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APPLICATION OF REMOTE SENSING AND GEOGRAPHICAL INFORMATION SYSTEM FOR FOREST RESOURCES BALANCE MAPPINGIN THE TARUSAN SUB-DAS, PESISIR SELATAN DISTRICT

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ABSTRACT: This forest resource balance mapping aims to (1) determine changes in the area of forest resources in the XI Tarusan sub-district, Pesisir Selatan Regency; (2) find out the forest balance in XI Tarusan District, Pesisir Selatan District; (3) determine the accuracy of Landsat 8 imagery for preparing forest resource balances. The method used in mapping the balance of forest resources is by carrying out a supervised classification for land use and land cover. Then the data is overlaid using a two-dimensional matrix approach. Furthermore, the data is analyzed using a Geographic Information System which provides spatial information to be able to present data in map form. The results of this study are changes in the area of forest resources in XI Tarusan District, Pesisir Selatan District, which is 28.62 Ha.,and the accuracy of the Landsat 8 image obtained in the preparation of this forest resource is 91.66%.

Keywords: NSDH, Land cover, Land Use

1. INTRODUCTION

Indonesia is blessed with the largest and most biologically diverse tropical forests in the world. Tens of millions of Indonesians directly depend on these forests for their livelihoods, whether from collecting forest products for their daily needs or working in the wood processing sector. Indonesia has an area of forest area based on the decision of the Minister of Forestry, namely an area of 133,528,579.71 Ha which consists of a water conservation area covering an area of 5,161,477.28 Ha and a land area of 1228,367,102.43 Ha. The area of the forest area required for the preparation of the balance of forest resources is the area of the land forest area of 128,367,102.43 Ha. Changes in the area of forest area are affected by changes in allotment of forest areas, changes in function and release of areas for other uses to become forest areas, releases for transmigration, and releases for plantations.

West Sumatra is located on the West Coast in the central part of Sumatra Island and has an area of around 42.2 thousand km2. Approximately 56.27% of the administrative area is a state forest area by the Decree of the Minister of Forestry Number SK.35/Menhut-II/2013 dated 15 January 2013. The West Sumatra forest area consists of forest areas for conservation, protection and production. The condition of the forest area section of Pesisir Selatan Regency isbased on the harmony between the Consensus Forest Use Plan (TGHK) and the Regional Spatial Plan (RTRW) for the Province of West Sumatra and stipulated by Decree of the Minister of Forestry No. 422/KptsII/99, dated June 15, 1999, it was determined that the area was 427,371 hectares or 69.03% of the area of Pesisir Selatan Regency.

The balance sheet for forest resources is prepared in the framework of implementing Law No. 41 of 1999 in Article 13 paragraph (4) which in its technical implementation still refers to the Decree of the Minister of Forestry and Plantation no. 6444/Kpts-ll/1999 concerning guidelines for preparing forest resource balances. Forest resource balance is information that can describe forest resource reserves, loss and use of forest resources, so that at a certain time the trend can be known, either surplus or deficit when compared to the previous time (explanation of Law 41 of 1999 article 13 paragraph 4) . The balance of forest resources is a balance between the assets and liabilities of forest resources, both from the calculation of area and forest potential. In addition, the balance of forest resources is used for policy or decision-makers (South Coastal District Government, 2007) With so much illegal logging happening everywhere, especially in several countries, namely Kapuh and Sungai Lundang (Kec. Koto XI Tarusan). Therefore the researcher raised the title with the theme Application of Remote Sensing and Geographic Information Systems for Mapping Forest Resource Balances in Nagari Kapuh and Sungai Lundang District XI Tarusan, Pesisir Selatan Regency.

2. THE METHOD

2.1 Research Sites

The research location is in the South Coastal District of West Sumatra Province. Geographically the Canal Is Located At $100°$**100 − '19**$°$34'7" East Longitude, $0°$**1 − '59**$°$17'30" South Latitude with an area of 425.63 Km2.

2.2 Research Methods

In this study, researchers used the Classification Supervised method.

3. RESULT

1 Changes in Forest Resources

Changes in forest resources in the Tarusan sub-watershed can be seen through two aspects, namely the status of land use and the status of existing land cover. Data on land use and the cover is more complete as follows:

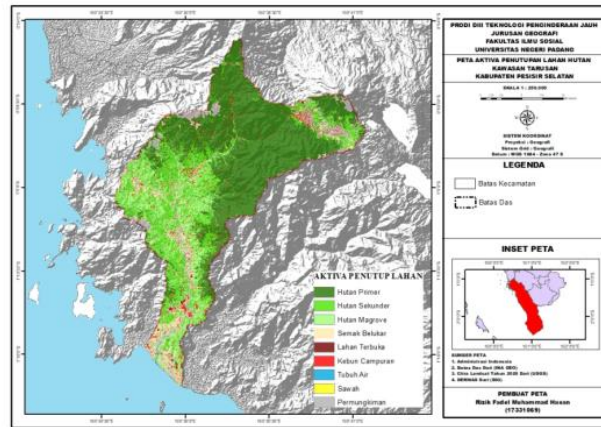a.   Land Cover and Forest Use in 2014

Interpretation of land cover and land use in 2014 was carried out manually with the classification standards found in the 2015 Ministry of Environment and Forestry regarding the balance of forest resources. This classification is used because the resulting accuracy is high enough to produce detailed data. Based on the results of image interpretation, the highest land area was obtained, namely primary forest with an area of 20987 Ha. In addition, the land is in the form of secondary forest with an area of 9255 Ha, mangrove forest with an area of 5801 Ha, settlements covering an area of 1089 Ha, and others.

Land cover and use in 2014 were classified into 9 classes according to the classification of the ministry of environment and forestry in 2015. This classification takes into account the scale of the data to be used. This classification is used to produce detailed data to contain accurate information. The following is a table of land cover and land use in 2014.

Table 1. Land cover and use in 2014 along with the total area.

Land Cover 2014	Area (Ha)	Area (%)
Primary Forest	20987	48.30 %
Secondary Forest	9255	21.30 %
Magrove Forest	5801	13.35 %
Mixed Garden	1529	3.52 %
Open field	203	0.47 %
Settlement	1089	2.51%
Ricefield	18	0.04 %
Shrubs	3517	8.09 %
Water Body	118	0.27 %

Source: Results of data processing, 2020

Pic.1 Land cover and use in 2014
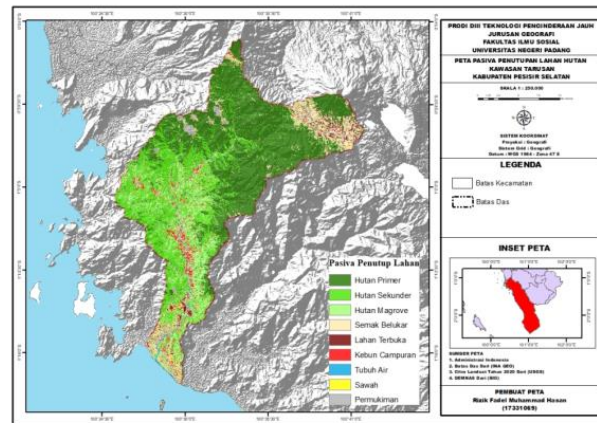
b. Land Cover and Land Use in 2020

Interpretation of land cover and land use in 2014 was carried out manually with the classification standards found in the 2015 Ministry of Environment and Forestry regarding the balance of forest resources. This classification is used because the resulting accuracy is high enough to produce detailed data. The following is the 2020 land cover in the Tarusan sub-watershed.

Table 2. Land cover and use in 2020 along with the total area.

Land Cover 2020	Area (Ha)	Area (%)
Primary Forest	19339	44.51 %
Secondary Forest	10013	23.05 %
Magrove Forest	6013	13.84 %
Mixed Garden	1245	2.87 %
Open field	669	1.54 %
Settlement	2019	4.65 %
Ricefield	388	0.89 %
Shrubs	4471	10.29 %
Water Body	220	0.51 %

Source: Results of data processing, 2020

Based on the table above, information can be obtained, namely that the most extensive land in 2020 is a primary forest with an area of 19339 Ha. Apart from that, there is also a secondary forest with an area of 10013 Ha, and land that has a small area, namely paddy fields. while the land in the form of mangrove forest has an area of 6013 Ha, the mixed garden has an area of 1245 Ha, open land 669 Ha, settlements 2019 Ha, shrubs 4471 Ha, and Body of Water has an area of 220 Ha.

Pic.2 Land cover and use in 2020
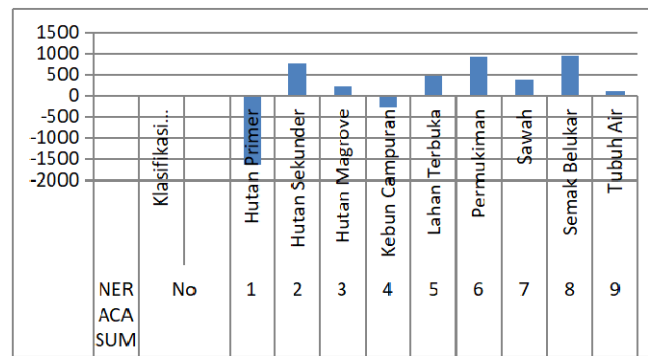
2. Forest Resource Balance

The balance of forest resources in the Tarusan sub-watershed is analyzed through the status of land use and land cover. When viewed from the use and land cover, there is a balance of forest resources in the Tarusan sub-watershed, which tends to experience a deficit. The biggest deficit is an area of 16.48 Ha. The following is a table of forest resource balances in the Tarusan sub-watershed.

Table 3. Forest resource balance

Land Cover	Land cover area t0 (Active)	Wide	(%) Land cover area t1 (Passive)	Wide	% Forest Resources Balance (-) / (+)	Forest Resources Balance (-) / (+) IN FORM %
Primary Forest	20987	48.30	19339	44.51	-1648	19,387.30
Secondary Forest	9255	21.30	10013	23.05	758	-9,991.70
Magrove Forest	5801	13.35	6013	13.84	212	-5,999.65
Mixed Garden	1529	3.52	1245	2.87	-284	1,248.52
Open field	203	0.47	669	1.54	466	-668.53
Settlement	1089	2.51	2019	4.65	-930	1,093.65
Ricefield	18	0.04	388	0.89	370	-387.96
Shrubs	3517	8.09	4471	10.29	954	-4,462.91
Water Body	118	0.27	220	0.51	102	-219.73

**Source:** Results of Data Processing, 2020

Based on the data, it can be seen that around 16.48 hectares of land in the form of primary forest experienced a reduction or deficit in the area. Apart from that, another land that has experienced a reduction in area is in the form of mixed gardens. As for the land that experienced the most significant increase in area, namely secondary forest covering an area of 7.58 ha from 2014 to 2020. The following is a diagram showing the deficit and surplus balance of forest resources in the Tarusan sub-watershed.

Pic.3. Forest resources balance diagram seen from land cover

Source: results of data processing, 2020

Based on the diagram above, number 1 is a primary forest, number 2 is a secondary forest, number 3 is a mangrove forest, number 4 is a mixed garden, number 5 is open land, number 6 is a settlement, number 7 is paddy fields, number 8 is shrubs, number 9 is a body of water.
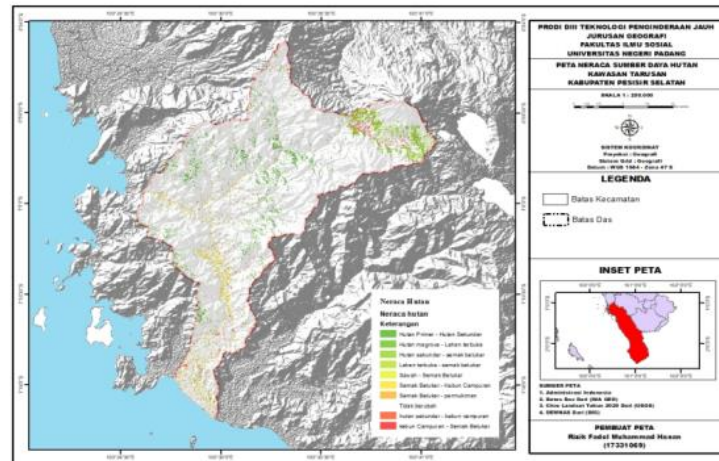
Pic.4 Forest resource balance map

3. Spot Image Accuracy in Land Resource Balance Mapping

The accuracy or level of accuracy of Landsat 8 imagery for forest resource balance mapping when viewed is equal to 91.66%.

Table 4. Cover accuracy test and land use

Kelas	Hutan Primer	Hutan Sekunder	Hutan Magrove	Kebun Campuran	Lahan Terbuka	Permukiman	Sawah	Semak Belukar	Tubuh Air	Total
Hutan Primer	13	1	1	0	0	0	0	0	0	15
Hutan Sekunder	0	5	0	1	1	0	0	1	0	8
Hutan Magrove	0	0	4	0	0	0	0	1	0	5
Kebun Campuran	0	0	0	1	0	0	0	0	0	1
Lahan Terbuka	0	0	0	0	1	0	0	0	0	1
Permukiman	0	0	0	0	0	1	0	0	0	1
Sawah	0	0	0	0	0	0	1	0	0	1
Semak Belukar	0	0	0	0	0	0	0	3	0	3
Tubuh Air	0	0	0	0	0	0	0	0	1	1
Total	13	6	5	2	2	1	2	4	1	36
Ovr	91,66									
Kappa	86,11									

Source: Data processing, 2020

4. DISCUSSION

Changes in forest resources in the Tarusan sub-watershed can be seen through two aspects, namely the status of land use and the status of existing land cover. Based on the analysis of land cover and land use data in the Tarusan Sub-watershed, changes in the area of forest resources in the Tarusan Sub-watershed were 48.30% primary forest, 21.30% secondary forest, 13.35% mangrove forest, 3.52% mixed garden %, open land 0.47% settlements 2.51%, rice fields 0.4%, shrubs 8.00%, and water bodies 0.27%. Based on the data above, it is clear that the most significant change in the area of forest resources occurred in the primary forest 48.30%. This shows that increased development in forest areas will cause land conversion which affects changes in the area of forest resources.

The balance of forest resources in the Tarusan sub-watershed is analyzed through the status of land use and land cover. When compared between land use and land cover and assessed from these two aspects, it can be seen that the balance of spatial forest resources in the Tarusan Sub-watershed in 2020 has experienced a deficit. This is also due to limited regional capacity, land clearing by clearing (forest and land burning), increasing critical land, lack of farmer capital to increase the planting area, low-income levels of farmers, and high demand for wood that exceeds availability so that timber theft becomes a business. which is profitable for poor families, and many people who convert forest land to plantations.

According to Veldkamp and Verdburg, 2004, the interaction between the dimensions of space and time with the biophysical and human dimensions results in changes in land cover and use. Climate change, increasing population, and the process of urbanization are common causal factors that are considered contributing factors to changes in land cover anduse (Wu et al., 2008), but in reality changes in land cover and use do not only occur due to the presence of a single factor (Veldburg and Veldkamp, 2001). The complexity between physical, biological, social, political, and economic factors that occur in the dimensions of space and time at the same time is the main cause of the process of changing land cover and land use (Wu et al, 2008).

The accuracy of Landsat 8 imagery in this study was obtained from the calculation results of the Producer's accuracy and user's accuracy and then Overall Accuracy was obtained. From the results of Overall Accuracy, the accuracy of Landsat 8 imagery for forest resource balance mapping is 91.66%. This proves that Landsat 8 imagery is very suitable for use in forest resource balance mapping.

5. CONCLUSION

The conclusions that can be obtained from this study are:

1. Forest resources in XI Tarusan District, Pesisir Selatan Regency experienced a change in the area of 28.62 Ha from 2014 to 2020. The largest area change occurred in the Primary forest class and mixed gardens.
2. The balance of forest resources in XI Tarusan District, Pesisir Selatan District, has experienced a significant balance. The balance of forest resources tends to experience a deficit. The deficit that occurs mostly is in the primary forest class.
3. The accuracy of the Landsat 8 image obtained in the forest resource balance study is 91.66%. This shows that Landsat 8 imagery is very appropriate for mapping forest resource balances and is very good as a source for mapping forest resource balances.

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