

## IMPLEMENTATION OF WEB-GIS FOR MONITORING ENVIRONMENTAL CHANGES RESULTING FROM EXPANSION IRON SAND MINING IN LUMAJANG

**Gilrandy Hardinadhir Zakirin<sup>1</sup>, Suprpto, S.T, M.T<sup>2</sup>, D.Sc. Fatwa Ramdani, S.Si.<sup>3</sup>**

Sistem Informasi, Fakultas Ilmu Komputer, Universitas

Brawijaya Jl. Veteran No.8 Malang

Email: gilrandy08@gmail.com<sup>1</sup>, praptomlg@yahoo.com<sup>2</sup>, fatwaramdani@ub.ac.id<sup>3</sup>

### ABSTRACT

*This research is motivated by iron sand mining activities in the southern coastal Lumajang - East Java that is not controlled and if continuous monitoring is not done in the long term can lead to negative impacts on local communities and the destruction of ecosystems environment. Geographic Information Technology Advancement is now urgently needed. So also in the field of Geo Information System (GIS), the technology into a tool and is essential to store, manipulate, analyze, and display back with the help of natural conditions and spatial attribute data. To anticipate the occurrence of disasters due to the negative impact of mining activities that have not been controlled. The researchers then wanted to take advantage of Technology Geo Information System (GIS) to monitor the Web-based iron sand mining activities and to determine the land area along the southern coast of Lumajang. The data is the data taken with the vulnerable period of 10 years starting from 1985 to 2015. Satellite data used is the Land Cover Classification using Semi Automatic Plugin QuantumGIS derived from Landsat satellite sensor and processed using QGIS. This research is expected to provide benefits, including to increase public awareness of the environment, increase understanding of the concepts and applications of Geographic theory, as consideration for the local government. And most importantly to anticipate the occurrence of natural disasters.*

*Keywords: WEB-GIS, Monitoring Environmental Change, Iron Sand Mining*

## 1. INTRODUCTION

### 1.1. Background

#### - Problem

This research is motivated by iron sand mining activities in the southern coastal Lumajang uncontrolled. If continuously left in the long term can lead to negative impacts on local communities and the destruction of ecosystems and infrastructure environment.

#### - Lumajang

Lumajang, is a district in East Java province, Indonesia. Its capital is Lumajang. The district borders in the north Probolinggo, Jember regency in the east, the southern Indian Ocean, as well as Malang regency in the west. Lumajang Regency is located in the area of horse hooves, East Java.



**Figure 1 : Lumajang**

#### - Iron Sand Lumajang

Lumajang iron sand has the best quality in East Java because the content Soil / sludge bit, standard sand grains and colors and adhesiveness the good one. (Head of Economy District. Lumajang

#### - Solutions

Researchers would like to take advantage of Geo Technology. Information System (GIS) to monitoring environmental changes (area) mined lands in the coastal Lumajang the south coast in the form of Web Deploy. To perform monitoring, researchers used data obtained from USGS Landsat satellite sensor belongs downloaded from the site earthexplore.usgs.gov

### 1.2. Formulation of the problem

- How to design a Geographic Information System (GIS) -based Web for monitor iron sand mining activities in the southern coastal district Lumajang?

- How hectarage iron sand mining activities in coastal areas south Lumajang unchanged throughout the study period?

### 1.3. Scope of problem

- Regions monitoring iron sand mining is focused on the area around the southern coast of Lumajang, especially on the land near the farm or plantation.

- The data taken is the data starts from 1995 to 2015.

- Satellite data used are processed using the Land Cover Classification Semi Automatic Plugin with QuantumGIS software.

- This system does not address the business process, but focus on monitoring changes in the area of iron sand mining land in Lumajang

## 2. GROUNDING LITERAURE

### 2.1. Geographic Information System (GIS)

Geographic information system is a computer-based system for capturing, storing, checking, integrating, manipulating, and displaying the data with digital maps. (Turban, 2005). The terms of geography used for GIS is built based on geography or spatial. This object leads to the specification of the location within a space. GIS is a computer system that is based on the information system used to provide digital form and analyzed the geography of the earth's surface. Geography is get to know the earth's surface and all objects above it, while the geographic information system (GIS) is a specialized information system that manages data having spatial information (spatial referenced). Geographic information system is a form of an information system that presents information in graphical form by using the map as an interface. SIG is composed of the concept of multiple layers (layer) and relationships. (Prahasta, 2002)

### 2.2. Landsat satellite

Landsat satellite is one of the satellites used to observe the Earth's surface. This satellite is known as a satellite of natural resources because its function is to map the potential of natural resources and monitor the environmental conditions. Instruments Landsat satellites have produced millions of images. These images archived in the United States and Landsat receiving stations around the world that have the resources to global change research and its application in agriculture, geology, forestry, regional planning, education, and national security. Landsat satellite is one of earth resources satellite developed by NASA and the United States Department of the Interior.

These satellites are divided into two generations, namely:

- The first generation, the first Landsat satellite, Landsat 2, and Landsat 3. This generation is an experimental satellite (experimental).
- The second generation, namely Landsat 4 and Landsat 5 satellite is operational (Lindgren, 1985), whereas (Short, 1982) named as a satellite research and development. (Sutanto, 1994)

Landsat satellites are constantly evolving in each generation. In the monitoring study of land area, I use Landsat 5, Landsat 6, Landsat 7 and Landsat 8.

### 2.3. Leaflet

Leaflet is a javascript library that is open source to build a web-based map applications. Open Source means free use, at no cost, and can be distributed freely (Safavi, 2014)

### 2.4. QuantumGIS

Quantum GIS is is the Geographic Information System (GIS) which is user friendly Open Source licensed under the GNU General Public License. QGIS is not an official project of the Open Source Geospatial Foundation (OSGeo). QGIS can run on Linux, Unix, Mac OSX, Windows and Android, and supports many formats and data functionality of vector, raster, and database. (QGIS, 2015)

### 2.5. Plugin Semi Automatic Classification

Semi Automatic Classification Plugin is a free open source plugin for QGIS that allows for the Semi Automatic Classification of remote sensing images. Also provides several tools for image pre-processing, post-processing classification and calculation of raster. (QGIS, 2015)

## 3. RESEARCH METHODS AND DESIGN

### 3.1. Literature Study

The literature study was conducted in order to learn how the literature of several disciplines related to the manufacture of Web GIS for environmental management as a result of iron sand mining in Lumajang.

Theories being studied are:

1. WEB Programming on Geographic Information Systems using PHP programming language
2. Methodology waterfall in SDLC (System Development Life Cycle)
3. Unified Modeling Language (Use Case Diagram, Sequence Diagram, Class Diagram)
4. Testing software

### 3.2. Collection Data

The collection of data is needed to determine what needs to be needed in this research. The aim is to facilitate the determination of the needs of the system. In this case the needs of the data that is needed is the data related to uncontrolled mining site in the southern coastal area Lumajang particular farm and surrounding residential areas. USGS data source using the site in the form of data Landsat and open street map. The method used by the search data by satellite Landsat and surveys.

### 3.3. Requirements Analysis

Requirements analysis is done by determining the needs of what is required in the manufacture of these systems. These needs include:

#### a. Hardware Requirements

1. PC with the following specifications:
2. at least 2 GB RAM
3. The minimum 500 GB Hard Drive

#### b. Software Requirements

1. Sublime Text / Notepad ++
2. Browser (Google Chrome, Mozilla Firefox, Torch)
3. XAMPP
4. PHP, MySQL, HTML, CSS, Javascript
5. Quantum GIS (QGIS)

**4. IMPLEMENTATION**

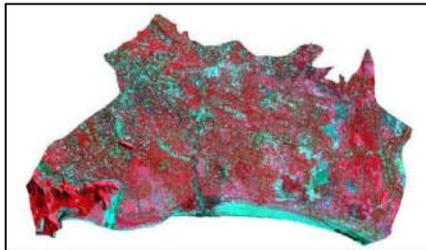
**4.1. Implementation Environment**

In this chapter will describe the implementation environment used in the development of the system. The software used in the development of the system: 1. Windows 7 64-bit 2. Xampp 3.2.1 3. Quantum GIS 2.10 4. Google Chrome 48.0.2564.97 m 5. MapSource 6.13.7 6. Notepad++ 6.8.8

**4.2. Process Data Management**

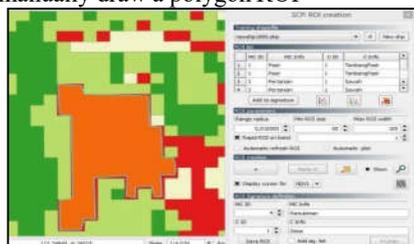
Preliminary data needed to build Web Geographic Information System (GIS) monitoring environmental changes as a result of the expansion of iron sand mining in Lumajang is the data land cover. The data was obtained through Landsat satellite sensor downloaded from the website belonging to the USGS, namely: <http://earthexplorer.usgs.gov/yang> form of raster data. The data is then managed by the classification using software QuantumGIS and implemented in the form of the web through the extraction process in the form of HTML and Javascript.

- Raster Data Lumajang before the classification process uses software QuantumGIS cut with a focus on research areas, namely in the area south coast near farmland and residential areas.



**Figure 2 : Raster Data Lumajang**

- The next step is to choose a ROI (Region of Interest) as an image region used for the classification process to be performed. In the panel select the Shapefile Training New.shp and specify the name and location of shp file that will be created as a polygon that will be used. ROI can be selected by using the button create a ROI to manually draw a polygon ROI



**Figure 3 : Drawing ROI Polygon**

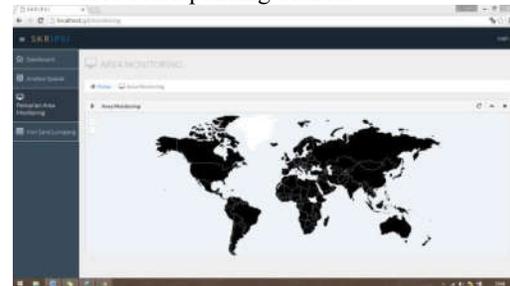
- In the classification phase change mined land on the south coast of Lumajang there are four criteria and distinguished by colors on each criterion. Those criteria are as follows:
  - Iron sand with white
  - Agriculture (rice field) with light green color
  - Settlement Residents in red
  - Forests in dark green



**Figure 4 : Criteria Process**

**4.3. Implementtion Interface**

- Page Searching Monitoring Area  
Monitoring Area Search page is a page that can be used by users / general public to conduct a monitoring area iron sand mining area corresponding desired.



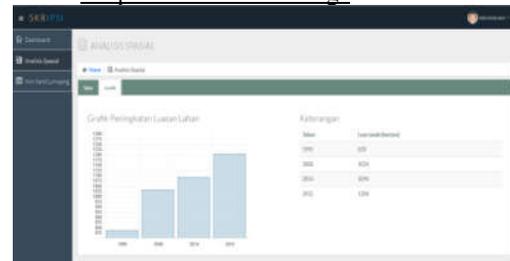
**Figure 5 : Search Monitoring Area**

- Page Analysis Spatial



**Figure 6 : Page Analysis Spatial**

- Graph difference hectarge



**Figure 7 : Graph difference hectarge**

## 5. CONCLUSION AND SUGGESTION

### 5.1. Conclusion

Implementasi Web-GIS that have been made. Can be concluded as follows:

Designing a Web-Geographic Information System for monitoring environmental changes as a result of the expansion of iron ore mining in Lumajang is done by taking the data obtained from sensors belonging USGS Landsat satellite were downloaded from the site [earthexplore.usgs.gov](http://earthexplore.usgs.gov). The data taken is sensor data starts from 1995 to 2015. The land cover data is processed by performing classification using semi-automatic classification plugin with SoftwareQuantumGIS.

Of identification that has been done to produce such implementation system that can display the differences hectarage iron sand mining area south coast of Lumajang district before and after mining. Based on the graph increase in hectarage result that before the mine in 1995 iron sand area covering 839 hectares and after mining seen in 2015 increased sand mining area is 1,206 hectares that extends to the area of agriculture and plantation.

### 5.2. Suggestion

Implementasi Web-GIS that have been made. The author offers suggestions that are likely to be useful to owners and users, namely:

1. In order for Web-GIS is more perfect required further development, especially in facilities complete web more like email, chart room and so forth.
2. The need for a security system developed, so Web-GIS is already available can be maintained from things that are not desirable.
3. This study is not comprehensive, because it merely displays hectarage as a result of mining activities throughout the study period. So to further research activities for those interested should be able to show on the mining areas which still do mining and vulnerable areas where mining continues it can lead to natural hazards.

## 6. BIBLIOGRAPHY

As'ad, 2005. Thesis : Pengelolaan Lingkungan pada Penambangan Rakyat ( Studi Kasus Penambangan Intan Rakyat di Kecamatan Cempaka Kota Banjarbaru Propinsi Kalimantan Selatan ).

Aini, Anisah, 2007. Sistem Informasi Geografis Pengertian dan Aplikasinya. STMIK AMIKOM Yogyakarta.

Azhar Susanto.2009. Sistem Akuntansi Prosedur dan Metode, Yogyakarta : BPFE.

Briyan. 2012. (online) (<https://bryanunited.wordpress.com/category/sistem-informasi-geografis>)Diakses 21 Maret 2016

Burch, John dan Grudnitski, Gary. 1986. Information Systems Theory and Practice. New York: John Wiley & Sons.

GordonB, Davis, 1989. Sistem Informasi Manajemen; PT. Pustaka Binaman Pressindo.

Hadi, S.P., 2006. Resolusi Konflik Lingkungan, Badan Penerbit Universitas Diponegoro, Semarang.

Hartono, 1999. Analisis Dan Disain Sistem Informasi: pendekatan terstruktur teori dan praktek aplikasi bisnis.

Jogiyanto Hartono, H.M., 1999. Sistem Informasi, PT. Wahana Komputer, Semarang.

Kadir, Abdul 2003. Pengenalan Sistem Informasi, Andi, Yogyakarta.

Kartodihardjo, H., Safitri, M., Ivalerina, F., Khan A., Tjendronegoro, S.M.P., 2005. Di Bawah Satu Payung Pengelolaan Sumber Daya Alam, Suara Bebas, Jakarta.

Kang-Tsung Chang, 2002. Introduction to Geographic Information System, Mc.Graw-Hill.

Lindgren D.T. 1985. Land Use Planning and Remote Sensing, Martinus Nijhoff Publishers, Doldrecht.

Leaflet, 2015. [online] Tersedia di: <http://leafletjs.com/index.html> [Diakses 3 Oktober 2015].

Minarni., Yusdi, Y., F., 2015. Sistem Informasi Geografis Pariwisata Kota Padang Menggunakan Application Programming Interface (Api) Google Maps Berbasis Web. ISSN: 2338-2724: Institut Teknologi Padang.

Mitchell, B., 2003. Pengelolaan Sumber Daya dan Lingkungan, Edisi Pertama, Gadjah Mada University Press, Yogyakarta.

Nurdin, A., Wiriosudarmo, R., Gautama, R.S., Arif, I., 2000. Agenda 21 Sektorl Agenda Pertambangan untuk Pengembangan Kualitas Hidup Secara Berkelanjutan, Proyek Agenda 21 Sektorl Kerjasama Kantor Menteri Negara Lingkungan Hidup dengan UNDIP, Jakarta.

OSGeo, Universitas Gadjah Mada, 2011. [online] Tersedia di: <http://osgeo.ft.ugm.ac.id/quantum-gis/> [Diakses 2 Oktober 2015].

Prahasta, Eddy, 2002. Konsep-konsep Dasar SIG, Informatika, Bandung.