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Evaluation of the Accuracy of Spatial Data in Detecting the Rate of Land Change in Sinjai District

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Evaluation of the Accuracy of Spatial Data in Detecting the Rate of Land Change in Sinjai District

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Abstrack, Aerial photo interpretation can make it easier to detect, identify and delineate the presence of an area so that it can save time and effort and costs to observe directly the area in question. With the presence of satellite images, we can retrieve data from an area without having to visit that area. In this research, the authors use 3 (three) types of satellite image data, namely Landsat 8 satellite image data with an accuracy of 30 meters,. The objectives of this study is to evaluate the rate of accuracy of spatial data in detecting the rate of land change between 2014 and 2019 in Sinjai Regency. This research is closely related to the enumerative induction process (calculation based induction). To find out the level of accuracy of the data from the results of image interpretation, a field check was carried out by taking a sample point of about 20% of the total pixels of 911111 pixels, so that 191 points were obtained which were distribution points for the accuracy test of using image data to evaluate the accuracy level of land cover based on 2019 image data. The overall accuracy test uses the Kappa formula.

Keywords: Evaluation, Spatial, Accuracy, interpretation

1. Introductions

The increasing need for land and the scarcity of fertile and potential agricultural land, as well as the competition for land use between the agricultural and non-agricultural sectors, require appropriate technology in an effort to optimize land use in a sustainable manner. To be able to utilize land resources optimally, directed and efficiently, data and information on soil, climate and other physical environmental characteristics are needed, as well as plant growth requirements, especially plants that have market opportunities and have a fairly good economic meaning [1]. The plantation land use system in Sinjai Regency, especially clove plants, has not been implemented properly, both in terms of planting and land management, because farmers generally still use traditional and hereditary farming systems, there is no accurate data regarding the area of clove planted land, and there are attacks. pests such as stem borer that cause plants to wither and die so that production decreases, in addition to frequent storm attacks so that many plants fall, this problem is a problem that still recurs every year and there is no right solution to overcome it. To find out the area of planting and the condition of the plants, a field survey is needed, but field surveys require a lot of manpower, a long time and are relatively expensive. Remote sensing technology is an alternative to get information about land use quickly and accurately.

The increasing need for land, the scarcity of fertile and potential agricultural land, and the existence of competition for land use between the agricultural and non-agricultural sectors, require appropriate technology in an effort to optimize land use in a sustainable manner. To be able to utilize land resources in a directed and efficient manner, it is necessary to have complete data and information regarding climate conditions, soil, and other physical environmental characteristics, as well as the requirements for growing cultivated plants, especially plants that have market opportunities and good economic significance. Data on climate, soil and other physical characteristics that affect plant growth and management aspects need to be identified through survey activities and mapping of land resources. This land resource data is needed primarily for development planning and agricultural development.

Data generated from surveying and mapping of land resources is still difficult for the user to use for a plan without interpretation for certain purposes. Land evaluation is an approach or way to assess the potential of land resources. The results of the evaluation of land resources will provide the information and/ or direction on land use needed, and finally the expected production values that are likely to be obtained. Several evaluation systems have been developed using various approaches, namely those with multiplication parameters, summation, and matching systems or matching land qualities and characteristics with land suitability class criteria compiled based on the requirements. growing agricultural commodities based on land.

Geospatial information is a breakthrough in the information revolution and is developing at an astonishing rate. This condition is due to its extraordinary spatial nature and visual usefulness. Geospatial information, which is managed through a Geographical Information System (GIS), continues to be disseminated in various sectors of life. With the development of the internet, this Geographical Information System has been developed based on the web and has been applied in various fields. The positive impact is that the quality of life of the people continues to improve along with the increasing quality of policies and decisions made based on geospatial information. In agriculture, technology plays a very large role in improving land quality and supporting the realization of sustainable agriculture. The riset to know the accuracy level, use of geospatial data in detecting land cover.

2. Method

2.1. Type of Research
This type of research used in this research is quantitative research. This research uses semi-quantitative and qualitative approaches with spatial and descriptive analysis. Quantitative research is research whose data is expressed in numbers and analyzed using statistical techniques

2.2. Location
Research on the detection of the distribution of clove cultivation and evaluation of the suitability of clove plantations in Sinjai Regency with geospatial technology was carried out at the end of May 2020 to July 2020. Covers 4 districts which are centers for clove development in Sinjai Regency

2.3. Tools and Materials
The materials used in this research are spatial data on land cover in Sinjai district, including:
a. Landsat TM + 8 image of Sinjai Regency in 2013, recorded on October 10, 2013 with path / row: 120/60
b. Base map: 1: 250,000 scale administration map in 2012, 1: 250,000 scale geological map in 2012, 1: 200,000 scale land map in 2011, 1: 250,000 scale slope map in 2012, DEM (digital elevation model)
c. Statistical data on population and land use in Sinjai Regency in 2013
d. RePPProT data scale 1: 250,000 in 1988
e. SRTM data (shuttle radar topographic mission)

The tools used in this research are:

a. Computer
b. GPS
c. Roll meter
d. Computer programs for data processing are ER Mapper 6.4, Arcgis and Arc view programs.
e. Digital camera
f. Stationery etc.

2.4. Data analysis
Image Processing
Interpretation of land cover classes based on reading satellite imagery data
From the image classification, the resulting land cover classes will be derived into land use information, this is in line with the opinion of [2] states that multispectral classification can only be applied to land cover mapping, and not land use. The land use map is obtained from the Landsat ETM + 8 satellite image classification map. Deductive land use aspects can be derived from land cover information, or in other ways through the inclusion of ancillary data (crop rotation, multitemporal imagery, land form factors, etc.). Therefore, the classification scheme prepared should contain land cover classes (eg agriculture, plantation, mixed forest, shrubland, grassland, open land, etc.); not land use (paddy field, moor, protected forest) because aspects of this function cannot be represented by pixel values, except for special cases.
The land use map obtained from the classification of image data can only be used after a ground truth test has been carried out. The accuracy value is obtained from the matrix error, which is by taking sample points from each land cover as a result of the classification then conducting a field check, whether or not it is suitable for the classification results based on the reading of the same pixels, the format can be seen in Appendix 1. The accuracy test is very important for maps of remote sensing data classification results, because the accuracy test provides an overview of the level of confidence in the information from the resulting map. To obtain the overall accuracy value, this study uses the chatt coefficient equation (see equation 1), based on existing references the accuracy of ETM + 8 landsat images reaches 95% to identify irrigated rice fields in California and wheat fields in Kansas, Oklahoma, and Texas in America. However, the accuracy of plant identification in developing countries is only about 75% - 85% (Aronof, 2005).
From the image processing, statistical values are generated, including the area of each land cover class, the data obtained from the software processing is then matched with statistical data about the area of clove cultivation in each area.

3. Result and discussion

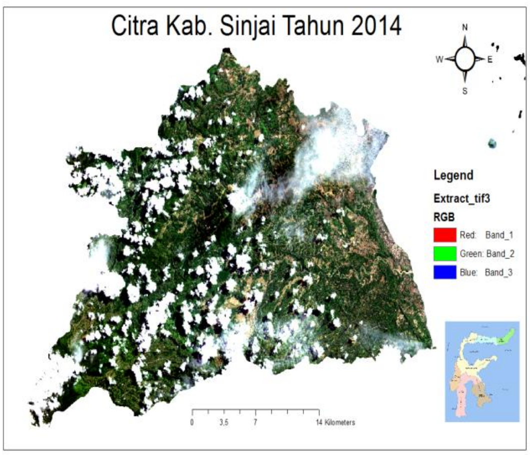

Figure 1. Landsat imagery in 2014 and in 2019 before being processed

From the image processing, statistical values are generated, including the area of each land cover class, the data obtained from the software processing is then matched with statistical data about the area of clove cultivation in each area [3] states that the remote sensing process data used has been corrected Radiomatically and Geometrically based on the standards set by the institution (Guidelines for Radiomatric Correction and Geometric Correction of Sensing Data, Pustekdata-Lapan) Using an unsupervised classification system, then a class is obtained. land cover as shown in Figure 1.

In this research, thematic information about land use / cover from satellite imagery was developed. The initial stage of this research is a field visit / survey, there are 2 classification methods used, namely unsupervised classification and supervised classification, 5 classes of land use / land cover are made that are easy to identify. For Guided Classification, basic data collection is done with area training. The training area aims to determine the areas to be classified mainly as plantations or forests. After the training area exists, the land cover classification is carried out as we can see in Figure 3.1 The final stage of the classification procedure is data validation using an error matrix with a total image reading accuracy based on the Chatt coefficient method, namely 83.3% [4],[5].

From the classification using the ETM + 8 Landsat satellite imagery of the Sinjai Regency in 2014, it was found that around 24,134 pixels or 2,172 hectares of agricultural land were obtained. Meanwhile, the other land cover, respectively 11.3% primary forest, 19.9% rice field, 7.3% settlement, 5.5% secondary forest, 11.1% seasonal crops and 21.1% are plantation land. mixed, this is a categorical accuracy test in accordance with the opinion of [6], which states that categorical accuracy tests are also carried out to determine the level of accuracy of each land use category. Because in general, misinterpretation occurs on land uses in one category. The accuracy of the image in identifying land cover (83.3%) is the achievement of a very accurate image interpretation for tropical areas that have uneven contours. This is in line with the opinion of [7], [8], which states that identification in developing countries is a maximum of 75 - 85 percent because tropical areas have complex and complex land cover.

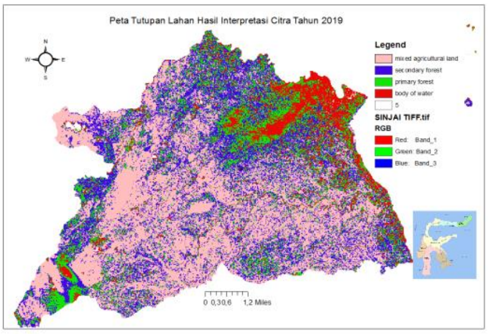

Figure 2. Map of 2019 Landsat Image Interpretation Results

Table 1. Land cover classification resulting from Landsat 2019 imagery

Land Cover Classification	Count	Luas (Ha)
Mixed agricultural land	727.914	65.512,33
Secondary forest	28.498	2.564,88
Primary forest	23.153	2.083,80
Body of water	115.778	10.420,02
Other use	15.766	1.418,97
	911.111	82.000

Source: Data from 2019 lamdsat image processing

The author classifies land cover in Sinjai district with several classes of land cover, namely: settlements, shrubs, swamps, mangroves, dry land, which is land that is not too wide and difficult to distinguish based on pixel perpixel analysis because it uses medium resolution image data, namely landsat 30 x 30 meter coverage. We can see the land cover based on the Landsat 8 image interpretation with an unmonitored classification system in table 1.

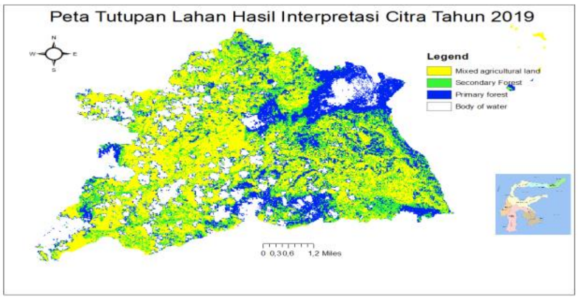

Figure 3. Results of interpretation of 2014 Landsat imagery

Table 2. Land cover classification resulting from image processing in 2014

Land Cover Classification	Count	Large (Ha)
Mixed agricultural land	731.111	65.800
Secondary forest	30.009	2700,81
Primary forest	23.376	2103,85
Body of water	117.372	10.563,55
ATC	9.244	832
	911.112	82.000

Source: Primary data 2019

Table 3. The rate of land change between 2014 and 2019

No	Land cover	Year 2014 (Ha)	Year 2019 (Ha)	Change (Ha)
1	Mixed Agricultural land	65.800	65.512,33	287,67
2	Secondary Forest	2.700,81	2.564,88	135,93
3	Primary Forest	2.103,85	2.083,80	20,05
4	Body Of Water	10.563,55	10.420,02	140,53
5	ATC	832	1.418,97	586,97

Source : Promary data 2019 after processing

Accuracy Evaluation

Field checks were carried out by taking a sample point of about 20% of the total pixels of 921111 pixels, to determine the accuracy of the data from the image interpretation results, 195 points were obtained which are distribution points for the accuracy test of using image data to evaluate the accuracy level of land cover based on image data from years. 2019. The Kappa formula is used in testing the overall accuracy of land cover as research conducted by [9],[10]. Observation points can be seen in the following table Table 4. Number of Ground Check Points for Each Land Cover Class for 2019 Landsat 8 Imagery.

Accuracy Evaluation

Reference data and results of field checks are used as references in testing the accuracy of the interpretation of satellite image data. The contingency matrix, used as a method for analyzing the accuracy of the interpretation of satellite image data, in the following table shows the overall accuracy value of 78%, the accuracy result with the overal system is also carried out by. This result shows that the pixels in the sample area are well classified, with an accuracy rate of above 84%, this is in accordance with the opinion of [11],[12].

Tabel. 4. Ground Check setiap clas cover land

Land cover	Number of pixel	Large (Ha)	Number of point
Mixed Agriculture Land	727.914	65.512,33	62
Secondary Forest	28.498	2.564,88	39
Primery Forest	23.153	2.083,80	37
Body Of Water	115.778	10.420,02	32
ATC	15.766	1.418,97	25
Total	911.111	82.000	195

Source: Primary data after processing, 2019

Table 5. The test matrix for the accuracy of Landsat imagery in 2019

	MAL	SF	PF	BOW	ATC	Total	User Acuracy
MAL	53	3	0	2	2	62	89%
SF	0	31	4	2	2	37	77%
PF	0	3	27	2	4	36	75%
BOW	2	1	1	25	2	31	80%
ATC	1	2	1	1	20	25	80%
Total	57	39	33	32	30	191	
Producer	94%	76%	81%	78%	66%		
Overal			83,30%				

MAL = Mixed Agriculture Land, SF= Secondary Forest, PF= Primary Forest,
BOW = Body Of Water, ATC = Other Use Land
Sumber: Data primer 2019

$$K_{chat} = \frac{N.\sum_{k=i}^{ii} - \sum_{k=i}^{ii}(xi*xii)}{(N*N)-\sum_{k=i}^{ii}(xi*xii)}$$

$$K= \frac{(191*156)-((57*61)+(39*38)+(33*36)+(32*31)+(30*25))}{(191*191)-((57*61)+(39*38)+(33*36)+(32*31)+(30*25))}$$

$$Kchat = \frac{(29796)-((3477)+(1482)+(1188)+(992)+(750))}{(36481)-((3477)+(1482)+(1188)+(992)+(750))}$$

$$Kchat = \frac{(29796)-(7889)}{(36481)-(7889)}$$

$$Kchat = \frac{21907}{28592}$$

$$K_{chat} = 83{,}3\%$$

Basically, the accuracy test is intended to determine the correct level of digital analysis results. This is important in assessing the appropriateness of the data when used as input in GIS, besides it can also give confidence to the users of the data. Inaccurate data, even if processed with correct procedures, it will still give unsatisfactory output, according to the concept of garbage in garbage out with opinion [13],[14]. Based on some literature and research results that have been conducted, the accuracy test is mostly applied to the interpretation and classification of land cover or land use derived from remote sensing data analysis, in this case digital image processing. In fact, data sources (input) in geographic information systems are not only derived from remote sensing data, but can also come from existing base maps and thematic maps, or from statistical data [15]. The map and attribute data also need to be evaluated for their level of accuracy before being entered and processed in GIS, because the transformation process of the map or source data, which is usually from analog to digital, allows for many errors that can come from various sources, for example data sources (maps or data that is used as a reference), the hardware and software used to process the data, or errors that come from human elements who carry out the processing [16],[17].

4. Conclusion

Based on the results of research and discussion, it can be concluded that of the 911111 pixels detected based on image data reading, an accuracy rate of 83.3 is obtained and is in the very good category for detecting the rate of land change.

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