Agrosilvopasture System in Taratara Village, West Tomohon District, Tomohon City, North Sulawesi

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ABSTRACT

The agrosilvopastura system is one part of an efficient agroforestry system to be applied in integrated landscape management. The community in Taratara Village, West Tomohon Sub-district, North Sulawesi Province has a majority of people who work as farmers. Some of the people of Taratara Village who work as farmers also raise livestock on the same plot of land with various crops. This indicates that the community group applies the agrosilvopastura system in their landscape management. This study aims to assess the pattern of agrosilvopastura application in Taratara Village. The research method used was a survey method by means of interviews using a questionnaire as a guide and field observations. The survey results show that, in Taratara Village there are as many as 5 farmers who apply agrosilvopastura patterns. The results showed that the agrosilvopastura pattern in Taratara Village combines the cultivation of forestry crops and agricultural crops together with the raising of livestock (pigs, ducks, chickens, cows) on the same land. Livestock are raised with various methods and feeds that are adapted to the type of livestock. Woody crops are planted randomly and regularly, and food crops are also planted regularly and regularly among woody crops. Farmers who apply the agrosilvopastura pattern in Taratara Village choose this pattern because of its advantages, namely 1) getting more optimal results with the presence of trees, food crops and livestock on the same land, 2) parts of cultivated plants that are not consumed or poor harvests can be used as animal food, 3) more efficient land utilization, 4) the acquisition of products (harvestable products) is more diverse, 5) certain livestock raised can be utilized for their energy, 6) improving soil fertility.
Keywords: agroforestry; landscape management; agrosilvopastura system; Taratara Village

INTRODUCTION

Forests, as a source of natural wealth and life support, need to be managed sustainably based on proper landscape planning to provide direct benefits (Langi and Saroinsong, 2024; Saroinsong et al., 2024). In the quest to use forest landscapes that have a good impact on the socio-economic conditions of communities around the forest, while still conserving the forest, the agroforestry system can be applied. Agroforestry is a land-use system that combines woody plants (trees) with agricultural crops or livestock on the same land unit, creating mutually beneficial ecological and economic interactions (Pangemanan and Ratag 2018).

Integrated landscape management, in the form of agroforestry, plays an important role in improving optimal land use as a source of income for forest communities and in maintaining sustainable natural resources. Agroforestry provides significant benefits to communities as it allows them to obtain products from forest land without having to wait for a long time to harvest forest plants (Kader et al., 2016; Titdoy et al., 2014; Suroso, 2018; Toding, Ratag and Pangemanan, 2021; Fahmi et al., 2023). With the combination of agricultural crops, yields can be obtained in a monthly or annual period, depending on the type of agricultural crop planted. In addition, agroforestry also increases the productivity of forest crops by providing nutrients and fertiliser from agricultural crops and by recycling agricultural crop residues to benefit forest plants.

The agrosilvopastura system constitutes a component of an efficient agroforestry pattern, which is to be implemented in order to optimise land use. The agrosilvopastura system is a land management system that combines

agricultural crops (annual crops) and forestry crops (annual crops) with livestock on the same land unit (Ma'ruf, 2017). The agrosilvopastura system offers three different sources of income concurrently: firstly, agricultural crops that serve as food providers. Secondly, timber provides ecosystem services and fulfils other needs. Thirdly, pasture land is used to raise livestock and provide feed for livestock. These combination of various elements in agrosilvopastura is done in a planned manner to optimise the services produced. In addition, the combination in this system is also strengthened by natural regeneration and the presence of wildlife (Aminuddin et al., 2022).

A plethora of studies have previously been conducted on agroforestry systems in North Sulawesi, including in Tolok Satu Village, Tompaso District, Minahasa Regency (Titdoy et al., 2014); in Klabat Village, Dimembe Sub-district, North Minahasa Regency (Kader et al., 2016); and in Mopolo Village, Ranoyapo Sub-district (Gusti et al., 2022), South Minahasa Regency by Toding et al. (2021), in Togid Village, Tutuyan Sub-district, East Bolaang Mongondow District by Laratmase et al. (2022), in Sumarayar Village, East Langowan District, Minahasa Regency by Gusti et al. (2022), in Wanga Village, East Motoling Sub-district, South Minahasa Regency by Oping et al. (2023), and in Paslaten Village, Tatapaan Sub-district, South Minahasa Regency by Pontoh et al. (2024). However, research on agroforestry systems in Taratara Village has never been conducted, especially on agrosilvopastura patterns. Taratara Village, West Tomohon Sub-district, Tomohon City, North Sulawesi Province, has a majority of people who are employed in agriculture, with some of these individuals also raising livestock on the same plot of land as various crops, indicating the application of the agrosilvopastura system in their land management. However, to date, no research has been conducted on the agrosilvopastura system practised by the community in Taratara Village. This study aims to identify the agrosilvopastura pattern applied in Taratara Village, West Tomohon Sub-district, Tomohon City.

METHODS
Research Location
This research was conducted in Taratara Village, West Tomohon Sub-district, Tomohon City, North Sulawesi Province, in June 2024.

Research Instrument
The materials and tools used in this research are presented in **Table 1**.

Table 1. Materials and tools used in research

No.	Tools/Materials	Function
1.	Questionnaire	As a guide in conducting interviews
2.	Agricultural land	Record the results of the interview
3.	Writing tools	As an object/media in research
4.	Measuring tools (Meters)	Measuring planting distance
5.	Voice recording device	Record the interview process
6.	Camera	Tools for taking documentation

Research Method

The method used in this study is a survey method by interviewing using a questionnaire as a guide and field observation. The respondents were selected by census, this was done because the number of respondents was relatively small, not more than 30 people.

The first step taken by the researcher was a pre-survey at the Taratara Village Office to find out the people who had the potential to become respondents in the field data collection. The people who became respondents were those who managed agrosilvopastura land.

The results of the data obtained in this study are primary data. Primary data are data that refer to the initial data collection in the field based on the object/ location of the research.

Research Variables

The observation variables in this study are: type and number of plants on each field observed; type and number of livestock on each field observed; number of individuals of plant and livestock species; and planting distance.

Data Analysis

Data obtained from the results of this study were analysed descriptively and presented in the form of tables and figures.

RESULTS AND DISCUSSION
General Description of Location

Taratara Village is located in West Tomohon District and covers an area of 525 hectares, of which 21 hectares are residential, 465 hectares are plantation land, 89 hectares are rice fields, 0.75 hectares are cemeteries, and 0.25 hectares are yards. The distance from the centre of Tomohon City to Taratara Village is 8.8 km, and the distance from Manado City to Taratara Village is 31 km.The road to the research location is not difficult to reach, and the distance from the Taratara Village settlement to the research location can be covered in approximately 5 minutes using a motorized vehicle. The majority of the population is employed in agriculture (Nongko et al., 2021).

Characteristics of Respondents

Respondents in this study are people who work as farmers in Taratara Village and utilise land using agrosilvopastura patterns. There are five farmers who apply the agrosilvopastura pattern. The five respondents who applied the agrosilvopastura pattern all used their own land. The characteristics of the respondents are presented in **Table 2**.

Table 2. Characteristics of Respondents

No.	Gender	Age (years)	Occupation	Land Area
1.	M	44	Farmer	1 ha
2.	M	79	Farmer	1 ha
3.	M	50	Farmer	1.2 ha
4.	M	49	Farmer	1.1 ha
5.	M	50	Farmer	1 ha

Type and Number of Woody Perennial Plants

The results of the study indicated the presence of six distinct types of woody plants within the agricultural landscape. Coconut (*Cocos nucifera*) emerged as a dominant species within this ecosystem, particularly in Taratara Village. A comprehensive overview of the taxonomic diversity and abundance of woody plants in agricultural areas is provided in **Table 3**.

Table 3. Type and Number of Woody Perennial Plants

No.	Local Name	Species	Quantity	Planting Pattern	Planting distance
1.	Cempaka	*Magnolia sp.*	34	random	3 m
2.	Coconut	*Cocos nucifera*	250	regular	7 m
3.	Clove	*Syzygium aromaticum*	240	random	6 m
4.	Durian	*Durio zibethinus*	30	random	10 m
5.	Mango	*Mangifera indica*	27	random	3 m
6.	Rambutan	*Nephelium lappaceum*	18	random	3 m

The observations presented herein indicate that the total number of woody plants is 250, with 240 being cloves, 34 cempaka, 30 durian, 27 mango, and 18 rambutan. It is evident that the least abundant individual type is rambutan. Of the six types of woody plants, coconut is distinguished by its regular cropping pattern. For farmers, coconut is a lucrative crop due to its high economic value, and it is the most cultivated crop in agrosilvopastura land. In addition to being sold, every part of the coconut tree is utilised and consumed, including the pulp, shell, coconut fibre, stem, and leaves.The second most common crop grown is cloves. Cloves are also considered a lucrative crop due to their ready market and relatively stable prices, and they are one of Indonesia's high-value commodities traded in the global market.The benefits of cloves are manifold, including use as a food seasoning, as a base for clove cigarettes, in cosmetics and in medicines (Pinto, 2022; Denissa, 2022; Margareta & Wonorahardjo, 2023). This renders cloves a lucrative venture for farmers.Moreover, the climate of Taratara is well-suited to the cultivation of both coconut and cloves. The majority of the population of Taratara Village (85%) is engaged in agriculture, as evidenced by the community's extensive coconut, clove, and other horticultural plantations (Ibrahim et al., 2017). The cultivation of both crops is conducive to the generation of substantial harvests.

Type and Number of Agricultural Crops

In accordance with the findings of the research conducted, it was determined that, in addition to woody plants, food crops are also present. The following are the types and number of food crops in the agrosilvopastura land of Taratara Village: four types of plants are depicted in **Table 4**.

Tabel 4. Type and Number of Agricultural Crops

No.	Local Name	Species	Quantity	Planting Pattern	Planting distance
1.	Corn	*Zea mays*	10,600	regular	40 cm x 60 cm
2.	Banana	*Musa sp.*	2,100	regular	30 cm x 50 cm
3.	Taro	*Colocasia esculenta*	900	random	30 cm x 50 cm
4.	Cassava	*Manihot esculenta*	500	regular	30 cm x 60 cm

From the results obtained, maize was 10,600, banana 2,100, taro yam 900 and cassava 500. Some other research results show that in addition to the woody perennial crops grown by farmers, there are also non-woody crops such as banana and papaya (Pontoh et al., 2024), chilli, papaya, banana yam, taro and vanilla (Oping et al., 2023), papaya, banana, pineapple, maize, taro, sugarcane, cassava and peanuts (Laratmase et al., 2022).

Type and Number of Livestock
The results showed that there are 4 types of livestock in agrosilvopastura land in Taratara Village (**Table 5**).

Table 5. Types and Number of Livestock

No.	Local name	Species	Quantity
1.	Pig	*Sus scrofa domesticus*	20
2.	Duck	*Cairina moschata*	5
3.	Chicken	*Gallus gallus domesticus*	60
4.	Cow	*Boss sp.*	10

Based on the results of the observations above, the 4 types of livestock that are most commonly found are chickens, numbering 60 (**Table 6**).

Table 6. Type and Number of Livestock for Each Respondent's Land

Respondent	Type and Number of Livestock			
	Pig	Duck	Chicken	Cow
1	8	-	9	2
2	0	-	10	2
3	2	-	19	2
4	3	-	9	1
5	7	5	13	3

The observations indicate that the most prevalent livestock species is chicken, with a total of 60 heads, followed by pigs (20 heads), cows (10 heads), and ducks (5 heads). The maintenance method employed for these animals involves various practices, including release, restraint in enclosures, and confinement. The feeding patterns of chickens and ducks are typically focused on corn (*Zea mays*) or taro yam (*Colocasia esculenta*) in the morning, while cattle are tied and given access to wild grasses found in the vicinity of the farmers' land, particularly palm grass (*Setaria palmifolia*). Pigs are penned and fed taro yams and, on occasion, kale or fruits. The findings of Putra et al. (2024) corroborate this, with their research results demonstrating that livestock on agrosilvopastura land are kept by being released, tied to trees or penned. The animal feed is sourced from agrosilvopastura land. This finding contrasts with the outcomes reported by Gusti et al. (2022), wherein livestock were not released but rather tied, with the objective being to prevent livestock from damaging crops on each respondent's land where livestock are located. Each farmer is responsible for providing feed for their livestock.

The Agrosilvopastura Pattern in Taratara Village
The existing pattern in Agrosilvopastura is characterised by a methodical arrangement or regularity in its implementation by farmers, typically commencing

with the process of planting, followed by the application of fertiliser, the removal of undesirable plants or weeds, and the utilisation of pesticides for pest control.The land is predominantly utilised for the cultivation of food crops and woody plants. The land is further utilised for livestock farming, with pigs, ducks, chickens and cattle being raised by the same farmers who cultivate the crops. The livestock is kept in various forms, including free-ranged, tied and penned.The chickens and ducks are typically fed corn (*Zea mays*) or taro yam in the morning. For cattle, they are only tied up and given wild grasses that grow around the farmers' land, namely palm grass (*Setaria palmifolia*). As for pigs, they are penned up and fed taro yams and sometimes kale or fruits. This finding is corroborated by the research conducted by Putra et al. (2024), which revealed that livestock on agrosilvopastura land are managed through the release of animals into the wild, the tying of animals to trees, or the confinement of animals in enclosures. The animal feed is sourced from the agrosilvopastura land itself, as evidenced by the findings of research conducted by Pontoh et al. (2024). The livestock is fed on the same land products, including bananas, papayas and grasses that naturally grow on farmers' land. Examples of such grasses include Acanthaceae and elephant grass, as well as *Paspalum dilatatum*. This approach contrasts with the findings reported by Gusti et al. (2022), who observed that in agrosilvopastura systems, livestock are not released but rather tethered. This is done to prevent livestock from damaging the plants on each respondent's land where livestock is present. Each farmer provides livestock with their own feed.

The observations indicate that the plants utilised in the agrosilvopastura system on the study's land were both planted in a regular and random manner. The woody plants were planted in a random and regular fashion, in conjunction with livestock rearing on the same land by farmers in Taratara Village. The objective of this study is to ascertain the number of plant and livestock types present on each farm owned by respondents, thereby facilitating the comprehension of the agrosilvopastura pattern characteristic of each respondent's land. The results of this study will be presented in **Table 7**, which provides a comprehensive overview of the crop and livestock types present on each respondent's land.

Table 7. Components of Agrosilvopasture Land in Taratara Village

Resp	Land Area (ha)	Number of Individuals													
		A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	1	4	20	5	-	5	4	2500	400	180	70	8	-	9	2
2	1	5	45	62	16	5	4	2500	550	325	45	-	-	10	2
3	1,2	12	100	12	-	7	8	4000	600	-	130	2	-	19	2
4	1,1	6	60	124	1	5	-	1000	100	190	110	3	-	9	1
5	1	7	25	37	2	5	2	600	450	205	145	7	5	13	3

Note: A = Cempaka, B = Coconut, C = Clove, D = Durian, E = Mango, F = Rambutan, G = Corn, H = Banana, I = Taro tuber, J = Cassava, K = Pork, L = Duck, M = Chicken, N = Beef

It was observed that respondent 3 had the highest number of plants compared to the other respondents. For the type of crops on the farm, the most common is maize, the second most is banana and the least is rambutan. And for livestock, the most common type is chicken, the second is pig, the third is cow and the least is duck. This is consistent with various studies on the application of other

agrosilvopastura patterns such as in the research of Gusti et al. (2022), Ratag et al. (2024), Putra et al. (2024), Pontoh et al. (2024), Toding et al. (2022) and Laratmase et al. (2022), which is the management of land by raising livestock and planting agricultural and forestry crops together.

Pros and Cons of Agrosilvopastura Pattern Implementation

From the results of the research, the advantages and disadvantages of applying the agrosilvopastura pattern can be seen according to the results of interviews with respondents. The advantages and disadvantages are described below.

The first advantage of applying the agrosilvopastura pattern is getting more optimal results with the presence of trees, food crops and livestock on the same land because income is increased. Some research results with similar results, among others, are related to increasing farmers' income. Research by Kader et al. (2016) on the Income of Coconut-based Agroforestry Pattern Farming (*Cocos nucifera*) and Taro (*Colocasia esculenta* L) in Klabat Village, North Minahasa Regency. The results showed that the income from the combination of coconut and taro in the agroforestry system was higher than if each type of plant was monocultured. Some studies also show that the income of farmers who apply land management with agroforestry systems is greater than non-agroforestry, including research by Wanderi et al. (2019) in Sidodadi Village, Lampung; research by Ayuniza et al. (2019) in Pinang Jaya Village, Bandar Lampung; and research by Sari et al. (2021) in Tulak Tallu Village, North Luwu District, South Sulawesi. Overall, this research shows that agroforestry systems play an important role in increasing farmers' income.

Secondly, parts of cultivated plants that are not consumed or that yield low returns can be used as animal feed, for example corn, bananas, and cassava. One example is that, in an area where corn is planted, the stems and leaves of the plant are usually considered waste and disposed of by farmers after the corn has been harvested. However, if the agrosilvopastura land is used for ruminants, such as cattle or goats, it is possible to utilise the waste as animal food (Mantja et al., 2017).

The agrosilvopastura pattern has been demonstrated to offer a number of advantages, including enhanced land utilisation. The integration of diverse plant and livestock species within the agrosilvopastura framework facilitates the optimisation of agricultural land use. Research conducted by Gusti et al. (2022) in Sumarayar Village, East Langowan District, Minahasa Regency, further substantiates this claim, asserting that the implementation of agrosilvopastura patterns significantly enhances land utilisation efficiency. The integration of diverse crops and livestock in agricultural land utilisation is a key finding of the study.

Concurrently, Tuhalauruw et al. (2021) in Namaa Hamlet, Haruku Island, Central Maluku Regency demonstrated that the implementation of an agrosilvopastura system engenders a diverse array of products, encompassing agricultural, plantation and forestry outputs. Notably, agrosilvopastura products have the capacity to satisfy the vegetable and animal food requirements across the spectrum of short, medium and long-term needs. Furthermore, livestock reared in

such an agricultural context can be utilised by farmers for the purpose of crop transportation (Fahmi et al., 2023).

The agrosilvopastura pattern has been shown to have certain shortcomings related to implementation constraints, including the requirement for greater expertise in cultivating a wider range of plants, due to the presence of livestock. While the diversity of plant species on a farm has been demonstrated to offer numerous benefits, if not accompanied by adequate planning and management, it can result in competition between plants for essential nutrient sources (Saroinsong, 2020). The presence of livestock can also potentially become a pest for plants if not properly supervised (Pontoh et al., 2021).

Another disadvantage of applying the agrosilvopastura pattern is that it requires special consideration in the time and manner of planting and maintenance. The application of agrosilvopastura patterns that integrate different types of crops and livestock requires different care and maintenance for each component, thus requiring more labour to ensure that all components are properly managed. Appropriate planting methods are also important in agrosilvopastura land management. Methods such as intercropping or catch crops mean that if one crop fails, there is still a chance of harvesting other crops. Selecting crops that are tolerant to biotic and abiotic environmental stresses in a particular location. In addition, changes in planting methods, tillage and planting time must also be considered when implementing agrosilvopastura patterns (Gusti et al., 2022)

The implementation of agrosilvopastura therefore necessitates a multifaceted approach, encompassing the judicious selection of species, the optimal timing and location of planting, with the overarching objective being to achieve a harmonious balance between productivity and sustainability. The release of livestock, particularly large-bodied species, to forage for their own sustenance, has the potential to adversely impact the integrity of cultivated crops. Consequently, farmers must assume the responsibility of providing adequate nourishment for their livestock. Research conducted by Pontoh et al. (2024) in Paslaten Village, Tatapaan District, South Minahasa Regency, and by Gusti et al. (2022) in Sumarayar Village, East Langowan District, Minahasa Regency, both of which yielded similar results, have asserted that the release of livestock does not occur in all areas of agrosilvopastura land due to the potential for damage to plant life.

CONCLUSION

The agrosilvopastura pattern in Taratara Village integrates the cultivation of forestry and agricultural crops with livestock farming (pigs, ducks, chickens, cows) on the same land. Land management under this pattern involves a range of practices, including planting, fertiliser application, weed removal, pesticide use, and livestock rearing. Livestock rearing practices are diversified, with different methods and diets employed for various livestock species. Woody plants are planted in a regular pattern, and food crops are also planted in a regular pattern among the woody plants. Farmers apply the agrosilvopastura pattern because of its advantages, namely 1) the optimisation of results through the presence of trees, food crops and livestock on the same land, and 2) the utilisation of parts of cultivated plants that are not consumed or poor harvests. Used as animal feed, 3) Land utilization is more efficient, 4) the acquisition of products (yields that can be

harvested) is more diverse, 5) certain livestock that are kept can be utilized for their energy, 6) improve soil fertility.

SUGGESTION

Further research is needed, including on yield productivity and increasing farmers' income in relation to the agrosilvopastura pattern.

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