



UTILIZATION OF SPOT IMAGERY TO EVALUATE THE SUITABILITY OF RICE FIELD SPACE PATTERNS IN PADANG CITY

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ABSTRACT: Land conversion in Indonesia has occurred frequently, one of the scattered changes occurs in paddy fields that are converted into built-up lands such as housing, shops and industry. According to Darmawan (2002), one of the factors that cause land change is the socioeconomic factors of the community related to the needs of human life. One of the provinces that experienced the largest paddy land conversion in Indonesia is the West Sumatra region. Many factors result in land use changes that have an impact on the land itself, such as social, and economic factors and also factors of increasing the number of inhabitants. Land use change is the transition of an old form and location of land use to a new one. Or the change in the function of agricultural land such as built-up land (Adhiatma et al., 2020).

The selection of the Padang City Area as a research site was based on significant land use changes in Padang City, this was caused by several factors such as the rate of population growth in Padang City which increased every year based on BPS data in 2015-2020 period was 1.52% with a population of 909.04 thousand people in 2020.

The spatial pattern that has been set by the government in general in the city of Padang is an area developed for the cultivation of rice fields covering an area of 4540.10 ha. Based on BPS data from Padang City, the area of paddy fields decreases by 0.7% every year which is converted into housing and shops and industries in Padang City. The development of built-up land that occurred in the city of Padang slowly changed the rice field area into a built-up area that was not by the provisions of the spatial pattern that had been set by the local government. The spatial pattern that has been set by the government so that the area of paddy fields can be maintained by utilizing remote sensing data. By using remote sensing data such as imagery. Spot imagery is one of the high-resolution remote sensing images that is a French-owned satellite that operates to provide remote sensing data. SPOT imagery provides an imaging instrument that is then carried out as an overlay method between the rice field map and the rice field space pattern that has been set by the government to see its suitability.

High-resolution optics are synonymous with panchromatic (P) and Multispectral (Green, Red, and Near Infrared). SPOT imagery has a spatial resolution of 2.5meter 10meters with a wide viewing angle that covers 60 x 60 km or 60 x 120 km in twin mode instruments, and an orbital altitude of 822 km, SPOT provides an ideal combination of high resolution and also wide visibility that can meet the needs of data that is accurate enough for identification of rice fields.

Keywords: Rice Fields, Geographic Information Systems, Remote Sensing and SPOT Image

I. INTRODUCTION

Land conversion in Indonesia has occurred frequently, one of the scattered changes occurs in paddy fields that are converted into built-up lands such as housing, shops and industry. According to Darmawan (2002), one of the factors that cause land change is the socioeconomic factors of the community related to the needs of human life. One of the provinces that experienced the largest paddy land conversion in Indonesia is the West Sumatra region. Many factors result in land use changes that have an impact on the land itself, such as social, and economic factors and also factors of increasing the number of inhabitants. Land use change is the transition of an old form and location of land use to a new one. Or the change in the function of agricultural land such as built-up land (Adhiatma et al., 2020).

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2. THE METHOD

1.1 Types of Research

This type of research is quantitative research by utilizing Geographic Information System (GIS) techniques to provide a detailed picture of what is in the field, through a spatial approach by interpreting imagery namely reviewing the image by doing manual digitization by making a map of rice field use in 2010 and 2020 in the city of Padang to see changes in paddy fields in Padang City, which is then carried out an overlay method between the rice field map and the rice field space pattern that has been set by the government to see its suitability.

This type of research is quantitative research by utilizing Geographic Information System (GIS) techniques to provide a detailed picture according to what is in the field, through a spatial approach by interpreting images, namely reviewing images by doing manual digitization by making maps of rice field use in 2010 and 2020 in the city of Padang to see changes in paddy fields in Padang City, which is then carried out an overlay method between the rice field map and the rice field space pattern that has been set by the government to see its suitability.

2.2 Research Time and Location

This research was carried out in the even semester of 2021/2022 in the city of Padang, which is one of the cities located in the province of West Sumatra, consisting of 11 sub-districts and 104 urban villages spread over an area of 693.66 km² which is at an altitude of 0-1853 m which extends from north to south has a coast of 68,126 km and there is a bukit barisan area of 486,209 km².

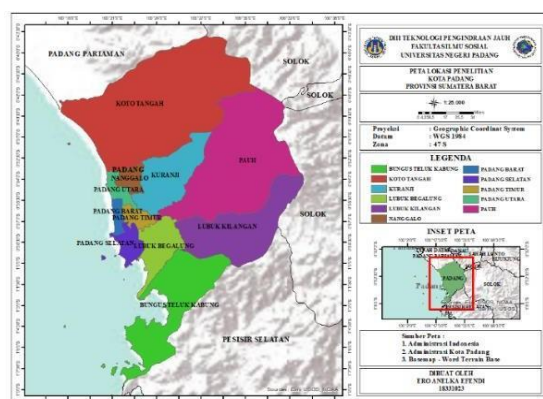


Fig1. Location Research

2.3 Tools and Materials

Table 1. The tools and materials used to support the research are as follows:

No	Tool	Material
1.	Software Arcgis 10.3	SPOT Imagery of the Year 2010
2.	Software ENVI 5.1	SPOT Imagery of the Year 2020
3.	Ms. Excel	Pattern Shapefile Data Padang City Space

2.4 Test interpretation accuracy

Table 2. Research Accuracy Test

Object	1	2	3	4	5	6	7	Number of samples	accuracy
1	16	0	1	0	0	0	0	17	94%
2	0	4	1	1	0	0	0	6	66%
3	0	0	3	0	0	0	0	3	100%
4	0	0	0	1	0	0	0	1	100%
5	0	0	0	0	5	0	0	5	100%
6	0	0	0	0	0	3	0	3	100%
7	0	0	0	0	0	0	1	1	100%
Total Sample and Accuracy								36	91,66%

The results of calculating land use accuracy using the Kappa method are as follows: Total Pixel Accuracy Rate = True pixels/Total pixels X 100% = 33 / 36 X 100% = 91.66%. The results of determining the value of land use accuracy showed a sample accuracy value of 91.66% of the total 36 samples. A total of 33 samples were correct that corresponded to land use class objects and 3 samples were incorrect or inconsistent with the circumstances in the field. The error sample is a sample point of mixed forest(9) which turns into shrubs, plantations (3) into shrubs and plantations(6) into open land, the results are obtained after doing an observation process to the field to test the correctness of the sample.

3. RESULTS AND DISCUSSION

3.1 Results

The results of manual classification for mapping changes in rice field areas in Padang City using SPOT 5 imagery in 2010 with a resolution of 10 meters and SPOT 7 imagery in 2020 with a resolution of 6 meters. SPOT imagery with a high-resolution image category is very helpful in identifying objects in the image, because the appearance of objects is very clearly visible by displaying clear colors and hues and providing natural colors where the appearance of these colors can be seen easily by the normal human eye, such as brown tile colors, green farmland and plantations, as well as the color of other objects corresponding to reality.

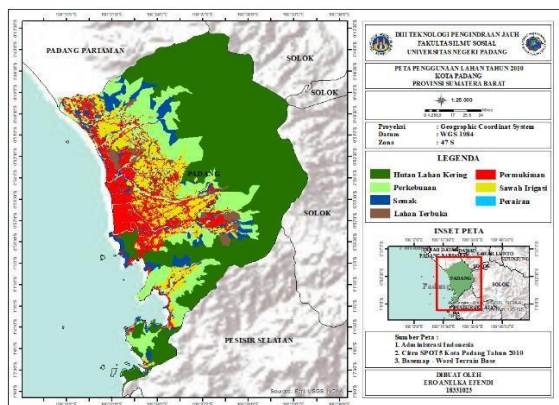


Figure 2. Land Use Map 2010

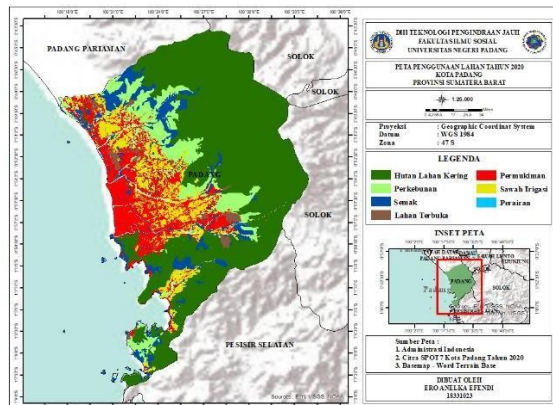


Figure 3. Land Use Map 2020

Table 3. Land Use Area Change 2010-2020

No	Land use	Year 2010 (Ha)	Year 2020 (Ha)	Total Changes (Ha)
1	Mixed Forest	34.758,71	34.383,71	(-) 375
2	Plantation	11.771,91	11.948,49	(+) 176,58
3	Bush	5.652,21	5.694,52	(+) 42,31
4	Open field	2.385,31	1.358,27	(-) 1.027,04
5	Settlement	7.772,10	9.622,29	(+) 1.850,19
6	Irrigated fields	6.714,98	6.047,94	(-) 667,04
7	Waters	440,78	440,78	0

In figures 2 and 3, it can be seen that the area of land use and changes in the area from 2010 to 2020 in the city of Padang that have been digitized can be seen in table 3 above. The biggest changes have occurred in settlements seen and development has been very significant in the last 10 years. The high development may be due to several factors, one of which is the high birth rate, which results in a high level of population density, while the smallest changes occur in mixed forests.

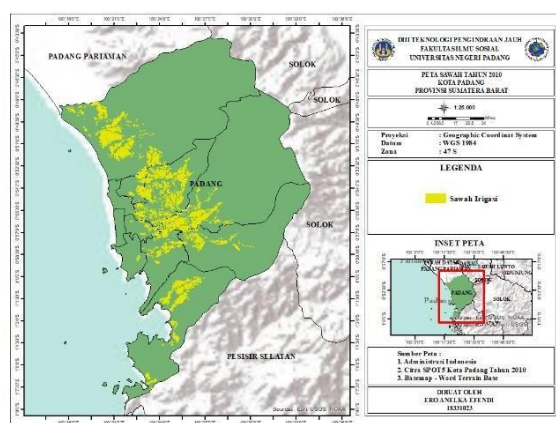


Figure 4. Rice Field Area Map 2010

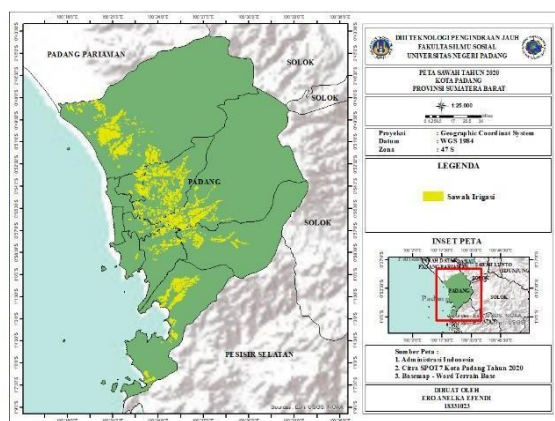


Figure 5. Rice Field Area Map 2020

In the results of digitizing the rice field map in 2010 and 2020 in the city of Padang, it is known the area of rice fields and the area of change which is listed in the table below:

Table 4. PL Area Change 2010-2020

No	Year	Area (Ha)
1	2010	6.714,98
2	2020	6.047,94
Total		667,04

Table 5. PL Area Change 2010-2020

The year 2010	The year 2020	Area of Change (Ha)
Paddy Field	Vacant Lots	30,33
Paddy Field	Bush	150,20
Paddy Field	Settlements	435,95
Paddy Field	Garden	50,56
Total		667,04

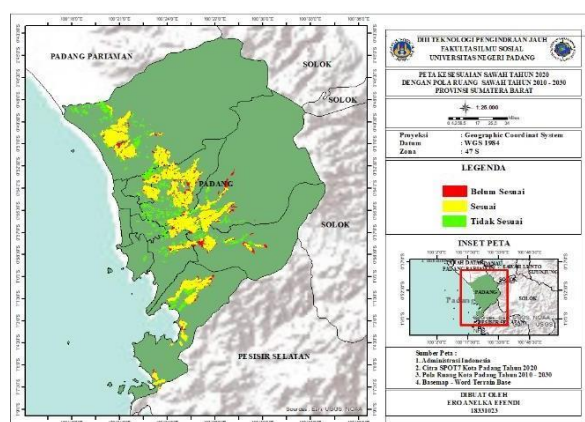


Figure 6. Conformity of Rice Field Space Pattern with Space Pattern 2010 – 2030

Table 6. PL Area Change 2010-2020

No	Classification	Area (Ha)	Percentage
1.	Appropriate	3.780,76	55%
2.	Non-Compliant	2.267,17	33%
3.	Not Yet Appropriate	807,36	12%
	Sum	6.855,29	100%

After obtaining the results of the analysis of the rice field area of Padang City in 2020 which is divided into appropriate, inappropriate and not suitable classifications, then the rice field shapefile is overlaid with the shapefile of the rice field space pattern plan for 2010-2030 which has been set by the regional government to see the suitability of the rice field area with the rice field space pattern in Padang City, after an overlay is then calculated the area of conformity using calculate geometry.

3.2 Discussion

The results of manual classification for mapping changes in rice field areas in Padang City using SPOT 5 imagery in 2010 and SPOT 7 imagery in 2020. SPOT imagery, which is classified as a high-resolution image, is very helpful in identifying objects in the image, because it displays clear colors and hues and gives natural colors where the appearance of these colors can be easily seen by the normal human eye, such as the color of tiles that are brown, farmland and plantations that are green, and other colors of objects that correspond to reality.

In terms of shape, we easily see large objects such as airports that have runways with elongated shapes whose ends are closed, then large buildings or settlements with a square or square shape with an area large enough so that the difference between settlements and school buildings can be seen in the image. Overall, all objects in the SPOT image look clean, making it easier for us to classify the image, but at certain pixels sometimes an object covered by clouds can make it difficult for us to classify land use around the area, so there are often errors and discrepancies between the identified object and the situation in the field. Therefore, in anticipation of misinterpretation of land use in images, researchers conduct ground checks or conduct field checks directly to ascertain the type of land use in areas that are difficult to classify where the imagery of the area is covered by clouds. This research focuses on changes in the area of rice fields that occurred from 2010 to 2020, when identifying rice field objects using SPOT images, the hue of bright rice field objects was seen in the image with dark green and brownish colors, the shape of some rice fields are square, some are slightly concave elongated. The texture of rice field objects is smooth with compound patterns. There are regular object patterns and some are irregular, regular object patterns are usually found in flat areas and close to settlements, while irregular patterns are found in areas that are not flat or areas that have a steep slope, these areas are generally found in hilly areas. The scale used in the digitization process using high-resolution imagery, namely SPOT imagery, is 1: 25,000.

3.3. Sample point

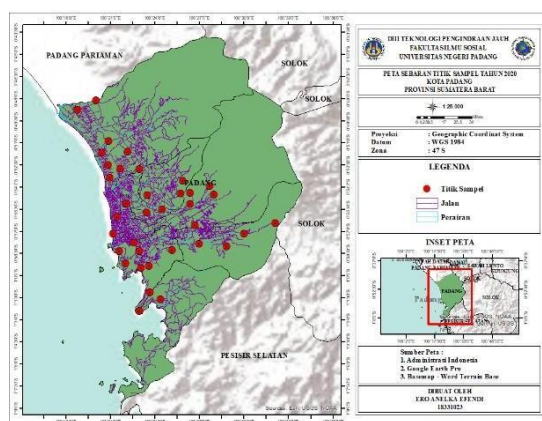


Figure 7. Distribution of Accuracy Test Sample Points



From the results of the mapping of the evaluation of the suitability of rice field space patterns in the city of Padang, 36 sample points were distributed in the city of Padang which can be seen in figure 7 above.

4. CONCLUSION

Based on the results of the analysis that has been carried out in this study, the following conclusions can be drawn:

1. Changes in the area of rice fields identified using SPOT imagery in 2010 and 2020 were reduced by 667.04 Ha, with rice fields in 2010 at 6,714.98 Ha and 6,047.94 Ha in 2020.
2. The suitability of rice fields with the rice field space pattern plan is dominated by the classification level corresponding to the area of 3780.76 Ha, furthermore, the classification does not correspond to the area of 2267.17 Ha and the classification does not yet match the area of 807.36 Ha.
3. The level of accuracy found in spot 7 imagery for the identification of paddy fields in Padang City in 2020 was 91.66% which was categorized as very strong based on the Kappa classification.

5. ADVICE

The suggestions from this study are:

1. The satellite imagery used in this study should be high-resolution imagery such as SPOT imagery, making it easier for us to interpret the image and minimize the occurrence of errors.
2. Research data should be prepared and ensured availability with agencies because the SPOT image itself is difficult data to obtain to facilitate the smooth process of research.
3. For further research, it is recommended to examine factors that influence changes in land dynamics using variables that are physical conditions, variables that are socio-demographic such as population, and variables of study in the field of economics.

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