Socioeconomic characteristics of communities utilizing land in forest areas in the Maros Watershed

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Abstract: The community has used the land throughout the area without exception in the forest area. The function of forest areas also varies based on the biophysical conditions of a land. The Maros River Basin has a complex forest area function ranging from production forest, protection forest to conservation forest (National Park). In addition, the Maros watershed also has its own uniqueness in the form of a karst ecosystem and biodiversity. This requires information related to activities, and the role of forests for people who use land in forest areas to meet their daily needs. Based on this, this study aims to analyze land use patterns, and socio-economic characteristics of the people in the Maros River Basin. This analysis begins with spot image analysis, and land use interpretation. The second analysis conducts detailed observations of land use in the field based on the results of land use interpretations that indicate community activities in forest areas. The last analysis is the socio-economic conditions, and the influence of the role of the forest on the community in using land in the forest area. The results of the analysis show that each area function is dominated by land use patterns in the form of dry land mixed with shrubs, rice fields, plantations, plantation forests, and secondary forests. Land use in the form of dry land mixed with shrubs is used as seasonal crops such as corn and horticulture. The use of plantation land, the community gets results in the form of candlenut and coffee. The use of plantation forest land is used to obtain pine resin, while the community uses the secondary forest as non-timber forest products such as honey bees and bamboo. The level of education of people who use forest areas is still low and the average income from the use of these areas is Rp. 1,372,679, - lower than the minimum wage in South Sulawesi Province.

1. Introduction

The island of Sulawesi is part of the Wallacea region which has enormous natural wealth. We can find this wealth starting from the condition of the landscape from the oceans, beaches, coasts, lowlands, highlands, valleys, and mountains. In addition, Sulawesi’s forests are classified as tropical rain forests which are home to most of the endemic species in the world [1]. Even the island of Sulawesi has a wealth of community customs ranging from beliefs, habits, and activities to fulfill their life needs.
One of the areas on the island of Sulawesi that has a very complex ecosystem function is the Maros River Basin. In terms of regional function, the Maros watershed has three forest areas, namely production forest, protected forest, and conservation forest. The conservation forest is Bantimurung Bulusaraung National Park which has the function of maintaining the diversity of plants and animals as well as ecosystems [2]. The most important thing about the Maros watershed is the presence of karst which is very important for the community, and the biodiversity that is rarely found.

Administratively, the Maros watershed is one of the watersheds, most of which are located in Maros Regency in South Sulawesi Province. The Maros watershed is one of three major watersheds located in the MAMINASATA National Strategic Area (KSN) (Makassar, Maros, Sungguminasa and Takalar). Furthermore, the position of the Maros Watershed with respect to KSN MAMINASATA distributes basic needs to meet the food requirements of the community around the center of economic activity. The Maros watershed must also have a balance of three aspects, namely economic, social and ecological.

The fact is that the Maros watershed continues to experience pressure, especially in forest areas which are marked by a reduction in forest cover. The forest area is used by the surrounding community to become agricultural land and even villages and settlements. Some areas will experience additional agricultural land, including in the upstream watershed [3]. This event will have a broad impact, especially on biodiversity, decline in ecosystem functions, and even destroy plant and animal ecosystems [4–6].

This condition must be controlled quickly by analyzing the activities of the community around the forest area in the Maros watershed. In addition, in order not to cause conflict, it is also necessary to identify the role of the forest to the community as initial information in forest management. Based on this description, it is important to analyze the socio-economic conditions of the community around the forest area in utilizing land in the Maros watershed.

2. Materials and method

2.1. Research location

Research locations in the Maros Watershed, Maros Regency, South Sulawesi province are located between 119° 28' 34"E - 119° 54' 53" East Longitude and 4° 58' 37"S - 5° 12' 5" South Latitude. The research location can be seen in Figure 1.
2.2. Materials

The tools used in this study are the Global Positioning System (GPS), Voice Recorder, Digital Camera, Writing Equipment, and question list. The materials needed in the form the map data used in this study are:

| No | Data                                              | Source                                                                 |
|----|---------------------------------------------------|------------------------------------------------------------------------|
| 1  | Watershed Boundaries                              | Directorate Watershed Management and Protected Forest of the Ministry of Environment and Forestry |
| 2  | Administration Data for South Sulawesi            | Geospatial Information Agency                                           |
| 3  | SPOT Image 6 for land use map on 2020             | National Institute of Aeronautics and Space (LAPAN)                    |
| 4  | Forest Area                                       | Directorate General of Planology and Environmental Management of the Ministry of Environment and Forestry |
| 5  | Socio-economic population                         | Central Statistical Agency                                             |

2.3. Population and sample

The population of this study is people who use the forest area in the Maros watershed. The sample used in this study was 20 heads of household. Sampling by intentional sampling based on the function of the forest area considering polygons of land use.

2.4. Collecting research data

- The Data collection was carried out after going through the zoning stage or limiting the research study space in the Maros Watershed. The data collection used in this research is done through:
  - Spot 6 image analysis to analyze land use. Interpretation of images, that is, identification of land use. After image analysis, interpretation analysis is carried out by observing differences in image color, pattern, and texture.
  - Field observation, which is taking the coordinates collected by making direct observations of the land use pattern obtained from the interpretation of the image that represents each of the land use patterns.
  - Interviews with communities that use forest areas in the Maros Watershed to determine the relationship between the results of image interpretation with the types of land use and land use in forest areas. These data are in the form of social characteristics (age, educational level, number of family and work dependents, and economic characteristics (household income and reasons for using land or forest areas).
- furthermore, Complementary data is data obtained through the study of the literature of the results of previous research, agencies, or institutions related to the research. The data is in the form of the general condition of the research site, the socio-economic population, and the general condition of the research site citing and recording the village office, the sub-district office, and the Central Statistical Agency (BPS).

2.5. Analysis data

The data from this study were spatially analyzed according to the interpretation of SOPT 6 images for land use data. In addition, field surveys and interviews were conducted on land use in the forest area. This is to
determine the socioeconomic characteristics of the respondents, including age, level of education, number of dependent family members, occupation, and household income. The final results of the data processing are discussed descriptively to describe the socioeconomic characteristics of the people who use the land in forest areas.

3. Result and discussion

3.1. Characteristics of the use of the forest area of the maros watershed

Based on the forest area data from Directorate General of Planology and Environmental Management of the Ministry of Environment and Forestry in the Maros Watershed, there are four forest areas at that location. The four areas include National Parks, Protected forests, Production forests and limited production forests and areas for other uses. This study does not include areas for other uses (Figure 2). The research location is only in forest areas in the Maros Watershed. Details of the area and percentage of land use in forest areas in the Maros Watershed (Figure 3 and Table 2).

![Figure 2. Forest Areas in the Maros Watershed](image-url)
Table 2. Area and percentage of land use in forest areas in the Maros watershed

| Land Use          | Area Function         | Area (ha) | Percentage |
|-------------------|-----------------------|-----------|------------|
| Protected Forest  | Secondary dry land forest | 2,529.38  | 23.08      |
| Plantation Forest | 521.27                | 4.76      |
| Meadow            | 380.60                | 3.47      |
| Settlement        | 9.78                  | 0.09      |
| Plantation        | 39.96                 | 0.36      |
| Dry land mixed bush farm | 6,277.63  | 57.28      |
| Rice Fields       | 401.73                | 3.67      |
| Shrubbery         | 628.26                | 5.73      |
| Open field        | 66.94                 | 0.61      |
| Water Body        | 103.19                | 0.94      |
| **Protected Forest Total** |                     | 10,958.74 | 100.00     |

Production Forest

| Land Use          | Area Function         | Area (ha) | Percentage |
|-------------------|-----------------------|-----------|------------|
| Secondary dry land forest | 1,768.61  | 16.42      |
| Plantation Forest | 386.68                | 3.59      |
| Meadow            | 111.59                | 1.04      |
| Settlement        | 19.18                 | 0.18      |
| Plantation        | 51.86                 | 0.48      |
| Dry land mixed bush farm | 6,300.10  | 59.99      |
| Rice Fields       | 1,252.21              | 11.63     |
| Shrubbery         | 547.96                | 5.09      |
| Open Field        | 20.30                 | 0.19      |
| Water Body        | 309.63                | 2.88      |
| **Production Forest Total** |                     | 10,768.14 | 100.00     |

Limited Production Forest

| Land Use          | Area Function         | Area (ha) | Percentage |
|-------------------|-----------------------|-----------|------------|
| Secondary dry land forest | 419.97    | 16.53      |
| Plantation Forest | 680.32                | 26.78     |
| Settlement        | 0.96                  | 0.04      |
| Plantation        | 70.46                 | 2.77      |
| Dryland mixed bush farm | 1,045.96 | 41.17      |
| Rice Fields       | 266.84                | 2.45      |
| Shrubbery         | 18.46                 | 0.73      |
| Open Field        | 36.54                 | 1.44      |
| Water Body        | 0.94                  | 0.04      |
| **Limited Production Forest Total** |                     | 2,540.45  | 100.00     |

National Parks

| Land Use          | Area Function         | Area (ha) | Percentage |
|-------------------|-----------------------|-----------|------------|
| Secondary dry land forest | 7,219.45  | 66.37      |
| Plantation Forest | 29.72                 | 0.27      |
| Settlement        | 11.35                 | 0.10      |
| Plantation        | 276.62                | 2.54      |
| Dry land mixed bush farm | 2,760.44 | 25.38      |
| Rice fields       | 567.36                | 5.22      |
| Shrubbery         | 12.30                 | 0.11      |
| **National Parks Total** |                     | 10,877.24 | 100        |
In addition, based on the results of the interviews with people who use the land and direct observations in the field, data on the use of forest areas were obtained for each land use in the area of the Maros Watershed.

Table 3. Community use of forest area based on each land use in forest area

| Functional Area | Land Use | Type of use                      |
|-----------------|---------|----------------------------------|
| Protected Forest| Secondary dryland forest| Bamboo and rattan collection |
|                 | Plantation forest        | Pine Sap Patter               |
|                 | Meadow                 | Animal feed                   |
|                 | Settlement             | Residential land              |
|                 | Dry land mixed bush farm| Corn and horticulture plants  |
|                 | Plantation             | Arabica and Robusta Coffee    |
|                 | Rice fields            | Irrigation and upland rice    |
|                 | Water body             | Irrigation sources            |
|                 | Secondary dryland forest| Bamboo and rattan collection  |
|                 | Plantation forest      | Pine Sap Patter               |
|                 | Meadow                 | Animal feed                   |
|                 | Settlement             | Residential land              |
| Production Forest| Dry land mixed bush farm| Corn and horticulture plants  |
|                 | Plantation             | Candlenut and chocolate       |
|                 | Rice fields            | Irrigation and upland rice    |
| Functional Area   | Land Use                      | Type of use                  |
|-------------------|-------------------------------|-----------------------------|
|                   | Water body                    | Irrigation sources          |
|                   | Secondary dryland forest      | Bamboo and rattan collection|
|                   | Plantation forest             | Pine Sap Patter             |
|                   | Settlement                    | Residential land            |
|                   | Plantation                    | Candlenut and chocolate     |
|                   | Dry land mixed bush farm      | Corn and horticulture plants|
|                   | Rice fields                   | Upland rice fields          |
| **Limited Production Forest** |                   |                              |
|                   | Secondary dryland forest      | Taking Bamboo and Palm Sugar|
|                   | Plantation forest             | Pine sap tapping            |
|                   | Settlement                    | Residential Land            |
|                   | Plantation                    | Candlenut                   |
|                   | Dry land mixed bush farm      | Corn Plant                  |
|                   | Rice fields                   | Rice Fields                 |
| **National Parks** |                   |                              |

Based on the results of the interpretation of images, the pattern of land use in protection forest has the same pattern as production forest, and production forest is limited of the Maros watershed. Partly of land use found were agriculture mixed with shrubs. The limited land they own is the main cause of the community entering the area to carry out agricultural activities. However, a large percentage of the land is not only in agricultural use, but also about 23% of secondary dryland forest is found in these protected forests.

Protected forest areas also contain forest plantations with pine vegetation (Pinus merkusii). However, people only use the sap. Also, the land use in the form of plantations in the area is for robusta, arabica coffee and candlenut plantations. This plantation is planted with trees in a protected forest area. The development of coffee agroforestry can increase the added value of farmers and will indirectly increase the role of the forest [7]. In the protected forest area there is also a body of water that is used as a source of irrigation for the rice fields of the inhabitants of this area. In addition, the protected area is also covered with various types of vegetation, including Soap (Anthocepthalus cadamba), Beringin (Ficus benjamina), Rattan (Calamus sp.), Bell flower (Spathodea campanulata).

These conditions over time, it can lead to a reduction in forest area, especially in production forests. This may also show that the community's level of dependence on agricultural land causes all its vital needs to be directed towards high land productivity for maximum yields. The vegetation commonly found on dry land mixed with shrubs, i.e. corn and horticulture. Settlement is not too large, the type of permanent building that allows the area that originally hovered small can continue to increase from year to year accompanied by an increase in the community in the Maros Watershed. The human population which is experiencing rapid population growth drives the need for food, and land for settlement [8].

Depending on its function, the national plantation forest can be used as a natural tourism park. Even so, in this area there are still people clearing land. In the forest area of the national park, there are 7 land use patterns. Unlike the three previous areas, in this forest area, the secondary forest cover has the largest
area. This illustrates that the condition of the forest in this area is classified as good. However, the data obtained also show the pattern of cover for agricultural lands with a percentage of 25% and rice fields with a percentage of 5%, which could be a threat to forest degradation if the community cultivates continuously in forest areas. Human activities in the form of agricultural land provide pressure that will cause forest fragmentation [9]. Over-exploitation of land in national park areas has certainly resulted in a decrease in land productivity. In addition, pressure on forests in national parks will have an impact on biodiversity, even to the point of decreasing ecosystem functions [4,5].

3.2. Socioeconomic characteristics of the communities in the forest areas of the Maros Watershed

3.2.1 Education. Overall, the level of education for the locations that became the research sample consisted of six categories, namely, not attending school, elementary, middle, high school, Diploma degree, and bachelor's degrees. The data obtained was obtained through interviews with the surveyed community. The non-school and primary education levels have the highest percentage, that is, 32.41% and 40%. The average age of people who use forest areas is 40 until 60 years with an average family member of 4 until 5 people. Age is one of the characteristics of an individual that plays an important role in determining work capacity and labor productivity [10,11]. The level of education of the community in the study sites is presented in Table 4.

Table 4. Education level of the surveyed communities by forest area

| Forest Area                  | Non attending school | Elementary School | Middle School | High School | Diploma degree | Bachelor degree | Total |
|------------------------------|----------------------|-------------------|---------------|------------|----------------|----------------|-------|
| Protected Forest             | 7                    | 9                 | 2             | 1          | 1              | -              | 20    |
| Production Forest            | 4                    | 5                 | 1             | 10         | -              | -              | 20    |
| Limited production Forest    | 6                    | 10                | 3             | 1          | -              | -              | 20    |
| National Parks               | 8                    | 8                 | 1             | 2          | -              | 1              | 20    |
| **Total**                    | **25**               | **32**            | **7**         | **14**     | **1**          | **1**          | **80** |
| **Percentage (%)**           | **31.25**            | **40**            | **8.75**      | **17.5**   | **1.25**       | **1.25**       | **100**|

3.2.2. Income. Based on the results of direct interviews with the community, the average income range of people who use the forest is IDR 1,372,679, lower than the 2015 IDR South Sulawesi provincial minimum wage 2,000,000. as presented in Table 5.

Table 5. Community socio-economic data based on average income in each land use class in forest areas

| Function                  | Area Function                        | Income (Rp) |
|---------------------------|--------------------------------------|-------------|
| Protect Area              | Plantation Forest                     | 1,130,000   |
|                           | Yard                                 | 1,485,200   |
|                           | Dry land mixed bush farm              | 1,604,920   |
|                           | Rice fields                           | 1,050,000   |
|                           | Yard                                 | 1,640,000   |
| Production Area           | Dry land mixed bush farm              | 1,986,000   |
|                           | Rice fields                           | 1,670,000   |
Based on the existing land use in the protected forest area, there are various types of land use by the community in this area, namely agriculture, plantations and rice fields. Of the three land uses used by the community there, agriculture is the land use that is primarily done by the community. The average area of agricultural land used by the community is 0.5 to 2 ha. The types of plants found mainly on community lands are horticultural crops and corn plants with an average income of Rp.1,380,000 from their agriculture. The community also uses land in protected forest areas to grow coffee (Robusta and Arabica coffee) with an average community income of 1,485,200 IDR with an average age range of 55 to 60 years and an average level of education only up to school level. Basic. For the extraction of pine sap by the community in forest plantations with an average income of Rp. 1,050,000. Regarding the utilization of rice fields in the form of irrigated rice fields and some rice fields with an average income of Rp 1,050,000.

In general, community activities in forest production areas are farmers. In addition to planting maize, the community also works in the rice fields, whether they cultivate them themselves or rent them to other people. On average, the inhabitants of this area have an area of 0.5 to 3 ha. The dry land and plantations in the forest area are quite high with an average income of IDR 1,986,000 and IDR 1,640,000. Addition to agriculture, most of the people in this area also raise livestock. However, not all people in this area have livestock, they only raise other people's livestock to increase their income.

In forest areas of limited production, the community uses the land in the form of agriculture, plantations and rice fields. The community's agricultural lands are dominated by horticultural crops and maize crops, with an average income of Rp 1,450,000. Meanwhile, rice cultivation activities in forest areas are carried out from generation to generation, both on their own land and cultivating other people's land. The rice fields in this location are with an average income of 1,100,000 IDR. In addition to the rice fields, the community grows nuts, coffee, cloves and cocoa with an average income of IDR 1,250,000. In addition, in this area there is also a forest plantation area whose vegetation is in the form of pine plants (Pinus merkusii). On this land, the community extracts pine sap, which can earn Rp 1,054,000 per month.

In the forest area of the national park, most of the people in this place live as farmers. This means that the community around the National Park relies heavily on the potential of natural resources in the form of land to meet their daily needs. The community's agricultural lands are dominated by horticultural crops and maize crops, with an average income of Rp 1,450,000. The rice fields in this location are with an average income of IDR 1,190,000. In addition to rice fields, the community grows nuts, coffee, cloves and cocoa with an average income of IDR 1,537,500. In addition, in this area there is also a forest plantation area whose vegetation is in the form of pine plants (Pinus merkusii). On this land, the community extracts pine sap, which can earn Rp 1,054,000 per month. Non-timber forest products in the form of palm sugar are also used in the national park area. This sugar palm then people sell to markets to increase their income. The availability of large enough land and growing economic needs encourage people to use forests in protected forest areas, so they tend to increase their income.
Based on the results of the interviews, the obstacles experienced by the community included insufficient land outside the area to meet the community's needs. As one of the areas that is close to forest areas, it is very difficult for the community to make room for agriculture with very limited land. The lack of community knowledge and education makes the community less aware of the importance of sustainable forests. Outreach activities to the community regarding the role of sustainable forests and enhancing skills are of course the responsibility of all parties.

However, based on the results of the interviews, the conflict over the boundaries between the community and the Babul National Park finally had the implication of a conflict in the use of natural forest resources, both in the form of use of the land as in the use of plants that had been developed by the community now located in the Babul National Park. Conflicts in land use occur due to differences of understanding between the community and the government about land use in forest areas. For the people who live around the forest, the existing land, both in the forest area and outside the forest area, can be used to meet their daily needs by opening plantations or rice fields. For the government, existing lands, especially those in forest areas, are designated according to their function and sometimes it contradicts what the community does. Likewise, in terms of the use of plants contained in forest areas, for the community everything that is produced with plants (wood and non-wood) can be used by the community to satisfy their daily needs regardless of the function of the forest. However, for the government, the use of plants in forest areas should be adjusted to the function of the forest.

4. Conclusions

Forest areas in the Maros watershed are used in the form of agriculture, plantations and rice fields. In addition, the community also collects non-timber forest products in the form of bamboo and takes pine resin. Communities in the Maros Watershed that use the forest area generally work as farmers. The level of education of the community using forest areas is classified as low and the average income earned from utilizing the area is lower than the minimum wage in South Sulawesi province.

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