PARTICIPATORY SELECTION OF PLANT SPECIES TO ENHANCE THE SUCCESS OF FOREST REHABILITATION IN BULUSARAUNG FOREST MANAGEMENT UNIT

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PARTICIPATORY SELECTION OF PLANT SPECIES TO ENHANCE THE SUCCESS OF FOREST REHABILITATION IN BULUSARAUNG FOREST MANAGEMENT UNIT. The success of forest area rehabilitation requires community involvement. The selection of plant species that are suitable to community preferences will substantially influence the success of rehabilitation efforts. Communities' preferences for specific plant species may increase their willingness to care the plant. This research explored the importance of participatory plant species selection in supporting forest rehabilitation success of Cahaya Tala-Tala Forest Farmers Group (FFG) in the Bulusaraung Forest Management Unit (FMU), South Sulawesi, Indonesia by applying the agroforestry technique. The study employed the participatory rural appraisal approach in one village and involved 50 respondents. The results indicated that the FFG members' preferences for specific plant species were categorized as being in the "affected" stage and positioned at the "preference" stage according to the hierarchy of effects model. The participation of the FFG members in forest rehabilitation activities at the Bulusaraung FMU is categorized as the "partnership" level. The selected multipurpose tree species are expected to substantially contribute to the community's income and help the success of forest rehabilitation activities in Indonesia.

Keywords: Forest rehabilitation, multipurpose tree species, preference, participatory rural appraisal, forest management unit

PEMILIHAN JENIS TANAMAN SECARA PARTISIPATIF UNTUK MENINGKATKAN KESUKSESAN REHABILITASI HUTAN DI KESATUAN PENGELOLAAN HUTAN BULUSARAUNG. Keberhasilan rehabilitasi kawasan hutan memerlukan keterlibatan masyarakat. Pemilihan jenis tanaman yang sesuai dengan preferensi masyarakat akan sangat mempengaruhi keberhasilan upaya rehabilitasi hutan. Preferensi masyarakat terhadap spesies tanaman tertentu dapat meningkatkan kesediaan mereka untuk memeliharanya. Penelitian ini bertujuan untuk mengetahui pentingnya pemilihan tanaman secara partisipatif dalam mendukung keberhasilan rehabilitasi hutan pada Kelompok Tani Hutan (KTH) Cahaya Tala-Tala di Kesatuan Pengelolaan Hutan (KPH) Bulusaraung, Sulawesi Selatan, Indonesia dengan menerapkan teknik agroforestri. Penelitian ini menggunakan pendekatan Participatory Rural Appraisal di satu desa dan melibatkan 50 responden. Hasil penelitian menunjukkan bahwa preferensi anggota KTH terhadap jenis tanaman berada pada tahap "terpengaruh (affected)" dan pada posisi "memilih (preference)" berdasarkan Model Hierarchi of Effect. Partisipasi anggota KTH tersebut dalam kegiatan rehabilitasi hutan di KPH Bulusaraung dikategorikan dalam tingkat "kemitraan". Jenis pohon serbaguna yang dipilih diharapkan dapat berkontribusi besar terhadap pendapatan masyarakat dan membantu tercapainya keberhasilan rehabilitasi lahan di Indonesia.

Kata kunci: Rehabilitasi hutan, jenis pohon serba guna, preferensi, participatory rural appraisal (PRA), Kesatuan Pengelolaan Hutan

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I. INTRODUCTION

The area of degraded forest and land in Indonesia has increased year by year; in 1968, degraded land was reported to be 20 million ha, in 1990, around 40 million ha, and in 2008, an area of 77.8 million ha (Dirjen Pengelolaan Daerah Aliran Sungai dan Perhutanan Sosial, 2011). However, in 2019, the degraded land in Indonesia was reported to have decreased significantly to 14.01 million ha (Dharmawan & Pratiwi, 2023). Forest degradation is mainly caused by illegal logging, forest conversion, expansion of agricultural land, and forest fires.

For decades, many initiatives have been developed by the Government of Indonesia through several programs and policies to reduce the degraded forest and land in Indonesia significantly. Indonesia has had a forest rehabilitation program since 1978 called the Afforestation and Reforestation Program, with a target of 2,500 ha of nurseries. The implementation of afforestation was 300,000 ha, and reforestation was 100,000 ha in 1978-1979 (Fisher et al., 2023). Indonesia has also carried out land and forest rehabilitation covering an area of 2,561,182 ha, in all provinces, during 2006 – 2010 (Handian & Supriyanto, 2012). The main milestone in the government's real action in forest and land rehabilitation activities was the launch of the GNRHL (National Movement for Forest and Land Rehabilitation) Program in 2003 by the Ministry of Forestry, which was targeted to rehabilitate 3.1 million ha of land (inside and outside forest areas) over 5 years (Nawir et al., 2008). The study revealed that for more than three decades, rehabilitation activities were carried out in more than 400 locations in Indonesia. The success of the forest rehabilitation project, generally characterized by active involvement of local communities, as well as the technical interventions used, specifically addresses the ecological causes of forest degradation.

Subsequently, policies and implementation of the forestry sector as part of corrective measures through a rehabilitation program continue to address the challenges of dealing with the impacts of climate change in the forestry sector (Dharmawan & Pratiwi, 2023). In 2019, the area of forest and land that had been rehabilitated was 395,168 ha, including an area of 206,000 ha of conservation areas and protected forests, 1,000 ha of mangrove forests, coasts, swamps, peatlands, and 188,168 ha of community-owned land (Indrajaya et al., 2022). Rehabilitation programs that have been running well include rehabilitation of ex-mining lands carried out by PT Berau Coal (BC), PT Kaltim Prima Coal (KPC), PT Trubaindo Coal Mining (TCM), PT Kitadin (KTD), and PT Kideco Jaya Agung (KJA) in East Kalimantan and PT Multi Tambangjaya Utama (MTU) in Central Kalimantan. Based on the research results in the six locations, the vegetation resulting from the rehabilitation grew well. Within 5 years, there had been improvements in the site as indicated by very low average erosion, decreased surface flow, increased soil infiltration capacity, many wild animals looking for food around the location, and ecosystem regeneration (Sudarmadji & Hartati, 2016). Reforestation with the enrichment planting method has restored hydrological conditions in the waters of Tabunio, South Kalimantan, and Central Java, after the eruption of Mount Merapi (Indrajaya et al., 2022).

Forest land degradation also occurs in the Bulusaraung Forest Management Unit (FMU) area, usually caused by encroachment activities, land conversion, and commodity conversion. There must be efforts to rehabilitate the degraded forest land to restore its function as a buffer for living ecosystems. In this case, Bulusaraung FMU has carried out several forest land rehabilitation activities from 2019 to 2022. The activities were carried out in Laiya Village, covering an area of 150 hectares; Bontomanurung Village, covering an area of 250 hectares; and in Pada Elo Village, covering an area of 1,000 hectares (KPH Bulusaraung, 2024). Many studies reveal that one of the keys to the success of forest rehabilitation is the active

engagement of the local community. Their close relationship with the surrounding forest and strong dependency on the forest will determine its success (Parhusip et al, 2019; Murniati et al., 2022; Octavia et al., 2023). In 2021, forest and land rehabilitation were also carried out by Bulusaraung FMU in collaboration with the AFoCO project in Tala-Tala Hamlet, Bonto Manai Village, covering an area of 13 hectares in the form of an agroforestry demonstration plot. The forest rehabilitation activities begin with the community's selection of plant species. Understanding community preferences on plant species, as well as the land suitability, will determine the success of the demonstration plot establishment. It will eventually become a pilot model of participatory land rehabilitation in other areas.

Subsequently, He et al. (2015) state that selecting plant species for forest rehabilitation requires local participation to achieve economic and ecological benefits. The success of plant growth in forest rehabilitation areas significantly hinges on the community's commitment to maintain the plants, as their livelihoods depend on the surrounding natural resources (Grix & Watene, 2022; Fisher et al., 2023). Local community involvement in land rehabilitation has been implemented in various regions, such as Gorontalo, where communities are involved in critical land rehabilitation programs. However, community involvement at the evaluation stage is still low (Suparwata et al., 2016). Similar research was also conducted by Golar et al. (2022) and Mukhlisa et al. (2023) in Central Sulawesi. The research results show that community involvement requires understanding the important meaning or purpose of the activities to be carried out. Community engagement activities in Central Sulawesi did not achieve the expected results because participatory planning only started towards the end of the activity. Martini et al (2016) further stated that intensive cooperation between extension workers and farmers was another important factor that determined the willingness of the community to participate in rehabilitation activities. However, while community preferences in selecting species for forest area rehabilitation are critical to its effectiveness, few studies have been conducted on participatory plant species selection, especially in South Sulawesi.

This research investigated the significance of participatory plant species selection on forest rehabilitation using the agroforestry technique in the Bulusaraung FMU of South Sulawesi. This research is more developed than previous research because there has been community involvement from the beginning of activity planning, activity socialization, selection of plant types and species, plant development and maintenance, and written agreements to ensure that the community is involved until the end of the activity.

II. THEORETICAL FRAMEWORK

The top-down approach in forest management has been proven to fail, particularly in areas where local communities heavily rely on forest resources (Haji et al., 2021; Höhl et al., 2020), such as the communities who settled surrounding the Bulusaraung FMU and at various other regions in Indonesia. Consequently, numerous forest management initiatives fail to achieve conservation and rehabilitation objectives and do not adequately contribute to the income of forest-dependent communities. These failures have exacerbated the difficulties faced by forest-dependent communities, thus prompting governments and other development institutions to involve local communities in forest governance.

In recent decades, community involvement in forest management activities has emerged in many countries as an innovative and promising approach to enhancing the success of forest management. This approach employs a forest rehabilitation strategy encompassing a comprehensive combination of ecological and socioeconomic aspects (Kalonga et al., 2014; Murniati et al., 2022). Many conservation and rehabilitation efforts were undertaken by using agroforestry techniques for sustainable

agroecosystem intensification. Sustainable intensification is a process or system in which production is increased without causing detrimental environmental impacts or expanding cultivated land (Pretty and Bharucha, 2014; Parhusip et al., 2019). Forest conservation and rehabilitation initiatives typically begin with selecting plant species based on community preferences and land suitability. Such a selection enhances community participation in managing agroforestry land. Forest rehabilitation activities supported by the community yield sustainable forests and thriving communities. However, the success of various efforts to involve the community in conservation and rehabilitation depends on their willingness to participate. According to Atin et al. (2022), individuals are more likely to engage in an activity if they are assured of receiving benefits. The framework of the research is presented in Figure 1.

The community's willingness to participate in forest rehabilitation activities of the Bulusaraung FMU area was investigated using preference theory, which concerns individuals' choices regarding whether they like or dislike the products (goods or services) consumed. In this study, community preferences are related to selecting plant species for forest rehabilitation activities. The preference of the community on plant species is determined by evaluating various available options, aligning with the perspective of Kotler and Keller (2009), who mentioned that evaluation involves alternative assessment and factor consideration, such as pleasure, satisfaction, fulfilment, and existing benefits. There are six steps in the hierarchy of effect model, namely: (1) Awareness, (2) Knowledge, (3) Liking, (4) Preference, (5) Conviction/intention to buy, and (6) Purchase.

Meanwhile, the extent of community participation in forest rehabilitation efforts was assessed by referencing the participation theory of Arnstein (1969). The ladder of participation from Arnstein (1969) consists of eight steps: (1) manipulation–at this level, the community is not involved because only a few individuals are selected as representatives, and the community is uninformed about the decision-making processes; (2) therapy–at this level, the community begins to be involved but can only receive information about decisions; (3) informing–the government does not hinder participation but only communicates information in one direction without considering people's aspirations; (4) consultation–discussions occur with other stakeholders, but the government decides whether community suggestions and criticisms will be implemented; (5) placation–the government promises to accommodate people's aspirations but secretly adheres to the original plan; (6) partnership–multiparty cooperation is formed to formulate or implement policies and programs; (7) delegation–the community

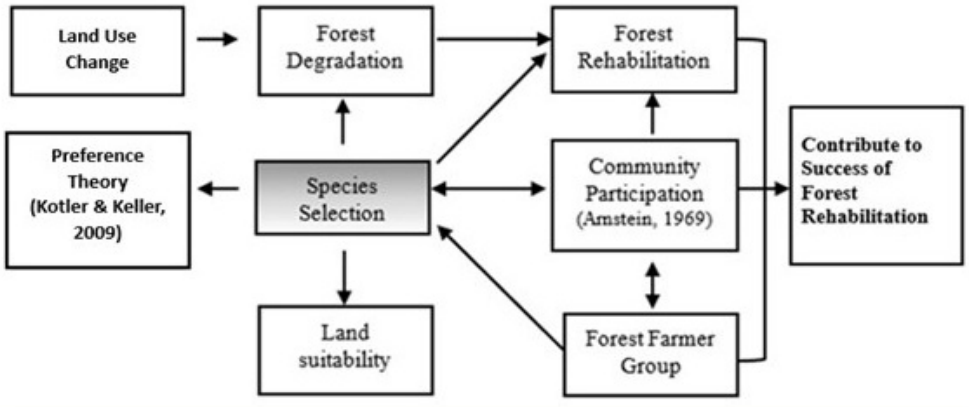

Figure 1. Theoretical framework

has the authority to influence activities, and representatives ensure that the community's voice is considered in the decision-making; and (8) citizen control–community participation is extensive, enabling them to effectively evaluate program/activity performance. Arnstein's participation model encompasses eight levels of participation categorized into three groups: nonparticipation (manipulation and therapy), pseudo-participation (information, consultation, and placation), and genuine community power (partnership, delegated power, and citizen control). This theory was also employed to analyse the social forestry program in Sanggau, Indonesia (Roslinda et al, 2022), and community forest–based management in Gabaldon, Philippines (Gabriel et al., 2017). The Arnstein's ladder of participation is presented in Figure 2.

III. MATERIALS AND METHODS

A. Time and location

The research was conducted over 18 months, from November 2021 to May 2023. The activity occurred in Tala-Tala Hamlet, Bonto Manai Village, Tompobulu Sub-District, Maros District, South Sulawesi Province. This location was chosen because it was a production forest that was burned in 2015, degraded, and yet to be rehabilitated. The construction of the rehabilitation area encompassed an area of 13 ha, geographically situated between the coordinates of latitude 5°5'54.654" S and longitude 119°44' 50.958" E (Figure 3).

The chosen location for the forest rehabilitation plot was an open area resulting from a pine forest fire in 2015. Before rehabilitation, the land was dominated by shrubs, mainly kerinyu (*Chromolaena odorata*) and

Figure 2. The Arnstein's ladder

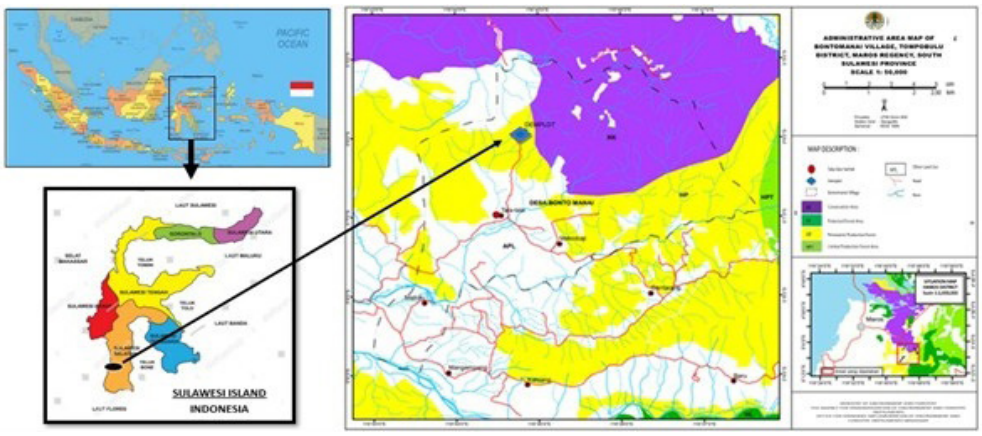

Figure 3. Map of research location

tembelekan (*Lantana camara*). In addition, there were several saplings of pulai (A*lstonia scholaris*) and pine (*Pinus merkusii*). The terrain is relatively flat, with steep slopes and small rivers flowing through the middle. The location lies at an altitude of 250 to 300 m above sea level (asl).

B. Data Collection Methods

Data was collected using mixed methods, or qualitative and quantitative approaches (Widodo et al., 2023) including field observations, questionnaire-based interviews, and focus group discussions (FGD). Field observations assessed the biophysical typology, including vegetation, topography, elevation, and socioeconomic and cultural conditions of the community, including the community participation in forest rehabilitation, which were used to determine the community participation levels based on the Arnstein ladder.

The respondents were selected using a purposive sampling technique. Structured interviews using questionnaires were conducted to gather socioeconomic and cultural data and information on farmers' total income, income contribution from rehabilitation activities, community preferences, and prospects for community involvement in forest rehabilitation activities. Fifty respondents from Bonto Manai Village were interviewed using prepared questionnaires.

In addition, data were collected through a series of FGDs to explore deeper information while validating observations and interview data with prospective participants in the forest rehabilitation site. Three stages of FGD were conducted. The first stage, which involved 50 respondents, aimed to elucidate forest area management issues in the Bulusaraung FMU and discuss factors that affect the success of forest rehabilitation and climate change adaptation and mitigation. The second stage included 26 persons, focusing on community preferences for plant species to be used in forest rehabilitation. The third stage involved 26 people aiming to establish local institutions at the farmer level to manage forest rehabilitation by the Minister of Environment and Forestry Regulation number P.89 in 2018.

C. Analysis

Data analysis was conducted descriptively, qualitatively, and quantitatively using several analytical tools. The analysis employed a system approach (Bahruni et al., 2007), which involved analyzing the components within the agroforestry system and exploring the connections between participation components, types, and species of tree crops cultivated, production, and income, as well as whether these components complement or contradict each other. The data analysis followed an inductive or qualitative approach and focused on deriving meaning rather than generalization.

The stages of data analysis included sociocultural analysis and evaluation of the contribution of community income from forest rehabilitation activities to total income. Sociocultural analysis encompassed several factors: educational level, livelihood, land ownership, and community culture. Data analysis for preference levels was carried out using descriptive analysis that describes the process of selecting plant species taken and chosen by respondents from several species of plants available, with the most appropriate stages of the hierarchy of effect model. Data analysis for participation levels was carried out using descriptive analysis in the form of narratives that connected the conditions of group participation with the most appropriate Arnstein ladder.

Income contribution

The income contribution derived from forest rehabilitation development activities to farmers' total income (on-farm and off-farm) over 1 year was calculated using the formula of Roslinda et al. (2022):

$$\text{Contribution (\%)} = \frac{\text{Income from forest rehabilitation activities (IDR)}}{\text{Total income of household (IDR)}} \times 100\% \quad (1)$$

Community preferences on plant species and participation in forest rehabilitation activities

Assessments and weighting were conducted to determine the plant species preferred by farmers. The criteria for plant species selection were based on four aspects (Reubens et al., 2011), each with several criteria. One of the criteria is the species of plant that is fire-resistant. The forest area around Tala-Tala Hamlet is dominated by pine forests where pine contains flammable resin (Prasetya et al, 2017). This causes the forest area in Tala-Tala Hamlet to be prone to fire during the long dry season. A major fire occurred in 2015, which resulted in around 16 ha of pine forest being severely damaged. So, the criteria for plant species resistant to fire must be considered when selecting the plant species. The plant species chosen by farmers were assessed according to these criteria and proceeded to weight the assessment criteria, as shown in Table 1. In addition, the selected plant species was checked through the Long-Term Management Plan (known as Rencana Pengelolaan Hutan Jangka Panjang, RPHJP) of Bulusaraung FMU.

Triangulation method validated the discussion results (Alfansyur & Mariyani, 2020). The triangulation approach was carried out by combining various methods, data sources, theories, or researchers that increases the credibility and validity of findings.

III. RESULT AND DISCUSSION

A. Result

1. Socioeconomic and cultural typology of society in Tala-Tala Hamlet

Table 2 shows the characteristics of the respondents. The proportion of men was considerably higher than that of women. Gender is important, as both men and women actively participate in land management. Educational level varies from no education to higher school, and the number of uneducated respondents was about half of the educated ones.

The respondents' main occupation is farming. Their average area of wet rice fields is less than 1 ha, and their gardens range from 0.5 to 2 ha. The distance to their residence ranges from 1 to 3 km. The socioeconomic characteristics of the community are important in restoring ecological functions or reducing the damage to the ecology during forest rehabilitation.

The contribution of income obtained from agroforestry development in the forest rehabilitation areas in Tala-Tala Hamlet to the farmers' total income ranged from 1% to 14%, with an average of 4%. This contribution is obtained from the wages of work in the demonstration plot. The plants have not yet contributed to the early stages of planting.

Table 1. Criteria for prioritizing plant species in forest rehabilitation

No.	Assessment aspect	Assessment criteria	Value
1.	Suitable site	Unable to grow	1
		Stunted growth	2
		Grow well	3
2.	Resistant to pests and diseases	Plant dies due to pests and diseases	1
		Plant keeps growing despite many pests and diseases attacks	2
		Plant diseases and pest resistance	3
3.	Resistant to weather and fire	Cannot withstand weather changes and fire	1
		Can withstand weather changes and fire, but its growth is stunted	2
		Can withstand weather changes and fire, still thrive	3
4.	Market prospect	No market prospects	1
		Reasonable price but hard to sell	2
		Reasonable price and easy to sell	3

The number of group members involved in rehabilitation activities was sixteen. Not all group members were eligible for initial land rehabilitation activities; some will be involved later. The total income of the group members ranged from USD 841.1 to USD 3364.5 per year (Table 2). This income was derived from various sectors, including agriculture, livestock, services, trade, and rehabilitation activities. Meanwhile, the income earned by the group members from forest area rehabilitation activities ranged from USD 12.6 to USD 196.3 per year (Table 2).

2. Community preferences on plant species for forest rehabilitation

The preference for certain plant species among the people in Tala-Tala Hamlet reflects the community's attitude toward plant species selection. The research results indicate that several preferred plant species for rehabilitation plots include mahogany (*Swietenia macrophylla*), teak (*Tectona grandis*), red jabon (*Neolamarckia macrophylla*), rambutan (*Nephelium lappaceum*), mango (*Mangifera indica*), durian (*Durio zibethinus*), pomelo (*Citrus maxima*), peanuts (*Arachis hypogaea*), ginger (*Zingiber officinale*), chilli (*Capsicum frutescens*), and corn (*Zea mays*). The

Table 2. Respondent characteristics

Variable	Value
Gender	- Men: 92% - Women: 8%
Educational level	- No education: 32% - Elementary school: 36% - Secondary school: 28% - Higher school: 4% - College: 0
Occupation	Main occupation - Farmer: 90% - Nonfarming: 10% Secondary occupation - Builder labor: 30% - Brown sugar makers: 8% - Trader: 4% - Carpenter: 4% - Resin collectors: 2% - Cattle farmers: 2% - Village officials: 4%
Range of land management (ha)	- Agriculture (private own) land: 0–2 ha household^{-1} - Farm/forest land: 0.5–2 ha household^{-1}
Land distance to the residence (km)	- Agriculture (private own) land: 0.2–2 km - Farm/forest land: 1–3 km
Total income (USD yr^{-1})	- Min: USD 841.1 - Max: USD 3,364.5 - Mean: USD 2,011.6
Income from forest rehabilitation activity (USD yr^{-1})	- Min: USD12.6 - Max: USD 196.3 - Mean: USD 84.1

Note: Number of respondents (variable no. 1–5) = 50 people; number of active respondents in rehabilitation activity (variable nos. 6 and 7) = 16 persons. The exchange rate in December 2021 was USD 1 = IDR 14,267.

Table 3. Weighting results for several species of plants

No	Common name (Species name)	Weighting results				Total value
		Suitable site	Resistance to weather and fire	Resistance to pests and diseases	Market prospects	
1.	Mahogany	3	3	3	3	12
2.	Bungur	3	3	3	3	12
3.	Cashew	3	3	3	3	12
4.	Ginger	3	3	3	3	12
5.	Jabon	3	3	2	3	11
6.	Avocado	3	3	3	2	11
7.	Chili	3	3	2	3	11
8.	Teak	3	2	2	3	10
9.	Tabebuia	3	3	3	1	10
10.	Mango	3	3	2	2	10
11.	Rambutan	3	2	2	3	10
12.	Jackfruit	3	3	2	2	10
13.	Pomelo	3	2	2	2	9
14.	Durian	2	1	3	3	9
14	Corn	3	2	1	3	9
15	Peanuts	3	2	1	3	9
17	Shallots	2	2	2	3	9
19	Rice	3	2	2	2	9
20	Red calliandra	3	-	-	-	-

participatory selection of plant species in the rehabilitation area involves determining priority scales with the community through weighting, as shown in Table 3. The main priority species of forestry plants are 1) mahogany and bungur (*Lagerstroemia speciosa*), 2) red jabon, 3) teak and tabebuia (*Handroanthus chrysotrichus*), and 4) red calliandra (*Calliandra calothyrsus*). The priority scale for MPTS consists of 1) cashew nuts (*Anacardium occidentale*), 2) avocado (*Persea americana*), and 3) mango, rambutan, and jackfruit (*Artocarpus heterophyllus*). Meanwhile, the priorities for annual plants comprise 1) ginger, 2) chilli, and 3) corn, peanuts, shallots (*Allium ascalonicum*), and rice (*Oryza sativa*). Both men and women preferred the annual crops that provide food, as they can be consumed daily by the family members.

Based on the availability of plant seeds and growing requirements (Appendix 1), not all of the plants proposed by the community could be planted in the forest rehabilitation area. Cajuput (*Melaleuca cajuputi*) is one of the proposed plants by Bulusaraung FMU. Based on community preferences on plant species, 52% of them were planted in forest rehabilitation areas, as shown in Table 4.

Table 4. Plant species preferred by the community that planted in the rehabilitation areas

No.	Common name (Species name)
1.	Mahogany
2.	Pine
3.	Red jabon
4.	Cajuput
5.	Rambutan
6.	Mango
7.	Durian
8.	Jackfruit
9.	Red calliandra
10.	Ginger
11.	Chili

3. Group participation in the development and management of forest rehabilitation

In the third stage of FGD, a forest farmers group (FFG) was established and was responsible for planning and managing forest rehabilitation activities in the Bulusaraung FMU. The group was named the Cahaya Tala-Tala FFG, hoping that this group would serve as a role model for the community in Tala-Tala Hamlet.

Candidates for FFG members were selected based on input from the village and the hamlet leader. The selection was based on several criteria, including high motivation to be directly involved in forest rehabilitation activities, gender representation, a shared perception of the benefits of forests, and residence close to the rehabilitation site.

Group formation is crucial to facilitate communication among members and the Bulusaraung FMU. From the selection results, 26 people met the criteria, including twenty-two men and four women. The FFG formation was achieved through deliberation and consensus. The group members elected a chairperson and administrators. They agreed on the group name and work mechanisms. The organizational structure of Cahaya Tala-Tala FFG consisted of 5 administrators (chairman, secretary, treasurer, business section, and cooperation section) and 21 members.

Group participation in the development and management of forest rehabilitation begins from the activity planning stage, which includes selecting plant types and species and creating agroforestry designs. At the planning stage, all group members were actively involved (100%). However, not all group members were consistently involved in the implementation stage, depending on their time availability. Thus, the percentages of the FFG members' involvement in the implementation stage ranged from 19% to 76% (Figure 4).

Although the FFG member participation during the implementation stage did not reach 100%, several members' involvement could be considered as representative of the group. Plant maintenance activities were only carried out by 23% of the group members and were alternated between them. Women and men in the Cahaya Tala-Tala FFG played equal roles at all rehabilitation activities stages, from seedbed nurseries to planting and maintenance. The group processes step by step, not only internally but also externally, with extension workers and FMUs. The group's position, role, and responsibility in maintening of the demonstration plot are written in a cooperation agreement. This proves that group participation in the maintenance of the demonstration plot has reached level 6, i.e., Partnership.

B. Discussion

1. Socioeconomic and cultural typology of society in Tala-Tala Hamlet

Forest rehabilitation requires support from farmer groups that are active, committed, and willing to be directly involved in all stages of forest rehabilitation activities in the Bulusaraung FMU. Therefore, it is necessary to establish an FFG in Tala-Tala Hamlet to manage these

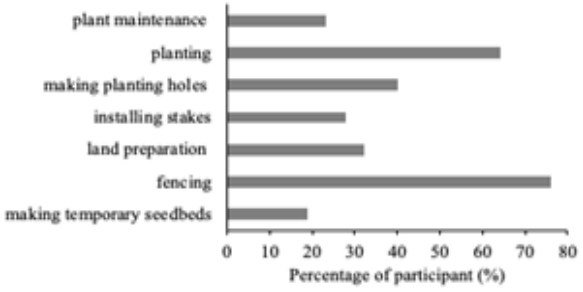

Figure 4. Involvement of the FFG member in the implementation stage of forest rehabilitation

rehabilitation activities. The interview results indicate that some individuals would more actively participate if they could gain an incentive or benefit from the activities. The cooperation and collective community actions in Tala-Tala Hamlet still need to be improved, indicating that social bonding among the community members should be strengthened. The level of trust among the Tala-Tala Hamlet people toward external parties is dynamic and depends on the success of the introduced program activities. When the programs yield actual results, the members' participation increases. This is based on a study by Sabar et al. (2022) in Bulukumba district, which found similar dynamics of the community's trust toward external parties. When external parties, such as an NGO, engage less and do not assist the farmers, the farmers cannot trust them. Conversely, if the farmers receive reasonable assistance, they will have a high level of trust in external parties and will be willing to participate in any activities offered. In the forest rehabilitation activities offered in the research area, the farmers were assisted in preparing an agreement to manage rehabilitation areas to ensure that the community benefits from the outcomes of forest rehabilitation. Consequently, they were motivated to actively participate in all stages of land rehabilitation, including planning, establishing rehabilitation areas, and maintaining the planted plants.

The contribution of income obtained from agroforestry development in the rehabilitation areas in Tala-Tala Hamlet to the farmers' total income ranged from 1% to 14%, with an average of 4%. This contribution was considered low compared to agroforestry's contribution in Nange Mentarep Village, West Kalimantan, Indonesia(Roslinda, Prisila, & Marian, 2023). The low contribution level is attributed to the contribution value only reflecting wages earned from work. This amount will become a benchmark of the success of the work or business, thereby influencing future considerations.

The projected income gained from the forest rehabilitation area in the first year will be from chilli and ginger crops. Further, the community may harvest cajuput leaves and jackfruit in the second year. Later, in the fifth year, all multipurpose tree species (MPTS) are expected to produce fruits or leaves as additional income for the community. This predicted income is expected to contribute to the total household income of group members. Details regarding MPTS, crops planted, and their economic potential are shown in Table 5.

Table 5. Economic value projection of MPTS and crops in the forest rehabilitation area

No.	Plant species	Life cycle (years)	Start of the productive period (years)	Production	Price (USD)	Source
1.	Nutmeg	70–100	3–5	60 kg fruit tree^{-1} yr^{-1}	1.8–2.5 kg^{-1}	Lawalata (2019); Parliansyah et al. (2019); Rawung and Kindangen (2020)
2.	Cajuput	19	2–5	3.97 tons leaves ha^{-1} yr^{-1}	70.1 kg^{-1}	Smith and Idrus (2018); Suhartati and Raharjo (2018)
3.	Durian	100	5–10	100 pcs fruit tree^{-1}	2.5 pcs^{-1}	Ministry of Agriculture (2021)
4.	Mango	50	4–5	200–300 pcs fruit tree^{-1}	1.4–2.1 kg^{-1}	Polosakan, (2016)
5.	Breadfruit	30	3–4	200–700 pcs fruit tree^{-1} yr^{-1}	0.85–1.4 pcs^{-1}	Waryat et al. (2016)
6.	Jackfruit	30	2–5	30–50 pcs fruit tree^{-1}	1.4–3.5 pcs^{-1}	Komarayati (1995); Balamaze et al., (2019)

Tabel 5. Continued

No.	Plant species	Life cycle (years)	Start of the productive period (years)	Production	Price (USD)	Source
7.	Rambutan	30–60	4–8	200–300 kg tree^{-1}	1.1–1.4 kg^{-1}	Arsyadmunir and Ghofur (2019)
8.	Mangosteen	80	5–8	200–500 kg tree^{-1}	1.1–1.8 kg^{-1}	Moniaga et al., (2018); Ministry of Agriculture (2022)
9.	Petai	25	3–4	100 bunches tree^{-1}	1.75 bunches^{-1}	Pujiasmanto, et al. (2022)
10.	Chili	0.5	75 days	13–15 tons ha^{-1}	1.4 kg^{-1}	Nauly (2016); Ministry of Agriculture (2020)
11.	Ginger	1	8–12 months	5.5–8.4 tons ha^{-1}	1.4 kg^{-1}	Gunawan and Rohandi (2018); Sulaehani and Bahrin (2022)

2. Community preferences for plants species

The forest area rehabilitation activities in Tala-Tala Hamlet consider the types of commodities traditionally cultivated by the community and the proposals from the FMU, which are in line with the Bulusaraung FMU's RPHJP. The proposed plant species from the Bulusaraung FMU included mahogany, bungur, pine, red calliandra, candlenut (*Aleurites moluccana*), rambutan, cajuput, upland rice paddy, and porang (*Amorphophallus sp.*).

The community of Bonto Manai Village cultivated various forestry tree species, estate crops, and agricultural commodities through monoculture or mixed cropping patterns (agroforestry). Monoculture crops commonly grown included corn, peanuts, rice, and bamboo (*Bambusa sp.*). Conversely, crops grown through mixed cropping patterns (complex agroforestry) included woody tree species mixed with fruit tree species. Woody tree species included mahogany, teak, jabon, sengon (*Falcataria moluccana*), gmelina (*Gmelina arborea*), kapok (Ceiba pentandra), and wiping fig (*Ficus benjamina*). In contrast, fruit tree species included candlenut, mango, rambutan, starfruit (*Averrhoa carambola*), langsat (*Lansium domesticum*), breadfruit (*Artocarpus altilis*), jackfruit, durian, pomelo, coconut (*Cocos nucifera*), banana (*Musa paradisiaca*), and other food and feed plant species, such as porang, chili, lemongrass (*Cymbopogon citratus*), and elephant grass (*Pennisetum purpureum*).

Based on the Hierarchy of Effect Model (Kotler & Keller, 2009), the Cahaya Tala-Tala FFG members are in the affected area and preference stage. In the affected area, respondents began to feel confident about the certain species of plant they liked and after which it would be used. Meanwhile, at the preference stage, the respondent likes this plant species but does not place it in the main position and still compares it with other species. Hence, the respondent needs a preference position for this species of plant to place the species of plant in an important position compared to other species. At this stage, group members begin to prefer this species of plant over other species (Paz & Vargas, 2023). Community preferences for the species that will be planted in Tala-Tala Hamlet emerge in the alternative evaluation stage in the purchasing decision process, where at this stage, the community is faced with various choices of plant types or species. FFG members' preferences for the species of plants they like are relatively homogeneous, indicating that all group members have the same preferences.

Preference for jabon plant species was mainly due to their rapid growth and short-cutting rotations. Jabon wood reaches a diameter of 30 cm or more within 5 years, making it suitable for timely harvesting and processing (Sarjono et al., 2017). The community also favoured teak and mahogany owing to their high economic value (Raharjo et al., 2016). Furthermore, selecting intercrop types in agroforestry patterns prioritized plant types with economic value, high market demand, ecological benefits, and suitability to local agroclimatic conditions (Prasetyo et al., 2019; Rusyana et al, 2020).

According to the decree of the Ministry of Environment and Forestry no. 23 in 2021, plant species that can be planted for forest rehabilitation in a production forest are woody trees and MPTS, which are suitable for agroclimatic conditions, have economic benefits, and are available in the market (MOEF, 2021). Among the 20 plant species listed in Table 3, some species, such as corn and rice, were not allowed to be planted in the FMU area. These two species require high light intensity for optimal production, thus becoming the main competitor for trees, the primary component of forest rehabilitation (De Oliveira et al., 2016; Nardini et al., 2019). Planting corn on rehabilitated land may hinder the growth of forestry plants. Corn monoculture contributes to soil degradation, characterized by a decline in organic matter content, leading to a decrease in other soil nutrients (Fiorini et al., 2020; Mera et al., 2021).

Red calliandra is planted as a boundary plant on rehabilitated land owing to its numerous benefits, such as functioning as a biofertilizer tree with root nodules that fix nitrogen. Its leaves quickly decompose, enriching the soil with nutrients and releasing allelochemical compounds that inhibit weed growth (Salvator et al., 2020). Furthermore, red calliandra leaves are used for animal feed owing to their high nutrient and energy contents (Franzel et al., 2014; Solomon, 2022). Red calliandra also provides pollen and nectar for bees; honey produced from bees that eat the pollen and nectar of red calliandra has excellent quality (Minarti et al., 2016; Chamberlain, 2000). Furthermore, red calliandra is an erosion-resistant plant on steep slopes (Núñez, 2022). However, red calliandra is an invasive species, so it is necessary to control its reproduction. Research by Yudaputra (2020) indicated that the population of red calliandra is projected to rapidly increase over the next 50 years in Bali Island, emphasizing the need to prevent this vegetation from dominating and posing threats to biodiversity, socioeconomics, and ecosystem health.

Community participation in selecting plant species for rehabilitation activities positively impact their success. Fajri et al. (2024) stated that community participation would increase responsibility in implementing forest and land rehabilitation activities and increase the success of the planting. Community participation in the form of community preferences will strengthen aspects of sustainability and manageability (Budiati & Surtiani, 2015).

3. Group participation in the development and management of forest area rehabilitation

Forest rehabilitation activities require support from farmer groups. Community participation in forest rehabilitation is also essential as it impacts the program's success (Erftemeijer et al., 2022). The group members created their organizational structure as the basis of work division within the organization (Nurlia, 2019), and the structure was completed during the FFG formation.

The participation of group members from the beginning of an activity is crucial, as it increases the group's readiness to carry out activities and programs (Yeny et al., 2018). The Cahaya Tala-Tala FFG shared the common goal of forest rehabilitation by applying agroforestry systems and conducting other forest management activities to preserve the environment and increase the members' income. Forest rehabilitation activities can also improve communal natural resource management because benefits are shared

(Sylviani et al., 2020). The FFG functioned well and was active during the forest rehabilitation activities. Active participation continues until the maintenance stage, aiming to produce products that significantly increase members' income.

To ensure fairness in the implementation of rehabilitation activities, all activities carried out by the group, from planning to implementation, were based on the Agreement of Sustainable Agroforestry Demonstration Plot Management. The agreement outlines the rights and obligations of the group members to plant, maintain, and harvest annual crops and independently market seasonal crops. The annual crop harvest is distributed among the group members managing the land, with 5% allocated to the group treasury. These funds are used for group activities and family members. This demonstrated that the inclusiveness of forest rehabilitation increases the income of the FFG members. This phenomenon also occurred in the FFG of Kampar Regency, Riau Province, as reported by Mohta et al. (2023).

Research findings indicated that community participation in the forest and land rehabilitation activities of the Cahaya Tala-Tala FFG has reached level 6 of Arnstein's participation ladder, i.e., partnership. This is evidenced by the fact that the Cahaya Tala-Tala FFG has gone through several stages of participation: (1) informing–the community received information about planned land rehabilitation activities; (2) consultation–several FGDs were conducted regarding the selection of plant types or species; and (3) partnership–multiparty cooperation was established in formulating policies and programs involving the Cahaya Tala-Tala FFG, the Bulusaraung FMU, the Implementation of Instrument Standardization Unit of Makassar, and the Bonto Manai Village Government. Tripartite collaboration would improve the strength of the FFG and support the success of forest rehabilitation in the Bulusaraung FMU area.

IV. CONCLUSION

The success of the forest area rehabilitation program depends on the community's participation at each stage of the activity. The contribution of income obtained from rehabilitation activities with mixed cropping patterns (agroforestry) in Tala-Tala Hamlet to the total income of the Cahaya Tala-Tala FFG members ranged from 1% to 14%, with an average of 4%. Based on the hierarchy of effects model, the Cahaya Tala-Tala FFG members' preferences for plant species were at the "affected" and the "preference" stages.

The plant species for rehabilitation activities were selected using participatory methods, considering the combination of local commodity plant species, suggestions from Bulusaraung FMU, community choices, and seed availability. The MPTS plants are expected to contribute financially to the local community and support Indonesia's forest rehabilitation.

The Cahaya Tala-Tala FFG's participation in forest and land rehabilitation activities at the Bulusaraung FMU aligns with Arnstein's steps at the "partnership" level. Forest area rehabilitation activities have involved the community, considering their preferences for particular species of plants, to achieve successful rehabilitation efforts. In its implementation, Bulusaraung FMU should take a more active role in providing assistance and offering various incentives to communities actively involved in forest area rehabilitation, enhancing enthusiasm, and fostering a sense of ownership toward the planted vegetation.

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REFERENCES

Alfansyur, A., & Mariyani. (2020). Seni mengelola data: penerapan triangulasi teknik, sumber dan waktu pada penelitian pendidikan sosial. *Jurnal Kajian, Penelitian & Pengembangan Pendidikan Sejarah*, *5*(2), 146–150. doi://10.31764/historis.vXiY.3432.

Arnstein, S. R. (1969). A Ladder of Citizen Participation. JAIP, 35(4), 216-224.

Arsyadmunir, A., & Ghofur, A. (2019). Produktivitas tanaman rambutan (*Nephelium lappaceum* L.) Lahan Pekarangan Kabupaten Bangkalan. *Agrovigor*, *12*(1), 32–38.

Atin, V., Ibrahim, A. L., & Lintangah, W. J. (2022). Food security and Sustainable Forest Management (SFM) implementation at the Forest Management Unit (FMU) level: A case study in Salarom Taka, Nabawan, Sabah. *IOP Conference Series: Earth and Environmental Science*, 1–6. doi://10.1088/1755-1315/1053/1/012015.

Bahruni, Suhendang, E., Darusman, D., & Alikodra, H. (2007). Pendekatan sistem dalam pendugaan nilai ekonomi total ekosistem hutan: Nilai guna hasil hutan kayu dan non kayu. *Jurnal Penelitian Sosial dan Ekonomi Kehutanan*, *4*(3), 369–378. doi://10.20886/jpsek.2007.4.4.%25p.

Budiati, & Surtiani. (2015). Rehabilitasi hutan dan lahan: Modal sosial sebagai penentu keberhasilan RHL. Keluarga Mahasiswa Manajemen Hutan. Retrieved from https://kmmh.fkt.ugm.ac.id/2023/12/15/ Diakses 5 Desember 2024.

Chamberlain, J. R. (2000). *Improving Seed Production in Calliandra calothyrsus: A field Manual for Researchers and Extension Workers*. Oxford: Oxuniprint, Oxford University Press.

De Oliveira, V.R, P.S.L.E Silva, P.L.D. O. F. Siqueira, I.M. Dantas, M.Z.D.Negreiros. (2016). Corn-tree proximity effects in agroforestry experiments. Rev. Caatinga. *Mossoró*, *29*(3), 648–655.

Dharmawan, I. W. S., & Pratiwi. (2023). Implementation of forest-land rehabilitation to support the enhancement of carbon stock on Indonesia's FOLU Net Sink 2030 strategy. *IOP Conf. Series: Earth and Environmental Science*, 1180. doi://10.1088/1755-1315/1180/1/012010.

Dirjen Pengelolaan Daerah Aliran Sungai dan Perhutanan & Sosial. (2011). *UNCCD Meeting, Asia Pacific Regional Consultation 14, Prepatory to COP-10*. Retrieved from www.tnbabul.org/index.php?option=com_, September 2011. ttp://%0AContent&view=article&id=346).

Erftemeijer, P., de Boer, M., & Hilarides, L. (2022). *Status of mangroves in the Western Indian Ocean Region*. Germani: WWF, IUCN and Wetlands International.

Fajri, A. ., Wulandari, C., Kaskoyo, H., & Bakri, S. (2024). Potential for successful forest rehabilitation based on participatory planning in Lampung Province. *Jurnal Belantara*, *7*(1), 141–154. doi://10.29303/jbl.v7i1.1019.

Fiorini, A., Boselli, R., Maris, S. ., Santelli, S., Ardenti, F., Capra, F., & Tabaglio, V. (2020). May conservation tillage enhance soil C and N accumulation without decreasing yield in intensive irrigated croplands? Results from an eight-year maize monoculture. *Agriculture, Ecosystems & Environment*, *296*. doi://10.1016/j.agee.2020.106926.

Fisher, M.R, Daulay M.H, Wicaksono S.A, Bisiaux A, A. E. C. (2023). *Forest Restoration and Rehabilitation in Indonesia: A Policy and Legal Review*. European Forest Institute and Sebijak Institute.

Franzel, S., E. Kiptot, B. L. (2014). Agroforestry: Fodder trees. *Encyclopedia of Agriculture and Food System*. 235–243. doi://10.1016/B978-0-444-52512-3.00023-1.

Gabriel, A. G., Claudio, E. G., & Bolisay, F. A. (2017). Saving Dupinga Watershed in Gabaldon, Nu- eva Ecija Philippines: Insights from community-based forest management model. *Open J Ecol*, *7*, 140–157. doi://10.4236/oje.2017.72011.

Golar, G., Muis, H., Herman, A., & Simorangkir, W. S. (2022). Effectiveness of community based-collaborative on forest management of the forest programme III in Central Sulawesi. *IOP Conference Series: Earth and Environmental Science*, *1114*(1). doi://10.1088/1755-1315/1114/1/012028.

Grix, M., & Watene, K. (2022). Communities and climate change: Why practices and practitioners matter. *Ethics & International Affairs*, *36*(2), 215–230. doi://10.1017/S089267942200020X.

Gunawan, & A, R. (2018). Productivity and quality of three varieties of ginger on many light intensity levels under stand of pine. *J Agroforestry Indonesia*, *1*(1), 1–13. Retrieved from https://media.neliti.com/media/publications/.

Haji, L., Valizadeh, N., & Hayati, D. (2021). The role of local communities in sustainable land and forest management. In: Shit, P.K., Pourghasemi, H.R., Das, P., Bhunia, G.S. (eds). *Spatial Modeling in Forest Resources Management: Environmental Science and Engineering*, 473–503. doi://10.1007/978-3-030-56542-8_20.

Handian, P., & Supriyanto. (2012). Status of land and forest rehabilitation in Indonesia. *Proceedings of the International Symposium on Reclamation, Rehabilitation, and Restoration Toward a Greener Asia, 5 – 12 July 2012*. Kuala Lumpur, Malaysia.

He, J., Ho, M. H., & Xu, J. (2015). Participatory selection of tree species for agroforestry on sloping land in North Korea. *Mountain Research and Development*, *35*(4), 318–327. doi://10.1659/MRD-JOURNAL-D-15-00046.1.

Höhl, M., Ahimbisibwe, V., Stanturf, J. A., Elsasser, P., Kleie, M., & Bolte, A. (2020). Forest landscape restoration—What generates failure and success? *Forests*, *11*, 938. doi://10.3390/f11090938.

Indrajaya, Y., Yuwati, T. W., Lestari, S., Winarno, B., Narendra, B. H., Nugroho, H.Y.S.H. Rachmanadi, D., … Adi, R. N. (2022). Tropical forest landscape restoration in Indonesia: A review. *Land*, *11*, 328. doi://10.3390/land11030328.

J., B., J.H., M., & Y.B, B. (2019). Production and utilization of jackfruit (*Artocarpus heterophyllus*) in Uganda. *African Journal of Food, Agriculture, Nutrition and Development*, *19*(2), 14289–14302. doi://10.18697/ajfand.85.17290.

Kalonga, S. K., Kulindwa, K. A., & Mshale, B. I. (2014). Equity in distribution of proceeds from forest products from certified community-based forest management in Kilwa District, Tanzania Smallscale Forestry. *Small-Scale Forestry*. doi://10.1007/s11842-014-9274-6.

Komarayati, S. (1995). Prospek pengembangan tanaman nangka ditinjau dari sifat arang dan aspek lainnya. *Forest Product Research Journal*, *13*(2), 45–51.

Kotler, P., & Keller, K. . (2009). *Manajemen Pemasaran*, *Edisi 13*. Jakarta: Penerbit Erlangga.

KPH Bulusaraung. (2024). *Daftar Lokasi Kegiatan RHL*. Maros: KPH Bulusaraung.

Lawalata, M. (2019). Analisis Saluran Pemasaran Pala Banda (Myristica fragrans Houtt) di Kecamatan Banda Neira Kabupaten Maluku Tengah. *Agric Jurnal Ilmu Pertanian*, *31*(1), 1–14.

Martini, E., Roshetko, J. M., Purnomosidhi, P., Sebastien, G., & ... (2016). Agroforestry extension needs for land rehabilitation in East Sumba, East Nusa Tenggara, Indonesia. In *ICRAF Working No 232*. doi://10.5716/WP16078.PDF Titles.

Mera, J. L. A., Vinces, L. M. G., Murillo, D. M. S., & Chilán, G. R. M. (2021). The monoculture of corn (zea mayz) and its impact on fertility soil. *International Journal of Chemical & Material Sciences*, *4*(1), 7–12. doi://10.31295/ijcms.v4n1.1649.

Minarti, S., Jaya, F., & Merlina, P. A. (2016). The Effect of Honey Harvesting Time on Kaliandra Plant Area (*Calliandra calothyrsus*) to The Production, Moisture, Viscosity and Sugar Content. *Jurnal Ilmu dan Teknologi Hasil Ternak*, *11*(1), 46–51.

Minisry of Agriculture. (2021). *Buku Lapang Budidaya Durian*. Jakarta: Ministry of Agriculture.

Ministry of Agriculture. (2020). *SOP Budidaya Cabai Rawit*. Jakarta: Ministry of Agriculture.

Ministry of Agriculture. (2022). *Profil Manggis*. Jakarta: Ministry of Agriculture.

MOEF (Ministry of Environment and Forestry). (2021). *Peraturan Menteri Lingkungan Hidup dan Kehutanan Republik Indonesia Nomer 23 Tahun 2021 Tentang Pelaksanaan Rehabilitasi Hutan dan Lahan*.

Mohta, G., Sundawati, L., & Kuncahyo, B. (2023). Forest farmer group development model for sustainable well-being in Kampar Regency. *Jurnal Sylva Lestari*, *11*(3), 427–453. doi://10.23960/jsl.v11i3.748.

Moniaga, I. L., Saerang, J. P., & Gedoan, S. (2018). Pengembangan kawasan agrowisata buah terpadu di Kecamatan Likupang Selatan Kabupaten Minahasa Utara. *Jurnal Abdimas*, *10*(2), 32–43.

Mukhlisa, A. N., Ashari, A. S., & Ariadi, A. (2023). Partisipasi masyarakat dalam rehabilitasi hutan dan lahan di Desa Bonto Manurung, Kabupaten Maros. *Jurnal Pengabdian Masyarakat Bangsa*, *1*(5), 300–310. doi://10.59837/jpmba.v1i5.150.

Murniati, Suharti, S., Yeny, I., & Minarningsih. (2022). Cacao-based agroforestry in conservation forest area: Farmer participation, main commodities and its contribution to the local production and economy. *Forest and Society*, *6*(1), 243–274. doi://10.24259/fs.v6i1.13991.

Nardini, C., Sgarbossa, J., Schwerz, F., Elli, E. F., Medeiros, S. L. P., & Caron, B. O. (2019). Growth and solar radiation use efficiency of corn cultivated in agroforestry systems. Emirates. *Journal of Food and Agriculture*, *31*(7), 535–543. doi://10.9755/ejfa.2019.v31.i7.1977.

Nauly, D. (2016). Fluktuasi dan disparitas harga cabai di Indonesia. *Jurnal Agrosains dan Teknologi*, *1*(1).

Nawir, A. A., Murniati, & Rumboko, L. (2008). Rehabilitasi hutan di Indonesia: akan kemanakah arahnya setelah lebih dari tiga dasawarsa? In *Rehabilitasi hutan di Indonesia: akan kemanakah arahnya setelah lebih dari tiga dasawarsa?* doi://10.17528/cifor/002455.

Núñez, J. A. . (2022). Leguminous trees for sustainable tropical agroforestry. In *Advances in Legumes for Sustainable Intensification* (pp. 483 – 504). doi://10.1016/B978-0-323-85797-0.00006-9.

Nurlia. (2019). Pengaruh struktur organisasi terhadap pengukuran kualitas pelayanan (Perbandingan antara ekspektasi /harapan dengan hasil kerja). *Meraja Journal*, *2*(2), 51–66.

Octavia, D., Murniati, Suharti, S., Hani, A., Mindawati, N., Suratman, … Faubiany, V. (2023). Smart agroforestry for sustaining soil fertility and community livelihood. *Forest Science and Technology*, *19*(4), 315–328. doi://10.1080/21580103.2023.2269970.

Parhusip, S, Suharti, S., Sukandi, T., Amano, M., & Matsumura, N. (2019). Economic analysis of local people's involvement in community-based forest management (CBFM) in Desa Ciomas, Indonesia. *Journal of Forest Planning*, *25*(1), 1–14. doi://10.20659/jfp.2019.002.

Parliansyah, R., Riniarti, M., & Duryat. (2019). Kajian produksi tanaman pala di HKm Rangai Sejahtera KPH Rajabasa Gorontalo. *Journal of Forestry Research*, *2*(2), 120–129. doi://10.32662/gjfr.v2i2.721.

Paz, M. D. R., & Vargas, J. C. . (2023). Main theoretical consumer behavioural models. A review from 1935 to 2021. *Heliyon*, *9*(e), 13895. doi://10.1016/j.heliyon.2023.e13895.

Polosakan, R. (2016). Sebaran jenis-jenis Mangifera di Indonesia. *Ethos Jurnal Penelitian dan Pengabdian Masyarakat*, *4*(1), 93–97.

Prasetya, C. D., Syaufina, L., & Santosa, G. (2017). The effect of various types of forest fires on pine resin productivity in Gunung Walat University Forest, Sukabumi, *Indonesia. BIODIVERSITAS*, *18*(1), 478 – 482. doi://10.13057/biodiv/d180105.

Prasetyo, A. D., Indriyanto., & Riniarti, M. (2019). Jenis-jenis tanaman di lahan garapan petani kpph wana makmur dalam tahura Wan Abdul Rachman. *Jurnal Sylva Lestari*, *15*(2), 154–165. doi://10.20527/es.v15i2.6944.

Pretty, J., & Bharucha, Z. . (2014). Sustainable intensification in agricultural systems. *Annals of Botany*, *114*(8), 1571–1596. doi://10.1093/aob/mcu205.

Pujiasmanto, B., Sulandjari, & Manurung, I. R. (2022). Pendampingan budidaya petai berbasis action research di Desa Kenayan, Kecamatan Ngemplak, Kabupaten Sleman, Yogyakarta. *Pemberdayaan Masyarakat Untuk Meningkatkan Ketahanan Pangan Menuju Indonesia Emas 2045*, 109–113. Surakarta.

Raharjo, A. S. ., Kurniawan., H., Umroni., A., Pujiono., E., & Wanaha., M. (2016). Potensi mahoni (Swietenia macrophylla King) pada hutan rakyat sistem kaliwo di Malimada, Sumba Barat Daya. *Jurnal Ilmu Lingkungan*, *14*(1), 1–10. doi://10.14710/jil.14.1.1-10.

Rawung, J. B. M., & Kindangen, J. G. (2020). Analisis kelayakan ekonomi usaha tani pala di Kabupaten Sitaro, Sulawesi Utara. *Jurnal Pengkajian dan Pengembangan Teknologi Pertanian*, *22*(2), 235-242. doi://10.21082/jpptp.v22n2.2019.p249-256.

Reubens, B., Moeremans, C., Poesen, J., Nyssen, J., Tewoldeberhan, S., Franzel, S., … Muys, B. (2011). Tree species selection for land rehabilitation in Ethiopia: From fragmented knowledge to an integrated multicriteria decision approach. *Agroforestry System*, *82*(3), 303–330. doi://10.1007/s10457-011-9381-8.

Roslinda, E., Prisila, F. W., & Marian, Y. (2023). The patterns of agroforestry and its contribution

to the community income. *Jurnal Sylva Lestari*, *11*(3), 543–557. doi://10.23960/jsl.v11i3.749.

Roslinda, E., Rianti, R., & Ershinta, H. (2022). Participatory analysis of social forestry program: case study in Sanggau district, Indonesia. *Jurnal Ilmu Kehutanan*, *16*(2), 128–141. doi://10.22146/jik.v16i2.2540.

Rusyana, N., K. Murtilaksono, & Rusdiana, O. (2020). Analisis potensi hutan rakyat dalam mendukung Kabupaten Kuningan sebagai kabupaten konservasi. *Jurnal Perencanaan Pembangunan Wilayah dan Perdesaan*, *4*(1), 14–30. doi://10.29244/jp2wd.2020.4.1.14-30.

Sabar, A., Dassir, M., & Ita, S. E. N. (2022). Modal sosial masyarakat pengelolaan Hutan Kemasyarakatan (HKM) Buhung Lali Kecamatan Gantarang Kabupaten Bulukumba. *Jurnal Kehutanan Papuasia*, *8*(1), 94–101. doi://10.46703/jurnalpapuasia.Vol8.Iss1.294

Salvator, K., Gaston, N., Menus, N., & Godefroid, N. (2020). Allelopathic effects of *Calliandra calothyrsus* Meisn, *Senna siamea* L. and *Gliricidia sepium* (Jacq.) walp leaves on maize (*Zea mays* L.) and bean (*Phaseolus vulgaris* L.) root and shoot growth. *IJASRE*, *6*(2), 47–59. doi://10.31695/IJASRE.2020.33711.

Sarjono, A., Lahjie, A. M., & Simarangkir, B. D. A. S. (2017). Carbon sequestration and growth Anthocephalus cadamba plantation in North Kalimantan, Indonesia. *Biodiversitas*, *18*(4), 1385–1393. doi://10.13057/biodiv/d180414.

Smith, H., & Idrus, S. (2018). Karakteristik minyak kayu putih pada berbagai lokasi di Maluku. *Majalah BIAM*, *14*(2), 58–69. doi://10.29360/mb.v14i2.3892.

Solomon, J. K. . (2022). Legumes for animal nutrition and dietary energy. In *Advances in Legumes for Sustainable Intensification* (pp. 227 – 244). doi://10.1016/B978-0-323-85797-0.00026-4.

Sudarmadji, T., & Hartati, W. (2016). The process of rehabilitation of mined forest lands toward degraded forest ecosystem recovery in Kalimantan, Indonesia. *Biodiversitas Journal*, *17*(1), 185 – 191. doi://10.13057/biodiv/d170127.

Suhartati, T., & Raharjo, H. (2018). Taksiran umur optimal produksi daun kayu putih. *Jurnal Wana Tropika. Jurnal Wana Tropika*, *8*(2), 69–72.

Sulaehani, R., & Bahrin. (2022). Aplikasi prediksi harga jahe merah metode time series autoregressive integrated moving average. Jambura *Journal of Electrical and Electronics Engineering*, *4*(1), 108–113.

Suparwata, D. O., Arsyad, M., Hamidun, M. S., Rukmana, D., & Bahua, M. I. (2016). Community participation on evaluation stage in critical land rehabilitation program. *Advances in Environmental Biology*, *10*(10), 170–180. Retrieved from http://www.aensiweb.com/AEB/http://creativecommons.org/licenses/by/4.0/.

Sylviani, Suka, A. P., Surati, & Kurniasari, D. R. (2020). Social capital in managing community plantation forest: A case study at KPH Boalemo, Gorontalo Province. *Indonesian Journal of Forestry Research*, *7*(1), 71–82. doi://10.20886/ijfr.2020.7.1.71-82.

Waryat, M., Yanis, & Mayasari, K. (2016). Analisis nilai tambah dan usaha pengolahan tepung sukun sebagai upaya peningkatan pendapatan petani. *Jurnal Agraris*, *2*(2), 128–133. doi://10.18196/agr.2233.

Widodo, G., Avenzora, R., Malihah, E., & Sunarminto, T. (2023). Polarization of local community perception on sociocultural dynamics in ecotourism development of Bopunjur, West Java. *Indonesian Journal of Forestry Research*, *10*(1), 113–134. doi://10.59465/ijfr.2023.10.1.113-134.

Wulandari, C., Budiono, P., & Iswandaru, D. (2021). Importance of social characteristic of community to support restoration program in protection forest. *Indonesian Journal of Forestry Research*, *8*(2), 173–186. doi://10.20886/ijfr.2021.8.2.173-186.

Yeny, I., Narendra, B. ., & Nuroniah, H. . (2018). Potensi pengembangan masoyi (Cryptocarya massoy (Oken) Kosterm) di Wilayah UPTD KPH Unit V Boalemo berdasarkan kesiapan masyarakat dan tingkat kesesuaian lahan. *Jurnal Penelitian Hutan Tanaman*, *15*(2), 125–145. doi://10.20886/jpht.2018.15.2.125-145.

Yudaputra, A. (2020). Modelling potential current distribution and future dispersal of an invasive species *Calliandra calothyrsus* in Bali Island, Indonesia. *Biodiversitas Journal of Biological Diversity*, *21*(2), 674–682. doi://10.13057/biodiv/d210233.

Appendix 1. Plant species and their growth requirements

No.	Plant species	Growth Requirements
1.	Rambutan (*Nephelium lappaceum*)	- Can grow well at an altitude of 1 – 700 m above sea level (asl) - Grows well in sandy or clay soil with a small amount of sand and lots of organic matter - pH between 6 – 6.7
2.	Durian (*Durio zibethinus*)	- Can grow well at altitudes up to 100 - 800 m asl - Rainfall 1500 mm yr^{-1}, pH 6 – 7 - Suitable for sandy loam soil
3.	Mango (*Mangifera indica*)	- Can grow well at altitudes up to 1,300 m asl - Suitable for growing on sandy loam soil - Rainfall 1000 mm yr^{-1}
4.	Nutmeg (*Myristica fragnans*)	- Can grow well at an altitude of 0 – 700 m asl - Rainfall 2000 – 3500 mm yr^{-1}, pH 5.5 – 7 - Suitable for growing on clay to sandy soil
5.	Mangosteen (*Garcia mangostana*)	- Grows well at an altitude of 0 – 800 m asl - Rainfall is around 1250 mm yr^{-1}, pH 5 – 7 - Grows well on red and yellow latosol and podzolic soil types
6.	Breadfruit (*Artocarpus altilis*)	- Grows well at an altitude of 750 – 900 m asl - Rainfall is around 2000 – 3000 mm yr^{-1}, pH 6 – 7 - Grows well on alluvial soil types that contain lots of organic material
7.	Red Jabon (*Neolamarckia macrophylla*)	- Grows well at an altitude of 10 – 1000 m asl - Damp areas
8.	White Jabon (*Neolamarckia cadamba*)	- Grows well at an altitude of 1500 – 3000 m asl - pH 4.5 – 7 - Brown alluvial and podzolic soil types
9.	Cajuput (*Melaleuca cajuputi*)	- Grows well at an altitude of 5 – 450 m asl - Rainfall 1,300 – 1,750 mm yr^{-1} - Grows well on grumusol, latosol and regosol soil types
10.	Mahogany (*Swietenia macrophylla*)	- Grows well at an altitude of 0 – 1500 m asl - Rainfall 500 – 2500 mm yr^{-1} - Grows in slightly clayey soil