Development Of Basic Map Prototype Of Irrigation Using Geographic Information System (GIS) Approach Of Public Works Department Of Merauke Regency Papua

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ABSTRACT

Irrigation system is natural resource potential which belongs to a region either man-made or naturally formed. The management and maintenance of the resources are needed in order to be maintainable and utilizable for various necessities, such as agriculture and fishery. Concerning with irrigation system in Merauke Regency recently it has not been maximal because it still relies on manual technique to carry out documentation of the irrigation system belongs to. This research carried out the study concerned with utilization of geographic information system (GIS) for necessity of irrigation system management in Merauke Regency. The software ArcGIS, Microsoft Access and Visual Basic were used as tools in the research conducted to develop the basic map prototype of irrigation system in Merauke Regency. Result of the research shows that by utilizing the GIS concept, management, logging, maintenance, and monitoring of resource potential as the irrigation system in Merauke Regency can be performed better. Any information of the irrigation system is provided completely on a map with other additional information. The system developed is also completed by facilities of query user and searching machine to make easier the user of developed application.

KEYWORDS

Irrigation System, GIS, ArcGIS, Ms. Access, Visual Basic

1. INTRODUCTION

Irrigation network is canal, construction, and complement construction   which is a unity needed for supplying, distributing, giving, using, and draining irrigation water (Sidharta, 1997). Irrigation network potential which belongs to Merauke Regency for agriculture and fishery activity is enough high. Therefore it is needed the effort of resource management of surface water to maintain the potential belongs to and also it functions as evaluation, monitoring and operational, and maintenance of the irrigation network.

Local government of Merauke Regency which is here the Irrigation Subdivision of Public Works Department now has made efforts in managing the resources intended by conventionally. The data management of the irrigation site has been conducted using photo as data taken from the field and made in report form. There are many difficulties faced by the Public Works Department in the process of doing it, especially in arranging the data into report document. The report document does not contain the information about the map of irrigation network site, water gate in certain district, length of irrigation in certain area, irrigation damage, the total length of irrigation in Merauke Regency. Beside that, the attributes showed up from the photos in the field sometimes are not appropriate with the condition in the field, so it makes difficult the policy makers to examine the reparation, addition or planning for the future irrigation canal.

To help the efforts of management and maintenance of the irrigation resources, so this research is conducted. One of the

approaches used in this research to support the efforts of Irrigation Subdivision of Public Works Department is by developing a model of basic map by prototype concept using Geographic Information System (GIS). The model developed is expected to be able to show the network spread of river which contains of the information as irrigation canal, and irrigation spread in Merauke Regency. The GIS model can be used interactively and manipulated appropriately with necessity so it makes easy the process of management, monitoring, and maintenance the irrigation canal in area of Merauke Regency. The use of GIS as the approach in this research was based on some previous researches that had utilized the GIS for many necessities. Some of researches intented are: mapping of irrigation infrastructure network (Rauf, 2012), evelution of irrigation infrastructure network system in sub-drainage basin Lowokwaru of Malang city (Rachmawati, 2007), GIS development to provide information about administrative region as the information of sub-district, topography, road/bridge network, drainage, utility and constructions (Muhajir et.al, 2005), analysis instrument for performing regional planning (Hsueh-Sheng et.al, 2009), grouping rural land based on rural condition element (Zhang et.al, 2013), and mapping of logistic distribution region (Chen et.al, 2008). Some of the researches indicated that GIS can be used for various necessities either as planning tool, analysis or certain potential mapping of a region. Therefore, in this research is highly possible that GIS is used as a medium to develop a model of basic map with prototype concept using Geographic Information System (GIS).

The discussion of this paper is divided into six main parts. The first part discusses about the problem background, objective and advantages expected from this research. The second and third parts are the theoretical base used for supporting the research. The fourth part explains about the steps. The fifth part is the discussion about the research includes the result of the research achieved. The sixth part is closing which contains the conclusion and

suggestion for model development in the future.

2. IRRIGATION CANAL

Irrigation canal is canal of construction, and complement construction which is a unity needed for supplying, distributing, giving, using, and draining irrigation water (Sidharta, 1997). There are three irrigation canals, those are:

2.1. Primary Irrigation Canal

Primary irrigation canal is a part of irrigation network which consists of main construction, primary canal, its drain canal, division construction, division-tap construction and its complement construction. The primary irrigation canal is the main irrigation canal which brings water into secondary canal. The water that has been entered into secondary canal will be continued to tertiary irrigation canal. The construction of primary irrigation canal commonly has permanent character which has been built by the local government of Merauke Regency through the Public Works Department.

2.2. Secondary Irrigation Canal

Secondary irrigation canal is a part of irrigation network which consists of its drain canal, division canal, division construction, division-tap construction and its complement construction. The canal brings water from primary canal into tertiary partitions which are served by the secondary canal. The irrigation end boundary is at the last tap construction. The function of this secondary irrigation canal is bringing water from primary irrigation canal and to be continued into tertiary irrigation canal.

2.3. Tertiary Irrigation Canal

Tertiary irrigation canal consists of some quarter partitions, each of them as large as about 8 to 15 hectare. Tertiary partition should abut directly on secondary or primary

canal. As much as possible it is avoided the tertiary partition which located indirectly along the main irrigation canal network, because it will need tertiary surface canal which limits other tertiary partitions.

3. GEOGRAPHIC INFORMATION SYSTEM

Geographic Information System (GIS) is special information system which manages the data that has spatial information (in reference to the room), or in brief meaning, is the computer system which has ability to develop, save, manage, and show the information in reference to geographic, for example the data that is identified based on the site, in a database. The practitioners also enter the men who develop and operate it and the data as the part of this system. (http://id.wikipedia.org/wiki/Sistem-Informasi-Geografis)

While according to Carter dan Agtrisasi (2002 ; Page; 6), Geographical information system (GIS) is a computer with information system based which is used to give form of digital and analysis towards earth geographic surface.

GIS is a formal unity which consists of various resources of physic and logic related to objects on the earth surface, GIS is also kind of software that is used for input, storage, manipulation, show, and output of geographic information with the attributes. (Prahasta Eddy 2001).

4. RESEARCH METHODOLOGY

This research was divided into two important steps. Firstly it was started by data collecting, secondly was continued by system development from the model developed. The data collected was literature data that used for that related to the discussion so it supported the research. Beside that, the secondary data as spatial and non spatial data about the irrigation was collected to support the research process. Observation was conducted at Public Works Department of Merauke Regency to obtain the data intended. The data obtained includes the field survey of irrigation infrastructure network system, the condition survey of canal sediment, the condition survey of existing of irrigation infrastructure canal structure.

The second step was the system development by following life cycle of system development commonly. The system development was started by planning step and then analysis of system necessity. The system planning was conducted to describe the system made. Designing system based on the result of necessity analysis which would be developed based on GIS such as: System design, as formation of information system model of irrigation network which is adjusted to frame of work reference and necessity from the institute which here is Public Works Department of Merauke Regency; Database design, on this step the data transformation was done from compilation result of primary and secondary data became digital database so that it can be integrated into this information system. The database formed includes two kinds are: 1) Spatial data, as the map of road network and other maps that related to irrigation network; 2) Attribute data, is the database contains of information about the spatial data such as the name of construction, code, year of making, condition, etc. the next on the second step was input and output design, the system or application making appropriate with designing made and system testing. Step of system testing is the step to evaluate the system made. Testing of the system was done to test whether ability of the application made has been appropriate with the design, included in it the use of data analysis available. The last step was doing evaluation and reparation to repair the data analysis and also the developed system if there is any mistake. The steps of the research can be seen at Figure 1 below.
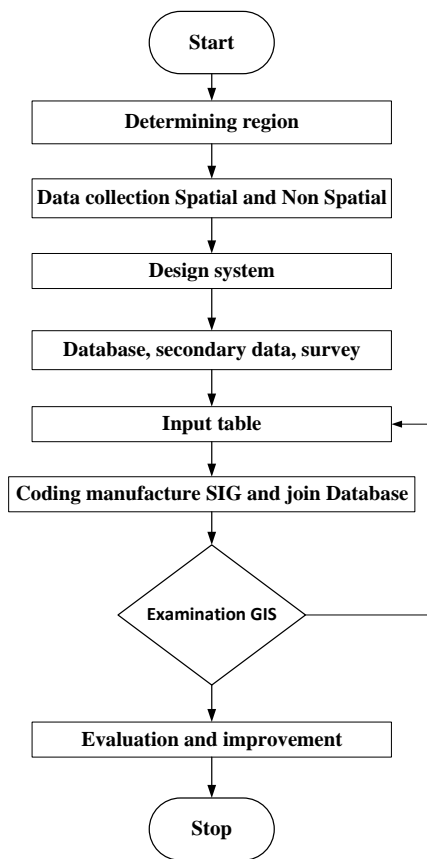
Figure 1. Flow diagram of GIS making

5. DISCUSSION

5.1. Map Analysis Result

Map analysis result which had been done towards the data and information in form of vector data obtained was the data and information of map as follows:

1) Data analysis of administration map

On the data analysis of administration map it can show the whole regions in the administration of Merauke Regency where there are 20 districts. The information shown is such as the name of district, landmass which their characteristic is dynamic or every regional data is changeable based on the last condition of the regions.

2) Data analysis of river

On the data analysis of river it can show the whole rivers in the area of Merauke Regency where there are many big and small rivers. The information shown are such as the name of river, the length of river, etc, which their characteristic is dynamic or every data is changeable based on the last condition of the rivers.

3) Data analysis of flood dike

On the data analysis of flood dike it can show the whole flood dikes in the area of Merauke Regency. The information shown are such as the name of dike, the length of dike, etc, which their characteristic is dynamic or every data is changeable based on last condition of the dikes.

4) Data analysis of primary water gate

On this data analysis of primary water gate it can show the whole primary water gates or main water gates in the area of Merauke Regency which their characteristic is dynamic or every data is changeable based on the last condition of the primary water gates.

5) Data analysis of secondary water gate

On the data analysis of secondary water gate it can show the whole secondary water gates in the area of Merauke Regency which their character is dynamic or every data is changeable based on the last condition of the secondary water gates.

6) Data analysis of canal

On the data analysis it can show the whole canals in the area of Merauke Regency which their characteristic is dynamic or every data is changeable based on the last condition of the canals.

7) Data analysis of road

On the data analysis of road it can show the whole roads in the area of Merauke Regency which their characteristic is dynamic or every data is changeable based on the last condition of the roads.

5.2. Result of developed system

Flow representation model of development process of basic map prototype of irrigation will be provided using Data Flow Diagram (DFD). DFD is a system design tool which is oriented on data channel can be used for describing analysis and designing system of context diagram (see Figure 2). Specifically the development system of this basic map prototype of irrigation consists of some form displays that are related each other and become a whole unity in an application. Follows are some of developed system displays.

The facility provided by the system can be accessed through menu, toolbar, and facility set in the tab menu. The tab menu can be accessed by putting the cursor at the left side of the display. Implant the nail sign so that the tab menu will appear at underside. Three tab menus available are Tab Data, Tab Legend, and Tab Tool. The Tab Menu Data contains of the data entered into the system which is categorized into some categories. Two main groups are Satellite Imagery layer and Map Layer (see Figure 3). Tab Menu Legend contains of map list which is being showed by the system. In every legend the map layer can be customized the symbolism by clicking twice on the map layer on Tab Menu Legend

(see Figure 4). While on tab Menu Tool there are some facilities are map inset that can be used to observe the relative position of the map which is zoomed towards the whole map areas (see Figure 5).

Toolbar facilities on Tools menu include print, navigation (zoom and displace), information and searching. The toolbar facilities of map information can be accessed by clicking the toolbar of information and choosing map layer on the legend and then choosing the object which is the attribute information intended to find out (Figure 6).
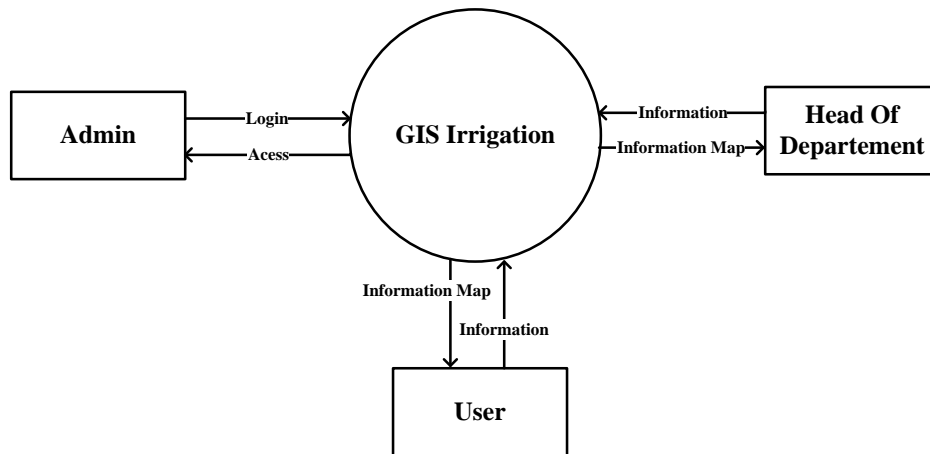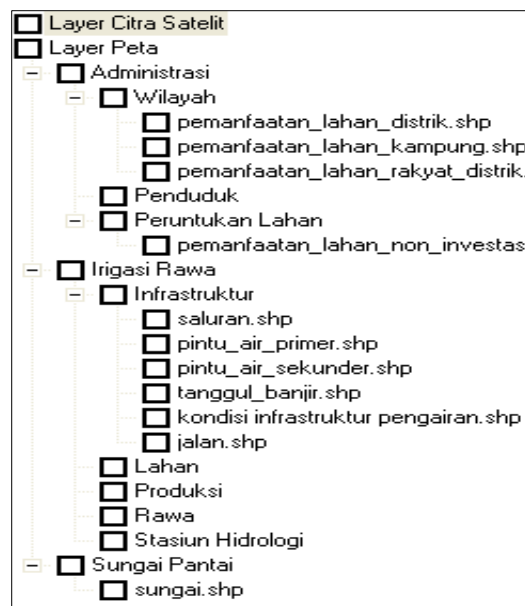
Figure 2. Context Diagram
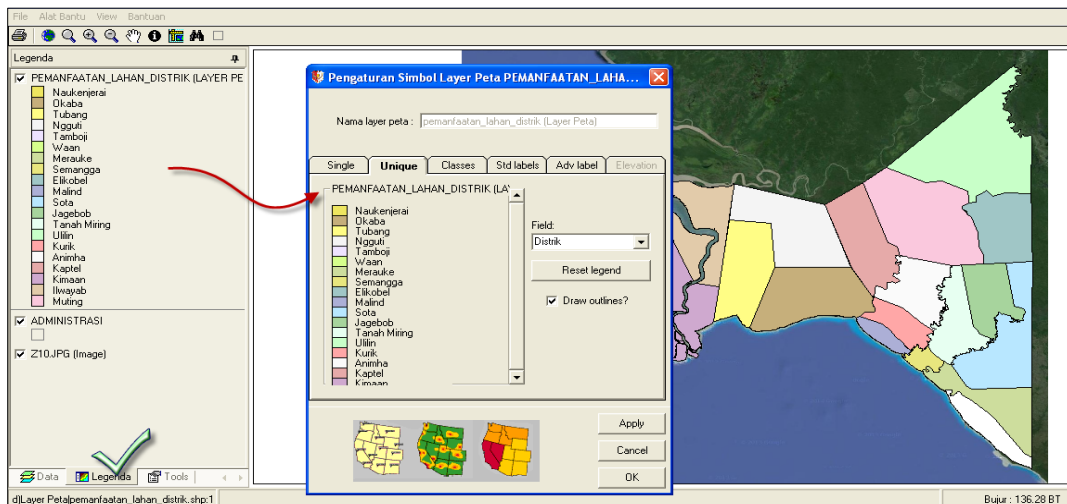

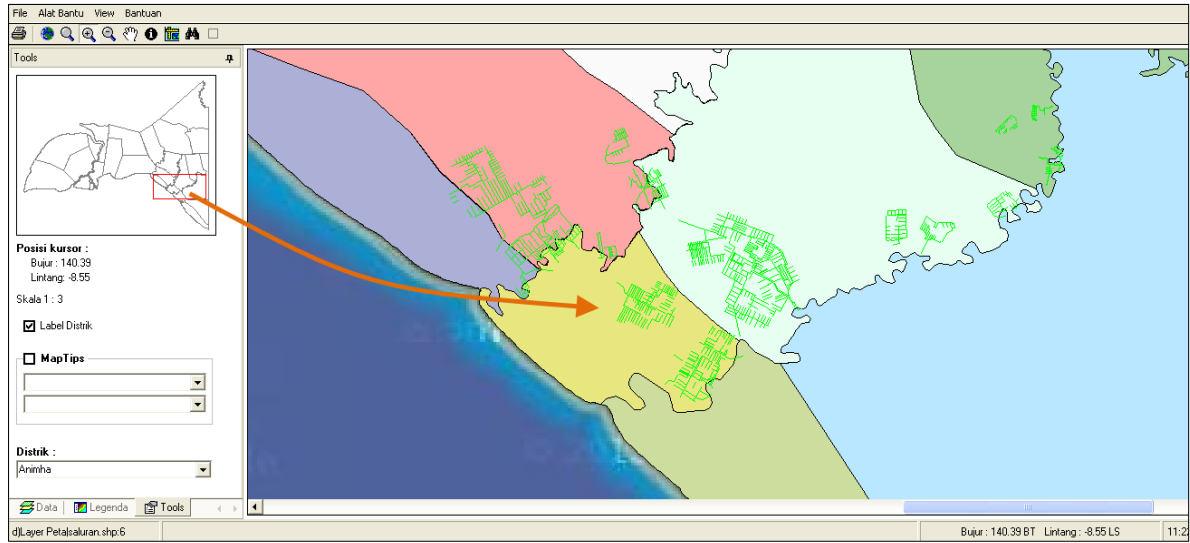**Figure 3. Map Layer Structure**

Figure 4. Tab Menu Legend

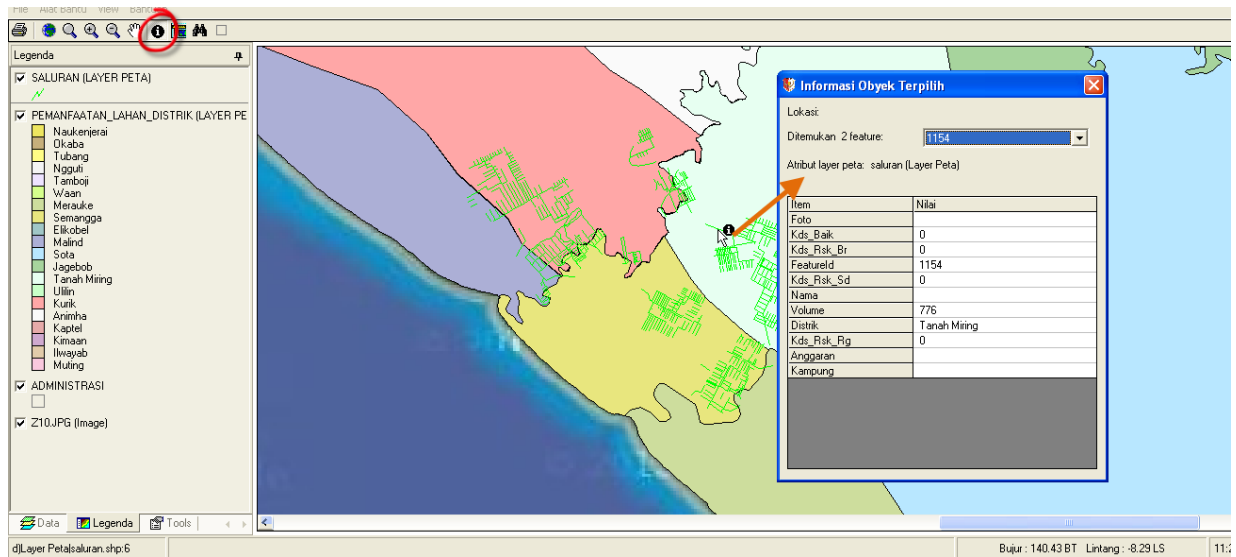**Figure 5. Tab Menu Tools**
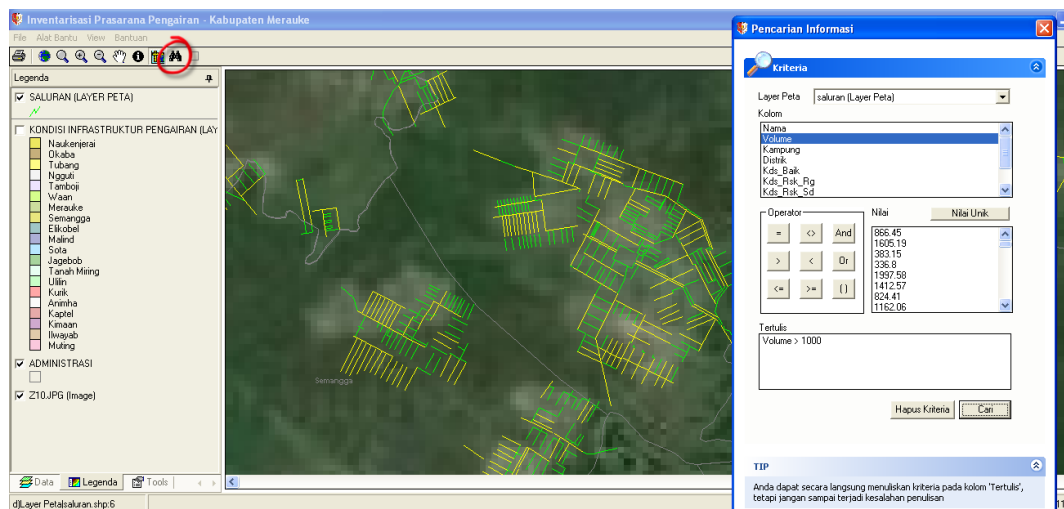

Figure 6. Map Information

Figure 7. Searching Based on Attribute

The developed system is also completed by searching system. Toolbar facility of data searching can be accessed through searching toolbar 🔍 (see Figure 7). On the dialogue of information searching can be chosen the map layer which the data is searched and the writing of criteria using column, operator and value.

The writing of criteria can be done by continually writing the criteria at the side provided. If the criteria is fulfilled, the object on the map layer which fulfilled the criteria will change into yellow color.

Other features provided by the system are facility of query user as updating, adding, and deleting the data.

6. CONCLUSION

Application of development system of basic map prototype of irrigation which is made using GIS can show the irrigation managements completely in Merauke Regency such as showing the map of administration area, irrigation canal, primary water gate, secondary water gate, flood dike, village, and road. The report resulted by the application of development system of basic map prototype of irrigation through attribute data for each map is appropriate with the data on the field and has dynamic characteristic or it is changeable based on the reconditioned data of the map.

The map development can be developed for utilization of non infestation land, utilization of society land on each district in Merauke Regency and utilization of society land on each village in Merauke Regency.

The research development then can be conducted by improving the application of Web-based Geographic Information System (GIS) known as Web GIS. The Web GIS is an application of Geographic Information System (GIS) that can be accessed online through the internet/web. On the configuration of Web GIS there is server which functions as Map Server which is on duty of processing map asking from client and then sending it back to the client.

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