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Perception of former illegal logger to agroforestry in Tetelan land of Meru Betiri National Park, Indonesia

Khusnatul Khomsah [1,2], Ihsannudin [3*], Sukmo Pinuji [4], Lenny Luthfiyah [3]

[1] Agribusiness Department, Faculty of Agriculture, Trunojoyo University of Madura, Jl Raya Telang PO BOX 2 Kamal, Bangkalan, Indonesia
[2] Ecoton Foundation, Dusun Krajan, RT.01/RW.05, Kandangasin, Wringinanom, Kec. Wringinanom, Gresik, Indonesia
[3] Agricultural Extension Department, Faculty of Agriculture, University of Jember, Jl. Kalimantan 37, Jember, Indonesia
[4] Chair of Land Management, School of Engineering and Design, Technical University Munich, Arcisstra ße 21 D-80333 Munich, Germany
*Correspondence email: ihsannudin@unej.ac.id

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ABSTRACT

Introduction: A sustainable livelihood program for former illegal loggers implemented by agriculture cultivation in rehabilitation zones or Tetelan land. Then, the agroforestry system should be applied to restore the function of forests and generate economic value. The research aims to examine the perceptions of former illegal loggers and the factors that influence the application of agroforestry on Tetelan land. **Methods:** The research was conducted in Sanenrejo Village and Andongrejo Village, Tempurejo District, Jember Regency, East Java as buffer villages of the Meru Betiri National Park (MBNP). The research data used has cross-sectional characteristics. The data were measured using the Likert scale and analyzed using descriptive quantitative methods, followed by the Chi-square method to determine the effect of the relationship between variables. **Results:** Perception of former illegal loggers of agroforestry in Tetelan land is in a good category. This means that efforts to implement an agroforestry system in Tetelan land to restore forest function have a high chance of success. At the same time, the factors that significantly influence the application of agroforestry are education and income. **Conclusion:** Individual approach efforts should target ex-illegal logger farmers with an elementary school education and low income (between IDR 300,000–IDR 6,200,000).

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INTRODUCTION

Indonesia has more than 90 million hectares of tropical forests, the third largest in the world after Brazil and Congo. However, some forest areas have been deforested (Pratama *et al.*, 2020). According to the *Kementerian Lingkungan Hidup dan Kehutanan* (2021) / [Ministry of Environment and Forestry] data, net deforestation in Indonesia in 2019-2020 reached 115.5 thousand hectares. From 2001 to 2021, Indonesia lost 28.6 million hectares of tree cover (Interfaith Rainforest Initiative, 2021). Even though FAO (2020) and BPS (2022) stated that deforestation is declining this data still needs to be addressed as soon as possible. This is because deforestation contributes to significant carbon emissions to the earth, disrupts hydrological functions, depletes nutrients, and results in reduced biomass and endemic flora/fauna (Baumann *et al.*, 2016; Ornetsmüller *et al.*, 2018).

Several factors cause deforestation in Indonesia. The triggers for deforestation include removing forest cover through illegal logging activities and forest fires and permanently converting forest areas into agricultural areas, housing, plantations, mining, etc (Abugre & Sackey, 2022; Garret *et al.*, 2018). Meanwhile, deforestation conditions in the Meru Betiri National Park (MBNP) area reach 3,382 Ha, or 6.5% of the entire MBNP area (Kementerian Lingkungan Hidup dan Kehutanan, 2020). This deforestation condition was triggered by logging in 1998-1999, especially in teak forest areas (Harada *et al.*, 2015; Utami *et al.*, 2020). Guntoro (2017) stated that the former logged-over *land* then changed its function to become an agricultural area, which the local people called Tetelan land.

The MBNP area has a strategic function as a biodiversity conservation area for both flora and fauna and supporting ecological functions. The flora and fauna owned by the MBNP area consist of 499 species of flora and 217 species of fauna, including protected and endemic flora and fauna (Pratama *et al.*, 2020). Andreetta *et al.* (2023) also revealed that the source of organic materials contributes to carbon storage to prevent the release of carbon into the atmosphere. Considering these conditions, rehabilitation steps are needed in the MBNP area, which has experienced

deforestation by restoring its primary forest function by involving local communities and an effort to empower former illegal loggers in agricultural business on Tetelan land (Utami *et al.*, 2020).

A simple agroforestry system can be applied to Tetelan land *to restore ecosystems and restore forest function*. An agroforestry system is a system that integrates the cultivation of woody plants into agricultural systems (Jha *et al.*, 2021). Agroforestry systems are considered necessary for the sustainability of agriculture and forestry because they can contribute to agricultural diversification (Feliciano *et al.*, 2018; Kiyani *et al.*, 2017; Roshetko & Bertomeu, 2015). Agroforestry systems have been promoted as adaptive solutions for deforestation and the greenhouse effect (Makate *et al.*, 2019; Minang *et al.*, 2014; Vignola *et al.*, 2015). In addition, agroforestry can also support biodiversity conservation and become a solution for food security in a region or country (Coe *et al.*, 2014; Glover *et al.*, 2013). In the context of farmer welfare, agroforestry systems can increase farmers' income (Adedayo & Oluronke, 2014).

In the agroforestry system approach, Tetelan land farmers are given the right to grow annual crops independently with the condition that they intercrop with woody plants (trees). Trees can be in the form of silk trees and various types of woody plants that produce fruit, such as durian, avocado, and candlenuts (Hariyadi & Suciati, 2018). Meanwhile, annual crops that may be intercropped with trees are corn, rice, *Pueraria javanica*, cassava, peanuts, and yardlong beans (Hariyadi & Suciati, 2018; Lastiantoro, 2020).

However, Tetelan land farmers still have not implemented rehabilitation efforts through an agroforestry approach. They did not plant trees as recommended by MBNP in the Tetelan land. This is due to the many perceptions that exist in society toward the application of agroforestry. Some local people perceive that planting trees on Tetelan land causes a reduction in the income generated from planting annual crops. Some people also perceive that farming results from trees tend to take longer.

Perception is explained as a person's subjective view of something that shapes the attitudes and behaviors of a society. The existence of perceptions influencing the realization of agroforestry is very diverse. Tsegeye (2023) shows that the perception of farmers in West Ethiopian's Chore on agroforestry is good and can support their jobs. But, Amare et al (Amare *et al.*, 2018) stated that farmers' perceptions of implementing agroforestry in Ethiopia were not a priority. However, farmers' perceptions of agroforestry do not always align with their attitude (Irwin *et al.*, 2022). So, certain subjects are needed to influence farmers' perceptions of agroforestry better (Irwin *et al.*, 2023). The factors that affect farmers' perceptions of agroforestry systems include education level, land ownership, age, and number of family dependents (Adedayo & Oluronke, 2014; Hou *et al.*, 2023). This explanation shows the perception of agroforestry of farmers' buffer village communities around the forest area. However, there has never been a study that discusses the specific subject of former illegal loggers towards forests with Protected Area (PA) status in the form of national parks such as MBNP.

This condition reflects the importance of assessing farmer perceptions in the application of agroforestry. Based on these conditions, this study aims to determine the perceptions of agroforestry on Tetelan land and determine the factors that influence the application of agroforestry on Tetelan land in the MBNP area.

METHODS

Location of research

The research was conducted in Meru Betiri National Park Jember, specifically in Sanenrejo Village and Andongrejo Village, Jember Regency, East Java, Indonesia. These villages are included in the management work area of the Ambulu National Park Management Section (SPTN) II management work area of the MBNP area. Sanenrejo and Andongrejo Villages are 68.89 km^3 and 262.79 km^3 respectively. These locations were chosen purposively considering that the two villages are buffer villages of MBNP and are directly adjacent to MBNP. In addition, these two villages have the largest Tetelan land area of all the buffer villages in MBNP, with a total of 300 Hectares.

Data collection

The research data used has cross-sectional characteristics to assess the perceptions of Tetelan land farmers and former illegal loggers on the application of agroforestry systems in Tetelan land and the factors that influence it. The research data is cross-sectional data collected at a time and then assessed or analyzed for the relationship between variables.

Tetelan land is a logged-over forest area located in the Meru Betiri National Park, which is classified as rehabilitation land. Currently, rehabilitation efforts are being carried out on the deforested land to restore the function of the forest. In this effort, the MBNP manager provides procedures for smallholder farmers to carry out an agroforestry system or plant trees on Tetelan land. As a community development step, Tetelan land farmers can also grow seasonal crops. Farmers are only given the right to manage Tetelan land, which will later return to forest areas and is state-owned land.

The population in this study was all members of the Community Empowerment group, former illegal loggers in Sanenrejo Village and Andongrejo Village loggers who cultivate agriculture on Tetelan land as a side job. Their main jobs

include farming on their land, farm laborers, construction workers, mushroom entrepreneurs, traders, and several other jobs. Based on these criteria, there are nine Community Empowerment groups in the two villages with 96 people. In detail, 85 samples belonged to 8 empowerment groups from Sanenrejo Village and 11 samples in 1 empowerment group from Andongrejo Village.

This study uses primary data obtained by field observation and interview methods. The interview method was carried out using closed and structured questions through questionnaires. Data on respondent characteristics and perceptions measured by the Likert scale were analyzed using descriptive quantitative through frequency, percentage, minimum, and maximum. Then, to determine the effect of the relationship between variables, the Chi-square method was used. Chi-square analysis is considered appropriate because it is often used for research on perception, as has been done (Amare *et al.*, 2018; Lastiantoro, 2020; Tsegaye, 2023).

Data analysis

Four categories were used, including those related to 1) Perception that Tetelan land is privately owned *land* that may be used according to one's own will, 2) perceptions that Tetelan land is state-owned *land*/MBNP which is only designated for conservation, 3) perception that Tetelan land is state-owned *land*/MBNP which is only designated for economic purposes, and 4) perception that Tetelan land is state-owned *land*/MBNP that can be allocated for economic purposes by fulfilling conservation principles. These four questions were given to the respondents to clarify their sense of ownership of the swallowed land, influencing their reluctance to apply agroforestry to the swallowed land. This sense of ownership needs to be questioned because the Tetelan land is not privately owned but will be returned to the forest. If agroforestry is not carried out on sparse land, then the return of forest functions will be hampered.

The dependent variable related to the application of agroforestry is measured using a Likert scale of 5 levels 1-5. Level 1 means strongly disagree, and level 5 means strongly agree, which are then categorized into three categories (disagree, neutral, and agree). This level explanation applies to perceptions 2-4. For perception 1, level 1 means strongly agree, and level 5 means strongly disagree. Then, it is divided into three categories: agree, neutral, and disagree.

The independent variables used are socio-economic data, namely education (X1), income (X2), number of family members (X3), age (X4), and length of time working on Tetelan land (X5). Education is a variable because education is considered a determinant of one's perceptions and actions of an object, one of which is applying agroforestry (Habtemariam *et al.*, 2016). Income was chosen because it can provide a better opportunity for someone to do something when the income is good, such as agroforestry (Sapbamrer & Thammachai, 2021). The number of family members was selected because it reflects the needs of a person who can influence the application of agroforestry. Age was chosen as the independent variable because age differences will lead to differences in sensitivity and access to a problem (Habtemariam *et al.*, 2016; Sapbamrer & Thammachai, 2021). Meanwhile, the time working on dry land was chosen because it shows that farming experience is one of the bases for making decisions on agroforestry implementation (Saqib *et al.*, 2016).

RESULTS AND DISCUSSION

Before the Chi-square test, the four variables that affect agroforestry were tested for validity, as seen in Table 1. It can be seen that all variables are declared valid because they have an R-count value more significant than the R-table, with a value of 1.671 and a significance of 0.05. This means that all variables can reflect the actual conditions of the problems that occur in the research location (Ahmed *et al.*, 2022).

Table 1. Validity test of all variables

Variables	Pearson Correlation
Perception-1: Tetelan land is privately owned and free to use at will	0.360*
Perception-2: Tetelan land belongs to MBNP, which is only used for conservation purposes	0.611*
Perception-3: Tetelan land belongs to MBNP, which is only used for economic purposes	0.785*
Perception-4: Tetelan land belongs to MBNP which is used for economic goals with conservation arrangements	0.411*

Note: *significant at α= 0.05.

The education level of the former illegal loggers who worked on Tetelan land was at the elementary school level (50%). However, there were also those with higher education, namely junior and senior high schools, and some who had never attended school. This is directly proportional to village data which states that of the total population of Sanenrejo Village (8091) and Andongrejo (6036), the majority of the population has an elementary school education level in both Sanenrejo Village (49.33%) and Andongrejo Village (60.28%). This condition was because the location of the secondary school was quite far from the village. The closest state high school in these two villages is Ambulu State High School, about 20 km from the two villages. Likewise, the willingness of the people in the two villages to continue

their education is also low. The community said they prefer not to continue further education because of reasons to work or marry (Table 2).

Table 2. Characteristics of respondents

Characteristics	Category System	Category	Frequency	Percentage
Education	School	Not going to school	19	19.8%
		Elementary School	48	50%
		Junior High School	23	24%
		Senior High School	6	6.2%
Income	IDR	Low	92	96%
		Moderate	3	3%
		High	1	1%
Number of family members	Number	Few	40	41.7%
		Several	48	50%
		Many	8	8.3%
Age	Year	Young adult	52	54.2%
		Middle-aged Adult	39	40.6%
		Older Adult	5	5.2%
Length of time working on Tetelan	Year	Still New	24	25%
		Quite a while	38	40%
		Long-time	34	35%

Based on income, most ex-illegal loggers who become farmers in Tetelan land have incomes ranging from IDR 300,000 to IDR 6,200,000 per month (96%). This interval belongs to the low category. The highest income of a former illegal logger who becomes a farmer on Tetelan land is IDR 18,600,000 per month. The average income of former illegal loggers who become farmers on Tetelan land is IDR 2,202,403 per month. This data shows income inequality among former illegal loggers who become farmers on Tetelan land. Likewise, these findings show that the expected income value of former illegal loggers is still below expectations (IDR 3,000,000-IDR 6,000,000). When examined further, the average income earned by former illegal loggers who become farmers on Tetelan land is still lower than the minimum wage (UMK) of Jember Regency in 2022 of IDR 2,355,662.91 per month but higher than the Provincial Minimum Wage (UMP) of East Java Province of IDR 1,891,567.12 per month. Most of this income is obtained from earning a living as a farmer (70%). The average income earned by former illegal loggers is classified as moderate. As explained by Danso-Abbeam *et al.* (2020), income has a positive effect on family welfare.

The allocation of tasks in the family is a criterion for family welfare (Ramos, 2021). Of the former illegal loggers who became farmers on Tetelan land, the majority (50%) had families of between 4-5 people. The least number of families owned by ex-illegal loggers who became farmers on Tetelan land was one and the most were eight people. This is because most former illegal loggers who become farmers on Tetelan land are aged 18-42 years, so the number of children in their families ranges from 2-3. Khanal *et al.* (2018), stated that the number of family members does not always reflect the large number of workers participating in farming.

Regarding age distribution, most ex-illegal loggers who became farmers on Tetelan land were mostly 18-42 years (54.2%), with the youngest being 18 years and the oldest being 90 years. While the average age of ex-illegal loggers who become farmers on Tetelan land is 42 years, with such an age range, the *Tetelan* farmers feel that they are still powerful at cultivating the Tetelan land so the cultivation of the Tetelan land is still carried out intensively. Based on Constitution number 13 of 1998, 18–42 fall within the productive age range. Productive ages are considered to be able to accept ideas, suggestions, and various adaptations related to the processing of Tetelan land so that it increases the possibility of returning the function of the forest in the MBNP area compared to those who are older (Serebrennikov *et al.*, 2020). This condition reflects that the above age groups apply the majority of agroforestry systems because they think that the application of agroforestry in the *Tetelan* area does not harm their farming.

The time a person runs a business will affect one's farming. Traces of former illegal loggers who became farmers on Tetelan land and ran their businesses were explored, showing that 40% have worked on Tetelan land for around 11-20 years. This means that the cultivation of the Tetelan land has existed since the beginning of 2000. This is based on the history of the formation of the *land* before it was designated as a national park in 1997 through Minister of Forestry Decree No. 277 of l997, this area has the status of a Wildlife Sanctuary. In 1998, the community engaged in massive illegal logging in former production forests dominated by teak trees, often in conjunction with the national political constellation. After that, the community turned it into agricultural *land*, commonly called Tetelan land. This agricultural business is ongoing, but now that the area has become a national park, it is included in the rehabilitation

zone. Khanal *et al.* (2018) stated that the longer a person has been doing agricultural business, the more skills and knowledge about farming they will have to cultivate the *land* properly.

Figure 1 provides visual context for the Tetelan land discussed, illustrating both the broader setting and specific land conditions within Meru Betiri National Park. The left image depicts the landscape perspective, showing how these agricultural areas are situated amidst the hilly, forested terrain characteristic of the national park environment. The right image offers a closer view, highlighting the logged-over nature of the land resulting from past deforestation events and its subsequent conversion for agricultural use, which defines the Tetelan land.

(a) (b)

Figure 1. Tetelan land in Meru Betiri National Park: (a) Landscape view showing agricultural areas adjacent to forested hills; (b) Detail of logged-over land condition.

Perceptions of Tetelan land farmers regarding their ownership of Tetelan land as private property whose utilization is free according to one's own will

Exploration of this perception becomes important when ex-illegal loggers who carry out agricultural business on Tetelan land feel that it is theirs, so restructuring efforts becomes difficult. As a result, there is a perception that utilization is according to one's own will. Such conditions will be reflected in the attitudes and actions of those who do not apply the agroforestry system to farming on Tetelan land.

The research results found that the majority (47.9%) of former illegal loggers who carried out agricultural business on Tetelan land stated that they did not agree with this statement. This means that most of the former illegal loggers who carried out agricultural business on Tetelan land felt that the Tetelan land was not their own and could not be used according to their own will. This perception is very important in efforts to provide awareness and in efforts to introduce agroforestry systems in Tetelan land. Even so, 36.5% of ex-illegal loggers who carry out agricultural business on Tetelan land feel free to own Tetelan land, so they feel no attachment to implementing an agroforestry system. It is necessary to draw attention again to the fact that the status of the National Park has not been understood by former illegal loggers who carry out agricultural business on Tetelan land. Farmer's intention to plant trees on Tetelan land is still low. As stated in The Constitution 5 of 1990 Concerning the Conservation of Natural Resources and Their Ecosystems, a national park is a nature conservation area with native ecosystems managed by a zoning system intended for research purposes, education, supporting cultivation, tourism, and recreation. Meanwhile, based on the Decree of the Director General of Conservation of Natural Resources and Ecosystems Number 157 of 2022, the area of Tetelan land is included in the rehabilitation zone area of 3,000.02 hectares, or 4.57% of the total area of MBNP.

The former illegal loggers who carried out agricultural business on Tetelan land had the perception that Tetelan land was not their own, so they had to implement the recommendations given by MBNP, namely the application of an agroforestry system on Tetelan land. The MBNP Central Office has issued a policy that the community cultivating Tetelan land is allowed to cultivate Tetelan land with MPTS (Multi-Purpose Trees Species) plants such as avocados but must plant MBNP native (endemic) trees such as areca/betel palm, candlenut, *Pangium edule Reinw*, and so on. Meanwhile, former illegal loggers operating agricultural businesses on Tetelan land have not implemented an intensive agroforestry system because they believe that income from trees takes longer than from annual crops such as corn. In addition, they assessed that the growth of trees would reduce the intensity of light required for annual crops, so they chose to cut the tops of trees, thereby slowing down the growth of annual crops.

Perceptions of Tetelan land farmers regarding their ownership of Tetelan land as the property of MBNP which is only used for conservation purposes

This statement assesses the perceptions of former illegal loggers who carry out agricultural business on Tetelan land regarding the status of *land* ownership and the purpose of using Tetelan land. The majority (45.8%) stated that they agreed with this statement, which indicated that former illegal loggers who carried out agricultural business on Tetelan land were aware that Tetelan land belonged to the state, in this case, MBNP, whose designation was for conservation purposes. At the very least, several regulations govern conservation activities in conservation areas such as the MBNP, such as Constitution No. 5 of 1990, Government Law Number 7 of 1999 concerning the Preservation of Plant and Animal Species Government Law Number 28 of 2011 concerning Management of Nature Reserves and Nature Conservation Areas and refined by Government Law Number 108 of 2015 concerning Amendments to Government Law Number 28 of 2011 Concerning Management of Nature Reserves and Nature Conservation Areas and Regulation of the Minister of Environment and Forestry Number 43 of 2017 Concerning Community Empowerment Around Nature Reserve Areas and Nature Conservation Areas. Based on these various regulations, the activities that can be carried out in conservation areas include planning, protection, preservation, utilization, and empowerment. This means that the MBNP area can only be used for economic purposes and must comply with applicable regulations.

This is because the income from farming results on Tetelan land is the same yearly. As many as 45% of respondents have income other than farming the *land* with a larger amount. This condition reduces farming intensity on Tetelan land to only harvesting trees. The former illegal loggers who carried out agricultural business on Tetelan land thought that trees on Tetelan land did not contribute significantly to the economy and required a long time. This is supported by the research of Fleming *et al.* (2019), which stated that trees are not part of an agricultural business. In addition, the income contributed by planting annual crops is felt to be greater than the tree yield (Staton *et al.*, 2022).

In addition, most ex-illegal loggers who carried out agricultural business on Tetelan land (40%) stated that they strongly agreed if the Tetelan land was asked to be returned by MBNP to its original function, namely as forest for conservation purposes. Through their observations, former illegal loggers who carried out agricultural business on Tetelan land revealed that they associated the positive effects of the presence of forests with the prevention of flooding, erosion, and *land*slides. They think this way because a *land*slide disaster in Mandilis Hamlet resulted in damage to houses in 2018. Research conducted by Blanco *et al.* (Blanco *et al.*, 2020) shows trees in the forest can have a positive impact, one of which is preventing erosion.

Perceptions of Tetelan land farmers regarding their ownership of Tetelan land as the property of MBNP which is only used for economic purposes

Furthermore, a search was conducted related to the perceptions of former illegal loggers who carried out agricultural business on Tetelan land about the ownership and purpose of using Tetelan land. Based on the questions submitted, it was shown that the majority (70.8%) of former illegal loggers who carried out agricultural business on Tetelan land confirmed that the Tetelan land belonged to MBNP, but its utilization was for economic purposes only. This condition deserves attention because it implies a lack of understanding of the existence of a national park and MBNP zoning regulations. However, there is hope for 18.8% of ex-illegal loggers who carry out agricultural business on Tetelan land, given the awareness that the existence of a national park and the zoning system applied in MBNP is primarily for conservation purposes and that implementation involves responsible utilization activities. Awareness efforts can also be carried out against the 10.4% of former illegal loggers who carry out agricultural business on Tetelan land and state that they do not know anything about the ownership and purpose of Tetelan land.

The impetus to answer that the Tetelan land is only used for economic purposes is implied by the dependence of former illegal loggers who carry out agricultural business on Tetelan land in the agricultural sector and only carry out this agricultural business on Tetelan land. According to more in-depth information exploration, for former illegal loggers, Tetelan land is one of the solutions to earning a living after stopping their illegal activities. It can be illustrated that cultivating 1 hectare of corn *land* on Tetelan land will at least generate a gross income of 15,000,000 IDR. Likewise, Tetelan land interspersed with trees in the form of fruit trees will contribute to income. This is in line with the results of research conducted by Fleming *et al.* (2019), which found that trees can make an economic contribution to humans even though they take a relatively long time compared to annual crops and can cover losses if they occur when planting annual crops.

However, in reality, there are still farmers who work on Tetelan land and cut down trees because they interfere with the growth of annual crops. A case similar to the findings of Phondani *et al.* (2020) is that to maintain the intensity of light received by annual crops in an agroforestry system, farmers cut down some trees and thinned trees. Farmers think that too many trees will cause nutrient competition with annual crops (Wartenberg *et al.*, 2018).

Perceptions of Tetelan land farmers regarding their ownership of Tetelan land as the property of MBNP which is used for economic purposes under conservation arrangement

Conservation activities as carried out by the national park area can never be achieved without involving utilization elements. Realizing this, the government through the Minister of Environment and Forestry Number 43 of 2017, stated that the government can provide access to traditional agricultural cultivation.

The majority of ex-illegal loggers who carried out agricultural business on Tetelan land (75%) agreed with the statement that Tetelan land belongs to MBNP and can be used for economic purposes with arrangements without abandoning conservation goals. Even though this majority figure is encouraging, it still needs attention because 9.4% of former illegal loggers carry out agricultural business on Tetelan land and say they disagree. 15.6% say neutral. This means that some former illegal loggers who operate agricultural businesses on Tetelan land are unaware that Tetelan land is used for more than just annual crop farming and that trees are required to restore forest functions, one of which is a conservation function for the surrounding environment. For a more complete mechanism for the utilization of Tetelan land by former illegal loggers who carry out agricultural business on Tetelan land, there needs to be an effort to socialize the Law of the Director General of Conservation of Natural Resources and Ecosystems number 6 of 2018 and refined to number 2 of 2019 concerning Technical Guidelines for Conservation Partnerships in Nature Reserves and Nature Preservation Areas.

Most ex-illegal loggers who carry out farming activities on Tetelan land stated that the soil on Tetelan land has high fertility. The fertility of this soil provides an opportunity for them to utilize the *land* for economic activities by planting annual crops such as corn. Apart from that, most of the ex-illegal loggers who carried out their farming business on Tetelan land expressed their agreement to return the Tetelan land if asked to do so by the MBNP. This is because they are aware of the importance of forests in maintaining the environmental balance, especially in preventing disasters.

Furthermore, it is felt that applying an agroforestry system on Tetelan land can fulfill the elements of conservation objectives. Among them are opportunities for several animals to use as a habitat. Some of the species that can obtain the new habitat include bees, and even the presence of bees will be able to provide additional income for *Tetelan* farmers by taking honey products. Therefore, applying an agroforestry system on Tetelan land can contribute to the return of the MBNP forest's function as a conservation forest for its ecosystem.

Perceptions of Tetelan land farmers who are former illegal loggers

The overall level of respondents' perceptions of the application of agroforestry on Tetelan land shows a total value of 912, which belongs in the interval between 897-1.152 and is categorized in the good category (table 3). This means the respondent views the agroforestry system as appropriate for the Tetelan land to restore its function as a forest. This result is directly proportional to the conditions at the study site, where most farmers have planted trees on Tetelan land. This condition is almost the same as farmers' perceptions of the application of agroforestry in Australia in the study of Fleming *et al.* (2019) Although the perceptions of respondents in the "trees are an economic proposition" group have many supporters, there are still many respondents in the "trees are not an economic proposition" and "trees are essential and economic considerations are unimportant" groups.

Table 3. Perceptions of Tetelan farmers, former illegal loggers on the application of agroforestry systems

Perceptions	Category	Score	Frequency	Total	Sum
Tetelan land is privately owned and free to use at will	Disagree	1	46	46	
	Neutral	2	15	30	211
	Agree	3	35	105	
Tetelan land belongs to MBNP which is only used for conservation purposes	Disagree	1	32	32	
	Neutral	2	20	40	204
	Agree	3	44	132	
Tetelan land belongs to MBNP which is only used for economic purposes	Disagree	1	18	18	
	Neutral	2	10	20	242
	Agree	3	68	204	
Tetelan land belongs to MBNP which is used for economic goals with conservation arrangements.	Disagree	1	9	9	
	Neutral	2	15	30	255
	Agree	3	72	216	
Total					912

Factors that Influence the Perception of the Application of Agroforestry in Tetelan land

Tetelan land is an area that is included in the rehabilitation zone in the MBNP area. According to Law of the Minister of Environment and Forestry Number 23 of 2021 concerning the Implementation of Forest and *Land*

Rehabilitation, it is stated that reforestation efforts can be carried out with an agroforestry system by optimizing *land* use with a system of combining woody, fruit, or annual plants so that ecological and economic interactions are formed between the constituent components.

To implement it, it is necessary to trace the perceptions of former illegal loggers who carry out farming activities on Tetelan lands. Based on Table 4, it is known that the perception of the application of agroforestry on Tetelan land by ex-illegal loggers who carry out farming activities on Tetelan land is influenced by education and income. These two factors are stated to affect the perception of the application of agroforestry because the significance value of the Pearson chi-square test has a value of less than 0.05. Meanwhile, the other three variables did not significantly affect the perception of agroforestry's application on Tetelan land by former illegal loggers who carried out farming on Tetelan land because the significance value of the Pearson chi-square was more than 0.05.

Table 4. Pearson chi-square value for each variable

Variable	Application of Agroforestry
Education	0.026^{*}
Income	0.030^{*}
Number of family members	0.214^{ns}
Age	0.903^{ns}
Length of time working in *Tetelan*	0.100^{ns}

Note: * significant at α= 0.05; ns= not significant

Education positively influences farmer performance, encouraging farming activities, including on Tetelan land. The higher the farmer's education, the more trees will be planted on the Tetelan land as the main indicator of the application of agroforestry. Indeed, Peden *et al.* (2019) stated that education influences perception, so it is important to participate in conservation activities by planting trees on Tetelan land. Then, education is the basis for ex-illegal loggers who carry out farming on Tetelan land to perceive farming on Tetelan land positively. This is supported by the findings of several studies, which reveal that education can support successful farming with agroforestry systems and has a significant influence (Ntshangase *et al.*, 2018; Paudel *et al.*, 2022; Wijayanto *et al.*, 2022). Although most respondents who are former illegal loggers possess elementary school education, it does not hinder their perception of agroforestry implementation. This condition is one of the results of the MBNP office's extension efforts to restore the rehabilitation zone area in the MBNP area. The Ministry of Environment and Forestry of the Republic of Indonesia has provided guidelines through Ministerial Regulation P.77/2016 concerning Forestry Extension Methods and Materials. Article 5 states that one of the forestry extension methods is carried out by developing and strengthening institutional/group management and social capital. The MBNP office has institutionalized Tetelan land farmers by forming rehabilitation land farmer groups. For the Ambulu MBNP National Park Management Section II (SPTN II) area, there are 43 groups with 1559 members, with a Tetelan land area of 1,033.93 Ha divided into 1763 plots. Furthermore, (Damanik & Triastuti, 2022) proposed that the development of group members needs to be directed towards agribusiness development supported by the skills of forestry extension agents and the materials provided.

Based on the analysis, it was also found that income can significantly influence the perception of the application of agroforestry systems in Tetelan land. The greater a person's income, the better the perception of the application of agroforestry, including planting trees on Tetelan land. The large income of farmers will provide an opportunity for farmers to buy tree seeds, which will then be planted on the Tetelan land. This condition is by the findings of (Windari *et al.*, 2024) that income between IDR 2,500,000 - 4,000,000 can increase farmer capacity. It should be noted that the biggest challenge faced in implementing agroforestry in the MBNP Tetelan land is that there are still those who choose corn and legume commodities with the local name "Peje" (Vigna Ungulata) which are considered to provide high-income. These two commodities do not support the implementation of agroforestry because it requires open and shade-free land. Facing this condition, it is directed to plant Multi-Purpose Species Trees (MPTS) commodities which consist of fruit plants such as durian and avocado. Meanwhile, to utilize land under shade, it is recommended to choose rhizome plants such as ginger, lesser galangal, and turmeric which have high economic value.

CONCLUSION

In general, the perception of Tetelan land farmers as former illegal loggers is in a good category. The majority of Tetelan land managers feel they do not own land, so the potential for forest function returns will be greater. Even though it is stated to have a good perception, the application of agroforestry in Tetelan land is still not optimal. Farmers' intention to plant trees on Tetelan land is still low. Meanwhile, in general, the factors that influence the perceptions of former illegal loggers are education and income. In maximizing the return of forest functions, it is better to make pre-emptive efforts which can be in the form of socialization for the application of agroforestry on Tetelan land provided by the Meru Betiri National Park to individual farmers based on their education and income.

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