INNSPUB

International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print), 2222-5234 (Online)
http://www.innspub.net
Vol. 16, No. 3, p. 183-195, 2020

RESEARCH PAPER OPEN ACCESS

Land use with agroforestry system in North Kalimantan Province Indonesia State

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Key words: Agrosilvopastura fishery; agrosilvopastura; agrisilviculture; silvopastura; agrosilvofishery; and important value index (INP).

http://dx.doi.org/10.12692/ijb/16.3.183-195 Article published on March 18, 2020

Abstract

The combination pattern in the Agroforestry system in a plot of land is determined by its constituent components, one of which is to look at tree vegetation that has the highest importance index. So the purpose of this study was to determine the pattern of agroforestry combination carried out by the community in Long Beluah Village and to find out the dominant tree species cultivated by respondent farmers in Long Beluah Village. The method used in this research was interview and survey methods. The field observation data collection was doneby using terraced path method. Furthermore, the data were analyzed descriptively and quantitatively and were calculated using Importance Value Index, while the data obtained from the agencies and the relevant agencies were processed with tabulation and were described descriptively in narrative form. The conclusion of this study is that the most common agroforestry combination patterns carried out by the community of Long Beluah Village are agrosilpopastura with a percentage of 36%, followed by agrosilvopastura fisheri and agrisilvikultur with a percentage of 16%, agrosilvofisheri 12% and Silvopastura by 8%. Then the types of tree plants that dominated in Long Beluah Village were rambutan plants with an important value index of 31.08% then followed by other tree species such as langsat by 28.38%, mangoes by 24.60%, Durian by 24.38% , coconut at 16.93%, sugar palm at 15.15%, cempedak at 14.45, salak at 13.88% and rambai at 9.77%. The recommendation of this research is that the potential of local fruits that have high economic value continues to be developed such as local durian and elai. Then the livestock component so that its utilization is more maximized by utilizing cow manure and urine for fertilizer.

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Introduction

Agroforestry is a land use system that includes the merging of trees with agricultural crops or animals simultaneously, so as to increase the productivity of plants and animals on an ongoing basis, especially under simple technological conditions and utilizing marginal land (Nair, 1993). It is well known that marginal land used for agriculture is also widely available in Kalimantan. The largest distribution of marginal land (critical land) in Kalimantan is in the area of East Kalimantan Province with an area of critical land of 12.96 million per hectare. The area of critical land in Central Kalimantan is 7.74 million hectares, and in South Kalimantan which is 2.13 million hectares (Suharta, 2010). This marginal land if managed as agricultural land requires an appropriate management system in order to produce optimal production.

One of the land management systems that can be offered is the agroforestry system. Agroforestry systems have many advantages compared to other land use systems. In the long run it turns out that the benefits derived from agroforestry systems are higher than monoculture systems. Through land use with agroforestry systems, land quality is increasingly fertile and productive because it always gets the addition of organic material from fallen leaves. Land cover in the form of trees provides maximum protection against local land from the risk of erosion by surface water flow.

Agroforestry as one of the agricultural technology models that is increasingly increasing its role, especially for rural communities who have limited land. Land use patterns with agroforestry systems are an important farming model for farmers who generally have limited agricultural land. Agroforestry patterns on limited land will increase the intensity of the harvest, which in turn can provide additional output in the form of physical as well as financial value. The agroforestry farming scheme also provides the possibility for landowners to increase the intensity of harvesting per certain area, so that the agroforestry pattern is considered to be able to overcome the problems of farmers' lives, especially in meeting their subsistence needs.

The agroforestry pattern that is commonly applied by the community in general is complex agroforestry where complex agroforestry is a permanent farming system that involves many types of trees, both deliberately planted and originating from natural regeneration. The constituent components of complex agroforestry, in addition to trees and agricultural crops, there are also components of livestock, fish, and others. In the components of trees and agricultural cultivation plants there are many types of plants, including industrial plants, fruits, starch producers, vegetables, spices, and medicines.

Based on the many constituent components of agroforestry, efforts that can be made to optimize the sustainability of farming by agroforestry farmers is the determination of a combination pattern. Determine the pattern of agroforestry combination there is a constituent component that shows the complementary function in the combination so that ecological interactions occur in synergy, not competing with each other. In addition to ecological interactions, an understanding of the structure of vegetation is very important in the effort to manage agroforestry systems. The actual agroforestry system can be studied based on its vegetation structure. All management activities that will be applied to the agroforestry system must be adjusted to the land being managed. Thus, it is necessary to calculate the importance of the vegetation compiler agroforetri.

The importance of a type of vegetation is reflected in the magnitude of the value index of the vegetation. Important value index is the most representative value in providing a picture of the dominance of a type of plant in the place of growth. The existence of the vegetation can be used as an indicator of the quality of the place to grow (Daryono, 1985).

Long Beluah Village is a village included in Tanjung Palas Barat District, Bulungan Regency. Most residents of Long Beluah Village have jobs as farmers

developing agricultural commodities for food crops and horticulture, plantations, and forestry (Long Beluah Village Government, 2019).

Therefore, it is necessary to conduct research to find out the pattern of land use of agroforestry farming systems implemented by the community of Long Beluah Village.

Materials and methods

Place and Time

This research was conducted in Long Beluah Village, Tanjung Palas Barat Subdistrict, Bulungan District, North Kalimantan Province, Indonesia. Graphically the village of Long Beluah is located at 2.731033 (2° 43'51.72 "N) and longitude 117.11471 (117° 6'52.96" E). Long Beluah village land use consists of rice fields, fields, yards and others (Long Beluah Village Government, 2019).

The time for conducting research starts from January-April 2019. As a guideline for conducting research in the field, this research uses stages of activities consisting of three stages: field orientation, identification and inventory, and data processing.

Sample Determination Method

Determination of the sample or respondent is done by purposive sampling method. The number of respondents was determined based on the Slovin Technique (Amirin, 2011). The Slovin formula used is:

$$n = \frac{N}{N\,(e)2 + 1}$$

Note: n = number of respondents sampled in the study

N = number of farmers in the group members in the study area

e = error limit (15%)

1 = constant number

The respondent was chosen based on community participation in land use and management by purposive sampling so that the number of respondents obtained was 25 farmers who owned gardens.

Stages of Research Activities

Field Orientation

Field orientation is carried out by looking at the whole area with a view to getting a general picture of the condition of the agroforestry system that exists in each Sub-District that is used as the research location. Results Field orientation is used as the basis for determining the location of research plots and research respondents.

Identification and Inventory

Identification is done by looking at agroforestry practices carried out by farmers regarding the agroforestry model used (agrisilvikultur, silvopastura, agrosilvofisheri, Agrosilvopastura fisheri, agrisilvopastur).

The dominant tree species inventory is by identifying the trees that exist in the agroforestry system cultivated by farmers. Before identification, determine the sample plot first and then measure the plot area according to the specified size.

The determination of the location of the sample plot is based on the checkered line method. This method is considered as a modification of the double plot method or the lane method, namely by jumping one or more plots in the lane, so that along the pioneering lines there are plots at a certain distance (Indriyanto, 2006). Observation plots were placed in the middle of the garden extending in the direction of the rows of plants. Sample plots in each study area were made of 5 plots for seedlings, shrubs, shrubs, small trees and large trees so that the total sample plots for one study area were 30 plots. The shape and size of sample plots can be seen as shown in Fig. 1 (Latifah, 2005).

Data processing

The data obtained were analyzed descriptively quantitatively so that the combination patterns, constituent components of agroforestry, and the index of importance of tree species constituting agroforestry systems can be identified. Data obtained

from the Office and related institutions (secondary data) are processed by tabulation and described in the description in the form of narration. Data from field observations and interviews with land owners (primary data) are processed using the Important Value Index (INP) method. Important Value Index is the most representative value in providing a picture of the dominance of a type of place of growth (Duryat, 2006).

INP calculation of tree species making up agroforestry pattern components is done using the formula: (Indriyanto, 2006).

INP = KR + FR +DR

Note: INP = important value index

KR = Relative density

FR = Relative frequency

DR = Relative dominance

$$Species\ Density\ (K) = \frac{Number\ of\ individuals\ of\ a\ species}{Sample\ plot\ area}$$

$$\text{The relative density of a species (KR)} = \frac{\text{Species density}}{\text{Density of all species}}\ x\ 100\%$$

$$\text{Frequency of a species (F)} = \frac{\text{Number of subspecies of species found}}{\text{Sum of all species}}$$

$$\text{The relative frequency of a species (FR)} = \frac{\text{The frequency of a species}}{\text{Frequency of all species}}\ x\ 100\%$$

$$\text{The dominance of a relative (D)} = \frac{\text{The basic area of a species}}{\text{Sample plot size}}$$

$$\text{The relative dominance of a species (DR)} = \frac{\text{Domination of a species}}{\text{Domination of all species}}\ x\ 100\%$$

Result and discussion

Combination Pattern of Agroforestry

Based on interviews and field surveys of 25 respondents, there are 22 fields that use a combination of agroforestry systems with 2-4 types of building components, while 3 fields are mixed gardens.

Table 1. Number and percentage of agroforestry combination patterns.

Number	Combination Pattern of Agroforestry	Notation	Land area (m²)	Amount of land (the unit)	Percentage (%)
1.	Agrosilvopastura	Asp	31.750	9	36
2.	Agrisilvikultur	As	136.100	4	16
3.	Agrosilvopastura fisheri	Aspf	29.000	4	16
4.	Agrosilvofisheri	Asf	28.260	3	12
5.	Silvopastura	Sp	22.780	2	
6.	Kebun campuran	KC	16.450	3	12
	Total		264.340	25	

Source: Primary Data (processed), 2019.

Table 2. Types of plants in a combination pattern of agrosilvopastura fisheri.

Number	Plant name	Latin name of the plant	Harvest age	Function
1.	Durian	*Durio zibethinus*	5 years	fruits
2.	Rambai	*Baccaurea motleyana*	3-4 years	fruits
3.	Jackfruit	*Artocarpus heterophyllus*	5-10 years	fruits
4.	Sugar Palm	*Arenga pinnata*	4-5 years	industry
5.	Rambutan	*Nephellium lappaceum*	8-10 years	fruits
6.	Mango	*Mangifera indica*	5-6 years	fruits
7.	Sawo	*Manilkara zapota*	7 years	fruits
8.	Langsat	*Langsium domesticum*	6 years	fruits
9.	Water apple	*Syzygium aqueum*	2-3 years	fruits
10.	Guava	*Psidium guajava*	2-3 years	fruits
11.	Coconut	*Cocos nucifera*	4-6 years	industry
12.	Sweet orange	*Citrus X sinensis*	7-9 months	fruits
13.	Ambarella	*Spondias dulcis*	5 years	fruits
14.	Longan	*Dimocarpus longan*	8-12 months	fruits
15.	Breadfruit	*Artocarpus altilis*	8-10 years	fruits
16.	Salak	*Nasalacca edulis*	3-4 years	fruits
17.	Papaya	*Carica papaya*	9-12 months	fruits
18.	Banana	*Musa sp*	4 months	fruits
19.	Corn	*Zea mays*	3-4 months	producing starch
20	Pumpkin	*Cucurbita moschata Durch*	2 months	vegetables
21.	Dragon fruit	*Hylocereus sp*	8-12 months	fruits

Source: Primary Data (processed), 2019.

The combination pattern of agroforestry that was formed from the 22 lands are agrosilvopasturafisheri (aspf), agrosilvopastura (asp), agrisilviculture (as), agrosilvofisheri (asf) and silvopastura (sp). The number and percentage of agroforestry combination patterns can be seen in Table 1.Table 1 shows that the most common agroforestry combination patterns of the Long Beluah Village were agrosilpopastura with a percentage of 36%, followed by agrosilvopastura fisheri and agrisilvikultur with a percentage of 16%, agrosilvofisheri 12% and Silvopastura at 8%.

Table 3. Types of livestock and fish in a combination pattern of agrosilvopastura fisheri.

Livestock			Fish		
Name	Function	Amount	Name	Function	Amount
Indian Runner Duck (*Anas Platyrhynchos domesticus*)	Animal protein	20	Patin (*Pangasius*)	Animal protein	5.100
Chicken (*Gallus gallus domesticus*)	Animal protein	95	Nile tilapia (*Oreochromis niloticus*)	Animal protein	1.015
Muscovy Duck (*Anatidae*)	Animal protein	10	cat fish (*Clarias*)	Animal protein	550
Cow (*Bos Taurus*)	Animal protein	2			
Goat (*Capra aegagrus hircus*)	Animal protein	10			

Source: Primary Data (processed), 2019.

Table 4. Types of plants in a combination pattern of agrosilvopastura.

Number	Plant name	Latin name of the plant	Harvest age	Function
1.	betel tree	*Areca catechu*	3 years	industry
2.	Coconut	*Cocos nucifera*	4-6 years	industry
3.	Mango	*Mangifera indica*	5-6 t years	fruits
4.	Rambutan	*Nephellium lappaceum*	5 years	fruits
5.	Langsat	*Langsium domesticum*	6 years	fruits
6.	Starfruit	*Averrhoa bilimbi*	3-4 years	vegetables
7.	Elai	*Durio kutejensis*	8-10 years	fruits
8.	Caffir Lime	*Citrus hystrix*	6 months	fruits
9.	Water apple	*Syzygium aqueum*	2-3 years	fruits
10.	Durian	*Durio zibethinus*	8-10 years	industry
11.	Cempedak	*Artocarpus integer*	5-10 years	fruits
12.	Noni	*Morinda citrifolia*	2 years	medicine
13.	Sugar palm	*Arenga pinnata*	4-5 years	industry
14.	Star fruit	*Averrhoa carambola*	3-4 years	fruits
15.	Petai	*Parkia speciosa*	3-4 years	fruits
16.	Matoa	*Pometia pinnata*	6 years	fruits
17.	Soursop	*Annona muricata*	3 years	fruits
18.	Breadfruit	*Artocarpus altilis*	8-10 years	fruits
19.	Jackfruit	*Artocarpus heterophyllus*	5-10 years	fruits
20.	Melinjo	*Gnetum gnemon*	5-6 years	fruits
21.	Sapodilla	*Manilkara zapota*	3-5 years	fruits
23.	Gamal	*Gliricidia sepium*	2 years	industry
24.	Sweet orange	*Citrus X sinensis*	7-9 months	fruits
25.	Teak	*Tectona grandis*	5 years	industry
26.	Dragon fruit	*Hylocereus sp*	8-12 months	fruits
27.	Banana	*Musa sp*	4 months	fruits
28.	Salak	*Nasalacca edulis*	3-4 months	fruits
29.	Corn	*Zea mays*	3-4 months	producing starch
30.	Cassava	*Manihot esculenta*	6-8 months	producing starch
31.	Jicama	*Pachyrhizus erosus*	4-8 bulan	fruits
32.	Long beans	*Vigna Unguiculata sp*	3,5-4 months	vegetables
33.	Red ginger	*Zingiber officinale Linn*	2,5-4 months	medicinal and herbs
34.	Galangal	*Alpinia galangal*	2,5-4 months	medicinal and herbs

Source: Primary Data (processed), 2019.

Agrosilvopastura fisheri

Agrosilvopastura fisheri is a combination of complex agroforestry components where the components consist of woody plants, cultivated plants, livestock and fish ponds. Based on field observations from 25 respondents observed, there are 4 fields that have implemented a combination pattern of Agrosilvopastura fisheri.

Table 5. Types of livestock in a combination pattern of agrosilvopastura.

Number	Name	Function	Amount
1.	Indian Runner Duck (*Anas Platyrhynchos domesticus*)	Animal protein	43
2.	Chicken (*Gallus gallus domesticus*)	Animal protein	108
3.	Goat (*Capra aegagrus hircus*)	Animal protein	16
4.	Cow (*Bos Taurus*)	Animal protein	4
5.	Boars (Sus scrofa Linnaeus)	Animal protein	90

Source: Primary Data (processed), 2019.

Types of plants grown on agrosilvopastura fisheri land are annual plants and cultivated plants. Annual plants planted such as rambutan, rambai, jackfruit, sugar palm, durian, mango, sapodilla, langsat, water apple, guava, coconut, ambarella, longan, and breadfruit. The plants were planted with planting techniques without using plant spacing while cultivated plants were corn with spacing of 80 × 70 cm, dragon fruit with spacing of 3 × 2.5 m, bananas, sweet oranges, papayas and pumpkin also grew scattered without the spacing of planting. Vegetation components that make up the combination pattern of agrosilvopastura fisheri can be seen in Table 2.

Table 6. Types of plants in a Agrisilvikultur combination pattern.

Number	Plant name	Latin name of the plant	Harvest age	Function
1.	Durian	Durio zibethinus	5 years	fruits
2.	Mango	Mangifera indica	5-6 years	fruits
3.	Lime	Citrus x aurantiifolia	3 years	fruits
4.	Langsat	Langsium domesticum	6 years	fruits
5.	Rambutan	Nephellium lappaceum	8-10 years	fruits
6.	Elai	Durio kutejensis	8-10 years	vegetables
7.	Water apple	Syzygium aqueum	2-3 years	fruits
8.	betel tree	Areca catechu	3 years	Industry
9.	Sungkai	Peronema canescens	10-15 years	Industry
10.	Cempedak	Artocarpus integer	5-10 years	fruits
11.	Coconut	Cocos nucifera	4-6 years	fruits
12.	Petai	Parkia speciosa	3-5 years	fruits
13.	Caffir Lime	Citrus hystrix	6 months	fruits
14.	Jackfruit	Artocarpus heterophyllus	5-10 years	fruits
15.	Sugar palm	Arenga pinnata	4-5 years	Industry
16.	Salak	Nasalacca edulis	3-4 months	fruits
17.	Papaya	Carica papaya	9-12 months	fruits
18.	Banana	Musa sp	4-5 months	fruits

Source: Primary Data (processed), 2019.

Table 2 shows that the function of plants in the research location in the combination pattern of agrosilvopastura fisheri is 4, namely the function of fruits consisting of 17 types of plants, with vegetable function consisting of 1 type, industrial function consisting of 2 types and 1 plant as a function of producing starch. This is in line with the opinion of Arifin *et al.* (2001) stating that horizontally the diversity of plant species is divided into eight categories or functions, namely as ornamental plants, fruit plants, vegetables, herbs, herbs, medicinal plants, starch-producing plants, plants industry, and other functions.

Table 7. Types of plants in silvopastura combination patterns.

Number	Plant name	Latin name of the plant	Harvest age	Function
1.	Durian	*Durio zibethinus*	8-10 years	fruits
2.	Coconut	Cocos nucifera	4-6 years	Industry
3.	Rambutan	*Nephellium lappaceum*	5 years	fruits
4.	Elai	*Durio kutejensis*	8-10 years	fruits
5.	Cocoa	*Theobroma cacao*	2,5-3 years	Industry
6.	Kwini or Saipan mango	*Mangifera odorata*	5-6 years	fruits
7.	Jackfruit	*Artocarpus heterophyllus*	5-10 years	fruits
8.	Mango	*Mangifera indica*	5-6 years	fruits
9.	Banana	*Musa sp*	4 months	fruits
10.	Salak	*Nasalacca edulis*	3-4 months	fruits

Source: Primary Data (processed), 2019.

The types of livestock and fish found in the combination pattern of agrosilvopastura fisheri can be seen in Table 3. Table 3 shows that the diversity of existing types of livestock and fish, this shows the occurrence of natural ecological interactions between the constituent components of the agrosilvopastura fisheri pattern. According to Vickery (1984), interactions between species are not limited to animals and animals, plants to plants, even between plants and animals. This suggests that even though plants are able to synthesize their own food, in reality the plant is never truly independent. Many plants depend on animals, such as nutrients in the soil sometimes do not meet all the nutritional needs of plants so with the presence of manure (cattle, goats, chickens, ducks or ducks) that are decomposed on the soil contain the elements needed by plants so that plants can absorb nutrients and grow well. Besides animals (birds or insects) can help in the pollination process on plants.

Table 8. Types of livestock in a silvopastura combination pattern.

Number	Name	Function	Amount
1.	Chicken (*Gallus gallus domesticus*)	Animal protein	34
2.	Indian Runner Duck (*Anas Platyrhynchos domesticus*)	Animal protein	8

Source: Primary Data (processed), 2019.

Interactions that occur naturally in woody plants with cultivated plants in agrosilvopastura fisheri land are protochopial interactions, thus forming positive and positive interactions. Woody plants provide shade from rain and direct sunlight on cultivated plants and litter of deciduous woody plants which then decompose to function as organic fertilizer thereby increasing soil fertility and cultivating plants produce optimal production. In accordance with Odum's (1993) opinion that in theory, species members of the population interact with one another and form positive interactions.

Table 9. Types of plants in agrosilvofisheri combination patterns.

Number	Plant name	Latin name of the plant	Harvest age	Function
1.	Durian	*Durio zibethinus*	8-10 years	fruits
2.	Tamarind	*Tamarindus indica*	8-10 years	fruits
3.	Rambutan	*Nephellium lappaceum*	5 years	fruits
4.	Sweet orange	*Citrus X sinensis*	2-3 years	fruits
5.	Water apple	*Syzygium aqueum*	2-3 years	fruits
6.	Langsat	*Langsium domesticum*	3-4 years	fruits
7.	Cempedak	*Artocarpus integer*	5-10 years	fruits
8.	Mango	*Mangifera indica*	5-6 years	fruits
9.	Banana	*Musa sp*	4 months	fruits
10.	Cassava	*Manihot esculenta*	6-8 months	producing starch

Source: Primary Data (processed), 2019.

Agrosilvopastura

Agrosilvopastura is a combination of agroforestry in which its components consist of woody plants, cultivated plants and livestock. Based on observations in the field of 25 respondents there are 9 fields that apply this combination pattern.

Annual plants grown in this combination pattern such as betel tree, coconut, mango, rambutan, langsat, starfruit, elai, Caffir Lime, Water apple, durian, cempedak, soursop, salak, breadfruit, Melinjo or Gnetum, Sapodilla, gamal and teak are planted spread out without spacing while rubber is planted with a spacing of 4×5 m. Cultivation plants are planted such as sweet orange, banana, Galangal and cassava without any spacing, while dragon fruit is planted with a spacing of 2.5 × 3 m, and long beans are planted on beds. The components of vegetation that make up the combination pattern of agrosilvopastura can be seen in Table 4.

Table 10. Types of fish in the agrosilvofisheri combination pattern.

Number	Fish Name	Function	amount
1.	Patin (Pangasius)	Animal protein	2500
2.	snakehead fish (Channa striata)	Animal protein	300

Source: Primary Data (processed), 2019.

Table 4 shows that there are 4 functions of plants in the research location in the agrosilvopastura combination pattern, namely fruit function consisting of 22 types of plants, plants with 2 types of starch producing functions, plants with spice function consisting of 1 type, and 1 type of plant with the function of drugs. This is in line with the opinion of Arifin *et al.* (2001) stating that horizontally the diversity of plant species is divided into eight categories or functions, namely as ornamental plants, fruit plants, vegetables, herbs, herbs, medicinal plants, starch-producing plants, plants industry, and other functions. Components of livestock species in the agrosilvopastura combination pattern can be seen in Table 5. Table 5 shows that there are various types of livestock.

In this combination pattern of agrosilvopastura, there are 3 constituent components that interact positively with each other, namely tree plants, cultivation plants and livestock. Evidence that this interaction is positive is seen that the combination pattern of agrosilvopastura still persists and continues. More and more the components of agroforestry compilers that interact positively between the other components, means that there is a land use process

with an agroforestry system that is mutually beneficial among its constituent components. It also shows that the agrosilvopastura system managed by farmers is a sustainable agriculture system.

Agrisilvikultur

Agrisilvicultur pattern is an agroforestry system that combines forestry plants with agricultural crops. Agrisilvikultur is a land use pattern consisting of a combination of agricultural crops and forestry plants in the same time space (Mahendra, 2009).

Based on observations in the field of 25 respondents there are 4 fields that apply this combination pattern.

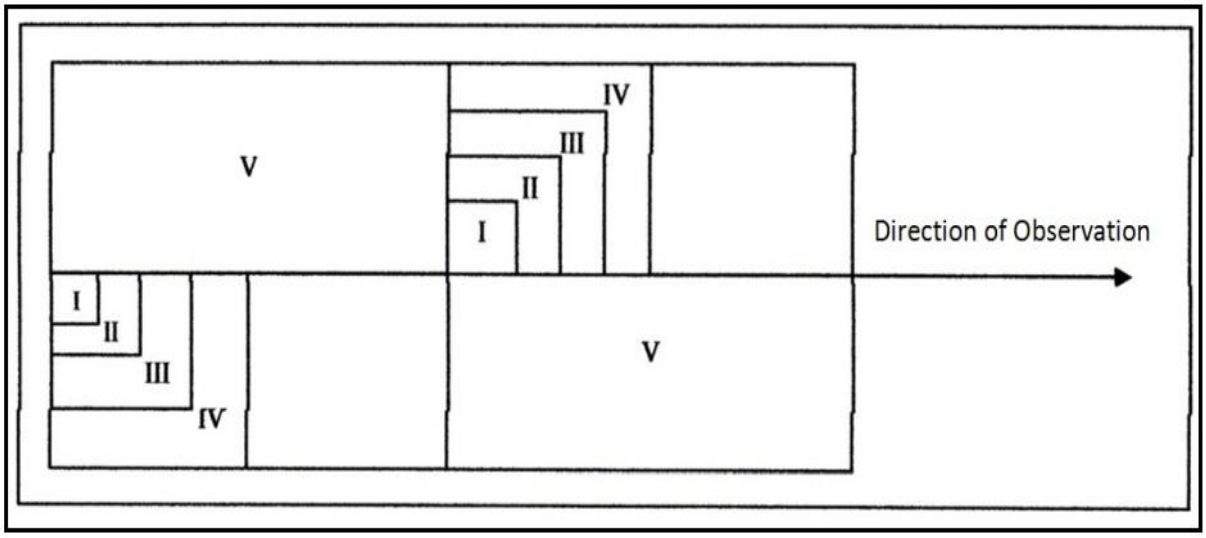
Table 11. Results of the Importance Value Index Analysis.

Number	Plant Species	Latin name	Woody Level			
			KR (%)	FR (%)	DR (%)	INP (%)
1.	Durian	*Durio zibethinus*	17,10	11,80	2,23	31,08
2.	Langsat	*Langsium domesticum*	9,49	7,19	11,70	28,38
3.	Elai	*Durio kutejensis*	6,54	9,15	8,91	24,60
4.	Rambutan	*Nephellium lappaceum*	10,10	12,40	1,84	24,38
5.	Coconut	*Cocos nucifera*	8,02	5,88	3,03	16,93
6.	Sugar palm	*Arenga pinnata*	2,32	1,96	10,90	15,15
7.	Cempedak	*Artocarpus champeden*	4,85	5,88	3,72	14,45
8.	Mango	*Mangifera indica*	5,49	3,92	4,47	13,88
9.	Rambai	*Baccaurea motleyana*	0,63	1,31	7,83	9,77
10.	Jackfruit	*Artocarpus heterophyllus*	2,53	2,61	3,96	9,11
11.	Papaya	*Carica papaya*	6,12	2,61	0,07	8,80
12.	Sungkai	*Peronema canescens*	1,90	1,31	4,47	7,68
13.	Water apple	*Syzygium aqueum*	1,90	4,56	0,29	6,76
14.	Ambarella	*Spondias dulcis*	0,42	1,31	5,01	6,74
15.	Petai	*Parkia speciosa*	1,48	2,61	2,42	6,51
16.	Salak	*Nasalacca edulis*	1,48	3,27	1,04	5,79
17.	Cassava	*Manihot esculenta*	3,59	1,31	0,02	4,91
18.	betel tree	*Areca catechu*	1,27	1,96	0,61	3,84
19.	Mangosteen	*Garcinia mangostana*	0,63	0,65	1,55	2,83
20.	Kwini or Saipan mango	*Mangifera odorata*	0,63	0,65	1,40	2,68
21.	Lime	*Citrus x aurantiifolia*	0,42	1,31	0,74	2,47
22.	Sweet orange	*Citrus X sinensis*	0,84	1,31	0,27	2,42
23.	Star fruit Carambola	*Averrhoa carambola*	0,21	0,65	1,55	2,41
24.	Tamarind	*Tamarindus indica*	0,21	0,65	1,40	2,30
25.	Caffir Lime	*Citrus hystrix*	0,84	1,31	0,03	2,18
26.	Guava	*Psidium guajava*	0,42	1,31	0,32	2,05
27.	Star fruit	*Averrhoa bilimbi*	0,42	1,31	0,16	1,90
28.	Breadfruit	*Artocarpus altilis*	0,42	0,65	0,76	1,83
29.	Matoa	*Pometia pinnata*	0,21	0,65	0,87	1,74
30.	Cocoa	*Theobroma cacao*	0,42	0,65	0,56	1,63
31.	Noni	*Morinda citrifolia*	0,21	0,65	0,66	1,53
32.	Soursop	*Annona muricata*	0,42	0,65	0,45	1,53
33.	Melinjo or Gnetum	*Gnetum gnemon*	0,21	0,65	0,65	1,52
34.	Coffee	*Coffea Arabica*	0,42	0,65	0,16	1,23
35.	Longan	*Dimocarpus longan*	0,42	0,65	0,14	1,22
36.	Sapodilla	*Manilkara zapota*	0,21	0,65	0,07	0,93

Source: Primary Data (processed), 2019

The types of plants that are planted on the agroforestry system land are annual crops and cultivated plants. Annual plants planted such as rambutan, mango, lime, langsat, durian, elai, Water apple, betel tree, sungkai. cempedak, coconut, petai, jackfruit, sugar palm, and while the cultivation plants that are planted are caffir lime, salak, banana and papaya. The components of vegetation that compose the combination of agrisilviculture can be seen in Table 6.

Table 6 shows that there are 2 functions of plants in the study location in the combination of agrisilviculture, namely the function of fruits consisting of 15 types of plants and 4 types of plants with industrial functions. agrisilvikultur combination patterns there is a natural ecological interaction between its components, namely protokooprasi interactions between woody plant components with cultivated plants. so as to form positive and positive interactions, woody plants provide shade from rain and direct sunlight on cultivated plants and litter of deciduous woody plants then decomposes to function as organic fertilizer thereby increasing soil fertility and cultivating plants produce optimal production.



Information :

I = plot size (1 m x 1 m) for observation of seedling and ground cover plants

II = plot size (2 m x 2 m) for observation of bush and herbal phases

III = plot size (5 m x 5 m) for observation of shrub phase

IV = plot size (10 m x 10 m) for small tree plants

V = plot size (20 m x 20 m) for large tree crops

Classification of plant vegetation consists of seedlings, poles, saplings and trees. These criteria are:

a. Seedling plants are characterized by plant height <1.5 cm

b. Plant level is characterized by plant height> 1.5 cm and plant diameter <10 cm

c. Plant level pole is characterized by a plant diameter of 10-19 cm

d. Tree level plants are characterized by diameters> 20 cm (core trees plant diameter 20 - 49 cm; large trees plant diameter> 50 cm).

Fig. 1. Design sample research plot.

Silvopastura

Silvopastura is a combination of agroforestry in which its components consist of woody plants with livestock. Based on field observations from 25 respondents, there are 2 respondents' land that applies this combination pattern.

Annual plants grown on this agroforestry system land such asdurian, coconut, rambutan, elai, cocoa, kwini, jackfruit, and mango, are planted scattered without any planting spacing arrangements. Vegetable components of silvopastura combination patterns can be seen in Table 7.

Table 7 shows that there are 2 plant functions in the study location in the Silvopastura combination pattern, ie fruit functions consisting of 9 types of plants and 2 types of plants with industrial functions. Components of livestock species in the silvopastura combination pattern can be seen in Table 8. Table 8 shows that the silvopastura combination pattern for the livestock component has an animal protein function consisting of only 2 types of animals namely chickens and ducks, where the number of animals that are more dominantly raised by respondents is chicken. The animals are released freely on agroforestry land. In this silvopastura combination pattern there is a natural ecological interaction between components. Interactions that occur in woody plants with livestock (chickens and ducks) are protokooprasi interactions, thus forming positive and positive interactions. Woody plants provide shade from rain and direct sunlight on livestock. Decomposed animal manure provides additional nutrients to the soil that can be absorbed by woody plants so as to produce optimal production.

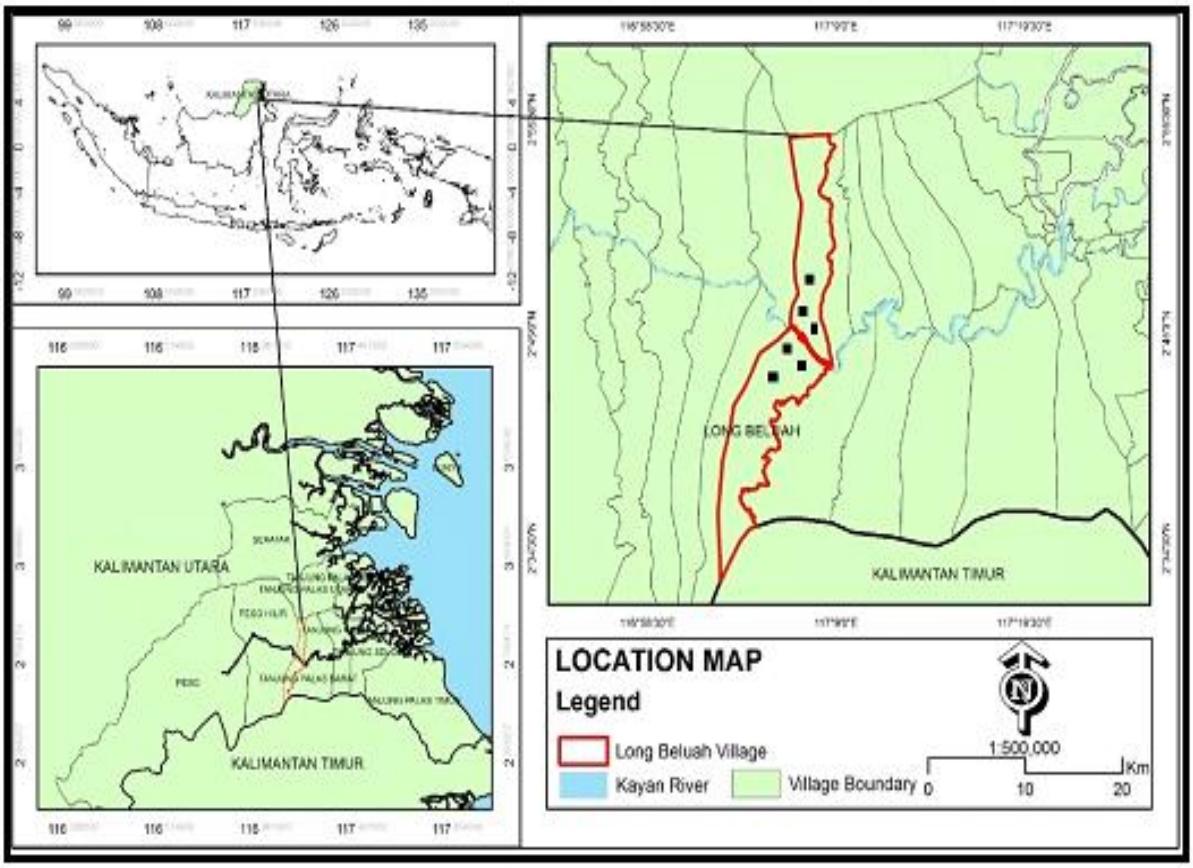


Fig. 2. Location studies of Long beluah village (•) Tanjung Palas Barat Subdistrict, Bulungan District, North Kalimantan Province, Indonesia.

Agrosilvofisheri

Agrosilvofisheri is a combination of agroforestry in which its components consist of cultivated plants, woody plants and fish ponds. Based on field observations from 25 respondents there are 3 fields that apply this combination pattern.The types of plants planted on the agroforestry system land are cultivated plants, annual crops and fish farming. Annual crops are planted such as durian, tamarind, rambutan, langsat, cempedak, and mango**.** Cultivation plants that are planted such as sweet oranges, bananas, and cassava that are planted are spread out without any spacing. For fish that are cultivated in agrosilvofisheri is a type of catfish with a number of about 2,500 fish with a pond area of about 250 m^2. Vegetation components of the agrosilvofisheri combination pattern can be seen in Table 9.

Table 9 shows that the function of plants in the study location on the tree components that comprise the combination pattern of agrosilvofisheri are 2, namely the function of fruits consisting of 9 types of plants and 1 type of plant with starch producing functions.

For fish components in the agrosilvofisheri combination pattern can be seen in Table 10. In Table 10 for fish components in the agrosilvofisheri combination pattern has a function as animal protein consisting of 2 types of catfish and cork.

Based on observations in the field that in the pattern of agrosilvofisheri combination there are ecological interactions between its components. Interactions that occur in woody plants with cultivated plants and interactions of woody plants with fish are protokooprasi interactions, thus forming positive and positive interactions. Woody plants provide shade from rain and direct sunlight on livestock. Decomposed animal manure provides additional nutrients to the soil that can be absorbed by woody plants so as to produce optimal production. The roots of woody plants can hold water or help reduce the process of infiltration of water into the soil so that water in the pond remains available, while woody plants can absorb the water needed to absorb nutrients from the soil.

Important Value Index (INP) Woody Plant

The level of woody plants is determined based on density, frequency, dominance and Importance Value Index (INP) expressed in percentage (%). The calculation results of the Importance Value Index at the level of woody plants can be seen in Table 11.Table 11 shows that the woody plants in the Long Beluah Village agroforestry land that have the highest Importance Value Index (INP) are Durian (*Durio zibethinus*) with a value of 31.08%, followed by langsat (*Langsium domesticum*) with a value of 28.38% and the lowest is sapodilla (*Manilkara zapota)* with a value of 0.93%.

In general, some woody plants with high importance value that produce these fruits are old plants which are inherited from previous ancestors. Farmers only do maintenance to get annual fruits every time they harvest. In addition, farmers also replace dead plants with fruit crops that are considered to be of more economic value. Other types of woody plants have less economic value so they tend to have low importance. Such conditions illustrate that the types of plants that control the land or dominate at the woody level are plants that are able to compete with other plants in ecological terms.

Durian (*Durio zibethinus*), langsat (*Langsium domesticum*), elai (*Durio zibethinus*), Rambutan (*Nephellium lappacium*), coconut (*Cocos nucifera*), sugar palm (*Arenga pinnata*), cempedak (*Artocarpus champeden*), mango (*Mangifera indica*), and rambai (Baccaurea motleyana) is a plant that has the potential to be developed because these types of fruit plants are local plants from the village of Long Beluah which have economic value. The fruits identified in this study included tropical fruits. According to Sarjono *et al.* (2003), fruits in Indonesia are basically divided into two groups based on their living requirements, namely sub-tropical fruits and tropical fruits. Types of tropical fruits that occupy the world market are bananas, pineapple, rambutan, mango, avocado, passion fruit soursop, guava, star fruit and mangosteen.

Farmers have a huge opportunity to develop tropical fruit plantations especially plants that have Importance Value Index (INP) rank 1-10 in Long Beluah Village. INP is the most representative value to determine which plants dominate in an area. The level of tree plants that dominates is greatly influenced by the suitability of plants with soil type and climate in the area. Although the state of the fruits in Long Beluah Village is not yet said to be ready to face the free market. However, if the fruit is seriously developed, it does not demand the possibility of local fruits that can penetrate the international market. Therefore, the role of local governments is needed to assist farmers in the development of agroforestry-based tropical local fruits in the use of critical land in Long Beluah

Village.

Conclusion

The conclusion of this study is that the most common agroforestry combination patterns carried out by the community of Long Beluah Village are agrosilpopastura with a percentage of 36%, followed by agrosilvopastura fisheri and agrisilvikultur with a percentage of 16%, agrosilvofisheri 12% and Silvopastura by 8%. Then the types of tree plants that dominated in Long Beluah Village were rambutan plants with an important value index of 31.08% then followed by other tree species such as langsat by 28.38%, mangoes by 24.60%, Durian by 24.38% , coconut at 16.93%, sugar palm at 15.15%, cempedak at 14.45, salak at 13.88% and rambai at 9.77%.

The recommendation of this research is that the potential of local fruits that have high economic value continues to be developed such as local durian and elai. Then the livestock component so that its utilization is more maximized by utilizing cow manure and urine for fertilizer.

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