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Land Change Patterns for Predicting Sustainable Agriculture Development

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Abstract. Land use must be planned and adjusted to the capabilities of the land itself. This study aims to analyze the pattern of land change over a period of 20 years in the Cimanuk Hulu watershed. The method employed is the confrontation between land-use patterns in 2000 and 2020. Landsat imagery through ERDAS Imagine 8.5 Software is used to analyze the classification of land use patterns from 2000 to 2020. Based on the analysis results, there has been an increase in land for settlements by 6.28 percent and water bodies by 2.35 percent. This is due to the construction of the Jatigede reservoir, while the allocation of rice fields decreased by 3.71 percent. For 20 years, there has been a change in land-use patterns by land conversion. This presents a challenge for the development in the Upper Cimanuk watershed area. Policymakers have a role in planning, developing, evaluating, and determining appropriate strategies in the process of sustainable agricultural development.

Keywords: land-use change, landsat imagery, upstream cimanuk.

Introduction

Regional development or natural resource management is related to land-use change as a phenomenon that must be considered, especially in developing countries. Irregular land-use changes will reduce the function of biological and ecosystem productivity on the land. Land degradation due to inappropriate agricultural activities will have an environmental and social impact. This should become a concern in policymaking concerning land use and agriculture (Rasul & Golam, 2009). This land-use change is an important phenomenon for every planner and regional policy maker (N Wijaya, 2015). Population growth affects changes in land use so that land-use planning must be done correctly (Widiatmaka, et al, 2015), Tejaningrum, et al, 2017.

In the United States, there are case studies that allow researchers and policymakers to focus on the relationship between agricultural land use, population change, agricultural sustainability, and the environment and society. This is because there has been a 35 percent decline in agricultural land since 1990 (Parton, 2003). Under these conditions, there is a need for an integrated assessment procedure to evaluate agricultural environmental policy strategies for sustainable agricultural development (Nijkamp, 2003). By looking at the decreasing agricultural diversity and threatening the sustainability of agriculture, it is necessary to have the concept of ecological, social, and economic dimensions (Tisdell, et al, 2019). The idea of sustainable land use continues to develop with the establishment of conditions for land-friendly

and efficient land management (Moteva, et al, 2020).

Sustainable land use is a form of land management that maintains the natural fertility of the soil or it can be said that sustainable land use is more comprehensive than an unsustainable land use. Sustainable land use includes not only the use of land for agricultural and forestry purposes, but also for settlements, industrial sites, roads, and other human activities. Rational land use planning is essential for this process (Wrachien, 2021). The world population is projected to reach around 10.9 billion in 2021. A population that continues to increase will also sustainably increase food production. However, there has been a significant decline in land and land degradation which become a challenge to redesign agricultural landscapes so that land use can be in accordance with the appropriate designation and be sustainable (Vimbayi, et al, 2021), (James, 2019). Food production in Indonesia depends on the island of Java which has the most fertile soil but is limited in a number of areas so that it is necessary to evaluate and analyze land availability. The analysis includes land evaluation with the integration of land structure, land capability, elevation, and land use/cover. Land availability needs to be analyzed by integrating the determination of forest area status and regional spatial planning patterns (Widiatmaka, et al, 2016).

Biodiversity conservation, protected area management, and sustainable development through strategies that take into account rural populations are current challenges in developing countries including Africa (Mucova et al, 2018). Sustainable agricultural land management can increase food production without destroying soil and water resources; it needs to be considered in developing countries because agricultural production is the fulfillment of food demand (Branca G, et al, 2013). Knowing that changes in land use are important for sustainable agriculture, then this study aims to analyze land changes over 20 years (2000 to 2020) and identify the main changes so that they are intended to predict and develop appropriate strategies for sustainable agriculture. This research was conducted in the area of the Upper Cimanuk River Basin (Garut Region, Sumedang).

Evaluation of existing land use and change is useful for the urban planner and natural resource management policymakers (Tahir, et al, 2013). Evaluation methods need to disclose sustainable land use and efficient land use as is the case in China (He Chenchun, et al, 2017). Non-degraded lands resources must be analyzed following land use capabilities and maintaining high land productivity (Widiatmaka, 2012). Such analysis is developed in this study (Bahagia, 2020).

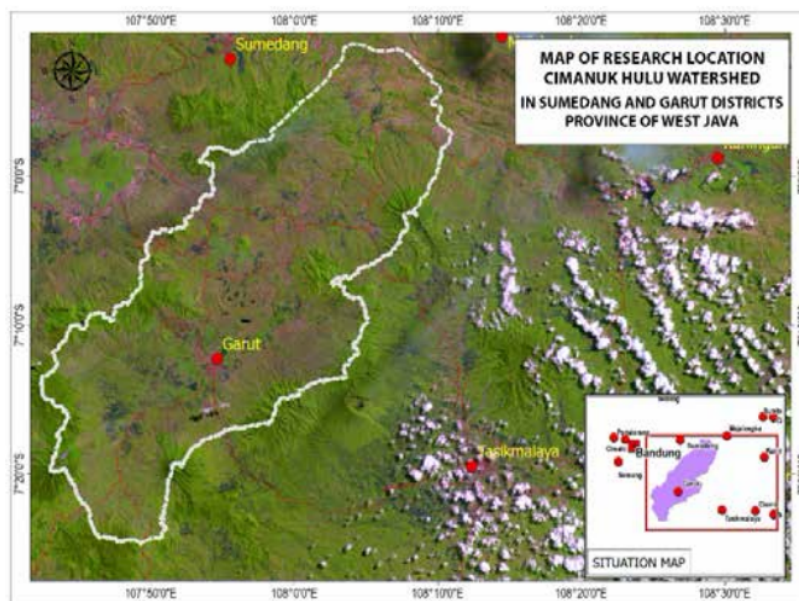


Figure 1. Location of Research

Research Methodology

The location of the research was in the upstream Cimanuk river flow that includes two districts, namely Garut Regency and Sumedang Regency as the area of the study object. The data used are primary data and secondary data from different time periods, namely secondary data in 2000 and 2020, with the supporting tools and materials used of Arcview software and ArcGIS version 10.3 for spatial analysis. The research location is depicted in Figure 1.

The method used is satellite image interpretation, namely the activity of analyzing images from remote sensing technology to identify objects on the earth's surface by grouping these objects based on their appearance characteristics on satellite images.

The interpretation of satellite imagery produces a Land Cover Map (PL Map), which is a description of the appearance of the earth's surface that has been grouped into certain land cover classes according to the land cover classification structure.

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Landsat 7 Enhanced Imagery Thematic Mapper Plus (ETM+) in 2000 and 2020. The tool used is a computer with the analysis program ArcGIS 10.3 software, Microsoft Word, and Excel 2000. Landsat7 ETM+ image data is processed using arcGIS software version 10.3 with the stages of interpreting Landsat imagery as follows: (1) Provision of Landsat 7ETM image data in 2000 and

2020; (2) Raster Processing by performing Composite Band using 3 original channels, namely bands 5, 4 and 3. This method is to identify rocks and landforms using relief approaches, flow patterns, and vegetation; (3) Radiometric and geometric corrections using the georeferencing tool in ArcGIS 10.3 software by applying the image to image method which corrects an image with other images that have been corrected by comparing the appearance of the image to be corrected against the reference image; (4) identification of research area boundaries; (5) Landsat Image interpretation by using the on-screen digitization method carried out directly on the computer screen after the image as the data source has been processed to provide an optimal visual appearance that shows the differences between objects. Furthermore, Landsat image interpretation is carried out, namely, the process of identifying certain objects or features based on elements of interpretation, referring to the key to Land Cover Classification SNI 7645:2010; (6) Land Use Patterns in 2000 and 2020 by grouping into 11 land cover classes; (7) Identification of Changes, which can be seen in Figure 2.

Results and Discussion

Land Use in 2000 and 2020 in the upstream Cimanuk Area

Based on the results of the Landsat TM 2000 and 2020 image classification process, the spatial configuration and classification of land use patterns in the upstream Cimanuk river basin includes two districts: Garut and Sumedang. Both districts are grouped into 11 patterns of land change, namely primary dryland agricultural areas, second dry land, plantation forests, settlements, dryland agriculture, dry land mixed with shrubs, rice fields, shrubs, open land, and bodies of water.

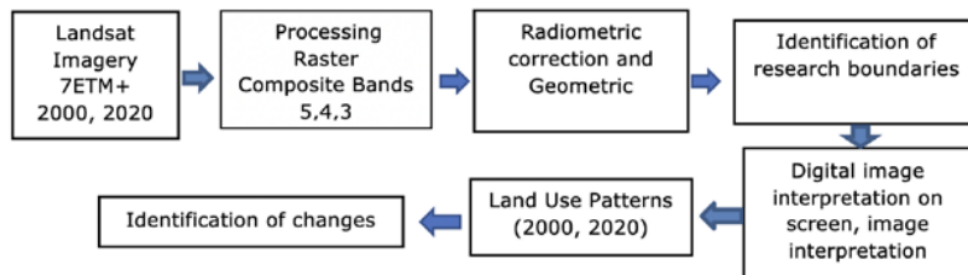


Figure 2. Research Line of Thought

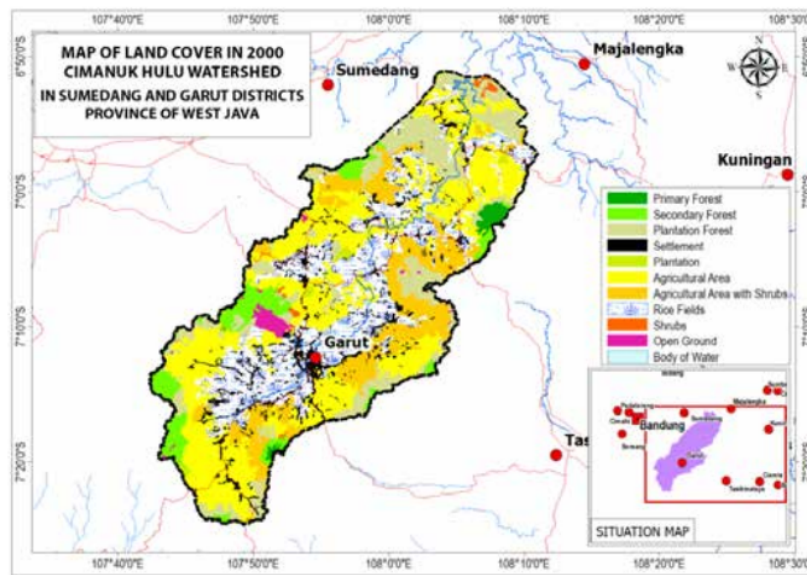


Figure 3. The Results of 2000 Landsat Imagery Calculations

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Patterns of Land Use and Changes in the upstream Cimanuk River

Pattern of land change in in 2000 and 2020 underwent ver¹⁶ significant changes, especially changes based on the interpretation of Landsat imagery on the basis of ¹⁸termining the use of color channels (Band). It can be seen that in 2000, the land use in Cimanuk was still dominated by dry agriculture (32.93%), followed by rice fields (22.72%), plantation forests (15.43%), and agriculture on dry land mixed with shrubs (13.25%) percent. A description of land use in 2000 can be seen in Figure 3.

The figure 3 explains that the land use for dry land and rice field agriculture in 2000 was very dominant, while the land use pattern in 2020 was still dominated by dry land and rice fields in upstream Cimanuk. However, based on image interpretation in 2020, there was a significant decline in land use, especially in the percentage of land use from 2000 to 2020, where plantations decreased by 1.09 percent, dry agriculture by 2.91 percent, even rice fields experienced a bigger decline of 3.71 percent. The picture of changes in land use in 2000 can be seen in Figure 4 and Table 1.

Judging from the pattern of land changes in each type of use in the area around Cimanuk River Basin, it is predicted that it will experience a continuous decline for plantation forest areas, mixed vegetation,

agriculture, and rice fields as shown in Table 1, which is due to the greater human need for land. Changes in land-use patterns can also result in various disasters in the upstream and downstream areas of Cimanuk River, such as floods, drought, and even erosion. From the results of field observations in the area around Cimanuk upstream, several factors led to a pattern of land change including (1) population growth which continued to increase that had an impact on the increased demand for residential land, (2) the biophysical conditions of the upstream Cimanuk River Watershed were converted to agricultural land and cultivation such as for horticulture in the Mount Cikurai area, Papandayan, (3) community farming patterns that continue to utilize Watershed conserva²⁸n areas without applying the principle of soil and water conservation, and (4) the community continues to do a lot of horticultural activities in the watershed area of Garut Regency. There is also a relationship between climatic conditions and land-use change in Jakarta, Indonesia (Tursilowati, et al, 2012), land-use change and temperature change (Hidayati, et al, 2014), and land suitability in determining conservation areas (Wijaya, 2004).

The calculation results of Landsat imagery showed that during a period of 20 years there was a change in land use from the undeveloped land to build up the land. These changes and improvements need to be

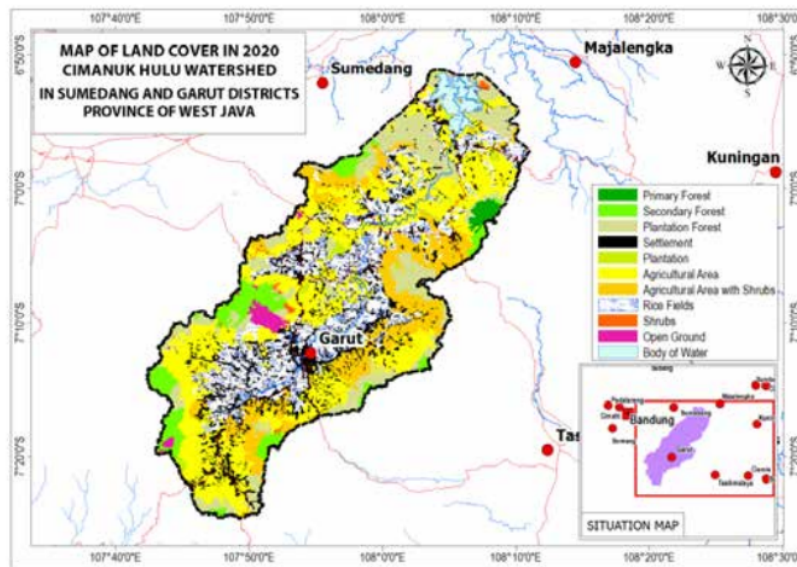


Figure 4. The Results of 2020 Landsat Imagery Calculations

evaluated for future agricultural development so that people do not lose their livelihoods as farmers due to changes in land-use patterns in the upstream Cimanuk area. Clearing new land for sustainable agriculture and rice fields as perennial land or land reform can be used as an alternative to sustainable agricultural development.

Conclusion

The results of the study based on the analysis of patterns of land-use change over a period of 20 years from 2000 to 2020 showed there were changes. There has been an increase in land for settlement by 6.28 percent and water bodies by 2.35 percent due to the construction of the Jatigede

Table 1
Classification of Land Use in the Upstream Cimanuk River Flow Area

Number	Land Closure	Year 2000 (Hectare)	%	Year 2020 (Hectare)	%	Changes
1	Secondary Dry land Agriculture	1,455.32	0.99	1,177.11	0.80	(278.21)
2	Primary Dry land Agriculture	8,923.86	6.07	9,037.61	6.15	113.74
3	Forest Plantation	22,680.35	15.43	21,077.59	14.34	(1,602.76)
4	Settlements	9,434.93	6.42	18,672.88	12.70	9,237.95
5	Plantation	862.30	0.59	950.00	0.65	87.70
6	Dry Agriculture	48,407.62	32.93	44,133.23	30.02	(4,274.39)
7	Dry land Agriculture mixed with shrub	19,479.83	13.25	18,290.16	12.44	(1,189.67)
8	fields	33,398.89	22.72	27,953.01	19.01	(5,445.88)
9	Open land	671.98	0.46	463.07	0.32	(208.91)
10	Water body	1,530.90	1.04	1,639.28	1.12	108.38
11	amount	160.74	0.11	3,612.79	2.46	3,452.05

Source :

reservoir, while the allocation of rice fields decreased by 3.71 percent as well as a decrease in agricultural land and forests. The change in land use presents a challenge for the development in the Upper Cimanuk watershed area. Things that need to be considered in this condition are an evaluation of the concept of sustainable agricultural development as well as a balance between ecology and economy towards land cover classification as the basis for the pattern of land-use change.

Acknowledgments

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References

- Bahagia, Rimun Wibowo, Fachruddin, Majeri Mangunjaya, Oking Setia Priatna (2020). Traditional Knowledge of Urug Community for Climate, Conservation, and Agriculture. *MIMBAR Jurnal Sosial dan Pembangunan* Vol 36, No 1 (2020).
- Berberoglu, S & Akin, A (2009). "Assessing Different Remote Sensing Techniques to Detect Land Use/Cover Changes in The Eastern Mediterranean. *International Journal of Applied Earth Observation and Geoinformation*, 11. 46-53
- Branca Giacomo, Leslie Lipper, Nancy McCarthy, Maria Christina Jolejole (2013). "Food Security, Climate Change and Sustainable Land Management A Review." *Agronomy For Sustainable Development* 33, 635-650. <https://doi.org/10.1007/s13593-013-01331>
- Evrendilek F & Doygun H, (2000). "Assessing Major Ecosystem Types and The Challenge of Sustainability in Turkey." *Environmental Management*, 26 (5), 479-489
- He Chenchen, Qi Han, Bauke De Vries, Xiaoming Wang, Zhao Guochao (2017). "Evaluation of Sustainable Land Management in Urban Area: A Case Study Of Shanghai China." *Science Direct Journal Ecological Indicators* Volume 80, September 2017, Pages 106-113. Elsevier. <https://doi.org/10.1016/j.ecolind.2017.05.008>
- Hidayati, I, (2014). "Analysis of Image Transformation and Land Use/Land Cover for Temperature Trends on Landsat Imagery." *Thematic Cartography For The Society*, 275-291
- James, H. Population, Development, and The Environment; Challenges to Achieving The Sustainable Development Goals in The Asia Pacific, Palgrave Macmillan; London UK, 2019.
- Moteva, Milena, Mondeshka, Margarita, Kostadinov, Georgi. 2020. Planning Options For Sustainable Land Use in Accordance With Modern Agricultural Technology. *International Multidisciplinary Scientific GeoConference, SGEM Sofia Vol 20 Iss 3.1 2020*. DOI:10.5593/sgem.2020/3T/s13.066
- Mucova Serafino Afonso Rui, Walter Leal Filho, Ulisses Miranda Azeiteiro, Mario Jorge Pereira (2018). "Assessment of Land Use and Land Cover Changes From 1979 to 2017 and Biodiversity Land Management Approach in Quirimbas National Park, Northern Mozambique Africa." *Global Ecology and Conservation* 16e00447. Doi:10.1016/j.gecco.2018.e00447
- N Wijaya (2015). "Detection of Land Use Change with Landsat Imagery and Geographic Information Systems: Case Studies in Bandung Metropolitan Area, Indonesia." *Geoplanning Journal of Geomatics and Planning* Vol 2 No 2, 2015.82-92. E ISSN 2355-6544. <http://ejournal.undip.ac.id/index.php/geoplanning>. doi.10.14710.geoplanning.2.2.82-92
- Nijkamp, Peter, Vindigni, Gabriella. 2003. Impact Assessment of Qualitative Policy Scenarios: A Comparative case study on Land Use in Sicily. *Management of Environmental Quality Bradford* Vol 14 Iss 1 108-133. DOI:10.1108/14777830310460423
- Parton, William, J, Gutmann, Myron P, Travis, William R. 2003. Sustainability and Historical Land-Use Change in The Great Plains; The Case of Eastern Colorado. *Great Plains Research Lincoln* Vol 13 Iss 1;97-125
- Purnomo Eko Priyo, Etika Khairina, Mochammad Iqbal Fadhlurrohman, Bhima Dya Andoko, Agus Priyanto. 2020. "Managing Biodiversity in Dealing with Sustainable Development Goals". *MIMBAR Jurnal Sosial dan Pembangunan*, Vol 36 No 2 (2020) ISSN 0215,8175 eISSN 2303.2499 PP 371-382. DOI://<https://doi.org/10.29313/mimbar.v3626029>
- Rasul, Golam. 2009. Ecosystem Services and Agriculture Land -Use Practice: A Case Study of The Chittagong Hill Tracts of Bangladesh. *Sustainability; Science*

- Practice & Policy; Philadelphia Vol 5, Is s. 2,). DOI:15487733.2009.11/10.1080 908032
- Tejaningrum Mira²¹ A, Muhammad Ardiansyah, Widiatmaka. 2017. Evaluation of Actual Landuse and Official Spatial Land Use Planning in Potianak Regency, West Java. Jurnal Ilmu Tanaman Lingkungan, 19 (1) April 2017. 1-5 ISSN 1410-7333, e-ISSN 2549-2853
- Tisc³¹l, Clement, Alauddin, Mohammad Md Abdur Rashid Sarker, Md Anwar Kabir.2019. Agriculture Diversity and Sustainability; General Features and Bangladesh Illustrations. Sustainability Based Vol 11 Iss 21 (2019): 6004. DOI:10.3390/su11216004
- ¹ Tursilowati L, Sumantyo, J T,S, Kuze, H & Adiningsih, E.S (2012). "Relationship Between Urban Heat Island Phenomenon and Land Use/Land Cover Changes in Jakarta-Indonesia." Journal of Emerging Trends in Engineering and Applied Sciences, 3(4):645-653 April 2017. 1-5 ISSN 1410-7333, e-ISSN 2549-2853
- ³ Vimbayi G.P, Chimonyo, Mbulisi Sibanda, Richard Kunz, Cecilia R Masemola, Albert T Modi,Tafadzwanashe M.2021. Evaluation of Land Suitability Methods With reference to Neglected and Underutilised Crop Species; A Scoping Review. Land-Based Vol 10 Iss 2; 125. DOI:10.3390/land10020125
- ¹⁰ Widiatmaka, Wiwin Ambarwulan, Yudi Setiawan, Christian Walter.2016. Assessing The Suitability and Availability of Land for Agriculture in Tuban Regency, East Jawa, Indonesia. Applied and Environmental Soil Science. Vol 2016. <https://doi.org/10.1155/2016/7302148>
- Widiatmaka, W, Ambarwulan, M.Y.J Purwanto, Y Setiawan, H Effendi. 2015. Land-based Environment Carrying Capacity in Tuban East Java. Jurnal Manusia dan Lingkungan, 22 (2); 247-259
- ⁴ Widiatmaka, W, Ambarwulan, M.Y.J Purwanto, Y Setiawan, H Effendi. 2015. Land-based Environment Carrying Capacity in Tuban East Java. Jurnal Manusia dan Lingkungan, 22 (2); 247-259
- Widiatmaka, S.P, Mulya, M Hendrisman, 2012. Settlement Unit Level Land Conformity Analysis with Automated Land Evaluaation System (ALES). Jurnal Pengelolaan Sumberdaya Alam dan Lingkungan 1 (2);46-55
- Wijaya, N (2004). "Use of GIS in Determining Conservation Areas, Case Study: North Bandung Area." Prosiding pada Seminar Nasional "Perencanaan Wilayah dan Kota Dalam Perubahan Multidimensi" Planologi ITB, Bandung.
- ¹⁹ Wrachien Daniele De.2021. Land Use Planning: A Key To Sustainable Agriculture. Conference; I World Congress on Conservation Agriculture Vol 1 At Madrid Spain. DOI:10.1007/978-94-017-1143-2_57

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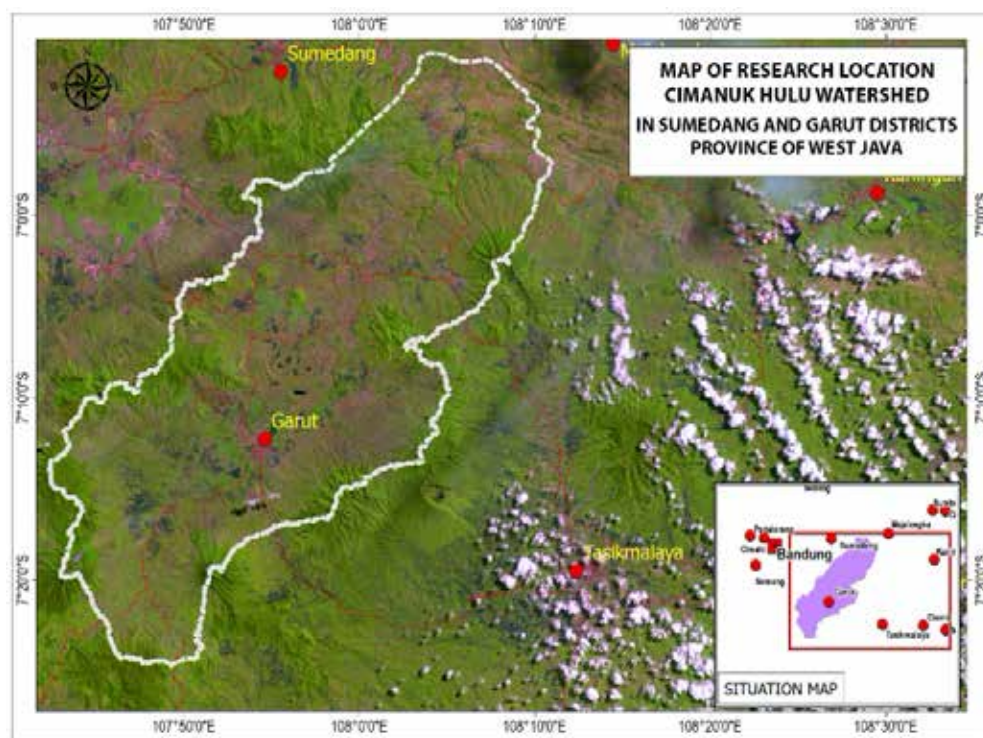


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Data Source:

Landsat 7 Enhanced Imagery Thematic Mapper Plus (ETM+) in 2000 and 2020. The tool used is a computer with the analysis program ArcGIS 10.3 software, Microsoft Word, and Exel 2000. Landsat7 ETM+ image data is processed using arcGIS software version 10.3 with the stages of interpreting Landsat imagery as follows: (1) Provision of Landsat 7ETM image data in 2000 and

2020; (2) Raster Processing by performing Composite Band using 3 original channels, namely bands 5, 4 and 3. This method is to identify rocks and landforms using relief approaches, flow patterns, and vegetation; (3) Radiometric and geometric corrections using the georeferencing tool in ArcGis 10.3 software by applying the image to image method which corrects an image with other images that have been corrected by comparing the appearance of the image to be corrected against the reference image; (4) identification of research area boundaries; (5) Landsat Image interpretation by using the on-screen digitization method carried out directly on the computer screen after the image as the data source has been processed to provide an optimal visual appearance that shows the differences between objects. Furthermore, Landsat image interpretation is carried out, namely, the process of identifying certain objects or features based on elements of interpretation, referring to the key to Land Cover Classification SNI 7645:2010; (6) Land Use Patterns in 2000 and 2020 by grouping into 11 land cover classes; (7) Identification of Changes, which can be seen in Figure 2.

Results and Discussion

Land Use in 2000 and 2020 in the upstream Cimanuk Area

Based on the results of the Landsat TM 2000 and 2020 image classification process, the spatial configuration and classification of land use patterns in the upstream Cimanuk river basin includes two districts: Garut and Sumedang. Both districts are grouped into 11 patterns of land change, namely primary dryland agricultural areas, secondary dry land, plantation forests, settlements, dryland agriculture, dry land mixed with shrubs, rice fields, shrubs, open land, and bodies of water.

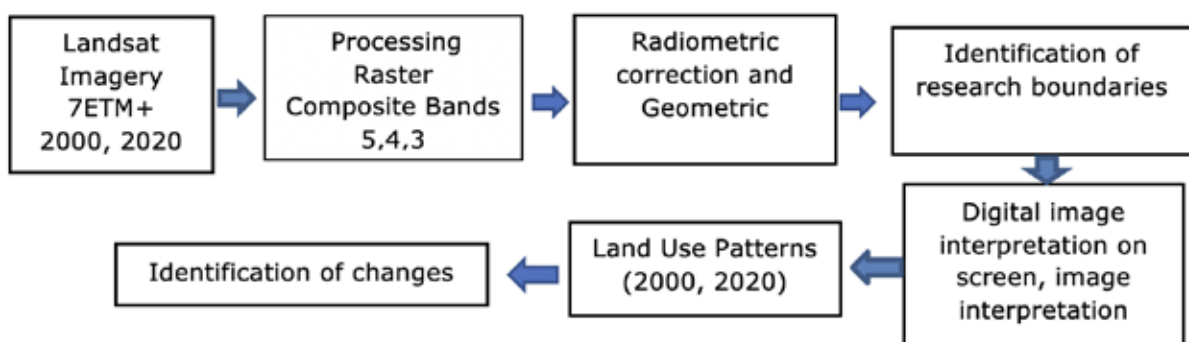


Figure 2. Research Line of Thought

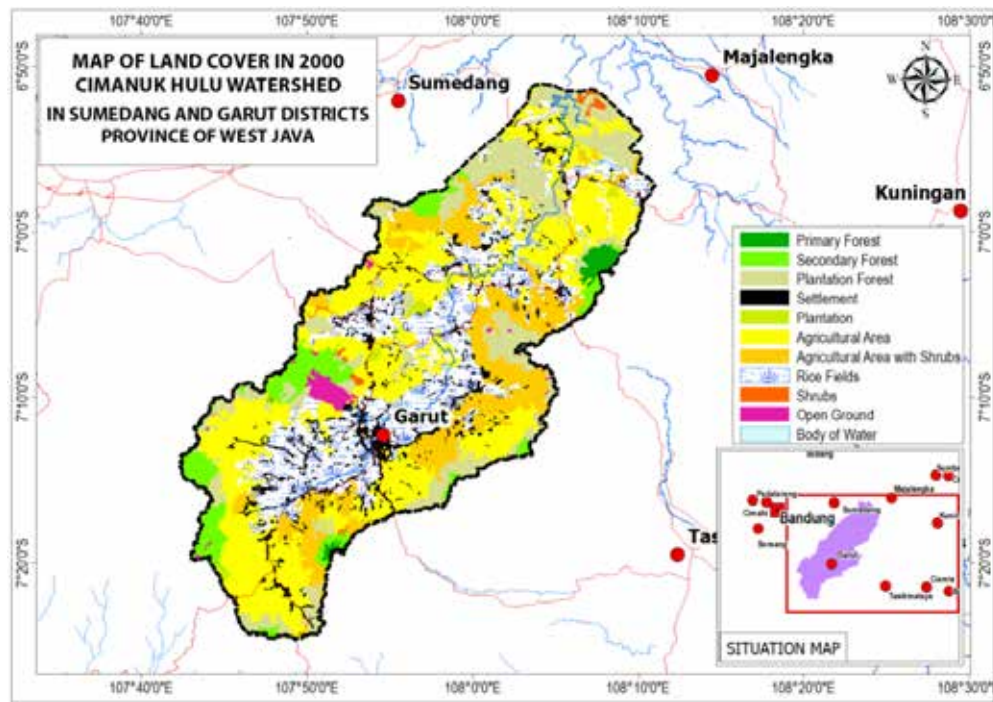


Figure 3. The Results of 2000 Landsat Imagery Calculations

Patterns of Land Use and Changes in the upstream Cimanuk River

Pattern of land change in in 2000 and 2020 underwent very significant changes, especially changes based on the interpretation of Landsat imagery on the basis of determining the use of color channels (Band). It can be seen that in 2000, the land use in Cimanuk was still dominated by dry agriculture (32.93%), followed by rice fields (22.72%), plantation forests (15.43%), and agriculture on dry land mixed with shrubs (13.25%) percent. A description of land use in 2000 can be seen in Figure 3.

The figure 3 explains that the land use for dry land and rice field agriculture in 2000 was very dominant, while the land use pattern in 2020 was still dominated by dry land and rice fields in upstream Cimanuk. However, based on image interpretation in 2020, there was a significant decline in land use, especially in the percentage of land use from 2000 to 2020, where plantations decreased by 1.09 percent, dry agriculture by 2.91 percent, even rice fields experienced a bigger decline of 3.71 percent. The picture of changes in land use in 2000 can be seen in Figure 4 and Table 1.

Judging from the pattern of land changes in each type of use in the area around Cimanuk River Basin, it is predicted that it will experience a continuous decline for plantation forest areas, mixed vegetation,

agriculture, and rice fields as shown in Table 1, which is due to the greater human need for land. Changes in land-use patterns can also result in various disasters in the upstream and downstream areas of Cimanuk River, such as floods, drought, and even erosion. From the results of field observations in the area around Cimanuk upstream, several factors led to a pattern of land change including (1) population growth which continued to increase that had an impact on the increased demand for residential land, (2) the biophysical conditions of the upstream Cimanuk River Watershed were converted to agricultural land and cultivation such as for horticulture in the Mount Cikurai area, Papandayan, (3) community farming patterns that continue to utilize Watershed conservation areas without applying the principle of soil and water conservation, and (4) the community continues to do a lot of horticultural activities in the watershed area of Garut Regency. There is also a relationship between climatic conditions and land-use change in Jakarta, Indonesia (Tursilowati, et al, 2012), land-use change and temperature change (Hidayati, et al, 2014), and land suitability in determining conservation areas (Wijaya, 2004).

The calculation results of Landsat imagery showed that during a period of 20 years there was a change in land use from the undeveloped land to build up the land. These changes and improvements need to be

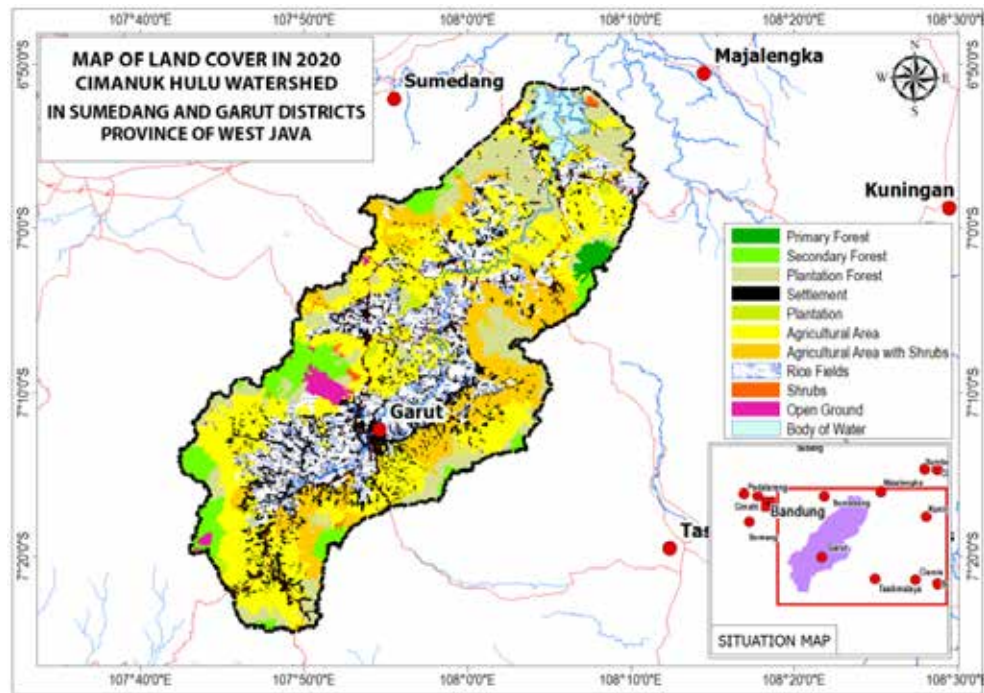


Figure 4. The Results of 2020 Landsat Imagery Calculations

evaluated for future agricultural development so that people do not lose their livelihoods as farmers due to changes in land-use patterns in the upstream Cimanuk area. Clearing new land for sustainable agriculture and rice fields as perennial land or land reform can be used as an alternative to sustainable agricultural development.

Conclusion

The results of the study based on the analysis of patterns of land-use change over a period of 20 years from 2000 to 2020 showed there were changes. There has been an increase in land for settlement by 6.28 percent and water bodies by 2.35 percent due to the construction of the Jatigede

Table 1
Classification of Land Use in the Upstream Cimanuk River Flow Area

Number	Land Closure	Year 2000 (Hectare)	%	Year 2020 (Hectare)	%	Changes
1	Secondary Dry land Agriculture	1,455.32	0.99	1,177.11	0.80	(278.21)
2	Primary Dry land Agriculture	8,923.86	6.07	9,037.61	6.15	113.74
3	Forest Plantation	22,680.35	15.43	21,077.59	14.34	(1,602.76)
4	Settlements	9,434.93	6.42	18,672.88	12.70	9,237.95
5	Plantation	862.30	0.59	950.00	0.65	87.70
6	Dry Agriculture	48,407.62	32.93	44,133.23	30.02	(4,274.39)
7	Dry land Agriculture mixed with shrub	19,479.83	13.25	18,290.16	12.44	(1,189.67)
8	fields	33,398.89	22.72	27,953.01	19.01	(5,445.88)
9	Open land	671.98	0.46	463.07	0.32	(208.91)
10	Water body	1,530.90	1.04	1,639.28	1.12	108.38
11	amount	160.74	0.11	3,612.79	2.46	3,452.05

Source :

reservoir, while the allocation of rice fields decreased by 3.71 percent as well as a decrease in agricultural land and forests. The change in land use presents a challenge for the development in the Upper Cimanuk watershed area. Things that need to be considered in this condition are an evaluation of the concept of sustainable agricultural development as well as a balance between ecology and economy towards land cover classification as the basis for the pattern of land-use change.

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References

- Bahagia, Rimun Wibowo, Fachruddin Majeri Mangunjaya, Oking Setia Priatna (2020). Traditional Knowledge of Urug Community for Climate, Conservation, and Agriculture. *MIMBAR Jurnal Sosial dan Pembangunan* Vol 36, No 1 (2020).
- Berberoglu, S & Akin, A (2009). "Assessing Different Remote Sensing Techniques to Detect Land Use/Cover Changes in The Eastern Mediterranean. *International Journal of Applied Earth Observation and Geoinformation*, 11. 46-53
- Branca Giocomo, Leslie Lipper, Nancy Mc Carthy, Maria Christina Jolejole (2013). "Food Security, Climate Change and Sustainable Land Management A Review." *Agronomy For Sustainable Development* 33, 635-650. [https:// doi.org/10.1007/s13593-013-01331](https://doi.org/10.1007/s13593-013-01331)
- Evrendilek F & Doygun H, (2000). "Assessing Major Ecosystem Types and The Challenge of Sustainability in Turkey." *Environmental Management*, 26 (5), 479-489
- He Chenchen, Qi Han, Bauke De Vries, Xiaoming Wang, Zhao Guochao (2017). "Evaluation of Sustainable Land Management in Urban Area: A Case Study Of Shanghai China." *Science Direct Journal Ecological Indicators* Volume 80, September 2017, Pages 106-113. Elsevier. [https:// doi.org/10.1016/j.ecolind.2017.05.008](https://doi.org/10.1016/j.ecolind.2017.05.008)
- Hidayati, I, (2014). "Analysis of Image Transformation and Land Use/Land Cover for Temperature Trends on Landsat Imagery." *Thematic Cartography For The Society*, 275-291
- James, H. Population, Development, and The Environment; Challenges to Achieving The Sustainable Development Goals in The Asia Pacific, Palgrave Macmillan; London UK, 2019.
- Moteva, Milena, Mondeshka, Margarita, Kostadinov, Georgi. 2020. Planning Options For Sustainable Land Use in Accordance With Modern Agricultural Technology. *International Multidisciplinary Scientific GeoConference, SGEM Sofia Vol 20 Iss 3.1* 2020. DOI:10.5593/sgem2020/3T/s13.066
- Mucova Serafino Afonso Rui, Walter Leal Filho, Ulisses Miranda Azeiteiro, Mario Jorge Pereira (2018). "Assessment of Land Use and Land Cover Changes From 1979 to 2017 and Biodiversity Land Management Approach in Quirimbas National Park, Northern Mozambique Aprica." *Global Ecology and Conservation* 16e00447. Doi:10.1016/j.gecco.2018.e00447
- N Wijaya (2015). "Detection of Land Use Change with Landsat Imagery and Geographic Information Systems: Case Studies in Bandung Metropolitan Area, Indonesia." *Geoplanning Journal of Geomatic and Planning* Vol 2 No 2, 2015.82-92. E ISSN 2355-6544. <http://ejournal.undip.ac.id/index.php/geoplanning>. doi:10.14710.geoplanning 2.2.82-92
- Nijkamp, Peter, Vindigni, Gabriella.2003. Impact Assessment of Qualitative Policy Scenarios: A Comparative case study on Land Use in Sicily. *Management of Environmental Quality Bradford* Vol 14 Iss 1 108-133. DOI:10.1108/14777830310460423
- Parton, William, J, Gutmann, Myron P, Travis, William R. 2003. Sustainability and Historical Land-Use Change in The Great Plains; The Case of Eastern Colorado. *Great Plains Research Lincoln* Vol 13 Iss 1;97-125
- Purnomo Eko Priyo, Etika Khairina, Mohammad Iqbal Fadhlurrohman, Bhima Widya Andoko, Agus Priyanto. 2020. "Managing Biodiversity in Dealing with Sustainable Development Goals". *MIMBAR Jurnal Sosial dan Pembangunan*, Vol 36 No 2 (2020) ISSN.0215,8175 eISSN 2303.2499 PP 371-382. DOI://<https://doi.org/10.29313/mimbar v3626029>
- Rasul, Golam.2009. Ecosystem Services and Agriculture Land -Use Practice: A Case Study of The Chittagong Hill Tracts of Bangladesh. *Sustainability; Science*

- Practice & Policy; Philadelphia Vol 5, Is s. 2,). DOI:15487733.2009.11/10.1080 908032
- Tejaningrum Miranti A, Muhammad Ardiansyah, Widiatmaka. 2017. Evaluation of Actual Landuse and Official Spatial Land Use Planning in Potianak Regency, West Java. *Jurnal Ilmu Tanaman Lingkungan*, 19 (1) April 2017. 1-5 ISSN 1410-7333, e-ISSN 2549-2853
- Tisdell, Clement, Alauddin, Mohammad Md Abdur Rashid Sarker, Md Anwar Kabir.2019. Agriculture Diversity and Sustainability; General Features and Bangladesh Illustrations. *Sustainability Based Vol 11 Iss 21 (2019)): 6004*. DOI:10.3390/su11216004
- Tursilowati L, Sumantyo, J T,S, Kuze, H & Adiningsih, E.S (2012). "Relationship Between Urban Heat Island Phenomenon and Land Use/Land Cover Changes in Jakarta-Indonesia." *Journal of Emerging Trends in Engineering and Applied Sciences*, 3(4):645-653 April 2017. 1-5 ISSN 1410-7333, e-ISSN 2549-2853
- Vimbayi G.P, Chimonyo, Mbulisi Sibanda, Richard Kunz, Cecilia R Masemola, Albert T Modi,Tafadzwanashe M.2021. Evaluation of Land Suitability Methods With reference to Neglected and Underutilised Crop Species; A Scoping Review. *Land-Based Vol 10 Iss 2; 125*. DOI:10.3390/land10020125
- Widiatmaka, Wiwin Ambarwulan, Yudi Setiawan, Christian Walter.2016. Assessing The Suitability and Availability of Land for Agriculture in Tuban Regency, East Jawa, Indonesia. *Applied and Environmental Soil Science*. Vol 2016. <https://doi.org/10.1155/2016/7302148>
- Widiatmaka, W, Ambarwulan,M.Y.J Purwanto, Y Setiawan, H Effendi. 2015. Land-based Environment Carrying Capacity in Tuban East Java. *Jurnal Manusia dan Lingkungan*, 22 (2); 247-259
- Widiatmaka, W, Ambarwulan,M.Y.J Purwanto, Y Setiawan, H Effendi. 2015. Land-based Environment Carrying Capacity in Tuban East Java. *Jurnal Manusia dan Lingkungan*, 22 (2); 247-259
- Widiatmaka, S.P, Mulya, M Hendrisman, 2012. Settlement Unit Level Land Conformity Analysis with Automated Land Evaluaation System (ALES). *Jurnal Pengelolaan Sumberdaya Alam dan Lingkungan* 1 (2);46-55
- Wijaya, N (2004). "Use of GIS in Determining Conservation Areas, Case Study: North Bandung Area." Prosiding pada Seminar Nasional" Perencanaan Wilayah dan Kota Dalam Perubahan Multidimensi" Planologi ITB, Bandung.
- Wrachien Daniele De.2021. Land Use Planning: A Key To Sustainable Agriculture. Conference; I World Congress on Conservation Agriculture Vol 1 At Madrid Spain. DOI:10.1007/978-94-017-1143-2_57