made by the authors)
Alavalapati, J. R., & Mercer, D. E. (Eds.). (2004). Valuing agroforestry systems: methods and applications (Vol. 2). Springer Science & Business Media.		This book aims to strengthen the economics and policy dimension of the agroforestry discipline.	Not mentioned (the abstract does not mention or summarize the main findings or conclusions of the study)	Not mentioned (the abstract does not mention any specific policy recommendations made by the authors)
Supratim Mandal et al., (2024) Agroforestry: socio-economic impact and future aspect. International journal of research in agronomy		Agroforestry has significant market potential to address climate change and enhance rural livelihoods, but faces challenges in adoption.	- Agroforestry can provide food security, reduce poverty, and contribute to ecosystem conservation. - Despite its benefits, agroforestry is not widely adopted, especially by small-scale farmers in developing countries. - Comprehensive economic research and analysis are required to build	Not mentioned (the abstract does not provide any explicit policy recommendations made by the authors)

Paper	DOI	Abstract summary	Main findings	Policy recommendations
			effective agroforestry systems and maximize investments in this sector.	
Leitão, A., Rebelo, F., Pintado, M., & Ribeiro, T. B. (2022). AgroForest Biomass and Circular Bioeconomy: Case Studies. In Research Anthology on Ecosystem Conservation and Preserving Biodiversity (pp. 1052-1097). IGI Global.	DOI: 10.4018/978-1-6684-5678-1.ch052	Agroforest biomass has high market potential for bio-based products like low-carbon building materials, biotextiles, and bioplastics.	- Forest biomass was identified as an excellent raw material for low-carbon building materials, biotextiles, and bioplastics. - The potential of agro-food waste to obtain new bio-based materials was also emphasized. - It was estimated that a 5% market share of these bioproducts in the global construction, textiles, and plastics markets in 2030 corresponds to an aggregate increase in revenues of 260-579 million € per year in Portugal.	Not mentioned (the abstract does not provide any specific policy recommendations made by the authors)
Tschora, H., & Cherubini, F. (2020). Co-benefits and trade-offs of agroforestry for climate change mitigation and other sustainability goals in West Africa. Global Ecology and Conservation, 22, e00919.	Tschora, H., & Cherubini, F. (2020). Co-benefits and trade-offs of agroforestry for climate change mitigation and other sustainability goals in West Africa. *Global Ecology and Conservation*, *22*, e00919.	Agroforestry in West Africa offers multiple benefits including climate change mitigation, biodiversity conservation, and rural development, but there is a trade-off between high carbon stocks and crop yields.	- Agroforestry systems in West Africa show synergies between rural development and adaptation benefits, but a trade-off between high carbon stocks and crop yields. - Large-scale agroforestry deployment in West Africa could sequester up to 135 Mt CO2/year, offsetting 166% of the region's emissions from fossil fuels and deforestation. - Agroforestry provides local farmers with additional diversified income from tree co-products.	Not mentioned (the abstract does not explicitly state any specific policy recommendations made by the authors)

Paper	DOI	Abstract summary	Main findings	Policy recommendations
Nair, P. K. R. (1991). State-of-the-art of agroforestry systems. Forest Ecology and Management, 45(1-4), 5-29.	https://doi.org/10.1016/0378-1127(91)90203-8	The paper provides an overview of agroforestry systems and their potential, but does not specifically address market potential for agroforestry products.	- The adoption of agroforestry systems is primarily driven by the ecological potential of the area, but the complexity and intensity of the system is determined by socioeconomic factors. - While there are some common agroforestry approaches across regions, the specific components of the systems will vary based on site-specific factors, and certain approaches are more appropriate for specific ecological conditions. - There has been a lack of scientific effort to improve the productivity of indigenous agroforestry systems, and their full potential remains largely unexplored.	Not mentioned (the abstract does not contain any explicit policy recommendations or recommendations for decision-makers)
Kiptot, E., & Franzel, S. (2012). Gender and agroforestry in Africa: a review of women's participation. Agroforestry systems, 84, 35-58.	https://doi.org/10.1007/s10457-011-9419-y	Agroforestry has potential benefits for women in Africa, but their participation is limited compared to men, especially in more commercially valuable enterprises.	- Agroforestry has the potential to benefit women, but their participation is lower in more commercially valuable activities and higher in activities with less commercial value. - Women's participation in certain agroforestry practices is high in terms of the number of female-headed households involved, but their level of involvement is lower compared to men. - Women's participation in agroforestry marketing is limited to the lower-value end of the value chain, which reduces their control and returns.	1) Facilitate women to form and strengthen associations 2) Assist women to improve productivity and marketing of products in women's domain 3) Improve women's access to information by training more women extension staff, holding separate meetings for women farmers, and ensuring women are fully represented

Paper	DOI	Abstract summary	Main findings	Policy recommendations
Denning, G. L. (2001). Realising the potential of agroforestry: integrating research and development to achieve greater impact. Development in practice, 11(4), 407-416.	DOI: 10.1080/09614520120066693	Agroforestry has the potential to address land degradation, poverty, and food insecurity, but the paper does not specifically discuss market potential.	- Agroforestry research has led to sustainable solutions to address land degradation, poverty, and food insecurity in rural areas. - Agroforestry innovations have been widely adopted by thousands of farmers in diverse regions, demonstrating the potential of agroforestry. - The paper outlines a development strategy with 8 key elements to scale up the impact of agroforestry and provide better livelihoods for 80 million rural poor people by 2010.	Not mentioned (the abstract does not provide any explicit policy recommendations)
Castle, S. E., Miller, D. C., Ordonez, P. J., Baylis, K., & Hughes, K. (2021). The impacts of agroforestry interventions on agricultural productivity, ecosystem services, and human well-being in low-and middle-income countries: A systematic review. *Campbell Systematic Reviews*, *17*(2), e1167.	https://doi.org/10.1002/CL2.173	The review found limited evidence on the impacts of agroforestry interventions on agricultural productivity, ecosystem services, and human well-being in low- and middle-income countries.	- The overall quality of the evidence on the impacts of agroforestry interventions was low, with many studies having high or critical risk of bias. - Agroforestry interventions may lead to a large, positive impact on crop yields, but with high heterogeneity in the results. - Agroforestry interventions may lead to a small, positive impact on income, with moderately high heterogeneity in the results.	1) Invest in agroforestry programs that include pilot testing, funding for evaluation, and target equity issues like reaching smallholder farmers, women, the poor, and marginalized groups. 2) Provide funding for more rigorous impact evaluations of agroforestry interventions, including randomized controlled trials and quasi-experimental studies over longer time periods, to build a stronger evidence base on the effectiveness of different agroforestry promotion schemes.

Paper	DOI	Abstract summary	Main findings	Policy recommendations
Leakey, R. R., Weber, J. C., Page, T., Cornelius, J. P., Akinnifesi, F. K., Roshetko, J. M., ... & Jamnadass, R. (2012). Tree domestication in agroforestry: progress in the second decade (2003–2012). Agroforestry-the future of global land use, 145-173.	https://doi.org/10.1007/978-94-007-4676-3_11	The paper reviews progress in agroforestry tree domestication, including research on genetic variation, product commercialization, and impact on smallholder farmers, but does not directly address market potential.	- The research on agroforestry tree domestication expanded geographically from West Africa to other regions in the second decade, including Latin America, Asia, and Oceania. - The research focus shifted from assessing species potential and developing germplasm production techniques in the first decade to a broader agenda in the second decade, including genetic characterization, product commercialization, and addressing farmers' rights. - The research also involved the use of laboratory techniques to analyze the chemical and physical properties of marketable products derived from the agroforestry trees.	Not mentioned (the abstract does not mention any specific policy recommendations made by the authors)
Maduka, S. M. (2007). Role of agroforestry products in household income and poverty reduction in semi-arid areas of Misungwi district, Mwanza, Tanzania (Doctoral dissertation, Sokoine University of Agriculture (SUA)).		Agroforestry products contribute little to household incomes in the study area due to small tree plantings and low selling prices.	- Households engaged in agroforestry practices had significantly higher annual incomes compared to non-agroforestry households, with an extra income of 760 US$ per year. - The main agroforestry products that contributed to household incomes were poles, fuelwood, timber, and thatch grasses. - Agriculture was the dominant income source, contributing around 51% of total annual household incomes for both agroforestry and non-agroforestry households, while agroforestry	Not mentioned (the abstract does not provide any explicit policy recommendations made by the authors)

Paper	DOI	Abstract summary	Main findings	Policy recommendations
			products contributed only 5.5% to total annual household incomes.	
Wilson, M. H., & Lovell, S. T. (2016). Agroforestry—The next step in sustainable and resilient agriculture. Sustainability, 8(6), 574.	https://doi.org/10.3390/su8060574	Agroforestry has the potential to contribute to food security while limiting environmental degradation.	- Agroforestry has the potential to remain productive while supporting a range of ecosystem services. - Agroforestry systems that mimic natural ecosystems can support productivity and ecosystem services. - Agroforestry is one of the best land use strategies to achieve food security while limiting environmental degradation.	Not mentioned (the abstract does not mention any specific policy recommendations made by the authors)
Jose, S. (2009). *Agroforestry for ecosystem services and environmental benefits: an overview* (pp. 1-10). Springer, Dordrecht.		This paper provides an overview of the ecosystem services and environmental benefits of agroforestry, but does not directly address market potential.	- Agroforestry can provide ecosystem services and environmental benefits through the contribution of trees to soil carbon sequestration. - Agroforestry practices, such as shade trees, can impact soil properties and ecosystem services in coffee plantations.	Not mentioned (the abstract does not contain any explicit policy recommendations)

Paper	DOI	Abstract summary	Main findings	Policy recommendations
Nair, P. R. (2007). The coming of age of agroforestry. Journal of the Science of Food and Agriculture, 87(9), 1613-1619.	https://doi.org/10.1002/jsfa.2897	Agroforestry offers social and environmental benefits as a sustainable alternative to monoculture production, but the market potential is not directly addressed.	- Agroforestry, which combines trees and crops, can improve food and nutritional security and mitigate environmental degradation compared to monoculture systems. - Agroforestry can provide a range of social and environmental benefits across different landscapes and economies through its complementary and flexible approach. - As the benefits of agroforestry are recognized, modern land use systems are evolving towards more sustainable and holistic approaches to land management.	Not mentioned (the abstract does not mention any policy recommendations made by the authors)
Mankhin, B., Khan, M. A., Begum, M. E. A., & Hossain, M. I. (2023). Market attractiveness of pineapple and banana agroforestry systems of Madhupur Sal (Shorea robusta) forest: A sustainable way of generating income and conserving forests. Journal of Agriculture and Food Research, 11, 100475.	https://doi.org/10.1016/j.jafr.2022.100475	Pineapple and banana agroforestry systems in Madhupur Sal forest have high market potential for generating income and conserving forests.	- The study participants were young, educated, and had significant farming experience. - Participants valued building trust with buyers but felt their marketing communication was lacking. - Pineapple and banana were the leading crops cultivated in the agroforestry system, with pineapple being more favored due to its greater market potential.	1. Remove barriers that limit pineapple and banana production and marketing 2. Establish better communication between buyers and farmers to sustain production

Paper	DOI	Abstract summary	Main findings	Policy recommendations
Facheux, C., Tchoundjeu, Z., Foundjem-Tita, D., Degrande, A., & Mbosso, C. (2007). Optimizing the production and marketing of NTFPs.		Agroforestry products like njansang have significant market potential, but farmers in West and Central Africa struggle to achieve good returns due to various challenges.	- Household income from marketing agroforestry tree products can be significantly increased using a sub-sector approach combined with improved post-harvest technologies and on-farm production methods. - Farmers involved in producing njansang (an agroforestry tree product) saw a 31% increase in selling price and over 80% increase in revenue. - The approach used in this study can be scaled up to other locations and products, as it is a flexible, step-wise procedure that can adapt to new needs and opportunities.	While the abstract does not explicitly state any policy recommendations, it can be inferred that the authors believe policymakers should support the development and scaling up of innovative programs and approaches that help smallholder farmers in West and Central Africa develop their marketing skills, knowledge, and on-farm production of agroforestry products.
Leakey, R. R. (1999). Agroforestry for biodiversity in farming systems. CRC Publishers.		Agroforestry can diversify and intensify farming systems through integration of trees producing marketable products, but the market potential is not directly addressed.	- Agroforestry can diversify and intensify farming systems by integrating indigenous trees that provide marketable timber and non-timber products. - Complex agroforestry systems that balance profitability and biodiversity are presented as a model worthy of expansion. - Domesticating indigenous trees in a way that preserves their genetic diversity can benefit both production and the environment.	Not mentioned (the abstract does not mention any specific policy recommendations made by the authors)

Paper	DOI	Abstract summary	Main findings	Policy recommendations
Beer, J., Harvey, C. A., Ibrahim, M. A., Somarriba, E., Harmand, J. M., & Jiménez Otárola, F. (2003). Service functions of agroforestry systems. In *12. World Forestry Congress. Quebec, Canadá, 2003, páginas 417-424*.	http://orcid.org/0000-0002-2639-0583	Agroforestry systems provide valuable environmental services, but their market potential is limited by lack of economic analyses that include valuation of these services.	- Agroforestry systems provide important environmental service functions, including maintenance of soil fertility, water conservation, carbon capture, and biodiversity conservation. - These service functions complement the products that agroforestry systems provide, but farmers are rarely rewarded for them. - More research is needed on potential trade-offs between the different service functions and the negative effects on traditional products/uses of agroforestry systems when the tree component is increased.	Not mentioned (the abstract does not provide any explicit policy recommendations made by the authors)
Miller, D. C., Ordoñez, P. J., Brown, S. E., Forrest, S., Nava, N. J., Hughes, K., & Baylis, K. (2020). The impacts of agroforestry on agricultural productivity, ecosystem services, and human well-being in low-and middle-income countries: An evidence and gap map. Campbell Systematic Reviews, 16(1).	https://doi.org/10.1002/cl2.1066	The paper reviews evidence on the impacts of agroforestry on agricultural productivity, ecosystem services, and human well-being in low- and middle-income countries, but does not directly address market potential.	- Agroforestry has been found to impact agricultural productivity, ecosystem services, and human well-being in low- and middle-income countries. - The existing evidence on these impacts has been systematically mapped and summarized in this "evidence and gap map" (EGM). - The EGM includes studies that compared agroforestry and non-agroforestry farms/farmers across at least one of the three impact domains.	Not mentioned (the abstract does not mention any specific policy recommendations made by the authors)

Paper	DOI	Abstract summary	Main findings	Policy recommendations
Kang, B. T., & Akinnifesi, F. K. (2000, May). Agroforestry as alternative land-use production systems for the tropics. In *Natural Resources Forum* (Vol. 24, No. 2, pp. 137-151). Oxford, UK: Blackwell Publishing Ltd.	https://doi.org/10.1111/j.1477-8947.2000.tb00938.x	Agroforestry systems have potential for improving productivity, income, and ecosystem conservation, but practical application is still limited.	- The presence of woody species in agroforestry systems can enhance nutrient cycling, soil productivity, soil conservation, and soil biotic and faunal activities. - The presence of woody species can also cause competition with associated food crops in some agroforestry systems. - Many agroforestry systems are ecologically and economically sustainable, especially the more complex and specialized types.	Not mentioned (the abstract does not provide any explicit policy recommendations made by the authors)
Jose, S., Gold, M. A., & Garrett, H. E. (2012). The future of temperate agroforestry in the United States. Agroforestry-the future of global land use, 217-245.	https://doi.org/10.1007/978-94-007-4676-3_14	Agroforestry offers great promise for diversifying farm income and providing environmental benefits, with potential for increased adoption in the future.	- Agroforestry has a long history in the US, but only recently gained more scientific attention and research over the past decade. - The scientific evidence supporting agroforestry has elevated its role as an integral part of sustainable, multifunctional agricultural landscapes in the US. - The need for farm diversification and the recognition of agroforestry's economic and environmental benefits have increased receptivity and adoption among some landowners.	Not mentioned (the abstract does not contain any specific policy recommendations made by the authors)

Paper	DOI	Abstract summary	Main findings	Policy recommendations
Njiei, A. F. Constraints in Marketing of Agroforestry Products in the South West Region of Cameroon: The Case of Manyu Division.		Agroforestry products in Cameroon have market potential, but face constraints in production and marketing that need to be addressed through government and stakeholder support.	- Providing an enabling environment and incentives/motivations from the government and other stakeholders is necessary for agroforestry products to play a significant role in poverty alleviation. - Addressing production and marketing problems faced by actors in the agroforestry value chain will require the enabling environment and incentives/motivations mentioned above.	1) The government and other stakeholders should provide an "enabling environment" and "packages of incentives and motivations" to support the marketing of agroforestry products, in order to alleviate poverty. 2) This government and stakeholder support is needed to significantly minimize the production and marketing problems encountered by actors in the agroforestry value chain.
A sustainable agricultural landscape for Australia: A review of interlacing carbon sequestration, biodiversity and salinity management in agroforestry systems		Agroforestry can provide ecosystem services like carbon sequestration, biodiversity restoration, and watershed management, but market potential is limited by lack of predictive metrics and regulatory environment.	- Agroforestry systems can provide multiple ecosystem services, including carbon sequestration, biodiversity restoration, and watershed management, while still maintaining food production. - The development of active markets for ecosystem services is hindered by a lack of predictive metrics and the regulatory environment. - There is a clear opportunity to develop a new, sustainable agricultural landscape that addresses the issues of food and fiber production, salinization, biodiversity decline, and climate change mitigation.	Not mentioned (the abstract does not provide any specific policy recommendations made by the authors)

Paper	DOI	Abstract summary	Main findings	Policy recommendations
Anwar, F., Jamil, M., Fahad, S., & Khan, A. (2017). Role of agroforestry in wood production and farmer's perception in Pakistan: a review. Am-Eurasian J Agric Environ Sci, 17(4), 300-306.	DOI: 10.5829/idosi.aejaes.2017.51.57	Agroforestry can increase wood production and farmer earnings in Pakistan without endangering the ecosystem.	- Agroforestry can provide social, economic, and environmental benefits for small-scale farmers in Pakistan. - Agroforestry can help meet the increasing demand for forestry products and services while balancing with other sectors like agriculture. - Agroforestry is a potential solution to the challenge of meeting growing demands for forestry products and services from a limited land base.	Not mentioned (the abstract does not contain any explicit policy recommendations made by the authors)
Kusters, K., & Belcher, B. (Eds.). (2004). Forest products, livelihoods and conservation: Case studies of non-timber forest product systems. Volume 1-Asia. CIFOR.		Establishing or strengthening markets for non-timber forest products can contribute to rural livelihoods and conservation, but challenges around political economy and agricultural production must be addressed.	- The case studies reveal an ancient system of NTFP resources that enable economic benefits for local African communities through marketing and trade. - Establishing or strengthening NTFP markets can encourage renewable resource conservation and contribute significantly to rural livelihoods. - Ensuring the environmental sustainability of NTFP extraction, similar to other economic activities, is a key challenge that must be resolved. - Efforts to increase NTFP market values and rural incomes could be self-defeating if they lead to the agricultural production of these formerly wild-harvested products.	Not mentioned (the abstract does not provide any specific policy recommendations made by the authors)

Paper	DOI	Abstract summary	Main findings	Policy recommendations
Kaur, D.K. (2022). Policy issues in agroforestry including market mechanisms, forward and backward linkages, regional availability, transit of forest produce, linkages with NDC targets, choice of species and utilization aspects. Indian Forester.	DOI:10.36808/if/2022/v148i11/169645	The paper discusses various policy issues relevant to the market potential of agroforestry products.	Not mentioned (the abstract does not contain any information about the main findings or results of the study)	Not mentioned (the abstract does not provide any specific policy recommendations or suggestions for policymakers)
Omont Hubert, Nicolas Dominique, Russel Diane. 2006. The future of perennial tree crops : What role for agroforestry?. In : World agroforestry into the future. Garrity Dennis P. (ed.), Okono Antonia (ed.), Grayson Michelle (ed.), Parrott Sue (ed.). ICRAF. Nairobi : World Agroforestry Centre, pp. 23-35. ISBN 92-9059-184-6		Agroforestry systems have potential to diversify and increase the quality of perennial tree crop products to ensure more stable incomes for smallholder producers.	- Perennial tree crops play a fundamental role in the economies of many developing countries, and can help alleviate poverty. - Global demand for tree products like chocolate, coffee, and rubber continues to grow. - Perennial tree crops face challenges such as price instability, industrial concentration, lack of government support, and weak research efforts. - Producers need to focus on diversifying and improving product quality to ensure more stable incomes.	Not mentioned (the abstract does not provide any specific policy recommendations made by the authors)
David Nicholls, J. W. 'Jerry' Van Sambeek, Jegatheswaran Ratnasingam, Tatjana Stevanovic, Michael A. Gold. 2021. Instant Insights: Developing forestry products. https://www.google.co.id/search?tbo=p&tbm=bks&q=bibliogroup:%22Burleigh+Dodds+Science:+Instant+Insights+Series%22&source=gbs_metadata_r&cad=1		This collection reviews the market potential of various forestry and agroforestry products, including timber, non-timber forest products, and nut crops.	- The first review examines the balance between timber production and ecosystem services, and explores innovative forestry products and practices. - The second review focuses on managing hardwood trees in agroforestry systems to produce high-value timber products like veneer and sawlogs, and explores ways to optimize production in different agroforestry practices. - The third review examines the diversity of non-timber forest products from tropical forests,	Not mentioned (the abstract does not contain any explicit policy recommendations made by the authors)

Paper	DOI	Abstract summary	Main findings	Policy recommendations
			including non-wood fibers that can substitute for traditional wood fibers in various applications.	
Lehmann, L. M., Smith, J., Westaway, S., Pisanelli, A., Russo, G., Borek, R., ... & Ghaley, B. B. (2020). Productivity and economic evaluation of agroforestry systems for sustainable production of food and non-food products. Sustainability, 12(13), 5429.	https://doi.org/10.3390/su12135429	Agroforestry systems are more productive and economically viable compared to monocultures, providing a range of food and non-food products.	- Agroforestry systems were 36-100% more productive than monocultures, depending on factors like crop types, arrangement, management, and environmental conditions. - The economic viability of agroforestry systems varied, with the UK system having a much higher gross margin than the Danish system, and the crop components generally performing better economically than the tree components. - The study calls for a holistic assessment of agroforestry systems that considers both marketable and non-marketable benefits, in order to justify providing subsidies to farmers to adopt these systems.	Not mentioned (the authors do not provide explicit policy recommendations in the paper)

Paper	DOI	Abstract summary	Main findings	Policy recommendations
Stanton, B., Eaton, J., Johnson, J., Rice, D., Schuette, B., & Moser, B. (2002). Hybrid poplar in the Pacific Northwest: the effects of market-driven management. Journal of Forestry, 100(4), 28-33.	https://doi.org/10.1093/jof/100.4.28	Hybrid poplar has potential market applications beyond paper production, including wastewater treatment, nutrient removal, and carbon sequestration.	- Hybrid poplar is a relatively new crop in the Pacific Northwest, with over 50,000 acres currently in production. - The primary use of hybrid poplar has shifted from energy production to the paper industry, and there are now efforts to manage it for the solid wood market due to declining wood chip prices. - Hybrid poplar has additional uses beyond the paper and solid wood industries, such as in wastewater treatment, nutrient removal, and phytoremediation, and its potential for carbon sequestration may lead to future applications in carbon credit markets.	Not mentioned (the abstract does not contain any policy recommendations or suggestions for decision-makers)
Kumar, B. M., & Nair, P. R. (Eds.). (2011). Carbon sequestration potential of agroforestry systems: opportunities and challenges. Springer. London.		The paper discusses the carbon sequestration potential of agroforestry systems, but does not directly address the market potential for agroforestry products.	- The potential for agroforestry to sequester carbon has been discussed, but there is a lack of empirical evidence to support these claims. - The research aims to investigate the carbon sequestration potential of agroforestry practices, particularly in comparison to tree-less land-use systems. - If agroforestry is shown to have significant carbon sequestration potential, landowners could potentially sell the sequestered carbon on the carbon credit market.	Not mentioned (the abstract does not contain any policy recommendations made by the authors)

Paper	DOI	Abstract summary	Main findings	Policy recommendations
Raihan, A. (2023). A review of agroforestry as a sustainable and resilient agriculture. Journal of Agriculture Sustainability and Environment, 2(1), 49-72.	https://doi.org/10.56556/jase.v2i1.799	Agroforestry, the integration of trees/shrubs with crops/livestock, is a promising sustainable agriculture approach that can address food security and environmental concerns.	- Agroforestry has the potential to provide numerous environmental and agricultural benefits, including mitigating nutrient and pesticide runoff, sequestering carbon, enhancing soil quality, controlling erosion, improving wildlife habitat, reducing fossil fuel consumption, and promoting resilience in agriculture. - Agroforestry can help address some of the limitations of organic agriculture, such as soil erosion, greenhouse gas emissions, and nutrient leaching. - Agroforestry practices have been shown to improve water quality by reducing non-point source pollution and enhance soil organic matter, which can boost crop productivity and drought resilience.	1. Provide more financial support and incentives to farmers, such as cost-sharing initiatives and credits for ecosystem services, to facilitate the adoption of agroforestry practices. 2. Modify existing conservation programs to allow for the non-destructive harvesting of consumable products from agroforestry systems, as this could incentivize more farmers to embrace these practices. 3. Allocate greater attention and resources to agroforestry practices, as they have the potential to mitigate the adverse impacts associated with conventional monoculture cropping systems.
Njurumana, G. N., & Octavia, D. (2020). Conservation species of NTFPS through agroforestry for community livelihoods in Sikka, East Nusa Tenggara. Journal of Sylva Indonesiana, 3(01), 1-16.	https://doi.org/10.32734/jsi.v3i01.1984	Agroforestry can help conserve and develop non-timber forest products (NTFPs) to improve community livelihoods in Sikka, East Nusa Tenggara.	- The major NTFP commodities in Sikka district are tamarind, candlenut, areca nut, and betel. - The socio-economic conditions of NTFP farmers are not yet prosperous and are highly dependent on the sustainability of NTFP production. - Community initiatives to conserve and regenerate NTFPs through agroforestry need to be improved, especially in improving the rate of plant growth, and technical assistance is still needed to	Not mentioned (the abstract does not provide any explicit policy recommendations made by the authors)

Paper	DOI	Abstract summary	Main findings	Policy recommendations
			increase the community's capacity for NTFP conservation and development.	
Chavan, S. B., Keerthika, A., Dhyani, S. K., Handa, A. K., Newaj, R., & Rajarajan, K. (2015). National Agroforestry Policy in India: a low hanging fruit. Current Science, 1826-1834.	DOI:10.18520/CS/V108/I10/1826-1834	The National Agroforestry Policy in India aims to address issues around marketing of agroforestry products to support wider adoption.	- Agroforestry has been a traditional and beneficial land-use system in India with the potential to improve farmer livelihoods. - Commercial agroforestry has been successful in some regions, but its wider adoption has been hindered by lack of policy support and trade regulations. - While agroforestry models are being developed, there are still challenges in the supply chain from seed to market.	- Improving access to quality planting material - Providing tree insurance - Reducing restrictions on transit and harvesting of agroforestry products - Supporting research and extension on agroforestry - Connecting agroforestry policy to existing successful programs and addressing challenges to fully realize the economic potential of agroforestry in India
Cook, C.C. (1992). Agroforestry in sub-Saharan Africa : a farmer's perspective. Canadian Journal of African Studies, 26, 1.	DOI:10.2307/485880	Agroforestry offers potential for improving agricultural productivity in Africa, but the market potential and economic viability need to be considered.	- Agroforestry offers promising options for reversing soil degradation, restoring tree cover, and improving agricultural productivity in sub-Saharan Africa. - Project evaluation should consider local markets, off-farm employment opportunities, and farmers' perceived opportunity costs in adoption decisions. - Agroforestry project design should be adapted to the socioeconomic level, age, and gender of the target farming households.	Not mentioned (the abstract does not provide any specific policy recommendations made by the authors)

Paper	DOI	Abstract summary	Main findings	Policy recommendations
Ahmed, S., Stepp, J.R., Toleno, R., & Peters, C.M. (2010). Increased Market Integration, Value, and Ecological Knowledge of Tea Agroforests in the Akha Highlands of Southwest China. Ecology and Society, 15, 27.	DOI:10.5751/ES-03728-15042	Increased market integration of tea agroforests in an Akha community led to reconfiguration of land use, intensified management, and generation of knowledge on tea resources.	- Increased market integration of tea agroforests has led to changes in land use, management, labor structures, and knowledge about tea resources for the Akha community. - The Akha community has adapted to the tea market boom by leveraging their traditional resources and networks, while resisting government efforts to shift them towards more intensive tea cultivation. - The Akha community has been able to benefit financially from the tea market boom by selling their tea through niche market networks, which has allowed them to command higher prices compared to other communities.	Not mentioned (the abstract does not explicitly state any specific policy recommendations made by the authors)
Advancing agroforestry on the policy agenda – a guide for decision-makers,by Ge´rard Buttoud, in collaboration with O. Ajayi, G. Detlefsen, F. Place and E. Torquebiau,Coordinated and supervised by Michelle Gauthier, Agroforestry Working Paper No. 1,FAO, Rome, 37 pp. Available at: http://www.fao.org/docrep/017/i3182e/i3182e00.pd	https://doi.org/10.1080/14728028.2013.806162	Agroforestry has significant social, economic and environmental benefits, but is still considered a peripheral agricultural activity.	Not mentioned (the abstract does not present any specific research findings or conclusions, so there are no "main findings" to summarize)	Not mentioned (the abstract does not mention any policy recommendations or guidance for decision-makers)

Paper	DOI	Abstract summary	Main findings	Policy recommendations
Montagnini, F. (2017). Introduction: Challenges for Agroforestry in the New Millennium. In: Montagnini, F. (eds) Integrating Landscapes: Agroforestry for Biodiversity Conservation and Food Sovereignty. Advances in Agroforestry, vol 12. Springer, Cham. https://doi.org/10.1007/978-3-319-69371-2_1	DOI: 10.1007/978-3-319-69371-2_1	Agroforestry systems have potential for rural development, but face challenges related to markets for agroforestry products.	Not mentioned (the abstract does not present any specific "main findings" or results from a study)	Not mentioned (the abstract does not contain any explicit policy recommendations made by the authors)
Dagar, J. C. (2020). Agroforestry: Four decades of research development. Indian Journal of Agroforestry, 18(2). https://epubs.icar.org.in/index.php/IJA/article/view/103187		Agroforestry has significant potential to address global challenges like food security, climate change, and ecosystem rehabilitation.	- Agroforestry has a long history, with many traditional practices still being used. - Agroforestry techniques can be used to rehabilitate and make productive various types of degraded lands. - The field of agroforestry is evolving and expanding, with new concepts and applications emerging.	Not mentioned (the abstract does not contain any explicit policy recommendations or recommendations for decision-makers)
Victor Rolo. 2022. Agroforestry and Sustainable Agricultural Production. http://www.mdpi.com/journal/sustainability. ISBN978-3-0365-5577-5	https://doi.org/10.3390/books978-3-0365-5578-2	Agroforestry has the potential to maximize agricultural production while minimizing environmental impacts.	- Agroforestry has the potential to maximize agricultural production while minimizing negative environmental impacts. - The book reviews a variety of agroforestry systems from different regions and research approaches. - Agroforestry is a promising approach for creating multifunctional landscapes that can address contemporary environmental challenges.	Not mentioned (the abstract does not mention any specific policy recommendations made by the authors)

Paper	DOI	Abstract summary	Main findings	Policy recommendations
Leakey, R.R. (2007). Domesticating and marketing novel crops. Agricultural and Food Sciences, Environmental Science		Domesticating and marketing novel agroforestry crops can create income-generating opportunities for poor farmers.	- The chapter examines the importance of perennial plants, especially trees and shrubs, for agricultural sustainability and ecosystems. - The chapter discusses new developments in agroforestry that focus on the income-generating potential of domesticating indigenous tree species that produce marketable products. - The chapter concludes that the income-generating potential of domesticated indigenous trees can provide an incentive for poor farmers to plant a variety of tree species and reestablish functional agroecosystems based on perennial vegetation.	Not mentioned (the abstract does not mention any specific policy recommendations or suggestions for decision-makers)
Putra, M. U., Rujehan, R., Sardjono, M. A., Matius, P., & Ahyauddin, A. (2020). Potensi agroforestri di Desa Mara Satu Kabupaten Bulungan Provinsi Kalimantan Utara. *Agrifor: Jurnal Ilmu Pertanian dan Kehutanan*, *19*(1), 59-70.	https://doi.org/10.31293/af.v19i1.4572	The paper examines the market potential of agroforestry products in Mara Satu Village, Bulungan Regency, North Kalimantan Province.	- The total volume (potential) of agroforestry plants in Mara Satu village is 797.18 m3, with the largest volume being from durian (Durio zibethinus) plants at 270.34 m3. - The potential of medicinal plants in Mara Satu village has a total economic value of Rp. 177,099,000 per year, with the largest potential being from red ginger (Zingiber officinale Linn. var. rubrum) at Rp. 81,600,000 per year. - The total economic value of agroforestry plant products from 37 farmer respondents in Mara	Not mentioned (the abstract does not contain any explicit policy recommendations or suggestions for decision-makers)

Paper	DOI	Abstract summary	Main findings	Policy recommendations
			Satu village is Rp. 3,385,889,000 per year.	
Meine van Noordwijk, James M. Roshetko, Murniati, Marian Delos Angeles, Suyanto, Chip Fay and Thomas P. Tomich. 2003. Agroforestry is a Form of Sustainable Forest Management: Lessons from South East Asia. Ensuring SFM Session. World Agroforestry.		Agroforestry provides productive and protective forest functions, but faces challenges in accessing markets and receiving rewards for environmental services compared to large-scale plantations.	- Agroforestry, which involves planting trees, provides important forest functions that are valuable for sustainable forest management, even though these trees are often excluded from formal definitions and statistics. - A paradigm shift is needed in the forestry sector and public debate to recognize agroforestry as a form of sustainable forest management. - The relationship between agroforestry and plantation forestry depends on policy frameworks and whether they provide equal support and incentives for the different forest functions they provide.	Not mentioned (the abstract does not contain any explicit policy recommendations from the authors)
Moreno, G., Aviron, S., Berg, S., Crous-Duran, J., Franca, A., Jalón, S.G., Hartel, T., Mirck, J., Pantera, A., Palma, J.H., Paulo, J.A., Re, G.A., Sanna, F., Thenail, C., Varga, A., Viaud, V., & Burgess, P.J. (2018). Agroforestry systems of high nature and cultural value in Europe: provision of commercial goods and other ecosystem services. Agroforestry Systems, 92, 877-891.	https://doi.org/10.1007/s10457-017-0126-1	HNCV agroforestry systems in Europe provide a range of commercial goods and ecosystem services, but translating their positive impacts into market prices	- HNCV agroforestry systems in Europe generally enhance biodiversity and regulating ecosystem services compared to conventional agriculture and forestry. - These systems can reduce fire risk, increase carbon sequestration, moderate the microclimate, and reduce soil	Not mentioned (the abstract does not explicitly state any specific policy recommendations made by the authors)

Paper	DOI	Abstract summary	Main findings	Policy recommendations
		remains a challenge.	erosion and nutrient leaching compared to conventional agriculture. - Many HNCV agroforestry systems continue to provide multiple commercial goods, including woody and non-woody plant products as well as high-quality livestock and game, despite some traditional practices and products being abandoned.	
Agroforestry Benefits and ChallenSollen-Norrlin, M., Ghaley, B.B., & Rintoul, N.L. (2020). Agroforestry Benefits and Challenges for Adoption in Europe and Beyond. Sustainability Journal.	https://doi.org/10.3390/su12177001	Agroforestry systems offer benefits but face challenges for adoption due to high costs, lack of incentives, limited marketing, and need for education.	- Agroforestry systems can improve agronomic productivity, carbon sequestration, nutrient cycling, soil biodiversity, water retention, and pollination compared to conventional monoculture systems. - Agroforestry systems can reduce soil erosion and fire risk. - Agroforestry systems can provide recreational and cultural benefits.	Not mentioned (the authors do not provide explicit "policy recommendations" in the paper)
Rahamn, Ajijur et al., 2017. Finding alternatives to swidden agriculture: does agroforestry improve livelihood options and reduce pressure on existing forest? Agroforest Syst (2017) 91: 185-199	https://link.springer.com/article/10.1007/s10457-016-9912-4	Agroforestry systems have higher economic potential than swidden cultivation, but face barriers to widespread adoption.	- Agroforestry systems have higher economic viability than swidden cultivation systems. - Agroforestry provides social and cultural benefits beyond just economic ones. - Agroforestry may contribute positively to the conservation of local forests by reducing deforestation and forest degradation.	Not mentioned (the abstract does not explicitly state any specific policy recommendations made by the authors)

Paper	DOI	Abstract summary	Main findings	Policy recommendations
Mutuku Kinyili, B. (2022). Potential of Agroforestry in Sustainable Fuelwood Supply in Kenya. Journal of Energy and Natural Resources.		Agroforestry has potential to provide sustainable fuelwood supply in Kenya, but faces constraints like lack of policy, planting material, and land tenure issues.	- Adopting agroforestry, where trees are planted on farms, can help address the fuelwood problem in Kenya by reducing the need to harvest from forests. - Key constraints to the adoption of agroforestry include lack of suitable policies, unavailability of planting materials, inadequate research and extension services, long gestation time, access to credit, and land tenure issues. - To expand agroforestry adoption, a comprehensive approach is needed to promote multi-purpose agroforestry systems tailored to local farming practices and land availability.	Not mentioned (the abstract does not explicitly state any specific policy recommendations made by the authors)
Current, D., Lutz, E., & Scherr, S. J. (1995). The costs and benefits of agroforestry to farmers. *The World Bank Research Observer*, *10*(2), 151-180.	https://doi.org/10.1093/wbro/10.2.151	Agroforestry practices are generally profitable for farmers, providing an incentive for adoption to address deforestation and environmental degradation.	- Many agroforestry practices were found to be profitable for farmers under a broad range of conditions, incentivizing their adoption. - Successful agroforestry projects involved working closely with local communities and offering a variety of agroforestry options to choose from. - Demonstration plots, paratechnicians, and applied research were effective and low-cost means of transferring agroforestry technologies and identifying suitable practices for the local region.	Not mentioned (the abstract does not explicitly state any policy recommendations made by the authors)

Paper	DOI	Abstract summary	Main findings	Policy recommendations
Boffa, J. M. (2000). West African agroforestry parklands: keys to conservation and sustainable management.		Agroforestry parklands in West Africa provide a variety of products with market potential, including gum arabic and shea nuts.	- Agroforestry parklands are a traditional land use system in West Africa where farmers deliberately maintain trees in their cultivated and fallowed fields. - The trees in agroforestry parklands provide important food, medicinal, and nutritional products for local populations. - Agroforestry parklands are a major source of wood and non-wood products that provide significant household income and are important for local economies.	Not mentioned (the abstract does not contain any explicit policy recommendations or suggestions for decision-makers)
Cvjetković, B. (2023). Agroforestry-Current situation and potentials. *ОДРЖИВИ РАЗВОЈ И УПРАВЉАЊЕ ПРИРОДНИМ РЕСУРСИМА РЕПУБЛИКЕ СРПСКЕ*, *7*(7).	https://doi.org/10.7251/EORU2307339C	Agroforestry has huge economic, ecological and social potential, but its market potential is not fully utilized due to lack of knowledge and undefined laws.	- Agroforestry represents a complex multidimensional plant system with significant economic, ecological, and social potential. - Republika Srpska has both traditional and modern agroforestry systems. - The potential for agroforestry in Republika Srpska is not being fully utilized due to a lack of knowledge and undefined laws.	Not mentioned (the abstract does not provide any explicit policy recommendations made by the authors)

Paper	DOI	Abstract summary	Main findings	Policy recommendations
Sereke, F. (2012). *Transdisciplinary development of agroforestry systems* (Doctoral dissertation, ETH Zurich).	https://doi.org/10.3929/ethz-a-009753126	Agroforestry practices can be more productive and profitable than monocultures, but face challenges with long establishment phases and low product prices.	- There was a lack of understanding among Swiss farmers about the ecosystem services that agroforestry systems can provide, and the authors recommend incorporating this concept into agricultural knowledge and the economic system. - The agroforestry practices studied were generally more productive than monoculture systems, with land equivalent ratios ranging from 0.95 to 1.30. - In the majority of the financial scenarios examined, the agroforestry practices were more profitable than monoculture systems, despite some disadvantages like long establishment phase and low fruit prices, which were offset by innovative marketing and payments for ecosystem services.	Not mentioned (the abstract does not explicitly state any policy recommendations made by the authors)
Nair, P. R. (2008). Agroecosystem management in the 21st century: it is time for a paradigm shift. *Journal of Tropical Agriculture*, *46*, 1-12.		The paper discusses the benefits of agroforestry systems, but does not directly address the market potential for agroforestry products.	section. Instead, I will summarize the key points made in the abstract in bullet point form.	Not mentioned (the abstract does not provide any specific policy recommendations)

Paper	DOI	Abstract summary	Main findings	Policy recommendations
Lewandowski, I. (2018). *Bioeconomy: Shaping the transition to a sustainable, biobased economy* (p. 356). Springer nature.	**DOI** 10.1007/978-3-319-68152-8	Bio-based products are gaining commercial and industrial traction as renewable and sustainable alternatives to traditional products.	- Biobased products are gaining traction in commercial and industrial applications due to their renewable and sustainable nature, as well as their potential to provide economic benefits. - Biowaste can be converted into a variety of valuable bioproducts through biorefinery processes. - Biopesticides, biostimulants, and biofertilizers are distinct types of agro bio-products that can serve as sustainable alternatives to synthetic agrochemicals.	Not mentioned (the authors do not provide any specific policy recommendations in this paper)
Khadka, D., Aryal, A., Bhatta, K. P., Dhakal, B. P., & Baral, H. (2021). Agroforestry systems and their contribution to supplying forest products to communities in the Chure range, Central Nepal. *Forests*, *12*(3), 358.	https://doi.org/10.3390/f12030358	Agroforestry systems in the Chure range of Nepal contribute to supplying forest products like fuelwood, fodder, and leaf litter to local communities.	- The dominant agroforestry (AF) system used in the study area was agri-silviculture, which local people used to derive important forest products like fuelwood, fodder, and leaf litter. - Compared to community forestry (CF), AF contributed about equally to fodder and leaf litter, but CF provided the majority (75%) of fuelwood. - Despite the potential of AF to fulfill local needs, promotional and development activities for AF were lacking.	Policymakers and stakeholders should promote and technically facilitate agroforestry systems, collaborate with local people to support the adoption of agroforestry, and recognize the potential of agroforestry to fulfill the demands of local people and conserve the fragile Chure soils.

Paper	DOI	Abstract summary	Main findings	Policy recommendations
Willmott, A., Willmott, M., Grass, I., Lusiana, B., & Cotter, M. (2023). Harnessing the socio-ecological benefits of agroforestry diversification in social forestry with functional and phylogenetic tools. *Environmental Development*, *47*, 100881.	https://doi.org/10.1016/j.envdev.2023.100881	Diversified agroforestry has great potential for sustainable, multifunctional land-use, but market access is a key challenge.	- Diversified agroforestry has significant potential benefits but is hindered by a lack of resources, technical support, and access to appropriate markets. - The paper presents two methodological tools - one based on functional traits and the other on phylogenetic relationships - that can help with the appropriate selection of species for diversified agroforestry systems. - The tools can help identify functionally distinct groups of species and provide recommendations for co-cultivation, which can lead to increased on-farm income diversification and environmental benefits.	Not mentioned (the abstract does not explicitly state any policy recommendations made by the authors)
Franzel, S., Scherr, S. J., Coe, R., Cooper, P. J. M., & Place, F. (2002). Methods for assessing agroforestry adoption potential. In *Trees on the farm: assessing the adoption potential of agroforestry practices in Africa* (pp. 11-35). Wallingford UK: CABI Publishing.	https://doi.org/10.1079/9780851995618.0011	The paper describes methods for assessing the adoption potential of agroforestry practices.	Not mentioned (the abstract does not provide any specific "main findings" or results from the study)	Not mentioned (the abstract does not contain any policy recommendations made by the authors)
Du Toit, B., Malherbe, G. F., Lambrechts, H., Naidoo, S., & Eatwell, K. A. (2018). Market analysis to assess timber products from dryland woodlots and farm forests in South Africa. Klaus Hess Publishers.	DOI: 10.7809/b-e.00343	The paper analyzes the market potential for timber products from dryland woodlots and farm forests in South Africa.	- Short-rotation pole crops and a combination of smaller poles from thinnings and sawlogs at clear-felling age can be economically feasible production options for farm forests and woodlots in dry regions. - Eucalyptus species can be grown profitably even on low-productivity sites, with financial returns in excess of 10% achievable	Not mentioned (the authors do not provide any explicit policy recommendations in this paper)

Paper	DOI	Abstract summary	Main findings	Policy recommendations
			on moderate site qualities. - Farm forestry in dryland areas can be an economically feasible land use that also yields additional benefits such as job creation and ecosystem services.	
Lehébel-Péron, A., Feintrenie, L., & Levang, P. (2011). RUBBER Agroforests'profitability, The Importance Of Secondary Products. *Forests, Trees and Livelihoods*, *20*(1), 69-84.	https://doi.org/10.1080/14728028.2011.9756698	Rubber agroforests in Indonesia provide cash income from secondary products, but their overall profitability remains low.	- Agroforest products are quite valuable, but the overall return on the land is low. - Enriching agroforests with Parkia speciosa Hassk trees could improve productivity and help farmers cope with economic crises.	Not mentioned (the abstract does not mention any specific policy recommendations made by the authors)
Dhyani, S. K., Kareemulla, K., Ajit, A., & Handa, A. K. (2009). Agroforestry potential and scope for development across agro-climatic zones in India.		Agroforestry has high potential to meet demands for timber, fodder, bioenergy, and food/fruit security across India's agro-climatic zones.	- Agroforestry has high potential to protect ecosystems, produce economic goods, and improve rural livelihoods. - Agroforestry can conserve natural resources across different agroclimatic regions. - Agroforestry has the potential to meet basic needs like food, fuel, fodder, and provide employment.	Not mentioned (the abstract does not explicitly state any specific policy recommendations made by the authors)
Makundi, W. R., & Sathaye, J. A. (2004). *GHG mitigation potential and cost in tropical forestry—relative role for agroforestry* (pp. 235-260). Springer Netherlands.		Agroforestry options have significant greenhouse gas mitigation potential at medium to low cost compared to other forestry options.	- About half of the total mitigation potential of 6.9 Gt C between 2000 and 2030 in the seven countries could be achieved at a negative cost, while the other half could be achieved at costs up to $100 per ton of carbon. - Agroforestry options accounted for a significant proportion of the mitigation potential, ranging from 6% to 21%, and were more cost-effective than	Not mentioned (the paper does not provide any explicit policy recommendations)

Paper	DOI	Abstract summary	Main findings	Policy recommendations
			most other options due to the low labor costs in rural areas. - The study found that agroforestry options had medium to low costs per ton of carbon compared to other mitigation options.	
Sereke, F., Graves, A. R., Dux, D., Palma, J. H., & Herzog, F. (2015). Innovative agroecosystem goods and services: key profitability drivers in Swiss agroforestry. Agronomy for sustainable development, 35, 759-770.		Agroforestry practices that incorporate innovative marketing of products and payments for ecosystem services can be more profitable than conventional farming.	- Agroforestry systems that combine trees and crops can be more productive than growing them separately. - Many agroforestry practices, especially those involving innovative marketing or payments for ecosystem services, can be more profitable than conventional agricultural systems. - Incorporating the concept of ecosystem services can help support the design of multifunctional agriculture and increase the willingness to pay for the services provided by agroforestry systems.	1. Applying the concept of ecosystem services to support multifunctional agriculture and increase payments for these services. 2. Improving collaboration between scientists and farmers to develop productive agroforestry practices.
Njurumana, G. N., & Octavia, D. (2020). Conservation species of NTFPS through agroforestry for community livelihoods in Sikka, East Nusa Tenggara. *Journal of Sylva Indonesiana*, *3*(01), 1-16.	https://doi.org/10.32734/jsi.v3i01.1984	Agroforestry can help conserve non-timber forest products and improve community livelihoods in Sikka, East Nusa Tenggara.	- The major NTFP commodities in Sikka district are tamarind, candlenut, areca nut, and betel. - The socio-economic conditions of NTFP farmers are not yet prosperous and are highly dependent on the sustainability of NTFP production. - Community initiatives to conserve and	1. Support and improve community-led efforts to conserve and regenerate NTFPs through agroforestry practices. 2. Provide technical assistance and capacity building to help communities better conserve and develop NTFP resources on both public and private lands. 3.

Paper	DOI	Abstract summary	Main findings	Policy recommendations
			regenerate NTFPs through agroforestry need to be improved, especially in improving the rate of plant growth.	Promote NTFP development and utilization as a strategy for improving community livelihoods and reducing poverty.
Josiah, S. J., & Kemperman, J. (1998). Emerging agroforestry opportunities in the upper Midwest. *Journal of forestry*, *96*(11), 4-9.	https://doi.org/10.1093/jof/96.11.4	Agroforestry is creating emerging market opportunities in the upper Midwest due to changing farm economics and new plant materials.	- Agroforestry is thriving in the upper Midwest due to changing farm economics, new plant materials, useful research results, and growing markets for specialty forest products. - Specific agroforestry practices like shelterbelts, riparian zones, and short-rotation plantations are providing economic and environmental benefits in the region. - Agroforestry requires partnerships and a more integrated, systems-level approach to implementation across the agricultural landscape to be most effective.	Not mentioned (the abstract does not mention any policy recommendations made by the authors)
Leakey, R. R. B., Temu, A. B., Melnyk, M., & Vantomme, P. (1996). Domestication and commercialization of non-timber forest products. *Non-Wood Forest Products Series*, *9*.		This paper discusses the domestication and commercialization of non-timber forest products in agroforestry systems.	Not mentioned (the abstract does not mention or summarize the main findings of the study)	Not mentioned (the abstract does not contain any information about policy recommendations or recommendations for decision-makers)

Paper	DOI	Abstract summary	Main findings	Policy recommendations
Cechin, A., da Silva Araújo, V., & Amand, L. (2021). Exploring the synergy between Community Supported Agriculture and agroforestry: Institutional innovation from smallholders in a brazilian rural settlement. *Journal of Rural Studies*, *81*, 246-258.	https://doi.org/10.1016/j.jrurstud.2020.10.031	Community Supported Agriculture can positively influence the adoption of agroforestry systems by smallholders by providing a secure marketing outlet.	- The CSA marketing arrangement is more financially viable for smallholders selling agroforestry products than the organic market, even in the most pessimistic CSA scenario. - The economic security provided by the CSA arrangement can foster the adoption of agroforestry systems by smallholders. - The CSA arrangement allows farmers to take a more holistic, ecological approach to farming, as they do not need to focus only on high-value crops.	Not mentioned (the abstract does not contain any explicit policy recommendations)
Duan, Faye. 2020. Policy Landscape for the Scaling-up of Agroforestry in Mali." Oxfam Research Backgrounder series. https://www.oxfamamerica.org/explore/research-publications/policy-landscapescaling-agroforestry-mali		The paper discusses the policy landscape for scaling up agroforestry in Mali, but does not directly address the market potential for agroforestry products.	Not mentioned (the abstract does not contain any "main findings" or results from a study)	Not mentioned (the abstract does not mention any specific policy recommendations)
Amatya S.M., Cedamon E., Nuberg I. (2018), AGROFORESTRY SYSTEMS AND PRACTICES IN NEPAL-Revised Edition, Agriculture and Forestry University, Rampur, Nepal, 108pp + xviii		The potential of agroforestry products in Nepal has been underutilized, and a project aims to improve community capacity to increase incomes from agroforestry.	- The project aimed to improve the capacity of local communities to increase incomes and livelihood opportunities from better management and development of agroforestry products. - Low productivity, poor marketing, and lack of services have hindered economic development and livelihoods improvement from agroforestry products. - The	Not mentioned (the abstract does not mention any specific policy recommendations made by the authors)

Paper	DOI	Abstract summary	Main findings	Policy recommendations
			potential of agroforestry products has been underutilized.	
Non-timber forest products markets and potential degradation of the forest resource in Central Africa: the role of research in providing a balance between welfare improvement and forest conservation. CARPE |		The market potential for agroforestry products like Irvingia, Cola, and Garcinia in Central Africa is significant but dynamic, requiring research to balance livelihood needs and forest conservation.	- The value of non-timber forest products (NWFP) marketed in the region declined from US$753,000 in the first half of 1995 to US$499,000 in the same period of 1996. - A portion of the NWFP value came from the marketing of barks from two Garcinia species, which was valued at US$30,000 and US$23,500 in 1995 and 1996 respectively. - The decline in NWFP value was due to lower supply, indicating the dynamic and unpredictable nature of these markets.	Not mentioned (the abstract does not state any specific policy recommendations made by the authors)
Latif, A., & Shinwari, Z. K. (2005). Sustainable market development for non timber forest products in Pakistan. *Ethnobotanical Leaflets*, *2005*(1), 3.		The paper explores the market development for non-timber forest products, identifying key challenges and opportunities.	- The study explores the market development for non-timber forest products (NTFPs), focusing on their economic viability, environmental sustainability, and socio-cultural significance. - The study uses a mixed-methods approach, including case studies, to identify key challenges and opportunities in the NTFP market. - The study provides strategic recommendations for stakeholders in the NTFP market.	Not mentioned (the abstract does not mention any specific policy recommendations made by the authors)

Paper	DOI	Abstract summary	Main findings	Policy recommendations
Jemal, O. M., & Callo-Concha, D. (2017). *Potential of agroforestry for food and nutrition security of small-scale farming households* (No. 161). ZEF Working Paper Series.		Agroforestry supports food and nutritional security through direct provision of tree foods, raising farmer incomes, and providing ecosystem services.	- Agroforestry supports food and nutritional security through the direct provision of tree foods, raising farmer incomes, providing fuel for cooking, and supporting ecosystem services essential for food production. - Agroforestry can help adapt to climate change by adjusting tree composition to new environmental conditions and developing vegetation maps to plan for future climate scenarios. - Policy reforms are needed to support agroforestry, including addressing tree and land tenure, improving farmer access to tree planting materials, and recognizing agroforestry as an investment option.	1. Better quantify the current role of agroforestry in supporting food and nutrition security for different groups (men, women, children, small-scale farmers, landless poor, local traders) to target interventions. 2. Develop distinct agroforestry policies that address issues like land tenure, access to tree planting materials, and recognizing agroforestry as a viable investment for food production. 3. Support research on food tree domestication options for smallholders and assessing the complementarity and resilience of agroforestry systems under climate change and other challenges.
Persoon, G. A., & van Beek, H. H. (2008). Growing 'the wood of the gods': agarwood production in southeast Asia. *Smallholder tree growing for rural development and environmental services: Lessons from Asia*, 245-262.		The paper discusses the market potential and production of agarwood, a valuable non-timber forest product, in Southeast Asia.	- Agarwood production is a defense mechanism in Aquilaria species in response to pathogens. - High demand for agarwood has led to the depletion of Aquilaria trees in natural forests, with Indonesia and Papua New Guinea now being the main suppliers. - Due to the rapid depletion of agarwood in the wild, Aquilaria species have been listed as endangered, and efforts have been made to increase agarwood production by deliberately wounding the trees, with some	Not mentioned (the abstract does not contain any explicit policy recommendations made by the authors)

Paper	DOI	Abstract summary	Main findings	Policy recommendations
			new techniques proving to be effective.	
Ajayi, O. C., & Place, F. (2012). Policy support for large-scale adoption of agroforestry practices: experience from Africa and Asia. *Agroforestry-The future of global land use*, 175-201.		Government policies and market opportunities play important roles in facilitating large-scale adoption of agroforestry practices.	- Widespread adoption of agroforestry is strongly influenced by the policy and institutional context. - Agroforestry is being increasingly incorporated into national development programs, but policy barriers still hinder its adoption. - Sustained adoption of agroforestry requires conducive policies, institutional support, economic incentives, and research on policy and dissemination aspects.	1. Integrate agroforestry into national development programs as the evidence of its benefits becomes better known. 2. Implement conducive policies, institutional frameworks, and economic incentives to support the dissemination of agroforestry at the farm level. 3. Conduct more research on the policy and dissemination aspects of agroforestry, in addition to the biophysical and farmer-level aspects, to ensure the long-term sustainability of agroforestry adoption.
Nigussie, Z., Tsunekawa, A., Haregeweyn, N., Tsubo, M., Adgo, E., Ayalew, Z., & Abele, S. (2021). Small-scale woodlot growers' interest in participating in bioenergy market in rural Ethiopia. *Environmental Management*, *68*(4), 553-565.		Agroforestry could provide biomass residues for improved bioenergy products, and farmers, especially younger and female-headed households, are interested in participating in a hypothetical biomass feedstock market.	- A majority of farmers expressed interest in supplying biomass residues, but the level of interest depended on individual socio-economic and demographic characteristics. - Younger and female household heads, households with improved biomass stoves, larger land holdings, and higher incomes were more interested in participating in the biomass market. - Larger households and those less vulnerable to firewood scarcity also showed more interest in participating.	1. Support programs that specifically target younger and female-headed households to ensure their inclusion in the biomass supply chain. 2. Provide proper incentives for the collection, baling, and transportation of woody biomass residues, or recruit new actors into the supply chain to facilitate these activities. 3. Provide households with energy-efficient tools like improved stoves, as this would increase the demand for biomass products and the

Paper	DOI	Abstract summary	Main findings	Policy recommendations
				amount of biomass residues that could be supplied to the market.
Kassie, G. W. (2018). Agroforestry and farm income diversification: synergy or trade-off? The case of Ethiopia. *Environmental Systems Research*, *6*, 1-14.		Agroforestry and non-farm income diversification activities are synergistic, with better economic returns and land management driving their joint adoption.	- The joint adoption of agroforestry and non-farm income diversification activities is positively influenced by the economic returns, land tenure security, and prior experience with these activities. - Distance from markets and roads, as well as the number of oxen owned, have a negative impact on the joint adoption of agroforestry and non-farm income diversification. - The study area has seen a shift from cereal crop production to agroforestry, which has allowed the community to diversify their income sources.	1) Implement policy interventions that simultaneously promote both agroforestry and non-farm income diversification activities, in order to enhance sustainable land management and maximize economic returns for farm households. 2) Improve access to agricultural technologies (e.g. fertilizers, improved seeds) and rural infrastructure/institutions (e.g. markets, roads) for farm households, in order to economically empower them in a sustainable way.
Beer, J., Fassbender, H. W., & Heuveldop, J. (Eds.). (1987). *Advances in agroforestry research* (No. 117). CATIE.		This paper provides a general overview of advances in the field of agroforestry, but does not specifically address the market potential for agroforestry products.	Not mentioned (the abstract does not mention any main findings or conclusions of the study)	Not mentioned (the abstract does not contain any information about policy recommendations or recommendations for decision-makers)

Paper	DOI	Abstract summary	Main findings	Policy recommendations
Gyau, A., & Muthuri, C. (2016). The socio-economic potential of under-utilized species to small holder farmers: The case of Khat (Catha edulis) in Ethiopia. *African Journal of Business Management*, *10*(11), 279-287.		Khat, an indigenous shrub in Ethiopia, has high market potential as a profitable agroforestry crop.	- Demand for khat exceeds its current supply, and farmers have the power to determine the price. - There is high competition among traders to source khat from farmers, leading to price competition. - The agroecological conditions are suitable for khat production, and more farmers could grow it if they were aware of its market potential.	Not mentioned (the abstract does not explicitly state any specific policy recommendations made by the authors)
Dosskey, M. G., Bentrup, G., & Schoeneberger, M. (2012). A role for agroforestry in forest restoration in the lower Mississippi alluvial valley. *Journal of Forestry*, *110*(1), 48-55.	https://doi.org/10.5849/jof.10-061	Agroforestry practices can restore bottomland hardwood forests and provide profit potential competitive with agricultural crops in the lower Mississippi Alluvial Valley.	- Agroforestry practices can augment the size and quality of BLH habitat, provide corridors between BLH areas, and enable restoration of natural hydrologic patterns and water quality. - Profit potential from some agroforestry practices is currently competitive with agricultural crops and production forestry on marginal agricultural lands in the LMAV. - Lack of experience with agroforestry in this region hinders adoption, but emerging markets for biofuels and ecosystem services could enhance future prospects.	Not mentioned (the abstract does not contain any explicit policy recommendations or suggestions for decision-makers)

Paper	DOI	Abstract summary	Main findings	Policy recommendations
Rolo, V. (2022). Agroforestry for sustainable food production. *Sustainability*, *14*(16), 10193.	https://doi.org/10.3390/su141610193	The paper discusses agroforestry as a sustainable approach to agricultural production, but does not specifically address market potential for agroforestry products.	- Agroforestry systems can improve soil fertility and nutrient availability, which is positively related to crop yield. - Agroforestry can increase carbon sequestration in agricultural landscapes, but the interaction between vegetation layers can also be competitive and reduce yields. - Agroforestry can help sensitive crops like coffee adapt to climate change by providing shade and improving soil water content.	1) For smallholder agroforestry systems in developing countries, address socioeconomic barriers like literacy, financial support, and land tenure to increase the productive capacity of these systems. 2) Promote the widespread adoption of agroforestry by carefully selecting appropriate tree species and planting arrangements. 3) For developed countries, tailor policies providing subsidies or payments for agroforestry and biodiversity conservation to specific farm types, rather than using a one-size-fits-all approach.
Swallow, B., Russell, D., & Fay, C. (2006). Agroforestry and environmental governance. *World agroforestry into the future*, 85-94.		The paper discusses how environmental governance trends create new opportunities and constraints for agroforestry, but does not directly address market potential for agroforestry products.	- Environmental governance is shifting from national to global, regional, and local levels. - There is a move towards more market-based and private sector approaches to environmental management and service provision. - Integrated, landscape-level approaches to environmental management that involve local communities as partners are being emphasized.	Not mentioned (the abstract does not contain any explicit policy recommendations made by the authors)

Paper	DOI	Abstract summary	Main findings	Policy recommendations
Agroforestry in Madagascar: past, present, and future Andriatsitohaina, R. N. N., Laby, P., Llopis, J. C., & Martin, D. A. (2024). Agroforestry in Madagascar: past, present, and future. *Agroforestry Systems*, 1-22.		Agroforestry systems in Madagascar provide cash and subsistence yields as well as other ecosystem services, but face challenges in scaling up.	- 27.4% of Malagasy exports are from crops typically farmed in agroforestry systems, supporting income for at least 500,000 farmers. - Agroforestry systems in Madagascar provide benefits for biodiversity and ecosystem services compared to annual crops and monocultures. - Limited research has been done on the social and economic outcomes of agroforestry in Madagascar, but findings suggest it provides financial benefits to smallholder farmers and a sense of community.	Not mentioned (the abstract does not contain any explicit policy recommendations made by the authors)
El Tahir, B. A., & Vishwanath, A. (2015). Estimation of economic value of agroforestry systems at the local scale in Eastern Sudan. *Journal of Geoscience and Environment Protection*, *3*(09), 38.	10.4236/gep.2015.39005	Agroforestry systems in Eastern Sudan provide significant economic value through marketable and non-marketable goods and services.	- The agroforestry systems (AFS) in the study sites provided significant economic value to the local communities, with an estimated average net direct-use value of over 1.3 million USD per household per year. - Gum arabic, sorghum, and cash crops were the main contributors to this total economic value. - The total economic value would likely be even higher if the study had also quantified the non-marketable ecosystem services provided by the AFS, such as shade, aesthetic and recreation, environmental protection, biodiversity, and carbon sequestration.	Not mentioned (the abstract does not provide any specific policy recommendations made by the authors)

Paper	DOI	Abstract summary	Main findings	Policy recommendations
Affandi, O., Zaitunah, A., & Batubara, R. (2017). Potential economic and development prospects of non timber forest products in community agroforestry land around Sibolangit Tourism Park. *Forest and Society*, *1*(1), 68-77.		Agroforestry products around Sibolangit Tourism Park have high economic potential and contribute significantly to household incomes.	- The communities cultivate a variety of NTFPs, including both forestry and agricultural products, in their agroforestry lands around the Sibolangit Tourism Park. - NTFPs contribute a substantial portion (over 75%) of total household income in the two villages studied. - The development of NTFPs in the agroforestry lands around the park has high potential to support household incomes.	Not mentioned (the abstract does not provide any specific policy recommendations made by the authors based on their study)
Charly, F., Gyau, A., Diane, R., Foundjem-Tita, D., Charlie, M., Steven, F., & Tchoundjeu, Z. (2012). Comparison of three modes of improving benefits to farmers within agroforestry product market chains in Cameroon. *African Journal of Agricultural Research*, *7*(15), 2336-2343.	DOI: 10.5897/AJAR11.577	The paper compares three modes of improving benefits to farmers within agroforestry product market chains in Cameroon.	- The three interventions compared (group sales, village-level stabilization fund, and improved storage) each have strengths and weaknesses, but are highly complementary. - The coupling of improved storage and guarantee funds can help enhance farmers' ability to delay sales until periods of higher prices. - Group sales can serve as a good starting point for helping farmer groups achieve quick gains, before introducing the other more complex interventions.	Not mentioned (the abstract does not explicitly state any policy recommendations made by the authors)
Nyaruai, M. A., Musingi, J. K., & Wambua, B. N. (2018). The potential of agroforestry as an adaptation strategy to mitigate the impacts of climate change: A case study of Kiine Community, Kenya. *Nusantara Bioscience*, *10*(3), 170-177.	https://doi.org/10.13057/nusbiosci/n100307	Agroforestry has the potential to mitigate the impacts of climate change and provide various products for subsistence and income generation.	- The most preferred agroforestry practices were planting trees and shrubs as windbreakers, riparian forest buffers, silvopasture, and boundary planting. - Farmers felt they needed more training and education on agroforestry practices and incorporating both indigenous and exotic tree species. -	1) Policymakers should promote the more preferable agroforestry practices like windbreaks, riparian buffers, and silvopasture over less preferable practices like forest farming and woodlots. 2) Policymakers should provide training and education for

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			Agroforestry provided a variety of products that farmers could sell, including food, fodder, fuelwood, and other materials, thereby increasing their livelihoods and subsistence.	farmers on identifying both native and non-native agroforestry tree species, as the majority of farmers felt this was very much needed. 3) Policymakers should support agroforestry as a strategy to improve the livelihoods and subsistence of local farmers, as it provides a diverse array of products that can be sold.
Chilalo, M., & Wiersum, K. F. (2011). The role of non-timber forest products for livelihood diversification in Southwest Ethiopia. *Ethiopian e-Journal for Research and Innovation Foresight*, *3*(1), 44-59.		Non-timber forest products, especially forest coffee and honey, have significant market potential and contribute to rural livelihoods in Southwest Ethiopia.	- NTFPs, particularly forest coffee and honey, account for nearly 50% of total household cash income for rural communities in Southwest Ethiopia. - The study identified three distinct household strategies related to NTFP production: diversification, specialization, and coping. - The value of NTFPs is higher in mid-hills zones with a mix of forests, agroforestry, and agricultural land compared to more remote upland zones with higher forest cover.	Not mentioned (the abstract does not explicitly state any policy recommendations made by the authors)
Latif, A., & Shinwari, Z. K. (2005). Sustainable market development for non timber forest products in Pakistan. *Ethnobotanical Leaflets*, *2005*(1), 3.		The paper examines the market potential and trade of non-timber forest products in Pakistan, which are an important source of income for local communities.	- A large majority (80%) of forest dwellers in Pakistan depend on NTFPs due to poverty. - About 34% of local people rely on NTFPs for income generation. - The prices and production of many NTFPs are highly variable from year to year.	Not mentioned (the abstract does not provide any explicit policy recommendations made by the authors)

Paper	DOI	Abstract summary	Main findings	Policy recommendations
Quli, S. M. S. (2001). Agroforestry for NTFPs conservation and economic upliftment of farmers.		Agroforestry can conserve non-timber forest products (NTFPs) while improving the economic conditions of farmers.	- Deforestation and loss of forest cover is an alarming issue. - Agroforestry schemes can be used to conserve non-timber forest products (NTFPs) while also improving the economic conditions of farmers. - Proper implementation of the proposed agroforestry schemes can lead to conservation of NTFPs and economic improvement for farmers.	Not mentioned (the abstract does not provide any specific policy recommendations made by the authors)
Chavan, S. B., Keerthika, A., Dhyani, S. K., Handa, A. K., Newaj, R., & Rajarajan, K. (2015). National Agroforestry Policy in India: a low hanging fruit. *Current Science*, 1826-1834.		The National Agroforestry Policy aims to address issues like weak markets and lack of institutional finance to promote agroforestry for sustainable agriculture.	Not mentioned (the abstract does not provide any specific "main findings" or results/conclusions of a study)	Not mentioned (the abstract does not mention any specific policy recommendations made by the authors)
Chambost, V., & Stuart, P. R. (2007). Selecting the most appropriate products for the forest biorefinery. *Industrial Biotechnology*, *3*(2), 112-119.		The paper discusses selecting the most appropriate products for the forest biorefinery, but does not specifically address the market potential for agroforestry products.	Not mentioned (the abstract does not contain enough information to summarize the main findings or conclusions of the study)	Not mentioned (the abstract does not contain any information about policy recommendations or recommendations for decision-makers)

Paper	DOI	Abstract summary	Main findings	Policy recommendations
Pandit, B. H. (2014). Sustainable local livelihoods through enhancing agroforestry systems in Nepal. *Journal of forest and Livelihood*, *12*(1), 17-17.		Agroforestry systems in Nepal have increased biodiversity and livelihood benefits, but require enabling policies and practices to commercialize agroforestry products.	- The agroforestry system in the study area has become more diverse over time, with an increase in the number of species, including medicinal plants, fodder trees, grasses, and fruit trees. - The increase in species richness, particularly in upland terraces, has led to increased livelihood benefits for local people, such as increased production of goat meat and buffalo milk. - The high economic benefits are mainly associated with the introduction of various fodder trees and grasses in private farmlands.	1. Carefully consider the various drivers of the agroforestry system in order to enhance both its conservation and livelihood benefits. 2. Implement enabling policies and practices to initiate and support farming cooperatives in the commercialization of agroforestry products and marketing the conservation values of agroforestry, especially in the context of climate change.
Akinnifesi, F. K., Jordaan, D., & Ham, C. (2005). Building opportunities for smallholder farmers to commoditize indigenous fruit trees and products in southern Africa: processing, markets and rural livelihoods. Book of abstracts. *The global food and product chain-dynamics, innovation, conflicts, strategies. University of Hohenheim, Deutscher Tropentag, Stuttgart-Hohenheim*.		The paper discusses building opportunities for smallholder farmers to commoditize indigenous fruit trees and products in southern Africa.	Not mentioned (the abstract does not contain any information about the main findings or results of the study)	Not mentioned (the abstract does not contain any policy recommendations or recommendations for decision-makers)
Arnold, J. E. M. (1996). Economic factors in farmer adoption of forest product activities. *Domestication and commercialization of non-timber forest products in agroforestry systems*, 131-146.		The adoption of commercial non-timber forest products within agroforestry systems is influenced by various economic factors.	- The adoption of commercial NTFPs in agroforestry systems is influenced by various economic factors. - Income from NTFP activities is important for meeting the needs of many rural households. - Commercial NTFP activities are often a secondary outcome of trees planted for other purposes or a response to changes	Not mentioned (the abstract does not provide any specific policy recommendations)

Paper	DOI	Abstract summary	Main findings	Policy recommendations
			in the availability of land, labor, and capital.	