

## LAND ALLOCATION ANALYSIS OF THE UPHELESS BELAWAN RIVER BASIN (DAS) IN RELATION TO SPATIAL PLANNING

**Rizki Hany<sup>1\*</sup>, Abdul Rauf<sup>2</sup>, Bejo Slamet<sup>3</sup>.**

<sup>1,2,3</sup> Master of Regional and Rural Planning, Universitas Sumatera Utara, Indonesia.

Received : 21 August 2024

Published : 22 October 2024

Revised : 31 August 2024

DOI : <https://doi.org/10.54443/morfai.v4i3.3491>

Accepted : 13 September 2024

Publish Link : <https://radjapublika.com/index.php/MORFAI/article/view/3491>

### Abstract

Regional development must be balanced and sustainable, particularly in managing the Belawan Watershed, which includes Deli Serdang and Medan. Proper spatial planning is essential to maintaining the upstream and downstream ecosystems and ensuring environmental sustainability. This study aims to analyze the availability of agricultural land in the upper Belawan Watershed to meet human needs. Additionally, it seeks to provide guidance on land allocation within spatial planning and develop sustainable land allocation recommendations for the future. The research methodology employs a qualitative descriptive approach to explain land use and a quantitative approach for presenting numerical data that can be processed using simple calculations. The study concludes that nearly all land in the upper Belawan sub-watershed has been utilized, with only 0.6% remaining as an ecological buffer. The most significant land-use change has been the conversion of production forests into plantations, covering an area of 4,808.70 hectares. Future spatial planning must balance land use with environmental conservation.

**Keywords:** *Watershed; Spatial Planning; Land Use*

### INTRODUCTION

Regional development is an integral part of National Development which aims to improve the standard of living and welfare of the community. The development will be implemented in a harmonious, balanced and balanced manner in urban and rural areas. In order to accelerate the implementation of development and services to the community, it can be realized through the arrangement of regional development areas. This arrangement is carried out with consideration of the real conditions and needs in the area. Sudaryono (2013) stated that development and management policies carried out by the region must maintain the stability of the ecosystem, economy and natural sustainability. We are sure that the regional policy management unit can be found in the River Basin Area (DAS). River Basin Areas (DAS) are the most appropriate areas for development, where national interests meet local interests. Economic development that processes Indonesia's natural resources must always pay attention to environmental sustainability issues for future generations. Therefore, natural resources, especially forests, land, and water, must be maintained so that their ability to repair themselves is always maintained. In the concept of regional development, many theories have been put forward that explain the problems of imbalance in regional development. Several important issues related to the role of the center in regional development that must be given important attention, such as determining how many main nodes are appropriate to function as centers of development areas, city hierarchy, functional relationships between nodes, namely in which direction the orientation is distributed geographically at each node. Currently, regional development has experienced rapid development, which is indicated by the problems that have emerged, including the increasing need for land and space. Lack of infrastructure, increasing frequency of flooding, expanding slum areas, which affect the development of a region. The region ultimately experiences significant pressure that must be anticipated.

The increasing need for land needs to be regulated in regional planning in order to create a balance of spatial planning that is sufficient for needs. Land allocation in each region to meet the need for land must be balanced so that the preservation of nature is maintained. In its management, land allocation cannot be managed by only looking at the division according to administrative areas, this will cause losses to other areas. For example, in a certain area, people who cultivate land that has a fairly high slope without using conservation techniques can cause land damage in the upstream area and cause flooding in the downstream area. For this reason, it is necessary to use a River Basin approach. Management based on administrative areas can overlap various interests. One of the efforts made by the government is through the River Basin (DAS) approach. One of the River Basins that is

included in the category of being restored because it is classified as critical is the Belawan River Basin (DAS). The River Basin (DAS) stretches from Deli Serdang Regency in the upstream part and Medan City in the downstream part. So that human life activities in the upstream and middle parts of the River Basin (DAS) will also have an impact on the downstream area. Land use in the Belawan River Basin (DAS) area is complex because it also includes urban areas. The result is the complexity of land allocation that is balanced between meeting needs and environmental preservation. The Belawan River Basin is administratively part of Medan City and Deli Serdang Regency. Based on its coordinates, the Belawan River Basin stretches at  $3^{\circ} 15'49.83'' - 3^{\circ} 50' 38.89''$  N and  $98^{\circ} 29' 58.56'' - 98^{\circ} 43' 21.76''$  E. The Belawan River Basin has an area of  $\pm 40,121.01$  Ha with the division of the Tuntungan sub-Region, Krio Region, Upper Belawan River Basin, Central Belawan, Lower Belawan. (Sumatra River Basin Center II, 2018). The upstream River Basin Ecosystem is an important part because it has a protective function for the entire River Basin. This protection functions, among other things, as water management protection. Therefore, in its planning, the upstream watershed is often the focus of planning considering that a watershed in the upstream and downstream areas has biophysical characteristics through the hydrological cycle (Asdak, 2012).

Spatial planning must consider the relationship between upstream and downstream areas of the watershed, related to land use, land use planning must cover the entire watershed. In relation to regional development planning, this study has a very close relationship where land use patterns will affect the continuity and sustainability of the upstream Belawan Watershed (DAS), namely Sibolangit, Tuntungan and Kutalimbaru. Given the importance of land use for life, it is necessary to study land use, protection functions, factual comparisons of land cover with its intended use, and spatial planning. The results of this study are expected to provide direction for land use and function for environmental sustainability and the maintenance of the ecosystem of the upstream Belawan Watershed.

## **LITERATURE REVIEW**

### **A. Watershed Ecosystem**

Ecosystem is an ecological system consisting of the most integrated components to form a unity. The system has certain properties, depending on the number and type of components that make it up. The size of the ecosystem depends on the view and boundaries given to the ecosystem, so the river basin can be considered as an ecosystem. According to Wicaksana (2017) River Basin Area (DAS) is a single ecosystem whose main elements consist of natural resources of land, water and vegetation as well as human resources as the actors who utilize these natural resources. Further explained according to Nilda (2015) states that River Basin Area is a natural system in hydrology with rivers as the main component that is greatly influenced by the characteristics of rainfall and biophysical conditions of the River Basin Area. In addition, a River Basin Area will be separated from other River Basin Areas around it by natural boundaries (topography) in the form of ridges or mountains which make it a sub-sub River Basin Area.

### **B. Land Management**

The term land can be defined as an area on the earth's surface, encompassing all components of the biosphere that can be considered permanent or cyclical that are above and below the area, including the atmosphere, soil, parent rock, relief, hydrology, plants and animals, and all the consequences caused by human activities in the past and present; all of which have an impact on human land use now and in the future. Land potential is determined by the potential of each resource that is its component, both innate potential and potential that develops from customers acting together (interactive relationship) and customers compensating (compensatory relationship) between resources. Land has a spatial dimension because it is a stretch of the earth's surface and its characteristics change from site to site. Land also has a time dimension because its characteristics change according to interactive and compensatory processes between its components and because of the cyclical nature of the identifiers of some of its components. So land can be called a system of space and time.

### **C. Previous Research**

- a. Dissertation written by Made Sri Sumarniasih (2015). "Land Use Planning in the Ayung River Basin, Bali Province". Udayana University, Bali. The purpose of this study is to analyze the discharge of the Ayung River Basin, to determine the level of erosion in the Ayung Watershed, to analyze the income of farmers in the Ayung Watershed and to analyze the effect of changes in land use on discharge and erosion levels in the Ayung River Basin. The results of the study showed that the river regime coefficient of the Ayung

Watershed was 3.2 with a maximum discharge of 9.37 m<sup>3</sup> sec<sup>-1</sup> and a minimum discharge of 2.92 m<sup>3</sup> sec<sup>-1</sup>. Erosion in the Ayung Watershed is classified as very light in the downstream (0.22-12.74 t ha<sup>-1</sup> yr<sup>-1</sup>), very light to very heavy erosion in the middle (0.50-221.97 t ha<sup>-1</sup> yr<sup>-1</sup>), very light to very heavy erosion in the upstream (1.04-724.86 t ha<sup>-1</sup> yr<sup>-1</sup>), exceeding the permissible erosion (Edp) 22.60-57.00 t ha<sup>-1</sup> yr<sup>-1</sup>. The income of farmers in the upstream Ayung watershed is Rp 165,987,641, (the highest) while in the middle and downstream parts it is Rp 50,184,416, and Rp 41,361,561. The use of intercropping land (orange + gumitir flower + elephant grass) can reduce erosion by 96% and increase farmer income by Rp. 2,380,000 per ha per year compared to the use of orange land.

- b. Thesis written by Imam Saifudin (2017). "Study of Land Use Change Response to Hydrological Characteristics of Garang Watershed". Diponegoro University Semarang. The purpose of the study is to predict changes in hydrological characteristics of the Garang Watershed using the SWAT model, to determine the effect of land use changes on changes in hydrological characteristics; and to compile recommendations for the best land use planning in the Garang Watershed. The results of this study indicate that the hydrological characteristics of the Garang Watershed in 2013 showed a surface flow of 1711.49 mm, with a base flow of 638.68 mm, with a flow coefficient and flow regime coefficient of 0.55 and 23.04, respectively. Changes in land use in 2000 and 2013 affected the hydrological characteristics, namely by increasing surface flow by 301.88 mm (14.64%) and the flow coefficient value to 0.55. The recommended land use is the application of agrotechnology with land management techniques for crop rotation according to contour and a combination with terraces.
- c. Thesis written by Muhammad Danial (2021). "Upstream Management Strategy of Jeneberang River Basin". Hasanuddin University Makassar". The purpose of the study was to evaluate management in the upstream area of the Jeneberang River Basin; analyze the factors that determine the success of the Jeneberang River Basin management and formulate a management strategy for the Jeneberang River Basin. The results of the study showed that the physical condition of the Jeneberang River Basin is critical due to massive land use, requiring the handling of the relevant government and the community to work together and synergize in managing the Jeneberang River Basin ecosystem. Analysis of success factors was obtained from local assessment rankings and global assessments of SWOT factors. The formulation of the Jeneberang River Basin management strategy is; (1) It is a priority watershed that really needs to be maintained according to the PP 37 of 2012 policy as a reference for restoring the Jeneberang River Basin and preventing environmental damage and providing incentives, opening up employment opportunities, education, training and assistance to the community who maintain the sustainability of the environment around the Jeneberang River Basin; (2) Cooperation and synergy of stakeholders in maximizing and prioritizing the management of the Jeneberang River Basin so that erosion, flooding, dam failures and environmental damage cannot threaten the area around the Jeneberang River Basin; (3) Minimal community knowledge in land management, so education is needed, mentoring and training so that the community knows and understands the main function of the Jeneberang Watershed.

#### **D. Research Thinking Framework**

The condition of the upstream Belawan River Basin is located in the Kutambaru and Sibolangit areas, Deli Serdang Regency. Human needs for land continue to increase, both for housing, business premises, public facilities (places of worship, markets and roads), and government facilities. Therefore, there are many regulations governing land use and regional spatial planning so that utilization patterns do not damage the existing ecosystem. The area studied is the upstream Belawan River Basin with a complex problem space, this will be reviewed with the data available at the authorized Government Agency, whether land use has been in accordance with the established plan (regulator).

### **METHOD**

#### **A. Location and Time of Research**

The location of this research is in the upstream Belawan River Basin Area (DAS) which is administratively located in Kutalimbaru, Pancurbatu and Sibolangit. This research will be conducted for 6 months starting from the preparation of the proposal, seminar and research results. The research will be conducted from January to June 2023. This study is limited to the physical aspects of the upstream Belawan River Basin (DAS) located in Deli Serdang Regency, namely Sibolangit and Kutalimbaru. Land use in the Belawan River Basin

(DAS) is related to spatial planning and analyzed using ArcGIS. This analysis was conducted to see land availability, the Regional Spatial Plan (RTRWP) of North Sumatra Province and Deli Serdang Regency, and the current factual conditions. The map overlay technique was conducted to obtain the specific information needed

### **B. Data Processing and Analysis**

The method used in this study is the OVERLAY method (overlapping) and Spatial Analysis using Geographic Information System technology, ArcGIS software program. The ArcGIS program has several applications and one that is often used in the analysis of Watershed (DAS) planning is ArcMap. The images or maps analyzed can be in the form of Digital Elevation Model (DEM), projection maps from Google Earth, and maps downloaded from the Indonesia Geospatial Portal (Inageoportal). Data processing is carried out to determine land use patterns (land use data), determine rainfall (BMG data), slope (topographic data), land cover (vegetation), protection functions (spatial data), spatial planning for the North Sumatra Province (RTRWP), population distribution (statistical data), high-resolution imagery (spot imagery), field survey data (ground check) in the upstream Belawan DAS area.

### **C. Spatial plans**

The Regional Spatial Plan is a policy direction and strategy for the utilization of space in the Deli Serdang Regency and North Sumatra Province, consisting of protection, supervision and utilization which is used as a reference for implementing development.

### **D. Factual Condition of Land**

Conditions or circumstances that state the time at the present time or the last time to be used in research, with the existence of factual conditions we can compare the deviations in spatial planning that have been made and the planning that should be.

### **E. Research Analysis**

In this study, the analysis used is more directed towards Spatial Analysis (spatial analysis of space) and a small part uses Image Analysis (image processing).

## **RESULTS AND DISCUSSION**

### **A. Geographical Location of Research Area**

From Figure 4.1 it shows that the Upper Belawan Sub-DAS is located at 98o 29'47.868"- 98o42'35.496" E and 03o50'23.676" – 03o15'24.036" N. Geographically, the Upper Belawan Sub-DAS is located at:

- a. The north borders the Krio Sub-DAS
- b. The south borders Karo Regency (Upstream DAS)
- c. The east side borders the Sei Tengah Sub-DAS
- d. The west side borders the Tuntungan Sub-DAS

# LAND ALLOCATION ANALYSIS OF THE UPHELESS BELAWAN RIVER BASIN (DAS) IN RELATION TO SPATIAL PLANNING

Rizki Hany et al

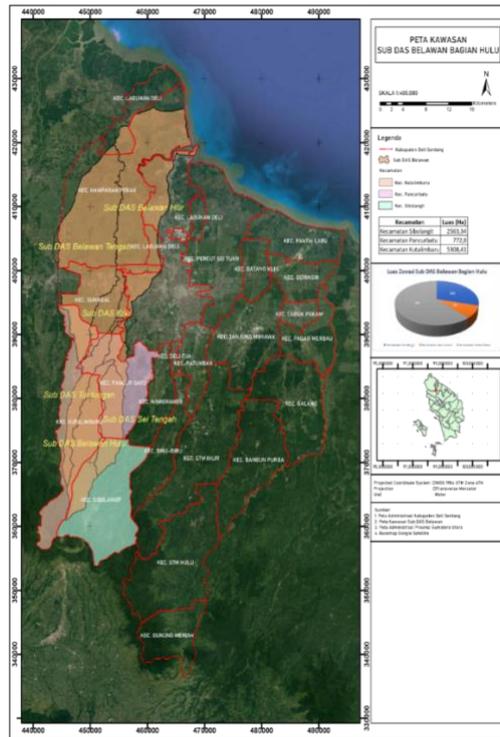


Figure 4.1 Map of the Upper Belawan Sub-DAS Area

The administrative areas passed through by the upstream Belawan Sub-River Basin Area (DAS) are:

**Table 4.1 Area of the Upper Belawan Sub-DAS**

No.	Subdistrict	Area (Ha)	Information (%)
1	Sibolangit	2563.34	30
2	The Stone of the Rock	772.8	9
3	New Kutalim	5308.41	61

According to the division of administrative areas, Kutalimbaru District is the area with the greatest influence on the Upper Belawan Sub-DAS in terms of administrative boundaries covering an area of 5308.41 Ha (61%) compared to Sibolangit District covering an area of 2563.34 Ha (30%) and Pancurbatu District covering an area of 772.8 Ha (9%). From the table, Kutalimbaru District plays a very full role in the sustainability of the Upper Belawan Sub-DAS ecosystem. The calculation of the area of the Upper Belawan Watershed based on the administrative boundaries of the sub-district aims to determine the area that greatly influences the sustainability of the upper Belawan Sub-DAS ecosystem.

## B. Demographics/Population

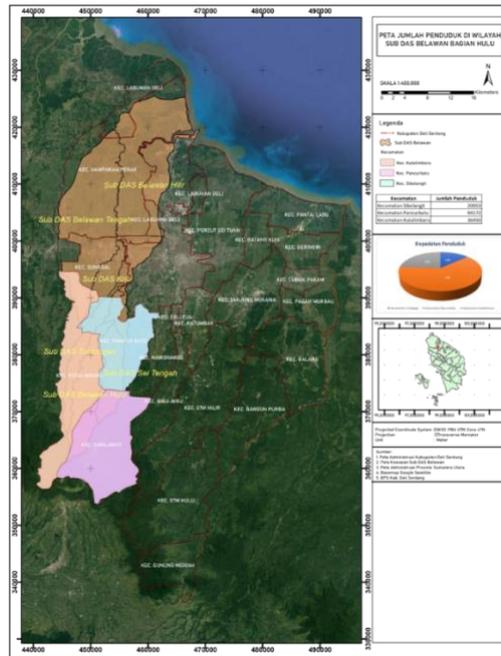


Figure 4.2 Map of population of the Upper Belawan Sub-Das area

**Table 4.2 Population of Medan City (Belawan Watershed)**

No.	Subdistrict	Population Number (KK)
1	Sibolangit	20053
2	The Stone of the Rock	94172
3	New Kutalim	36450

Source: BPS Deli Serdang, 2022.

According to the Deli Serdang Central Statistics Agency in 2022, the largest number of residents (KK) is in Pancurbatu sub-district, which is 94,172 people. While the smallest number of residents (KK) is in Sibolangit sub-district with a total of 20,053 people.

### C. Land Cover Condition of Belawan Hulu Watershed

**Table 4.3 Area of Land Use in the Upper Belawan Watershed**

Land Use	area (ha)	%
pond	12.51	0.06
Building/Construction	3.41	0.02
Jungle	6277.50	31.63
Plantation/Gardening	11665.41	58.78
Settlements and Places of Activity	550.28	2.77
Swamp	2.83	0.01
Ricefield	979.79	4.94
Shrubs	217.16	1.09
River	38.39	0.19
Fields/Fields	98.13	0.49
<b>Grand Total</b>	<b>19845.40</b>	<b>100</b>

Other types of land use have a much smaller proportion, such as rice fields (4.94%), settlements and activity areas (2.77%), and bushes, dry fields/fields, ponds, and swamps, each of which is below 1%. The presence of small settlements indicates that settlement and industrial activities have not developed widely in this area, making the Sub-DAS still classified as predominantly natural and agrarian. However, this condition also indicates

the potential for pressure on forest and agricultural areas if regional development plans are not directed by the principles of conservation and sustainable spatial planning, especially in maintaining the balance between the ecosystem and the socio-economic needs of the surrounding community.

**D. Land Availability**

Human needs always increase along with the development of a region. Almost every Zone in the upstream Belawan Sub-River Basin (DAS) is not appropriate in its land use, resulting in the Sub-DAS ecosystem being threatened with extinction due to human life needs. Space utilization patterns need to be regulated by government agencies to maintain the sustainability of the upstream Belawan Sub-River Basin (DAS) ecosystem.

**Table 4.9 Utilization of the upstream Belawan River Area (DAS) for residential purposes**

No.	Utilization of Space	Information	Area (±Ha)	(%)
1	Residence	Settlement	4243.76	1.4
2	Place of Business	Mixed gardens, fields/dry fields, rice fields, plantations.	298349.56	98
2	Non Identification	Open land, green open space, bushes, rivers	1975.34	0.6

The upstream Belawan watershed is used by the community for 302,584.32 Ha (99.40%) for housing and business, overall the upstream Belawan Sub-watershed is used for human activities. Only 1,975.34 Ha or 0.60% remains as a hope for balancing the ecosystem of the upstream Belawan Sub-watershed which is open land, green open space, and unused bushes.

Table 4.9 shows that this area is very much dominated by the use of space for land-based business activities, such as plantations, mixed gardens, fields/dry fields, and rice fields, which cover around 298,349.56 hectares or 98% of the total area. This shows that the upstream Belawan Sub-DAS plays an important role as an agrarian production area, especially for large-scale agricultural and plantation commodities. With the dominance of space use for this sector, the issues of land productivity, soil conservation, and sustainability of farming businesses become very crucial in the management of this area.

**E. Spatial Planning of the Upper Belawan River Basin Sub-Area (DAS) Current Condition**

The plantation area is the largest area, which is 11,999.12 Ha (52.1%). Meanwhile, the area around the lake/reservoir is the area with the smallest area, which is 4.88 Ha (0.0%). With the analysis of the Belawan River Basin Area, it is known the number of residents, types of jobs, area of settlements, area of business land, protected area which is the ecosystem utilization area of the upstream Belawan Sub River Basin Area (DAS). With this data, we can find out the future spatial plan for the sake of ecosystem sustainability and land availability to meet human needs.

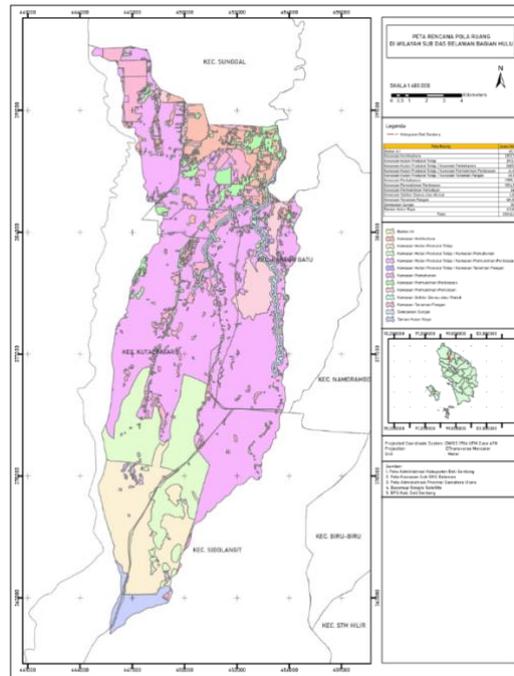


Figure 4.1 Utilization of Sub-DAS Space in the Upstream Belawan River (DAS)  
**Table 4. 10 Table of Spatial Patterns of the Upper Belawan Sub-DAS Region**

No.	Spatial Pattern of the Upper Belawan Sub-DAS Region	Area (Ha)	Percentage (%)
1	Horticultural Area	1252.76	5.4
2	Permanent Production Forest Area	2512.11	10.9
3	Permanent Production Forest Area/Plantation Area	2685.09	11.7
4	Permanent Production Forest Area/Rural Settlement Area	41.44	0.2
5	Permanent Production Forest Area/Food Crop Area	30.99	0.1
6	Plantation Area	11999.12	52.1
7	Rural Residential Area	1054.96	4.6
8	Urban Residential Area	869.00	3.8
9	Area around the lake/reservoir	4.88	0.0
10	Food Crop Area	16161.58	7.0
11	Forest Park	413.88	1.8
12	River Boundary	506.00	2.2
13	Water Body	60.19	0.3
	Total	23042.81	100

Source: Calculation of Spatial analysis results using GIS Tools.

Table 4.10 on Spatial Pattern of Sub-DAS Belawan Hulu, there is a clear division regarding the designation and use of space in the area. Based on existing data, plantation areas dominate the area with an area of 11,999.12 hectares or 52.1%, which shows that this area is mostly used for plantation activities. This includes various types of plantations that can contribute greatly to the local economy, but also require careful management regarding environmental and social sustainability. In addition, the food crop area also covers 16,161.58 hectares or 7% of the total area, which shows the importance of the agricultural sector in meeting local food needs and possibly also for export activities. The permanent production forest area (2,512.11 hectares or 10.9%) and the permanent production forest/plantation area (2,685.09 hectares or 11.7%) show the importance of the forestry sector in nature conservation, although there is overlap with plantations. Areas such as rural and urban settlement areas, which cover 1,054.96 hectares (4.6%) and 869.00 hectares (3.8%) respectively, also show pressure on land

use for settlement development along with the growing population and economic activities in this area. The existence of a forest park area (1.8%) and river boundaries (2.2%) show that aspects of environmental conservation and ecosystem protection are also considered in the spatial planning of the upstream Belawan Sub-DAS area.

**F. Future Spatial Planning in Relation to Regional Planning for the Upper Belawan River Basin Sub-Area (DAS).**

Based on the image above, the spatial plan map of the Upper Belawan River Basin Area (DAS) and the suitability map of the use of the spatial pattern of the Upper Belawan River Basin Area (DAS) are Overlaid to obtain a solution to the problem of finding areas of land availability for human needs in the Upper Belawan River Basin Area (DAS). With the analysis of the Upper Belawan River Basin Area (DAS), information can be obtained in the form of population, spatial patterns, spatial suitability, land use and area of settlements from each sub-district included in the Upper Belawan River Basin Area (DAS), including Sibolangit District, Pancurbatu District, and Kutalimbaru District. With this data, we can find out the future spatial plan for the sake of ecosystem sustainability and land availability to meet human needs and its management in the Upper Belawan River Basin Area (DAS). By conducting a comprehensive analysis of the Upper Belawan River Basin Area (DAS), regional spatial planning can be directed to utilize the potential of the region sustainably, protect the environment, and improve the quality of life of the community in the area.

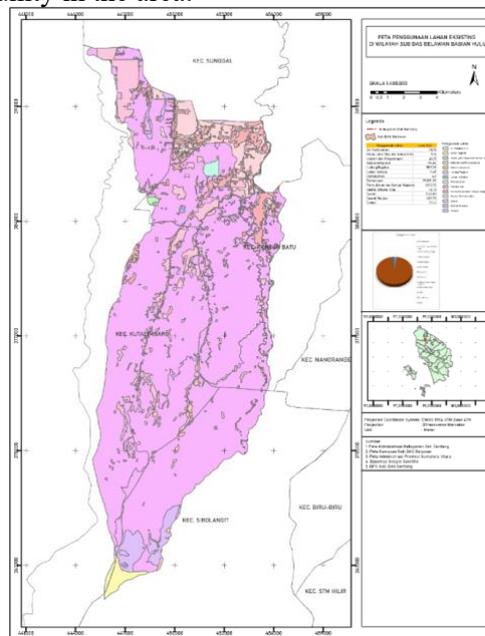


Figure 4.4 Existing Map of the Upper Belawan River Basin Sub-Area (DAS).

G. Change of Land Use

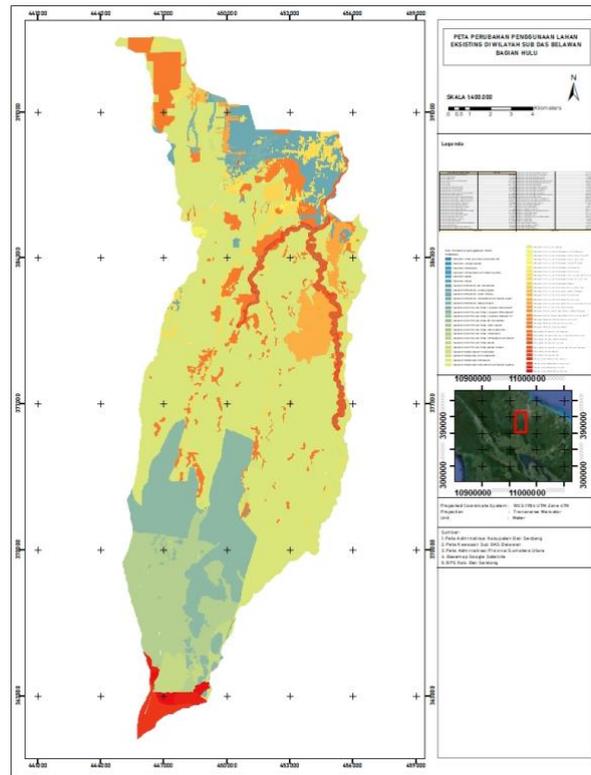


Figure 4.5 Land Use Change Map

Table 4.11 Land Use

Spatial Pattern Plan	Land Use (Existing)											
	Deepening Water	Fishery Cultivation	Mangrove Forest	Similar Forests	Industry and Warehousing	Road	Mixed garden	Fields/Fields	Open Land	Plantation	Settlements and Places of Activity	Total
Water Body	10.00	4.86	130.32	0.15	0.20	0.02	62.62	10.83	0.35	86.65	21.67	327.65
Secondary Dryland Forest	1.06	6.37	181.97	0.09	1.40	0.14	100.28	44.40	0.62	2593.32	54.74	2984.39
Secondary Mangrove Forest	0.99	2.65	1381.82	0.09	0.08		315.34	22.25	0.01	261.40	23.81	2008.45
Settlement	0.22	5.18	21.37	0.27	182.08	14.39	140.45	182.31	2.87	418.72	3885.61	4853.47
Plantation	3.43	4.69	227.64	34.12	18.87	9.21	3396.92	1039.53	5.88	19417.98	780.40	24938.69
Dry Land Farming	6.11	11.41	52.88	4.10	35.41	8.21	1399.19	1426.61	11.44	7447.39	2623.58	13026.33
Ricefield	7.48	8.61	193.43	2.61	8.96	0.34	954.62	271.80	13.59	787.09	357.65	2606.2
Pond	7.20	40.63	251.41		0.19		72.90	5.31	0.27	40.64	10.19	428.75

Source: Calculation of results using Pivot Table Ms. Excel

Table 4.12 Continued Land Use

Spatial Pattern Plan	Land Use (Existing)										Total Table 4.1	Total Overall
	Farm	Burial	Swamp	Green open space	Ricefield	Shrubs	River	Pond	Excavation Land	Total		
Water Body	0.18	1.26		1.40	67.52	5.32	422.63	129.00	0.67	627.98	327.65	955.63
Secondary Dryland Forest	0.86		0.23	1.63	170.27	216.13	5.69	2.81	1.32	398.93	2984.39	3383.32
Secondary Mangrove Forest	2.75			2.54	71.57	31.18	35.88	145.87		289.80	2008.45	2298.25
Settlement	32.01	0.43	0.64	14.53	384.12	25.94	5.83	22.54	38.51	524.56	4853.47	5378.03
Plantation	5.39	2.05	0.19	61.97	2481.14	448.65	82.59	146.82	10.21	3239.02	24938.69	28177.71
Dry Land Farming	5.95	2.08	0.30	137.96	2453.82	177.86	27.07	28.18	6.92	2840.14	13026.33	15866.47
Ricefield	1.22	0.11	0.21	5.56	2256.80	51.36	83.67	242.41	9.88	2651.22	2606.20	5257.42
Pond			0.63	0.80	60.46	17.94	102.60	469.57	2.10	654.11	428.75	1082.86

Source: Calculation of results using Pivot Table Ms. Exce

Based on Tables 4.11 and 4.12 on Land Use Changes, it can be seen that the allocation of space in the upstream Belawan Sub-DAS area has experienced significant division based on the spatial pattern plan. This table shows various types of land use which are divided into several categories, such as water bodies, secondary dryland forests, secondary mangrove forests, settlements, plantations, dryland agriculture, rice fields, and ponds.

Some of the most significant categories in land use change are plantations, which are recorded at around 28,177.79 hectares or around 45.2% of the total land use change, and dryland agriculture with an area of around 15,867.37 hectares. The agriculture and plantation sectors show that this region still relies on plantation and agricultural activities as the main sectors that dominate the region. In addition, land use for rice fields and ponds is also quite large, covering 5,257.42 hectares and 1,082.85 hectares respectively, indicating the importance of the agriculture and fisheries sectors in this region. In addition to these sectors, land use is also distributed for water bodies, settlements, industry, and green open spaces, reflecting the development of infrastructure and the need for open spaces in this region. Overall, these land use changes reflect a dynamic of spatial utilization that prioritizes the plantation and agricultural sectors, while also paying attention to conservation aspects through land use for mangrove forests, green open spaces, and water bodies. These changes are important to ensure the continuity of land management and regional planning that balances the economy and environmental sustainability.

## CONCLUSION

- The Upstream section shows that of the total area of the Belawan Sub-DAS upstream, 302,584.32 Ha (99.40%) is used by the community for housing and business, overall the land use of the Belawan Sub-DAS upstream is used for human activities. Only 1975.34 Ha or 0.60% remains as a hope for balancing the ecosystem of the Belawan Sub-DAS upstream which is open land, green open space, and unused bushes.
- Spatial Planning of the Upper Belawan Sub-River Basin Area (DAS) Current conditions show that the plantation area is the largest area, which is 11,999.12 Ha (52.1%). Meanwhile, the area around the lake/reservoir is the area with the smallest area, which is 4.88 Ha (0.0%). With the analysis of the Belawan River Basin Area, it is known the number of residents, types of jobs, area of settlements, area of business land, protected area which is the ecosystem utilization area of the Upper Belawan Sub-River Basin Area (DAS). With this data, we can find out the future spatial plan for the sake of ecosystem sustainability and land availability to meet human needs.

## Suggestion

Plantation development in upstream areas must be carried out sustainably and responsibly, taking into account its impacts on the environment, society, and economy. Conservation, reforestation, and wise management efforts must be carried out to maintain the balance of the ecosystem and support the sustainability of the area.

**REFERENCES**

- Andes D, Satria PU and Rohidin M. 2019. Community-Based Natural Resource Management in Conservation Efforts in the Lubuk Langkap River Basin Area, Suka Maju Village, Air Nipis District, South Bengkulu Regency. *Journal of Natural Resource and Environmental Management Research*. 2, (6): 35-48.
- Ariyani, Ariyanti, Ramadhan. 2020. Ideal Regulation on River Basin Management in Indonesia (Study on Serang River, Kulon Progo Regency). *IUS QUIA IUSTUM Law Journal* 27 (3): 5-15.
- Asdak, Chay. 2012. *Study Environment Life Strategic, The Road Towards. Sustainable Development*. Yogyakarta: Gadjah Mada University Press.
- Baharinawati W. Hastanti. 2017. Environmental Conditions and Socio-Cultural Characteristics for River Basin Management (Case Study on the Dani Tribe in Jayawijaya Papua). *Journal of Research and Development of River Basin Management Technology*. 7 (3): 10-17.
- But, Shabbir, et al. 2015. Land use change mapping and analysis using Remote Sensing and GIS: A case study of Simly watershed, Islamabad, Pakistan. *Journal of Remote Sensing and Space Sciences*. 5(2): 18-30.
- Danial, Muhammad, Arsyad, Eymal. 2020. Upstream Management Strategy of the Jeneberang River Basin, South Sulawesi Province. *Ecosolum Journal* 9 (2): 12-22.
- Gunawan T. 2012. Review of Guidelines for the Preparation of Watershed Characteristics. Paper on the Socialization of PP. 73. Concerning Watershed Management. Manado 7 – 9 March 2012.
- Harahap, Anggi, Rauf, Mulya. 2021. Condition and Management of the Upper Belawan Watershed Area in Relation to the Level of Erosion Danger on Cultivated Land in Deli Serdang Regency. *Serambi Engineering* 6 (3): 15-22.
- Irawan E, 2018., Dynamics of Consensus Achievement in the Watershed Management Coordination Forum: Agent-Based Modeling. *Journal of the Research and Development Center for Watershed Management Technology*. Surakarta.
- Ministry of Forestry of the Republic of Indonesia. 2013. *Technical Plan for Forest and Watershed Land Rehabilitation (DAS) – RTKRHL-DAS*.
- Ningkeula, Edy Said. 2016. Analysis of Morphometric and Hydrological Characteristics as Biogeophysical Characteristics of the Wai Samal Watershed, North East Seram Kobi District, Central Maluku Regency. *Scientific Journal of Agribusiness and Fisheries (Agrikan UMMU-Ternate)*. 9 (2): 20-35.
- Notohadiprawiro. 2014. *Soil Fertility Management and Increasing Fertilization Efficiency*. Yogyakarta: Gadjah Mada University Press.
- Prahasta, Eddy. *Geographic Information System. Informatics*. Bandung.
- Sudaryono. 2012. Integrated River Basin Management, Sustainable Development Concept. *Journal of Environmental Technology*. 3 (2): 28-38.
- Upadani, IGAW 2017. Social Capital Utilization Model in Empowering Rural Communities to Manage River Basins (DAS) in Bali. *Wicaksana, Journal of Environment & Development* 1 (1): 11–22.
- Wicaksana, Usman A., Budirman B., And M. Irfan. 2017. Identification of Water Absorption Areas in the Upper Malino River Basin Sub-Area, Jeneberang River Basin Area, Gowa Regency. *Journal of Forestry and Society* 9 (2): 93–104.
- Saifuddin, Imam. 2017. *Study of Land Use Change Response to Hydrological Characteristics of Garang Watershed*. Thesis. Diponegoro University: Semarang
- English: 2013.
- Government Regulation No. 37 of 2012 concerning River Basin Management
- Sumarniasih, Sri Made. 2015. *Land Use Planning in the Ayung River Basin, Bali Province*. Dissertation: Udayana University, Bali.