

Geographic Information System for Mapping Agricultural Land in North Samarinda District

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Abstract—This research is motivated by the unavailability of an information system that facilitates data processing of agricultural land for rice commodities at the Agricultural Extension Center of Suluh Manuntung Lempake and the delivery of information that is easily accessible in the form of a web regarding the mapping of agricultural land and land data for rice commodities. North Samarinda sub-district is the center of food crop agriculture and the most cultivated by the community is rice, which has the largest rice harvest area compared to other sub-districts. Ease of access to that information can be presented in the form of a Geographic Information System or GIS (*Geographic Information System*). GIS is a system designed to capture, store, manipulate, analyze, organize and display all types of geographic data. The results of this study are to build an information system application to facilitate data processing and delivery of information regarding agricultural land mapping as well as farmer data information and farmer group harvest data in North Samarinda District, which is presented in the form of WebGIS mapping of agricultural land for rice commodities, for public knowledge. That the District of North Samarinda has the potential to produce plants that are beneficial to the community.

Keywords—Geographic Information System, Mapping, Agricultural Land, Rice Commodities.

I. INTRODUCTION

Agriculture is the most important sector for the Indonesian people, agriculture is the livelihood of most Indonesian people and until now the agricultural sector is one of the mainstay sectors for the Indonesian economy. Almost all major cities in Indonesia have agriculture, one of which is Samarinda City. One of the potential natural resources owned by the City of Samarinda is agriculture which is also the dominant potential in supporting the regional economy.

Samarinda City has several sub-districts that have agricultural land, including the North Samarinda District, which is the center of food crop agriculture. with five sub-districts/villages it owns (Statistik, 2018). The more advanced developments of the world today require humans to produce information that is more easily obtained and easily accessible either through cellphones, television, or the internet and can be accessed by anyone and anywhere. Ease of access to that information can be

presented in the form of a Geographic Information System or GIS (Geographic Information System). The application of an information system is the right step for land-based agricultural land mapping to facilitate the process of delivering clearer and more complicated information because it is assisted by visual displays in the form of data and land locations.

The purpose of this research is to build an application that provides information about agricultural land for rice commodities in North Samarinda District and makes it easier for the Suluh Manuntung Agricultural Extension Center (BPP) to process data on agricultural land for rice commodities and the public can see agricultural land mapping and commodity land data rice in the North Samarinda District using WebGIS.

II. LITERATURE REVIEW

A. Study Of Literature

Some of the literature studies used as guidelines and references in this study include:

Research that has been conducted by Sumardin, 2016 from STMIK AKBA entitled Application of Geographic Information Systems in Mapping Agricultural Production in Bone Regency. The purpose of the research that will be carried out by integrating geographic information system technology in mapping agricultural production, especially in Bone Regency is as a reference for the government in making decisions about efforts to improve in the following years, references for other researchers who develop geographic information system technology. In addition, the government in this case as a stakeholder in deciding strategic steps to increase production for superior commodities in each region and find alternative solutions for regions that have the potential for developing other types of production outside the region's leading commodities.

Research conducted by Kurniawan, 2016 from the Indonesian College of Informatics & Computers Malang, a study entitled Geographic Information Systems for Agricultural Data Control to Facilitate Farmer Data Collection and Harvest Results at the Agricultural Service in Malang Regency. agriculture to obtain domestic food adequacy targets, avoid food shortages, manage food

needs, predict needs in agriculture, promote farmer welfare, apply current technology to develop agricultural systems so that domestic agricultural systems are able to obtain maximum and profitable results for farmers and agriculture in Indonesia.

A student from the Musamus University of Merauke, Loppies, 2017 conducted a study entitled Geographic Information System of the Potential of Productive Agricultural Land in Merauke Regency at the Food Crops and Horticulture Service. This research has produced a web-based geographic information system with information in the form of promotional media spatial data for the Department of Food Crops and Horticulture of Merauke Regency regarding the information on the potential of productive land available in Merauke Regency.

The research that was conducted by Barir dkk., 2019 from Hasyim Asy'ari University entitled Geographic Information System for Mapping Shallot Agricultural Land Using the Website-Based K-Means Clustering Method. The purpose of this study was to design a Website-based GIS and apply the K-means Clustering method for mapping shallots' agricultural land. The method used in this study is qualitative and uses K-means Clustering for GIS. This method is used for grouping data that have the same variables. This method produces several iterations that have cluster values. From these several iterations, the minimum cluster value is used to determine the agricultural land mapping group. The result of this research is a geographic information system that can map shallot farming land.

Students from STMIK Bina Patria, Putra, et al., (2019) conducted a study entitled Geographic Information System for Mapping Tobacco Farming Land in Kledung District, Temanggung Regency. The purpose of this research is to design and build a Geographic Information System (GIS) mapping tobacco farming land in Kledung District, Temanggung Regency, to facilitate the process of finding tobacco farming land by type. The development method used is the Waterfall method. The stages of the waterfall method are Requirement Definition, System and Software Design, Implementation and Unit Testing, Integration and System Testing, and Operation and Maintenance. The design used in this study is UML (Unified Modeling Language) modeling. The results of this study are in the form of a GIS that can map tobacco farming land according to its type in Kledung District, Temanggung Regency.

B. Geographic Information System

In general, the definition of Geographic Information System (GIS) is a component consisting of hardware, software, human resources, and data that work together effectively to enter, store, repair, update, manage, manipulate, integrate, analyze and display data in a geographic-based information (Rosdiana et al., 2015).

C. Agriculture

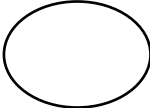



Agriculture in the broadest sense is all activities that include farming, fishing, animal husbandry, and forestry.

Indonesia is an agricultural country, meaning that most of the population lives in agriculture. Based on the type of crop, agriculture is divided into two, namely food crop agriculture and plantation crop agriculture (Susanto et al., 2016).

D. Data Flow Diagram (DFD)

This DFD is a system design tool that is oriented to the data flow with the concept of decomposition, which can be used to describe the analysis and design of systems that are easily communicated by system professionals to users and program makers. In table 1 this is the notation of DFD (Shalahuddin and A.S, 2013).

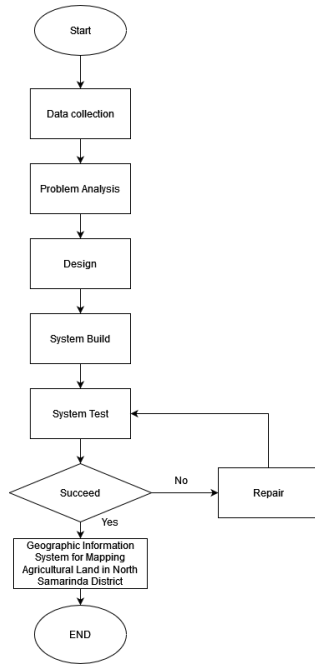
Table 1. Notation DFD

Notation	Description
	Process or procedure function, in software modeling that will be implemented with structured programming, then this notation modeling must be a function or procedure in the program code
	Database files or storage, in software modeling that will be implemented with structured programming, then this notation modeling should be made into the required database tables, these tables must also be following the design of the tables in the database.
	External entities, entry, exit, or people who use/interact with the modeled software or other systems related to the flow of data from the modeled system
	Data flow is data that is sent between processes from storage to process, or from process to input or output.

III. RESEARCH METHODS

A. Research Procedure.

The stages of making a Web-based Geographic Information System application for Agricultural Land Mapping in North Samarinda District used the System Development Life Cycle (SDLC) method with a waterfall model which provides a sequential or sequential software life flow approach. In Picture 1 this is the research procedure.



Picture 1. Flowchart of Research Procedures

B. System Planning

The design of a Web-Based Geographic Information System for Mapping Agricultural Land in North Samarinda District will be presented in the form of Entity-Relationship Diagrams (ERD), Context Diagrams, and Data Flow Diagrams (DFD).

1. Entity Relationship Diagram (ERD)

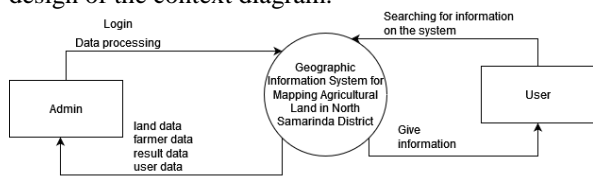
Entity Relationship Diagram (ERD) is a model to explain the relationship between data in the database based on basic data objects that have relationships between relationships. In Picture 2 this is the ERD.



Picture 2. Entity Relationship Diagram (ERD)

2. Context Diagram

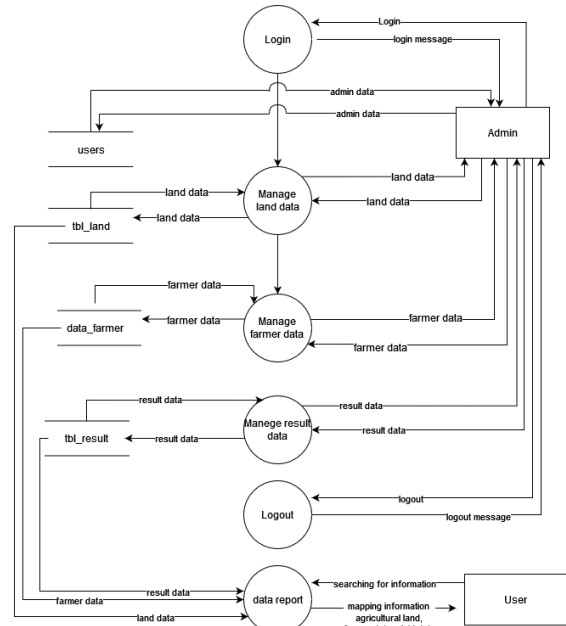
A context diagram is a process that provides an overview of the whole system. In Picture 3 this is the design of the context diagram.



Picture 3. Context Diagram

3. Data Flow Diagram Level 1

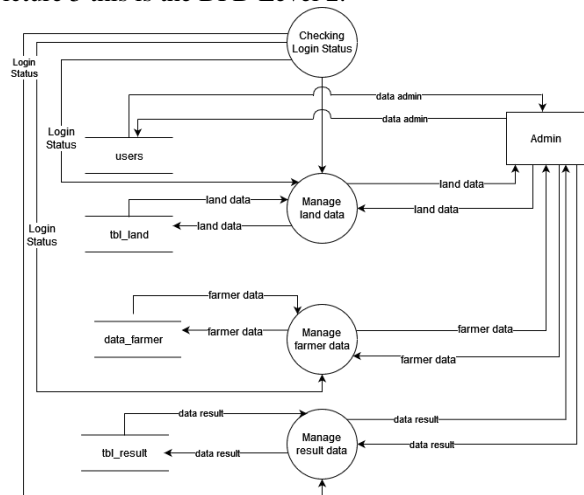
Data Flow Diagram Level 1 are the details of the context diagram for the admin side where in this level 1 DFD there are various data inputted by the admin and then stored into the storage table of each data that has been created in the database. In Picture 4 this is the DFD Level 1.



Picture 4. DFD Level 1

4. Data Flow Diagram Level 2

Data Flow Diagram Level 2 admins can log in to enter the application and can process data, such as edit data, add data, and delete existing data on the system. In Picture 5 this is the DFD Level 2.



Picture 5. DFD Level 2

II. RESULT AND DISCUSSION

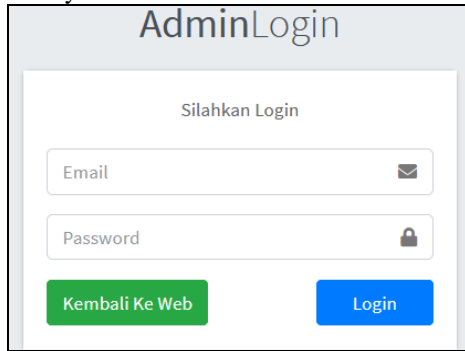
The results and discussion of this research are to produce a Web-Based Geographic Information System Application for Mapping Agricultural Land in North Samarinda District, which can be accessed by users and admins as follows:

1. Admin Page

The following is a special page provided by the Geographic Information System for Mapping Agricultural Land in North Samarinda District for admins to manage the required data.

a. Admin Login Page

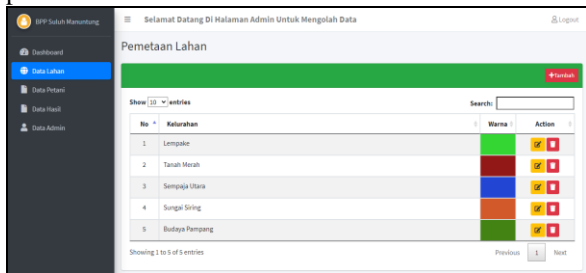
Picture 6 shows, a display for the admin to do the login process, the admin enters the email and password so that they can enter the system which is specifically accessed by the admin.



Picture 6. Admin Login Page

b. Land Data Page

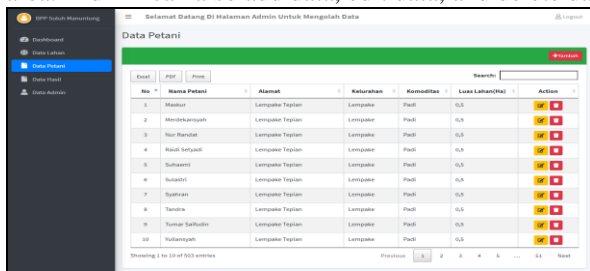
Picture 7 shows, a display of land data that has been inputted by the admin on the system in which there are, villages and colors. Admin can also add data, edit data and delete data, and export data in excel, PDF, and export print forms.



Picture 7. Land Data Page

c. Farmer Data Page

Picture 8 shows, a display of farmer data that has been inputted by the admin on the system which includes the farmer's name, address, village, commodity, and land area. Admin can also add data, edit data, and delete data.

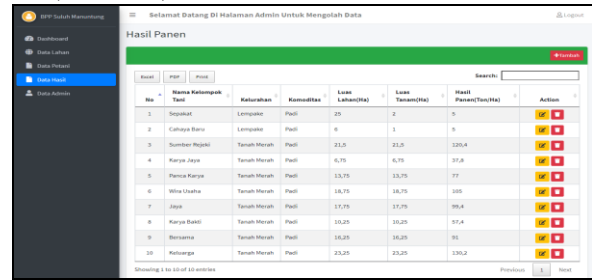


Picture 8. Farmer Data Page

d. Result Data Page

Picture 9 shows, a display of result data that has been inputted by the admin in the system which includes the name of the farmer group, village, commodity, land

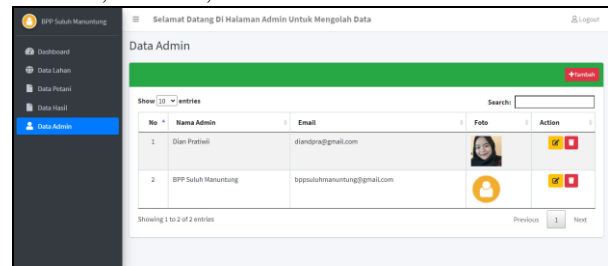
area, planting area, and land yield. Admin can also add data, edit data, and delete data.



Picture 9. Result Data Page

e. Admin Data Page

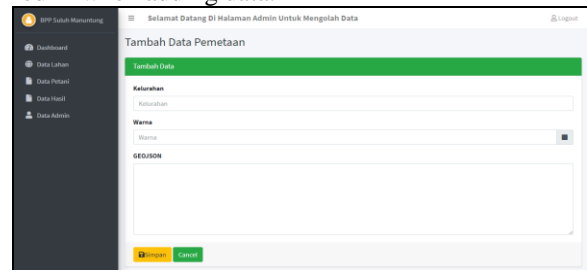
Picture 10 shows, a display of admin data that has been inputted by the admin on the system which includes the admin name, email, and admin photo. Admin can also add data, edit data, and delete data.



Picture 10. Admin Data Page

f. Add Land Data Page

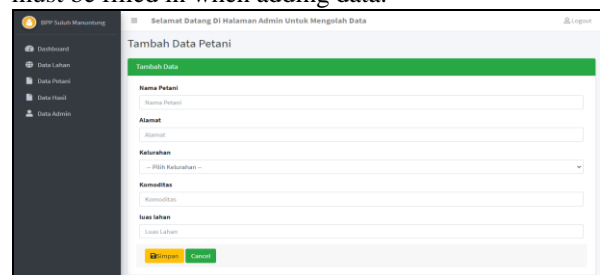
Picture 11 shows, a display of mapping land data required by the system that the admin can do after logging in. Added view of mapping land data which includes the village, color, and GeoJson which must be filled in when adding data.



Picture 11. Add Land Data Page

g. Add Farmer Data Page

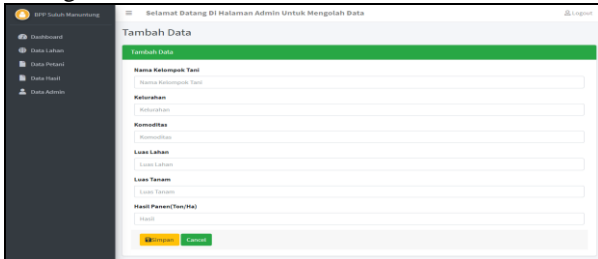
Picture 12 shows, a display of added farmer data needed by the system that the admin can do after logging in. Display of added farmer data which includes the name of the farmer, village, commodity, and land area that must be filled in when adding data.



Picture 12. Add Farmer Data Page

h. Add Result Data Page

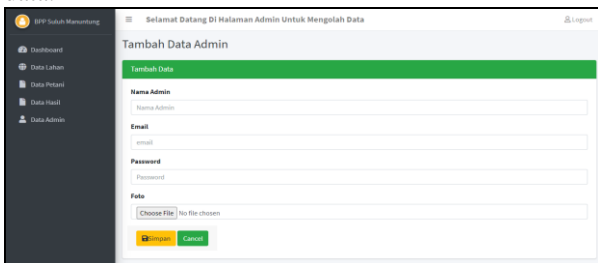
Picture 13 shows, display of added harvest data needed by the system that the admin can do after logging in. Display of added crop yield data which includes the name of farmer group, village, commodity, land area, planting area, and harvest that must be filled in when adding data.



Picture 13. Add Result Data Page

i. Add Admin Data Page

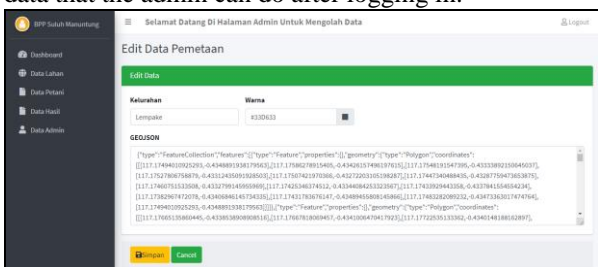
Picture 14 shows, a display of adding admin data that the admin can do after logging in. Display added data on admin data which includes admin name, email, password, and photo that must be filled in when adding data.



Picture 14. Add Admin Data Page

j. Land Data Edit Page

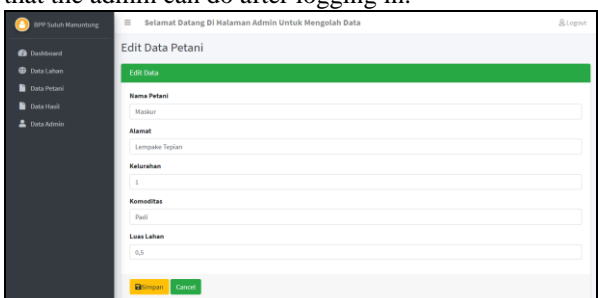
Picture 15 shows, a display of editing mapping land data that the admin can do after logging in.



Picture 15. Land Data Edit Page

k. Farmer Edit Data Page

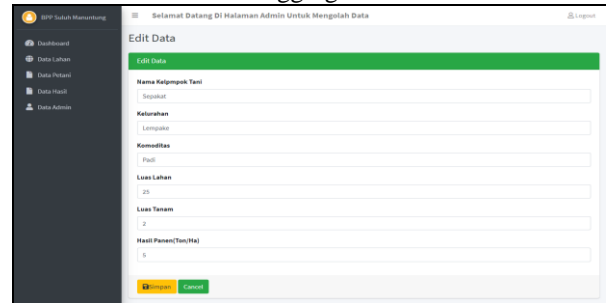
Picture 16 shows, a display of editing farmer data that the admin can do after logging in.



Picture 16. Farmer Edit Data Page

1. Result Edit Data Page

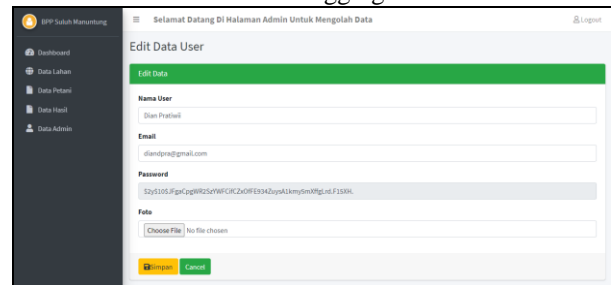
Picture 17 shows, a display of editing result data that the admin can do after logging in.



Picture 17. Result Edit Data Page

m. Admin Edit Data Page

Picture 18 shows, a display of editing admin data that the admin can do after logging in.



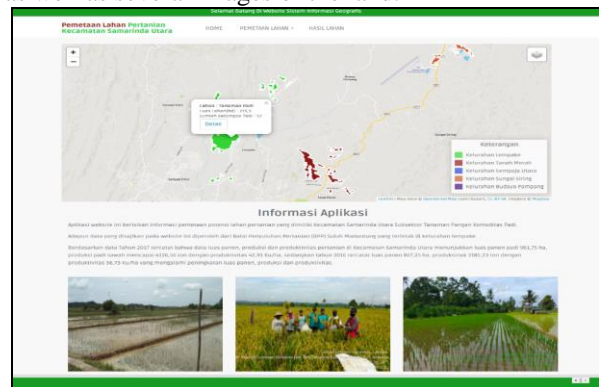
Picture 18. Admin Edit Data Page

2. User Page

On this page is a view that can be accessed by users when opening the Geographic Information System for Mapping Agricultural Land in North Samarinda District.

a. Homepage

Picture 19 shows, a display initial website there is some information and several menus that can be accessed by the user. This home menu displays land mapping where this map displays all land mapping in each village in the northern Samarinda sub-district, and also displays legends/information, and displays application information as well as several images of the land.

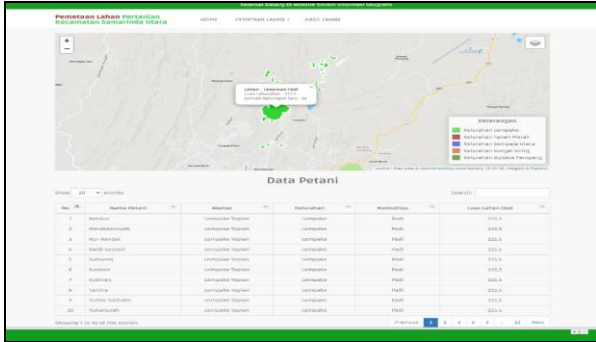


Picture 19. Homepage

b. Land Mapping Menu Page

Picture 19 shows, a display of the land mapping menu containing 5 villages, the mapping page will be displayed according to the village selected by the user

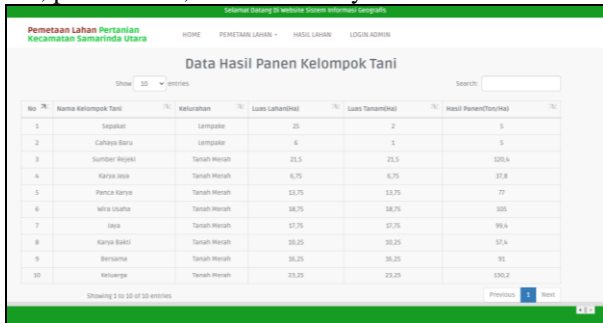
and also displays farmer data according to the selected village. In the farmer data, there are names of farmers, addresses, villages, commodities, and land area.



Picture 20. Land Mapping Menu Page

c. Result Menu Page

Picture 20 shows, a display of the land product menu containing the harvests of farmer groups. In this land product, there are names of farmer groups, village, land area, planted area, and harvested yields.



Picture 21. Result Menu Page

3. Black Box Testing

Black box testing is done to ensure the application runs properly. With this test can also find out the weaknesses of this system. So, if there is an error in the system, it can be repaired. In this test, the black box method is used.

1) Admin Login Page Test

Testing the admin login page in Table 2 is done to find out whether the login page on the system has been running properly according to what was created.

Table 2. Admin Login Page Test

Testing	Output	Result
Login Page	Displays a login form containing an email and password form.	Succeed
Login	Get access rights after entering email and password correctly, then can enter the system to process data.	Succeed

2) Admin Page Test

Testing the admin page in table 3 is carried out to find out whether the menus and buttons on the admin page on the system are running well as they were made.

Table 3. Admin Page Test

Testing	Output	Result
Dashboard Page	Displays the dashboard page along with a menu that can be accessed by the admin.	Succeed
Land Data Page	Displays land mapping data and admins can input, edit and delete land mapping data.	Succeed
Farmer Data Page	Display farmer data and admin can input, edit and delete farmer data.	Succeed
Result Data Page	Displays the result data and admin can input, edit and delete the result data.	Succeed
Admin Data Page	Displays admin data and admins can input, edit and delete admin data.	Succeed

3) Map Page Test

Testing the map page in table 4 is carried out to find out whether the map page on the system is running well as it was created.

Table 4. Map Page Test

Testing	Output	Result
Website home page	This page serves to display the mapping in all villages, also displays legends/information, and displays application information that can be accessed by users and admins.	Succeed
Website land map page	This page serves to display land mapping in each village and displays available farmer data, farmer name, address, village, commodity, and land area, which can be accessed by users and admins.	Succeed
Website Results page	This page serves to display land yields in each existing farmer group, the name of the farmer group, village, land area, planting area, and crop yields that can be accessed by users and admins.	Succeed

4. Validity Test

Before testing, the questionnaire used is tested whether it is valid or not, to find out, validity testing is carried out on each item of the questionnaire. The validity test can be seen in table 5.

Table 5. Validity Test

	Corrected Item-Total Correlation	Description
q1	.616	Valid
q2	.462	Valid
q3	.582	Valid
q4	.502	Valid
q5	.692	Valid
q6	.734	Valid
q7	.614	Valid
q8	.726	Valid
q9	.674	Valid

All questions asked to respondents were declared valid because the Correlation value was above 0.3 and could be used for further testing (Imam Ghozali, 2016).

5. Respondent Test

Testing the results of the respondents in table 5 below, there are 30 respondents including the Agricultural Extension Officer Suluh Manuntung and the Samarinda community, there are 10 questions with answers, totally agree (TA), agree (A), disagree (D) and totally disagree (TD). N (Number of respondents), M (Mean), C (Criteria).

Table 6. Respondent Test

TA		A		D		TD		N	M	C
F	%	F	%	F	%	F	%			
5	17	25	84	0	0	0	0	30	3,17	Agree
4	13	26	87	0	0	0	0	30	3,13	Agree
5	17	25	84	0	0	0	0	30	3,17	Agree
11	37	19	63	0	0	0	0	30	3,37	Agree
5	17	24	80	1	3	0	0	30	3,13	Agree
4	13	26	87	0	0	0	0	30	3,13	Agree
6	20	23	77	1	3	0	0	30	3,17	Agree
3	10	25	83	2	7	0	0	30	3,03	Agree
3	10	22	73	5	17	0	0	30	2,93	Disagree
4	13	25	83	1	3	0	0	30	3,10	Agree
Average								3,13	Agree	

The purpose of this trial is to find out whether this application has achieved the desired goals and to find out suggestions from respondents who have tried the Web-Based Geographic Information System for Mapping Agricultural Land in North Samarinda District. From the results of this trial, the application is feasible to use.

Based on the suggestions and comments given by the respondents through this questionnaire, the conclusions obtained are that the Web-Based Geographic Information System Application for Mapping Agricultural Land is good and can be used in helping agricultural land mapping data processing at the Suluh Manuntung

Lempake Extension Center and data processing farmers and rice commodity yields and make it easier for the public to obtain information about agricultural land mapping, farmer data and rice commodity yield data in North Samarinda District and it is hoped that this application can be developed even better with a more attractive appearance and the addition of more useful information features other.

IV. CONCLUSION

The conclusion that can be drawn from the research and development of an Agricultural Land Mapping Information System application, North Samarinda District, is that this research has succeeded in designing and building an application for a Geographical Information System for Mapping Agricultural Land in North Samarinda District which provides information on mapping agricultural land in the food sub-sector of rice and rice commodities, displaying data on farmers in each village and displaying the yields of farmer groups in North Samarinda District and Based on the results of respondents' responses, this information system can provide convenience for the Suluh Manuntung Lempake Agricultural Extension Center in processing agricultural land data for the food crop sub-sector for rice commodities and make it easier for the public to obtain information about agricultural land mapping, farmer data, and yields. harvesting of rice commodity farmer groups and conveying information to the public that this North Samarinda District has the potential to produce rice commodity food crops, with the results of respondents' assessments and validity tests, the Correlation value is above 0.3 with an average value of 3.13 (Agree).

Based on the results of the experiment from the Geographic Information System for Mapping Agricultural Land in North Samarinda District, the suggestions obtained are that the display on the user interface can be developed to be more attractive and easy to understand how to use it. The addition of features can also be further developed, for example, the addition of a land mapping feature for other commodities, and the addition of a crop price information feature, and other useful features that can be used as a medium for promoting farmers' crops.

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