

# Analyzing the Factors Which Influence the Development of Mangrove Forest in Kulon Progo Using Binary Logistic Regression and Remote Sensing Method

Muhammad Hasan Sidiq Kurniawan<sup>1,\*</sup>, Akhmad Fauzy<sup>1</sup>, Muhammad Muhajir<sup>1</sup>

<sup>1</sup>*Department of Statistics, Faculty of Mathematics and Natural Science, Islamic University of Indonesia, Yogyakarta.*

<sup>\*</sup>*Corresponding Author. E-mail: hasan.sidiq@uii.ac.id*

## ABSTRACT

The Province of Yogyakarta is one of the tourism destinations in Indonesia. In recent years, there are new many tourism sites in Yogyakarta. One of them is the Mangrove forest in Kulon Progo. The Mangrove forest is a popular tourist site among the locals in there but many outsiders of Yogyakarta that do not know about this site yet. That is because the access to that site is quite difficult. Also, we believe that there are many factors which delay the development that Mangrove site. In order to help the development of that area, we would like to know the real factor which impacts the development of the Mangrove site, especially from the tourism perspective. Therefore we analyze the factors which influence the happiness of the tourist using the binary logistic regression, because the happier the tourist, the site will be more popular and hopefully develop from the tourism perspective. The binary logistic regression's result shows that the happiness of the tourist influenced by mangrove location, age, and gender. The mangrove location factor that influences tourist happiness is about the difficultness of access. As for that factor, we will use the remote sensing method to identify what really happened in the locations and give solutions to that problem.

**Keywords:** *Mangrove, Binary Logistic, Remote Sensing, Kulon Progo.*

## 1. INTRODUCTION

The Province of Yogyakarta is well known for its culture, school, and tourism. That Province also called the city of culture. The consequences of that are there are many tourism sites in Yogyakarta, which is based on the culture in Yogyakarta. There is two types of tourism site in Yogyakarta: man-made tourism and nature tourism. Yogyakarta has many beaches as a tourism site and in one of those beaches, exist the Mangrove forest, located in Kulon Progo. But, the existence of that forest not yet well known by a tourist. Tourist knew Yogyakarta for its Tugu, Malioboro, and Parang Tritis. The tourism site, Mangrove forest, not yet fully become the Yogyakarta tourism trademark. As we analyze further, the locally well-known Mangrove forest has a very difficult access and the promotion effort is very minimal [1]. We will use the remote sensing method to know the problem in that Mangrove forest from a spatial perspective. From the result of remote sensing analysis, hopefully, we will find the solution for the difficultness access to that site and to set up some shrimp pond which is, for now, no legal regulations about that which cause the Mangrove site became dirty and uncomfortable. The using of remote sensing analysis and

GIS (Geographic Information System) to analyze the mangrove problem is common sense. The same research already was done by Thi, et. al (2014) to analyze the change of mangrove shorelines in long time period[12]. That is because remote sensing and GIS can evaluate the nature condition from time to time using the aerial photo. Gandhi, et. Al (2015) also using those methods to analyze the vegetation change[11]. Also, we will analyze the happiness of the tourist in there using the binary logistic regression because the happiness of the tourist is correlated with the development of the Mangrove forest as tourism site. We divide the happiness variable into two different categories, which are happy and unhappy. Also, we decide the independent variable consist of gender, age, and their purpose in the mangrove site. In the near future, we will hope that the Mangrove forest could be the tourism trademark in Yogyakarta, not only for its tourism aspect but also for its function to conserve Mangrove in Yogyakarta [10].

This paper consists of four sections. Section II tell about the material and method used in this research. Section III consist of the result of the analyzed data using binary logistic regression, remote sensing, and GIS. And the last one is section IV that conclude the conclusion of this research.

## 2. MATERIAL AND METHOD

### 2.1. Binary Logistic Regression

Logistic regression is part of regression analysis used to analyze the dependent variable for which is the category and the independent variable is category, continuous, or aggregation of them. Binary logistic regression model used to analyze the relationship between one dependent variable (Variable response) and some independent variable, with variable response in the form of qualitative dichotomous that is worth 1 to declare "existence" of the characteristics and is said to be worth 0 to declare "not existence" a characteristic [2]. Logit model of logistic regression as defined as:

$$\left(\frac{\pi(x_i)}{1 - \pi(x_i)}\right) = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \dots + \beta_p X_{pi} \quad (1)$$

To know the influence of independent variable, so conducted by test significance as the parameter as a whole as well as individually. Statistics test used in overall test is G test or likelihood ratio test. Whereas test used in the partial test is Wald test [3].

In the progress of the analysis, eventually we will have more than one logistic regression models. Therefore we had to choose one model among the others which is best describe the situation based on the data collected. In choosing the model, we will use the AIC (*Akaike Information Criterion*). AIC is used to measure the goodness of the statistical models. The little the value of AIC, the model is better. The AIC is defined by:

$$AIC = -2 \log(L) + 2K \quad (2)$$

where  $K$  is the number of the parameter consisted in the model and  $L$  is the maximum likelihood of the model. For example, if the data consist of 3 independent variables then the parameters are  $\beta_0, \beta_1, \beta_2$  and  $\beta_3$ . Therefore the value of  $K$  is 4. As for the value of  $L$ , its value is based on the likelihood function of the residual.

### 2.2. Selection Based Method

AIC method is a method that can be used to select the best regression model invented by Akaike and Schwarz [4]. How to select several models to choose the best model is based on AIC with the following formula [5]

### 2.3. Geographic Information System

Geographic information system or information system based mapping and geography is management of information closely related to a mapping system. GIS technology integrating the operation of a database that are used today, As the collection of data , as well as statistic analysis with

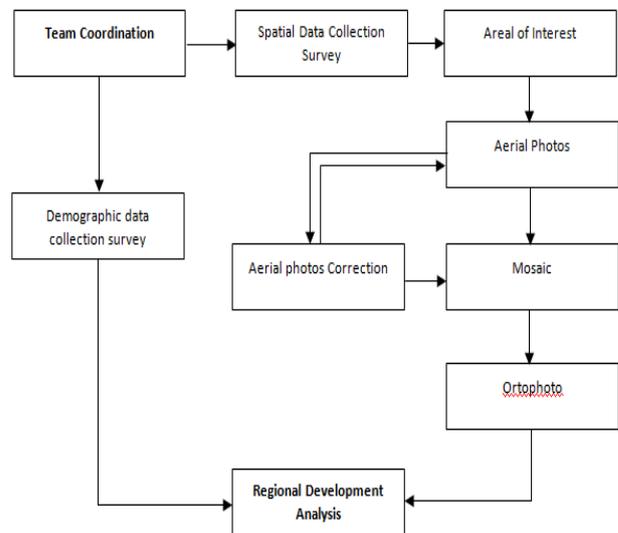
visualization. The data process in geographic information system there are two kinds of the data geospatial or usually called spatial data and data non spatial (attributes) [6].

### 2.4. Remote Sensing

Remote sensing is a technology that is able to overcome the problems measurement of data for information that fast and accurate. Implementation of remote sensing technology in regional mangrove, one of them is taking process mosaic aerial photographs to attempt developing the sustainable mangrove. Development activities ecotourism industry based conservation in the region ecotourism Kulonprogo regency especially Pasir Mendit and Jangkaran village started by taking aerial photos data use *Unmanned Aerial Vehicle* (UAV) [7].

Development of an area, requires a variety of supporting data, so that the direction of regional development can be measured and maintained and sustainable. One of the supporting data that can be used for regional development is spatial data. in its development, the use of spatial data, can be used for sustainable development efforts [8].

One source of spatial data, which is used in this study is aerial photo data. Photo data is obtained by using Unmanned Aerial Vehicle (UAV) technology. Aerial photo data is used because it has a large resolution [9], so that the information obtained about the existing conditions in the study area will also be more complete. In simple terms, the research process from data retrieval to processing can be observed in the flow diagram of Figure 1.



**Figure 1.** Flow Chart for obtaining the Photo data

The process of shooting is done by paying attention to the sidelap and overlap, so that later the aerial photo data can be merged.

To simplify what we have done, we will show the flow-chart for the whole research. Hopefully, from the flow chart,

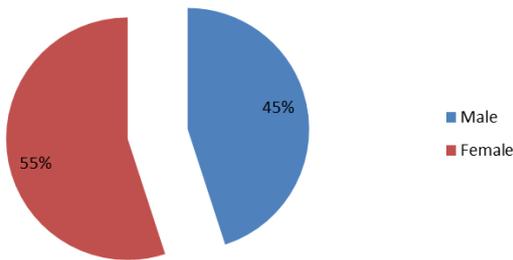
the connection between the logistic regression and remote sensing method can be shown.

### 3. RESULT AND DISCUSSION

In this section, we will analyze the data collected from tourism survey and spatial survey.. The first one, we will analyze based on tourism data.

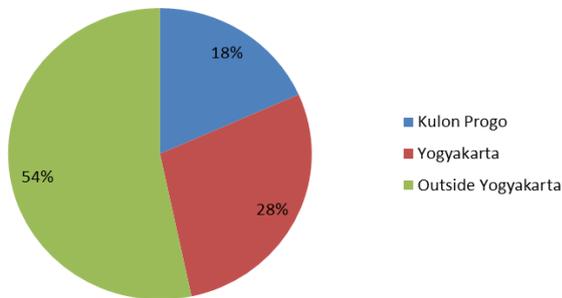
#### 3.1. Characteristic Demography of Tourism

As the initiative, we will use the descriptive statistics to know from general perspective about the data.



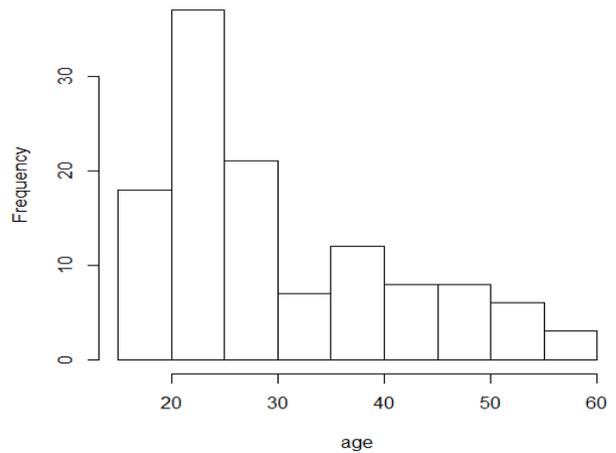
**Figure 2.** The proportion of tourist's gender

As shown on Fig 2. we knew that the female tourist is more quantity. All of that tourist is coming from Kulon Progo, Yogyakarta, and outside Yogyakarta.



**Figure 3.** The proportion of tourist's origin.

The tourist in the mangrove forest are coming from various age. Most of the are youngster. But, there are some elderly too. The detailed figure about the proportion of tourist's age is shown in the histogram below.



**Figure 4.** Histogram of tourist's age

From the figure we know that many youngster on age 20-25 are coming to this site. And the tourist on age 55-60 are having the least amount.

The next analysis have a goal to know what are the factors that influence the tourist's happiness. We will use the binary logistic regression and determined the dependent variable is the tourist's happiness which consist of "happy" and "not happy" category. Also, we determined the independent variable are the Mangrove location (X1), gender (X2), age (X3), their intention going into the Mangrove site (X4), and their priority in the Mangrove site (X5). The X4 and X5 variables consist of categorical data. The variable X4 consist of three categories, which are vacation, research, and others. The categories in X4 are determined by the result of interviewing the Mangrove site visitors. Most of them visit the site for vacation or research purposes, while the other purposes we classify it as others. As for variable X5 also consist of three categories, which are main destination, alternative destination, and transit. Most of the visitors have top priority to go into the Mangrove site while the others go into the site not as their main destination or just for transit. Using the the binary logistic regression, we will know about the prediction of the tourist's happiness based on the independent variable that significantly influence that variable. For this research we selected the significance level as 10% because this research is about social phenomena in the Mangrove site, which is the happiness of the tourist. Using the parsimony principle and significance rate at 10%, we get the best three model with AIC as follow:

**Table 1.** The Model's AIC Comparison

Model	Variable Excluded	AIC
1	None	47.682
2	X4	47.481
3	X4, X5	43.679

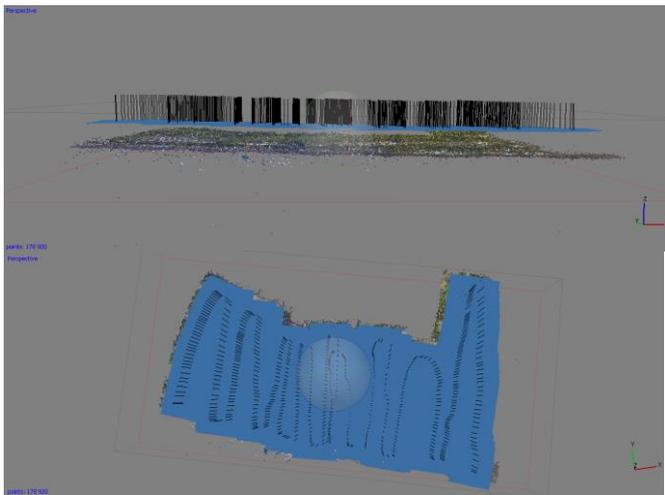
From the Table I above, we will choose model 3 because it has the least AIC among those three. The model is written in the equation below

$$\log\left(\frac{\pi_{unhappy}}{1-\pi_{unhappy}}\right) = 7.8749 - 20.3553(X1Mendit) + 4.1642(X1Wanatirta) + 2.0208(X2) - 0.4807(X3)$$

From the equation above, we knew that the Mangrove location is influencing the happiness of the tourist. In reality, there are three Mangrove location in Kulon Progo and there is a significance difference among those three. Also, the female tourist have bigger probability to become unhappy and the younger the tourist, the more they can become unhappy. That is, of course, because the youngster have a lot of demand on that Mangrove location. They want some place where they can selfie and enjoy themselves. As for the elderly, they only want some piece in the Mangrove location. The location of the mangrove become a key factor in order to increase the popularity of the tourist attraction. The easiness of the access become a plus point for the tourist attraction. Otherwise, it could decrease the interest of the tourist to go there. Therefore, in this research we will analyze the location factor using the remote sensing method in order to know the real condition based on the aerial photography result and give solution to the problem. The explanation of the remote sensing method and its result will be explained in the next sub-section.

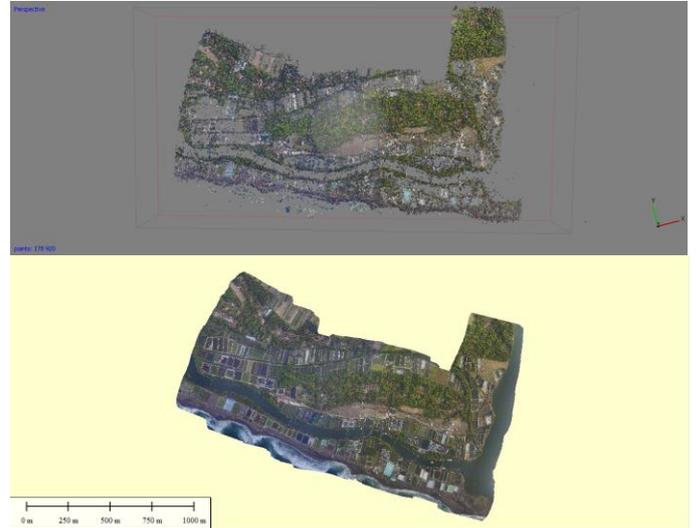
### 3.2. Data Aerial Photography Acquisition of Mangrove Areas

The acquisition process begins by shooting aerial photo data using a UAV vehicle. The results of shooting using a vehicle, obtained 600 upright photos at a cruising range of 200m. We checked those photos and some of them are blur and error. Therefore we re-shooting aerial photo once again to correct the blur and error photos. The next step is combine all of the obtained upright photos. The combined result can be observed in **Figure 5**.



**Figure 5. Combined Aerial Photo**

Then the photo correction process is carried out, obtained 425 upright photos that can be done by aerial photo mosaic process. Aerial photo mosaic process uses computer applications. Aerial photographic mosaic results can be observed in **Figure 6**.



**Figure 6. Aerial photographic mosaic results**

The Aerial photographic mosaic results have spatial resolution up to 7.4 cm. That high resolution can be used to high scale mapping. Based on the results on **Figure 6**. The full map for the Mangrove site can be created, which is shown on **Figure 7**.



**Figure 7.Orthopoto Mangrove Area**

The results of the acquisition of aerial photographs, obtained high-resolution aerial photos (5 cm). with high resolution data it can be used for large scale mapping. In addition, the level of information and accuracy of identification of objects in the field will also be higher. The use of UAV technology is very helpful also in the context of monitoring the condition of the region, one of which is the change in land use in the mangrove area.

### 3.3. Regional Development Planning

Development of the area in the Kulonprogo district mangrove area, must consider several elements, such as aesthetic elements, but do not forget the environmental elements. At present the mangrove area in Kulonprogo Regency is developed as a coastal tourism area. most of the rides in the area utilize environmentally friendly wood materials, which are then formed into various rides such as bridges and small huts. In addition, there are also tours by boat.



**Figure 6.** Mangrove Coastal Tourism in Kulonprogo Regency

Some problems that have the potential to damage the mangrove tourism area, even the mangrove ecosystem itself is a waste problem. Problems regarding waste must get extra attention, because the position of mangrove areas on the banks of the river, and also the tides of the sea, will carry waste shipments. Furthermore, aerial photo data, as can be observed in **Figure 6**, can be used to develop plans for developing more mature mangrove tourism areas. A number of things that can be done in the future are using the aerial photo spatial data by mapping land use, zoning mangrove areas and mapping potential disasters in the area, such as abrasion and flash floods.

### 4. CONCLUSION

Based on binary logistic regression analysis, we knew that the variable which influence the happiness of the tourist are Mangrove location, gender, and age. The female and younger tourist has higher probability to become unhappy. And there is difference satisfaction between the three Mangrove location. The government and the management should be aware of that information, in order to expand the popularity of the Mangrove location among the tourist.

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