

## IMPLEMENTATION OF WEB-GIS FOR MAPPING SUGARCANE LAND: CASE STUDY OF PABRIK GULA KREBET BARU MALANG

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### ABSTRACT

*Pabrik Gula (PG) Kreet Baru Malang is a producer of sugar in large scale. This factory has made achievements production of the highest rendement (sugar content in sugarcane) on national scale in 2014. To ensure that sugarcane produced has a good quality, it is necessary to analyze the potential of the lands to control and monitor the plant development at the same time to predict the outcome of harvest. Analysis of the agricultural area makes it possible to do using GIS software. One is WebGIS that easy to use. The use of WebGIS has not been fully exploited by the manufacturer because during this time the manufacturer still using a very simple way, so it can't to do mapping and analysis of sugarcane that is needed. Based on these issues, the author develops a web-based geographic information system that capable to display the distribution of sugarcane land belongs to the manufacturer simultaneously visualize the sugarcane field in the form of digital maps and analyze the potential yield of the land. This research is important because it can help the manufacturer in monitoring, analyzing, and managing sugarcane in order to maintain the sustainable sugar production. The result from this study is a web-based Geographic Information System that can be used by the manufacturer to map and analyze the sugarcane land on certain criteria.*

*Development of this system is done through the stages of data collection, analysis of requirements, implementation, and testing of the system. Then, to visualize spatial data in map form by performing data processing using software MapSource and QuantumGIS, the addition of tabular data, export the data in the form of HTML, import the data into the database, and display digital maps using the leaflet library. The result of functional testing in this system shows that the system functions were tested in accordance with the specifications and the compatibility testing shows that the system is able to run well on the Internet Explorer browser, Microsoft Edge, Mozilla Firefox, Google Chrome, Safari, Opera, iOS browser, and Android browser.*

**Keywords:** *Sugarcane, Land mapping, Agriculture, WebGIS, GIS.*

### 1. Introduction

#### 1.1. Background

Sugar is one of the basic human needs in daily life . Sugar can be used to increase human stamina . There are different types of sugars , no sugar, liquid sugar , brown sugar , and other types of other sugars . However , the type of sugar that is most widely used is sugar . Granulated sugar form of white crystals which can dissolve in water.

Sugar is derived from a variety of natural resources . One resource is the dominant producer of sugar cane . Sugarcane is the main raw material in producing sugar. The need of sugar increased from year to year in line with population growth ( Nasir , 2013 ) , resulting in an increase in the number of sugarcane farmers.

Pabrik Gula (PG) Kreet Baru Malang is a subsidiary of PT Rajawali Nusantara Indonesia ( RNI ) who have made achievements production of the highest rendement (sugar content in sugarcane) on national scale in 2014 (Kompas, 2014). PT Rajawali Nusantara Indonesia ( RNI ) is one of the Badan Usaha Milik Negara (BUMN) which is engaged in the field of Agro-Industrial, Pharmaceutical and Medical Devices and Trade. As

a parent company , PT RNI has a special unit that handles sugar factory . The unit company PT PG Rajawali I. The company houses two units of sugar factories , namely PT Pabrik Gula Kreet Baru Malang and PT PG Rejo Agung Madiun.

Pabrik Gula Kreet producing sugar from sugar cane milling process, the crystallization process saris sugar until sugar becomes unfit for consumption. This process occurs only once in a year , which occurred between May and November. Each year the plant get sugarcane from farmers who register their land in cooperatives partner factories . In addition , to realize the vision of a company that wants to become the largest sugar factory in the district / city of Malang , then the factory did a field survey to select other lands that could potentially produce sugar cane in large quantity and quality.

Then , to maintain productivity and quality of the crop , it is necessary for an analysis of the potential of land in order to control and monitor the plant development at the same time predicting yields. According to Sugianto , the analysis of the potential of agricultural land is necessary, because by knowing farmland predictable yields and can

create the corresponding land use recommendations , so that it will eventually obtain maximum yields to meet food needs of a region ( Sugianto , 2010) . The success of the harvest an area supported by the management and analysis of good land.

According Balamurugan, et al. (2014), the analysis of the agricultural area makes it possible to do using GIS (Geographic Information Systems), since the device is able to visualize spatial data in the right format, so that the interpretation of spatial data into easy to understand. Unfortunately, not many people who know and be able to use GIS, because special knowledge needed in their use. WebGIS can be the answer to these problems. WebGIS is a tool that is cheap and easy to visualize geospatial data in a format that is easy to understand.

Use of WebGIS not been fully exploited to the maximum by the New Kreet PG because during this time the manufacturer still using a very simple way of doing land mapping, by some combination of spatial data in ArcView software to view surface of the Earth from the satellite imagery on Google Earth software. By the way, have not been able to do the mapping and analysis of sugar cane land is needed because not supported by the data master farmer or land attribute data. Moreover, spatial data and master data of farmers are still separated in different sub-divisions, so the analysis of sugarcane land is still difficult to do.

Therefore, to answer these problems , we need a system that can display the distribution of sugar cane land belongs to PG Kreet Baru Malang and can classify these lands based on certain criteria . Geographic Information Systems ( GIS ) can help to visualize the sugar cane fields in the form of digital maps based on satellite image data and to analyze the potential yield of the land. Thus, the study focused on the development of web-based GIS ( WebGIS ) that utilize spatial data to help the factory in monitoring , analyzing , and managing sugarcane land in order to maintain sustainable sugar production.

Based on the research background , the main problem in this research is to know whether it is possible to build an WebGIS prototype to demonstrate the mapping of sugarcane land in PG Kreet Baru Malang. The main problem formulation can be lowered to the formulation of the problem in more detail as follows;

1. How to visualize spatial data using WebGIS for mapping the sugarcane land?
2. How to design and implement WebGIS for mapping sugarcane land in PG Kreet Baru?

3. How the test result of WebGIS for mapping the sugarcane land in PG Kreet Baru Malang?

## 2. Literature Review

### 2.1. Company Profile

PT Pabrik Gula (PG) Kreet Baru Malang is a company producing sugar which stands under the auspices of the Badan Usaha Milik Negara (BUMN). More precisely is one of the subsidiaries of PT Rajawali Nusantara Indonesia (RNI) Group through a special business unit of sugar factory, PT PG Rajawali I.

PG Kreet Baru located on Highway Kreet Bululawang District of Malang. PG Kreet Baru focuses on the processing of sugar cane yields up into a finished product in the form of sugar. Based on research that has been conducted by the authors, the company received the results of the sugarcane harvest sugar cane farmers to be processed into two types of products, namely sugar and non-sugar. For products such as sugar, divided into two, namely sugar, which will be given to farmers as partial compensation from sugar cane and sugar deposited into the plant to be resold by the manufacturer. Whereas, which includes non-sugar products such as fertilizers and drops. Fertilizer can be reused by farmers to fertilize cane fields, while the drops is the raw material that can be processed into other finished goods.

In one year, the company has a one-time sugar cane milling, which occurred between May and November. The amount of sugar that is produced depends on the content of sucrose content in sugarcane. In the context of the sugar cane plantations, the yield levels of sugar content in sugarcane. If the content in the sugarcane yield is high, the more sugar that can be generated from a single stem of sugar cane.

Then, in a sugar factory environment , especially in PG Kreet Baru, there are some foreign terms relating to the processing of sugar cane . These terms are listed in Table 2.1 .

**Table 2.1 Foreign terms in PG Kreet Baru**

No	Name	The meaning
1	Rayon	The division of the working area of PG Kreet Baru . There are currently four rayon , rayon ie north , south, east , and central. For regions that have not been listed on any of the four rayon , then including other rayon.
2	Afdeling	Solving the working area in a smaller scope , usually per-district.
3	Koperasi	Is the liaison between farmers

		and factory . In this case , a group of farmers to register land in regional co-operatives in order to enter the harvest cane to the mill .
4	Kelompok	A group of farmers that consists of many farmers . Each group has a specific
5	PLPG (Petugas Lapangan Pabrik Gula)	Workers from factories to supervise and conduct the verification of land measurement data. A PLPG charge of several surveyors .
6	Juru Ukur	Workers from factories that served to measure a land / plot using GPS. Surveyor responsible to a PLPG.
7	TRK (Tebu Rakyat Kemitraan)	Is one type of soil that has a partnership relationship between the owner of the sugar factory.
8	TRM (Tebu Rakyat Mandiri)	Is one type of soil that does not have a partnership relationship between the owner of the sugar factory.
9	Repl (Replanting)	A turn of the new seedlings soil types . In this case , after a certain period of one type of sugar cane planting , the soil productivity will decline, therefore it will be the turn of the types of sugarcane planted to improve productivity.
10	TRS (Tebu Rakyat Sawah)	Is one category of land where water easily found around the cane fields, can also be said wet soil .
11	TRT (Tebu Rakyat Tegall)	Is one category in which the land is difficult to find water around the cane fields , can also be said dry soil .

## 2.2. Geographic Information Systems (GIS)

Geographic Information Systems ( GIS ) is an information system based computer that is a merger between the elements of the map ( geographical ) and information about the map ( the attribute data ), which is designed to obtain, process , manipulate , analyze , demonstrate and display spatial data to complete the planning , process and investigate the problem [5].

## 2.3. WebGIS

WebGIS is the GIS or digital mapping applications that utilize the Internet as a communication medium that serves to distribute , publish , integrate , communicate and provide information in the form of text , digital maps and

perform analysis functions and queries related to GIS through the Internet [2].

## 3. Research methodology

### 3.1. Study of literature

The literature study conducted to gain knowledge about the application of WebGIS , especially in agriculture . The study of literature is done by reading books, scientific journals and other sources.

### 3.2. Data collection

The data collection is done in two ways , namely interviews and observation . Interviews were conducted at the staff of the EDP ( IT ) , Mechanization and TU Plant . The observations were made by taking the spatial data and attribute data of each land through related divisions .

Spatial data obtained then - convert using MapSource software to be processed in software QuantumGIS . The extraction of QuantumGIS used in its construction WebGIS.

### 3.3. Development System

Construction of the system in this study conducted using a waterfall approach model . This model uses the software life cycle approach in sequence or sequential starting from the analysis phase to testing [8]. The waterfall model can be seen in figure 1.

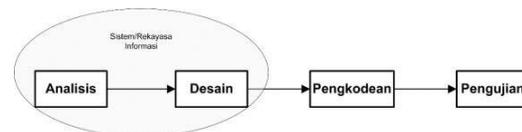


Figure 1 Waterfall Model [8]

## 4. Implementation

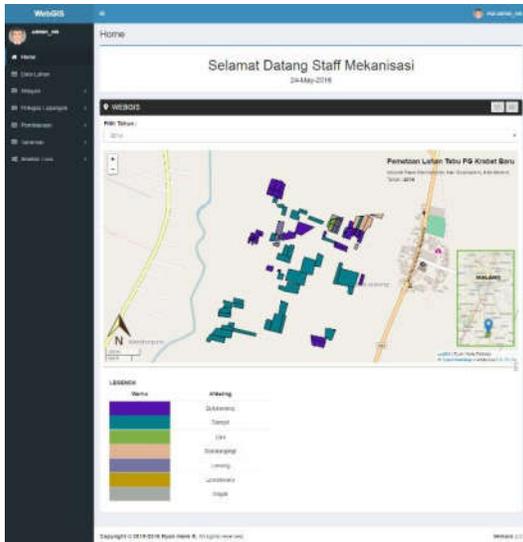
### 4.1. Implementation Environment

In this chapter will describe the implementation environment used in the development of the system. The software used in the development of the system:

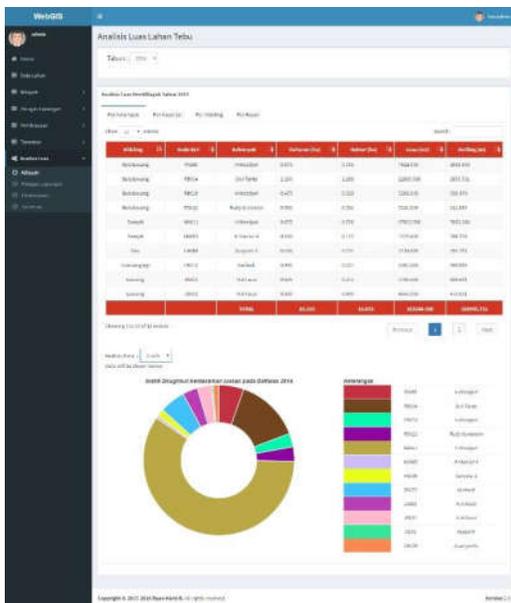
1. Windows 7 64-bit
2. Xampp 3.2.1
3. Quantum GIS 2.10
4. Google Chrome 48.0.2564.97 m
5. MapSource 6.13.7
6. Notepad++ 6.8.8

### 4.2. Implementation Interface

Implementation of the interface to be described include home tab interface , features comprehensive analysis by the group in the form of graphs and features a comprehensive analysis based on the department in the form of a map.

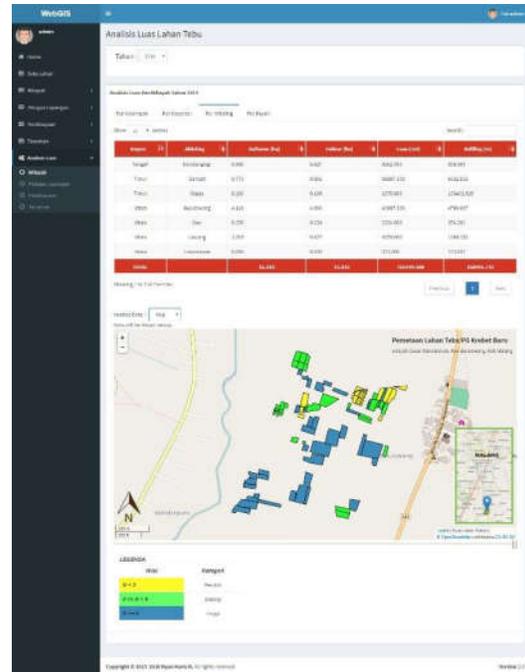


**Figure 2.** Implementation Interface of Home Page  
Home page is the initial view when the system is run . On this page the user can see the distribution of sugarcane land registered under afdelingnya each year.



**Figure 3.** Implementation Interface of comprehensive analysis by the group in the form of graphs

This page is a feature comprehensive analysis based on the data of existing groups . The analysis result is displayed as a percentage through a donut chart . In addition , the analysis results can also be visualized in the form of maps.



**Figure 4.** Implementation Interface of comprehensive analysis by the group in the form of a map

This page is a feature comprehensive analysis based on the data existing section . In this page , the data analysis dirupakan in map form and are classified based on the total registrations generated.

## 5. Closing

### 5.1 Conclusion

The conclusion of this study is :

1. Visualization of spatial data using WebGIS can be done by extracting the data processing software QuantumGIS . Data processing starts from taking land forming dots using a GPS device . GPS measurement data is stored in a format mps . After that, the data processing is done using MapSource software . The points of measurement results need to be connected with other points to form a cane land . Results of the connecting points are stored in gpx format . Furthermore , gpx file is processed using software QuantumGIS . The points which have been connected need to be converted into a polygon shape that resembles the shape of the land. The next step is to complete the data attributes to each polygon formed land . Once the attribute data has been filled , it can be done the extraction of data into HTML format to be used as construction material WebGIS.
2. Development of WebGIS is done starting from the phase of requirements analysis, design,

- implementation, until the test. In the requirements analysis phase, obtained functional requirements and non-functional system. Furthermore, the functional requirements of the system will be translated into the design through DFD (Data Flow Diagram) that describes the data flow in each process and a detailed description of the DFD are available in PSPEC (Process Specification). The next step is to create the database design through the ERD (Entity Relationship Diagram) and PDM (Physical Data Model). After the completed database design, interface design can be done. Results from the design DFD, ERD, PDM, and interface design executed in the implementation phase. Then, to ensure that the software is built in accordance with the needs of users, the software needs to be tested. The results of the testing of the system shows that the system has met the needs of users and compatible on multiple browsers specified.
3. Based on the results of functional tests that have been done 100 % valid results obtained on 81 test cases were tested and based on non- functional testing results showed that the system was compatible with 8 browsers tested so that has met the non-functional requirements that have been set.

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