MODEL OF GROWTH OF SETTLEMENT AREAS IN JAMBI CITY

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ABSTRACT: This study illustrates the growth model of Jambi City until 2035 supported by several driving factors derived from human activities and patterns of movement. Sampling based on the administrative Area of Interest (AOI) of Jambi City. Sources of data obtained from relevant agencies and remote sensing imagery (Landsat Image). Analysis of research data using demographic analysis, GIS, Cellular Automata and statistics. The results showed that there was a change in land cover during the predictions between 2016-2035; Judging from the growth of settlements, each year it is increasingly referring to the expansion diffusion model with concentric shapes through Cellular Automata modeling. Settlements will always grow in the Central Business District, namely Pasar Jambi District and Jelutung District and South Jambi District will further develop in 2035.

Keywords: Growth Model, Prediction, Land Cover, Settlement

1. INTRODUCTION

The city is a residential area that is physically indicated by a collection of houses that dominate the spatial layout and have various facilities to support the lives of its citizens independently. Understanding the city in terms of physical aspects is an area with a dense built area more than the surrounding area. In the demographic aspect of the city is an area with a population concentration that is reflected by the number and level of density that is higher than the condition of the surrounding area. In the social aspect of the city is an area with heterogeneous social groups. In the geographical aspect of the city is an area with a dense developed area compared to the surrounding area.

The population that continues to increase in an area will affect the increasing need for space that triggers the growth and development of an urban area. Basically, the development of an urban area is influenced by several aspects namely physical, social, cultural, knowledge and technological aspects. Urban developments from physical aspects can be observed directly from the land use of an urban area. Physical urban development can result in intensification of land use in cities and extensification of land use in the suburbs. The pattern of city development in a relatively flat area is generally easily spread out and evenly distributed.

Judging from its development, the City of Jambi is experiencing very rapid development. Starting from the economic sector, tourism, development and government. This resulted in many development activities in the city of Jambi caused by the increasing population in the city of Jambi. Population growth in the city of Jambi is due to several factors that drive the increase in population including the number of regional development activities, increased employment needs, the number of investors and others so that the need for shelter will follow the increase in population. The development of the City of Jambi is also accompanied by easy access, distribution of primary needs, infrastructure, centers of buying and selling activities, tourist destinations, government centers which are very easy to reach by the community.

The population from 1990-2015 increased by 236,123 people or 69% from 1990. In 1990-1995 the population increased 9%, in 1995-2000 the population increased 21.6%, in 2000-2005 the population decreased 1.9%, in 2005-2010 the population increased 29.9% and in 2010-2015 the population increased by 8.3%. These things will affect the amount of development in terms of residential development.

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The rise of the construction of settlements, especially housing-housing is rife with the increasing interest in subsidized housing at affordable prices. Law Number 32 of 2004 concerning Regional Government which was later revised to Act Number 23 of 2014 in article 274 mandates that regional development planning is based on data and information managed in the Regional Development Information System (SIPD). This further strengthens the position of SIPD as a reference material in the process of preparing regional development planning documents. However, the use of the SIPD application as a reference in the preparation of regional development planning documents is focused on the utilization of information generated based on data processing that has been inputted by local governments. Factors of completeness, up-to-date, accuracy and validity of the data become an important element in the process of collecting and inputting data elements which will then be further processed to produce data analysis in the SIPD application so that the results of this study are expected to be data for planning in development for the City of Jambi.

2. METHOD

This type of research is applied research. Applied research is carried out with regard to practical realities, the application and development of knowledge produced by basic research in real life. Applied research serves to find solutions about certain problems. The main purpose of applied research is problem solving so that research results can be utilized for the benefit of humans either individually or in groups or for industrial or political purposes and not for scientific insight only (Sukardi, 2003). The method in this study consisted of a database and data analysis using statistics and remote sensing data.

Data collection techniques in the study consisted of observation, remote sensing data collection and documentation. Observation is a method or technique of collecting data by systematically observing and recording the symptoms or phenomena that exist on the object of research (Pabundu, 2005). In geography, remote sensing is also very important in a study. Remote sensing data can be in the form of photo images, numerical data or digital data. To obtain remote sensing data can be done manually and electronically. The manual way by interpreting aerial photographs visually and electronically through technological assistance can distinguish the characteristics of an area through the electromagnetic spectrum through photo image data, non-photographic images or numerical data (Lillesand and Kiefer, 1990). In this study remote sensing data used to see the growth of residential areas is to use data through electronic means with the help of computers. Documentation is data retrieval in the form of photographs when in the field using a camera, recorder, and so forth. Documentation data in the form of photos during the observation and research activities regarding the growth of residential areas in the city of Jambi.

The data source in this study is secondary data as a reference for hypotheses and analysis obtained through libraries and related institutions. Secondary data needed are Jambi City Administration Map, Jambi City RTRW Map, Landsat Image Time Series in 2000, 2008, and 2016 through USGS Earth Explorer, Jambi City Population data, supporting data on Jambi City population and spatial planning.

Population is a generalization area that consists of objects or subjects that have certain qualities and characteristics determined by researchers to be studied and then conclusions drawn. While the sample is part of the number and characteristics possessed by the population. (Pabundu, 2005). The population in this study is the Jambi Province region. The sample used in the study used purposive sampling which is a sampling technique with certain criteria. The sample in this study is the Jambi City residential area in the form of an administrative area using AOI (Area of Interest) size of 20 x 20 km with a scale of 1: 90,000 that is processed through spatial processing using image data or map sources available as shown in Figures 1a, 1b , and 1c.

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(a) Landsat 2000   (b) Landsat 2008   (c) Landsat 2016

Picture 1. Data Citra Landsat Kota Jambi (USGS Earth Explorer)

GIS analysis used in this study is to use an automated or digital-based system. The computer as a data processing system through the digitization process obtained through image data, non-photographic and numeric data. GIS analysis to see the growth of the Jambi City settlement area through supervised classification of land cover (Supervised Classification) which has been corrected (Lo, 1995).
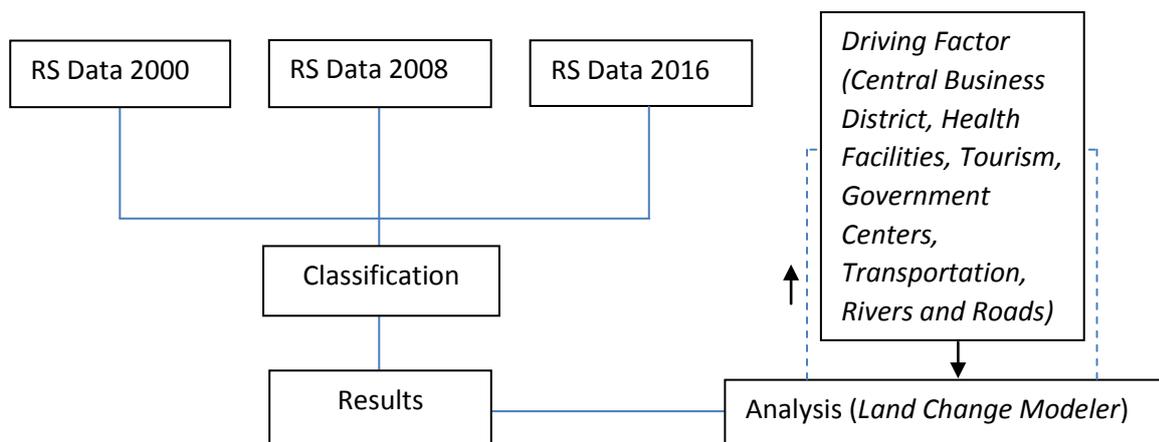
Picture 2. Proses Analisis *Land Change Modeler*

Changes in use will be modeled through the Land Change Modeler. Land Change Modeler (LCM) is modeling land changes in a particular area. LCM has the benefit of predicting land changes in the future so that it can be known the impacts arising from these changes. By knowing developments in the future, policy makers will be able to make current policies to avoid negative impacts in the future. Policies that see and pay attention to the quality of an area in the future are known as sustainable development (Antomi, 2016). Model validation that is often used to test the quality of land use classification results based on remote sensing data is Kappa accuracy (Jensen, 1996).

$$ K = \frac{N * \sum_{i=1}^{i} X_{ii} - \sum_{i=1}^{i}(X_{i+} * X_{+i})}{N^2 - \sum_{i=1}^{i}(X_{i+} * X_{+i})} $$

Description :

K   =   Kappa Value

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X_{ii} = Size of the i-th type of land use simulation results with the area of the i-th type of land use observation results

X_{i+} = Size of the third type of land use simulation results

X_{+I} = The area of the type of land use i observation

N = Total area of all types of land use

Z = Number of types of land use

After calculating the kappa, the kappa value will be interpreted based on the Coofesien of Agreement (Altman, 1991) which can be seen in table 1.

Table 1. Kappa Accuracy values based on Strength of Agreement

Value of K	Strength of Agreement
< 0.20	Poor (Rendah)
0.21 - 0.40	Fair (Lumayan)
0.41 - 0.60	Moderate (Cukup)
0.61 - 0.80	Good (Baik)
0.81 - 1.00	Very good (Sangat Baik)

Source: Altman, 1991

The table shows that the higher the value of the Kappa calculation results, the level of accuracy of the strength of the image classification is better so that the data can be received.

3. RESULTS AND DISCUSSION

3.1 Changes in Settlement Areas 2000-2016

The results of the interpretation of the Jambi City land cover map consist of forest land, agricultural land, open land, bush, body of water and settlements. Then the results of interpretation on the image calculated the extent of the change in figure 3.

Change in Land Cover of the City of Jambi in 2000, 2008, 2016

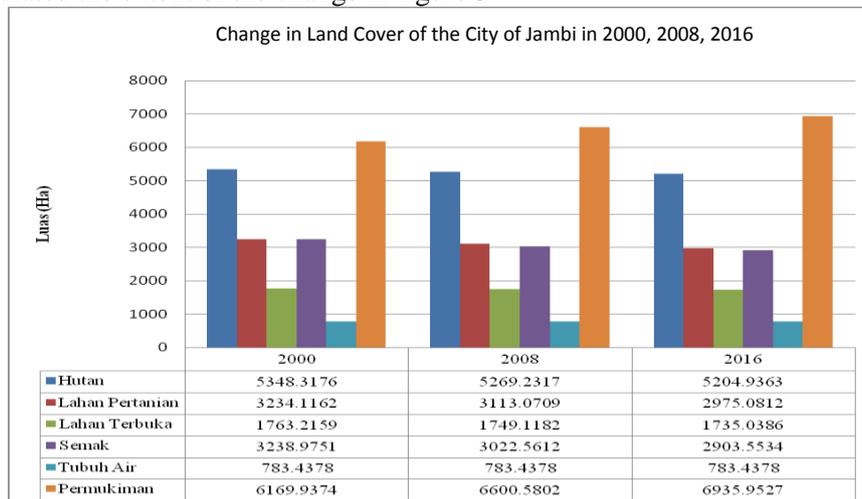|	2000	2008	2016
Hutan	5348.3176	5269.2317	5204.9363
Lahan Pertanian	3234.1162	3113.0709	2975.0812
Lahan Terbuka	1763.2159	1749.1182	1735.0386
Semak	3238.9751	3022.5612	2903.5534
Tubuh Air	783.4378	783.4378	783.4378
Permukiman	6169.9374	6600.5802	6935.9527

Figure 3. Changes in Land Cover of Jambi City in 2000, 2008 and 2016

The results of the analysis of land cover classification in figure 3, in 2000 the area of forest cover in Jambi City was 5348.3176 ha, agricultural land was 3234.1162 ha, open land was 1763.2159 ha, bush land was 3238.9751 ha, water body of 783.4378 ha and residential land of 6169.9374 ha. In 2008, the area of forest cover in Jambi City was reduced to 5269.22317 ha, agricultural land was reduced to 3113.0709 ha, open land was reduced to 1749.1111 ha, bush land was reduced to 3022.5612 ha, water bodies remained broad and land area settlements increased to 6600,5802 ha. In 2016, the area of forest cover in Jambi City was reduced to 5204.9363 ha, agricultural land was

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reduced to 2975.0812 ha, open land was reduced to 1735.0386 ha, bush land was reduced to 2903.5534 ha, water bodies were fixed and land area the settlement increased to 6935,9527 ha.

In 2000-2008 there was an increase in residential areas by 6.97% or 430.6428 ha. In 2008-2016 residential areas continued to grow by 5.08% or 335.3725 ha. The change in land of Jambi City is triggered by several factors driving the development of Jambi City settlements such as increasing population, Jambi City as an economic sector of trade, services and services that is centered on the center of Jambi City.

3.2 Driving Factors that Affect Changes in the Jambi City Settlement Area

Changes in land cover in Jambi City in particular changes in residential areas are based on several driving factors namely physiographic, economic, trade, service and service factors (Mitsova, 2011). Some of these factors are broken down into spatial data to see the strength of these factors affecting settlement changes in the City of Jambi. Economic factors, trade, services and services obtained through the Ground Check Point (GCP) and digitization which then conducted a proximity analysis to see the extent of influence of each factor on changes in residential areas.

Proximity used consists of 7 driving factors including the Central Business District, Health, Tourism, Central Government, Transportation, River and Roads. Proximity area is obtained from the driving factor through the stages of GIS analysis. The proximity area that affects the growth of settlements can be seen in Figure 4.

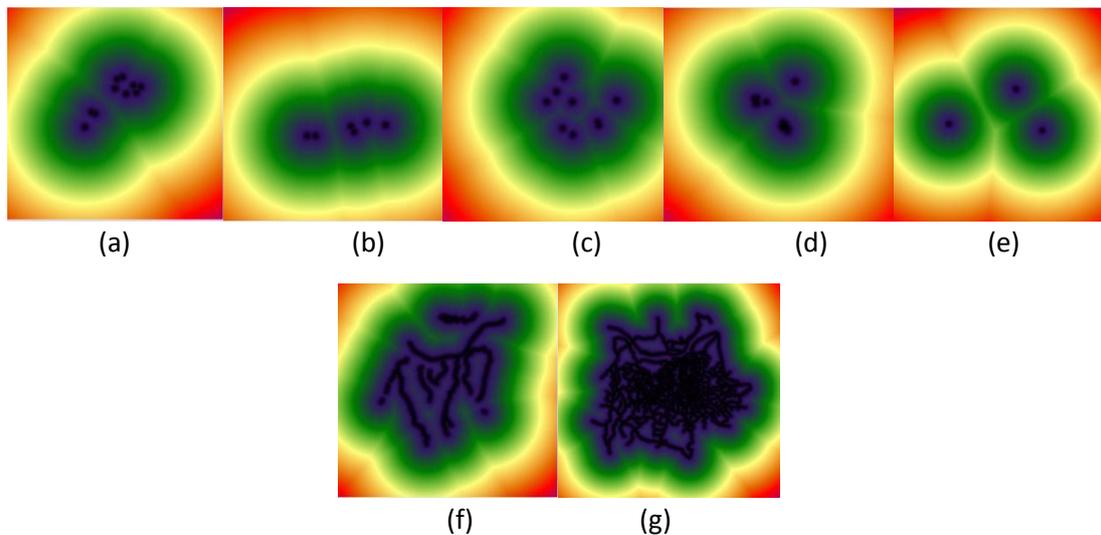(a) (b) (c) (d) (e)

(f) (g)

Figure 4. Proximity Area Driving factors: (a) Central Business District, (b) Health Facilities, (c) Tourism, (d) Government Centers, (e) Transportation, (f) Rivers and (g) Roads

Figure 4 shows that each driving factor that has been analyzed as a proximity area has a different color. These colors indicate the influence of driving factors in the growth of the residential area of Jambi City. As can be seen in the picture, the more directed towards red means the spatial distribution of cells is getting weaker while the more directed towards dark colors, the spatial distribution of cell movement is getting stronger.

In this study, the response variable used is the occurrence of changes and no changes in land cover within a certain period. The occurrence of change is denoted by number 1 and not occurrence of

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change is notated by number 0. In binary logistic regression, the regression equation will connect the logit of change (pi) which functions as the response variable with a number of predictor variables Xi (1, 2, ... k) (Munibah, 2008). Binary logistic regression calculations are done with the help of software. The binary logistic regression equation can be written as follows:

$$\text{Logit } (pi) = α + β1X1 + β2X2, βkXk$$

The change logit is basically the natural logarithm (ln) of the change odd. Odd of an event is the ratio between the chance of an event occurring and the chance of an event not occurring. The results of regression performed the results of the analysis of the software produced an Odd Ratio of 572.9784. Odd Ratio can be said to be used for prediction if the value is more than 1. Because the Odd Ratio is> 1 then the driving factor can be used for prediction in cellular automata modeling.

3.3 Changes in residential areas using the Cellular Automata Model

Cellular automata models use images and driving factors to predict the picture of land cover development. The results of predictive image quality can be seen from kappa accuracy and for driving factors using the odd ratio from statistical analysis. Kappa accuracy for predictions has good criteria with a value of 0.63 and an odd ratio of driving factors> 1. So the image can be projected forward based on driving factors. The projection of the growth of Jambi City settlements is carried out for 2020 - 2035. It was found that the growth of the Jambi City area is increasing and for other land cover is decreasing. This can be seen in table 2.

Table 2. Changes in Land Cover of the City of Jambi (Ha) based on Predictions of Businees as Usual (BaU)In 2016-2035

Land Cover	Hutan	Lahan Pertanian	Lahan Terbuka	Semak	Permukiman
Hutan	5012.296	45.4496	17.5659	7.788	121.8365
Lahan Pertanian	5.9169	2547.2579	38.7574	46.6089	336.5401
Lahan Terbuka	4.6418	16.0876	1676.9442	9.2353	28.1297
Semak	24.8528	60.5116	79.7366	2401.011	337.4416

Source: Processed Research Data

Based on the data in table 2, changes in the area of Jambi City land cover based on BaU predictions for 2016-2035, the forest land cover that has changed into agricultural land by 45.4446 ha, open land by 17.5659 ha, bushes by 7.788 ha and settlements amounting to 121,8365 ha. On agricultural land cover which changed into forest land amounted to 5.9169 ha, open land amounted to 38.7574 ha, bush amounted to 46.6089 ha, and settlement amounted to 336.5401 ha. In the open land cover which changed into forest land amounted to 4.6418 ha, agricultural land amounted to 16.0876 ha, bush amounted to 9.2353 ha and settlements amounted to 28.1297 ha. On shrub land that has changed into forest land by 24.8528 ha, agricultural land by 60.5116 ha, open land by 79.7366 ha and settlements by 337.444 ha.

Total land cover changes that occurred in the period 2016-2035 for forest land cover which was consumed as another land cover amounted to 192.64 ha, agricultural land that was consumed as another land cover amounted to 427.8233 ha, open land that was consumed became another land cover amounting to 58.0944 ha, bushes which are consumed as other land cover is 502.5426 ha, and settlements are increasing at 1181,1003 ha.

The growth model of residential areas in the city of Jambi uses the Cellular Automata model which is a dynamic model of regular cell-to-cell interactions that can present changes in land use and

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predictions in the future. Spatial data and driving factors are core data in interpreting changes and predictions of future land use (Guan et al., 2011).
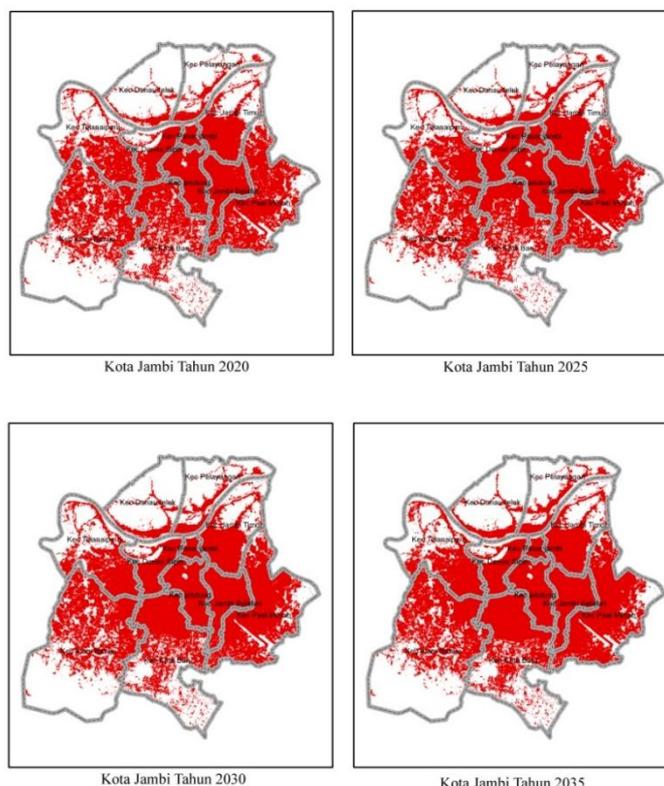

Figure 5. Change of Settlement Area with Cellular Automata Modeling

The results in Figure 5 show that Cellular Automata modeling is used not only in predicting land use change, but can also be a design plan and policy direction. Cellular Automata modeling began in 2020 - 2035. In Cellular Automata modeling seen in 2020-2035, the city of Jambi is developing very rapidly in terms of the growth of residential areas.

Judging from the pattern of the direction of its development according to Haget (2001), the pattern of development of the Jambi City settlement area is more directed to the concentric (centralized) pattern. The direction of its development is centered in the Central Business District in Pasar Jambi District. Furthermore, it experienced a development in the direction of Jelutung and South Jambi Districts.

4. CONCLUSION

The growth of residential areas in the city of Jambi experienced very rapid development until the year 2035. Along with the problem of population growth, it is possible to influence the increasing number of settlements in the city of Jambi. Based on the results of image analysis that has been overlaid, it is found that Jambi City settlements from 2000, 2008 and 2016 have always experienced a very large development. The development that occurred was concentrated in the center of the CBD, Pasar Jambi District. The results of image analysis using the Cellular Automata Model show concentric developmental directions.

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