Vol. 12(2): 279-295, May 2024

DOI: https://doi.org/10.23960/jsl.v12i2.813

**Jurnal Sylva Lestari**

P-ISSN: 2339-0913
E-ISSN: 2549-5747

Journal homepage: https://sylvalestari.fp.unila.ac.id

*Full Length Research Article*

# Socio-Ecological Effect of Transition Landscape Dynamics from Agroforests to Monoculture Plantation in Upper Citarum Watershed

Luthfan Meilana Nugraha[1,2*], Lukmanul Hakim[2,3], Oekan Soekotjo Abdoellah[2,4], Arief Darmawan[5], Bondan Winarno[1]

[1] Research Center for Ecology and Ethnobiology, Research Organization for Life Sciences and Environment, National Research and Innovation Agency (BRIN), Cibinong, Indonesia
[2] Program on Environmental Studies, Universitas Padjadjaran, Bandung, Indonesia
[3] Mount Ciremai National Park, Ministry of Environment and Forestry (MoEF), Kuningan, Indonesia
[4] Department of Anthropology, Faculty of Social and Political Sciences, Universitas Padjadjaran, Sumedang, Indonesia
[5] Department of Forestry, Faculty of Agriculture, University of Lampung, Bandar Lampung, Indonesia
[*] Corresponding Author. E-mail address: luth007@brin.go.id

ARTICLE HISTORY:

*Received: 25 September 2023*
*Peer review completed: 2 December 2023*
*Received in revised form: 5 March 2024*
*Accepted: 12 March 2024*

KEYWORDS:

*Agriculture commercialization*
*Agroforestry*
*Land use change*
*Poverty index*
*Rural development*



## ABSTRACT

Agroforests in many tropical countries have long been acknowledged as substantially necessary to contribute to biodiversity conservation and community livelihood. The importance of agroforest biodiversification is now overlooked and replaced by a simplified structure due to the impact of agricultural commercialization. Land use changes have occurred in the Upper Citarum Watershed over time, converting traditional agroforests into monoculture plantations at the expense of their socio-ecological function. This paper aimed to analyze land use change dynamics and the effect of biodiversity loss on the socio-economy aspect of the rural agricultural landscape in the Upper Citarum Watershed. We conducted a survey of 95 respondents of community farmers in the agricultural landscape in Sukapura and Resmi Tingal Village using questionnaire guidelines and direct interviews to gather information. There was a significant decrease in plant diversity in some plot agroforests, which, in the previous study, was dominant to be reduced even to local extinctions. The results also show that the farmer poverty index according to BPS criteria is 12.63% of respondents who are below the poverty line. Our results imply that preserving mixed-garden (*talun*) patches in a landscape dominated by cash-crop gardens is one of the strategies that could conserve landscape biodiversity and increasingly a sustainable livelihood.

## 1. Introduction

The agroforestry system in West Java, better known as "*kebun-talun*" or mixed garden, has a long history and has existed until now. The rapid rate of agricultural capitalization in the context of commercialization in rural areas has impacted traditional agroforestry systems, causing them to experience transformation and changes in social-ecological functions (Abdoellah et al. 2020). One of the significant changes in agricultural land use dynamics occurred in the highland landscape in the Upper Citarum watershed (UCW). The UCW agroforestry systems have unique complex agroforestry sourced from local wisdom as "*Talun*/mixed gardens". Landscape changes in the UCW began with clearing forests for fields (*huma*) using a shifting cultivation system. The forest with its dense trees was cleared, then the remaining felling was dried and burned for later planting. After harvest, the field is fallow for a certain period to become a secondary forest (Iskandar et al. 2018). In the next period, agricultural activities in the UCW area become controversial; upstream management is a complicated endeavor that requires the integration of different scientific conclusions (Nugroho et al. 2022). Biophysical approaches are dominant in delivering essential ecosystem services (e.g., groundwater recharge, flood mitigation, and drought occurrences); upstream areas face the most substantial problems regarding natural resource depletion and socio-economic changes. This tendency is very related because most of the population in forest areas depends on forest resources for ecosystem services that support their livelihoods (Mohta et al. 2023; Wijayanto and Briliawan 2016).

The UCW has witnessed tremendous agricultural development since the 1970s and after the Green Revolution, marked by the greater use of agrochemicals and a shift from production for domestic consumption to market demand. The agricultural landscape has undergone significant changes due to this agricultural industrialization, which has been more pronounced in the 2000s, along with rising agricultural commercialization in the area (Muhamad et al. 2014; Yokosawa and Mizunoya 2022). A few commercial crops now comprise most of the area farmed in the UCW, replacing the once-diverse landscape of agroforests, mixed gardens, and homegarden plots (Hakim et al. 2020). A significant impact is also played by agricultural commercialization, especially the increased use of synthetic fertilizers, pesticides, and herbicides, as well as practices that worsen soil erosion due to changes in the ecological function of UCW landscape dynamics (Parikesit et al. 2012).

The conversion of traditional agroforestry, mixed gardens, and paddy fields into commercial dryland farming, which tends to be monoculture, is carried out in order to maximize profits and has become a common practice in the UCW (Hakim et al. 2020; Parikesit et al. 2012). Traditional agroforestry, paddy fields, and mixed gardens increase the environment's carrying capacity, including the ecological function of minimizing surface flow (run-off) and preventing landslides. Mixed gardens and traditional agroforestry also have economic, socio-cultural, aesthetic, and landscape functions (Abdoellah et al. 2020; Soemarwoto and Iskandar 2021). On the other hand, agricultural commercialization also impacts environmental (ecological) aspects where the impacts tend to be negative. Various previous studies have concluded that changes in land use due to agricultural commercialization cause negative impacts on the environment, including changes in the structure and function of homegardens and the extinction of local species (Abdoellah et al. 2020; Zhou et al. 2013), changes in the structure and function of "*kebon tatangkalan*"/mixed gardens increased surface run-off and soil erosion (Asdak 2006) and water and soil pollution due to increased residues of chemical fertilizers and pesticides (Husnain et al. 2015).

Commercialization and infusion of technology will be the primary pressure for rural communities on the island of Java. These conditions will affect traditional agroforestry systems so that sooner or later, the subsistence function of homegardens will be dominated by commercial cash crop plantation (Abdoellah et al. 2020; Hailua et al. 2015). Farmers will concentrate more on planting cash crops in their yards, such as vegetables, cloves, and coffee (Withaningsih et al. 2018). Commercial plants will be a potential source for changes in the structural patterns of ecological and social functions of traditional agroforestry (Carletto et al. 2017). The commercialization in the UCW has changed forests, rice fields, and traditional agroforestry systems with high biodiversity into monocultures emphasizing one or several commercial crops (Amsalu 2014). The need for money for the livelihood needs of community farmers is increasingly driving the commercialization of traditional agroforestry so that their economic function becomes more prominent than their social and ecological functions (Iskandar et al. 2016, 2018; Kem 2017).

Many studies explain that agricultural commercialization and its expansion impact the ecology and socio-economics of the farmer's community. Cervellati and Sunde (2011) showed that land use change to large-scale commercial agriculture eliminates traditional agroforestry practices and reduces in line with the impact of decreasing ecological function; agricultural commercialization also continues to make the socio-economic conditions of the farmer's community below the poverty line. Research on land use change dynamics in agroforestry systems and the socio-economy aspect (poverty index) effect in the UCW will be interestingly carried out. It is the basis of this research's interest in answering whether the commercialization of agriculture influenced the agroforestry system and the decline in the community farmer's livelihood in the UCW landscape, West Java. Commercialization of agriculture can increase farmers' income by planting types of vegetable crops that have high sales value and are in demand by the market. This economic motivation causes farmers to transition from an agroforestry system to intensive monoculture farming. This research aimed to describe the relationship between agricultural commercialization, its impact on agroforestry systems, and the poverty index in farmers' communities in rural agricultural landscapes.

## 2. Materials and Methods

### *2.1. Research Location and Time*

The research was conducted in two stages in Sukapura Village and Resmi Tingal Village, Kertasari District, Bandung Regency. The first stage was performed for 10 days in May 2017; the second was in February–March 2018. Geographically, villages lie between 07° 04' 00"-07° 10' 30" South and 107° 40' 30"-107° 44' 45" East; altitude 1,000–1,250 meters above sea level (ASL). The study site is about 30 km southeast of Bandung Municipality, with good asphalt roads connecting the villages to Bandung, the capital city. Sukapura Village was administratively divided into Sukapura and Resmi Tinggal in 2012. Located in the UCW, the two villages exhibit characteristics typical of high-altitude agricultural landscapes and social conditions in West Java. The research location can be seen in (**Fig. 1**).

### *2.2. Data Collection and Instruments*

#### *2.2.1. Sampling design*

The population in this research is the farming community in Sukapura Village and Resmi Tingal Village, Kertasari District. The characteristics of small-scale farmers are the well-drained and fertile soil, most households rely on agriculture as their primary livelihood, high poverty, cash-crop production under contract with agribusiness firms is dominant, and intensive agricultural commercialization has occurred since the 1990s. Major land-use types in the study area are settlement and homegardens, mixed-garden (*talun*), crop fields, and paddy fields. The process of selecting respondents is by random sampling in which each individual in the population has the same probability of being selected (Cresswell 2014). The unit of analysis in this research is the KK (Head of Family) of farmers and farm workers spread across Sukapura Village and Resmi Tingal Village, Kertasari District.

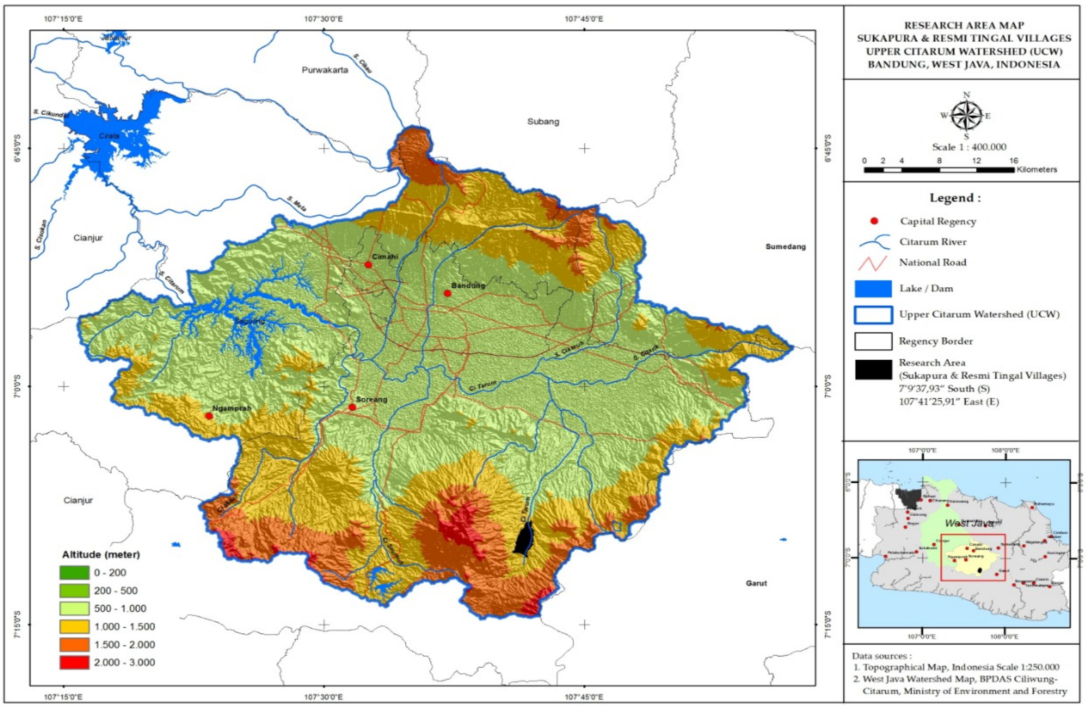


**Fig. 1.** Research location map.

To determine the number of households for the sample, we used the following Equation 1 from Lynch et al. (1974).

$$n = \frac{NZ^2 . p(1-p)}{Nd^2 + Z^2 .p(1-p)} \quad (1)$$

where $n$ is the number of samples, $N$ is the number of households in the study village, $Z$ is the value of the standard variable (1.96) for a reliability level of 0.95, $d$ is the sampling error (10%), and $p$ is the highest possible proportion (50%).

Based on government data for 2017, Sukapura Village had 2,914 households, and ResmiTingal Village had 1,884 households. With 4,798 households for the two villages, we calculated the sample size for our study with Equation 1.

$$n = \frac{(4{,}789).(1.96)^2\ 0.5(1-0.5)}{(4{,}789).(0.1)^2 + (1.96)^2.\ 0.5(1-0.5)} = 95 \text{ households}$$

We used purposive sampling to get to the 95 households needed. Three considerations guided sample selection. First, we limited the sample to farming households, which reported involvement in agricultural activities, including land ownership and/or land cultivation in the most recently completed agricultural season. Second, because the primary goal of the research was to analyze the impact of land use change dynamics from Agroforests to Monoculture Plantation in Rural Agricultural Landscapes, we needed to draw the sample from a population of villagers who had homegardens before the commercialization era. We assumed the commercialization era began after the Green Revolution in the 1970s and intensified in the 2000s. Therefore, we defined the sample population as farming households with a head of household at least 30 years of age. Third, the age limitation was insufficient since we needed to survey people who had experienced homegardens, not just those who were alive during the commercialization. Therefore, we sampled heads of households whose primary occupation was related to homegardens (i.e., farming) before and after the commercialization era.

*2.3. Data Analysis*

Data from the farming community was used to analyze the agricultural commercialization index and farmer poverty levels. At this quantitative stage, the information collected includes farmers' socio-economic data (for example, family identity, total income, and expenditure of farmers, land area, capital sources, production costs, marketing), aspects of agricultural production such as production inputs in the form of fertilizer, pesticides, and output. This data was obtained using a survey method with interview techniques using questionnaire instruments and direct observation in the field. Meanwhile, the poverty level of farmers in the research location will be analyzed using criteria from the BPS-Statistics Indonesia and the measurement of the Foster-Greer-Thorbecke (FGT) index developed by Foster et al. (1984), namely the Poverty Gap Index and Poverty Severity Index. Foster-Greer-Thorbecke Index (FGT). The poverty level is measured using the Foster-Greer-Thorbecke (FGT) poverty index formulation (Foster et al. 1984). The FGT Poverty Index is calculated using Equation 2.

$$Pa(y;z) = \frac{1}{n} \sum_{i=0}^{q} \left( \frac{z-yi}{z} \right)^{a} \text{, where } a > 0 \quad (2)$$

where $yi$ is the average per capita expenditure value of the individual in a household that has been ranked based on expenditure level, $n$ is the total population, $q$ is the number of poor populations, and $z$ is the poverty limit.

So, the poverty gap ratio is $Gi = (z - yi)/z$, where $Gi = 0$ when $yi > z$. Equation 3 was used for calculations.

$$P_1 = \frac{1}{n} \sum_{i=0}^{Q} \left( \frac{z-yi}{z} \right)^{2} \quad (3)$$

This index is a measure that is sensitive to changes in income or income distribution of the poor population (distributionally sensitive index). This measure is called the poverty 'severity' ratio (severity of poverty).

## 3. Results and Discussion

*3.1. Biophysics Condition of Agricultural Landscape in Upper Citarum Watershed*

*3.1.1. Agroforest and mixed-garden*

In West Java, the location of the present research, mixed-garden (*talun*), has historically been important for rural households. Over the past three decades, intensive agricultural development programs and industrialization have been implemented in many tropical regions, including West Java. This tendency has altered the natural environment considerably and transformed formerly sustainable agricultural systems into commercialized mono-cultural production systems (Abdoellah et al. 2020; Hakim et al. 2020). Mixed garden (*talun*) systems have not escaped these global trends. Many mixed gardens (like many other agroforestry systems) are being converted to cash-crop gardens, decreasing agrobiodiversity and the kinds and amounts of foodstuffs directly available for the household (Abdoellah et al. 2020; Nautiyal et al. 2007). In Indonesia, for example, (Abdoellah et al. 2006, 2020) report a decline in the structure and function of agroforestry systems in mountainous areas in Bandung, West Java, due to commercialization processes. Similar situations are found in the Indian Himalayas (Nautiyal et al. 2007), where subsistence agriculture and agroforest have been transformed into cash-crop-based agriculture.

In many West Java rural areas, particularly higher elevations, commercialization and intensification have also spread to traditional agroforestry like the mixed garden, homegardens, and "*talun*" or "*kebon tatangkalan*". For example, in a village in the UCW, 37% of homegardens were intensified and planted with crops in a year (Abdoellah et al. 2020; Hakim et al. 2020). Annual crops such as potatoes, green onions, carrots, and cabbages replace many plants in mixed gardens, adversely impacting productivity, stability, sustainability, autonomy, and equitability. Profit maximization through cash crop gardens is the principal driver of such changes, leading to a considerable landscape homogenization and loss of structural complexity of the vegetation. Although homogenization of mixed gardens may result in greater productivity per unit of land and may be more productive by economic measures, bringing economic progress through specialization and commoditization, this is at the expense of several ecosystem services and social values that are associated with mixed gardens, including food security and nutrition.

The existing "*talun*" and "*kebon tatangkalan*" are the remaining traditional agroforestry, which previously was widely available in Sukapura Village, and the current condition has been turned into a cash-crop garden. The mixed garden is still maintained because it has an essential role in the community, especially as a source of springs, erosion, and landslide retention. After all, the location is on steep slopes and a public cemetery (grave). Some of the existing talun conditions have been converted into cash-crop gardens. Talun is fragmented into small patches between cash-crop gardens, the dominant land uses in Sukapura Village and Resmi Tingal Village.

#### *3.1.2. Homegarden and cash-crop garden*

Homegardens are an inseparable part of the food system and biodiversity conservation of agricultural landscapes (Prihatini et al. 2018). Homegardens were observed at 12 different locations throughout the two villages: 6 locations in Sukapura Village (Mekarsari and Sukamaju Hamlet or "*dusun*") and 6 locations in ResmiTingal Village (Kebon Sagu and Joglo Hamlet, respectively). Fruits such as jackfruit (*Artocarpusheterophyllus*), guava (*Syzigum densifolia*), avocado (*Persea americana*), mango (*Mangifera sp.*), and coffee (*Coffea arabica*) contribute to the majority of the vegetation in homegardens. The homegardens contain some woody species, such as eucalyptus (*Eucalyptus alba*) and jabon (*Anthocephalus cadamba*); however, they are not abundant. Most of the homegardens at the research site have also been converted into a monoculture plantation due to the restrictions of cash-crop gardens held by farmers and to boost the economic value of the homegardens. Regarding a social-ecological system, homegardens are never separated from human interactions in exchanging energy, materials, and information. Homegardens provide many benefits, including maintaining the diversity of flora and fauna as food sources (Harnowo et al. 2021; Soemarwoto and Iskandar 2021). The flora and fauna in the homegardens can be used to meet nutritional needs and improve the economy (Ogutu et al. 2023).

There are 12 observation locations in the cash-crop garden, with 6 in Sukapura Village (Mekarsari Hamlet) and 6 in Resmi Tingal Village (Pogokan Hamlet). Green onions (*Allium stulosum*), carrots (*Daucus carota*), and celery (*Apium graveolens*) are the primary cash crop plants in both villages. These permanent cash crop gardens were initially transformed from paddy fields and mixed gardens (*talun*). The primary land use on the research site is currently cash-crop gardens. Farmers rely more on single species of commercial plants that function solely for economic purposes. They only grew crops that have a high economic value in the market, such as green onions (*A. fistulosum*), carrots (*D. carota*), cabbage (*Brassica sinensis*), or potatoes (*Solanum tuberosum*). Homogenization and monoculture plantation may result in greater productivity per unit of land and may be more productive by economic measures, bringing economic progress through specialization and commoditization; this is at the expense of several ecosystem services and social values that are associated with homegardens, including biodiversity plant conservation and food security status of the household. According to the results of previous studies in the exact location, homegardens that were initially traditional and polyculture farming systems (Abdoellah et al. 2020; Hakim et al. 2020; Prihatini et al. 2018), are now planted with many commercial and monoculture crops as a result of the commercialization of homegardens. These changes cause decreased biodiversity, reduced social balance, increased external input, and disaster risk (Abdoellah et al. 2020).


**Fig. 2.** The condition of land-use type in UCW: a–b are mixed gardens (*Talun*), and c–d are cash-crop gardens.

### *3.2. Agriculture Commercialization Index*

The commercialization index is used to measure the level of agricultural commercialization in farming households. The formulation developed by Von Braun et al. (1994) is based on the output side of production, namely the total amount of production sold divided by the total production output. The calculated commercialization index consists of the yard and garden commercialization indexes. The data processing results show that the agricultural commercialization index at the research location is 80.89 (**Table 1**), meaning that agricultural production sold to the market is 80.89% of total production. All of the types of plants produced are sold to the market; for example, leeks (*Allium fistulosum*), carrots (*D. carota*), potatoes (*S. tuberosum*), cauliflower (*Brassica oleracea*), white mustard greens (*Brassica sinensis*), tomatoes (*Solanum lycopersium*), and red chilies (*Capsicum annuum*). The remaining 19.11% is used for personal needs, including all leeks not harvested, some of which are used for seeds. Apart from that, some yards have a low commercialization index value because they are used for their purposes.

The commercialization index value is 0–100, where 0 indicates subsistence, meaning that agricultural production only meets one's needs or the land is used more for one's own needs (not commercial). In contrast, a value of 100 means that all agricultural production is sold to the market. The commercialization index of 80.89% shows that the level of agricultural commercialization in the research location is relatively high.

**Table 1.** Agriculture commercialization index

| Commercialization Index | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| | 5 | 30 | 100 | 80.89 | 13.41 |

The commercialization index shows that the agricultural patterns of farmers in the research location are commercial or agricultural production aimed at meeting market needs. It is done by farmers in order to increase land productivity and income. This result aligns with the research results of (Abdoellah et al. 2020) that agricultural commercialization by converting mixed gardens with commercial vegetable crops aims to maximize profits. Apart from that, (Amsalu 2014; Hailua et al. 2015) also explained that agricultural commercialization transforms a subsistence agricultural system into an agricultural production system oriented towards meeting market needs to achieve maximum financial profits.

Commercialized agricultural land comprises mixed gardens and paddy fields converted into vegetable/cash crop gardens. In transforming the subsistence farming system into an agricultural system oriented towards meeting market needs, agricultural production is no longer seen as a means to meet household needs but as the primary source of household income (Wanderi et al. 2019; Kem 2017). The findings show that in the homegarden plot, there are still yards that are not commercialized or are not planted with vegetables. This is because the owner still has a more extensive vegetable garden to plant in order to maximize income. Homegardens like this are planted with ornamental plants, fruit, and fish ponds to be more functional for fulfilling one's needs, beauty, and inner satisfaction. It is on a semi-commercial scale; farmers do not have a wide range of products and generally have a subsistence lifestyle. It makes fulfilling daily living needs the most essential basis for consideration (Sudomo et al. 2023). Semi-commercial scale farming systems are widely applied in areas with open accessibility; they tend to increase productivity and the quality of the produce on the market to obtain cash (Pretty and Bharucha 2014).

Commercialization is only carried out by farmers who do not have land other than a yard, so they plant their yards with commercial crops to increase their income. The homegarden pattern provides varied income, namely routine, daily, weekly, monthly, seasonal, and annual, to provide sustainable results for farmers (Tiurmasari 2016). Meanwhile, cash crop garden yard is yard that is intended for commercial purposes, where almost all of the types of plants produced are sold to the market, for example leeks (*Allium fistulosum*), carrots (*D. carota*), potatoes (*S. tuberosum*), cauliflower (*Brassica oleracea*), white mustard greens (*Brassica sinensis*), tomatoes (*Solanum* *lycopersium*), and red chilies (*Capsicum annuum*). Woody plant species do not contribute much to household income because farmers plant as shade or hedge crops. This result contrasts the traditional agroforestry system, which has more sustainability value. The planting distances are generally irregular, and the number of trees for each type also varies within one type. There are different age variations, so there are variations in harvesting between each agroforestry plant, which also causes differences in time to earn income from agroforestry products (Sudomo 2023).

### *3.3. Farmers Community Poverty Index*

Based on the characteristics of respondents, the majority of residents of Sukapura Village and Resmi Tingal Village are of productive age, where the population of Sukapura Village with an age range between 21–50 years is 3,793 people (45.32%), with an age range of 0–20 years is 3,854 people (46.02%) and an age range of > 51 years as many as 722 people (8.62%). The number of residents in the Resmi Tingal Village with an age range between 18 – 49 years is 2,966 people (52.49%), an age range of 0–17 years is 1,783 people (31.55%), and an age range > 50 years is 901 people (15.94 %). Most of the Village population works in the agricultural sector, with 3,879 people (547 farmers, 1,230 agricultural laborers, and 2,120 daily laborers) or around 89.79% of the population working there.

The poverty line for the Bandung Regency area in 2016 was IDR 297,483 per capita per month, where this figure uses the average reference figure per capita expenditure per month. In 2022, the poverty line for the Bandung district will be IDR 398,884. The calculation results show that the poverty level of farmers in the research location is 12.63%, or around 12.63% of farmer households are below the poverty line. The poverty rate for farmers in the research location is higher than that for Bandung Regency in 2016, 7.61%, and the poverty rate for West Java Province, 8.95%. However, compared with the national village poverty rate of 14.11% (BPS 2016, BPS 2023), the poverty rate in the research location is still lower. A comparison of poverty rates in the research location with district, provincial, and national poverty rates can be seen in **Table 2**.

**Table 2.** Comparison of poverty rates for research locations with district, provincial, and national poverty rates in 2016

| Poverty Status | Percentage of poor households based on 2016 BPS Criteria | | | |
|---|---|---|---|---|
| | Research Location | Bandung Regency | West Java Province | National |
| Poor | 12.63 | 7.61 | 8.95 | 14.11 |
| Not Poor | 87.37 | 92.39 | 91.05 | 85.89 |

The FGT analysis by Foster et al. (1984), which can measure the depth and severity of the poverty that occurs, was used to look further into farmers' poverty in the research location. Poverty analysis based on the FGT index is presented in **Table 3.** The results of the Headcount Index calculation, namely the percentage of poor people below the Poverty Line (GK), show a figure of 0.12, meaning that 12% of farming households in the population are classified as poor. The headcount index figure is the same as the poverty figure for the BPS criteria because the poverty line used in the calculation refers to the BPS figures.

**Table 3.** Poverty analysis of research locations based on the FGT Index

| FGT Index | Index Value |
|---|---|
| Headcount Index (HCI-P0) | 0.12 |
| Poverty Gap Index (PGI-P1) | 0.01 |
| Poverty Severity Index (PSI-P2) | 0.02 |

The second indicator is the Poverty Gap Index (Poverty Gap Index-P1), which measures the average gap between each impoverished population's expenditure and the poverty line. The higher the index value, the greater the distance between the average population expenditure and the poverty line. The calculation results show that the P1 figure is 0.01. This result showed that the poverty level is relatively low, which can be interpreted as the gap between the total poor population and the poverty line if averaged over all households (both poor and non-poor), which is 1%. A comparison of per capita expenditure per month with the poverty line can be seen in **Fig. 3**.

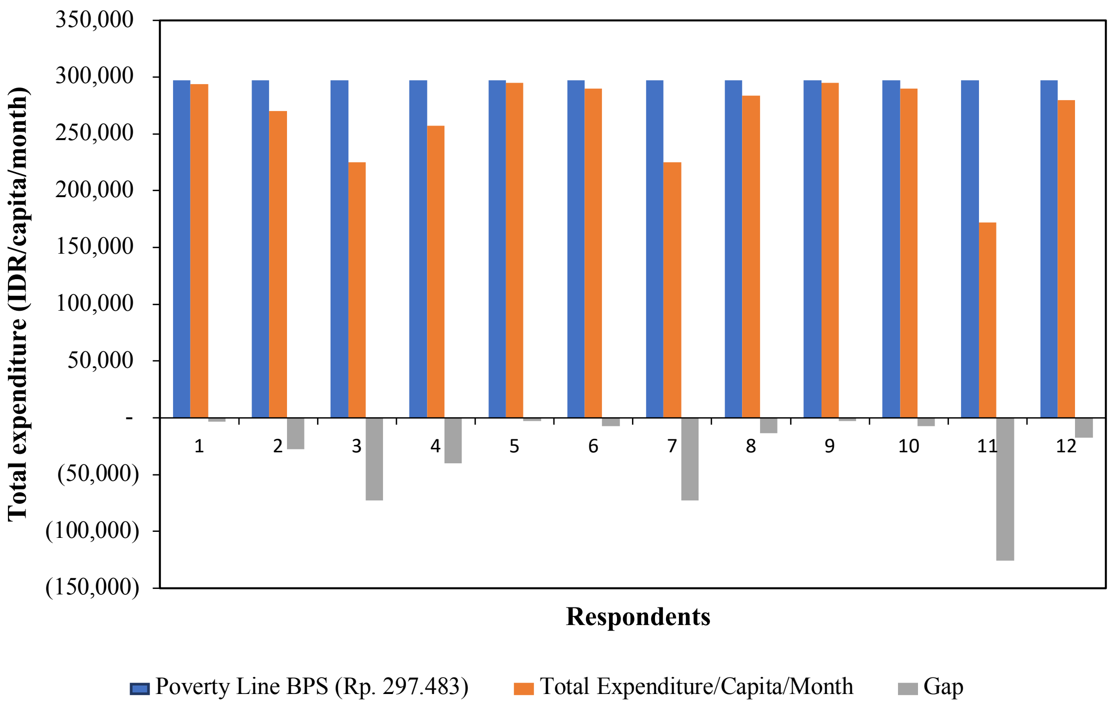


**Fig. 3.** Comparison of poor farmers' total expenditure/capita/month with the poverty line.

**Fig. 3** shows that respondents classified as poor are heads of families who work as agricultural laborers and are the dominant residents in Sukapura Village and Resmi Tingal Village. Apart from that, the highest level of inequality or difference in expenditure with the poverty line is experienced by agricultural laborers, with a difference of IDR 125,433 per capita. Meanwhile, the inequality or difference in expenditure among farmers is smaller, below IDR 50,000 per capita. The level of expenditure gap with the P-1 indicator of 0.01 indicates that the respondent's poverty depth index is relatively small. A large number of family dependents influences the amount of household expenditure, uncertain income, and the absence of other alternative sources of income, which are the leading causes of farming families being in poverty (Tiurmasari et al. 2016).

The next indicator is the Poverty Severity Index (P2), which provides an overview of the distribution of expenditure among poor people or the variety of expenditure among poor households, where the smaller the gap (closer to 0), the more uniform conditions are. This poverty status can be avoided if farmers do alternative side jobs to increase their household income, such as becoming traders or craftsmen, and services usually provided by housewives or other household members. Most of the side jobs carried out by farmers are casual laborers, so if there is a call, usually the head of the farming family will temporarily leave his agricultural activities (Syofiandi et al. 2016).

On the other hand, the greater the poverty gap (the poorer the household), the greater the weighting given, so this index can also be said to be an index that measures sensitivity to poverty (Desmiwati et al. 2021). Generally, the greater the value of this index, the more severe poverty is. Based on the calculation results, this index value of 0.02 is relatively low, meaning that the poverty is not too severe or that the distribution of farmer household expenditure is even more. According to BPS, farmers' poverty level is greatly influenced by the monthly expenditure per capita and the number of family members. Farmers will be included in the poor category if the respondent's monthly per capita expenditure is smaller than the 2016 Bandung Regency poverty line, which was set at IDR 297,483. The monthly per capita expenditure of poor agricultural workers ranges from IDR 860,000 to IDR 1,470,000 with a family of 4–5 people. With small expenditures and an enormous burden on family members, the burden on poor farmers becomes even more remarkable. The income level will influence household expenditure patterns; the greater the income tends to be, the greater the household expenditure (Syofiandi et al. 2016).

One of the factors that influences farmer poverty is farmer income, where the lower the farmer's income, the greater the chance of becoming poor. Apart from that, the majority of farmers in Sukapura Village and Resmi Tingal Village are agricultural laborers whose income is more than their wages as agricultural laborers. According to (Briones and Felipe 2013), the agricultural development era in Indonesia should reduce income inequality and poverty because most providers of agricultural production were small farmers, so agricultural growth could reduce rural inequality and structural poverty. Structural poverty is a condition where a person is said to be poor if the person's income is above the poverty line but is relatively low compared to the income of the surrounding community. Income inequality in Indonesia is relatively high, and this relatively high income inequality is a problem in rural-agricultural development. This income inequality can be categorized as farmers' households having unsustainable livelihoods (Sulistiyowati et al. 2023). The findings in the field show that agricultural workers at the research location earn wages of around IDR 45,000–IDR 60,000 per day or around IDR 900,000–IDR 1,200,000 per month. Meanwhile, the average income of farmers in the research location is around IDR1,500,000–IDR2,000,000 per month, depending on the land area. If the BPS poverty indicator is used, some farm workers and farmers will not be below the poverty line. However, when compared with the size of the landlord's income, which is IDR 5,000,000–IDR 12,000,000 per month, then the income of these agricultural laborers and farmers is relatively lower, or in other words, they are included in the structural poor category. These differences form social layers in Sukapura Village and Resmi Tingal Village, and then social layers are formed, namely the first group of farmers who own large areas of land, the second group of farmers with limited land, and the third group of farm workers. Returning the commercial monoculture farming system to a traditional agroforestry system could again be a solution. At the very least, farmers can obtain continuity of income by using annual crops and plantations to meet their daily needs. Meanwhile, income from wood can be used not only for daily needs but also to fulfill temporal needs so that apart from maintaining ecological functions, sustainable livelihoods for farmer's households can be realized (Quandt et al. 2019).

*3.4. Access and Land Ownership Status*

The majority of farmers in the research location have minimal land. The largest land area owned by respondents is under 500 m², namely 46.32% or 61.06% of respondents' land area is under 0.1 hectare (ha). Farmers are very dependent on their crop yields, which are highly dependent on climate, price fluctuations, additional employment opportunities, and increases in fertilizer and agricultural production inputs (Widianingsih et al. 2019). The size of the land area affects the production and the farmer's income. The area of agricultural land will influence the scale of the business, ultimately influencing whether management is efficient or not. Generally, the larger the area of land used in agricultural business, the less efficient the cultivated land is (Collier et al. 2018). The results show that this dramatically affects their income and agricultural production costs. Meanwhile, only a handful of the first landlords owned quite large land, namely around 0.5–1 ha, only 9.47% of all respondents. There is even 1 farmer who controls 5 ha of land in Sukapura Village. With enough land, they can get harvests that guarantee their family's livelihood (Mariyono et al. 2017). The diversity of homegarden plant types cannot be separated from the ratio of land area and the choice of plants to be planted because this will affect the income and interests of farmers. The type of commodity planted should be chosen based on the condition of land resources, market demand, and the background of the community or farmers (Pretty and Bharucha 2014). This group is generally landowners, while farm workers who do not own land and farmers whose land is minimal are included in the structural poor category. Most farmers in Sukapura Village and Resmi Tingal Village have agricultural land, but the area is small. Of the 95 respondents, only 3 respondents rented their land. The average area of agricultural land owned by respondents, both yards and vegetable gardens, is around 1,583 m².

Based on the results of data processing presented in **Table 4**, the average area of agricultural land owned by respondents is 1,583.19 m², with the majority of land ownership between 0–500 m² being 46.32%. Agricultural land in Sukapura Village and Resmi Tingal Village is property rights obtained through inheritance and a buying and selling system. Land areas of 0–500 m² are owned mainly by farm workers whose management is carried out after "*Ngebedug*" in the afternoon–evening. Agricultural land area under 5,000 m² or 0.5 ha is owned by 90.53% of respondents. This tendency shows that smallholders dominate farmers in both villages. Small farmers own or rent cultivated land with an area of less than 5,000 square meters or the equivalent of 0.5 ha (BPS West Java Province). Redevelopment of traditional agroforestry systems will be suitable for small-scale farmers, but this requires the right approach to provide complete information, including advantages and disadvantages to farmers. Based on social, economic, and ecological considerations, it is hoped that farmers can choose what system to apply to their land to escape poverty (Ngaji et al. 2021).

**Table 4.** The area of the respondent's agricultural land

| No. | Land Area (m²) | Respondent (Farmers) | Percentage (%) |
|---|---|---|---|
| 1 | 0–500 m² | 44 | 46.32 |
| 2 | 500–1,000 m² | 14 | 14.74 |
| 3 | 1,000–2,500 m² | 19 | 20.00 |
| 4 | 2,500–5,000 m² | 9 | 9.47 |
| 5 | 5,000–10,000 m² | 8 | 8.42 |
| 6 | > 10,000 m² | 1 | 1.05 |
| | Total | 95 | 100.00 |

**Table 4** shows that there is inequality in land ownership in the research location, where land with an area of more than 5,000 $m^2$ is only owned by 9.47% of respondents. The largest land farmers own 5 ha (50,000 $m^2$), owned by one head of the family. This result shows that the larger the land, the fewer family heads own it.

With a small land area, many farmers or farmer laborers use state-owned land, including forestry land (BKSDA and Perhutani) and plantation land, to become vegetable/cash crop gardens, both legally and illegally. Legally, it is carried out through collaboration between community groups and Perhutani through the Joint Community-Based Forest Management (CBFM/*PHBM*) scheme with the Intercropping system, namely planting coffee plants interspersed with vegetable plants. Community interaction in forest use generally aims to meet family consumption needs (Kristin et al. 2018). Illegal practices often occur in conservation areas managed by the West Java Natural Resources Conservation Center (BBKSDA), where the area is for conservation and protection functions, and farming (production function) is not permitted (Hakim et al. 2020).

Commercializing agriculture in the UCW is a process that cannot be avoided because, on the one hand, it has a positive impact on increasing farmers' income. However, on the other hand, it has a negative impact on the environment. The dynamics of landscape change are characterized by the transition trajectory of subsistence farming systems, which have become commercial and monoculture planting systems, which ultimately eliminate traditional agroforestry systems. Based on various issues and problems in the Citarum watershed, the government has issued a series of programs and policies to rehabilitate the watershed. The phenomenal program is the "*Citarum Harum"* Program mandated by Presidential Regulation Number 15/2018 regarding the Citarum Watershed rehabilitation program. It is a national program to control the damage and pollution and restore the watershed (Sumaryanto et al. 2022). Agrarian reform must be carried out in the UCW area to overcome inequality and low land ownership by farmers, which causes poverty. Because most of the land in the UCW is a state forest area in the form of protected forests managed by Perhutani, the agrarian reform program must be careful not to cause environmental damage. One program that can be carried out in protected forest areas is a social forestry program through the Forestry Partnership scheme. The forestry partnership scheme can be implemented by replacing or updating the Joint Community-Based Forest Management (CBFM) program currently carried out by Perhutani, where the CBFM program has not worked well in the field. Therefore, it is necessary to build an understanding and good cooperation between encroaching farmers and Perhutani, facilitated by trusted institutions, to create a Forestry Partnership program that is transparent, fair, participatory, and responsible.

## 4. Conclusions

The process of agricultural commercialization in Sukapura Village and ResmiTingal Village has occurred since the 1970s (Green Revolution), which was marked by a transition trajectory from a subsistence agricultural system to a semi-commercial and commercial system. The dynamics of land use change from traditional agroforestry to monoculture plantations, which is taking place rapidly in the UCW, West Java, Indonesia. Although commercialization promises to improve the "lives and livelihoods" of smallholder farmers, our analysis shows that agricultural commercialization cannot be a solution to get farmers out of the structural poverty trap. The negative impacts of agricultural commercialization on biodiversity conservation and the poverty line index of farmer communities coincide. Structural poverty in Sukapura Village and Resmi

Tingal Village is characterized by differences in wages for agricultural laborers, low income for farmers, limited access to land, and dependency of poor farmers on those in the socio-economic class above them. For the future, preserving Traditional agroforestry, mixed-garden (*talun*) patches in a landscape dominated by cash-crop gardens is one of the strategies that could conserve landscape biodiversity and increasingly a sustainable livelihood.

## Acknowledgments

The authors acknowledge contributions from research participants in the Sukapura Village and Resmi Tingal Village. The support of Rector Universitas Padjadjaran-Bandung, Indonesia. The research was funded by an Academic Leadership Grant from the University of Padjadjaran-Bandung, Indonesia.

## References

Abdoellah, O. S., Hadikusumah, H. Y., Takeuchi, K., Okubo, S., and Parikesit. 2006. Commercialization of Homegardens in An Indonesian Village: Vegetation Composition and Functional Changes. *Agroforestry Systems* 68(1): 1–13. DOI: 10.1007/s10457-005-7475-x

Abdoellah, O. S., Schneider, M., Nugraha, L. M., Suparman, Y., Voletta, C. T., Withaningsih, S., Parikesit, Heptiyanggit, A., and Hakim, L. 2020. Homegarden Commercialization: Extent, Household Characteristics, and Effect on Food Security and Food Sovereignty in Rural Indonesia. *Sustainability Science* 15(3): 797–815. DOI: 10.1007/s11625-020-00788-9

Amsalu, M. 2014. Impact of Smallholder Farmers Agricultural Commercialization on Rural Households' Poverty. *The International Journal of Applied Economics and Finance* 8(2): 51–61. DOI: 10.3923/ijaef.2014.51.61

Asdak, C. 2006. Hydrological Implication of Bamboo and Mixed Garden in Upper Citarum Watershed. *Indonesian Journal of Geography* 38(1): 15–25. DOI: 10.22146/ijg.2231

BPS. 2016. Penghitungan dan Analisis Kemiskinan Makro Indonesia 2016. Badan Pusat Statistik (BPS), Jakarta, Indonesia.

BPS. 2023. Penghitungan dan Analisis Kemiskinan Makro Indonesia 2023. Badan Pusat Statistik (BPS), Jakarta, Indonesia.

Briones, R., and Felipe, J. 2013. Agriculture and Structural Transformation in Developing Asia: Review and Outlook. *Agricultural Outlook* 3(363): 21.

Carletto, C., Corral, P., and Guelfi, A. 2017. Agricultural Commercialization and Nutrition Revisited: Empirical Evidence from Three African Countries. *Food Policy* 67: 106–118. DOI: 10.1016/j.foodpol.2016.09.020

Cervellati, M., and Sunde, U. 2011. Life Expectancy and Economic Growth: The Role of the Demographic Transition. *Journal of Economic Growth* 16(2): 99-133. DOI: 10.1007/s10887-011-9065-2

Collier, N. F., Sayer, J., Boedhihartono, A. K., Hanspach, J., Abson, D., and Fischer, J. 2018. System Properties Determine Food Security and Biodiversity Outcomes at Landscape Scale: A Case Study from West Flores, Indonesia. *Land* 7(1): 1–19. DOI: 10.3390/land7010039

Cresswell, J., 2014. Research Design: Qualitative, Quantitative and Mixed Methods Approaches. 4th ed. SAGE Publications, Inc. Thousand Oaks.

Desmiwati, D., Veriasa, T. O., Aminah, A., Safitri, A. D., Hendarto, K. A., Wisudayati, T. A., Royani, H., Dewi, K. H., Raharjo, S. N. I., and Sari, D. R. 2021. Contribution of agroforestry systems to farmer income in state forest areas: A case study of Parung Panjang, Indonesia. *Forest and Society* 5(1): 109–119. DOI: 10.24259/fs.v5i1.11223

Foster, J., Greer, J., and Thorbecke, E. 1984. A Class of Decomposable Poverty Measures. *Econometrica* 52(3): 761–766. DOI: 10.2307/1913475

Hailua, G., Manjureb, K., and Aymutc, K. M. 2015. Crop Commercialization and Smallholder Farmers Livelihood in Tigray Region, Ethiopia. *Journal of Development and Agricultural Economics* 7(9): 314–322. DOI: 10.5897/jdae2015.0649

Hakim, L., Abdoellah, O. S., Parikesit, and Withaningsih, S. 2020. Impact of Agricultural Crop Type and Hunting on Bird Communities of Two Villages in Bandung, West Java, Indonesia. *Biodiversitas* 21(1): 57–66. DOI: 10.13057/biodiv/d210109

Harnowo, D., Indriani, F. C., Susanto, G. W. A., Prayogo, Y., and Mejaya, I. M. J. 2021. Biodiversity Conservation through Sustainable Agriculture, Its Relevance to Climate Change: A Review on Indonesia Situation. *IOP Conference Series: Earth and Environmental Science* 911(1). DOI: 10.1088/1755-1315/911/1/012066

Husnain, Nursyamsi, D., and Purnomo, J. 2015. *Penggunaan Bahan Agrokimia dan Dampaknya terhadap Pertanian Ramah Lingkungan*. In: Hartatik, W. (eds) Pengelolaan Lahan pada Berbagai Ekosistem Mendukung Pertanian Ramah Lingkungan. IAARD Press, Jakarta.

Iskandar, J., Iskandar, B. S., and Partasasmita, R. 2016. Responses to Environmental and Socio-Economic Changes in the Karangwangi Traditional Agroforestry System, South Cianjur, West Java. *Biodiversitas* 17(1): 332–341. DOI: 10.13057/biodiv/d170145

Iskandar, J., Iskandar, B. S., and Partasasmita, R. 2018. Review: The Impact of Social and Economic Change on Domesticated Plant Diversity with Special Reference to Wet Rice Field and Home-Garden Farming of West Java, Indonesia. *Biodiversitas* 19(2): 565–577. DOI: 10.13057/biodiv/d190227

Kem, S. 2017. Commercialization of Smallholder Agriculture in Cambodia: Impact of The Cassava Boom on Rural Livelihoods and Agrarian Change. Sothorn Kem BSc (Agronomy) MSc (Agriculture Systems). School of Agriculture and Food Sciences. Australia.

Kristin, Y., Qurniati, R., and Kaskoyo, H. 2018. Interaksi Masyarakat sekitar Hutan terhadap Pemanfaatan Lahan Taman Hutan Raya Wan Abdul Rachman. *Jurnal Sylva Lestari* 6(3): 1–8. DOI: 10.23960/jsl361-8

Lynch, F., Hollnsteiner, M. R., and Corvar, L. C. 1974. Data Gathering by Social Survey Trial Edition. Social Science Council Inc., Quezon City.

Mariyono, J., Kuntaringsih, A., Dewi, H. A., Latifah, E., Daroini, P. B., Negoro, A. A., Afari-sefa, V., and Luther, G. 2017. Pathway Analysis of Vegetable Farming Commercialization in Indonesia. *Economic Journal of Emerging Markets* 9(2): 115–124. DOI: 10.20885/ejem.vol9.iss2.art1

Mohta, G., Sundawati, L., and Kuncahyo, B. 2023. Forest Farmer Group Development Model for Sustainable Well-Being in Kampar Regency. *Jurnal Sylva Lestari* 11(3): 427–453. DOI: 10.23960/jsl.v11i3.748

Muhamad, D., Okubo, S., Harashina, K., Parikesit, Gunawan, B., and Takeuchi, K. 2014. Living Close to Forests Enhances People's Perception of Ecosystem Services in A Forest-Agricultural Landscape of West Java, Indonesia. *Ecosystem Services* 8: 197–206. DOI: 10.1016/j.ecoser.2014.04.003

Nautiyal, S., Kaechele, H., Rao, K. S., Maikhuri, R. K., and Saxena, K. G. 2007. Energy and

Economic Analysis of Traditional Versus Introduced Crops Cultivation in the Mountains of the Indian Himalayas: A Case Study. *Energy* 32(12): 2321–2335. DOI: 10.1016/j.energy.2007.07.011

Ngaji, A. U. K., Baiquni, M., Suryatmojo, H., and Haryono, E. 2021. Assessing the sustainability of traditional agroforestry practices: A case of mamar agroforestry in Kupang-Indonesia. *Forest and Society* 5(2): 438–457. DOI: 10.24259/fs.v5i2.14380

Nugroho, P., Rahayu, A. D., Juliani, R., Indarto, Cahyo, A. D., Ankhoviyya, N., Gumilar, E., Susanto, D., and Nugroho, A. 2022. Understanding Resident Intention and Behavior toward Water Conservation Initiative in the Upstream of West Java, Indonesia. *Jurnal Sylva Lestari* 10(1): 12–25. DOI: 10.23960/jsl.v10i1.541

Ogutu, S. O., Mockshell, J., Garrett, J., Labarta, R., Ritter, T., Martey, E., Swamikannu, N., Gotor, E., and Gonzalez, C. 2023. Homegardens, Household Nutrition and Income in Rural Farm Households in Odisha, India. *Journal of Agricultural Economics* 74(3): 744–763. DOI: 10.1111/1477-9552.12525

Parikesit, P., Okubo, S., Husodo, T., and Takeuchi, K. 2012. *The Biodiversity Observation Network in the Asia-Pacific Region*. In: Nakano, S., Yahara, T., Nakashizuka, T. (eds) Ecological Research Monographs. Springer Japan, Tokyo. DOI: 10.1007/978-4-431-54032-8

Pretty, J., and Bharucha, Z. P. 2014. Sustainable Intensification in Agricultural Systems. *Annals of Botany* 114(8): 1571–1596. DOI: 10.1093/aob/mcu205

Prihatini, J., Iskandar, J., and Partasasmita, R. 2018. Struktur Pekarangan Komersil: Studi Kasus Di Desa Sukapura Kecamatan Kertasari Kabupaten Bandung, Das Citarum Hulu, Jawa Barat, Indonesia. *BIOTIKA Jurnal Ilmiah Biologi* 16(2): 5. DOI: 10.24198/bjib.v16i2.19904

Quandt, A., Neufeldt, H., and McCabe, J. T. 2019. Building Livelihood Resilience: What Role Does Agroforestry Play? *Climate and Development* 11(6): 485–500. DOI: 10.1080/17565529.2018.1447903

Soemarwoto, R., and Iskandar, J. 2021. Plant Knowledge Richness in the Sundanese Upland Village: A Case Study in Sindangsari, West Java, Indonesia. *Biodiversitas Journal of Biological Diversity* 22(9): 3722–3735. DOI: 10.13057/biodiv/d220916

Sudomo, A., Leksono, B., Tata, H. L., Rahayu, A. A. D., Umroni, A., Rianawati, H., Asmaliyah, Krisnawati, Setyayudi, A., Utomo, M. M. B., Pieter, L. A. G., Wresta, A., Indrajaya, Y., Rahman, S. A., and Baral, H. 2023. Can Agroforestry Contribute to Food and Livelihood Security for Indonesia's Smallholders in the Climate Change Era? *Agriculture* 13(10): 1896. DOI: 10.3390/agriculture13101896

Sulistiyowati, E., Setiadi, S., and Haryono, E. 2023. The Dynamics of Sustainable Livelihoods and Agroforestry in Gunungkidul Karst Area, Yogyakarta, Indonesia. *Forest and Society* 7(2): 222–246. DOI: 10.24259/fs.v7i2.21886

Sumaryanto, Susilowati, S. H., Nurfatriani, F., Tarigan, H., Erwidodo, Sudaryanto, T., and Perkasa, H. W. 2022. Determinants of Farmers' Behavior Towards Land Conservation. *Land* 11(10): 1–21. DOI: 10.3390/land11101827

Syofiandi, R., Hilmanto, R., and Herwanti, S. 2016. Analisis Pendapatan dan Kesejahteraan Petani Agroforestri di Kelurahan Sumber Agung Kecamatan Kemiling Kota Bandar Lampung. *Jurnal Sylva Lestari* 4(2): 17-26. DOI: 10.23960/jsl2417-26

Tiurmasari, S., Hilmanto, R., and Herwanti, S. 2016. Analisis Vegetasi dan Tingkat Kesejahteraan Masyarakat Pengelola Agroforestri di Desa Sumber Agung Kecamatan Kemiling Kota

Bandar Lampung. *Jurnal Sylva Lestari* 4(3): 71-82. DOI: 10.23960/jsl3471-82

Von Braun, J., Bouis, H., and Kennedy, E. T. 1994. *Conceptual Framework*. In: Von Braun, J., Kennedy, E. T. (eds) Agricultural Commercialization, Economic Development and Nutrition. John Hopkins University Press, Baltimore.

Wanderi, Qurniati, R., and Kaskoyo, H. 2019. Contribution of Agroforestry Plants to Farmers' Income and Welfare. *Jurnal Sylva Lestari* 7(1): 118-127. DOI: 10.23960/jsl17118-127

Widianingsih, N. N., David, W., Pouliot, M., and Theilade, I. 2019. Land Use, Income, and Ethnic Diversity in The Margins of Hutan Harapan – A Rainforest Restoration Concession in Jambi and South Sumatra, Indonesia. *Land Use Policy Elsevier* 86: 268–279. DOI: 10.1016/j.landusepol.2019.05.006

Wijayanto, N., and Briliawan, B.P. 2022. Study on the Growth of Falcataria moluccana at 14-Month-Old and the Productivity of Rice Plant (*Oryza sativa*) IPB 3S in Agroforestry System. *Jurnal Sylva Lestari* 4(1): 11–20. DOI: 10.23960/jsl.v10i3.573

Withaningsih, S., Andari, C. D., Parikesit, and Fitriani, N. 2018. The Effect of Understory Plants on Pollinators Visitation in Coffee Plantations: Case Study of Coffee Plantations in West Bandung District, West Java, Indonesia. *Biodiversitas* 19(2): 559–567. DOI: 10.13057/biodiv/d190231

Yokosawa, R., and Mizunoya, T. 2022. Improving Water Quality in the Citarum River through Economic Policy Approaches. *Sustainability* 14(9): 5038. DOI: 10.3390/su14095038

Zhou, S., Minde, I. J., and Mtigwe, B. 2013. Smallholder Agricultural Commercialization for Income Growth and Poverty Alleviation in Southern Africa: A Review. *African Journal of Agricultural Research* 8(22): 2599–2608. DOI: 10.5897/ajar11.1040