

## THE UTILIZATION OF SATELLITE IMAGERY FOR THE STUDY OF SETTLEMENT DEVELOPMENT TRENDS

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\*Corresponding Author, Received: Sept 20, 2021. Revised: Nop 28, 2021. Accepted Dec 9, 2021

**ABSTRACT:** This study aims to see the development trend of the residential area in the City of Solok by using Landsat imagery and SPOT imagery through the processing of Geographic Information Systems and Remote Sensing. The type of research used is descriptive with a quantitative approach. The results of this study show that there has been an increase in residential areas by 656.02 hectares from 2009 to 2019 using Landsat imagery. and 122.26 hectares using SPOT imagery. The research was conducted using a weighted tiered supervised method and manual digitization to identify land use for settlements in order to determine the distribution of residential areas and the trend of settlement development in the City of Solok. The results of the distribution of settlement developments in Solok City where the Tanah Garam sub-district is the most dominant with an area of 234.63 hectares using Landsat imagery and 86.51 hectares using SPOT imagery.

*Keywords: Settlements, Development Trends, Geographic Information Systems, Remote Sensing, Supervised*



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### 1. INTRODUCTION

The settlement is defined as an area of land that is used as a living environment or residential environment and a place for activities that support livelihoods and livelihoods, and is part of the environment outside the protected area, both in the form of urban and rural areas [5].

As written in the 1945 Constitution Article 28H the first Paragraph said that the house is one of the basic rights of the people and therefore every citizen has the right to live and get a good and healthy living environment, therefore the house is a basic need of every human being, every human being will try in any situation to have a house as a place to live and a place to rest with the family, in terms of development in all fields and especially the construction of housing and settlements, the community acts as the main actor, while the government has an obligation as the party in charge of directing, guide and create a conducive atmosphere for the creation of a good and healthy residential atmosphere in national and regional development, Along with the increasing number of residents in an area will certainly affect the need for housing, in that area will need land for the availability of settlement development, the trend of settlement development trends leads to suburban areas as a result

of the expansion of urban activities. Most of the City centers are no longer able to accommodate the pressure of the population, along with the increasing population growth indicating that population development is spreading towards the suburbs (sub-urban) so that as a consequence there is a change in land use in urban areas, and the development of residential areas that are not in accordance with its use will have a negative impact, one of which is the ineffectiveness of building settlements, City service facilities and can even cause disasters because of inappropriate land use as it should, therefore in carrying out settlement development it is necessary to understand the physical characteristics of the area to be developed, it can be seen and monitoring of the land suitability of the area, monitoring the development of residential land manually will take a lot of time, effort, and cost so that making it becomes ineffective, therefore in this study will use the application of GIS (Geographical Information System) in evaluating land suitability for settlements which will facilitate, and accelerate the identification process of residential area development.

Solok City is an urban area with its complexity will continue to grow from time to time in covering the field of development, the development in Solok City will be a special attraction for people from other regions to carry out economic activities such as plantation crops

which are marketed in the Solok City area. Besides that, education factors also affect developments in the Solok City area, this of course results in migration which of course adds to the activity of Solok City both in terms of space and the intensity of activities in the Solok City area which will increase, based on data from the Solok City statistical center, it can be seen the population and intensity in Solok City is always increasing, where in 2010 the population of Solok City was 59,623 people and in 2019 as many as 71,010 people this needs to be anticipated early by preparing for the availability of settlement support and good urban infrastructure so that it does not bring new problems due to the increasing population, and considering that Solok City has a strategic location in the region of West Sumatra Province as a transit City from and to Padang City and other cities in West Sumatra Province and even Sumatra Island, based on this it is necessary to prepare an integrated settlement development strategy in Solok City and it is hoped that development in Solok City is carried out optimally and as well as possible.

## 2. METHODS

Mapping of settlement development trends in the Solok City using Landsat Imagery seen from changes in land use using the Supervised method (guided method) where it is necessary to determine several training areas (sample areas) on Imagery as a certain land use class, the sample area is then used by the computer as the key to recognize the same pixel on another pixel, the area that has the same pixel value will be included in the previously determined land class, based on the results of the year land use map 2009, 2014 and 2019 scale 1:100,000 obtained from the interpretation of Landsat Imagery which has a spatial resolution of 30 M sourced from USGS Earth Explorer are as follows:

Table 1. The land usage of Solok City Image Landsat in 2009

No	The land usage	Width (H)	Percentage (%)
1	Wet rice field	1649,94	28,78
2	Forest	1617,91	28,22
3	Mixed garden	797,84	13,92
4	Bush	1056,67	18,43
5	Open field	92,94	1,62
6	Settlement	516,92	9,02
Total		5732,22	100

Source: Interpretation Results, 2020

The interpretation results of the dominant land usage is rice fields with an area of 1649.94 hectares or 28.78% and the least is open land with an area of 92.94 hectares or 1.62% , for settlements in 2009 is 516.92 hectares or 9.02%.

Furthermore the interpretation results of the dominant land usage is rice fields with an area of 1618.75 hectares or 28.24% and the least is open land with an area of 294.09 hectares or 5.13%, for settlements in 2014 is 7595.08 hectares or 13.87%.

Table 2. Land Usage of Solok City Image Landsat 2014

No	The land usage	Width (H)	Percentage (%)
1	Wet rice field	1618,75	28,24
2	Forest	1316,86	22,97
3	Mixed garden	1022,41	17,83
4	Bush	685,44	11,96
5	Open field	294,09	5,13
6	Settlement	795,08	13,87
Total		5732,63	100

Source: Interpretation Results, 2020

Table 3. The Land Usage of Solok City Image Landsat City in 2019

No	The land usage	Width (H)	Percentage (%)
1	Wet rice field	1574,2	27,46
2	Forest	1466,93	25,59
3	Mixed garden	611,42	10,67
4	Bush	315,32	5,50
5	Open field	66,26	1,16
6	Settlement	1172,94	20,46
Total		5732,63	100

Source: Interpretation Results, 2020

The interpretation results of the dominant land usage is rice fields with an area of 1574.20 hectares or 27.46% and the least is open land with an area of 66.26 hectares or 1.16%, for settlements in 2019 is 1172.94 hectares or 20.46%

- The mapping of settlement development trends in Solok City using Spot Image is seen from land use change using the manual digitization method,

because the resolution in the Spot Image entered is in the type of High Resolution Image, making it easier for the manual digitization process because the object is clearly visible in the image, based on the 2009 2014 and 2019 land use maps with a scale of 1:100,000 obtained from the interpretation of the SPOT image which has a spatial resolution of 2.5M sourced from Public Works Department.

Table 4. The Land Usage of Solok City Image Spot in 2009

No	The land usage	Width (H)	Percentage (%)
1	Watershed	23,27	0,41
2	Forest	1563,32	27,24
3	Mixed Garden	830,51	14,47
4	Open field	531,17	9,26
5	Settlement	430,02	7,49
6	Rice field	430,02	16,69
7	Bush	1402,20	24,44
Total		5738,32	100

Source: Interpretation Results, 2020

The result of the interpretation of the dominant land use is that the forest has an area of 1563.32 hectares or 27.24% and the least is a body of water with an area of

23.27 hectares or 0.41%, for settlements in 2009 were 430.02 hectares or 7.49%

Table 5. The Land Usage of Solok City Image Spot in 2014

No	The land usage	Width (H)	Percentage (%)
1	Watershed	26,98	0,47
2	Forest	1586,79	27,65
3	Mixed Garden	1367,45	23,83
4	Open field	222,21	3,87
5	Settlement	536,97	9,36
6	Rice field	952,79	16,60
7	Bush	1045,12	18,21
Total		5738,31	100

Source: Interpretation Result, 2020

The result of the interpretation of the dominant land use is that the forest has an area of 1586.79 hectares or 27.65% and the least is a body of water with an area of

26.98 hectares or 0.417%, for settlements in 2014 is 536.97 hectares or 9.36%.

Table 6. The Land Usage of Solok City Image Spot in 2019

No	The land usage	Width (H)	Percentage (%)
1	Watershed	26,98	0,47
2	Forest	1568,25	27,32
3	Mixed Garden	1302,08	22,69
4	Open field	230,67	4,02
5	Settlement	552,28	9,62
6	Rice field	949,84	16,55
7	Bush	1109,37	19,33
Total		100	5739,47

Source: Interpretation Results, 2020

The result of the interpretation of the dominant land use is the forest that has an area of 1568.25 hectares or 27.32% and the least is a body of water with an area of 26.98 hectares or 0.47%, for settlements in 2019 is 552.28 hectares or 9.62%.

- The suitability of the trend of settlement development with the RTRW of Solok City. The analysis technique of this research can be answered by using the analysis technique of land use classification for settlements and in Overlay with

the RTRW of Solok City using Arcgis 10.3 software, Based on the results of processing data on land use change in 2009,2014 and 2019 show that the annual increase in residential areas in Solok City uses Landsat and SPOT imagery, as follows below.

### 3. RESULTS AND DISCUSSION

#### 3.1 Solok City Settlement Trend Map Using Landsat Imagery and RTRW

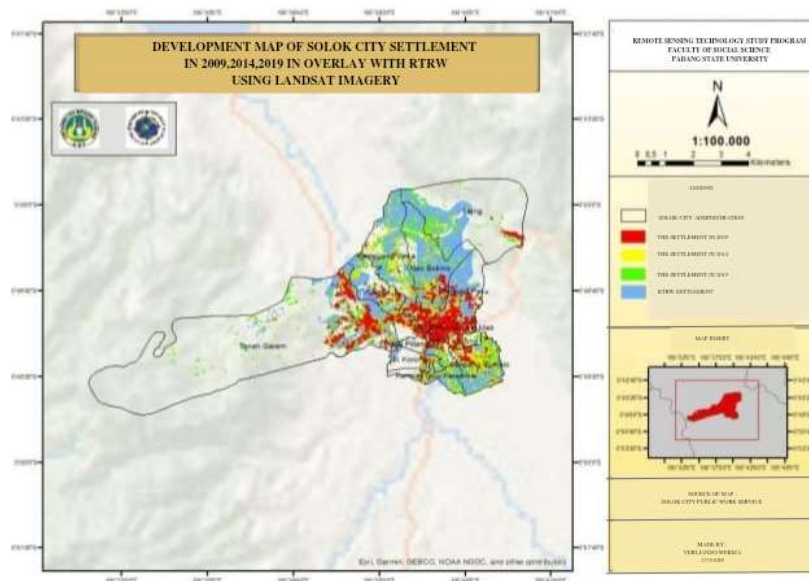


Fig. 1. Solok City Settlement Development Map Image Landsat Year 2009,2014,2019 Overlay with RTRW  
 Source: Interpretation Results, 2020

A very significant increase in 2014 from 2009 with an area of 278.16 hectares, and from 2014 to 2019 happened residential development of 377.86 hectares.

### 3.2 Solok City Settlement Trend Map Using SPOT Image and RTRW

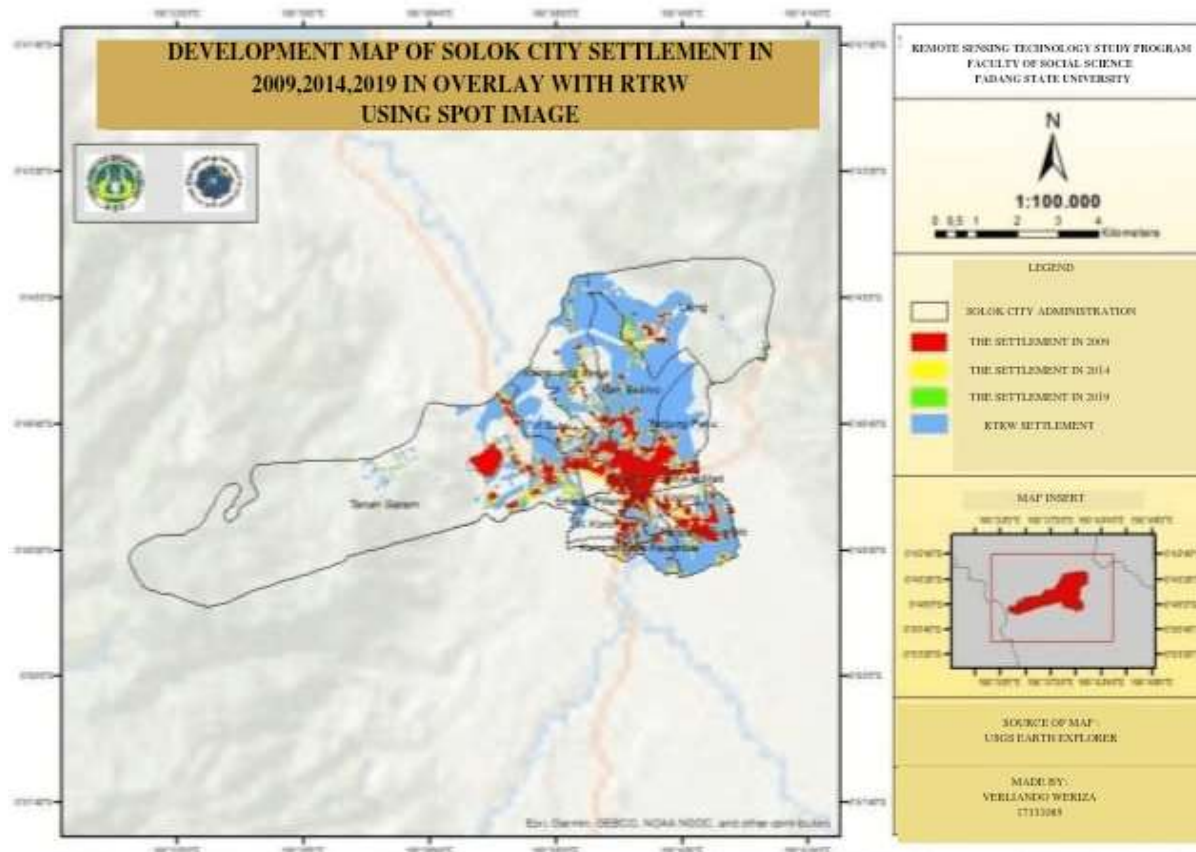


Fig. 2. The Map of the Development Solok City Settlement Image SPOT 2009,2014,2019 Overlay with RTRW  
 Source: Interpretation Results, 2020

The increase in settlement development is also seen using SPOT imagery in 2014 from 2009 with an area of 106.95 hectares, and from 2014. In 2019, there was a 15.31 hectare settlement development. Based on the results of the Supervised classification for mapping Settlement Development in Solok City using Landsat Satellite Imagery in 2009, 2014, and 2019 which has a spatial resolution of 30 meters, using Landsat Imagery through the process of interpreting objects can be

recognized by looking at the characteristics of the interpretation elements, namely Hue or Color, Size, Shape, Texture, Pattern, Shadow, Site and Association of Appearance of Objects in the Image, such as the example For settlements in Landsat images using the original composite band (Natural Color) settlements appear red in the image, whereas if using the infrared band composite (Color Infrared) settlements are shown in blue.

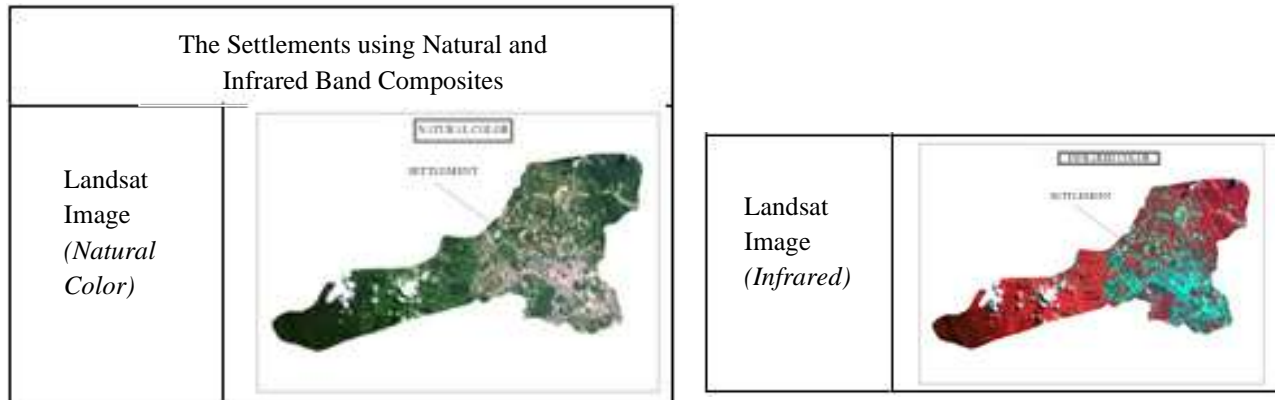


Fig. 3. Composite Band Landsat Image  
 Source: Interpretation Results, 2020

For the objects that are seen more clearly in Landsat Imagery is Forest, due to the appearance of objects that are close and far from the City center, so that the process of identifying Forest objects is easier, while objects that are difficult to identify or become a weakness in Landsat Imagery which has a resolution of

30 meters that are bush and mixed gardens, because most of the positions of the two objects are close together and their shapes do not look much different on the image, so it is quite difficult to distinguish the two objects on the Landsat Image.



Fig. 4. Objects in Landsat Image  
 Source: Interpretation Results, 2020

The results of Landsat Image Processing in 2009 were 516.92 hectares, or 9.02% of the total area of Solok City. This year, the dominant land use type is rice fields with an area of 1649.94 hectares or 28.78% of the area of the City, the increase in the development of settlements as the development of the City adds to the residential area in the City of Solok 278.16 hectares in 2014 making the settlement area 795.08 hectares, or 13.87% of the Solok City area, in 2014 the dominant

land use was 1618.75 hectares of rice fields, or 28.24% of the Solok City area, Along with the development of the City, five years later there was the development of residential areas in Solok City covering an area of 377.86 hectares, making the area of settlements in Solok City to 1172.94 hectares or 20.46% of the Solok City area, the dominant land use in 2019 was rice fields with an area of 1574.2 hectares, or 27.46% of the Solok City area.

The results of manual classification for mapping the development of settlements in the Solok City using SPOT 5 imagery with a resolution of 2.5 meters and SPOT 6 imagery with a resolution of 1.5 meters, using SPOT images with high resolution image categories are very helpful in identifying objects in the image because

of their shape. The objects that are clearly visible, overall all objects in the SPOT image are clearly visible so that when classifying land use for settlements and other land uses manually the objects are clearly visible and the results are also better than Landsat images and other medium resolution images.

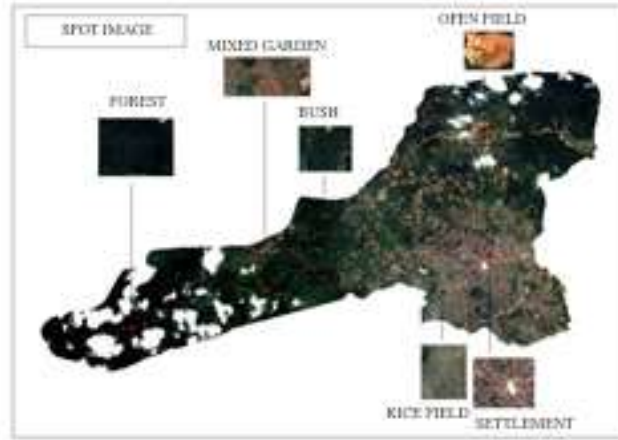


Fig. 5. Objects in SPOT Image  
 Source: Interpretation Results, 2020

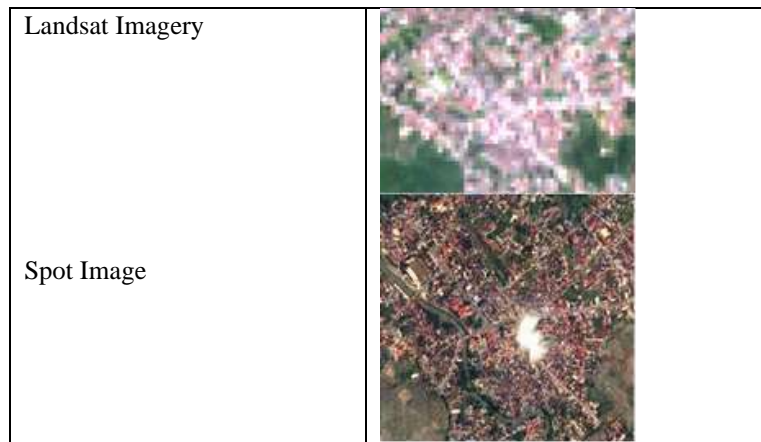


Fig. 6. Differences of Landsat Imagery and SPOT Image  
 Source: Interpretation Results, 2020

The processing results using Image of SPOT Year 2009, 2014 and 2019, in 2009 the settlement area was 430.02 hectares or 7.49% of the total area Solok City, this year for The dominant type of land use is forest with an area of 1563.32 hectares, or 27.24% of the City area, an increase The development of settlements occurs as the development of the City increases the area of the settlement area in Solok City 106.95 hectares in 2014, making the settlement area 536.97 hectares, or 9.36% of the Solok City area, in 2014 the dominant land use was forest 1586.79 hectares or 27.65% of the Solok City area, the development of the City in the next

five years increased the area of settlements in Solok City by 15.31 hectares, bringing the area of settlements in Solok City to 552.28 hectares or 9.62% of the Solok City area, for the dominant land use in 2019 is forest with an area of 1568.25 hectares, or 27.32% of the Solok City area.

#### 4. CONCLUSION

The conclusions obtained from this study are as follows:

1. The trend of Settlement Development in Solok City as seen from the results of interpretation using Landsat Imagery leading to Sub-areas or suburbs, where the sub district which has the most dominant settlement is Tanah Garam Village with an area of 234.63 hectares with a scattered (radial) settlement pattern, and at least Koto Panjang Village with an area of 9.24 hectares with a clustered settlement pattern.
2. The trend of Settlement Development in Solok City seen from the results of interpretation using Spot Image leading to Sub-areas or suburbs, where urban villages have the most settlements. The dominant one is Tanah Garam Village with an area of 86.51 hectares with a radial pattern of settlement, and at least 7.88 hectares of Koto Panjang Village with a clustered settlement pattern.
3. The results of Conformity Mapping of Settlement Development Trends in Solok City using Landsat Imagery, and in Overlay with RTRW it looks 9.42 hectares, there is a mismatch of Settlement development based on RTRW in 2014, and in 2014 2019 with an area of 5.62 hectares, while the results of the Conformity Mapping of the Settlement Development trend in Solok City using SPOT Imagery, and in Overlay with RTRW it can be seen 12.88 hectares did not happen the suitability of Settlement development based on the RTRW in 2014, and in 2014 2019 with an area of 0.32 hectares.

## 5. ACKNOWLEDGEMENTS

This research can be carried out smoothly, because of the help and cooperation of various parties. Therefore, the authors would like to thank all parties involved and the Bappeda of Solok City for providing information and data to hone our academic skills, especially in the field of remote sensing data processing in the study of settlement development.

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