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Land Cover Changes from 2000 to 2021 in the Watershed Area of Sub-Watersheds Banyu Irang and Banyu Maluka in Cempaka Village, South Kalimantan

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ABSTRACT

The Maluka Watershed, covering an area of 89,506.19 hectares, includes the sub-watersheds of Banyu Irang and Bati Bati, which span Tanah Laut Regency, Banjar Regency, and Banjarbaru City, in South Kalimantan Province. This research aims to analyze land cover changes and soil fertility in the watershed area, as conducted in the Banyu Irang sub-watershed, Cempaka Village, Banjarbaru City, South Kalimantan Province, focusing on land cover changes from 2000 to 2021. The analysis of land cover changes in 2000 and 2021 was conducted using land cover Shapefiles from 2000 and 2021. The land cover changes from 2000 to 2021 in the Catchment Area of the Banyu Irang sub-watershed, Maluka Watershed, Cempaka Village, show several significant changes.

Keywords: *Watersheds, Catchments, Land, Banyu Irang, Maluka*

INTRODUCTION

A watershed is an area bounded by mountain ridges, where rainfall is collected and channeled through small streams to the main river. The characteristics of a watershed include various parameters reflecting morphometric, topographic, hydrological, geological, soil, vegetation, land use, and human conditions. This makes a watershed a crucial hydrological unit in water resource and environmental management (Naharuddin & Tadulako, 2018).

Government Regulation Number 37 of 2012 on Watershed Management emphasizes that a watershed is a land area that forms a unity with the river and its tributaries. The primary function of a watershed is to collect, store, and naturally channel rainwater to lakes or seas, with land boundaries forming topographic separators and sea boundaries extending to certain areas. This highlights the importance of watershed management in maintaining ecosystem balance and the sustainability of water resources (Puja & Atmaja, 2022).

The Maluka Watershed, covering an area of 89,506.19 hectares, includes the Banyu Irang and Bati Bati sub-watersheds, which span Tanah Laut Regency, Banjar Regency, and Banjarbaru City in South Kalimantan Province. According to BPDAS Barito (2013), the Maluka Watershed has slightly to severely critical land covering 75,869.78

hectares (84.77%). The availability of groundwater is significantly influenced by land use changes in the watershed, affecting rainwater recharge areas (Ruslan et al., 2009). Differences in soil physical properties under various land uses determine the soil's ability to absorb water, influencing infiltration, erosion, and land criticality levels.

Land cover is an important indicator of the condition of a watershed, encompassing the percentage of land covered by vegetation, including both natural forests and rehabilitated land. Good land cover reflects successful maintenance of the hydrological and ecological functions of the watershed. Changes in land cover significantly impact the environment and surrounding communities, such as the loss of biologically diverse natural forest habitats, decreased biodiversity, and ecosystem degradation (Saosang et al., 2022).

The success of plant growth and production heavily depends on soil conditions as a growing medium, water provider, and source of essential nutrients. Factors such as climate, parent material, topography, organisms, and time lead to differences in soil characteristics, including physical, chemical, and biological properties. Soil fertility, defined as the quality of soil for cultivation, is determined by the interaction of various physical, chemical, and biological soil properties that form the habitat for active plant roots. Soil fertility issues in watersheds are caused by natural factors (geology, soil type, topography, and land use), land use patterns (shifting cultivation and deforestation), and land degradation due to natural disasters such as flash floods (Batu et al., 2019).

This study aims to analyze land cover changes and soil fertility in the watershed area, as conducted in the Banyu Irang sub-watershed, Cempaka Village, Banjarbaru City, South Kalimantan Province, focusing on land cover changes from 2000 to 2021.

MATERIALS & METHODS

This study was conducted in the Catchment Area of the Banyu Irang Sub-Watershed, Maluka Watershed, in Cempaka Village, Cempaka District, Banjarbaru City, South Kalimantan Province. The analysis focuses on land cover changes between 2000 and 2021 using the following datasets:

1. Land cover shapefile for the year 2000 in the Catchment Area of the Banyu Irang Sub-Watershed, Maluka Watershed.
2. Land cover shapefile for the year 2021 in the Catchment Area of the Banyu Irang Sub-Watershed, Maluka Watershed.

RESULT

The analysis results of land cover changes and soil fertility in the Catchment Area of the Banyu Irang Sub-Watershed, Maluka Watershed, in Cempaka Village, focus on exploring the impact of environmental transformation during the period from 2000 to 2021. Land cover changes can provide insights into the ecological dynamics and interactions between humans and the environment in the area. By monitoring land cover changes over time, we can understand how human activities, such as agriculture, urbanization, or forestry, affect ecosystem diversity and soil quality in the region. Therefore, this analysis will offer valuable insights for natural resource management and conservation efforts in the Catchment Area of the Banyu Irang Sub-Watershed, Maluka Watershed. The analysis results are presented in the following figures:

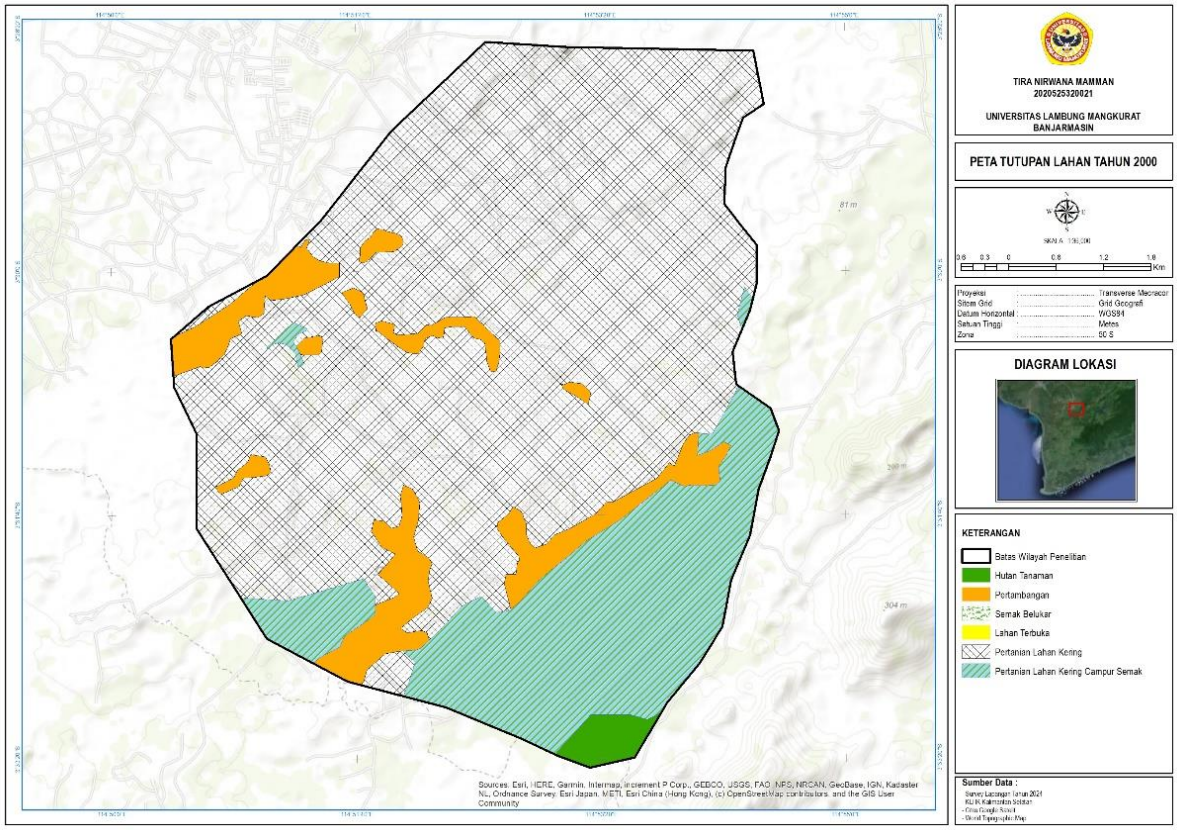

Figure 1. Land Cover Map in 2000 Water Catchment Area SUB Banyu Irang Watershed Area Maluka River Watershed Area

In 2000, the land cover in the Catchment Area of the Banyu Irang Sub-Watershed, Maluka Watershed, Cempaka Village, comprised four categories: Plantation Forest, Mining, Dryland Agriculture, and Mixed Dryland Agriculture. The largest land cover category was Dryland Agriculture, covering 3,515.23 hectares or approximately 70.40%, while the smallest was Plantation Forest, covering 56.61 hectares or around 1.13%. The detailed land cover area in 2000 is shown in the table below:

Table 1. Land Cover Area of Water Catchment Area, Banyu Irang River Watershed Sub Area, Maluka River Watershed Area, 2000

No	Land Cover	Ha	%
1	Plantation Forest	56,61	1,13
2	Mining	419,25	8,40
3	Dryland farming	3.515,23	70,40
4	Mixed Dryland Farming	1.001,94	20,07
Total		**4.993,03**	**100**

The next analysis was conducted on the land cover in 2021 in the Catchment Area of the Banyu Irang Sub-Watershed, Maluka Watershed. The results are presented in the following figure:

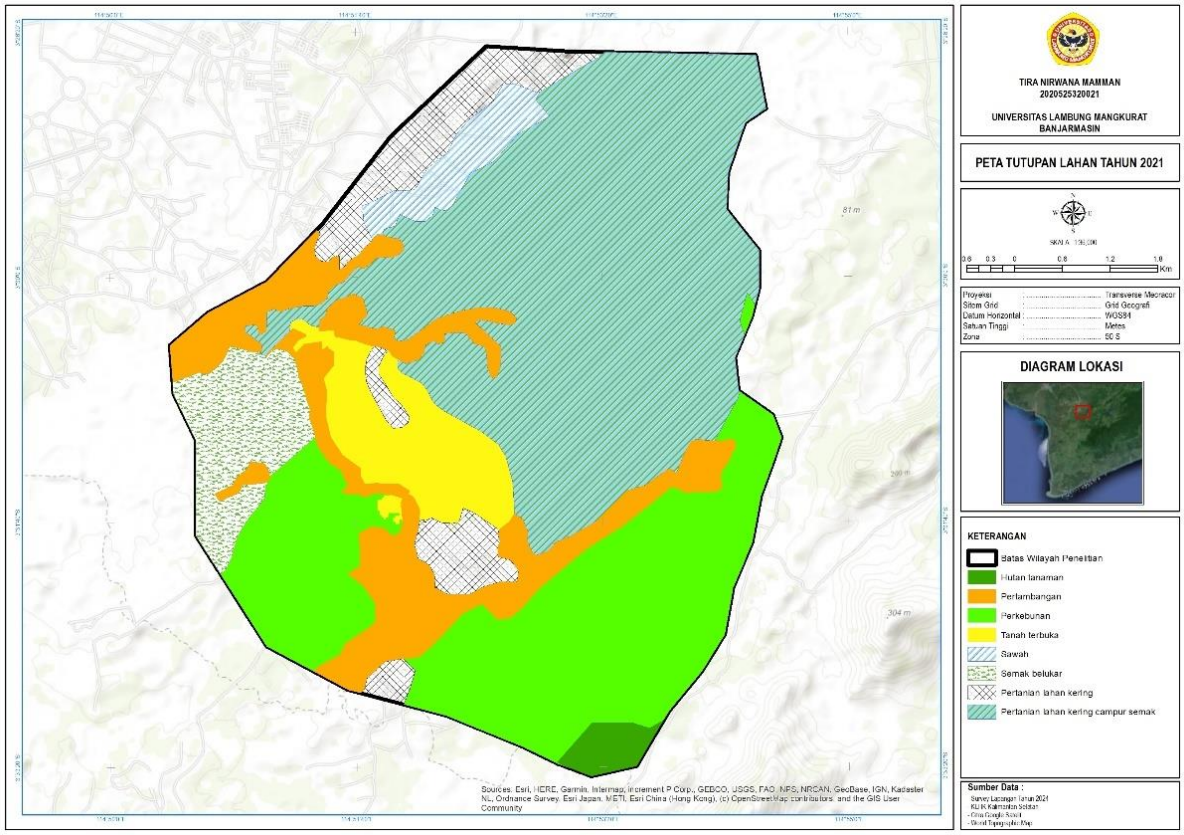

Figure 2. Land Cover Map in 2021 SUB Water Catchment Area Banyu Irang River Watershed Area Maluka River Watershed Area

In 2021, the land cover in the Catchment Area of the Banyu Irang Sub-Watershed, Maluka Watershed, Cempaka Village, comprised eight categories: Plantation Forest, Plantation, Mining, Paddy Fields, Open Land, Shrubs, Dryland Agriculture, and Mixed Dryland Agriculture. The largest land cover category was Mixed Dryland Agriculture, covering 1,970.37 hectares or approximately 40%, while the smallest was Plantation Forest, covering 56.61 hectares or around 1%. The detailed land cover area in 2021 is shown in the table below:

Table 2. Land Cover Area of SUB Water Catchment Area Banyu Irang River Watershed Area Maluka River Watershed Area in 2021

No	Land Cover	Ha	%
1	Hutan tanaman	56,61	1
2	Perkebunan	1.246,76	25
3	Pertambangan	650,68	13
4	Sawah	129,82	3
5	Tanah terbuka	313,06	6
6	Semak belukar	269,47	5
7	Pertanian lahan kering	356,49	7
8	Pertanian lahan kering campuran	1.970,14	40
Total		**4.993,03**	**100**

The results of the analysis of the Land Cover Change Map in 2000 – 2021 are presented in the following figure:

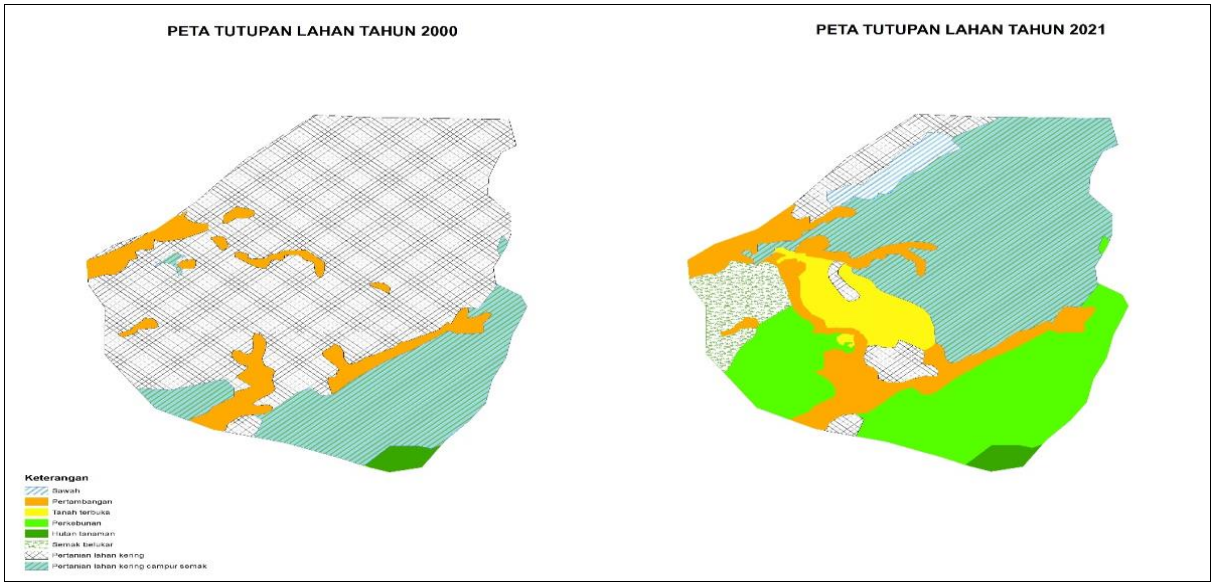

Figure 3. Map of Land Cover Changes in 2000 - 2021

The land cover in the Catchment Area of the Banyu Irang Sub-Watershed, Maluka Watershed, Cempaka Village, underwent significant changes between 2000 and 2021. The research analysis presents data on significant changes in the land cover structure in the Catchment Area of the Banyu Irang Sub-Watershed, Maluka Watershed, Cempaka Village, between 2000 and 2021. The rate of change for each land cover category can be seen in the table and graph below.

Table 3. Rate of land cover change in each category

No	Land Cover	Hectare Area (Ha)			Description/Condition
		2000	2021	Change	
1	Plantation forest	56,61	56,61	0	Still
2	Plantation	-	1.246,76	1.246,76	Increase
3	Mining	419,25	650,68	231,43	Increase
4	Ricefield	-	129,82	129,82	Increase
5	Open ground	-	313,06	313,06	Increase
6	Shrubs	-	269,47	269,47	Increase
7	Dryland farming	3.515,23	356,49	-3.158,74	Reduce
8	Mixed dry land farming	1.001,94	1.970,14	968,43	Increase
Total		**4.993,03**	**4.993,03**		

Note: Change = data for 2021-2000

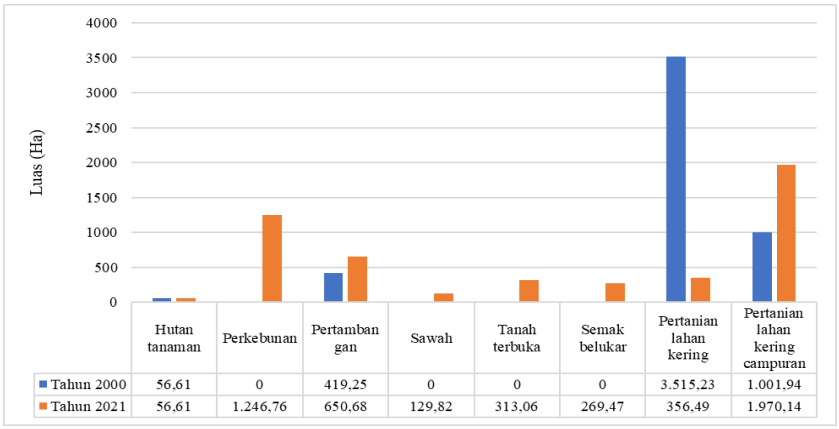

Figure 4. Graph of Land Cover Change

Table 3 and Figure 4 illustrate the rate of land cover change in each category between 2000 and 2021 in the Catchment Area of the Banyu Irang Sub-Watershed, Maluka Watershed, Cempaka Village. Significant variations in land cover change are evident during this period. Some of the most notable changes are outlined below:

1. Plantation Forest: No change from 2000 to 2021, remaining at 56.61 hectares.
2. Plantation: Converted from Dryland Agriculture covering 261 hectares and Mixed Dryland Agriculture covering 986 hectares.
3. Mining: Increased by 231.43 hectares over 21 years, originating from 221 hectares of Dryland Agriculture and 16 hectares of Mixed Dryland Agriculture.
4. Paddy Fields: Appeared in 2021, converted from Dryland Agriculture covering 129.82 hectares.
5. Open Land: Formed from Dryland Agriculture covering 313.06 hectares.
6. Shrubs: Formed from Dryland Agriculture covering 269.47 hectares.
7. Dryland Agriculture: Changed to Plantation, Mining, Mixed Dryland Agriculture, Paddy Fields, and Open Land, with a total area change of 3,158.74 hectares.
8. Mixed Dryland Agriculture: Increased in area, originating from Dryland Agriculture covering 968.43 hectares.

These changes reflect complex dynamics in land use within the region over a 21-year period. Significant increases in plantation area, mining, and mixed agricultural land indicate heightened pressure on natural ecosystems and land conservation. The dramatic decrease in dryland agriculture suggests a significant shift in land use patterns influenced by economic, social, and environmental factors. A deep understanding of these influencing factors is crucial for developing sustainable land management strategies to ensure ecological and economic sustainability in the Catchment Area of the Banyu Irang Sub-Watershed, Maluka Watershed, Cempaka Village.

Changes in land cover in river basins have significant impacts on ecosystem and environmental sustainability. Studying these changes not only enhances our understanding of environmental dynamics but also plays a crucial role in planning sustainable natural resource management. Therefore, research on land cover changes in river basins provides a solid foundation for sustainable decision-making in resource management and environmental preservation (Misnawati et al., 2020).

Changes in land cover in river basins are also vital in the context of climate change mitigation and adaptation to environmental changes. These changes can affect water cycles, groundwater availability, and rainfall patterns, all of which are critical factors in regional and global climate regulation. Understanding how changes in land cover influence environmental dynamics allows us to develop appropriate adaptation strategies to reduce natural disaster risks and strengthen environmental resilience in river basins. Thus, research on land cover changes in river basins is not only relevant for environmental conservation but also for efforts in climate change mitigation and sustainable development (Zhang et al., 2018).

CONCLUSION

The land cover changes from 2000 to 2021 in the Catchment Area of the Banyu Irang Sub-Watershed, Maluka Watershed, Cempaka Village, demonstrate several significant transformations. Plantation forest remained unchanged at 56.61 hectares. Plantations increased by 261 hectares from dryland agriculture and 986 hectares from mixed dryland agriculture. Mining expanded

by 231.43 hectares from dryland agriculture and mixed types. Paddy fields in 2021 covered 129.82 hectares converted from dryland agriculture. Open land formed from 313.06 hectares of dryland agriculture. Shrubs emerged from 269.47 hectares of dryland agriculture. Dryland agriculture underwent the largest change into various other land types, totaling 3,158.74 hectares. Mixed dryland agriculture increased by 968.43 hectares from dryland agriculture.

Declaration by Authors
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