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Community Participation in Various Stages of Non-Timber Forest Product Management: Case Study in the Tebing Siring Community Forest, Indonesia

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ABSTRACT

Community participation is a key component of sustainable forest management, particularly in social forestry schemes that utilize non-timber forest products (NTFP). However, empirical evidence on how participation varies across specific operational stages of NTFP management remains limited, especially in Indonesian Community Forest settings. Examining participation at different stages is important because involvement in nursery, planting, maintenance, and harvesting may reflect distinct responsibilities, incentives, and benefit-sharing arrangements. This study therefore aimed to analyze community participation across four operational stages of NTFP management in the Tebing Siring Community Forest, Tanah Laut Regency, South Kalimantan. A descriptive quantitative case-study design was applied to 20 purposively selected members from a population of 65 group members. Participants were selected based on their involvement in NTFP management activities and availability during data collection. Participation was assessed using a four-point ordinal rating scale, with higher scores indicating greater participation. Descriptive analysis showed mean scores of 3.20 for nursery, 2.95 for planting, 2.70 for maintenance, and 2.65 for harvesting. These results suggest greater participation in the first stages and less in maintenance and harvesting. However, the Friedman test found no statistically significant differences between the four stages ($\chi^2 = 2.73$; df = 3; p = 0.436) and Kendall's W suggested very weak concordance (W = 0.045). The observed differences across stages should thus be viewed as descriptive patterns rather than statistically validated differences. The study contributes a stage-based perspective for evaluating community engagement in social forestry management. The findings suggest clarifying maintenance responsibilities and improving transparency in harvesting and benefit-sharing arrangements. Nevertheless, the small, purposively selected sample limits generalizability. Future studies should use larger, more representative samples, validate the participation measurement instrument, and examine factors influencing participation using inferential or causal analyses.

1. Introduction

Community-based forest management was created to address the problems in centralized forest management systems that often failed to assure ecological sustainability and well-being of forest-dependent communities. In this respect, social forestry shifts local communities from

passive policy beneficiaries to active stakeholders in forest management. This reform recognizes communities' access rights, strengthens local institutions and promotes participatory governance. Collectively, these elements may improve the success of community-level forest management and forest governance more generally (Gutiérrez-Zamora et al. 2023; Hidayat et al. 2025; Hidayat et al. 2024; Massiri et al. 2024).

Social forestry is also globally recognized as an adaptable governance mechanism that links conservation goals, poverty reduction and the promotion of local community rights, especially in developing countries under significant deforestation pressure (Devkota 2020; Lin et al. 2019; Suswadi et al. 2023).

Minister of Environment and Forestry Regulation Number 83 of 2016 on Social Forestry, subsequently strengthened by Minister of Environment and Forestry Regulation Number 9 of 2021 on Social Forestry Management, illustrates this policy commitment. These policies determine community access to forest management, institutional development and sustainable economic advantages. One recognized social forestry scheme is *hutan kemasyarakatan* (HKm), hereafter referred to as community forest, which aims to integrate livelihood improvement with ecological functions (Astuti et al. 2020; Dasril et al. 2025; Hidayat et al. 2025; Massiri et al. 2024).

Nevertheless, legal access alone does not ensure effective management because outcomes also depend on farmer cooperation, organizational capacity, institutional support, program trust, business management, and broader governance conditions (Lawasi 2024; Mohta et al. 2023; Nugroho et al. 2025; Ramadhan et al. 2022; Ramadhani et al. 2024; Wulandari et al. 2024).

Non-timber forest products (NTFPs) play an essential role in community forestry by providing livelihood options for local populations. They are generally sustainable alternatives to activities that could destroy forest resources. In addition to raising household income, NTFPs can support more stable livelihoods while reducing demand on timber resources (Latifah et al. 2021; Rehan et al. 2019). However, their economic significance depends on local conditions, market access, production volume and participation in local or regional value chains (Akomaning et al. 2023; Nguyen et al. 2025). To achieve these benefits, community participation is required at all stages of the management cycle, including nursery construction, planting, maintenance and harvesting (Muin et al. 2021; Rao and Rao 2024, 2025).

Community participation is central to social forestry because access rights become meaningful only when local people can take part in the activities through which forest resources are planned, managed, maintained, and used. Participatory-development literature distinguishes different intensities and forms of involvement rather than treating participation as a single condition (Sianturi et al. 2026; Sukran et al. 2026). In community forestry, participation may take the form of decision-making, collective work, implementation, benefit sharing, institutional engagement, or other contributions. This study focuses more narrowly on implementation-related participation across four operational stages of NTFP management. This distinction matters because involvement may vary with labor requirements, expected benefits, institutional arrangements, social conditions, and individual capacities (Derkyi et al. 2021; Morizon et al. 2023; Timilsina et al. 2024).

Although Indonesian social forestry research frequently discusses participation, it often reports it as an aggregate or broadly descriptive condition rather than disaggregating it by operational activity. Such aggregation can hide whether members participate consistently across the NTFP management cycle or focus on particular activities. Stage-specific description therefore provides a practical way to examine how engagement is distributed across nursery, planting,

maintenance, and harvesting, while non-parametric repeated-measures analysis can test whether the observed differences are statistically supported. This study applies that established analytical logic to the Tebing Siring Community Forest case and uses the results to identify management issues that may require closer attention (Agus et al. 2020; Anatika et al. 2019; Dyck 2023; Gusmailina et al. 2020; Suswadi et al. 2023).

Accordingly, this study aims to: 1) describe the level and distribution of community participation at the nursery, planting, maintenance, and harvesting stages of NTFP management and 2) test whether participation differs statistically among these related stages. The study contributes by applying stage-based participation analysis to an Indonesian Community Forest group, rather than by proposing a new participation theory or statistical method.

2. Materials and Methods

2.1. Research Design

This study used a descriptive quantitative case-study approach to measure community participation across four operational stages of NTFP management. The individual member of the Tebing Siring Community Forest Farmers Group was the unit of analysis because the participation score reflected each respondent's reported involvement, although the activities occurred within the institutional setting of the farmer group (Derkyi et al. 2021; Jalonen et al. 2023). The stage-specific design described participation in nursery, planting, maintenance, and harvesting separately before testing the related scores using a non-parametric repeated-measures procedure.

2.2. Location Map

The research was conducted in the Tebing Siring Community Forest, Tanah Laut Regency, South Kalimantan Province (**Fig. 1**). The site was purposively selected because the farmer group actively manages NTFPs across the management cycle from nursery activities to harvesting. The NTFPs reported in the study area include rubber (*Hevea brasiliensis*), dogfruit (*Archidendron pauciflorum*), candlenut (*Aleurites moluccanus*), cinnamon (*Cinnamomum burmannii*), and several fruit-tree species. Researchers commonly use purposeful site selection in community-based natural resource research when a location has characteristics directly relevant to the analytical objectives (Budi et al. 2021).

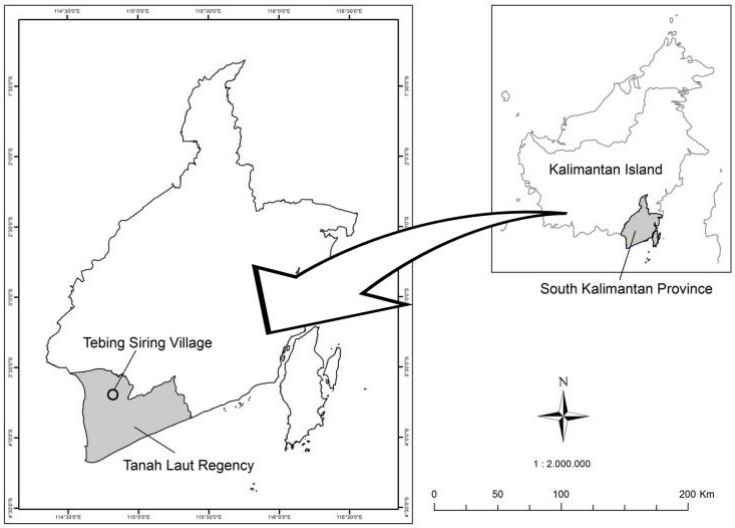


Fig. 1. Research location map.

2.3. Population and Sampling Techniques

The research population consisted of 65 registered members of the Tebing Siring Community Forest Farmers Group. The analysis used a purposive, non-probability subsample of 20 members selected because they were directly involved in NTFP management activities and could provide stage-specific participation ratings. Random sampling was not used because the original field design prioritized information from members with direct operational experience; however, this choice limits population-level inference and may underrepresent inactive or minimally involved members. No a priori power analysis was conducted, and a census or probability-based sample would have provided stronger generalizability. Accordingly, the 20 respondents are treated as an involved-member case-study sample rather than as a statistically representative sample of all 65 members. The Results and Discussion section reports respondent characteristics available from the primary field dataset. After identifying the target respondents, the study defined the specific research variables and indicators used to measure participation at each management stage.

2.4. Research Variables and Indicators

In this study, community participation is defined as members' involvement in implementing NTFP management operations throughout the operating cycle. Conceptually, the study draws on participatory-development concepts that distinguish between forms and intensities of involvement, rather than presenting participation as a single undifferentiated condition (Pretty 1995). The present analysis does not assess empowerment, citizen control, or institutional power as distinct constructs; instead, it operationalizes participation narrowly as reported involvement in nursery, planting, maintenance, and harvesting activities. This operational definition facilitates comparison of activity-specific engagement within the research site, but should not be regarded as an overall measure of participation in decision-making, benefit sharing or governance.

2.5. Variable and Measurement

The key variable was community participation in NTFP management, measured separately at the nursery, planting, maintenance, and harvesting stages. These stages represent the major operational cycle of NTFP management at the study site and allow participation to be examined as a process rather than as one aggregate condition. Previous research indicates that participation in community-based forest management can vary across activities based on labor requirements, institutional arrangements, and expected benefits (Derkyi et al. 2021; Timilsina et al. 2024).

Primary data were collected using a structured questionnaire in which respondents rated their participation at each management stage on a four-point ordinal scale: 4 = very active, 3 = active, 2 = less active, and 1 = inactive. The instrument consisted of four stage-specific ordinal ratings rather than a multi-item psychometric scale intended to measure one latent construct. The available study documentation provides no evidence of formal expert validation, pilot testing, Cronbach's alpha, or construct-validity testing; therefore, no such validation is claimed, and this limitation is explicitly acknowledged. Semi-structured interviews provided contextual information for interpreting the quantitative findings, while secondary information came from group activity records, government documents, and supporting reports on community forestry and NTFP management.

2.6. Data Collection Procedure

Data were collected through field visits using three complementary sources consistent with the triangulation shown in **Fig. 2**: (1) structured questionnaires for the four stage-specific participation ratings, (2) semi-structured interviews with selected group members and local actors to clarify contextual issues such as labor availability, land-management arrangements, and benefit-sharing practices, and (3) secondary documentation from group and government records. The interview observations provided qualitative context and were not analyzed as quantitative predictors of participation. Combining these sources supported contextual interpretation of the field findings (Friedman et al. 2020; Massiri et al. 2024).

2.7. Data Analysis

Descriptive statistics and non-parametric inferential analysis were used. For each NTFP management stage, participation was summarized using frequency, percentage, mean, standard deviation, standard error, and coefficient of variation. Because the four-point responses are ordinal, the mean and related dispersion statistics are presented as descriptive summaries and are interpreted together with the full frequency distribution. The mean participation score was calculated using Equation 1.

$$\bar{x} = \frac{\sum x_i}{n} \quad (1)$$

where $\bar{x}$ is the mean participation score, x_i is the participation score of each respondent, and n is the number of respondents. To describe the relative variability of participation scores across respondents, the coefficient of variation (CV) was calculated using Equation 2.

$$CV = \frac{SD}{\bar{x}} \quad (2)$$

where CV is the coefficient of variation, SD is the standard deviation, and $\bar{x}$ is the mean participation score.

Differences in participation across the four related NTFP management stages were examined using the Friedman test, a non-parametric alternative to repeated-measures ANOVA that is suitable for repeated ordinal observations from the same respondents (Nath et al. 2024). The test was applied to the four stage-specific scores reported by the same 20 respondents. Kendall's coefficient of concordance (Kendall's W) was reported as an effect-size measure of concordance associated with the Friedman analysis (Andraka-Christou et al. 2022). Given the small purposive sample, interpret inferential results cautiously and do not generalize them to the entire population. All statistical analyses were performed using JASP version 0.19.3.0. Kendall's W was calculated using Equation 3.

$$W = \frac{12S}{m^2(n^3 - n)} \quad (3)$$

where W is Kendall's coefficient of concordance, S is the sum of squared deviations of the rank totals from their mean, m is the number of respondents, and n is the number of management stages.

For descriptive presentation, mean scores were grouped into three author-defined categories by dividing the theoretical score range into equal one-point intervals: low (1.00–2.00), moderate (>2.00–3.00), and high (>3.00–4.00). These intervals are not presented as an externally validated participation classification; they are used only to aid descriptive interpretation. Statistical conclusions about differences among stages are based on the Friedman test and Kendall's W.

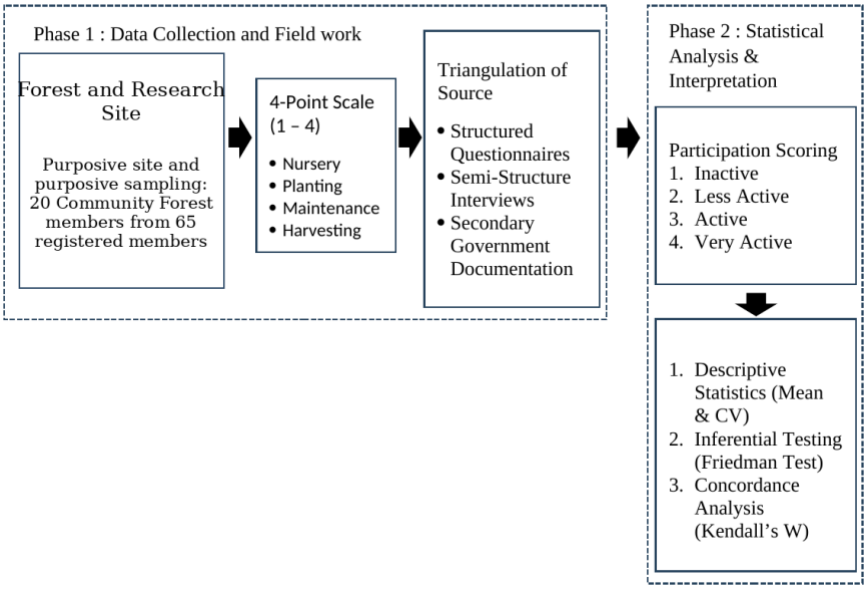


Fig. 2. Flowchart of the research procedure for assessing community participation across the stages of NTFP management.

3. Results and Discussion

3.1. Participation Patterns Across NTFP Management Stages

The analysis was done on twenty respondents, who gave their grade of participation in nursery, planting, maintenance and harvesting. The mean age of respondents was 50.45 ± 10.02 years (range 34–71 years). Nineteen respondents (95%) were male; sex was not recorded for one respondent, and the item was left as missing rather than inferred. Fifteen respondents (75%) completed elementary school, and five (25%) completed junior high school. All 20 respondents reported rubber tapping as their main occupation. The mean number of household dependents was 3.50 (range 2 to 6). Regarding secondary jobs, six respondents (30%) indicated no secondary occupation; six (30%) reported casual labor; four (20%) reported farming; two (10%) reported livestock farming; one (5%) claimed workshop work; and one (5%) reported work as a carpenter. Twelve responders (60%) were from the Ingin Maju group and eight (40%) from Suka Maju. These characteristics represent the purposively selected respondents and should not be read as population estimates for all 65 registered members. The NTFPs handled in the research region are rubber (*Hevea brasiliensis*), dogfruit (*Archidendron pauciflorum*), candlenut (*Aleurites moluccanus*), cinnamon (*Cinnamomum burmannii*) and several fruit tree species. **Table 2** shows the frequency distribution of respondents' involvement. It can be seen that the mean participation was highest for nursery (3.20), followed by planting (2.95), maintenance (2.70) and harvesting (2.65) (**Table 1**).

Table 1. Descriptive statistics of community participation levels at each stage of NTFP management

Repeated Measures Factor 1	N	Mean	SD	SE	Coefficient of variation
Nursery	20	3.20	0.95	0.21	0.30
Planting	20	2.95	1.00	0.22	0.34
Maintenance	20	2.70	1.13	0.25	0.42
Harvesting	20	2.65	1.14	0.25	0.43

The descriptive distribution indicates stronger involvement in early operational activities. At the nursery stage, 50% of respondents were very active, and 25% were active, whereas only 5% were inactive. Planting also showed a relatively high proportion of very active respondents (40%), while maintenance and harvesting displayed more even distributions across activity categories (**Table 2** and **Fig. 3**). Interviews suggested that nursery and planting were easier to join because they involved familiar species, visible group activities, and, in some cases, support through government programs, CSR assistance, or group self-help. Similar studies have shown that commodity familiarity, institutional support, expected benefits, and the organization of collective work can influence participation in forest and agroforestry activities (Gutiérrez-Zamora et al. 2023; Muin et al. 2021; Mohta et al. 2023; Timilsina et al. 2024). These explanations are qualitative and should not be interpreted as statistically tested determinants in the present study.

Table 2. Frequency distribution and percentage of community participation levels at each stage of NTFP management

Participation Category	Nursery n (%)	Planting n (%)	Maintenance n (%)	Harvesting n (%)
Very active	10 (50.00)	8 (40.00)	6 (30.00)	6 (30.00)
Active	5 (25.00)	4 (20.00)	6 (30.00)	5 (25.00)
Less active	4 (20.00)	7 (35.00)	4 (20.00)	5 (25.00)
Inactive	1 (5.00)	1 (5.00)	4 (20.00)	4 (20.00)
Total	20 (100)	20 (100)	20 (100)	20 (100)

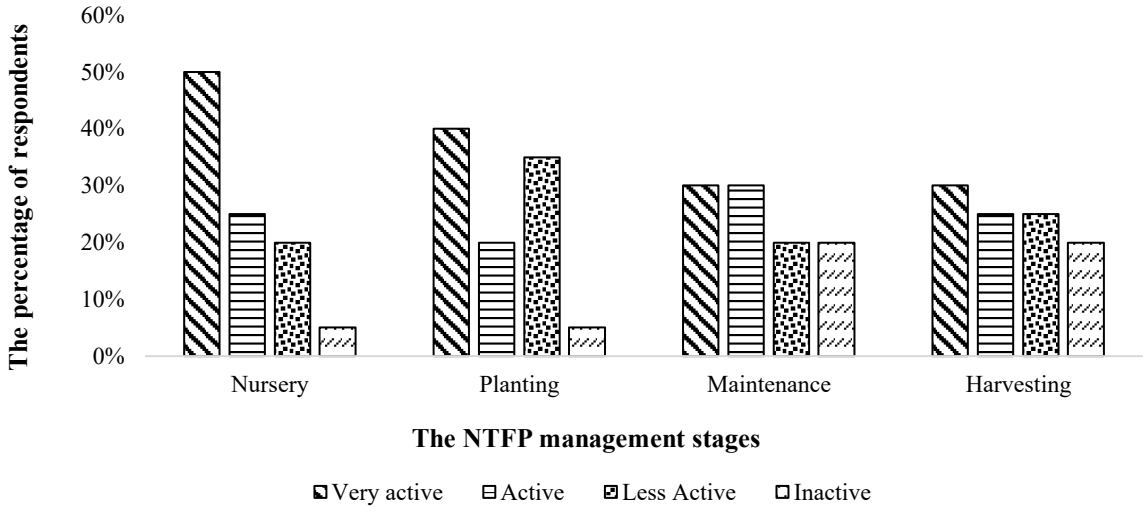


Fig. 3. Percentage distribution of community participation levels at each stage of NTFP management.

Using the author-defined descriptive intervals specified in the Methods, nursery was classified as high (3.20), whereas planting (2.95), maintenance (2.70), and harvesting (2.65) were classified as moderate. The overall mean across the four stages was 2.88, also classified as moderate (**Table 3**). These values were recalculated directly from the frequency distribution reported in **Table 2** to ensure consistency across the manuscript.

Table 3. Level of community participation at each stage of NTFP management based on average score value

Stages of NTFP Management	Average Score Value	Participation Level Category
Nursery	3.20	High
Planting	2.95	Moderate
Maintenance	2.70	Moderate
Harvesting	2.65	Moderate
Overall Average	2.88	Moderate

3.2. Statistical Comparison and Interpretation of Participation

The Friedman test found no statistical evidence of differences in participation among nursery, planting, maintenance, and harvesting ($\chi^2 = 2.73$; df = 3; $p = 0.436$). Kendall's W was 0.045, indicating a very small degree of concordance/effect associated with the stage rankings (**Table 4**). Therefore, although the sample shows descriptive differences in means and category distributions, the data do not support a conclusion that participation differs systematically among the four management stages. This is the study's central inferential result and requires cautious interpretation because of the small purposive sample.

Table 4. Results of the Friedman and Kendall's W tests on the level of community participation in NTFP management

Test Statistics	Mark
Number of respondents (n)	20
Number of activity stages	4
Friedman's chi-square (χ^2)	2.73
Degrees of freedom (df)	3
Significance value (p-value)	0.436
Kendall's W	0.045
Test decision	No significant difference
Level of agreement	Very small concordance/effect

Higher descriptive participation in nursery and planting may relate to the characteristics of early-stage activities at the study site. The farmed species – rubber, dogfruit, candlenut, cinnamon and fruit trees – are familiar to farmers and have perceived economic worth. Seedlings have also been provided through government support, CSR programs and group self-help. Consistent with previous studies, commodity suitability, expected advantages, and external assistance may motivate participation in forest and agroforestry operations (Astuti et al. 2020; Gutiérrez-Zamora et al. 2023; Latifah et al. 2021; Mohta et al. 2023; Timilsina et al. 2024). In the present study, however, these parameters were not quantified as explanatory variables, but rather used to frame the descriptive pattern.

Maintenance and harvesting are separate kinds of promise. Interviews suggested that maintenance entailed continuous work over a longer period, while harvesting could involve direct labor by landowners or delegated labor under the group's benefit-sharing structure. These variables may explain the more diffuse descriptive categories of participation at later phases, but the study did not quantify labor requirements, delegation frequency, incentive amounts or their statistical correlations with participation ratings. Thus, these contextual observations do not permit any causal inference (Morizon et al. 2023; Muin et al. 2021; Rao and Rao 2024).

The stage-specific presentation remains a useful descriptive organizing structure because it shows how responses are distributed across operational tasks that would otherwise be combined into a single aggregate score. However, dividing activities into stages and applying the Friedman test and Kendall's W are established analytical procedures rather than novel methodological innovations. Accordingly, this study contributes by applying these procedures to the Tebing Siring Community Forest context and identifying management questions suggested by the observed descriptive patterns.

The Friedman test was non-significant, indicating no statistically significant systematic change between management phases. The very low value of Kendall's W also indicates little concordance/effect in the stage rankings. Interviews also identified potential limitations, including age, health, competing activities and labor availability. However, the paper does not provide full respondent-level data on these factors, and no correlation or regression analyses were undertaken. These points are therefore mainly qualitative observations rather than statistically supported conclusions.

The lack of statistical significance should not be taken as evidence of a consistent pattern of strong or weak involvement. It simply means this data set does not provide sufficient evidence that the four stage-specific participation distributions differ fundamentally. The small purposive sample, potential selection bias toward active members, and limitations in measurement validation mean alternative explanations cannot be disentangled. These findings therefore support a careful, case-specific interpretation rather than sweeping institutional claims about community forestry groups.

The results jointly suggest that descriptive stage-level patterns may inform management diagnosis even when inferential differences are not statistically verified. This distinction is essential because management attention can be directed to activities with larger proportions of less-active or passive responses without claiming a statistically proven stage effect (Derkyi et al. 2021; Morizon et al. 2023; Timilsina et al. 2024).

Future implementation should strengthen the evidence base by using a census or probability-based sample where practical, expanding respondent-level variables to include health status and working hours, verifying participation in the instrument, and directly testing explanatory variables. Such enhancements would enable more confident linking of stage-specific descriptions to social, economic and institutional causes.

3.3. Management Implications and Study Limitations

The analytical findings described above, while modest in scope, suggest possible operational areas for attention in the Tebing Siring Community Forest. Although the Friedman test did not identify significant differences among management stages, the descriptive distributions show larger proportions of less-active or inactive responses in maintenance and harvesting than in nursery. These patterns may therefore provide a cautious basis for identifying activities that warrant further management attention, rather than evidence of statistically distinct stage effects. Interviewees described a 50:50 benefit-sharing arrangement between landowners and laborers during harvesting. Based on these interviews, such an arrangement may allow landowners with physical or time constraints to remain involved indirectly; however, this study did not quantitatively test its effect on direct landowner participation. Practical follow-up could include clearer assignment of maintenance roles, a simple activity plan and participation record, and

transparent documentation of the existing harvesting benefit-sharing arrangement (Lawasi 2024; Wulandari et al. 2024).

Forest extension officers and relevant local forestry agencies could coordinate routine facilitation, as they are well positioned to support farmer-group organization and follow-up at the site level. Universities and CSR partners already active in seedling or technical support can provide complementary training and monitoring, especially for maintenance planning and basic record-keeping. These recommendations are deliberately limited to operational concerns identified in the Tebing Siring case and are not intended as universal prescriptions (Lungwana et al. 2025; Massiri et al. 2024; Mncina and Agholor 2021). Several constraints should also be mentioned. The 20 respondents were a deliberate subsample of a 65-member population. Selecting members who are directly involved may underrepresent inactive members and overestimate descriptive levels of participation. No a priori power analysis was performed. One respondent had no sex recorded, and respondent-level information on health state, working hours, and labor availability was not systematically available for quantitative analysis. Stage-specific ratings were not explicitly psychometrically evaluated, and explanations for context in interviews were not assessed as statistical determinants. These constraints limit the generalizability of the findings and constrain causal interpretation.

4. Conclusions

Descriptive community participation varied across four stages of NTFP management in Tebing Siring Community Forest. The mean involvement score was highest for nursery (3.20), followed by planting (2.95), maintenance (2.70), and harvesting (2.65), as shown by the frequency distribution. However, the Friedman test failed to discover statistical evidence of differences among stages ($\chi^2 = 2.73$; df = 3; p = 0.436), and Kendall's W was very small (0.045). Thus, the stage-specific perspective is of most use here as a descriptive device for structuring patterns of engagement, not as a marker of different stage effects. Management should specify upkeep tasks, keep basic participation records and describe the current benefit-sharing system for public harvesting. Future research should use census or probability sampling when feasible and systematically document respondent characteristics. The measurement instrument should be validated, and the explanatory elements should be tested before causal or larger institutional implications are drawn. Mixed-method approaches that combine statistical analysis with in-depth qualitative investigation of institutional dynamics could provide a fuller understanding of the social and organizational factors driving participation in community forestry.

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Author Contributions

M.A.: Conceptualization, Methodology, Validation, Supervision, Writing – Original Draft Preparation, Writing – Review and Editing, Project Administration; T.S.: Methodology, Validation, Formal Analysis, Writing – Review and Editing, Project Administration; H.K.: Data Curation, Validation, Writing – Review and Editing; W.N.H.: Formal Analysis, Investigation, Data Curation, Writing – Original Draft Preparation, Visualization; H.R.: Investigation,

Resources, Visualization, Writing – Review and Editing.

Conflict of Interest

The authors declare no conflict of interest.

Declaration of Generative AI And AI-Assisted Technologies in the Manuscript Preparation

During manuscript preparation, the authors used ChatGPT to improve academic English, revise sentence structure, and assist with manuscript organization. The authors also used Turnitin for similarity reports and AI writing reports. After using these tools, the authors carefully reviewed, verified, and edited the manuscript as necessary. The authors take full responsibility for the accuracy, integrity, and content of the published work.

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