Development Web-GIS of Commodity Information System for Agriculture, Establishment and Forestry in Marangkayu District

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Abstract: Agriculture, Plantation and Forestry Commodities are the main sectors supporting household daily needs and people's income for improving the economy. District of Marangkayu is located in Kutai Kartanegara area, East Kalimantan Province, where geographical condition consists of the terrain of hilly steeps surrounding the lake of Kutai Kartanegara. The geographical contours make the sector of agriculture, plantation and forestry the people's primary choice to meet the needs of household as well as increase the standard of economy of the people. In order to maintain the stability of price and production of agricultural commodities, Commodity Information System is required to provide information of the location, coordinate of positions, area of production, as well as presenting information of prices, price fluctuations and changes, along with a display of information over the accumulation of agricultural commodity production of the Kutai Kartanegara area, with additional features of appropriate distribution and production thereof. Therefore, it is necessary to develop the Web-Based Geographic Information System (GIS) for Agricultural Commodity, Plantation and Forestry of Marangkayu Area. GIS application is built using the Rapid Application Development (RAD) method, which consists of the phase of Requirements planning, User design phase, Construction phase and Cut-over phase. Database for the implementation uses PostgreSQL and PostGIS extensions. Programming language uses PHP, JavaScript, and HTML. The interface implementation is built using Bootstrap. The testing of the application uses the Black box testing method. The results of the test show that the Web-Based GIS Application has met the needs of the requirement system and the problems.

Index Terms: Web-Based GIS, Marangkayu, Commodity, Price, location.

1. Introduction

Marangkayu is a sub-district located in Kutai Kartanegara Regency, East Kalimantan Province, Indonesia. The administrative center of this sub-district is in Nagari Kutai Kartanegara with an area that covers the area around the Kutai Kartanegara Lake. District with an area of 150.76 KM2 which is located at an altitude of 471 meters above sea level [1]. Marangkayu sub-district has superior commodities such as lowland rice, corn, peanuts, chili, nutmeg, cloves, casionvera, durian coffee and avocado [2]. This great commodity potential is not in line with the dissemination of adequate commodity information, thus causing the commodity potential of Marangkayu sub-district not to be known by the wider community.

Against the background of the importance of information, a commodity information system is needed that makes it easier for the public, government, market players, both producers and consumers to find contacts, locations, prices, production and other information. This system is also expected to be able to introduce the potential of agricultural,

plantation and forestry commodities in the District Marangkayu. Therefore, it is necessary to build an application for Commodity Information on Agriculture, Plantation and Forestry for Marangkayu District, Kutai Kartanegara Regency Based on GIS Web.

2. Literature Review

2.1. Geographic Information System (GIS)

GIS can describe the characteristics of objects on the map and determine the position of their coordinates, perform queries and spatial analysis as well as being able to store, manage, and update data in an organized and efficient manner [3]. Through this GIS can also assist in making decisions related to geographic issues. GIS can be categorized into three applications, namely: desktop-based, web, and mobile [4].

Web-based GIS (Web-based GIS) or web-based GIS is a geographic information system distributed throughout a computer network environment to integrate, disseminate and communicate information. Geographical area visually on the World Wide Web via the internet [5,2]. Web GIS is a combination of graphic mapping design, digital maps with geographic analysis, computer programming, and a database that is interconnected into one part of web design and web mapping.

Coordinates are parameters to define the location of objects in numbers. The coordinate system itself on the map is a system that determines the location of objects in points / points that are in the geoid scope and represents the location with geographical features. The global coordinate system uses latitude-longitude data and is commonly referred to as a geographic coordinate system. A coordinate system that provides a variety of mechanisms for projecting a map of the surface of the globe onto a two-dimensional Cartesian coordinate plane. The projection coordinate system is also known as a map projection. Examples: Universal Transverse Mercator (UTM), Albers Equal Area, and Robinson. The UTM system (a system started in the 1940s by the US Army Corps of Engineers) with coordinates WGS 84 is often used in mapping Indonesian territory [7].

2.2. Spatial Data

Spatial data is also known as geographic data, namely data consisting of explicit geographic locations arranged in the form of coordinates, both geographical coordinates (latitude and longitude) and XYZ coordinates. For example, the location of an area, the position of oil sources, etc. The forms of spatial data are points, lines (polylines and polygons), the sources of which are analog maps, remote sensing, field measurements and GPS data [6].

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2.3. SQL

PostgreSQL is an open source Object-Relational Database Management System (ORDBMS) that supports C, C++, Java, Tcl, Perl, Python, PHP, and so on. PostgreSQL is able to accommodate very large binary data objects such as images or photos, sounds or songs, and even videos [2,12]. PostGIS is an extension of PostgreSQL which is an object relational database server that has the ability to store GIS features in the database server [11]. PostGIS serves to add geometry functions (Geo Objects) to PostgreSQL as a Spatial Database System [11]. PostGIS is open source software that you don't need to buy a license to use.

2.4. Google Maps

Google Maps is a map that can be viewed using a browser. Google Maps can be added to the web that has been created with the Google Maps API. Google Maps API is a free service provided by Google and is very popular. Google Maps is made using a combination of map images, databases, and interactive objects created with HTML, JavaScript, and AJAX programming languages as well as several other programming languages [12].

2.5. Commodity of Agriculture

Commodity, Agriculture, Plantation and Forestry Commodities are all goods, services, other rights and interests, and any derivatives of Commodities, which can be traded and become the subject of Futures Contracts, Sharia Derivative Contracts, and/or other Derivative Contracts [8-10]. Agriculture is all activities that include upstream business, farming, agro-industry, marketing, and supporting services for the management of living natural resources in suitable and sustainable agro-ecosystems, with the help of technology, capital, labor, and management to obtain the maximum benefit for welfare society [9]. Forestry is a management system that related to forests, forest areas, and

forest products that are carried out in an integrated and sustainable manner [9]. Plantation is all activities that cultivate certain plants on soil and/or other growing media in suitable ecosystems, process and market goods and services resulting from these plants, with the help of science and technology, capital and management to create prosperity for business actors [10-13], as a Spatial Database System [11]. PostGIS is open source software that you don't need to buy a license to use.

3. Methodology

In developing this application, the researcher uses the Rapid Application Development (RAD) method [14,15], which is a software development methodology that proposes an approach to systematic and sequential software starting at the level of system progress in all analysis, design, code, testing and maintenance [16]. The advantages of Rapid Application Development (RAD) are that the quality of the resulting system will be good. This is due to its gradual implementation. So it is not focused on a particular stage [17]. And the system development document is very organized, because each phase must be completed completely before moving on to the next phase. So each phase or stage will have certain documents. The Rapid Application Development (RAD) method consists of the Requirements planning phase, the User design phase, the Construction phase and the Cut-over phase.

3.1. Requirements planning phase.

At this stage an analysis of system requirements is carried out on the problems and objectives of this study. Then, a literature review was carried out which was used as a reference and consideration in the development of the application of the Agricultural, Plantation and Forestry Commodity Information System, Marangkayu District, Kutai Kartanegara Regency Based on GIS Web. From this analysis, it can be seen that the required data are in the form of spatial data and data attribute data in the system. Furthermore, complete data collection is carried out which is then defined in detail according to research needs [18,19].

3.2. User design phase

The next stage is to design an application system to display information, prices, contacts, production and location of agricultural, plantation and forestry commodities in Marangkayu District, Kutai Kartanegara Regency. At this stage the results of the analysis will be presented in the form of architectural design, database design, user interface design, and process design that will describe the overall functionality of the system [20,21]. At this stage, the results of data processing obtained from field surveys and map digitization are also presented.

3.3. Construction phase and Cutover phase

In this stage, the results of the application design for the Commodity Information System for Agriculture, Plantation and Forestry, Marangkayu District, Kutai Kartanegara Regency, based on Web GIS will be realized at the implementation stage. Each unit will be tested whether it meets its specifications. Fig 1 show, the stage of research on making applications for Agricultural, Plantation and Forestry Commodity Information Systems, Marangkayu District, Kutai Kartanegara Regency, based on Web GIS based on the Rapid Application Development (RAD) method.
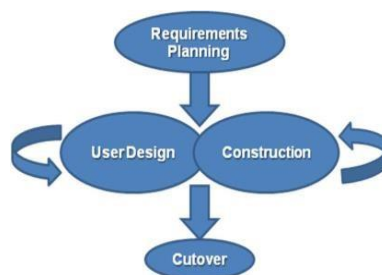

Fig.1. Rapid Application Development (RAD).

Functional systems are features or all activities that can be performed by the system. The Information System for Agricultural, Plantation and Forestry Commodities, Marangkayu District, Kutai Kartanegara Regency, Based on GIS Web is as follows:

1. Users can see their position when using the system.
2. Users can add their position manually when using the system.
3. Users can search for commodity positions based on the owner's name.
4. Users can search for commodity positions by village.
5. Users can search for commodity positions by Sector.
6. Users can search for commodity positions by type.
7. User can perform position search.

8. The user can search for the closest commodity position from the user's position.
9. Users can view information on commodity location markings such as commodity name, owner, address, telephone number and photo.
10. Users can view detailed information on commodity location markings such as commodity name, owner, address, telephone number, area, yield, price, fertilizer, seeds, pests, and cropping patterns.
11. Users can activate the legend feature that provides information on the map.
12. User can see the route to the selected commodity location.
13. Users can view commodity data by Sector.
14. User can view commodity data by commodity name.
15. Users can view progress reports on commodity prices.
16. Users can view progress reports on commodity production.
17. Users can view reports on commodity Prices and Production developments.
18. Verified users can log into the system.
19. Verified users can change passwords.
20. Verified users can view, modify, and delete spatial data and commodity attribute data.
21. Verified users can add new spatial data and commodity attribute data.
22. Verified users can add commodity Price and Production progress reports.
23. Verified users can add new sectors.
24. Verified users can add new types.
25. Verified users can add new commodity names.

Use case diagrams describe the interaction between users and the system. Based on the functional requirements that have been designed, there are two actors who interact with the system, namely users and admins. Admin is a user who has been verified by the system as a data manager in this application. In this use case diagram, there are 25 use cases in accordance with predetermined functionalities that have a relationship with each actor. User has 17 functional and admin has 8 functional. The use case diagram can be seen in Fig 2.
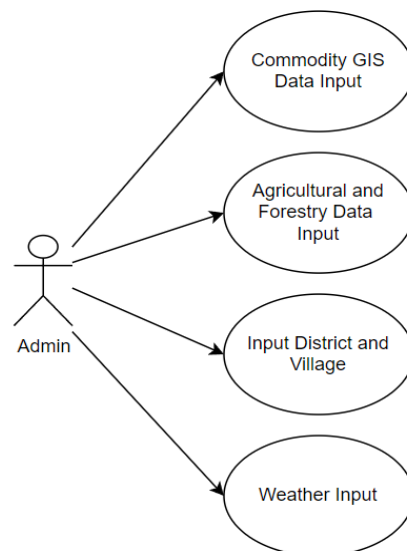

Fig.2. Use Case Diagram

3.4. Database implementation

Database implementation in the development of the Agricultural, Plantation and Forestry Commodity Information System application, Marangkayu District, Kutai Kartanegara Regency. Web-based GIS using the PostgreSQL Database Management System (DBMS) with PostGIS extension. The implemented database consists of seven tables. The implementation of the user interface describes the appearance of the Agricultural, Plantation and Forestry Commodity Information System application, Marangkayu District, Kutai Kartanegara Regency. Web-based GIS built.

3.5. Program Implementation

The implementation of this program uses JavaScript and the PHP programming language. The user interface in this application uses the CSS bootstrap framework. The user page contains menus provided by the application such as a search menu, search results and a map of Marangkayu District. This page is the initial screen when visitors first access agricultural GIS. The page view can be seen in Fig 3.
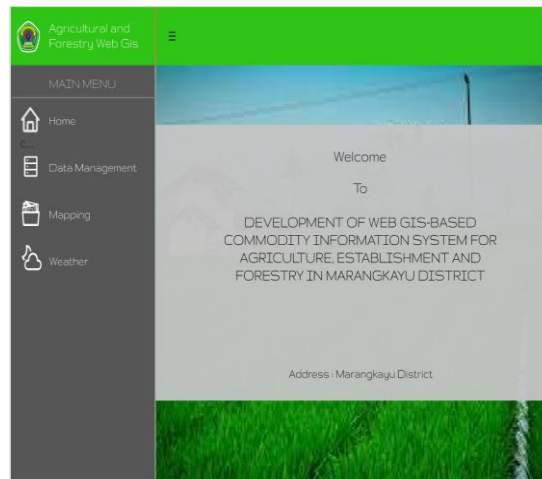
Fig. 3. Homepage

This page is used by the admin to input data. The data input display can be seen in Fig 4.
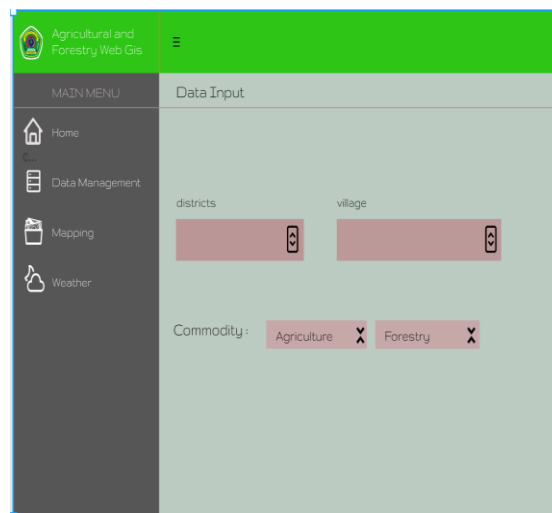

Fig. 4. Data Input Page

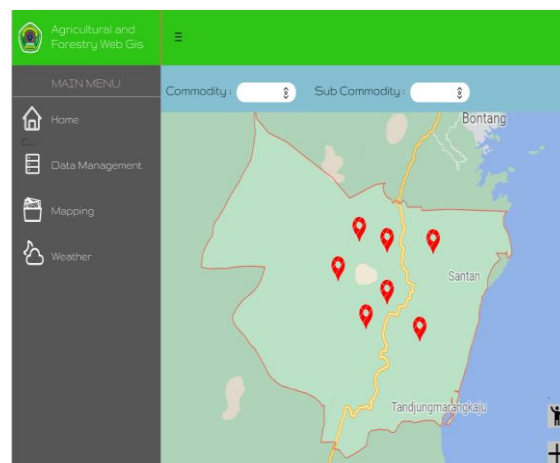Mapping of agricultural commodities can be seen in Fig 5.

Fig. 5. Mapping Page

This page displays a climate chart, namely rainfall, humidity, air temperature in the form of a revenue chart and agricultural commodities in the form of a pie chart. Can be seen in Fig 6.
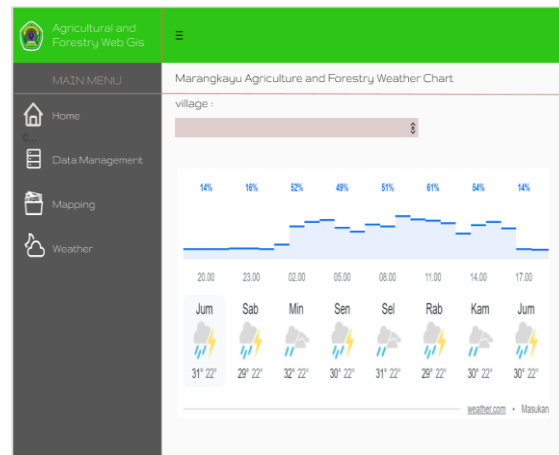

Fig.6. Weather Page

3.6. Program Testing

Testing on this system is carried out using the black box testing method. The black box testing method focuses on the functional requirements of the software. If the output of the system is functional, then the system is declared to have passed the testing phase. But if the output of the system is not in accordance with the functional system, then the test is declared inappropriate and improvements will be made. Based on the results of the tests carried out on the system, it was found that the application of the Agricultural, Plantation and Forestry Commodity Information System in the District Marangkayu, Kutai Kartanegara Regency Web-based GIS which consists of 25 functional has been in accordance with the functional design.

4. Conclusion

Based on the application of the Agricultural, Plantation and Forestry Commodity Information System, Marangkayu District, Kutai Kartanegara Regency, Web-based GIS which has been built using the Rapid Application Development (RAD) method, it is concluded that the functional requirements analysis is carried out by analyzing research and related applications. Then added from the analysis of the data obtained and the request for BP4K2P Marangkayu. The results of the analysis resulted in 25 functional requirements consisting of 17 functional accessible by system users and 8 functionally accessible by admin. These functional requirements are from viewing the user's position, adding his position manually, searching for positions based on the name of the owner, village, sector, type, commodity, commodity closest to the user's position, viewing all commodity positions, commodity positions on the map, commodity information, viewing all data. commodities by sector and commodity, view routes to selected commodities, view commodity Price and Production progress reports, admin logins, change admin passwords, manage (add, change, view, and delete) spatial data and commodity attribute data, add sectors, types commodities and create commodity data reports.

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