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QUANTIFYING THE ECONOMIC VALUE OF TRADITIONAL AGROFORESTRY TREE-CROPS AND THE ECOSYSTEM SERVICES: A STUDY FROM BERINGIN TINGGI, JAMBI, INDONESIA

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Abstract

This study was conducted in Beringin Tinggi Village, Merangin Regency, Jambi Province where the village still maintains a traditional agroforestry farming system. The purpose of this research is to calculate the economic value of traditional agroforestry ecosystem services in Beringin Tinggi Village. The quasi-option value was calculated based on the market price of the traditional food-tree-crops growing in the agroforestry system (durian, kepayang, jengkol, candle nut, enau) and the indirect use value was estimated through respondents' willingness to pay for the environmental services of food security, clean water and natural disaster prevention. The results indicate the quasi-option value of the traditional agroforestry amounted to IDR 2,860,938,714 (USD 190,729) per year. The indirect use value for food security, clean water, biodiversity and natural disaster prevention amounted to IDR 829,380,000 (USD 55,292) per year. Direct use value comprising from paddy, coffee, cinnamon, chili, corn and cucumber amounting to IDR 1,169,030,200 (USD 76,302) per year. The finding from this study highlights the understanding for both quasi option value and indirect use values is essential for making informed decisions about land management, resource allocation and policy development.

Keywords*: Traditional Agroforestry; Economic Valuation; Use Value; Land Management*

Introduction

The attempt to address the need for agricultural land while maintaining forest and environmental functions is through the implementation of agroforestry systems. The legal framework governing agroforestry in Indonesia is outlined in Government Regulation 23/2021, as well as Minister of Environment and Forestry Regulations 8 and 9/2021 [1]. Agroforestry, according to these regulations, entails maximising the utilisation of forest land through a combination of planting arrangements involving forest trees and agricultural tree crops and/or

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animals. The goal is to increase forest land productivity while preserving its primary function. Agroforestry is a land management approach that involves cultivating various types of plants, including trees and non-trees, while nurturing useful vegetation that naturally grows on the land [2]. It integrates agricultural and forestry components to create a more integrated, diverse, productive, profitable, healthy and sustainable land use system. This approach creates a landscape resembling a forest, thereby serving purposes of production, protection and conservation. Various types of agroforestry are practised around the world; however, tropical agroforestry has historically received more attention and adoption than temperate agroforestry [3]. Traditional agroforestry systems have existed for centuries in various parts of Indonesia and have become local wisdom with various informal names. A notable characteristic of traditional agroforestry systems is the deliberate choice of a variety of crops, which helps ensure the resilience of farmer households in securing food, timber, firewood and herbal medicines from their land [4]. The establishment of these agroforestry patterns is influenced by the expertise of local farmers as well as the area's specific agroecological conditions.

Agroforestry not only supplied food but provides important ecosystem services such as carbon sequestration, biodiversity conservation, erosion management, air, water quality, reduced nutrient and pesticide runoff, improved wildlife habitat, reduced reliance on fossil fuels and increased resilience in the face of an uncertain agricultural future [5, 6]. Specifically, such as soil quality improvement is facilitated by higher organic matter levels, a more diverse microbial population and improved nutrient cycling, which can boost crop productivity and drought resilience [7]. For water quality, the incorporation of agroforestry vegetative buffer strips reduces non-point source pollution from row crops. Apart from environmental benefits, agroforestry has the potential to produce a variety of products such as timber, crops, fruits, nuts, mushrooms, livestock and herbal medicine [3].

Merangin is one district that having a traditional agroforestry system in Jambi, Indonesia. This district is the largest district in the province and plays an important role in contributing to food security and ecological sustainability for the entire province. The district government policy has established a program to support farmer-based corporations to develop food estates. The program potentially supported about 94,898.10 hectares of traditional agroforesty (non-rice) farmlands in Merangin. This study explores the traditional agroforestry system in Merangin which is in Beringin Tinggi Village. This area is one of Indonesia's 25,863 forest-based villages [8]. The community received rights to manage 2,038 hectares of state forest land, under the status of Village Forest. It is part of the government's social forestry program in 2011 [9]. About 62.5% of the total area or 1,274ha is a primary forest, comprising a portion of Sumatra's highly biodiverse, yet highly threatened forest ecosystems. Although remote, the village has internet access. The agroforest lands here, handed down from generation to generation, have been managed in such a way that parts look not unlike natural old growth forests in terms of structure and the large numbers of species diversity. The forests around the community are also habitat for the endangered Sumatran tiger.

However, due to growing financial needs, farmers have begun converting the tradition agroforestry into monoculture plantations. Due to the remoteness of this region, residents have begun growing the oil palms, which have led to widespread deforestation elsewhere in Sumatra [10]. Currently, due to the relative ease of transport, most monoculture plantations in the area consist of cinnamon.

Beringin Tinggi's landscape is also gradually changing into a mosaic of cinnamon and coffee plantations, replacing the traditional agroforestry system that had sustained the village for

centuries. Farmers say they need money and their traditional agroforestry systems don't give money to them.

To develop effective policies and strategies that promote sustainable land use, it is critical to quantify the economic value of the environmental services provided by various types of land. Also, it needs to understand the landscape dynamics and land use change. This can be used to assist the government in making decisions and to design government interventions in a landscape for future benefits [11]. Overlooking the use and non-use value of environmental services supplied by various land-use systems may unconsciously support policies that lack incentives for sustainable agriculture practices. International efforts such as The Economics of Ecosystems and Biodiversity (TEEB) and the United Nations initiative on The Economics of Land Degradation have adopted an ecosystems-oriented strategy to address sustainable land management, based on the principles of natural capital and ecosystem services [12]. Furthermore, the Millennium Ecosystem Assessment also provides guidelines in analysing and quantifying the value of ecosystems to make better decisions about the sustainable use of ecosystem services [13].

Since ecosystem services are not commonly traded in the markets, they cannot be easily measured using market prices. Numerous valuation techniques have been developed to estimate various types of values attributed to ecosystem services, with neoclassical economics employing the concept known as total economic value [14]. Therefore, this study uses the framework of total economic value which economists use to identify and categorise environmental benefits, to assess the value of traditional agroforestry ecosystem services in the study area. However due to data limitation, the study only focuses on the use value of traditional agroforestry ecosystem services in Beringin Tinggi Village, Jambi.

The value of agricultural land is primarily determined by its productive potential. To achieve land use sustainability, however, the multifunctionality of this scarce resource must be valued and considered in decision making [12]. Despite the existence of various value theories, economic value continues to dominate resource management discussions. The justification for applying economic valuation to ecosystem services stems from the need to ensure that all services are considered during the decision-making process. Although there is no universally accepted method for categorising all ecosystem services, the Millennium Ecosystem Assessment framework is widely recognised and accepted. Ecosystem services can be categorized into provisioning, regulating, supporting and cultural services.

The value of natural resources is frequently assessed within the framework of total economic value and this framework can be used to value ecosystem services [14]. Total economic value can be divided into use and non-use values which use values include direct, indirect use and option values, whereas non-use values include existence value, altruistic value and bequest value [12].

In detail, direct-use value refers to the value of all goods and services derived from the direct or planned use of ecosystems, consumptive use of resources such as food, timber, or non-consumptive use of services such as recreation and landscape amenity. They are generally associated with provisioning and cultural services [12]. Indirect-use value is derived from the functioning of ecosystems that support and regulate direct-use activities [15]. These services include climate regulation, water regulation, pollution filtering, soil retention and provision, nutrient cycling, waste decomposition and pollination [12].

Option value is the value that people place on the ability to use a resource in the future (direct or indirect) even if they are not current users. It describes the value placed on preserving ecosystems and their component species and habitats for potential future uses, some of which are unknown. Whereas non-use value is derived from the knowledge that ecosystems are maintained

rather than the actual use of ecosystem goods and services [12]. Quasi-option value (QOV), which was explained by *A.V. Dushin et al.* [16] is the value of information that arises after making choice: to conserve or to develop the resource. *D.V. Pearce et al.* [17] define that quasi-option value is the value of learning about the future benefits that would be precluded if development were chosen now.

Valuation techniques for ecosystem services can be classified as either revealed or stated preferences. Revealed preference refers to people's preferences for a marketable good and values are determined by examining people's preferences and willingness to pay (WTP) for a marketable good with environmental attributes [12, 18]. This method includes market prices, replacement cost, productivity change, hedonic pricing and the travel cost method. Stated preference involves the use of a hypothetical market to solicit individuals' preferences and willingness to pay for a nontraded environmental good or service. This methodology is applicable in a variety of scenarios and is capable of estimating non-use values. This method includes contingent valuation and choice modelling [14].

Materials and Methods

Study Area

Jambi is a province in the centre of Sumatra Island. Riau Province borders it to the north, Berhala Strait to the east, South Sumatra Province to the south and West Sumatra Province and Bengkulu Province to the west. The geographically strategic position amidst other provinces makes its role quite significant, especially considering the abundant natural resources. The province of Jambi covers an area of 53,435.72km², with a land area of 50,160.05km² and is renowned for its plantations of palm oil, rubber, cinnamon and tea. Jambi Province holds the record for securing the highest number of forest management rights in Indonesia. As of August 2014, a total of 28 villages in the province have been granted the Rural Forest Working Area (PAK) designation by the Ministry of Forestry, covering approximately 66,671 hectares of land. Beringin Tinggi Village is located in the Merangin Regency, Jambi Province, Indonesia, is one such village with a population of 820 people, with 343 males and 477 females.

This study builds on a two-year Participatory Action Research (PAR) activity in 2019 and 2020, carried out with 132 farmer families involving 165 plots of their land by the Sekar Kawung Foundation. The research revealed that the highly biodiverse traditional agroforest system in this village was becoming seriously fragmented due to the introduction of high economic value monoculture, or simple agroforest plots of coffee and cinnamon beginning in 2005. The main reason behind this transformation is growing economic pressure [19].

The PAR documented numerous trees that are important for the local food culture, including the Pangium edule nut, durian, candle nut, jengkol, sugar palm etc. High levels of edible plants (156 specimens of different plants), were associated to these trees in the village's remaining traditional agroforest areas. This high level of edible plant biodiversity was not found in the coffee and cinnamon plantations and raised concern and awareness among the farmers involved in the research about the possible threat to food security if they continued to convert their traditional agroforest into cash-based monoculture plantations. Map for land cover and land use of Beringin Tinggi Village are shown in figures 1 and 2.

Through their two-year PAR the community became aware about the need to contain the expansion of coffee and cinnamon expansion into the traditional agroforest, for this, they reasoned it would be necessary to develop the economic value of remaining food tree crops in

their traditional agroforest system. The village is aware that protecting their traditional agroforest system is critical in sustaining both the community's wellbeing and the local environment.

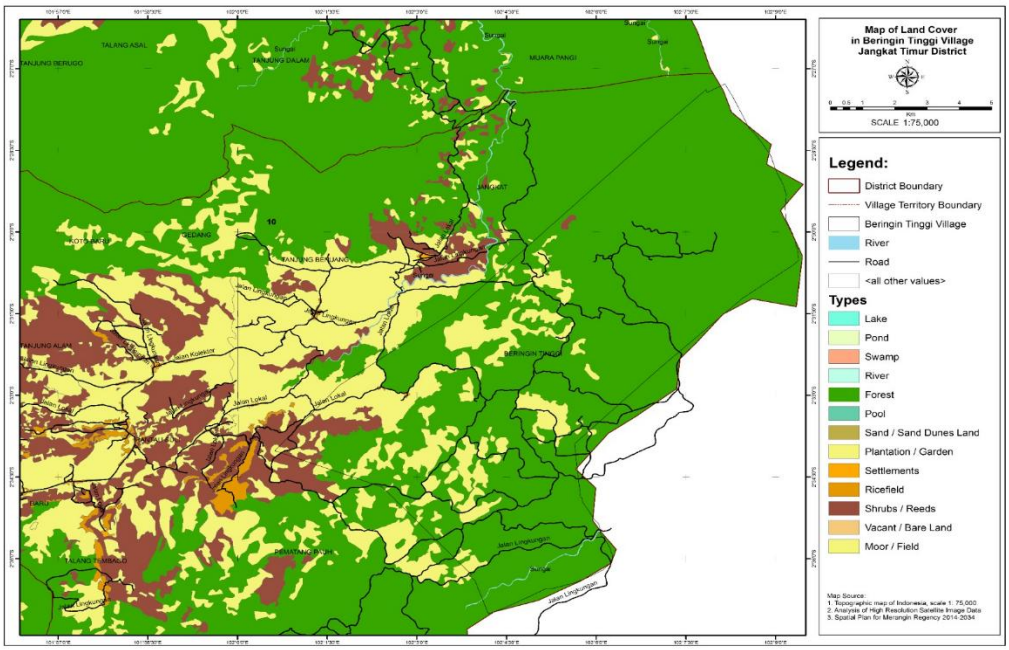

Fig. 1. Map of land cover of Beringin Tinggi Village

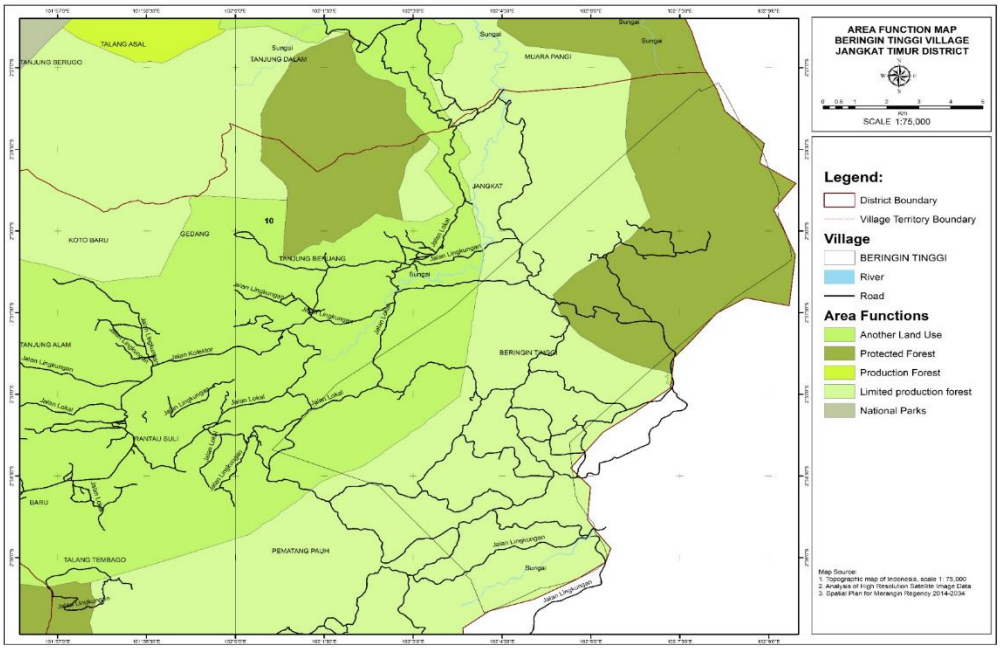

Fig. 2. Map of land function of Beringin Tinggi Village

Traditionally the agroforest in Beringin Tinggi Village brought together the ecological and economic functions, where customary rules acted as controllers over actions that may harm the integrity of natural resources in the landscape and its ability to deliver important environmental services such as clean water and disaster prevention. The realization of the ecological interconnections between the traditional agroforestry system and water governance in Beringin Tinggi Village is closely related to the local knowledge they acquire from preserved customary norms.As is well known, the villagers' lives are inextricably linked to their strong and profound traditional values, particularly in the management of forest resources with a focus on ecological and hydrological sustainability. The Indigenous Law in Beringin Tinggi Village continues the legacy of noble values passed down by their forefathers, such as prohibiting land or forest clearing in the upstream region that contains water sources. The combination of ecology, economics and culture has until recent years distinguished the traditional agroforestry in Beringin Tinggi Village from other villages. However, this is now changing, the PAR has made it clear that if farmers cannot actualize the economic potential held within traditional agroforest tree crops, it will be impossible to save the traditional agroforest system from conversion.

In 2021, The University of Jambi provided technical assistance to Beringin Tinggi to carry out research on the economic value of their traditional food-tree crops in an effort to develop an economic basis to preserve and rebuild the traditional agroforestry villages. Furthermore, research was carried out to quantify the value the environmental services that the traditional agroforest system can provide if it is kept intact.

Data collection

This study calculates the potential benefit of direct-economic value of selected traditional tree food crops resulting from the initial two-year PAR activity conducted by Sekar Kawung and University of Jambi. The data was collected through survey of 165 traditional agroforest plots, of which 160 plots were managed by 132 families with total area of 243ha and the other 5 plots commonly used in 2020 to 2021.

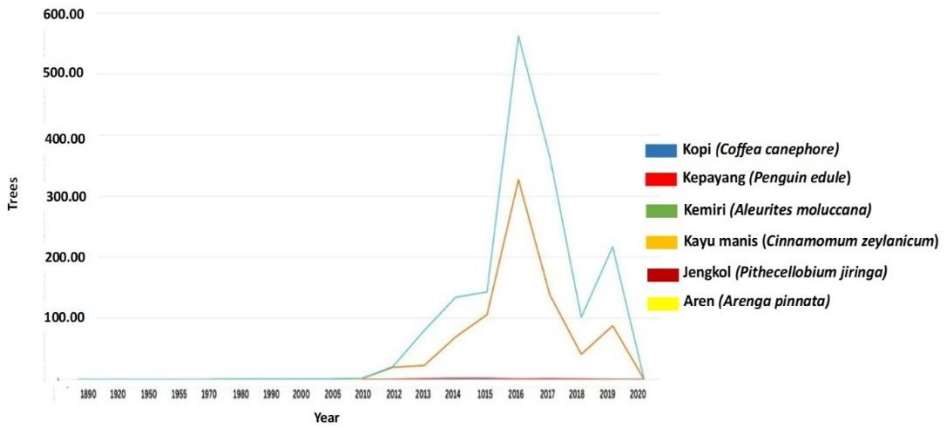

Fig. 3. Distribution of traditional agroforestry commodities from year to year
Notes: Blue: coffee (81,130 trees); Orange: cinnamon (80,522 trees); Others: kepayang or *Pangium edule* (140 trees); candle nut or *Aleurites moluccanus* (73trees); jengkol or *Archidendron pauciflorum* (648 trees); sugar palm or *Arenga pinnata* (72 trees); durian or *Durio* (823 trees).

The produce of these trees is selected to calculate the direct economic value that can be delivered by the traditional agroforest system because of their important ecological role in the bio-physical structure of the traditional agroforest system. Without these trees, the traditional agroforest system of Beringin Tinggi will not exist.

To calculate the non-direct value of the specific ecosystem services of food-security, both primary and secondary data were incorporated. Primary data was gathered through interviews with 68 residents of Beringin Tinggi Village between December 2022 and April 2023 (Table 1).

Table 1. Socio-demographic characteristics of respondents for the indirect value survey

Gender	Frequency (n)	Percentage (%)
Female	19	27.94
Male	49	72.06
Total	**68**	**100.00**
Age		
20-30	28	41.18
31-41	13	19.12
42-52	12	17.65
53-63	10	14.71
64-74	4	5.88
75-85	1	1.47
Total	**68**	**100.00**
Educational level		
Primary school	42	61.76
Secondary school	10	14.71
High school	14	20.59
College	2	2.94
Total	**68**	**100.00**
Monthly Income (IDR)		
< 500.000	2	2.94
500.000 - 1.000.000	14	20.59
1.000.000 - 1.500.000	25	36.76
1.500.000 - 2.000.000	10	14.71
2.000.000 - 2.500.000	12	17.65
2.500.000 - 3.000.000	4	5.88
> 3.000.000	1	1.47
Total	**68**	**100.00**

Source: Field data, 2023

Data analysis

This study examines the option value (OV), indirect use value (IUV) and direct use value (DUV) of traditional agroforestry ecosystem services. The two values (OV and IUV) represent ecology benefits of the traditional agroforestry that conserve forest and various tree crops like kepayang, candle nut, jengkol, sugar palm and durian.

The OV in this study was determined through the combination of revealed preference and stated preference techniques. To be more specific, the OV of the traditional food tree crops in the traditional agroforestry were calculated using an estimated lower-than -average yield per mature tree per year. This was done by taking consideration the fact that trees are growing in the polyculture semi-domesticated ecosystem of the traditional agroforest system, while data about the particulate tree productivity is only available for monoculture plantation settings where tree crops are intensively cultivate and may have higher yields per tree. Once the volumes of production have been accounted for, the study uses current market prices for the yields and or products made from the various tree crops (a revealed preference approach). The study assessed

the option value and indirect value for the agroforestry ecosystem services. The OV was calculated based on the market prices of that particular crops, while the IUV such as food security, clean wate and natural disaster prevention, was assessed using the Contingent Valuation Method (CVM). It was assessed based on the willingness to pay of the respondent to protect environmental services of the traditional agroforestry ecosystem.

The DUV of the simple agroforestry system represents a financial benefit that was determined through the revealed preference to estimate the direct use value of paddy, coffee, cinnamon, chilli, corn and cucumber was calculated using market prices of crops generated within the simple agroforestry system.

Both values of the ecological benefits and the financial benefits will be compared to know how much opportunity cost of converting the traditional agroforestry to monoculture system. This information will be useful to reconcile both functions for sustainability purposes of the traditional agroforestry in Beringin Tinggi Village.

Results and discussion

Socio-demographic characteristics of respondents

The survey involved 68 respondents from Beringin Tinggi Village in Jambi, Indonesia. The majority of them were male (72.06%), aged 20 to 30 (41.18%), had completed primary school (61.76%), with the monthly income between IDR 1.000.000 and IDR 1.500.000 (USD 65 to USD 98) and owned land with a size of 0.5 to 2 hectares (39.71%) (Table 1).

In calculating the benefits of traditional agroforestry in the Beringin Tinggi Village, supporting factors are used as references. Land area and production are two factors that influence the magnitude of agroforestry benefits in the Beringin Tinggi Village. Based on the research findings in the Beringin Tinggi Village, it can be observed that 19.12% of respondents own land less than 0.5 hectares, 39.71% of the respondents have land ranging from 0.5 hectares to 2 hectares, 36.76% have land between 2 hectares and 5 hectares and 4.41% have land between 5 hectares and 10 hectares.

Table 2. Option value of the Traditional Agroforestry services in Beringin Tinggi Village, Jambi

Traditional agroforest tree crop	Number of trees	Potential yield	Potential yield if processed for added value	Market value in IDR	Value (IDR) per year
Kepayang or Pangium edule	140	At 350 kg of seed/tree/year = 49,000 kgs/year	10 kg seeds make 1 kg oil	50,000/kg	245,000,000
Candle nut or Aleurites moluccanus	73	At 150 kg of seed/tree/year = 10,950 kg/year	3 kg seeds make 1 litre of oil	96,900/litre	353,685,000
Sugar palm or Arenga pinnata	72	At 10 litres of sap/tree/day* = 265,800 litres/year.	7 litres of sap make I kg of sugar	18,000/kg	683,485,714
Jengkol or Archidendron pauciflorum	648	At 200 kg/tree/2 x/year = 129,600 kg/year	Can be sold directly	7000/kg	907,200,000
Durian or Durio	823	40 fruits/tree/year	Assuming one fruit is 1 kg and contains 30% pure fruit flesh.	68,000/kg	671,568,000
	Total Value				2,860,938,714

Source: Sekar Kawung Foundation, 2019

Production also influences the value of agroforestry benefits because the higher the production yield obtained from the agroforestry system, the greater its economic benefits. On average, the majority of respondents harvest more than 20kg per month (45.59%). This followed by with the range of 15kg to 20kg (25%), the range of 5kg to 10kg accounting for 16.18% and the range of 10kg to 15kg accounting for 13.24%. No respondents reported yields less than 5kg.

Option value of the traditional agroforestry services

A conservative estimation of the direct value that could be derived from a select number of traditional food tree crops in the Beringin Tinggi agroforest system. Table 2 shows the option value for the traditional agroforestry services in the Beringin Tinggi Village. Based on the report from the Sekar Kawung Foundation (2019), Jengkol (*Archidendron pauciflorum*) had the highest value about IDR 907,200,000 (USD 55,6257.28) per year, followed by Sugar Palm (*Arenga pinnata*) amounts to IDR 683,485,714 (USD 41,895.48). Total option values provided by the traditional agroforestry ecosystem services is IDR 2,860,938,714 (USD 175,422.65) per year.

Indirect use value of simple agroforestry system

Indirect use values were obtained based on interviews with respondents by asking their willingness to pay for environmental services provided by the agroforestry system in Beringin Tinggi Village. It can be identified that the indirect benefits of the environmental services provided by the agroforestry system in the Beringin Tinggi Village, as perceived by the community at present, include food security, clean water, biodiversity and prevention of natural disaster.

Based on the survey, the willingness to pay for the environmental service of irrigation of agricultural land amounts to IDR 10,440,000 (USD 681.42) per year. When the sum of indirect benefits is multiplied by the total of 16 respondents, the total benefit from food security amounts to IDR 167,040,000 (USD 10,902.68). The willingness to pay for the environmental service of clean water amounts to IDR 14,280,000 (USD 932. 05) per year. When the sum of indirect benefits is multiplied by the total of 20 respondents, the total benefit from clean water amounts to IDR 285,600,000 (USD 18,641.08).

Based on the survey results, the willingness to pay for the environmental service of natural disaster such as flood and landslide prevention amounts to IDR 17,940,000 (USD 1,170.94) per year. When the sum of indirect benefits is multiplied by the total of 21 respondents, the total value from flood and landslide prevention amounts to IDR 376,740,000 (USD 24,589.78). Thus, total indirect use value for all the environmental services provided by the traditional agroforestry ecosystem services is IDR 829,380,000 (USD 55,292) per year as presented in Table 3.

Table 3. Indirect benefit of the Traditional agroforestry ecosystem services in Beringin Tinggi Village, Jambi

Indirect benefit	Total WTP/year (IDR)
Irrigation of agricultural land	167,040,000
Clean Water	285,600,000
Prevention of flood and landslide	376,740,000
Total Indirect Use Value	829,380,000

Direct use value of the simple agroforestry system

Based on primary data obtained from interviews and questionnaires with respondents, it can be determined that the direct benefits of the monoculture system in the Beringin Tinggi Village as perceived by the community at the time, include paddy, coffee, cinnamon, chilli, cucumber and corn. The summary of the direct use value is presented in Table 4.

Based on interviews with the respondents, the average paddy harvest per respondent is 276kg per year, with an average selling price of IDR 7,250 (USD 0.47) per kg. The value of paddy benefits amounts to IDR 2,001,000 (USD 130.61). When this benefit is multiplied by the total of 61 respondents who produce rice, the total value of rice benefits amounts to IDR 122,061,000 (USD 7,966.91). For the coffee, the average coffee harvest per respondent is 278 kg per year with an average selling price of IDR 22,925 (USD 1.50) per kg. The value of coffee is IDR 6,373,150 (USD 415.97). The sum of these benefits is multiplied by the total of 61 respondents who produce coffee, resulting in a total benefit from coffee of IDR 388,762,150 (USD 25,374.46).

For cinnamon, the average harvest per respondent is 246 kg per year with an average selling price of IDR 42,825 (USD 2.80) per kg. The value of cinnamon is IDR 10,534,950 (USD 687.62). When the benefits are summed and multiplied by the total of 59 respondents who produce cinnamon, the total value from cinnamon amounts to IDR 621,562,050 (USD 40,569.29). Only 3 respondents reported producing chillies in their farms. The total chili harvest amounts to 240 kg per year, with an average selling price of IDR 40,000 (USD 2.61) per kg. The value from chili is IDR 9,600,000 (USD 626.59). The total benefit from chillies is IDR 28,800,000 (USD 1,879.77) per year.

Table 4. Direct use values of the Simple Agroforestry System in Beringin Tinggi Village

Crops	Average per respondent	Value (IDR)/year
Paddy		
Average paddy harvest	276 kg/year	
Average selling price	IDR 7,250/kg	
Value of paddy benefits		2,001,000
Coffee		
Average coffee harvest	278 kg/year	
Average selling price	IDR 22,925/kg	
Value of coffee benefits		6,373,150
Cinnamon		
Average cinnamon harvest	246 kg/year	
Average selling price	IDR 42,825/kg	
Value of cinnamon benefits		10,534,950
Chillies		
Average chillies harvest	240 kg/year	
Average selling price	IDR 40,000/kg	
Value of chillies benefits		9,600,000
Corn		
Average corn harvest	330 kg/year	
Average selling price	IDR 5,500/kg	
Value of corn benefits		1,815,000
Cucumber		
Average cucumber harvest	60kg/year	
Average selling price	IDR 10,000/kg	
Value of cucumber benefits		600,000

Based on interviews with respondents, the average corn harvest per respondent is 330 kg per year, with an average selling price of IDR 5,500 (USD 0.36) per kg. The value of corn is IDR 1,815,000 (USD 118.46). When the benefits are summed and multiplied by the total of 3 respondents who produce corn in their farms, the total benefit from corn amounts to IDR 5,445,000 (USD 355. 39). For cucumber, only 4 respondents reported producing cucumbers in

their farms. The total cucumber harvest amounts to 60 kg per year, with an average selling price of IDR 10,000 (USD 0.65) per kg. The benefit from cucumbers is IDR 600,000 (USD 39.16). The total benefit value from cucumber production of 4 respondents amounts to IDR 2,400,000 (USD 156.65) per year. Table 3 summarizes the total direct use value for the crops harvested in Beringin Tinggi Village, Jambi. The total direct use value is IDR 1,169,030,200 (USD 76,302) per year.

Table 5. Direct Use Value of the Monoculture System in Beringin Tinggi Village, Jambi

No	Production	Value (IDR) per year
1	Paddy	122,061,000
2	Coffee	388,762,150
3	Cinnamon	621,562,050
4	Chillies	28,800,000
5	Corn	5,445,000
6	Cucumber	2,400,000
	Total Value	1,169,030,200

Comparation of traditional and simple agroforestry system

Table 6 below shows the total benefits of traditional agroforestry and simple agroforestry system. Based on the calculation, the total value of traditional agroforestry system was IDR 3,690,318,714 (USD 246,021) per year. This value is higher than the direct benefits (value) of the simple agroforestry system which amount IDR 1,169,030,200 (USD 76,302).

Table 6. Use Value of the Traditional Agroforestry Ecosystem Services and Simple Agroforestry System, in Beringin Tinggi Village

Land Use	Value and Types	Value (IDR)/year	Total (IDR)/Year
Traditional Agroforestry System	Direct Use Value:		
	Jengkol	907,200,000	
	Durian	671,568,000	
	Sub Total		1,578,768,000
	Option value:		
	Kepayang	245,000,000	
	Candle nut	353,685,000	
	Sugar palm	683,485,714	
	Sub Total		1,282,170,714
	Indirect use value:		
	Food Security	167,040,000	
	Clean Water	285,600,000	
	Prevention of Nat. Disaster	376,740,000	
	Sub Total		829,380,000
	Total		3,690,318,714
Simple Agroforestry System	Direct Use Value:	122,061,000	
	Coffee	388,762,150	
	Cinnamon	621,562,050	
	Chillies	28,800,000	
	Corn	5,445,000	
	Cucumber	2,400,000	
	Total		1,169,030,200

Conclusion

The total use value generated by the traditional agroforestry system in Beringin Tinggi Village, Merangin Regency, amounts to IDR 3,690,318,714 (USD 246,021) per year. This is three times higher than benefit derived from the monoculture system such as paddy, coffee, cinnamon, chili, corn and cucumbers, totalling IDR 1,169,030,200 (USD 76,302) per year. The indirect use value, obtained through the willingness to pay of respondents for environmental services, amounts to IDR 829,380,000 (USD 55,292) per year, covering aspects like food security, clean wate and natural disaster prevention. The direct use value contributes more significantly than the indirect use value for the agroforestry ecosystem services in Beringin Tinggi Village, Jambi.

Based on the research results, this study suggests a policy towards the potential of the traditional agroforestry such as to improve the accessibility and quality of agricultural infrastructure, such as irrigation, road and distribution networks; strengthen facilities for storing and processing agricultural products to reduce post-harvest losses and increase the added value of products; encourage farmers to expand the types of crops and trees grown in the agroforestry system, including food crops, spices and other high-value economic crops; provide technical support and access to superior seeds/varieties suitable for the agroecological conditions of Beringin Tinggi Village; promote sustainable natural resource management practices to preserve biodiversity, mitigate natural disasters and reduce negative environmental impacts; identify and assess the potential environmental services provided by agroforestry, such as clean water supply, biodiversity conservation and its impact on food security and conduct educational campaigns for the community on the importance of environmental conservation and the natural ecosystem benefits derived from the agroforestry system.

Key policy recommendations include improving agricultural infrastructure, encouraging crop diversification, promoting sustainable natural resource management, raising awareness about environmental benefits and actively involving local communities in policy formulation and evaluation. These policies are expected to enhance the benefits of agroforestry in Beringin Tinggi Village while considering economic, environmental and social aspects. With the proper implementation of these policies and the support of all relevant parties, it is hoped that Beringin Tinggi Village can become a successful example of sustainable agroforestry agricultural systems.

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