



Beyond Subsistence: How Livelihood Assets Shape Farmers' Crop Preferences in Community Forest Areas in Maros, Indonesia

(Melampaui Kebutuhan Subsisten: Bagaimana Aset Penghidupan Membentuk Preferensi Tanaman Petani di Kawasan Hutan Komunitas di Maros, Indonesia)

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ABSTRACT

This study examines how the livelihood assets of farmers managing land within Community Forest areas influence their crop preferences in Laiya Village, Maros Regency, Indonesia. Using the Sustainable Livelihood Framework, farmers' preferences were categorized into two groups: crops currently cultivated and crops they intend to develop. The data collected covered household livelihood conditions, including expenditures for activities within and outside the Community Forest area, total household expenditures, and income and earnings from both forest-based and non-forest sources. The findings show that the main commodities produced within the Community Forest area are pine resin and honey, while outside the forest area farmers cultivate rice, peanuts, porang, and ginger, as well as raise livestock such as cattle and poultry. In terms of average income contribution, pine resin accounts for approximately 27% and is the largest source of income from the Community Forest area. However, overall, the average income generated from outside the forest area is still higher than income from Community Forest sources. As a result, most farmers prefer to expand rice and peanut cultivation outside the forest area, as these activities are perceived to be more profitable and provide more stable income. These findings suggest that farmers' choices are influenced not only by basic subsistence needs but also by the pursuit of higher and more stable income. Limited financial and physical assets, such as low bargaining power and restricted access to pine resin sites, drive their focus on food crops outside the forest. Strengthening infrastructure, capacity building, and value-added forest product development are needed to enhance livelihoods.

ABSTRAK

Penelitian ini menganalisis bagaimana modal penghidupan (*livelihood assets*) yaitu yang dimiliki petani di kawasan Hutan Kemasyarakatan (HKm) memengaruhi pilihan komoditas yang mereka usahakan di Desa Laiya, Kabupaten Maros, Indonesia. Menggunakan kerangka *Sustainable Livelihood Framework*, preferensi petani dibagi menjadi komoditas yang saat ini sedang dikembangkan dan komoditas yang akan direncanakan untuk dikembangkan. Data penelitian mencakup pengeluaran rumah tangga, pengeluaran dan pendapatan dari aktivitas pengelolaan lahan di dalam dan luar kawasan HkM. Hasil menunjukkan bahwa getah pinus dan madu merupakan komoditas utama yang dihasilkan di dalam kawasan HKM, sementara di luar HkM, petani menanam padi, kacang tanah, porang, jahe, serta memelihara ternak seperti sapi dan unggas. Getah pinus memberikan kontribusi sekitar 27% terhadap pendapatan HKM, namun secara keseluruhan, kontribusi pendapatan terbesar berasal dari aktivitas dari luar HKM. Kondisi ini membuat sebagian besar petani lebih memilih mengembangkan padi dan kacang tanah karena dianggap lebih menguntungkan dan memberikan pendapatan yang lebih stabil. Temuan ini

mengindikasikan bahwa pilihan komoditas petani dipengaruhi tidak hanya oleh kebutuhan dasar, tetapi juga oleh pertimbangan ekonomi jangka panjang. Keterbatasan aset finansial dan fisik, seperti rendahnya daya tawar dan akses yang terbatas ke lokasi penyadapan, turut mendorong fokus petani pada komoditas pangan di luar Hkm. Penguatan infrastruktur, peningkatan kapasitas, serta pengembangan nilai tambah produk hutan diperlukan untuk memperbaiki kondisi penghidupan petani.

1. Introduction

Effective and well-structured forest management planning is essential for achieving sustainable forest governance. The Community Forest program, established under Minister of Forestry Regulation P.37/Menhut II/2007, serves as a key initiative to ensure the optimal, equitable, and sustainable use of forest resources while maintaining ecological and environmental functions (Latifah et al. 2023). The adoption of agroforestry practices within Community Forest areas also has the potential to restore ecological functions and enhance community welfare (Permana et al. 2025).

Although farmers' crop preferences in Community Forest areas are often assumed to be driven primarily by subsistence needs, especially for household food security, empirical evidence shows that their decisions are more complex. Crop choices are influenced not only by subsistence requirements but also by income diversification strategies, risk management considerations, and the availability of livelihood assets (Anisah et al. 2022). Livelihood assets such as financial capital, physical infrastructure, and social capital play a crucial role in shaping these decisions (Oktalina et al. 2016). Farmers with greater access to financial and physical resources tend to cultivate crops with higher economic value, whereas those with limited assets rely more heavily on production focused on subsistence. These findings challenge the assumption that farmers act solely based on subsistence needs and show that their choices reflect adaptive strategies shaped by both opportunities and constraints (Permatasari & Rondhi 2022).

This study was conducted in the Community Forest area of Laiya Village in the

Cenrana Sub district of Maros Regency, South Sulawesi, Indonesia, a region where social forestry programs are actively implemented. The research examines how livelihood assets, particularly financial and physical capital, influence farmers' crop preferences within Community Forest areas. The findings are expected to inform the development of more effective policies and program designs for Community Forest management, thereby strengthening household resilience and increasing community income derived from forest-based products.

2. Materials and Methods

2.1. Study Area

The research was conducted in a Social Forestry area under the Community Forest (HKm) permit scheme, managed by the Abulo Sibatang Farmer Group in Laiya Village, Cenrana Subdistrict, Maros Regency (5°3'34.85" S and 119°49'20.10" E), Indonesia. Laiya Village covers an area of 79.83 km² or 7,983.17 hectares. The location was selected because previous studies indicated the presence of extensive under-canopy areas that could be cultivated, but local farmers have not fully utilized them. Studying this site makes it possible to understand how farmers decide which crops to plant and what factors, such as income needs and resource availability, influence their decisions in the Community Forest area

2.2. Sampling Methods

The respondents were selected using a snowball purposive sampling method with a focus on members of the Abulo Sibatang Forest Farmer Group. A total of 29 respondents were included, with the main criterion being active

group membership. This technique was chosen based on the consideration that it helps identify farmers who are actively managing community forest land while also obtaining diverse information from individuals with different experiences in crop selection. The number of respondents was determined until reaching the point of data saturation, which is the condition when the information obtained is considered sufficiently representative to describe the general patterns in the field

2.3. Procedures of Research

The data collected in this study included both quantitative and qualitative information. Quantitative data covered household income, production costs, and net income from various livelihood sources inside and outside the community forest area, as well as land use patterns, which included the types of crops currently cultivated and preferences for future crop development. Qualitative data were obtained through in-depth interviews and focus group discussions with farmers, focusing on their perceptions of the factors that influence crop preferences. These factors included subsistence needs, market opportunities, availability of livelihood assets such as financial and physical capital, and constraints such as market access, infrastructure, and regulations.

A snowball purposive sampling technique was employed to identify respondents who were actively engaged in community forest management and possessed direct experience in decision-making related to land use and crop selection. The initial participants were selected based on their land tenure status, active membership in community forest farmer groups, and dependence on forest-based livelihoods. These initial respondents subsequently referred other farmers who met the same eligibility criteria. In total, 29 respondents were included in the study. This number is considered representative of farmer households managing community forest plots in the research area, as it captures variations in livelihood strategies, landholding sizes, and

levels of dependence on forest resources. The sample size is therefore sufficient to reflect the diversity of conditions without resulting in data redundancy.

The analysis was carried out using an integrated quantitative and qualitative approach. The quantitative approach was applied to calculate total income, costs, and net earnings from each livelihood source. Crop preferences were also examined by comparing the types of crops currently cultivated with those planned for future development. The qualitative approach was conducted descriptively to explore the factors influencing farmers' preferences through questionnaires, interviews, and focus group discussions. By combining both approaches, this study aims to provide a more comprehensive understanding of the relationship between livelihood assets and farmers' crop preferences, as well as their implications for community forest management strategies.

3. Results of Research

3.1. Farmers' Crop Choices

The types of crops currently cultivated by farmers are quite diverse and include sugar palm (*Arenga pinnata*), clove (*Syzygium aromaticum* L.), ginger (*Zingiber officinale*), coconut (*Cocos nucifera* L.), porang (*Amorphophallus muelleri*), pine resin (*Pinus merkusii*), groundnut (*Arachis hypogaea* L.), and rice (*Oryza sativa* L.). However, the products directly harvested from within the Community Forest area are relatively limited, consisting mainly of pine resin and wild honey (**Figure 1**).



Figure 1. Pine Forest Seen from the Access Road

The analysis shows that rice cultivation is the dominant crop, occupying 49% of the total cultivated land (Figure 2).

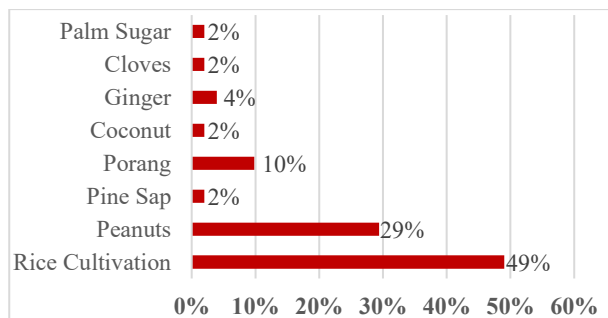


Figure 2. Percentage of Types of Commodity Crops Currently Being Cultivated

This reflects its role as the staple food for local households and its strategic importance in supporting local food security. Peanuts rank second with 29%, largely due to their relatively low maintenance requirements and stable market demand. Porang is the third most cultivated crop with 10%, a finding consistent with Permatasari and Rondhi (2022) and Hasibuan et al. (2022), who note the increasing market demand for porang as an export commodity and as a raw material for both food and non-food industries.

Other crops such as palm sugar, cloves, ginger, coconut, and non-timber forest products including pine resin and honey are also cultivated, although on a smaller scale. This diversity of crop choices demonstrates a combination of food crops, plantation crops, medicinal plants, and forest products, which if managed in an integrated manner have the

potential to enhance household economic resilience while maintaining the sustainability of Community Forest management. Fahrizal (2017) similarly reported that the main activities of communities in Community Forest areas are tapping pine resin and collecting wild honey

Nevertheless, only about 2 % of respondents reported tapping pine resin within the Community Forest area. This suggests that although resin tapping and honey collection are the primary forest-based activities, the number of farmers engaged in them is relatively small. The main reason is the limited accessibility of the tapping sites, which are distant and difficult to reach. Pine resin tapping is carried out throughout the year by farmer group members, although the intensity decreases during the rainy season due to lower resin productivity, greater labor allocation to rice farming, and poor road infrastructure leading to the pine forest.

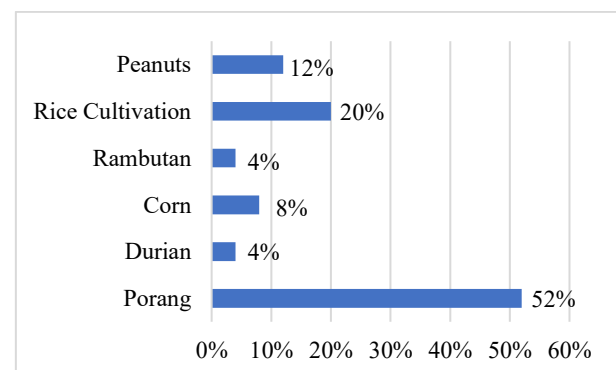


Figure 3. Percentage of Types of Commodity Crops Farmers Intend to Develop

The analysis shows that the crop most widely chosen by farmers for development is porang, accounting for 52 % followed by rice at 20 % and peanuts at 12 % (Figure 3). Interestingly, none of these primary crops selected by farmers are cultivated within the Community Forest area, meaning their utilization is mostly concentrated outside the forest area. One of the most preferred crops among farmers is porang, which is typically harvested in March, April, June, and July, with the peak harvest occurring in April. The high

interest in porang is largely due to its promising economic value. In the study area, the price of porang can reach around IDR 10,000 per kilogram, although under certain conditions the price may drop by half, with the average falling to only around IDR 5,000 per kilogram. This price decline is primarily linked to accessibility issues.

The main road, which serves as the only route for transporting agricultural products from the study area, was once blocked by a landslide. Under normal conditions, farmers typically transport their porang harvest to the market themselves or sell it directly to middlemen at prices aligned with market standards. However, when road access was disrupted, farmers' bargaining power weakened because middlemen had to come directly to the site, causing the purchase price of porang to fall significantly, in some cases to only half of the normal price.

This phenomenon illustrates that the price of agricultural commodities is strongly influenced by infrastructure conditions and road access. Road infrastructure plays a crucial role in enhancing rural livelihoods, as shown by its positive impact on household income in China (Lu et al., 2023) and by its contribution to increased agricultural productivity, improved market access, economic diversification, and overall quality of life in rural Indonesia (Zulham et al., 2025). When road access is difficult or disrupted, farmers lose their bargaining position in the supply chain. Therefore, beyond cultivation techniques, the availability of reliable road infrastructure and adequate transportation facilities becomes a key factor in stabilizing prices and improving farmers' welfare.

Table 1. Percentage of Reasons for Choosing Commodity Crops to be Developed

No	Reason for Choosing the Crop	Total Number of Farmer	Percentage (%)
1	The crop has been traditionally cultivated by the family/ancestors	4	7
2	Easily grows on the local land	14	26
3	Has good market value/sale potential	19	35

4	Supports conservation (ecological benefits)	3	6
5	Serves as food for family consumption	14	26

Based on the data, community livelihood assets, such as limited land, capital, and market access, strongly influence their crop preferences in the forest area. The majority of farmers, 49 %, currently cultivate rice as the main source of family food, but they are shifting to *porang*, with a 52 % preference for future commodity crops. This shift is primarily driven by economic considerations: 35 % of respondents choose crops based on promising market value, while 25 % prioritize ease of cultivation on local land. The fact that family consumption, 25 %, and ancestral tradition, 7 %, are not dominant reasons shows that farmers act rationally given their limited assets. They optimize scarce resources by moving from subsistence crops, rice and peanuts, to high-value commodities such as *porang*, which are more adaptable to land conditions while offering additional income.

3.2. Income from Community Forest Area and Non-Community Forest Area

The average income obtained by respondents from the Community Forest area is IDR 15,528,897 per year. This income is calculated as the difference between total revenue and the costs incurred. The main sources of respondents' income come from the sale of pine resin, forest honey, palm sugar, and coconut. Analysis shows that the commodity contributing the most to income is pine resin, accounting for 72.84% of total income, followed by forest honey at 26.71% (Figure 4). Interestingly, only about 17% of respondents harvest forest honey, yet its contribution to income reaches nearly 27%. This indicates that forest honey is a highly potential commodity for development, which aligns with findings by Hikmah and Astaman (2024). In contrast, the majority of respondents (93%) tap pine resin. However, the marketing of forest honey still faces challenges in packaging. Honey products are generally sold in used plastic bottles without

labels, so their selling price has not reached its maximum potential. This is consistent with research by Wijaya et al. (2023) on a Beekeepers' Group in Berembeng Village, Bali, where honey packaging still uses recycled bottles without product labels.

The price of forest honey in the study area is IDR 120,000 for a 600 ml bottle. A distinctive characteristic of honey in this area is its slightly sour or fresh taste, which is influenced by the types of flowers providing nectar. Some flowers naturally produce honey with this flavor, such as calliandra (*Calliandra calothyrsus*), coffee (*Coffea sp.*), rambutan (*Nephelium lappaceum L.*), and mango (*Mangifera indica L.*). Calliandra trees are found abundantly within the Community Forest area.

Although almost all respondents engage in pine resin tapping as a primary source of income from community forest, forest honey also has significant potential as a promising alternative commodity. According to Fazriyas, Nababan, and Ulma (2024), pine resin tapping has high potential and can increase income. This potential could be further optimized with improvements in packaging, branding, market access expansion, and adequate support.

In non-community forest areas, the average total annual income of respondents reached IDR 29,634,760. The largest source of income came from cattle farming, contributing 43%, followed by rice sales at 27%, while the lowest contribution came from ginger, accounting for only about 1% (Figure 5).

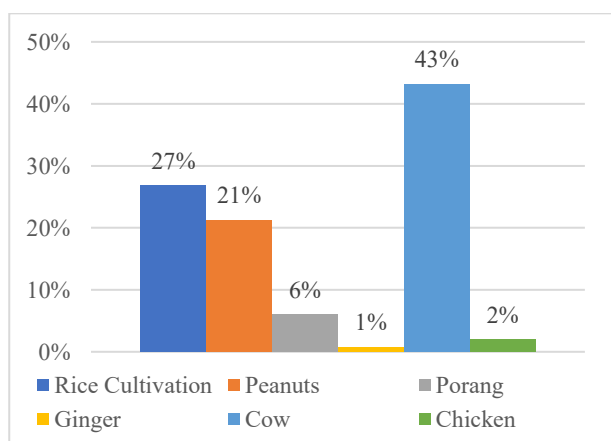


Figure 5. Percentage of Total Income from Non-Community Forest Areas

Furthermore, a comparison of household income contributions between community forest and non-community forest areas is shown in Figure 6.

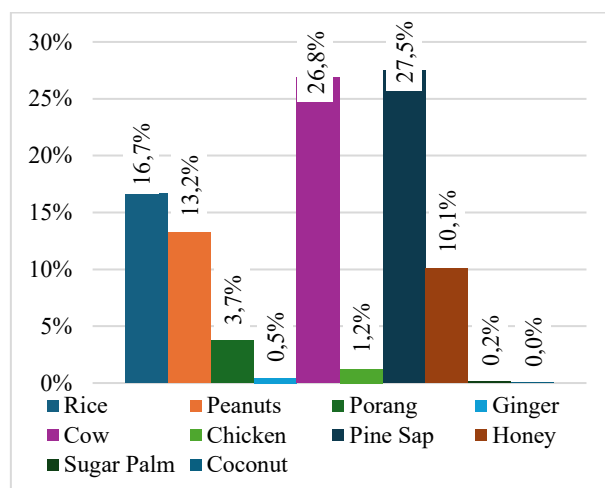


Figure 6. Percentage of Total Household Income Earned by Farmers from both Community Forest and Non-Community Forest

Overall, income from non-community forest areas dominates compared to income derived from community forest areas. The largest contributions in non-community forest areas come from paddy farming, which accounts for nearly 17%, followed by legume crops with a contribution of almost 16%. In contrast, income sources from community forest areas are relatively smaller. The most prominent commodity from community forest areas is pine sap, yet it accounts for only about 3% of total household income. These findings indicate that communities still rely heavily on livelihoods outside community forest areas, particularly from the agricultural and livestock sectors. When viewed from the average percentage contribution of income between commodities inside and outside the Community Forest area, pine resin is the largest contributor from within the forest, accounting for about 27 percent. However, overall, the average total income from outside the Community Forest area remains higher than that from within. The

average household income derived from Community Forest activities is IDR 15,528,897, while the average income from non-Community Forest activities reaches IDR 29,633,747.

4. Discussion of Research

The results of this study indicate that farmers' preferences for crop types within community forest areas are strongly influenced by their access to livelihood assets. Human capital, particularly farming skills and local knowledge, plays a crucial role in determining farmers' capacity to diversify crops beyond subsistence needs. Fazriyas, Nababan, and Ulma (2024) found that human capital was the most frequently discussed asset class, mentioned in over 76% of the selected studies, as a key determinant of diversification strategies, including crop diversification. Human capital encompasses knowledge, skills, creativity, health, and education level, all of which enable farmers to implement various livelihood strategies.

Similarly, Habib, Ariyawardana, and Aziz (2023) suggest that for households in southwest Ethiopia, the adoption of crop diversity within livelihood strategies is driven less by the pursuit of economic gains or asset accumulation and more by the fundamental necessity of securing direct access to food. This is reflected in differing crop preferences: large-scale farmers typically favor cash crops, while small-scale farmers prioritize food crops. For smallholders, achieving food self-sufficiency through food crop production is the most reliable means of ensuring food security, even when food markets are accessible.

Financial capital also shapes crop preferences by determining farmers' capacity to invest in higher-value commodities. Households with stronger financial capital tend to combine staple food crops with commercial crops, not only to meet household food security but also as a source of income. This indicates that farmers' crop selection decisions are not solely driven by survival needs but also represent strategies related to household

resilience and aspirations for upward economic mobility.

Manlosa et al. (2019) emphasize that farmers accumulated experience enhances their ability to adapt to climate-related risks in agriculture. By learning from past practices, experienced farmers can better optimize production through the selection of crop varieties suited to changing conditions. Therefore, experiential factors as part of human capital are essential in shaping farmers' decisions toward sustainable agriculture, as they facilitate continuous learning and adaptation to environmental changes in the field.

The findings indicate a gradual transition from subsistence-oriented agriculture toward more market-oriented production. According to Nguyen, Tuyen, Nguyen-Anh, and Nguyen-The (2025) accelerating this transition in Sub-Saharan Africa has the potential to increase farmers' income while simultaneously strengthening local food security. While staple crops remain essential for household food security, commodities such as pine resin and forest honey are increasingly valued for their role in generating cash income. This pattern supports the argument that community forest management contributes to livelihood diversification.

Research by Kubitza et al. (2024) shows that community forestry schemes in Southwest Papua not only successfully reduce deforestation and forest degradation but also enhance community income. Emphasizing cash-generating commodities indicates that farmers view community forests not merely as a subsistence safety net but also to improve economic well-being. This finding aligns with Rumaday, Sangadji, and Isan (2025) who reported that households managing land within community forests can increase income and improve community livelihoods in efforts to alleviate poverty.

Despite these diversification opportunities, farmers still face several constraints. Limited market access restricts the potential benefits from certain commodities, while inadequate

road infrastructure affects both product prices and daily activities. Wudad, Naser, & Lameso (2021) highlight that poor road conditions increase transportation costs, damage products, and reduce household income.

These findings underscore the importance of strengthening livelihood assets as a pathway to enhancing the effectiveness of community forestry. Supriadi and Hardiansyah (2025) argue that building such assets is essential for achieving sustainable forest-based livelihoods. Policy interventions should go beyond granting access rights and actively build farmers' capacity through training, financial support, and market facilitation. Supporting livelihood diversification, particularly by linking non-timber forest products to more stable value chains, can help farmers move beyond subsistence and engage more actively in market-oriented livelihood strategies.

These findings indicate that the effectiveness of Community Forest management cannot be achieved solely by relying on the provision of legal access. Limitations in capital, difficult access to tapping sites, weak bargaining power in the marketing of pine resin and honey, and the high dependence on non-forest sectors necessitate the strengthening of livelihood assets through more comprehensive interventions that encompass social, economic, and ecological dimensions. Therefore, farmers' capacities need to be enhanced through technical training, institutional strengthening of farmer groups, expanded access to financing, and facilitation of forest product marketing. These efforts affirm that Community Forest management cannot depend solely on the existing access rights. Advanced strategies are required that focus on strengthening farmers' capacity, institutions, technical support, financial access, and market development to ensure that economic benefits and sustainable management are achieved optimally.

5. Conclusion

This study shows that community forest management requires a more comprehensive

approach than merely granting legal access. Strengthening farmers' capacities through technical training, institutional support, financial assistance, and facilitation of market access are key factors in enhancing household livelihood assets. The selection of crop types prioritized by farmers reflects not only short-term household needs but also long-term strategies to ensure land sustainability and improve well-being. The findings also indicate that farmers' decisions are driven not only by subsistence needs but also by efforts to increase income and reduce household economic vulnerability. Financial and physical capitals such as limited bargaining power over pine resin prices and challenges in accessing tapping sites further shape farmers' preference to focus more on food crops outside community forest areas. Therefore, it is necessary to strengthen farmers' institutional capacity to improve their bargaining position for pine resin and honey prices, enhance road infrastructure leading to tapping areas, and develop value-added forest products. These efforts are expected to increase income contributions from community forest areas, thereby strengthening livelihood resilience and household welfare among farmers in community-managed forest landscape

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References

- Anisah, Muhaimin AW, Maulidah S. 2022. Strategy of risk adaptation for local maize farmers based on livelihood assets in Madura. *Agriekonomika* 10:125–136.
- Astuti EW, Hidayat A, Nurrochmat DR. 2020. Community forest scheme: measuring impact in livelihood case study Lombok

- Tengah Regency, West Nusa Tenggara Province. *Jurnal Manajemen Hutan Tropika* 26:52. doi:10.7226/jtfm.26.1.52
- Fahrizal M. 2017. Pemanfaatan hasil hutan bukan kayu oleh masyarakat di Desa Labian Ira'ang dan Desa Datah Diaan di Kabupaten Kapuas Hulu. *Jurnal Hutan Lestari* 5(1). Available from: <https://jurnal.untan.ac.id/index.php/jmfkh/article/download/18467/15586>
- Fazriyas F, Nababan TA, Ulma RO. 2024. Analisis pendapatan petani getah pinus KTH Bina Saudara pada wilayah KPH XIII Dolok Sanggul Kabupaten Humbang Hasundutan Provinsi Sumatera Utara. *J Silva Trop* 8:65–74. Available from: <https://online-journal.unja.ac.id/STP/article/download/35335/18591>
- Habib N, Ariyawardana A, Aziz AA. 2023. The influence and impact of livelihood capitals on livelihood diversification strategies in developing countries: a systematic literature review. *Environmental Science and Pollution Research* 30:69882–69898. doi:10.1007/s11356-023-27638-2
- Hasibuan A, Nasution SP, Yani FA, Hasibuan HA, Firzah N. 2022. Strategi peningkatan usaha tani padi sawah untuk meningkatkan perekonomian masyarakat desa. *ABDIKAN Jurnal Pengabdian Masyarakat Bidang Sains dan Teknologi* 1:477–490. doi:10.55123/abdikan.v1i4.1095
- Hikmah AN, Astaman P. 2024. Potensi pengembangan agribisnis madu sebagai sumber nafkah petani di Kabupaten Maros. *Tarjih: Agribusiness Development Journal* 4:56–64.
- Kubitza C, Hackfort S, Opiyo A, Rauh C, Stoikes CS, Huyskens-Keil S. 2024. The effects of market-oriented farming on living standards, nutrition, and informal sharing arrangements of smallholder farmers: the case of African indigenous vegetables in Kenya. *Food Security* 16:1363–1379. doi:10.1007/s12571-024-01480-x
- Latifah S, Yonariza, Purwanto. 2023. Study of Community Forest Management (HKm) on socio-economic sustainability in several regions of Indonesia. *IOP Conference Series: Earth and Environmental Science* 1188:012026.
- Lu H, Li Y, Zhang C, Liu Y, Guo Y. 2023. Exploring the heterogeneous impact of road infrastructure on rural residents' income: evidence from nationwide panel data in China. *Transport Policy* 134:155–166. doi: 10.1016/j.tranpol.2023.02.019
- Manlosa AO, Hanspach J, Schultner J, et al. 2019. Livelihood strategies, capital assets, and food security in rural Southwest Ethiopia. *Food Security* 11:167–181. doi:10.1007/s12571-018-00883-x
- Nguyen TT, Tuyen T, Nguyen-Anh T, Nguyen-The P. 2025. Impact of human capital and risk preferences on farmers' decisions towards sustainable farming practices: a meta-analysis. *Journal of Environmental Management* 392:126752. doi: 10.1016/j.jenvman.2025.126752
- Oktalina SN, Awang SA, Hartono S, Suryanto P. 2016. Pemetaan aset penghidupan petani dalam mengelola hutan rakyat di Kabupaten Gunungkidul. *Jurnal Manusia dan Lingkungan* 23:58.
- Permana D, Rahim SE, Helida A, Harbi J. 2025. Analysis of agroforestry types and their contribution to sustainable agriculture in the community forest (HKm) Kibuk, Pagaralam City, South Sumatra. *Journal of Global Sustainable Agriculture* 5:1–8.
- Permatasari A, Rondhi M. 2022. Faktor-faktor yang memengaruhi petani padi dalam mengikuti kemitraan di Indonesia. *Jurnal Agribisnis Indonesia* 10:15–30. doi:10.29244/jai.2022.10.1.15-30
- Rumaday SM, Sangadji IM, Isan M. 2025. Pengelolaan hutan kemasyarakatan sebagai

upaya konservasi dan peningkatan ekonomi di Papua Barat Daya. *Agriva Journal* 3:12–17. doi:10.33506/agriva.v3i1.4195

Supriadi R, Hardiansyah G. 2025. Assessing the sustainability of community livelihoods: an ecological approach to enhancing livelihoods in forest area. *Journal of Critical Ecology* 2:18–34. doi:10.61511/jreco.v2i1.1741

Utami A, Harianto H. 2021. Farmers' subsistence in Indonesian rice farming. *Jurnal Agribisnis Indonesia* 9:79–87.

Wijaya GNS, Ciptahadi KGO, Ayuningsih NPM, Narindo L. 2023. Pengembangan usaha kelompok peternak lebah Trigona Ampel Mesari Banjar Bebali Desa Berembeng. *Jurdimas* 6:356–363. doi:10.33330/jurdimas.v6i3.2270

Wudad A, Naser S, Lameso L. 2021. The impact of improved road networks on marketing of vegetables and households' income in Dedo district, Oromia regional state, Ethiopia. *Heliyon* 7: e08173. doi:10.1016/j.heliyon.2021.e08173

Zulham A, Sumaryanto, Wardono B, Saptana, Permana D, Pramoda R, Shafitri N. 2025. Effect of rural road improvement on the main source of income changes: evidence from brackishwater villages in Indonesia. *Journal of Open Innovation: Technology, Market, and Complexity* 11:100452. doi:10.1016/j.joitmc.2024.100452.