

Unlocking the sustainable livelihoods strategy for forest communities in the southern slope of Mount Slamet, Indonesia

*Explorando as estratégias de subsistência sustentável
em comunidades florestais na encosta sul do Monte
Slamet, Indonésia*

Budiyoko Budiyoko ¹

Lutfi Zulkifli ^{2*}

Budi Dharmawan ³

Sunendar Sunendar ⁴

Malinda Aptika Rachmah ⁵

Kunandar Prasetyo ⁶

Wahyu Adhi Saputro ⁷

Dewanti Risa Utami ⁸

¹ MSc in Agricultural Economics, Lecturer, Jenderal Soedirman University,
Purwokerto, Central Java, Indonesia
E-mail: budiyoko@unsoed.ac.id

² MSc in Agribusiness Management, Lecturer, Jenderal Soedirman University,
Purwokerto, Central Java, Indonesia
E-mail: lutfizulkifli@unsoed.ac.id

³ PhD in Agricultural and Environmental Policy, Associate Professor, Jenderal Soedirman University,
Purwokerto, Central Java, Indonesia
E-mail: budi.dharmawan@unsoed.ac.id

⁴ MSc in Agribusiness Management, Lecturer, Jenderal Soedirman University,
Purwokerto, Central Java, Indonesia
E-mail: sunendar@unsoed.ac.id

⁵ MSc in Agribusiness Management, Lecturer, Jenderal Soedirman University,
Purwokerto, Central Java, Indonesia
E-mail: malinda.aptika@unsoed.ac.id

⁶ MSc in Agricultural Economics, Lecturer, Jenderal Soedirman University,
Purwokerto, Central Java, Indonesia
E-mail: kunandar.prasetyo@unsoed.ac.id

⁷ MSc in Agricultural Economics, Lecturer, Jenderal Soedirman University,
Purwokerto, Central Java, Indonesia
E-mail: wahyu.adhi@unsoed.ac.id

⁸ MSc in Agribusiness Management, Lecturer, Jenderal Soedirman University,
Purwokerto, Central Java, Indonesia
E-mail: dewanti.risa@unsoed.ac.id

*Corresponding author: lutfi.zulkifli@unsoed.ac.id

doi:10.18472/SustDeb.v15n1.2024.52568

Received: 12/02/2024
Accepted: 02/04/2024

ARTICLE-VARIA

ABSTRACT

Mount Slamet in Central Java Province, Indonesia, boasts significant biodiversity potential, yet communities on its southern slope grapple with poverty. This study delves into sustainable livelihood strategies for these communities. Employing participatory rural appraisal methods engages residents in identifying issues and devising solutions. Findings advocate for agrosilvopasture as a viable livelihood, blending crop farming, silviculture, and animal husbandry to balance environmental preservation with economic advancement. Additionally, the study underscores the importance of capacity-building within local communities, emphasizing skill and knowledge enhancement. By advocating community engagement and offering multifaceted sustainable livelihood strategies, this research enriches the discourse on sustainable development for forest communities residing on the southern slope of Mount Slamet.

Keywords: Sustainable livelihoods. Economic resilience. Participatory rural appraisal. Agrosilvopasture. Sustainable forest management.

RESUMO

O Monte Slamet, na Província de Java Central, Indonésia, possui um significativo potencial de biodiversidade, no entanto, as comunidades que residem em sua encosta sul enfrentam a pobreza. Este estudo investiga estratégias de subsistência sustentável para essas comunidades. Utilizando métodos participativos de avaliação rural, envolve os moradores na identificação de questões e na formulação de soluções. Os resultados defendem a agrossilvopastagem como uma subsistência viável, mesclando agricultura de cultivo, silvicultura e criação de animais para equilibrar a preservação ambiental com o avanço econômico. Além disso, o estudo enfatiza a importância do fortalecimento da capacidade nas comunidades locais, ressaltando o aprimoramento de habilidades e conhecimentos. Ao defender o engajamento comunitário e oferecer estratégias de subsistência sustentável multifacetadas, esta pesquisa enriquece o discurso sobre o desenvolvimento sustentável para as comunidades florestais que residem na encosta sul do Monte Slamet.

Palavras-chave: Meios de subsistência sustentáveis. Resiliência econômica. Avaliação rural participativa. Agrossilvopastoril. Gestão florestal sustentável.

1 INTRODUCTION

Mount Slamet, located in the Districts of Banyumas, Purbalingga, Pemalang, Tegal, and Brebes, stands as the highest mountain in Central Java Province, Indonesia. This region encompasses rich biodiversity,

including diverse ecosystems (Aqim; Permatasari, 2023; Widhiono, 2015), flora and fauna (Pribadi et al., 2011; Setiawan et al., 2011; Wibisono et al., 2018; Widhiono, 2015; Widhiono et al., 2017). The diversity and sustainability of this biodiversity hold significant value from ecological, social, and economic perspectives. The ecological importance of the forest ecosystem manifests in its pivotal role in supporting life, serving as a water source (Livesley et al., 2016; Neary et al., 2009), preventing landslides (Moos et al., 2018; Preti, 2013; Scheidl et al., 2020), and contributing to climate change mitigation (Alemu, 2014; Hisano et al., 2018; Munang et al., 2013). From a sociocultural perspective, the forest area significantly shapes the community's way of life and culture (Ihemezie et al., 2021; Torri; Herrmann, 2011). Mount Slamet, situated in the central part of Java Island (Sutawidjaja, 2009), is revered as a sacred site by certain communities (Sulistyo, 2020). This belief system influences the social dynamics within the community, leading to the preservation of Mount Slamet's sustainability through traditional rituals that endure to the present day (Asofi et al., 2023; Rostiyana, 2020). Economically, Mount Slamet and its ecosystem play a pivotal role in sustaining the livelihoods of the surrounding communities (Dewanti; Ayuwat, 2015). The communities residing on the slopes of Mount Slamet, spanning across 14 districts in 5 different districts, often depend on the sustainable management of Mount Slamet's ecosystem for their economic well-being.

Despite its crucial significance for life, the forest ecosystem of Mount Slamet continues to face ecological pressures (Devenish et al., 2022; Saringatin; Hidayati, 2021; Soemarno; Girmansyah, 2012). These pressures are triggered by anthropogenic factors, such as land-use conversion from forest to non-forest, wildlife hunting (Setiawan et al., 2011; Van Balen et al., 2010), and forest fires. These conditions can potentially result in ecosystem degradation, fragmentation, or even the loss of wildlife habitats (Maharadatunkamsi, 2011). A study on small mammals biodiversity in Central Java was conducted. Three types of habitats as representation of primary forest, secondary forest and plantation were examined at Kalipagu, Kaliwadas and Bambang in order to record its small mammals biodiversity. Combination of trapping and direct observation recorded 31 species of small mammals from the areas observed. ShannonWiener index was the highest in secondary forest (3.8).

Upon further examination, the pressures causing ecological damage in the Mount Slamet area are driven by economic factors and the limited knowledge of the community regarding the sustainable utilization of forest resources (Dharmawan et al., 2023). According to the Central Bureau of Statistics of Central Java Province (2023), four districts on the slopes of Mount Slamet are identified as poverty-stricken areas in Central Java Province. The significant number of impoverished communities in these regions is presumed to result from their primary dependence on natural resources, including agriculture and the forest ecosystem in Mount Slamet.

In the context of conventional management, the preservation of forest resources and community welfare is often perceived as conflicting (Miteva et al., 2015; Nugroho et al., 2023). Therefore, addressing issues of poverty and the limited knowledge of communities regarding sustainable forest resource utilisation requires a comprehensive approach (Haji et al., 2021; Kumar et al., 2021). Communities around the forest need to be equipped with knowledge about models of forest resource utilisation that integrate various efforts (Torres-Rojo et al., 2019). This model enables the alignment of efforts for protecting and conserving forest resources with the enhancement of the welfare of surrounding communities, eliminating the dichotomy between these two aspects. Using a case study approach, this research aims to develop sustainable livelihood strategies for communities living on the southern slopes of Mount Slamet. Therefore, by developing an innovative framework, we aim to establish agrosilvopasture as a sustainable method of livelihood inside the framework of this research. The procedure was perceived as a significant advancement with the goal of enhancing the welfare of the forest community. Our main objective is to prioritise sustainability in all aspects of life, including the economic and social aspects.

2 METHODS

2.1 THE STUDY AREA

This research took place in Kemutug Lor Village, situated on the southern slope of Mount Slamet in Banyumas District, Central Java Province, Indonesia. The research location is shown in Figure 1. At least two factors drive the selection of this location. First, community groups affiliated with the village forest community institution are actively engaged in efforts to protect the forest ecosystem. Second, this village is one of the areas with the largest population in the southern region of Mount Slamet, characterised by socioeconomic features where the community still relies on the forest ecosystem, both directly and through its environmental services.

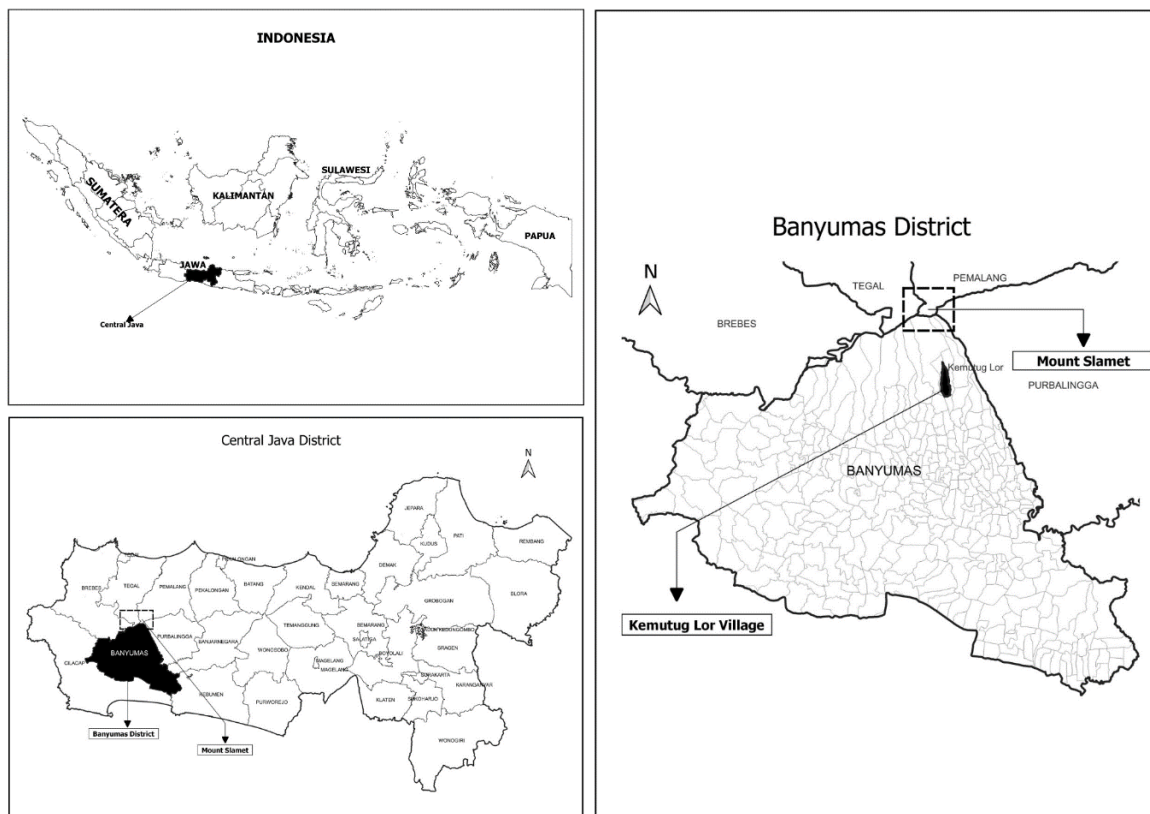


Figure 1 – Study Area. Kemutug Lor Village, Banyumas District, Indonesia

Source: Elaborated by the authors.

2.2 RESEARCH DESIGN

This research employed a qualitative descriptive approach. Creswell and Creswell (2013) suggest that a qualitative approach has advantages in revealing the phenomena of community participation habits, which are common in development planning. Additionally, this approach provides a more comprehensive explanation through interpretations based on logical and intuitive certainty.

The research was conducted from April to December 2023. The respondents of this study amounted to 36 individuals who are members of forest management community groups affiliated with the *Wana Karya Lestari* Forest Village Community Organization (LMDH *Wana Karya Lestari*). The number of respondents accounts for 62 per cent of the total members of LMDH *Wana Karya Lestari*. The data

type used was primary data obtained from interviews and direct field observations and secondary data obtained from various relevant publications or literature. Subsequently, triangulation methods were employed to test the validity and reliability of the collected data.

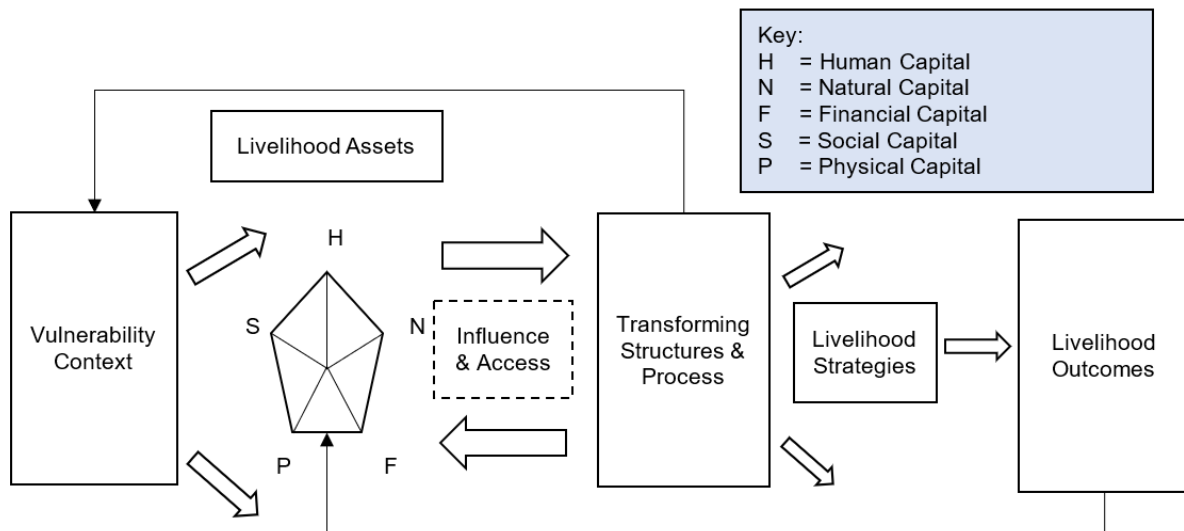


Figure 2 – Sustainable Livelihood Framework

Source: DFID, 1999

The formulation of sustainable livelihood strategies for the forest communities in Kemetug Lor Village is conducted within the framework developed by the Department for International Development/DFID (1999), as illustrated in Figure 2. The approach employed is participatory rural appraisal (PRA) to derive these strategies. PRA is a community-based research and assessment approach emphasising active collaboration between researchers and local communities to comprehensively understand rural issues, resources, and needs (Aziz *et al.*, 2011). PRA underscores the exchange of knowledge, experiences, and ideas among community members, empowering them to participate in problem-solving, decision-making, and the development of sustainable solutions (Bonye *et al.*, 2012).

In this study, the research team simultaneously acted as facilitators in identifying issues and formulating sustainable livelihood strategies. This process was carried out through a participatory approach, specifically using the PRA method. The process unfolded in three main stages: (1) preparation, (2) formulation of the analytical framework, and (3) local-level analysis (Chiwaka; Yates, 2005). The preparation stage involved raising awareness at the site level, setting objectives, stakeholder analysis, team preparation, and formation. The second stage involved a situational analysis, which entailed identifying issues that cause vulnerability, analysing community actions and capacities, and formulating a strategy. The third stage involved local-level analysis, where the team presented the obtained results to the community for validation and feedback.

This study only presents various strategies that support sustainable livelihoods for forest communities in Kemetug Lor Village, based on forest resource management and environmental services. These strategies were formulated participatively to explore the community's capacity to identify potentials and problems and devise activities to address them. Subsequently, the community will implement the formulated strategies within the land they manage. Therefore, various benefits from the strategies and actions implemented have not been directly experienced. The presentation of the benefits of implementing strategies in this study is based on previous research findings or best practices from similar activities.

3 RESULTS AND DISCUSSION

3.1 THE LIVELIHOOD ASSETS OF FOREST COMMUNITIES IN SOUTHERN SLOPE OF MOUNT SLAMET

In order to build a sustainable livelihood strategy, this research has identified the assets possessed by the community that contribute to their livelihoods. DFID (1999) and Veisi *et al.* (2014) identify five asset types: human capital, natural capital, physical capital, social capital, and financial capital. Table 1 presents the socioeconomic characteristics of the participants. Those living in Kemutug Lor Village's livelihoods are predominantly intertwined with natural resources and agriculture. The Village economy is primarily sustained by the agricultural sector, with a substantial portion of the people engaged in farming or small-scale traders. The research findings indicated that 91.67% of the respondents were male, while 41.67% came in the productive age range of 30 to 40 years. This condition differs from that reported by Budyoko *et al.* (2023), who found that farmers in rural areas of Central Java Province are predominantly elderly (above 60 years old).

Regarding education, 36.11% of participants have completed junior high school. An individual's socioeconomic characteristics significantly impact their motivation to enhance productivity and foster personal development to enhance their overall welfare (Putri, 2023; Sumo *et al.*, 2022). In particular, an individual's educational background will impact their capacity to embrace novel technologies or acquire new knowledge (Sennuga *et al.*, 2020; Suvedi *et al.*, 2017) focus group discussion and in-depth interview while the secondary data which relate to the objectives of the study were collected from the office of the Kaduna State Agricultural Development Project (ADP. Meanwhile, Zulkifli *et al.* (2023) discovered that the failure to embrace sustainable agriculture puts farming businesses vulnerable, causing limited gains from the crop.

Kemutug Lor Village in Baturraden District has rich natural tourism potential, as demonstrated by the characteristics of its natural resources. Located at the base of Mount Slamet, this community provides magnificent natural landscapes with a blend of rugged mountains, cascading waterfalls, cultural richness, and a refreshing climate. This community is situated near several renowned tourist destinations, including the Baturraden Botanical Gardens, Baturraden *Lokawisata*, and numerous more captivating attractions. Consequently, this region has emerged as a popular tourist spot, attracting both domestic and international visitors who seek to relish the ambience of relatively intact tropical rainforests. Moreover, this factor contributes to the economic reliance of many people on tourism-related pursuits, including employment in tourist destinations and commerce involving food and beverages in nearby places.

Table 1 – Socioeconomic Characteristics of Respondents

<i>Socioeconomic Characteristic</i>	<i>Percentage (%)</i>
<i>Age (Year)</i>	
<30	16,67
30-40	41,67
41-50	22,22
>50	19,44
<i>Gender</i>	
Male	91,67
Female	8,33

Socioeconomic Characteristic	Percentage (%)
<i>Educational Background</i>	
Elementary School	25
Junior High School	36,11
Senior High School	30,56
Higher Education	8,33
<i>Occupation</i>	
Farmer	33,33
Tradesman	36,11
Labourer	5,56
Employee	22,22
Housewife	2,78

Source: Elaborated by the authors.

Furthermore, apart from its notable prowess in nature tourism, the village of Kemutug Lor exhibits substantial agricultural potential. The location is renowned for its production of premium-grade bovine milk. Kemutug Lor has a total area of 1,251 hectares, with 79.92% covered by forests (Central Bureau of Statistics of Banyumas, 2023). This evidence emphasizes the importance of maximizing land utilization in rural areas to effectively enhance the welfare of individuals, particularly in terms of sustainable economic prospects. Kemutug Lor, located in the Baturraden area, is a popular tourist attraction and presents a chance for economic development, particularly through agriculture, which serves as the basis of the local economy.

The physical capital examined in this research encompasses land ownership, power lines, machinery, and equipment. Based on the identification, it is evident that most farmers in the village of Kemutug Lor cultivate small plots of land, specifically less than 0.5 hectares in size. The money generated by such agricultural activities is generally inadequate to cover the overall living expenses of the community, hence leading to economic fragility among households in the society. Nevertheless, the people of Kemutug Lor Village delight in excellent access to power. Every household can utilize electrical energy, including Kemutug Lor village, which ranks fifth in terms of electricity usage within the Baturraden (Central Bureau of Statistics of Banyumas, 2023). Nearly all communities possess basic manual farming equipment for the ownership of agricultural machinery. Agricultural machinery, including tractors and lawnmowers, is a valuable resource owned by farmers that the community may share and utilise. Facilitating the sharing of agricultural equipment and machinery can enable small-scale farmers to acquire contemporary equipment and enhance efficiency in a cost-efficient manner (Artz; Naeve, 2016; Singh *et al.*, 2016).

The social capital identified in this study comprises informal norms utilised and applied by the community, particularly *LMDH Wana Karya Lestari* members. Two major societal norms in interpersonal interactions are mutual cooperation (*gotong royong*) and tolerance (*tepo seliro*). These rules serve as both social dynamics and a solid basis for regulating social life. The establishment of community cohesiveness and harmony within organisational processes, along with the allocation of responsibility in the management of forest resources, enhances the overall efficacy of management and contributes to the well-being of the surrounding communities. *LMDH Wana Karya Lestari* is an organization that assists in forest management and serves as a model for other communities. It promotes the preservation of social norms, which in turn becomes a valuable asset for the community. This organization aims to achieve sustainable forest management and improve the community's welfare. Chhetri *et al.* (2023) and

Poudyal *et al.* (2023) assert that incorporating forest area communities is essential for implementing adaptive forest management in response to socioeconomic changes.

Financial capital encompasses monetary resources and credit instruments utilised to sustain individuals' livelihoods. Within the scope of the research, there is a substantial availability of credit facilities, encompassing both official offerings from the government and commercial sector, as well as informal credit options. Formal credit facilities are provided through banks and financial institutions, including cooperatives. Non-formal credit refers to loans obtained via intermediaries or individuals inside one's community, such as middlemen or relatives/fellow community members (Yoko; Prayoga, 2019).

Financial capital encompasses monetary resources and credit instruments utilised to sustain individuals' livelihoods. Within the scope of the research, there is a substantial availability of credit facilities, encompassing both official offerings from the government and commercial sector, as well as informal credit options. Formal credit facilities are provided through banks and financial institutions, including cooperatives. Non-formal credit refers to loans obtained via intermediaries or individuals inside one's community, such as middlemen or relatives/fellow community members (Yoko; Prayoga, 2019).

The forest-adjacent community in the research site tends to avoid debt. A total of 91.67 per cent of respondents stated their preference not to incur debt. This finding is consistent with (Trinh *et al.*, 2022), who noted that individuals residing in rural areas tend to refrain from borrowing. However, when compelled to borrow or necessitate external funding, 75 per cent of respondents prefer accessing non-formal financing from their relatives, particularly for consumption needs, children's education expenses, or agricultural capital. Rural communities with strong familial ties tend to favour non-formal financing over formal financing (Dwiputri, 2020; Sulistianingsih; Santi, 2023). Meanwhile, 25% of respondents access financing from financial institutions such as cooperatives and government-facilitated microfinance institutions. This group of respondents has their primary occupation as traders.

3.2 SUSTAINABLE LIVELIHOOD STRATEGIES FOR FOREST COMMUNITY ON THE SOUTHERN SLOPE OF MOUNT SLAMET

The development of sustainable livelihood strategies for the forest communities in Kemutug Lor Village, Baturraden Sub-district, is a collaborative effort involving facilitators and the community. This process consists of a sequence of participatory steps to augment awareness (Cilliers; Timmermans, 2014) and foster a sense of ownership of the formulated program (Ramos *et al.*, 2017). Referring to the sustainable livelihood framework presented in Figure 2, the initial stage involves facilitators striving to impart an understanding of sustainable forest management and applying the PRA approach in crafting sustainable livelihood strategies. The objective is to enhance awareness and community participation in all planned activities. Subsequently, facilitators and the community identify the stakeholders involved and delineate the outcomes of these activities. The established outcome is 'Sustainable Forest, Prosperous Community.' The philosophy underpinning this objective is the commitment to sustainable forest utilisation to improve the community's well-being continually.

In the second stage, facilitators and the community strive to identify and analyze vulnerability-related issues. This process unfolds through guided discussions to elucidate the community's perspectives on the interconnectedness of primary issues and their resultant impacts. Ecosystem degradation and low community well-being are deemed the most critical issues associated with economic, social, and ecological changes affecting their lives. Cahyaningsih *et al.* (2022) assert that forest degradation is primarily triggered by anthropogenic factors leading to the conversion of forest land to non-forest. Pressures partly originate from the extensive development of tourist attractions and related activities in the southern region of Mount Slamet. In order to address the issue of forest degradation caused by tourism development, it is crucial to adopt sustainable management approaches. This encompasses meticulous strategizing, constructing ecologically sustainable infrastructure, implementing effective

waste management systems, educating tourists, and enforcing stringent rules to save natural habitats. Engaging local people in the decision-making process can additionally guarantee environmental sustainability in the area of Mount Slamet. Climate crises and natural factors also contribute to the decline in the quality of the forest ecosystem (Boisvenue; Running, 2006; Seidl *et al.*, 2017). According to De Chazal and Rounsevell (2009), these various factors then lead to land fragmentation, posing a potential threat to biodiversity loss.

The decline in the ecosystem quality of Mount Slamet’s forest poses a significant threat to the livelihoods of communities heavily dependent on it (Mainka *et al.*, 2008). Therefore, efforts are needed to manage and utilise forest resources that can serve as a middle ground for the conservation of forest resources and support the economic and social well-being of the community. In connection with the capacity and conditions at the local level, the strategy that is driven to address this issue is the development of an agrosilvopasture model. This model is considered appropriate as it combines forest conservation efforts with integrated farming practices involving seasonal crops and livestock cultivation (Febriantoko *et al.*, 2023; Haddad; Ariza; Malmer, 2021; Hanisch *et al.*, 2022).

The second identified issue is associated with the low well-being of the communities residing around the forest. This observation is linked to the limited diversification of livelihood sources in the research area. The majority of the population in this region depends on income derived from forest resources and agriculture (Central Bureau of Statistics of Banyumas, 2023), as well as tourism services (working in tourist locations or trading around them). Unfortunately, the community lacks full rights to forest management, as the forest in the Baturraden Area is presently under the jurisdiction of a state-owned enterprise (SOE) in the forestry sector.

The well-being issue is intricately linked to the educational and skill factors within the community. Demographically, most participating community members hold only primary school degrees (see Table 1). Therefore, addressing this issue requires strategic efforts to enhance the forest surrounding communities’ capacity, knowledge, and skills, especially those related to the development of local economic activities that can diversify their livelihoods (Kusel, 2001; Tole, 2010). This is as stated by the chairman of *LMDH Wana Karya Lestari*:

The forest on the southern slope of Mount Slamet is rich in biodiversity and the potential for environmental services, such as water provision and tourism. However, the community has not managed it well. Empowerment efforts are needed to enhance the capacity of the community to manage the forest and its environmental services, thereby opening up various new economic opportunities for the surrounding forest community (Lestari, [s.d]).

To ensure the achievement of these objectives, the involvement and collaboration of various stakeholders are required, including the government, universities, the private sector, and social organizations. The forest surrounding the community plays a strategic role, acting as both an actor and a beneficiary of these activities. The matrix depicting the identification results between facilitators and the community can be found in Table 2.

Table 2 – Identification of Vulnerability Issues, Sources, Impacts, and Formulated Strategies

<i>Vulnerability Issues</i>	<i>Source</i>	<i>Impact and consequences</i>	<i>Strategy</i>
Degradation of forest ecosystems	<ul style="list-style-type: none"> Land-use conversion from forest to non-forest triggered by the development of tourist attractions Climate change 	<ul style="list-style-type: none"> Land fragmentation Biodiversity decline 	Agrosilvopasture

Vulnerability Issues	Source	Impact and consequences	Strategy
The low well-being level of the community	<ul style="list-style-type: none"> • Undiversified livelihood sources • Dependency of livelihood on natural resources (forests and agriculture) 	<ul style="list-style-type: none"> • Increase in the number of impoverished population • High urbanization • Decrease in agricultural land productivity • Abandon farms and shift to off-farm jobs 	Enhancement of community capacity, knowledge, and skills

Source: Elaborated by the authors.

3.3 IMPLEMENTATION OF THE AGROSILVOPASTURE MODEL FOR SUSTAINABILITY SOLUTIONS

The implementation of the agrosilvopasture model carried out together with local communities, is a dynamic approach to sustainable land management and economic empowerment. This initiative includes the creation of pilot plots that apply agrosilvopasture principles and integration of agriculture, forestry and livestock. Through a series of educational training and community engagement, participants gain the skills and knowledge needed to implement and manage the system effectively.

The main objective of this initiative is to empower the community with a range of skills and sustainable livelihood sources, allowing them to exploit different income streams through crop cultivation, livestock farming, and environmental services. The community's ability to navigate changes in economic, environmental, and social conditions is fortified by developing these competencies. Consequently, this initiative provides a route to achieving long-term economic stability and promotes sustainable land-use practices.

The existing vegetation in the Kemitug Lor forest area consists of *damar* (*Agathi dammara*) and *rasamala* (*Altingia excelsa*), which a state-owned forest company manages. The agrosilvopasture plots will be developed among these *damar* and *rasamala* trees. The development of the agrosilvopasture model involves a participatory approach, engaging in discussions with the community, particularly in the selection of commodities for cultivation. This process considers the suitability of plant types based on the land characteristics and existing vegetation at the agrosilvopasture development site. Furthermore, the selection of commodities is based on considerations such as economic value, harvest time, and their contributions to the conservation of water resources and biodiversity. These considerations aim to align with the primary objective, which is to bolster the economic resilience of forest communities intricately connected to forest protection and conservation efforts on the southern slope of Mount Slamet.

Based on discussions with the community, the agrosilvopasture model to be developed involves the integration of forest plants with biopharmaceutical plants/medical herbs, multipurpose tree species (fruit trees), elephant grass (*Pennisetum purpureum cv.Mott*), goat farming, and beekeeping. Biopharmaceutical plants/medical herbs are designated as low shrubs that can yield short-term harvests. Some of the biopharmaceutical plants grown are cardamom (*Amomum compactum*), turmeric (*Curcuma longa*), ginger (*Zingiber officinale*), and galangal (*Kaempferia galanga*). Furthermore, the cultivated fruit trees include durian (*Durio zibethinus*), stink beans/petai (*Parkia speciosa*), avocado (*Persea americana*), matai (*Pometia pinnata*), and guava (*Psidium guajava*). The development of biopharmaceutical plants/medicinal herbs and fruit plants is expected to provide an alternative livelihood source for the Kemitug Lor Village community.

Furthermore, the cultivation of elephant grass is an integral component of the goat farming practices already adopted by the community. The developed elephant grass serves as a source of livestock feed, and the resulting animal waste can be utilized as organic material to enhance soil fertility. Additionally,

within the same land area, the community integrates beekeeping into their practices. The abundant availability of natural nectar and pollen, coupled with the economic value derived from honey production, is a primary consideration in opting for beekeeping. The selection of these commodities and implementing of the agrosilvopasture model are expected to generate a sustainable circular effect, positively impacting economic and environmental productivity. A comprehensive illustration of the agrosilvopasture model implemented in Kematug Lor Village is discovered in Figure 3. Meanwhile, documentation of the participatory process in developing activities and implementing agrosilvopasture model activities is presented in Figure 4.

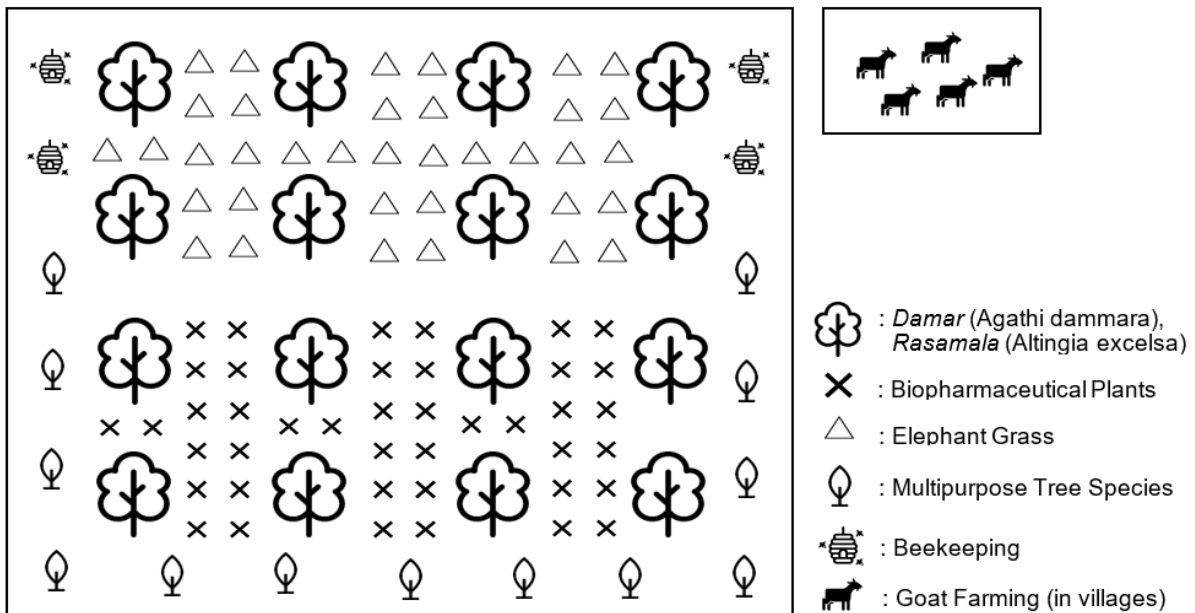


Figure 3 – Agrosilvopasture model in Kematug Lor, Banyumas District

Source: Elaborated by the authors.

The integration of trees, forage, and livestock in agrosilvopasture has influenced farmers' well-being favourably. Studies have shown that agrosilvopasture systems can result in higher production, greater ability to withstand challenges, and improved household income, food security, and nutrition in rural areas (Makate *et al.*, 2016). Moreover, the implementation of these agricultural innovations has been proven to enhance agricultural productivity, relieve poverty, and enhance smallholder farmers' ownership of assets, hence encouraging their economic and social progress (Awotide *et al.*, 2015). Furthermore, studies have demonstrated that agricultural extension programs, which disseminate knowledge and familiarize farmers with advanced techniques like agrosilvopasture, effectively enhance agricultural output and welfare (Ngeno, 2018). These findings emphasize the potential of agrosilvopasture to enhance the economic conditions of farmers by improving their general well-being and resilience to environmental and economic challenges.



Figure 4 – Forest-adjacent community activities in the development of the agrosilvopasture in Kemutug Lor, Banyumas District

Source: Elaborated by the authors

In the medium term, the development of the existing agrosilvopasture model has the potential to evolve into an agro-educational facility managed by the local community. This future vision acknowledges that the agrosilvopasture model currently under development serves as more than just a means to yield harvests (both food and biopharmaceuticals) directly. They also serve as a tool for disseminating knowledge and skills within the community. Through well-structured agro-educational programs, community members can acquire comprehensive insights into agrosilvopasture practices, encompassing diverse crop cultivation, sustainable forestry, and effective animal husbandry. This knowledge transfer process enhances their capacity to manage agrosilvopasture systems and teaches them how to enhance the economic benefits of forests without resorting to damaging practices. Thus, this enhances the ecosystem's sustainability and supports sustainable economic growth for the local community and its surrounding environment.

The main objective of this agroeducation dedication is to shift the approach towards economic growth of forest-dependent communities towards utilising non-timber forest products and environmental services. By implementing agrosilvopasture and sustainable land management, community members can gain economic benefits that are intrinsically linked to the protection of forest ecosystems while also revolutionising the approach to natural resource management. An important aspect of this approach is the recognition that exploitation or deforestation is not sustainable. Instead, agrosilvopasture allows for coexistence between economic development and ecosystem preservation. This encourages communities to work harmoniously with the forest, and fosters shared responsibility for their well-being (Dar *et al.*, 2023; Köthke; Ahimbisibwe; Lippe, 2022).

4 CONCLUSION

Strengthening the capacity of forest communities around the southern slope of Mount Slamet to develop productive activities is critical for enhancing their economic resilience. Promoting productive economic activities should align with conservation principles and the sustainable utilisation of forest resources. Through participatory identification and analysis, it has been determined that an appropriate and suitable sustainable livelihood strategy for the conditions and characteristics of Kemutug Lor Village, Banyumas District, is the development of agrosilvopasture. This model incorporates a blend of damar and rasamala trees, biopharmaceutical plants, multipurpose tree species (such as fruit trees), elephant grass, and the husbandry of goats and beekeeping. The implementation of the agrosilvopasture model adopts a participatory approach, involving the community in the planning, execution, and maintenance phases. Active community engagement has proven to enhance participation and ownership of the implemented program. The integration of seasonal crops and livestock on forest land is anticipated to offer sustainable alternative livelihoods for communities, thus mitigating conflicts between community economic development and forest conservation initiatives. Furthermore, it is envisaged that this agrosilvopasture development area will evolve into an agroeducational zone managed by the community, disseminating information and knowledge through best practices in integrated farming techniques and forest ecosystem conservation.

ACKNOWLEDGEMENT

This work was funded by the Indonesian Environmental Fund through the TERRA Project Fund in 2023.

REFERENCES

- ALEMU, B. The Role of Forest and Soil Carbon Sequestrations on Climate Change Mitigation. **Research Journal of Agriculture and Environmental Management**, v. 3, n. 10, p. 492–505, 2014.
- AQIM, S.; PERMATASARI, I. T. Species Diversity of Gunung Slamet Protection Forest. **JPPP**, v. 1, n. 1, p. 21–30, 2023.
- ARTZ, G.; NAEVE, L. The Benefits and Challenges of Machinery Sharing Among Small-scale Fruit and Vegetable Growers. **Journal of Agriculture, Food Systems, and Community Development**, p. 1–17, 2016.
- ASOFI, T. S.; BANOWATI, E.; HAYATI, R. Tuk Sikopyah Water Taking Ritual to Revitalize Local Wisdom in Anticipating Drought in Serang Village. **Journal of Educational Social Studies**, v. 12, n. 2, p. 101–109, 2023.
- AWOTIDE, B. A. *et al.* Impact of agricultural technology adoption on asset ownership: the case of improved cassava varieties in Nigeria. **Food Security**, v. 7, n. 6, p. 1239–1258, dez. 2015.
- AZIZ, A.; SHAMS, M.; KHAN, K. S. Participatory action research as the approach for women’s empowerment. **Action Research**, v. 9, n. 3, p. 303–323, set. 2011.
- BOISVENUE, C.; RUNNING, S. W. Impacts of climate change on natural forest productivity – evidence since the middle of the 20th century. **Global Change Biology**, v. 12, n. 5, p. 862–882, maio 2006.
- BONYE, S. Z. *et al.* Promoting Community-Based Extension Agents as an Alternative Approach to Formal Agricultural Extension Service Delivery in Northern Ghana. **Asian Journal of Agriculture and Rural Development**, v. 2, n. 1, p. 76–95, 2012.

BUDIYOKO, B. *et al.* Don't stop me now: ageing farmers and its impact on rice farming productivity. **International Conference on Economy, Management, and Business (IC-EMBus)**, v. 1, p. 496–502, 2023.

CAHYANINGSIH, A. P. *et al.* Review: causes and impacts of anthropogenic activities on mangrove deforestation and degradation in Indonesia. **International Journal of Bonorowo Wetlands**, v. 12, n. 1, 12 fev. 2022.

CENTRAL BUREAU OF STATISTICS OF BANYUMAS. **Baturraden in Numbers 2023**. CENTRAL BUREAU OF STATISTICS OF BANYUMAS, 2023.

CENTRAL BUREAU OF STATISTICS OF CENTRAL JAVA PROVINCE. **Poverty 2021-2023**. 2023. Available in: <https://jateng.bps.go.id/indicator/23/34/1/kemiskinan.html>.

CHHETRI, R. *et al.* Forest, agriculture, and migration: contemplating the future of forestry and agriculture in the middle-hills of Nepal. **The Journal of Peasant Studies**, v. 50, n. 1, p. 411–433, 2 jan. 2023.

CHIWAKA, E.; YATES, R. **Participatory vulnerability analysis: a step-by-step guide for field staff**. ActionAid International, 2005.

CILLIERS, E. J.; TIMMERMANS, W. The Importance of Creative Participatory Planning in the Public Place-Making Process. **Environment and Planning B: planning and design**, v. 41, n. 3, p. 413–429, jun. 2014.

CRESWELL, J. W.; CRESWELL, J. D. **Research Design: qualitative, quantitative, and mixed methods approaches**. 2013.

DAR, A. M. *et al.* Socioeconomic and ecological sustainability of agroforestry in mountain regions. *In: Understanding Soils of Mountainous Landscapes*. [s.l.] Elsevier, 2023. p. 375–394.

DE CHAZAL, J.; ROUNSEVELL, M. D. A. Land-use and climate change within assessments of biodiversity change: a review. **Global Environmental Change**, v. 19, n. 2, p. 306–315, maio 2009.

DEPARTMENT FOR INTERNATIONAL DEVELOPMENT (DFID). **Sustainable Livelihoods Guidance Sheets**. DEPARTMENT FOR INTERNATIONAL DEVELOPMENT (DFID), 1999.

DEVENISH, C. *et al.* Biological richness of Gunung Slamet, Central Java, and the need for its protection. **Oryx**, v. 56, n. 3, p. 429–438, maio 2022.

DEWANTI, D. S.; AYUWAT, D. The Livelihoods of Sawangan Village, a Disaster Prone Area of Mt. Slamet. **I J A B E R**, v. 13, n. 7, p. 6147–6164, 2015.

DHARMAWAN, B. *et al.* Introduksi Model Agrosilvopastura Kepada Masyarakat Sekitar Hutan Di Desa Kemutug Lor, Kabupaten Banyumas. **Jurnal Pengabdian dan Pemberdayaan Masyarakat Inovatif**, v. 2, n. 2, p. 47–53, 2023.

DWIPUTRI, I. N. Relationship Between Non-Formal Credit and the Welfare of Indonesian Households. **KnE Social Sciences**, 14 jul. 2020.

FEBRIANTOKO, J. *et al.* Implementation of Agrosilvopasture and MSME Incubation to Support Sustainability Development Goals: a multidisciplinary perspective on economic enhancement. Proceedings of the 6th International Conference of Economics, Business, and Entrepreneurship, ICEBE 2023, 13-14 September 2023, Bandar Lampung, Indonesia. **Anais [...]** *In: Proceedings of the 6th International Conference of Economics, Business, and Entrepreneurship, ICEBE 2023, 13-14 September 2023, Bandar Lampung, Indonesia*. Bandar

Lampung, Indonesia: EAI, 2023. Available in: <http://eudl.eu/doi/10.4108/eai.13-9-2023.2341396>. Access in: 10 fev. 2024

HADDAD, F. F.; ARIZA, C.; MALMER, A. **Building Climate Resilience Dryland Forest and Agrosilvopasture Production System**. Rome, Italy: FAO, 2021.

HAJI, L.; VALIZADEH, N.; HAYATI, D. The Role of Local Communities in Sustainable Land and Forest Management. *In*: SHIT, P. K. *et al.* (ed.). **Spatial Modeling in Forest Resources Management**. Environmental Science and Engineering. Cham: Springer International Publishing, 2021. p. 473–503.

HANISCH, A. L. *et al.* Combining silvopastoral systems with forest conservation: the caíva system in the Araucaria Forest, Southern Brazil. **Agroforestry Systems**, v. 96, n. 4, p. 759–771, abr. 2022.

HISANO, M.; SEARLE, E. B.; CHEN, H. Y. H. Biodiversity as a solution to mitigate climate change impacts on the functioning of forest ecosystems. **Biological Reviews**, v. 93, n. 1, p. 439–456, fev. 2018.

IHEMEZIE, E. J. *et al.* The influence of human values on attitudes and behaviours towards forest conservation. **Journal of Environmental Management**, v. 292, p. 112857, ago. 2021.

KÖTHKE, M.; AHIMBISIBWE, V.; LIPPE, M. The evidence base on the environmental, economic and social outcomes of agroforestry is patchy—An evidence review map. **Frontiers in Environmental Science**, v. 10, p. 925477, 11 ago. 2022.

KUMAR, M.; NISHA PHUKON, S.; SINGH, H. The role of communities in sustainable land and forest management. *In*: **Forest Resources Resilience and Conflicts**. [s.l.] Elsevier, 2021. p. 305–318.

KUSEL, J. Assessing Well-Being in Forest Dependent Communities. **Journal of Sustainable Forestry**, v. 13, n. 1–2, p. 359–384, 7 mar. 2001.

LIVESLEY, S. J.; MCPHERSON, E. G.; CALFAPIETRA, C. The Urban Forest and Ecosystem Services: impacts on urban water, heat, and pollution cycles at the tree, street, and city scale. **Journal of Environmental Quality**, v. 45, n. 1, p. 119–124, jan. 2016.

MAHARADATUNKAMSI. Profil Mamalia Kecil Gunung Slamet Jawa Tengah. **Jurnal Biologi Indonesia**, v. 7, n. 1, p. 171–185, 2011.

MAINKA, S. A.; MCNEELY, J. A.; JACKSON, W. J. Depending on Nature: ecosystem services for human livelihoods. **Environment: science and policy for sustainable development**, v. 50, n. 2, p. 42–55, mar. 2008.

MAKATE, C. *et al.* Crop diversification and livelihoods of smallholder farmers in Zimbabwe: adaptive management for environmental change. **SpringerPlus**, v. 5, n. 1, p. 1135, dez. 2016.

MITEVA, D. A.; LOUCKS, C. J.; PATTANAYAK, S. K. Social and Environmental Impacts of Forest Management Certification in Indonesia. **PLOS ONE**, v. 10, n. 7, p. e0129675, 1 jul. 2015.

MOOS, C. *et al.* Ecosystem-based disaster risk reduction in mountains. **Earth-Science Reviews**, v. 177, p. 497–513, fev. 2018.

MUNANG, R. *et al.* The role of ecosystem services in climate change adaptation and disaster risk reduction. **Current Opinion in Environmental Sustainability**, v. 5, n. 1, p. 47–52, mar. 2013.

NEARY, D. G.; ICE, G. G.; JACKSON, C. R. Linkages between forest soils and water quality and quantity. **Forest Ecology and Management**, v. 258, n. 10, p. 2269–2281, out. 2009.

NGENO, V. Impact of dairy hubs on smallholder welfare: empirical evidence from Kenya. **Agricultural and Food Economics**, v. 6, n. 1, p. 9, dez. 2018.

NUGROHO, H. Y. S. H. *et al.* A Chronicle of Indonesia's Forest Management: a long step towards environmental sustainability and community welfare. **Land**, v. 12, n. 6, p. 1238, 16 jun. 2023.

POUDYAL, B. H. *et al.* Examining forest transition and collective action in Nepal's community forestry. **Land Use Policy**, v. 134, p. 106872, nov. 2023.

PRETI, F. Forest protection and protection forest: tree root degradation over hydrological shallow landslides triggering. **Ecological Engineering**, v. 61, p. 633–645, dez. 2013.

PRIBADI, T.; RAFFIUDIN, R.; HARAHAP, I. S. Termites community as environmental bioindicators in highlands: a case study in eastern slopes of Mount Slamet, Central Java. **Biodiversitas Journal of Biological Diversity**, v. 12, n. 4, 1 jul. 2011.

PUTRI, D. D. Analisis Karakteristik Dan Motivasi Sosial Ekonomi Petani Kapulaga Di Lahan Perhutani Kabupaten Banyumas. **SEPA: Jurnal Sosial Ekonomi Pertanian dan Agribisnis**, v. 20, n. 1, p. 107, 28 fev. 2023.

RAMOS, A. K. *et al.* Sense of community, participation, and life satisfaction among Hispanic immigrants in rural Nebraska. **Kontak**, v. 19, n. 4, p. e284–e295, 21 nov. 2017.

ROSTIYANA, N. Fungsi Ritual Agung Banyu Panguripan Dalam Menjaga Ketersediaan Air Bagi Masyarakat Di Kecamatan Pulosari Kabupaten Pemalang. **Universitas Diponegoro**, 2020.

SARINGATIN, S.; NUR Hidayati, I. Identification of spatial ecological sensitivity in Banyumas region. P. WICAKSONO, S. B. WIBOWO (ed.) Seventh Geoinformation Science Symposium 2021. **Anais [...]** In: Seventh Geoinformation Science Symposium. Yogyakarta, Indonesia: SPIE, 22 dez. 2021. Available in: <https://www.spiedigitallibrary.org/conference-proceedings-of-spie/12082/2615748/Identification-of-spatial-ecological-sensitivity-in-Banyumas-region/10.1117/12.2615748.full>. Access in: 11 fev. 2024

SCHEIDL, C. *et al.* The influence of climate change and canopy disturbances on landslide susceptibility in headwater catchments. **Science of the Total Environment**, v. 742, p. 140588, nov. 2020.

SEIDL, R. *et al.* Forest disturbances under climate change. **Nature Climate Change**, v. 7, n. 6, p. 395–402, jun. 2017.

SENNUGA, S. O.; FADIJI, T. O.; THADDEUS, H. Factors Influencing Adoption of Improved Agricultural Technologies (IATs) among Smallholder Farmers in Kaduna State, Nigeria. **International Journal of Agricultural Education and Extension**, v. 6, n. 2, p. 358–368, 2020.

SETIAWAN, A. *et al.* Population density and distribution of Javan gibbon (*Hylobates moloch*) in Central Java, Indonesia. **Biodiversitas Journal of Biological Diversity**, v. 13, n. 1, 27 set. 2011.

SINGH, T. S.; RUPINDER, C.; KUMAR, N. M. Joint Farm Machinery Ownership in Indian Agriculture-Need of the Time. **SKUAST Journal of Research**, v. 18, n. 1, p. 1–11, 2016.

SOEMARNO, S.; GIRMANSYAH, D. Kondisi Kawasan Hutan Alam Gunung Slamet, Jawa Tengah. **LIPI**, p. 41–61, 2012.

SULISTIANINGSIH, H.; SANTI, F. Does SME's financing decisions follow pecking order pattern? The role of financial literacy, risk preference, and home bias in SME financing decisions. **Cogent Business & Management**, v. 10, n. 1, p. 2174477, 31 dez. 2023.

- SULISTYO, A. Persebaran Situs-Situs Megalitik Di Lereng Tenggara Gunung Slamet: bukti determinisme manusia Indonesia pada lingkungan. *Prosiding Balai Arkeologi Jawa Barat. Anais [...] In: SEMINAR NASIONAL ARKEOLOGI 2019*. Balai Arkeologi Jawa Barat, 29 dez. 2020. Available in: <http://prosidingbalarjabar.kemdikbud.go.id/index.php/seminar/article/view/9>. Access in: 10 fev. 2024
- SUMO, T. V.; RITHO, C.; IRUNGU, P. Effect of farmer socioeconomic characteristics on extension services demand and its intensity of use in post-conflict Liberia. *Heliyon*, v. 8, n. 12, p. e12268, dez. 2022.
- SUTAWIDJAJA, I. Cinder cones of Mount Slamet, Central Java, Indonesia. *Indonesian Journal on Geoscience*, 2009.
- SUVEDI, M.; GHIMIRE, R.; KAPLOWITZ, M. Farmers' participation in extension programs and technology adoption in rural Nepal: a logistic regression analysis. *The Journal of Agricultural Education and Extension*, v. 23, n. 4, p. 351–371, 8 ago. 2017.
- TOLE, L. Reforms from the Ground Up: a review of community-based forest management in tropical developing countries. *Environmental Management*, v. 45, n. 6, p. 1312–1331, jun. 2010.
- TORRES-ROJO, J. M.; MORENO-SÁNCHEZ, R.; AMADOR-CALLEJAS, J. Effect of capacity building in alleviating poverty and improving forest conservation in the communal forests of Mexico. *World Development*, v. 121, p. 108–122, set. 2019.
- TORRI, M. C.; HERRMANN, T. M. Spiritual Beliefs and Ecological Traditions in Indigenous Communities in India: enhancing community-based biodiversity conservation. *Nature and Culture*, v. 6, n. 2, p. 168–191, 1 jun. 2011.
- TRINH, K. A. *et al.* Why Did They Not Borrow? Debt-Averse Farmers In Rural Vietnam. *The Developing Economies*, v. 60, n. 4, p. 228–260, dez. 2022.
- VAN BALEN, S. (BAS); NIJMAN, V.; SÖZER, R. Distribution and conservation of the Javan Hawk-eagle *Spizaetus bartelsi*. *Bird Conservation International*, v. 9, n. 4, p. 333–349, 2010.
- VEISI, H.; LIAGHATI, H.; VANINEE, H. S. Participatory assessment of the sustainability of livelihoods in the agroecosystem of Abesard, Iran. *Sustainability Science*, v. 9, n. 3, p. 347–359, jul. 2014.
- WIBISONO, H. T. *et al.* Identifying priority conservation landscapes and actions for the Critically Endangered Javan leopard in Indonesia: conserving the last large carnivore in Java Island. *PLOS ONE*, v. 13, n. 6, p. e0198369, 27 jun. 2018.
- WIDHIONO, I. Diversity of butterflies in four different forest types in Mount Slamet, Central Java, Indonesia. *Biodiversitas Journal of Biological Diversity*, v. 16, n. 2, 1 jan. 2015.
- WIDHIONO, I.; DARSONO, D.; FASIHAH, N. Short Communication: endemics species of dung beetles (Coleoptera: Scarabaeidae) on the southern slope of Mount Slamet, Central Java, Indonesia. *Biodiversitas Journal of Biological Diversity*, v. 18, n. 1, 13 fev. 2017.
- YOKO, B.; PRAYOGA, A. Understanding Farmers' Access and Perception to Islamic Microfinance on Agricultural Financing: study in Central Lampung Regency. *Journal of Halal Product and Research*, v. 2, n. 1, p. 6, 2 jun. 2019.
- ZULKIFLI, L. *et al.* The hidden vulnerabilities behind financial sustainability: a case study of a sugarcane farm business in Pemalang City, Central Java, Indonesia. *Sustainability in Debate*, v. 14, n. 3, p. 207–218, 10 dez. 2023.