



# An Ecosystem Services Approach in Valuing Contribution of Agrosilvopasture to Household's Income in Rural Area Central Kalimantan

Afentina<sup>1\*</sup>, Yanarita<sup>1</sup>, Tri Minarni<sup>2</sup>, Yuliana<sup>3</sup>

<sup>1</sup> Forestry Department Faculty of Agriculture, Palangka Raya University, Indonesia.

<sup>2</sup> Planning Development, Innovation and Research Agency, Central Kalimantan Government, Indonesia.

<sup>3</sup> Regional Secretariat Murung Raya Regency, Central Kalimantan, Indonesia.

Received: February 17, 2026

Revised: April 25, 2026

Accepted: May 25, 2026

Published: May 31, 2026

Corresponding Author:

Afentina

[afentina@for.upr.ac.id](mailto:afentina@for.upr.ac.id)

DOI: [10.29303/jppipa.v12i5.15320](https://doi.org/10.29303/jppipa.v12i5.15320)

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**Abstract:** Agroforestry is a sustainable land use system that provide wide range of ecosystem services, recommending solutions for biodiversity conservation, rural livelihood, and climate change adaptation. To be able to compete with large-scale monoculture plantations such as oil palm plantations, traditional agroforestry is required to provide better economic benefits to farmers. This research aimed to provide empirical evidence of role of agrosilvopasture to rural livelihood by assessing provisioning services and economic contribution to household income. The Data collected from field observation included species component of agrosilvopasture, utilization, and economic value using market approach. The Analysis employed descriptive statistics. The research found three types of agrosilvopasture based on the livestock species: pig-based agrosilvopasture, goat-based agrosilvopasture and chicken-based agrosilvopasture. Agrosilvopasture provide various provisioning services including food, cooking spice, construction material, medicine, fodder and fertilizer. Income from agrosilvopasture provides a significant contribution to total farmer income, varying from 59% to 65%. In addition, agrosilvopasture assured sustainable income by providing weekly income, monthly oncome and long-term income. The study concluded that agrosilvopasture provide a variety of products to meet farmers' needs and a sustainable source of income. Studying agrosilvopasture components and how they contribute economically is important to increase adoptability and provide recommendations for decision-makers in developing strategies for rural development and ecological conservation.

**Keywords:** Agrosilvopasture; Ecosystem services; Household income; Rural development.

## Introduction

Traditional agroforestry in rural areas in Indonesia exhibits a wide range of ecosystem services encompassing regulating services, mitigating climate change, restraining soil erosion, and supporting food security (Afentina et al., 2021) Oktavia et al., 2022), and improving income and expanding livelihood diversification (Dassir et al., 2019; Hairiah & Ashari, 2013). In addition, these systems proved to have a significant contribution to absorbing GHGs including

CO<sub>2</sub> from the atmosphere and storing it in biomass (Bastin et al., 2019; Griscom et al., 2017; IPCC, 2019) IPCC, 2019; Strass Burg et al., 2020). For subsistence community, traditional agroforestry is essential in providing a wide range of provisioning services including food, biomass, medicines and construction materials. Therefore, preservation and development of these system is necessary (Achmad et al., 2022; Ghosh-Jerath et al., 2021).

Ecosystem services is a framework used for obtaining deep understanding about the contribution of

## How to Cite:

Afentina, Yanarita, Minarni, T., & Yuliana. (2026). An Ecosystem Services Approach in Valuing Contribution of Agrosilvopasture to Household's Income in Rural Area Central Kalimantan. *Jurnal Penelitian Pendidikan IPA*, 12(5), 460-469. <https://doi.org/10.29303/jppipa.v12i5.15320>

ecosystem and human wellbeing (Costanza et al., 1997; Daily & Matson, 2008). For more systematic understanding ecosystem services is classified into provisioning services, regulating services, cultural services and supporting services. The recent development, the ecosystem concept expand its significant in addressing poverty alleviation whose livelihood highly dependent on natural ecosystem including forest (Cavendish, 2000; Fisher et al., 2014). Agroforestry purposively integrates agriculture, forestry, and other components for example fish and cattle to achieve optimum total production while maintaining the carrying capacity of the environment. Combining practice and science, agroforestry has great potential to improve rural livelihood through various alternative techniques and output. The main principle of agroforestry is positive interaction between trees and other elements both economically and ecologically. A combination of various components resulted in higher income and increasing prosperity (Dhanushkodi et al., 2019; Julius et al., 2012). Spatial and temporal arrangement are the key success of agroforestry. Therefore agroforestry is widely implemented in all kinds of ecosystem types around the world (Pantera et al., 2021; Zomer et al., 2016). Varied products and services provided by agroforestry support livelihood, food security, and income generation for local communities especially those who live around the forest (Pandey et al., 2019). Agroforestry ensures that the local communities' basic needs for food, energy, and medicines are provided (Dhakal & Rai, 2020; Kumar & Thakur, 2017; Octavia et al., 2022; Wiyanti, 2016).

Traditional agroforestry in Central Kalimantan is threatened by land use change, deforestation, and expansion of large-scale monoculture plantations. Agroforestry systems along with fishing, hunting, and collecting non-timber forest products such as honey, latex, medicines, and rattan are fundamental for food security and income generation for indigenous people (Page et al., 2009; Suyanto et al., 2009). Because of the alteration from traditional agroforestry to monoculture plantation, the local communities are subject to the loss of their source of food and income generation (Afentina et al., 2021; Law et al., 2015; Miettinen et al., 2016). To be able to compete with large-scale monoculture plantations such as oil palm plantations, traditional agroforestry should exhibit better economic benefits. The economic benefits of agroforestry are determined by several factors including the composition and combination of plant species, land size, and the technology applied. Jordon et al. (2020) conducted research on agrosilvopasture in temperate areas and found that 43% to 49% of farmers' total income is contributed by agroforestry. Economic benefits are also

influenced by the type of agroforestry, such as agrosilvopasture (forestry-crop-animal husbandry), agrosilvofisheries (crop-forest-fisheries husbandry), or complex agroforestry such as home garden and agroforest. Agroforestry can be an option for conservation strategies and climate change adaptation since the benefits of agroforestry cover many aspects including economic, social cultural, and ecological (Dhanushkodi et al., 2019). The income obtained from agroforestry is also sustainable, providing long-term and short-term income (Kinyili et al., 2020; Mutua et al., 2014).

Studying agrosilvopasture components and how they contribute economically is important to increase adoptability and provide recommendations for decision-makers in developing strategies for empowering communities around the forests. Research on agrosilvopasture in Central Kalimantan is still limited, there were no detail information how each component in agroforestry support sustainable income of the household. Therefore, there is a need to collect detailed information regarding this land use system to create a rural development strategy in Central Kalimantan. This research aimed to identify the detailed provisioning services of four type of agrosilvopasture at Pilang Village Central Kalimantan Indonesia. The assessment was also conducted to calculate the contribution of agrosilvopasture to farmers' income generation and support sustainable income stability. The result of this research could provide empirical evidence regarding the importance of traditional agroforestry in achieving sustainable development.

## Method

### *Research Location*

This research was conducted at Pilang Village, Jabiren Raya District, Pulang Pisau Regency, Central Kalimantan Province Indonesia. Geographically, the research location is situated at S.02°29'14.3" South Latitude and E.114°11'43.4" East. Pilang Village covers an area of 33,113.36 ha. Based on the Peat Village Profile compiled by the Peat Restoration Agency (2018), there are 2 types of land in Pilang Village, namely: a. Swamp soil dominated by shallow peat with a depth of between 0.5 – 3 m with a raw or fabric maturity level. b. Alluvial soil or fertile minerals from river deposits that stretch along the banks of the Kahayan River for 1-2 km.

Pilang Village has a humid tropical climate with a maximum air temperature reaching 32.5°C an average minimum temperature of 22.9°C and an average humidity above 80%. With a wet tropical climate, Pilang Village has two seasons, namely the rainy season starting from October – March with rainfall ranging

from 2,000-3,500 mm/year, and the dry season from June – September (Peat Restoration Agency, 2018). The time required to carry out this research was eight months from January to August 2022, consisting of the preliminary study, research designing, collecting data and field observations, data analysis, and writing the report. The research focused on assessing in detail agrosilvopasture in Pilang Village.



**Figure 1.** Map of Pilang Village

*Data Collection and Analysis*

The research was conducted from January to August 2024, consisting of the preliminary study, research designing, collecting data and field observations, data analysis, and writing the report. The research focused on assessing in detail agrosilvopasture in Pilang Village.

Employing case study approach, the research detailed observed the agrosilvopasture system at Pilang village. The data collected in this research includes primary data and secondary data. We observed in detail all agrosilvopasture in Pilang village that accounted for 12 agrosilvopastura systems. The primary data consists of provisioning services from tree species, crop species, and livestock species. Other primary data was income generation from the agrosilvopasture system. This data was obtained by interviewing 12 key informants who own agrosilvopasture. Sampling selection in this study used a purposive sampling method with the criteria of a minimum area of 0.5 ha and the presence of annual plants, crops plants, and livestock with the following details: four chicken-based agrosilvopasture units; four pig-based agrosilvopasture units; and four goat-based agrosilvopasture units.

Data collection in this research was conducted using the method field observation, interview, and literature review.

The observation method in this research aims to obtain primary data and directly observe land conditions, component layout, number, and type of agrosilvopasture components in the agrosilvopasture. Field observation was conducted to identify all the species components of agrosilvopasture and the design. The interviews were designed to obtain information regarding the agrosilvopasture components and income generation.

An interview is a conversation with agroforestry farmers using semi-structured questionnaires (Moleong, 2019). The interviews in this study were employed with a questionnaire, according to Arikunto (2019), the questionnaire contains written questions to obtain information from respondents.

The literature review in this research takes the form of information obtained from scientific books, journals, research reports, government reports, theses, and dissertations. A literature review is carried out to obtain secondary data such as village demographic data and supporting theories.

*Data Analysis*

Data obtained from field observations were then analysed using a descriptive statistical approach while information from interviews was analysed in a qualitative descriptive manner (Creswell & Creswell, 2018). Analysis of the economic contribution of agrosilvopasture obtained by farmers is carried out by comparing the amount of agrosilvopasture income with the total community income using the following formula (Soekartawi, 1995).

$$K = \frac{I_{Agf}}{I_{tot}} \times 100\% \tag{1}$$

Where:

K = Contribution of agrosilvopasture to farmer's total income

I Agf = Income from agrosilvopasture

I Tot = House hold total income

**Result and Discussion**

*Respondent Characteristic*

This research observed and analysed 12 agrosilvopasture owned by 12 farmers. Most of the respondents or owners of agrosilvopasture were in the age range of 46-55 years. Of the respondents who manage agrosilvopasture, 58% are women and 42% are men. Respondents' education varied from graduating from elementary school to graduating from college.

Most of the respondents graduated from Senior High School. One household in Pilang Village is usually inhabited by an extended family, where the grandfather, grandmother, father, mother, and children live in the same house. The number of people in one household ranges from two to eight people. All respondents have a variety of livelihoods, apart from managing agrosilvopature they also cultivate rubber, vegetable traders and services sector.

*Component and Provisioning Services of Agrosilvopature in Pilang Village*

Agrosilvopature in the study is located around the house as part of the home garden. Through this placement, it is more convenient for farmers to raise and monitor their cattle. The design allows farmers to have an easy access to their cattle. They can feed, watch, and monitor their cattle efficiently. The size of agrosilvopature in this research is one hektare in avarage.

The income generation of the community in Pilang village usually comes from multiple sources including

planting rubber, fishing, collecting non-timber forest products, and cooperating cattle in their home garden (agrosilvopature). The latest one is relatively new, introduced by a transmigrant from Java. Most of the community are subsistence farmers. Fishing, shifting cultivation and home garden mostly used to fulfill their needs for food. Developing agrosilvopature by integrating livestock into their home garden is a new improvement to increase their income especially medium and long-term revenue. Based on the type of livestock cultivated, there are three types of agrosilvopature, namely goat-based agrosilvopature, chicken-based agrosilvopature, and pig-based agrosilvopature.

*Component and provisioning services of goat-based agrosilvopature*

The observations identified a total of 20 plant species and one species of livestock. Details of the components of Goat-Based Agrosilvopature are presented in Table 1.

**Table 1.** Provisioning services of Goad-Based agrosilvopature

Local Name	Scientific Name	Provisioning Services
<b>Tree species</b>		
<i>Karet</i>	<i>Hevea brasiliensis</i>	Latex, fuel wood,
<i>Durian</i>	<i>Duriozibethinus</i>	Food, fuel wood
<i>Papaken</i>	<i>Durio kutejensis</i>	Food
<i>Sengon</i>	<i>Albizia falcataria</i>	Construction material, fodder, fertilizer
<i>Cempedak</i>	<i>Artocarpus integer</i>	Food
<i>Kelapa</i>	<i>Cocos nucifera</i>	Food, construction material
<i>Nangka</i>	<i>Artocarpus heterophyllus</i>	Food, construction material
<i>Petai</i>	<i>Parkia speciosa</i>	Food, fodder, fertilizer
<i>Langsat</i>	<i>Lansium domesticum</i>	Food
<b>Crops species</b>		
<i>Lengkuas</i>	<i>Alpina galangal</i>	Cooking spice, medicine
<i>Pisang</i>	<i>Musa parasidica</i>	Food
<i>Kacang Panjang</i>	<i>Vigna unguiculuta</i>	Food
<i>Cabai</i>	<i>Capsicum frutescens</i>	Food
<i>Terong</i>	<i>Solanum malongna</i>	Food
<i>Keladi</i>	<i>Caladium</i>	Food
<i>Kunyit</i>	<i>Curcuma domestica</i>	Cooking spice, medicine
<i>Tomat</i>	<i>Solanum lycopersicum</i>	Food
<i>Kangkung</i>	<i>Ipomoea reptans</i>	Food, fodder
<i>Jagung</i>	<i>Zea mays</i>	Food, fodder
<i>Daun bawang</i>	<i>Allium fistulosum</i>	Food
<b>Livestock Species</b>		
<i>Kambing</i>	<i>Capra aegagrus hircus</i>	Food, fertilizer

Tapping rubber provides farmers with daily income. The latex production from traditional tapping is an average of 15 kg per day, resulting an income ranging from IDR 50,000 until IDR 100,000. Rubber trees are planted in alluvial soil or shallow peatland where the elevation of soil is relatively high, preventing rubber trees from flooded for a long time. Rubber trees can

survive flooding for a short-time period, approximately 3 to 7 days.

Interview with the respondent revealed that the selection of tree species is based on economic considerations and households' need for food. Rubber can provide daily income while Sengon trees can provide long-term income through the sale of the wood.

Sengon wood can be harvested after 4 to 7 years old. Other types of trees are fruit trees that usually produce various fruits once a year. Besides household consumption, fruit production is also sold to generate additional income. Fruit season usually starts from October and peaks in January. Several types of leaves from Petai (*Parkia speciosa*), jackfruit (*Artocarpus heterophyllus*), and sengon (*Albizia falcataria*) trees are utilised as fodder. Crops are mostly for domestic consumption purposes and the production surplus is sold in the neighbourhoods.

In the households' economic system, raising goat serve as long-term savings or investment. Goats can be sold at the age of one to one and a half years. The selling price was IDR 500,000/goat to IDR 1,500,000/goat, depend on the size of the goat. The consideration for choosing goat as livestock includes low capital, easy maintenance, abundant feed and relatively resistance to diseases. Goat manure can be used as fertilizer for agricultural plants and fruit trees. The number of goats owned by respondents varied between 3 to 21

The results of field observations show that in goat-based agrosilvopasture, rubber plants and other forestry are planted at the back of the house, located some distance from the house. Some fruit plants are planted mixed with rubber plants and forest plants, but some are also planted around the house to provide shade for the house as well as for aesthetic considerations. The goats are placed in a pen not far from the house. This is intended to facilitate monitoring and maintenance. Agricultural plants are also placed close to the house to facilitate maintenance and watering using water sources from the house.

**Table 2.** Sustainable Income from Goad based agrosilvopasture

Type of income	Agrosilvopasture component
Weekly income	<i>Hevea brasiliensis</i> , <i>Alpina galangal</i> , <i>Vigna unguiculata</i> , <i>Capsicum frutescens</i> , <i>Solanum malongna</i> <i>Caladium</i> , <i>Curcuma domestica</i> , <i>Solanum</i> <i>lyopersicum</i> , <i>Ipomoea reptans</i>
Monthly income	<i>Cocos nucifera</i> , <i>Zea mays</i> , <i>Artocarpus</i> <i>heterophyllus</i> , <i>Parkia speciosa</i> , <i>Zea mays</i> , <i>Musa parasidica</i>
Annually income	<i>Duriozibethinus</i> , <i>Durio kutejensis</i> <i>Artocarpus integer</i> , <i>Parkia speciosa</i> , <i>Lansium domesticum</i>
Long-term income	<i>Albizia falcataria</i> , <i>Capra aegagrus hircus</i>

*Component and design of pig-based agrosilvopasture*

The results of observations and identification in the field found that at pig-based agrosilvopasture there are 7 species of tree, 9 species of agricultural plants and 1

type of livestock. The table 3 shows detailed results of identifying the types of components present in pig-based agrosilvopasture systems.

Based on the interviews, it is known that the main reason for selecting plant types in the pig-based agrosilvopasture system is fulfilling the need of household for food and income generation. They build their agroforestry system as a self-sufficient system. Most of the plant components were food source plants. Durian, paken and rambutan are types of annual fruit trees, which produce fruit once a year. Lengkuas and serai utilized as medicine for curing stomachache. The fruit produced is usually for household consumption, and if there is surplus production it is then sold as additional income. Likewise, agricultural crops are usually sold within the village or sold to middleman.

The choice of pigs as livestock was based on several considerations, including the requirement of initial capital, which is not too expensive, easy to rise, abundant feed availability, and easy to breed. Raising pigs for the community is a form of investment, the results of which can be used to finance children's education or other expenses. The number of pigs respondents own varies, ranging from 4 - 6.

Raising pigs is a way for respondents to invest, besides that, the capital needed to start raising pigs is relatively cheaper than the capital needed to raise other large meat animals. Respondents gave the pigs vegetables such as keladi dan kangkung which was boiled and then mixed with rice bran. Pig is a profitable livestock due to its growth rate and breeding capability.

**Table 3.** Provisioning seervices of pig-base agrosilvopasture

Local Name	Scientific Name	Provisioning Services
<b>Tree species</b>		
Karet	<i>Havea brasiliensis</i>	Latex, fuel wood
Durian	<i>Duriozibethinus</i>	Food, fuel wood
Papaken	<i>Durio Kutejensis</i>	Food
Petai	<i>Parkia speciosa</i>	Food, fodder, fertilizer
Rambutan	<i>Nephelium lappaceum</i>	Food
Kelapa	<i>Cocos nucifera</i>	Food, construction material
Mangga	<i>Mangifera indica</i>	Food
<b>Crop species</b>		
Lengkuas	<i>Alpina galangal</i>	Cooking spice, medicine
Cabai	<i>Capsicum frutescens</i>	Cooking spice
Terong	<i>Solanum malongna</i>	Food
Timun	<i>Cucumis sativus</i>	Food, fodder
Keladi	<i>Colocasia esculenta</i>	Food, fodder
Kangkung	<i>Ipomoea reptans</i>	Food, fodder
Singkong	<i>Manihot utilisima</i>	Food, fodder
Serai		Cooking

Local Name	Scientific Name	Provisioning Services
Pisang	<i>Cymbopogon citratus</i> <i>Musa acuminata</i>	spice, medicine, Food, fodder
Livestock species Babi (Pig)	<i>Sus scrofa domestica</i>	Food, fertilizer

The annual plant component is located around the house and the largest number is rubber forestry plants because the main source of income is located at the back of the yard. The position of the agricultural plant component is closest and located next to the house because the number and type of agricultural plants are not many and are grown only to meet daily food needs. The location of the pig pen is behind the house. The feed given by respondents to pigs is taro which is boiled first and then mixed with bran which is given twice a day.

**Table 4.** Sustainable Income from pig based agrosilvopasture

Type of income	Agrosilvopasture component
Weekly income	<i>Hevea brasiliensis, Alpina galangal, Capsicum frutescens, Solanum malongna, Cucumis sativus, Colocasia esculenta, Ipomoea reptan, Manihot utilisima, Cymbopogon citratus,</i>
Monthly income	<i>Parkia speciosa, Cocos nucifera, Musa acuminata</i>
Annually income	<i>Duriozibethinus, Durio kutejensis, Nephelium lappaceum, Mangifera indica</i>
Longterm income	<i>Sus scrofa domestica</i>

*Component and provisioning services of chicken-based agrosilvopasture*

Similar to the components of goat and pig-based agrosilvopasture, the components of chicken-based

agrosilvopasture also consist of components from trees, agricultural plants, and livestock. Details of chicken-based agrosilvopasture components can be seen in the Table 5.

**Table 5.** Provisioning services of Chicken-Based Agrosilvopasture

Local Name	Scientific Name	Provisioning Services
Trees		
Karet	<i>Hevea brasiliensis</i>	Latex, fuel wood
Durian	<i>Durio Zibethinus</i>	Food
Papaken	<i>Durio Kutejensis</i>	Food
Petai	<i>Parkia speciosa</i>	Food, fertilizer
Rambutan	<i>Nephelium lappaceum</i>	Food
Kuweni	<i>Mangifera odorata</i>	Food
Cempedak	<i>Artocarpus integer</i>	Food
Manggis	<i>Garcinia mangostana</i>	Food, medicine
Mengkudu	<i>Morindo citrifolia</i>	Food, medicine, fodder
Crops		
Serai	<i>Cymbopogon citrates</i>	Food, medicine
Kunyit	<i>Curcuma longa</i>	Food, medicine
Lengkuas	<i>Alpinia galangal</i>	Food, medicine
Pisang	<i>Musa paradisiacal</i>	Food
Keladi	<i>Caladium</i>	Food
Rimbang	<i>Solanum toroum</i>	Food
Kacang panjang	<i>Vigna unguiculata</i>	Food
Pepaya	<i>Carica papaya</i>	Food, fodder
Livestock		
Ayam	<i>Gallus gallus domesticus</i>	Food, fertilizer

There are a total of 18 species of components in chicken-based agrosilvopasture yards, consisting of 9 species of tree, 8 species of agricultural plant components, and 1 species of livestock component. The composition of agricultural plants and trees is almost equal, while the livestock component is only 6%. The number of chickens owned by respondents varied, ranging from 24 - 35. Chicken farming was chosen because it does not require special feed and complicated

maintaining. Livestock animals are allowed to roam freely around the house. The feed given to chickens can be made from leftovers from family food, or mix of vegetables and rice bran.

The most abundant component of forestry component is rubber, which provides the main source of income for respondents. Rubbers are planted at the back and relatively distance from the house. Fruit trees are located to the left and right of the house while

agricultural plants are located on the side of the house yard. The location of the chicken coop is relatively closer to the house when compared to the location of the coops in pig and goat-based agrosilvopasture. This is designed to facilitate the care and maintenance of chicken livestock which are more prone to theft than goats and pigs.

Chicken manures are used as fertilizer. Chicken manure is an organic fertilizer that provides soil

nutrients and improves soil structure. Chicken manure is a good organic fertilizer because improving the physical, chemical, and biological properties of the soil. In addition, chicken manure has a higher Nitrogen, Phosphor, and Kalium content compared to other manure. Therefore, using chicken manure as fertilizer reduces respondents' expenses for chemical fertilizer.

**Table 6.** Sustainable Income from chicken based agrosilvopasture

Type of income	Agrosilvopasture component (Chicken-based)
Weekly income	<i>Hevea brasiliensis, Cymbopogon citrates, Curcuma longa, Alpinia galangal, Caladium, Solanum toroum, Vigna unguiculata,</i>
Monthly income	<i>Musa paradisiacal, Carica papaya, Parkia speciosa, Gallus gallus domesticus</i>
Annually income	<i>Duriozibethinus, Durio kutejensis, Nephelium lappaceum, Mangifera indica, Nephelium lappaceum, Mangifera odorata, Artocarpus integer, Garcinia mangostana,</i>
Long-term income (more than one year)	<i>Gallus gallus domesticus,</i>

*Contribution of Agrosilvopasture to the Respondent's Income*

In general, the respondents in this research are farmers who depend on rubber cultivation for their main income and also working as labor, fishing and vegetables trader. Implementing agrosilvopasture in the

home yard is a way for respondents to optimize the productivity of home yard and increase economic income. The table 7 present the contribution of agrosilvopasture system to total farmer income.

**Table 7.** Economic contribution of agrosilvopasture to the total income

Agrosilvopasture type	Income from non -agrosilvopasture (IDR)	Income from agrosilvopasture (IDR)	Total income (IDR)	Contribution (%)
Pig base agrosilvopasture	18,000,000	35,974,500	53,974,300	65
Goat base agrosilvopasture	16,500,000	28,840,500	45,340,500	63
Chicken base agrosilvopasture	27,000,000	46,107,750	73,107,750	59

Table 7 shows that income from agrosilvopasture contributes significantly to the total income of farmer households. The contribution of agrosilvopasture was more than 50%. The largest agrosilvopasture contribution was received by respondents who implemented goat-based agrosilvopasture, namely 65% of the total income for a year. Furthermore, what respondents received from implementing pig-based agrosilvopasture was 63% of their total annual income. Next, the lowest contribution is chicken-based agrosilvopasture accounted for 59%.

*Discussion*

Development in rural areas in Indonesia faces complex problems. Often conservation interests' conflict with economic interests. Conservation efforts often emphasize maintaining natural cover such as forests, rivers, and lakes. Contrary, development process in Indonesia is often carried out by expanding large-scale agriculture which has the potential to cause deforestation. The biggest challenge is to find a rural

area development strategy that can accommodate conservation, economic and socio-cultural interests (Li et al., 2021; Purwanto et al., 2020).

The results of this research provide empirical evidence that agrosilvopasture can be an alternative solution to the challenges of developing rural areas in Indonesia. Agrosilvopasture is an environmentally friendly land use system that uses simple technology. In-cooperating livestock into traditional agroforestry is a farmers' innovation to cope with rapid environment degradation and competing land use system such as oil palm plantation.

From an economic perspective, this research provides empirical evidence that agrosilvopasture has a significant contribution to farmer income. The finding consisten with research from Jordon et al. (2020) which found that agrosilvopasture plays important role in household economic. This system generates sustainable income. Rubber plants and vegetables are supply daily and short-term income while livestock components and seasonal fruits provide medium and long-term income.

Agrosilvopasture was born from the culture and adaptation of local communities to ecological conditions and economic development. This makes agrosilvopasture adaptable to the culture and social system of society. The community uses their traditional knowledge and local wisdom to maintain and run the agrosilvopasture system. This research finds that an agrosilvopasture design that places its components around the house provides maintenance efficiency and optimizes positive interactions between its components.

The agrosilvopasture system is a mutualistic symbiosis system, where its component support and benefited one another. Agricultural crops and the leaves of some fruit trees produce food for livestock. On the other hand, livestock manure can be used as organic fertilizer for fruit and vegetable plants.

## Conclusion

This research found three main patterns of agrosilvopasture based on the livestock, pig-based agrosilvopasture, goat-based agrosilvopasture and chicken-based agrosilvopasture. Each type of agrosilvopasture provide wide range of provisioning services, fulfilling basic household need and income generation. Agrosilvopasture provides a significant contribution to farmer income and ensures the sustainability of farmers income by covering weekly, monthly and long-term income.

## Acknowledgments

The authors gratefully acknowledge all individuals and parties who have provided support, assistance, and valuable contributions throughout the research process.

## Author Contributions

Conceptualization, A and Y.; methodology, T and Y. All authors have read and agreed to the published version of the manuscript.

## Funding

This research received no external funding.

## Conflicts of Interest

The authors declare no conflict of interest.

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