

Implementation of Agroforestry System of Bakubakulu Village Communities

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Abstract: The community in Bakubakulu Village, Palolo District, Sigi Regency, is one of the communities that is developing an agroforestry system. This research aims to determine the agroforestry patterns used on community land in Bakubakulu Village. This research was carried out for 3 months, from October to December 2022. Respondents were taken in this research using the Purposive Sampling technique, namely deliberate (not random) sampling of respondents according to the criteria. Data were analyzed using descriptive methods. Respondents' research results on agroforestry patterns according to the time dimension are Intermittent on sloping land and Coincident on flat land. According to the spatial aspect, the pattern respondents use is Regular Temporary on flat land and Random Permanent on sloping land. The types of plants most commonly planted by the community are candlenuts, sugar palms, cocoa, cloves, and coconuts. The Regular Temporary Pattern is the pattern most frequently applied by respondents

Keywords: Agroforestry; Agroforestry pattern; Permanent random; Temporary regular

Introduction

Land as a natural resource has a role, including as a producer of agricultural commodities (Blum, 2013; Feng et al., 2023). The increase in population and basic needs has resulted in the need for larger agricultural areas to be cultivated more intensively (Ickowitz et al., 2019); (Hemathilake et al., 2022). One way that can be used to utilize land optimally is through agroforestry activities (Reith et al., 2022; Shapla et al., 2022). Agroforestry is an activity that is defined as an optimal method of land use, which combines short and long-rotation biological production systems in a manner based on the principle of sustainability, simultaneously or sequentially both within forest areas and outside forest areas (Çakmakçı et al., 2023; Hasannudin et al., 2022; Russo, 2023).

Agroforestry has advantages compared to other land use systems, including higher total product, diversity of products and services, free from dependence

on external products, and guarantees farmers' income (Gonçalves et al., 2021; Sagastuy et al., 2019; Viana et al., 2022). Sustainable agriculture is a future-thinking concept. Sustainable agriculture is sustainable agriculture now, in the future, and forever (Janker et al., 2018; Siebrecht, 2020). This means that agriculture still exists is beneficial to all and does not cause disaster for all (Hallberg-Sramek et al., 2022; Naharuddin, 2018). Meanwhile, agroforestry is a permanent land-use system (Lojka et al., 2021; Mosquera-Losada et al., 2018), where annual and perennial plants are planted together or in rotation to form a layered canopy, so it is very effective in protecting the soil from raindrops (Gusmanov et al., 2023). This system will provide benefits both ecologically and economically. So that the concept of complex agroforestry can be used as a sustainable agricultural effort to overcome environmental problems (Mbow et al., 2014; Plieninger et al., 2020; Telwala, 2023).

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The application of the agroforestry pattern system in Bakubakulu Village which was developed is still traditional, resulting in the community not understanding the combination patterns that exist in the system. While applying agroforestry patterns appropriately can provide financial benefits for the community, optimize yields from each land managed by the community, as well as an effort to preserve land and forest resources. The purpose of this research is to find out the agroforestry patterns used on community lands in Bakubakulu village.

Method

This research was carried out for 3 months, from October to December 2022 in Bakubakulu Village, Palolo District, Sigi Regency, Central Sulawesi Province. The location selection was based on the consideration that in Bakubakulu Village the community implemented an agroforestry pattern to increase added value. The respondents in this research were 16 farmers who manage agroforestry land in Bakubakulu Village. The sampling of respondents in this study used a purposive sampling technique, namely the sampling of respondents intentionally (not randomly) adjusted to the research objectives (Vicente, 2023); (Busetto et al., 2020). Considering that the sample meets the criteria required in the research.

Result and Discussion

Respondents Ages

Respondents' ages were classified into 4 groups, including group I (age 21-30 years), group II (31-40 years), group III (age 41-51 years) and group IV (age above 50 years). The distribution of the number of respondents by age class is presented in Figure 1.

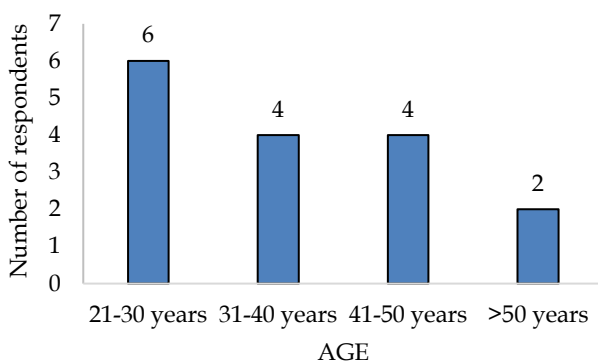


Figure 1. Age graph of respondents

The age factor is very influential in agricultural or farming activities, where in this study the age level of

respondents is dominant in group I (aged 21-30 years) (Ankrah et al., 2021; Girdziute et al., 2022; Salman et al., 2022). The total of 6 respondents is that this age is still very productive for carrying out agricultural or plantation work so it still dominates in this study, the lowest number of respondents was in age group IV (age > 50 years). 2 respondents at this age were less productive due to health factors that did not prevent them from working again.

Education Levels

The Respondents' education levels were classified into 3 groups, including group I (Primary School), group II (Junior High School), group III (High School), and group IV (Vocational High School). The distribution of the number of respondents based on education level is presented in Figure 2.

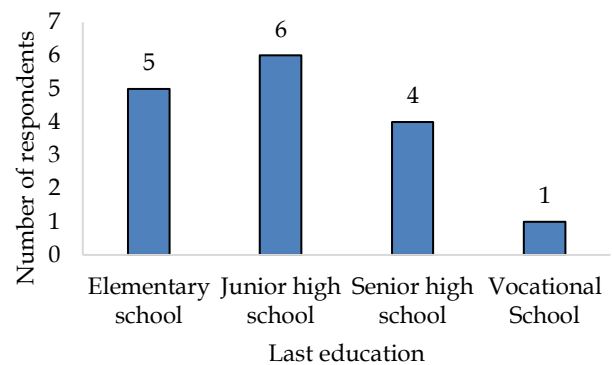


Figure 2. Education level of respondents

Figure 2 shows that the education level of the respondents is dominant in group 2 (junior high school) with a total of 6 respondents. The education level of the lowest respondent was in group IV (Vocational High School) with 1 respondent.

Respondent's Length of Residence and Land Ownership

Respondents' length of residence in Bakubakulu Village was classified into 3 groups, including group I (11-20 years), group II (21-30 and group III (over 30 years). The distribution of the number of respondents based on their length of residence is presented in Figure 3 shows the length of residence of the dominant respondents in group III (> 30 years) of 10 respondents. Meanwhile, the lowest respondent's length of residence was in group I (11-20 years) with 2 respondents. Respondents' land area in Bakubakulu Village was classified into 3 groups including Group I (0 - 1.5 Ha), Group II (1.6 - 2.5 Ha), and Group III (above 2.5 Ha). The distribution of the number of respondents based on land area is presented in Figure 4 showing that the dominant land area of respondents was in group I (0 - 1.5 Ha) with

8 respondents. Meanwhile, the lowest respondent's land area was in group III (Above 2.5 Ha) with 2 respondents.

Spiegelaar et al., 2013). This combination pattern can be seen in Figure 6.

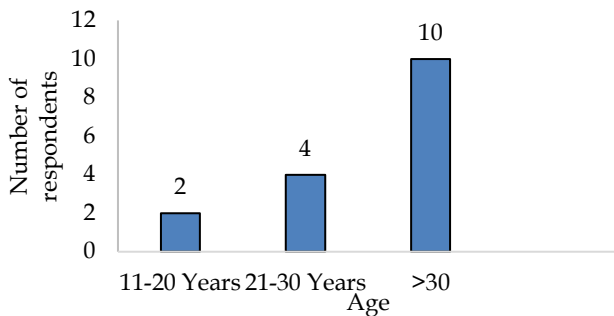


Figure 3. The length of residence of the respondent

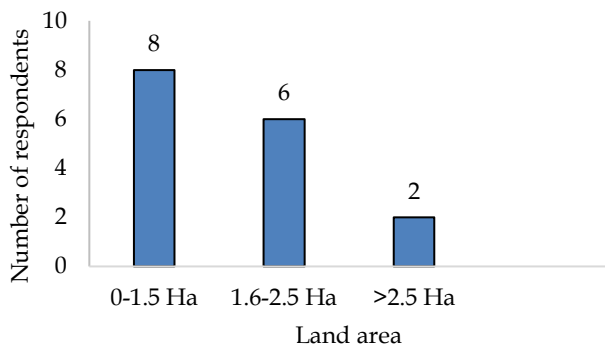


Figure 4. Respondent's land area

Community Agroforestry Patterns

According Du et al. (2023), Wang et al. (2022); Xu et al. (2023), and Sun et al. (2024) to the time dimension, there are 2 types of combinations carried out by the community in Bakubakulu Village. Intermittent combination patterns are used on flat land, which means that crops are usually planted only for one harvest, then the plants will be replaced with other crops (Esteso et al., 2022; Grigorieva et al., 2023; Liliane et al., 2020). Meanwhile, forestry plants will continue to grow as living fences (Border tree planting). On sloping land, a Coincident combination pattern is used, namely a combination of components continuously as long as the land is used (Herbanu et al., 2024; Petropoulos et al., 2022; Veste et al., 2024). Meanwhile, if seen from the spatial aspect, the combination pattern used by the Bakbakulu community is regular, and temporary where the combination pattern can be seen in Figure 5.

In Figure 5, where trees are placed around the plot or placed on the sides of the plot, it is called a tree along the border or a box system. In the picture above it can be seen that crops (corn) are planted in one plot and outside the plot there are forestry plants (candlenuts) lined up around the plot. Meanwhile, on sloping land, the agroforestry pattern used by the community when viewed from a spatial planning aspect is Permanent Random (Castle et al., 2022; Roslinda et al., 2023;



Figure 5. Agroforestry patterns on community flat land



Figure 6. Patterns of community combination on sloping

In picture 6 above you can see candlenut trees and palm trees growing irregularly. Under the candlenut trees there are clove, banana, grapefruit and cocoa plants. From the picture above, it can be seen that the tree that dominates is candlenut because candlenut is the main commodity with results that are considered to provide more economic benefits. To see more clearly the details of the planting patterns used on the community's flat land, see Figure 7. To see the details of the cropping pattern used on the community's sloping land, see Figure 8.

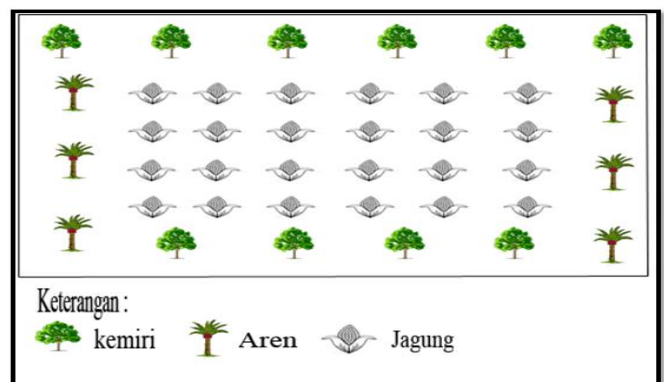


Figure 7. Regular temporary agroforestry pattern

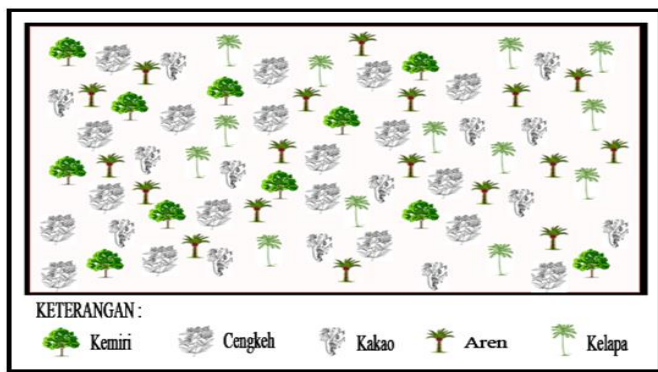


Figure 8. Permanent agroforestry pattern random

In Figure 8, it can be seen that candlenuts, clove, cocoa, and coconut plants were planted randomly. Spacing also varies from 5-15 M, clove plants are always under shade plants such as candlenut or sugar palm because if cloves are planted without another protective plant it will most likely cause the cloves to wilt.

Community Plant Type Combinations

The combination of community plant types in Bakubakulu Village is classified into 4 groups, including group I (candlenut, sugar palm, and corn), group II (candlenut, cassava, and coconut), group III (candlenut, sugar palm, cocoa, cloves and coconut), group IV (candlenut, cassava, grapefruit, coconut and avocado).

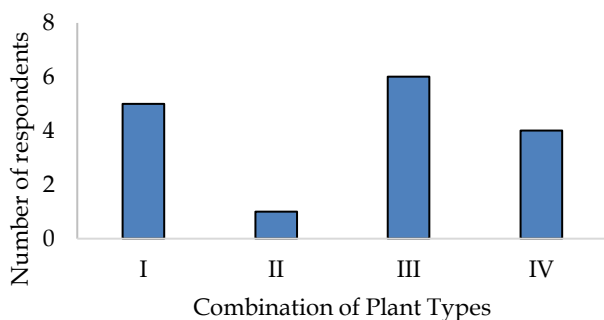


Figure 9. Combination of community plant types

Figure 9 shows that the combination of plant types being developed in Bakubakulu Village is dominated by group III (candlenut, sugar palm, cocoa, clove and coconut) with 6 respondents, while the lowest combination of plant types is group II (candlenut, cassava and coconut) with 1 respondent.

Conclusion

The agroforestry pattern implemented by the community in Bakubakulu Village according to the time dimension is an intermittent/periodic combination pattern on flat land and a coincident combination pattern on sloping land. Meanwhile, from the spatial

aspect, the combination pattern applied by the Bakbakulu community is regular temporary for flat land and a random permanent combination for sloping land. The most widely used combination pattern by the people in Bakubakulu Village is the Regular Temporary combination pattern.

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Author Contributions

Conceptualization; A. S. R.; methodology.; R.; validation; I. R., formal analysis; H. P.; investigation.; E; resources; H.; data curation: E.; writing—original draft preparation. A. S. R.; writing—review and editing; R.; visualization: I. R. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest

The authors declare no conflict of interest.

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