



Practical Training on Grafting of Multi Purpose Tree Species Durian (*Durio zibethinus*) as an Innovation for Youth Empowerment

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Abstract: Durian (*Durio zibethinus*) is an important Multi Purpose Tree Species (MPTS) in the Maluku *dusung* system, yet seed-propagated trees are slow to fruit and variable, and young people's vegetative propagation skills remain limited. This community service program aimed to improve the knowledge and skills of members of the Angkatan Muda Gereja Protestan Maluku (AMGPM), North Ambon Island Region, in durian grafting and to foster their interest in nursery enterprises. The activity was held on 30 May 2026 in Hatu Village, West Leihitu District, Central Maluku Regency, with 40 participants, using an andragogical approach combining lectures, discussions, demonstrations, and hands-on practice. Effectiveness was assessed with pre- and post-tests of knowledge and a before-and-after skills assessment. Mean MPTS knowledge scores increased from 30.00 to 90.00 (N-gain 0.86, high), and mean skill scores increased from 1.26 to 3.86 on a 1–4 scale, with the largest gain in vegetative propagation (1.15 to 3.88). About 80% of participants were interested in replicating the training. This practical training can strengthen church youth as suppliers of quality seedlings and agents of conservation based on local resources.

Introduction

Maluku is an archipelagic region whose people largely depend on the agriculture, plantation, and forestry sectors for their livelihoods. At the site level, a traditional land management system known as *dusung* combines fruit trees, timber trees, spices, and food crops on the same area, thereby producing a variety of products while maintaining ecological functions (Irwanto *et al.*, 2023; C. M. A. Wattimena *et al.*, 2025). Agroforestry, a land management system that combines forestry crops with agricultural crops on the same land unit,

provides economic benefits without sacrificing conservation functions (Hairiah *et al.*, 2003; Irwanto *et al.*, 2026; Nair *et al.*, 2021). This system provides ecosystem services, such as soil and water protection and carbon storage, while diversifying farmers' income (Jose, 2009; Mbow *et al.*, 2014).

An important component of agroforestry is *Multi Purpose Tree Species* (MPTS), namely tree species that yield more than one product or benefit, for example fruit, timber, and non-timber forest products. Durian (*Durio zibethinus*) is a high-value MPTS in Maluku, alongside clove, nutmeg, canarium nut (*kenari*), and cashew (C. M. A. Wattimena *et al.*, 2025). Indonesia is a center of origin and dispersal of durian, so its genetic diversity is high, and local Maluku durians have great potential for development (Sagurung & Putri, 2024; Zainal & Mundjanah, 2023).

Nevertheless, durian trees grown from seed generally take much longer to bear fruit, and their fruit characteristics are not always the same as those of the mother tree because seeds resulting from cross-pollination produce diverse offspring (Nahar, 2025; Sarun, 2026). Vegetative propagation by grafting overcomes both constraints. Scions from superior mother trees carry the parent's traits intact, and grafted plants tend to bear fruit earlier than plants grown from seed (Sarun, 2026; Simons & Leakey, 2004). The success of durian grafting is determined by many factors, including the compatibility of rootstock and scion, the condition of the seedlings, and the position and precision of the graft. A study on local Maluku durian reported graft success of up to 98% at the best grafting position (Sagurung & Putri, 2024). In other words, the technique can succeed well when done correctly, but it demands manual dexterity that can only be mastered through direct practice.

Training in vegetative propagation of fruit trees in Leihitu District has been reported for air layering (Sahupala & Irwanto, 2025). However, to the authors' knowledge, training in durian grafting that specifically targets church youth in Maluku has not been widely documented. Yet the Angkatan Muda Gereja Protestan Maluku (AMGPM; Youth Movement of the Protestant Church of Maluku) is a church-based youth organization with an extensive network reaching the level of congregation branches and villages (*negeri*), making it a strategic partner for replicating skills in many communities (Pongtambing *et al.*, 2024).

The situation analysis identified three partner problems: (1) limited member knowledge about the concepts and techniques of MPTS cultivation, including vegetative propagation of durian; (2) a lack of practical grafting skills; and (3) low involvement of the younger generation in the management of *dusun* resources and environmental conservation.

This article reports a practical durian grafting training for members of AMGPM, North Ambon Island Region. The objectives of the activity were (1) to improve participants' knowledge of MPTS cultivation and vegetative propagation of durian, (2) to improve participants' skills in grafting durian, and (3) to foster young people's interest in and readiness to replicate these skills, including as a nursery business opportunity. The reporting focuses on evidence of improvement in participants' understanding and skills based on a comparison of the initial and final evaluations. This activity supports the *Sustainable Development Goals* (SDGs) 8 and 15 (Leal Filho *et al.*, 2023; Unga, 2015).

Methods

Target, Time, and Location

The target of the activity was 40 AMGPM members from the North Ambon Island Region representing various congregation branches. The activity took place on Saturday, 30 May 2026, from 09:00 to 15:00 WIT (Eastern Indonesia Time). The lecture session was held in the Hall of SMA Negeri 14 Hatu (State Senior High School 14 Hatu), and the practical session in the yard of the same school, in Hatu Village, West Leihitu District, Central Maluku Regency. This durian grafting training was one part of a series of agroforestry community service activities for AMGPM held on the same day.

Approach and Stages of the Activity

The activity used an andragogical approach that emphasizes participatory, two-way, and practice-oriented learning because the participants were young adults who already had local experience in managing land (Knowles, 1980; Spoto, 2025). The learning design followed the experiential learning cycle (Kolb, 1984), namely delivery of concepts, demonstration and hands-on practice, and then joint reflection. The stages of the activity included:

- **Preparation and coordination** with AMGPM leaders, preparation of materials, preparation of practical grafting materials and tools (rootstock seedlings, scions, sharp grafting knives, binding material, and plastic bags for covers), and preparation of evaluation instruments.
- **Initial evaluation** (*pre-test*) at participant registration, before the material was delivered, to measure initial knowledge and skills.
- **Interactive lecture and discussion** on MPTS cultivation and vegetative propagation (resource person Andjela Sahupala, S.Hut., M.P.), moderated by Dr. Irwanto, S.Hut., M.P. The material covered agroforestry concepts, potential MPTS species, nursery practices, and the principles of durian grafting.
- **Demonstration and hands-on practice of durian grafting** in groups with guidance from the resource person; participants carried out every stage themselves.
- **Final evaluation** (*post-test*) and participatory evaluation in the form of participant feedback, followed by closing of the activity.

Table 1. Schedule of activities

Time (WIT)	Activity
09:00–09:15	Participant registration and initial evaluation (<i>pre-test</i>)

Time (WIT)	Activity
09:15–10:30	Welcome remarks (Advisor, Secretary of the Central Board, and Regional Chair of AMGPM) and introduction to the activity by the Team Leader
10:45–11:30	Lecture and discussion: MPTS cultivation and vegetative propagation of durian
12:15–13:00	Break and lunch
13:00–14:00	Demonstration and practice of durian grafting (in groups)
14:00–14:30	Final evaluation (<i>post-test</i>) and participant feedback
14:30–15:00	Closing

The schedule is shown in part; other sessions held on the same day are outside the scope of this article.



Figure 1. Community Service Team and AMGPM Leaders

Technical Stages of Durian Grafting

The grafting taught was top grafting, namely joining the shoot tip of a scion from a superior mother tree with a rootstock in the form of a seed-grown durian seedling. The main principle is to bring the cambium tissues of the rootstock and the scion into contact so that callus tissue and vascular connections form (Harun *et al.*, 2022). The technical stages explained and practiced by participants are presented in Table 2.

Table 2. Technical stages of durian grafting practiced

Stage	Activity practiced	Principle and purpose
1. Rootstock preparation	Selecting healthy, straight, seed-grown durian seedlings with sufficiently sturdy stems, and keeping them in a shaded place.	A vigorous rootstock provides roots and nutrient reserves for the graft.
2. Scion selection	Taking healthy twigs from a superior mother tree that has borne fruit, of a size comparable to the rootstock stem, with fresh buds.	Ensuring that the mother tree's superior traits are inherited and that the scion diameter matches the rootstock.

Stage	Activity practiced	Principle and purpose
3. Cutting	Cutting and splitting the rootstock, and trimming the base of the scion into a wedge with a sharp, clean knife.	A smooth cut widens the cambium contact area.
4. Joining	Inserting the scion into the split of the rootstock so that the cambium of both touch each other.	Cambium contact is the key to graft union formation.
5. Binding and covering	Binding the graft tightly, then covering the scion with a transparent plastic bag as a cover.	Maintaining humidity and preventing the scion from drying out or the graft from shifting.
6. Initial care	Placing the seedling in a shaded place, watering, monitoring shoot growth, gradually opening the cover, and removing wild shoots from the rootstock.	Directing nutrients to the scion shoots and helping the seedling adapt.

Source: activity materials and practice, 2026.

Initial and Final Evaluation Instruments

Improvement in participants' capacity was measured using a *one-group pretest–posttest* design. Two instruments were used, with identical items in the initial and final evaluations so that the results could be compared.

- **Knowledge test:** 10 multiple-choice questions on MPTS cultivation (agroforestry concepts, MPTS species, planting patterns, nursery practices, and vegetative propagation). Scores were calculated on a 0–100 scale and categorized as low (<60), moderate (60–79), and high (≥80).
- **Skills assessment:** four indicators of practical MPTS cultivation skills (Table 3), rated on a 1–4 scale (1 = unable to perform; 2 = able with full assistance; 3 = able with minimal assistance; 4 = able to perform independently). In the initial evaluation, participants rated their own abilities. In the final evaluation, the assessment was supplemented with a facilitator observation sheet during the practice so that it did not rely solely on self-assessment.

Table 3. Skill indicators assessed

Code	Skill indicator
K1	Selecting superior durian MPTS
K2	Preparing grafting tools and materials
K3	Carrying out vegetative propagation by grafting
K4	Planting seedlings with appropriate agroforestry spacing and planting patterns

Indicator K3 includes durian grafting, which was the focus of the training.

Data Analysis

The data were analyzed using simple descriptive methods. For each aspect, the mean initial and final scores, the difference in means, and the percentage of relative improvement were calculated, namely $(\text{final mean} - \text{initial mean}) / \text{initial mean} \times 100\%$. For knowledge scores, the normalized *N-gain* was also calculated, $g = (\text{final score} - \text{initial score}) / (100 - \text{initial score})$, with the categories high ($g \geq 0.7$), moderate ($0.3 \leq g < 0.7$), and low ($g < 0.3$) (Hake, 1998). Qualitative data in the form of participants' responses and suggestions were analyzed using descriptive-thematic analysis.



Figure 2. The welcome remarks from the Advisory Pastor.

Results And Discussion

Implementation of the Activity

The activity was attended by 40 AMGPM members from the North Ambon Island Region and proceeded as planned. The welcome remarks from the Advisory Pastor, the Secretary of the Central Board, and the Regional Chair of AMGPM expressed appreciation for the university's concern for the empowerment of church youth in natural resource management. The lecture session covered agroforestry concepts, potential MPTS species in Maluku (durian, clove, nutmeg, canarium nut, cashew, and breadfruit) (C. M. A. Wattimena *et al.*, 2025), site criteria and multistrata planting patterns on dry and sloping land, nursery and planting techniques, and vegetative propagation of durian through grafting, including the reasons why grafted seedlings bear fruit earlier and are more uniform than seed-grown seedlings.



(a) The speaker provides an illustration (b) Participants

Figure 3. Implementation of the Lecture and Discussion

In the practical session, the resource person first demonstrated the stages of durian grafting (Table 2), after which participants carried them out themselves with guidance from the resource person. Participants were directly involved in every stage, from preparing the rootstock and scion, cutting, joining, and binding, to covering the graft, rather than merely observing.



(a) Demonstration of durian shoot grafting (b) Practice by participants

Figure 4. Implementation of the Grafting and MPTS Propagation Practice

Improvement in Understanding (Knowledge)

A comparison of the initial and final evaluation results is presented in Table 4. The mean MPTS cultivation knowledge score increased from 30.00 in the initial evaluation to 90.00 in the final evaluation, a rise of 60 points (relative improvement of 200%). The *N-gain* value of 0.86 is classified as high (Hake, 1998). By category, the average participant shifted from the low level (<60) in the initial evaluation to the high level (≥ 80) in the final evaluation.

Table 4. Participants' knowledge scores in the initial and final evaluations

Knowledge aspect	Initial mean	Final mean	Gain (points)	Relative gain (%)	N-gain
MPTS cultivation (10 items)	30.00	90.00	60.00	200.0	0.86

Scores on a 0–100 scale (n = 40). $N\text{-gain} \geq 0.7$ = high. Source: primary data, 2026.

This large improvement is understandable because part of the material, particularly the principles of vegetative propagation and grafting, was relatively new to the participants. General agroforestry concepts and local MPTS species are already close to participants' gardening experience, so there was less room for increase (Sahupala & Irwanto, 2025; A. Wattimena & Makaruku, 2022). The skills assessment results in the following section reinforce this, because the largest improvement actually occurred in vegetative propagation. This pattern is consistent with the andragogical principle that adults learn most effectively when the material relates to real experience and needs (Knowles, 1980; Yahya *et al.*, 2024).

Improvement in Skills

The results of the skills assessment in the initial and final evaluations are presented in Table 5. The overall mean skill score (K1–K4) rose from 1.26 (category: unable to perform) to 3.86 (category: able to perform independently), with a facilitator observation score of 3.72 in the final evaluation. The largest improvement occurred in K3, namely vegetative propagation including grafting, from 1.15 to 3.88, with a facilitator observation score of 3.88. The smallest improvement occurred in K2 (seeding/nursery work), which was already more familiar to participants (initial score 1.50).

Table 5. Participants' skill scores in the initial and final evaluations (1–4 scale)

Indicator	Initial mean	Final mean	Change	Facilitator score
K1 Selecting superior durian MPTS	1.15	3.80	2.65	3.70
K2 Preparing grafting tools and materials	1.50	3.84	2.34	3.60
K3 Carrying out vegetative propagation by grafting	1.15	3.88	2.73	3.88
K4 Planting seedlings with appropriate agroforestry spacing and planting patterns	1.25	3.92	2.67	3.70
Mean	1.26	3.86	2.60	3.72

For indicator descriptions, see Table 3. Initial scores are self-assessments; observation scores are available only for the final evaluation. Source: primary data, 2026.

The improvement in skills was supported by the substantial share of practice in the activity design, namely one hour of hands-on practice after the lecture session. Learning

through concrete experience, reflective observation, and re-application (Kolb, 1984) allows participants to turn conceptual knowledge into working ability. Grafting is a psychomotor skill: the precision of the cut, cambium contact, and binding can only be mastered when participants try it themselves and receive direct correction (Sagurung & Putri, 2024). Guidance from the resource person in small groups gave participants the opportunity to try, correct mistakes, and ask questions directly.

It should be noted that skills in the initial evaluation were self-assessed by participants. Self-assessment at the initial stage is potentially overestimated because participants did not yet know the correct work standards, so the apparent improvement may be smaller than the actual improvement. For this reason, the final assessment was supplemented with facilitator observation. The skill scores also describe participants' ability to carry out the grafting stages during the training; the survival of the grafts in the field can only be assessed several weeks later and forms part of the follow-up.

Participant Feedback and Interest

In the participatory evaluation session, participants expressed high enthusiasm for the potential of developing MPTS as an alternative source of income for families and congregations. Participants also asked follow-up questions and provided input showing an interest in applying and replicating the training outcomes in their respective villages. Several participants said that MPTS could become a new business opportunity for young people.

Based on the evaluation results, about 80% of participants stated that they were interested in applying or replicating the training results in their respective communities, while the remaining participants expressed interest in continuing the discussion and obtaining technical support before implementation. This high response indicates that the training not only improved knowledge and skills but also opened participants' insight into the link between environmental conservation and economic opportunity. This finding is in line with the third objective of the activity, namely to foster young people's interest in and readiness to replicate the skills acquired.

Innovation and Implications for Youth Empowerment

This activity introduced three forms of innovation to the partner. **First**, a technical innovation in the form of durian grafting for church youth. This technique enables young people to propagate superior mother trees vegetatively, produce more uniform seedlings that tend to bear fruit earlier, and enrich the MPTS composition of existing *dusung* (Hartmann & Kester, 1959; Simons & Leakey, 2004). **Second**, a social innovation in the form of youth empowerment through practical training. The AMGPM network of branches and congregations allows the training outcomes to be replicated widely, and the value of caring for creation (*eco-theology*) provides a moral foundation for conservation efforts. **Third**, an economic innovation in the form of grafted-durian nursery business opportunities run by youth groups or congregations, using local Maluku durian as rootstock and superior varieties as the scion source (Sagurung &

Putri, 2024; Zainal & Mundjanah, 2023).

In terms of economic resilience, durian as an MPTS provides a long-term and diverse source of income for families, while nurseries open up small-scale business opportunities that can be initiated by young people and congregations. In terms of the environment, multistrata tree cover helps conserve soil and water on sloping land and stores carbon (Jose, 2009; Mbow *et al.*, 2014). This contribution is in line with SDG 8 (decent work and economic growth) and SDG 15 (life on land), as well as the role of youth organizations in supporting the achievement of the SDGs (Pongtambing *et al.*, 2024; Unga, 2015).

The planned follow-up includes monitoring graft success several weeks after grafting, establishing demonstration plots or seedling nurseries in congregations, technical assistance for participants who wish to start a nursery business, and further training on seedling care and marketing. This technical support responds to the request of some participants and is important for sustaining the impact of the activity.



Figure 5. Group Photo with Training Participants

Conclusion and Recommendation

The practical durian grafting training for 40 AMGPM members of the North Ambon Island Region was carried out successfully on 30 May 2026 in Hatu Village. The comparison of the initial and final evaluations showed an improvement in MPTS cultivation knowledge (mean from 30.00 to 90.00; *N-gain* 0.86) and MPTS skills (mean from 1.26 to 3.86), with the largest improvement in vegetative propagation (1.15 to 3.88). About 80% of participants were interested in applying or replicating the training results. The combination of lectures, discussions, demonstrations, and hands-on practice using an andragogical approach was effective in building the capacity and interest of church youth to become suppliers of superior durian seedlings. The sustainability of the impact needs to be maintained through monitoring of graft success, demonstration nursery plots, and long-term assistance.

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