GEOGRAPHIC INFORMATION TO DETERMINE THE DISTRIBUTION AND POTENTIAL OF AGRICULTURAL LAND IN BENGKALIS DISTRICT

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ABSTRACT

Bengkalis Island is one of the regencies located in Riau Province and its territory is on the east coast of Sumatra Island with coordinates 2º7'37,2"0º55'33,6 " North latitude and 100º57'57,6"-102º30'25 , 2 " East Longitude. Bengkalis Regency was ratified as autonomous region of the district based on the issuance of Law No.12 of 1956.

The results of interviews that have been done with Khairul Ashri, SP, M.Si as the Head of Sub Division of Agriculture and Food Security, stated that to see the distribution of agricultural land the agency has made a masterplan area based on RTRW Bengkalis Regency, but until now the land distribution existing agriculture is still not well controlled. This problem of course causes a lot of agricultural land that is planted with the same plant so that makes the supply of one of the plants becomes very abundant or on the other hand the supply to other plants will be greatly reduced. In addition, the distribution of agricultural land to be not optimal because there are still many potential land that has not been in accordance with the geographical and geomorphological conditions of the agricultural land. Based on data in 2016, as much as 50% of agricultural land in Bengkalis Regency is planted by rice, when in fact many agricultural land is not suitable planted by rice, this happens because there is no education or recommendation to farmers groups related to land potential.

BAPPEDA Kabupaten Bengkalis requires a geographic information system that can map and provide information on the distribution and potential of agricultural land, so it can serve as a media monitoring of agricultural land developments.

Keywords: geographical, information system, geographic information system

1. INTRODUCTION

Bengkalis Island is one of the regencies located in Riau Province and its territory is on the east coast of Sumatra Island with coordinates 2º7'37,2"0º55'33,6 " North latitude and 100º57'57,6"-102º30'25 , 2 " East Longitude. Bengkalis Regency was ratified to become autonomous region of the district based on the issuance of Law No.12 of 1956. Currently Bengkalis Regency has an area of about 7,793.93 and is located in lowland area which has an average height of about 2 to 6.1 meters from sea level . Bengkalis Regency has a great potential in agriculture, with agricultural land that mostly manosol soil type makes Bengkalis Regency has a variety of commodities are abundant with high economic value. In addition, the existing agricultural land in Bengkalis Regency is still quite extensive, but so far not been well utilized. In order to make it happen, the related agencies such as the Regional Development Planning Board (BAPPEDA) should be able to handle regional development plans such as organizing, planning, compiling, implementing, evaluating, monitoring and reporting. In addition, the government also cooperates with the Bogor Agricultural Institute (IPB) and South East Asia Center for Tropical Biology (SEAMEO Biotrop) research institute. This cooperation is expected to provide superior commodities to be developed in Bengkalis Regency.

The results of interviews that have been conducted with Khairul Ashri, SP, M. Si as the Head of Sub Division of Agriculture and Food Security, stated that the agency has made the planning of agricultural areas based on Spatial Planning (RTRW) Bengkalis Regency, but until now still many farmer groups are not yet aware of the plan, so farmer groups still plant the majority of which are rice. This problem of course causes a lot of agricultural land that is planted with the same plant so that makes the supply of one of the plants becomes very abundant or on the other hand the supply to other plants will be greatly reduced. Distribution of agricultural land that is currently not

optimal because there are still many potential land that is not in accordance with the geographical and geomorphological conditions of the agricultural land. Based on data in 2016, as much as 50% of agricultural land in Bengkalis Regency is planted by rice, when in fact many agricultural land is not suitable planted by rice, this happens because there is no education or recommendation to farmers groups related to land potential. Whereas agricultural land that is not in accordance with its designation will cause the destruction of agricultural land both physically and economically. Currently for presentation of data distribution and agricultural land potential is still using desktop applications and the process is done just to see the distribution of agricultural land. While doing the data processing to determine the distribution and know the potential of an agricultural land still can not be done. So, to facilitate in viewing the distribution and potential of a land hence required a visualization media that can combine between graphical data (spatial) with text data (attribute) that is by using a Geographic Information System, with GIS then will be able to do data merging, data and perform analysis of data that will ultimately produce output that can be used as a reference in decision making.

BAPPEDA Kabupaten Bengkalis requires a geographic information system that can map and provide information on the distribution and potential of agricultural land, so it can serve as a media monitoring of agricultural land developments.

2. RESEARCH CONTENTS

2.1 Theoretical Basis

Theoretical basis is a set of definitions, concepts and propositions that have been arranged neatly and systematically about the variables in a research. The foundation of theory is very important in a research, especially in the writing of thesis. Researchers can not develop problems that may be encountered in the research site. If it does not have a supporting theoretical reference.

2.1.1 Information System

Information system is a system that combines between human and machine to provide information to support the functions of operations, management and decision making within the organization. another definition states that the information system is a set of interconnected components and work together to collect, process, store and distribute related information to support decision-making, coordination and control. The purpose of the Information System is to provide and systematize information that reflects all the activities necessary to control the organization's operations [1]

2.1.2 Geographic Information System

Geographic Information System or Geography Information System (GIS) has an ever-changing understanding in accordance with its development. This is evident from the increasing number of GIS definitions that have been circulating in various sources of literature. Geographic Information System (GIS) is a computer-based system that has the capability to handle geographically referenced data including data entry, data management (storage and retrieval), manipulation and data analysis, and output as output. Outcome (output) can be used as a reference in decision making on problems related to geography.[2]

2.1.3 Spasial Data

Spatial data is an information system that contains information about the surface of the earth, waters, marine and under the atmosphere. Spatial data and derived information are used to determine the position of the identification of an element on the surface of the earth.[1]

2.1.4 Non-spatial Data

Non-spatial data are attribute data that represent descriptions and modeled phenomena that include items and properties, so that the information conveyed will be more diverse, non-spatial data also stores the attributes of the surface appearance of the earth. Non-spatial data or attribute data is stored in the form of lines and fields.[1]

2.1.5 Land

Land is part of the landscape that includes the understanding of the physical environment including climate, topography / relief, soil, hydrology, and even the state of natural vegetation that will potentially affect land use. Land in a broader sense includes those influenced by the activities of flora, fauna and humans, both in the past and present, such as reclaimed swamp and tidal land or soil conservation measures on a particular land. [3]

2.1.6 Land Characteristic

Characteristics of land is the nature of land that can be measured or estimated. Each land characteristic used directly in the evaluation usually has interaction with each other. In interpretation it is necessary to consider or compare the land with its use in terms of land quality. For example, the availability of water as the quality of land is determined by the dry month depending on the quality of other land, such as the condition or rooting medium, such as the soil texture and the depth of the root zone of the plant concerned. [3]

3. BASIC THEORY

3.1 Problem Analysis

Problem analysis is an assumption of the problem that will be described in the data processing procedure on the geographic information system determines the distribution and potential of agricultural land. Based on the observations made in the field of research, Head of Sub Division of Agriculture and Food Security want to determine the agricultural area in accordance with the geographical conditions of the agricultural land, so that the distribution of agricultural land can be evenly distributed and get maximum results.

3.2 Analysis Spasial Data

Spatial data on applications to be built include the potential land, agricultural land and farmer groups. Spatial data is distinguished by different shapes and colors so that the information in the show look more clear. The following specification of spatial data information on the application to be built:

Table 1 Spatial Data Analysis

No	Indicator	Description	Spasial Data	Example
1	Agricultural Land	Agricultural land area of 10,000 hectares to 20,000 hectares	Polygon	
		Priority 2 agricultural land that has an area of > 20,000 hectares to 40,000 hectares	Polygon	
		Farm priority 3 which has an area of more than 40,000 hectares	Polygon	
		Priority 4 agricultural land area of <10,000 hectares	Polygon	
2	Districts	District Bengkalis	Polygon	
		District Bantan	Polygon	
		District Siak Kecil	Polygon	
		District Bukit Batu	Polygon	
		District Rupat	Polygon	
		District Rupat Utara	Polygon	
		District Pinggir	Polygon	
		District Mandau	Polygon	
3	Potential agricultural land	If the potential land is rice	Polygon	
		If the potential of the farm is corn	Polygon	
		If the potential of the farmland is cassava	Polygon	

3.3 Analysis Non-Spasial Data

Non spatial data analysis used in this Geographic Information System application can be seen in the following table :

Table 2 Non-Spasial Data Analysis

No	Name	Description	Atribut
1	Farmers	Contains information about the data of each farmer group	Id_kelompok_tani, Nama_kelompok_tani, jml_anggota
2	Village	Contains existing village data in Bengkalis District	Kode_desa, nama_desa
3	Types of plants	Contains any type of plants that exist in Bengkalis District	Id_jenis_tanaman, nama_tanaman

3.4 Analysis of Land Potential

Here are the steps taken in determining the potential of agricultural land in Bengkalis Regency.

1. Characteristics of Rice

The weighting of rice crops can be seen in Table 3 below

Table 3 Charecteristic of Rice

No	Variable	Variable Range	Weight
1	Average Temperature (C)	24-29	4
		22-24, 29-32	3
		18-22, 32-35	2
		<18, >35	1
2	Rainfall (mm)	175-500	4
		500-650, 125-175	3
		650-750, 100-125	2
		>750, <100	1
3	Humidity(%)	33-90	3
		30-33	2
		<30, >90	1
4	Drainage	Hampered, somewhat obstructed	4
		Rather quickly, medium, good	3
		Severely Hampered	2
		Fast	1
5	Slope	< 3	4
		3-8	3
		>8-25	2

Table 3 Charecteristic of Rice

		>25	1
6	Soil Texture	Smooth, somewhat subtle, medium	4
		-	-
		Rather rough	2
		Rude	1

2. Charecteristic of Corn

The weighting of maize crops can be seen in Table 4 below:

Table 4 Characteristic of Corn

No	Variable	Variable Range	Weight
1	Average Temperature (C)	25-27	4
		27-30, 18-25	3
		30-35, 15-18	2
		>35, <15	1
2	Rainfall (mm)	400-900	4
		300-400, 900-1200	3
		130-500, 1200-1400	2
		<150, >1400	1
3	Humidity (%)	<75	3
		75-85	2
		>85	1
4	Drainage	Somewhat obstructed	4
		Agak cepat, sedang	3
		Hampered	2
		Sangat terhambat, cepat	1
5	Slope	<8	4
		8-16	3
		16-50	2
		>50	1
6	Soil Texture	Halus, agak halus, sedang	4
		-	-
		Rather rough	2
		Rude	1

3. Charecteristics of cassava

The weighting of cassava plants can be seen in Table 5 below

Table 5 Characteristic of Cassava

No	Variabel	Rentang Variabel	Bobot
1	Average Temperature(C)	12-23	3
		10-12, 23-25	2
		<10, >25	1
2	Rainfall (mm)	350-1250	4
		250-350, 1250-1500	3
		200-250, 1500-1750	2
		<200, >1750	1
3	Humidity(%)	Fits in all humidity	3
4	Drainage	Good, somewhat obstructed	4
		Rather quickly, medium	3
		Hampered	2
		Very obstructed, fast	1
5	Slope	<8	4
		8-16	3
		16-30	2
		>30	1
6	Soil Texture	Smooth, somewhat subtle, medium	4
		-	-
		Rather rough	2
		Rude	1

4. Characteristic of Land

The following is one of the characteristics possessed by agricultural land in Bengkalis Regency

Table 6 Characteristics of Land

Criteria	Value
Temperature	25
Rainfall	250
Humidity	78
Drainage	Somewhat Hampered
Slope	3
Soil Texture	Smooth

5. Plants Scores

Here is a score that can be obtained from rice, corn and cassava

Table 7 Plants Scores

Criteria	Rice(a)	Corn(b)	Cassava(c)
Temperature	4	4	2
Rainfall	4	2	3
Humidity	3	2	3
Drainage	4	4	4
Slope	4	4	4
Soil Texture	4	4	4

6. Calculation of Preference Value

At this stage, will begin the calculation prometheenya based on the above table. First compare the criteria value of one plant with other plants. We take the example for the slope slope criteria we compare between corn and cassava with the slope of the existing slope. Compare it by subtracting the value of the rice criteria with corn, then calculate its preference value according to the type of preference used. To simplify the calculation, let us suppose the rice as (a), corn as (b) and cassava as (c). based on the maximization rule if the value of d is less than or equal to zero then the value of H (d) is zero, and if the value of d is greater than zero, then the value of H (d) is one. the results of calculations from the multicriterian preference index can be seen in Table 8

Tabel 8 Indeks Preference Multikriterian

	(a)	(b)	(c)
(a)	-	0.33	0.33
(b)	0	-	0.17
(c)	0	0.33	-

2. Leaving Flow

How to calculate the leaving flow is by the formula contained in equation (2.8) below

$$\varphi^{+}(a) = \frac{1}{n-1} \sum_{x \in A} \varphi\,(x, a) \qquad (1)$$

Where n is the comparable plant species and the sigma is the sum of the criteria preferences index horizontally.

LF(a)=1/(3-1) * (0.33+0.33)= 0.33
LF(b)=1/(3-1) * (0+0.17)= 0.085
LF(c)=1/(3-1) * (0+0.33)= 0.165

3. Entering Flow

How to calculate the entering flow is by the formula contained in equation (2.9) below

$$\varphi^{-}(a) = \frac{1}{n-1} \sum_{x \in A} \varphi\,(x, a) \qquad (2)$$

Where n is the comparable plant species and the sigma is the sum of the vertical preference index criteria

EF(a)=1/(3-1) * (0+0)= 0
EF(b)=1/(3-1) * (0.33+0.33)= 0.33
EF(c)=1/(3-1) * (0.33+0.17)= 0.25

4. Net Flow

How to calculate the net flow is by the formula contained in equation (2.10) below

$$\varphi(a) = \varphi^{+}(a) - \varphi^{-}(a) \qquad (3)$$

NF(a)=LF(a)-EF(a)= 0.33 – 0 = 0.33
NF(b)=LF(b)-EF(b)= 0.085 – 0.33 = - 0.245
NF(c)=LF(c)+EF(c)= 0.165 – 0.25 = - 0.085

From the above calculation it can be concluded that the most suitable plant is rice, because it has the highest net flow value compared with the net flow value of other plants

3.5 Monitoring Analysis

Monitoring of agricultural land is an activity of observation and supervision continuously or periodically. Monitoring of agricultural land has indicators in observing or supervising existing agricultural land. Monitoring is seen from the area of land that will be a priority and of the potential owned by agricultural land

.

Table 9 Agricultural Land Monitoring Indicators

Indikator	Warna	Status
Priority 1		Potential land should be determined most important
Priority 2		The land potential is determined after all the priority land one is determined
Priority 3		The land potential is determined after all priority 1 and 2 lands are determined

This monitoring aims to monitor agricultural land that will be a top priority for determining the potential of agricultural land. After monitoring the agricultural land priority then will be carried out monitoring the potential of agricultural land. The following is a monitoring of potential agricultural land.

Table 10 Monitoring Indicators of Agricultural LandPotential

Indikator	Warna	Status
Potensial of paddy		Agricultural land planted by rice crops
Potential of corn		Agricultural land planted by corn crops
Potential of cassava		Agricultural land cultivated by cassava plants

3.6 Database Analysis

Database analysis is used to describe and identify data related to the geographic information system to be applied. Database analysis of this geographic information system can be seen in the following figure:

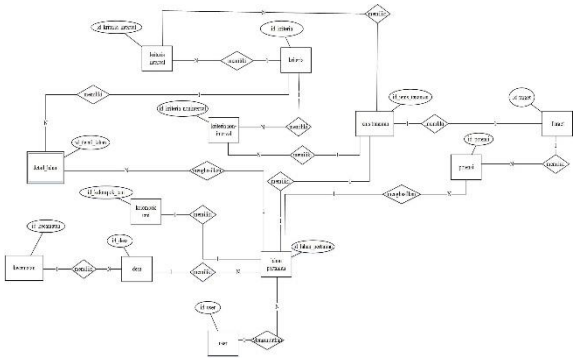


Image 1. ERD Geographic Information System to Determine the Distribution and Potential of Agricultural Land in Bengkalis Regency

3.7 Context Diagram

Context diagram is a diagram illustrating the relationship between external entities with the system to be built. Where data entered by external component parts will be processed within the system and generate reports desired by those external components in accordance with the data entered. Context diagram of the geographic information system to be built as in the following picture:

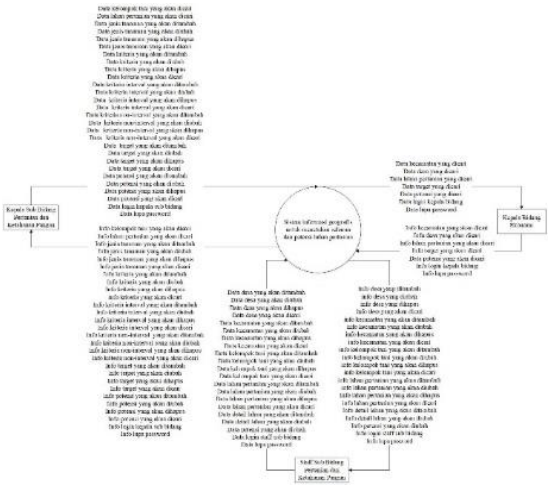


Image 2. Diagram Konteks Geographic Information System to Determine the Distribution and Potential of Agricultural Land in Bengkalis Regency

3.8 *Data Flow Diagram* (DFD)

Data flow diagram is a flow of data described to describe the processes that occur on the system to be created so that the data covering the system can be known well. Here is the DFD on the system to be created

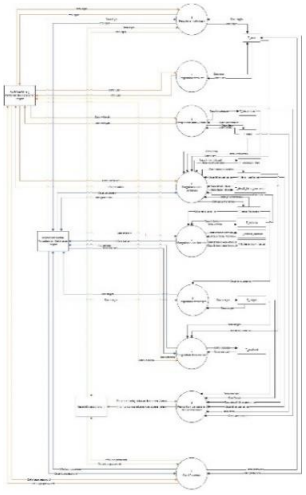


Image 3. DFD Level Geographic Information System to Determine the Distribution and Potential of Agricultural Land in Bengkalis Regency

3.9 Relation Table

The scheme of relations between files is a combination of files that have the same primary key, so that the files become one entity connected by the key field. Relation scheme of the system to be built seen in the picture below.

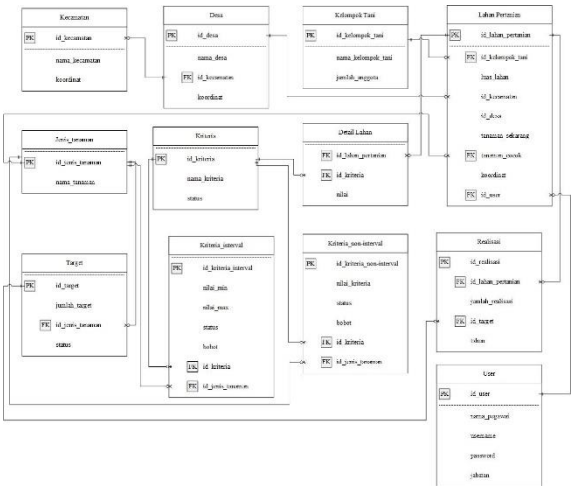


Image 4. Relation Diagram Geographic Information System for Determining the Distribution and Potential of Agricultural Land in Bengkalis Regency

3.10 Interface Design

Designing the interface of the Sub Staff of Agriculture and Food Security in the geographic information system to determine the distribution and potential of agricultural land in Bengkalis Regency is as in the following picture

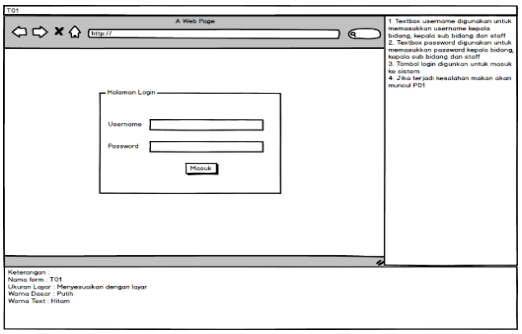


Image 5. Geographic Information System Interface Design To Determine Distribution and Potential of Agricultural Land in Bengkalis Regency

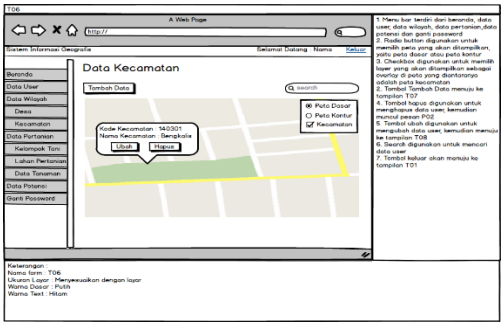


Image 6. Geographic Information System Interface Design To Determine Distribution and Potential of Agricultural Land in Bengkalis Regency

3.11 Design of Sematic Network

Semantic networks describe the interconnection of menu navigation from one form to another. The following semantic network of Staff Sub Division of Agriculture and Food Security can be seen in Figure 6 below

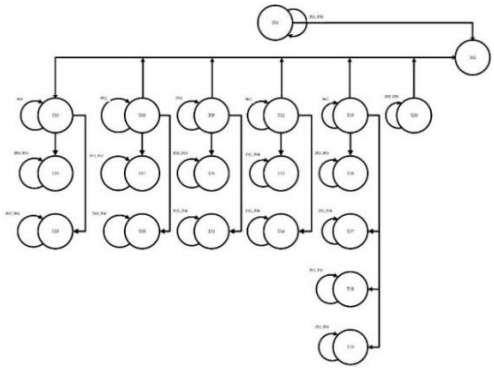


Image 7. Design of Semantic Staff Network

3.12 System Testing

The test system used to test the new system is by black box testing method, then the test focuses on user acceptance (end user) by using UAT (User Acceptance Testing), and test of user acceptance (end user)

.

1 Black Box Testing

Based on the test results with a sample test that has been determined then it can be concluded that the process performed by the system is correct. The error filtering process performed by the system is enough max. Functionally, the system can provide the expected output.

2 User Acceptance Testing Testing

Based on testing using UAT (User Acceptance Testing) can be concluded that the geographic information system to determine the distribution and potential of agricultural land in Bengkalis Regency can already be continued to the end user acceptance testing stage.

3 End User Testing

Based on the results of interviews that have been conducted with the Staff, Head of Sub Division and Head of Field then the beta test results can be concluded that the geographic information system to determine the distribution and potential of agricultural land in Bengkalis Regency is in accordance with the expected goal is to assist Head of Sub Division of Agriculture and Food Security in determining agricultural areas in accordance with the geographical conditions, so that the distribution of agricultural land can be evenly distributed and get maximum results.

4 PENUTUP

4.1 Conclusion

Based on the results obtained in the writing of this thesis it is concluded that the system built to assist the Head of Sub Division of Agriculture and Food Security in determining the agricultural area in accordance with geographical conditions, so that the spread of agricultural land can be evenly distributed.

4.2 Suggestion

Based on the results achieved in establishing Geographic Information System for Determining the Distribution and Potential of Agricultural Land in Bengkalis Regency still has shortcomings, therefore it is suggested to add things that can complete it in the future, including:

1. Plants used for determining the potential of agricultural land not just rice, corn and cassava, but can be added with other crops so that the results obtained can be better
2. For the development of this application future coverage for the determination of the distribution and potential of agricultural land not only in the Bengkalis Regency.

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