Research Article **Open Access**

Development of Crops Featured Commodities Application in Java and Sumatera Island Based on Geographic Information System

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Abstract Indonesia is an archipelago country that some of the population work as farmers. Farmers can plant excellent commodities such as rice, corn, potato tubers, bulbs timber, soybeans, green beans, and peanuts on the available land. All this time, Indonesian people only know the agricultural land that has good quality found in big cities, in any small town also has land that produces the same quality of food crops. Advanced research goal is to develop an application that has been designed to make distribution of food crops. This research-based Geographic Information System (GIS) to determine location of food crops distribution in the islands of Java and Sumatera. This research produced an application that has data base more complete and it can be accessed by internet and mobile phones. Making it easier for the user or society to know distribution of food plants in Java and Sumatera, then society can find out information about location which has the desired crops.

Keywords *Application; Commodities; Crops; Information Systems*

1. Introduction

Indonesia is an archipelago country that some of population work as farmers. Farmers can plant excellent commodities such as rice, corn, potato tubers, bulbs timber, soybeans, green beans, and peanuts on the available land. All this time, Indonesian people only know the agricultural land that has good quality found in big cities, in any small town also has land that produces the same quality of food crops. Related to this, the writer has an idea to make the research about food crops. This research is based on Geographic Information System (GIS) which to find out location of food crop distribution in Java and Sumatera Island.

Based on (Budiyanto E., 2002) Geographic Information Systems (GIS) is a specialized information system to manage data that has spatial information (spatial referenced) or it is a computer system that has the ability to build, store, manage and show the geographic information for example, data

identified based on its location, in a database. GIS can be explained into several subsystems as follows:

a) Data Input: This Sub-system is responsible for collecting, preparing, and storing spatial data and attributes from a variety of sources. This Sub-system is also responsible for converting or transforming the original data formats into a format that can be used by SIG software.

b) Data Output: This Sub-system is responsible to show or produce output (include exporting to the desired format). All of or part of database (spatial) both softcopy and hardcopy such as a table, graph reports, maps, and etc.

c) Data Management: This sub-system is well organized both spatial data and attribute tables related to database system, so it allows retrieving, updated, and edit.

d) Data Manipulation & Analysis: This Sub-system determined information that can be produced by GIS. In addition, this sub-system also performs manipulations (evaluation and usage of functions and mathematical and logical operators) and data modeling to produce the expected information.

According to (Z. Duran A, A. Garagon Doğru B., and G. Toz, 2003) the detailed GIS can operate with the following components.

a) The person performs the system such those who operate, develop and get benefit from the system. Categories of people who are part of the SIG variety, for example operators, analysts, programmers, database administrators and even stakeholders.

b) Application is procedure used to process data into information. For example, the sum, classification, rotation, geometry correction, query, overlay, buffer, and join table.

c) The data can be used in GIS, such as graphic data and attribute data.

d) Software is GIS software application that has the ability to program management, storage, processing, and analysis and show data spatial (eg *Arc View, Idrisi, ARC / INFO, ILWIS, MapInfo*).

e) Hardware is needed to run system in the form of computers, printer, scanner, digitizer, plotter and other supporting devices.

According to (Hosse and Schilcher, 2002) in agriculture, crops are all subjects of farm business that are not animals and cultivated in a space or a media which suitable for that business. This meaning can be distinguished from public use that the crops same with the plants. In fact, almost all crops are plants, but definition of plant covers several fungi (*mushroom foods, such as button mushrooms and studs mushroom*) and algae (*agar-producing* and *Nori*) deliberately cultivated for the benefit of economy. Crop *accidentally* planted, while the plant is something that appears or grows from the earth's surface.

Advanced research goal is to develop an application that has been designed to make distribution of food crops. This research-based Geographic Information System (GIS) to determine location of food crops distribution in the islands of Java and Sumatera.

2. Method and Design Applications

Application development is aimed at the development spread area of excellent food crop in Indonesia, which is on the island of Sumatera. Previous research only covers distribution of excellent crops across the province on the island of Java. Development was also conducted on the methodology of research such as creating *the Geographic Information System* of excellent crops distribution in Indonesia using *Google Maps* and *Fusion Database*. It also includes development of database structures for all provinces in Java and Sumatera. Mapping data is performed on the territory of which consists of several Region/Island. Each Region has some of the provinces.

The obtained data includes excellent crops data in all districts in Java and Sumatera which consists of plant Corn, Green Beans, Peanut, Soybean, Rice, sweet potato, and cassava. That data based on indicators of harvested area, production and productivity in 2008, 2009, and 2010. Table 1 is an example of data distribution of maize throughout the district in Banten province, which is one of the provinces on the island of Java.

Table 1: Corn Data in Banten Province

Regency	Harvested Area			Production			Productivity		
	HA			TON			Ku/HA		
	2008	2009	2010	2008	2009	2010	2008	2009	2010
Pandeglang	2.042,00	3.219,00	2.694,00	0	10.348,00	8.836,0	0	32,15	32,8
Lebak	1.762,00	2.180,00	1.968,00	0	7.008,00	6.456,0	0	32,15	32,81
Tangerang	297	209	1.170,00	0	672	3.840,0	0	32,15	32,82
Serang	2.114,00	2.241,00	1.367,00	0	7.204,00	4.498,0	0	32,15	32,9
Tangerang	4	3	1	0	10	3	0	32,15	32,78
Cilegon	69	27	47	0	87	155	0	32,15	32,88
Serang	0	448	1.092,00	0	1.569,00	3.600,0	0	32,15	32,97
Tangerang Selatan	0	58	358	0	185	1.170,0	0	32,15	32,69

The usage of methodology in this research is development system using *Google Map technology* and *Fusion Database* which has ever been done by (Prahasta E., 2007). Figure 1 is workflow display of the method used. Frontend requested interface to the server which is received by SPARQL. Data is entered through *Tomcat servlet* matched and adjusted with *knowledge base* which available in *datasets* based on its ontology, and the result (*Ontology/Ontology Web Language/RDF*) transferred again into the server to be done *query* based on that Ontology.
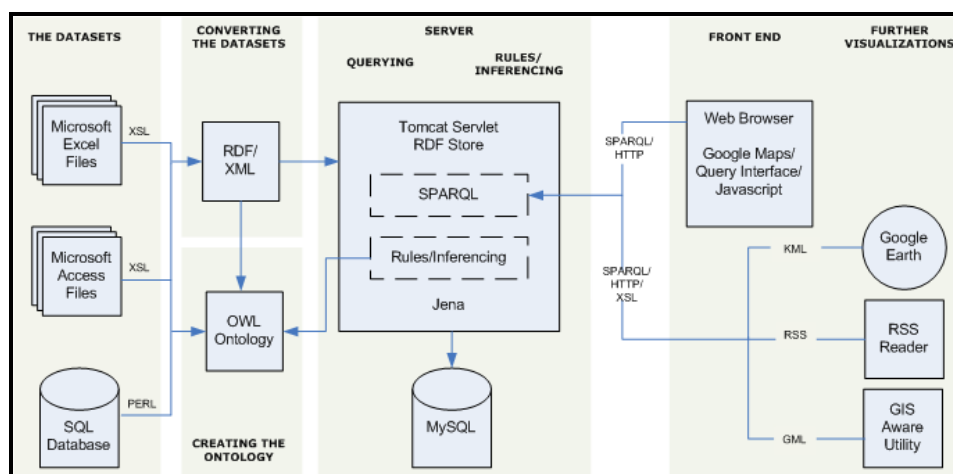

Figure 1: Methodology of Database Connection and Google Map

System development analysis has been done in this research which refers to (Mao J., R. Dutton, W. Chen, and W. Watson, 2008) in implementation of database is needed table structure design that can include the needs of system. Figure 2, table structure is used in the system includes the State Table, Table Region, Province Table, Regency Table, Plant Table, Table indicators, and Table Year along each attribute contained in the table.
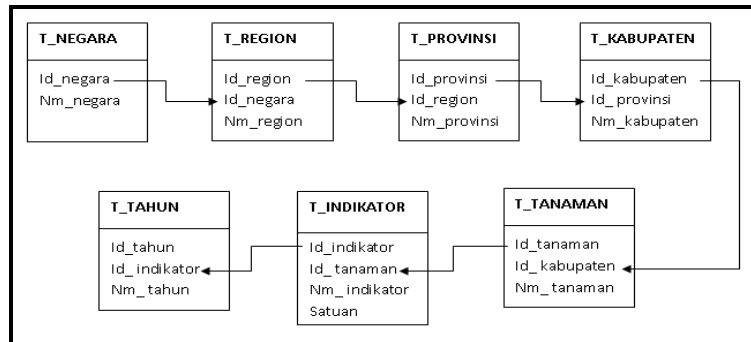

Figure 2: Table Structure

Development of database structure allows developers if there is the data changes such as addition, renewal, and or deletion of data on certain parts of it, then it will not affect the overall data structure. Here is an explanation of each table used in the system:

a. State table, this table shows location of country consisting of Id_State and Nm_State. Example of table 2 contains N01: country code, Indonesia.

Tabel 2: State Table

Id_state	Nm_state
N01	Indonesia

b. Region table, this table shows the region/island located in Indonesia country consisting of Id_region, Id_state, and Nm_region. Data region connected with id_state as the foreign key. Example of Table 3 contains of R 01 01: shows 01 the first is Indonesia, the second 01 is region/Java. R 01 02: shows 01 Indonesia, 02 Sumatera Island.

Table 3: Region Table

Id_region	Id_State	Nm_region
R0101	N01	Java island
R0102	N01	Sumatera island

c. Province table, this table shows all provinces in Java and Sumatera consisting of Id_province, Id_region, and Nm_province. Provincial data connected with Id_region as the foreign key. Example of Table 4 contains P 01 01 01: 01 shows the first is Indonesian, the second 01 is region/Java, and the last 01 is serial number of Banten. P 01 02 01: shows 01 state of Indonesia, 02 Sumatera Island, and 01 for serial number of Aceh Province and so on.

Table 4: *Province Table*

Id_province	Id_region	Nm_province
P010101	R0101	Banten
P010102	R0101	DI. Yogyakarta
P010201	R0101	Aceh
P010202	R0101	Bengkulu

d. Regency table, this table shows all districts in each province consisting of Id_Regency, Id_province, and Nm_Regency. Regency Data connected with Id_province as the foreign key. Example of Table 5 contains K <u>01</u> <u>01</u> <u>02</u> <u>001</u>: shows 01 the first is Indonesia, the second 01 is region/Java Island, 02 are DIY, and 001 is serial number of Bantul and so on.

Table 5: *Regency Table*

Id_Regency	Id_province	Nm_ Regency
K010102001	P010101	Bantul
K010102002	P010101	Gunung Kidul
K010201001	P010202	Aceh Barat
K010201002	P010202	Aceh Barat daya

e. Plant table, this table shows data on each plant consisting of Id_Plant, and Name_Plant. Example of Table 6 contains T01: Corn, T02: Green Beans plant.

Table 6: *Plant Table*

Id_plant	Nm_ Plant
T01	Corn
T02	Green beans
T03	Peanuts
T04	Soybean
T05	Rice
T06	Sweet potato
T07	Cassava

f. Indicators table, this table shows indicators on each plant consisting of Id_indicator, Nm_indicator, and Unit. Example of Table 7 contains I01: shows Area Harvested with the unit Hektor Are (Ha) and so on.

Table 7: *Indicator Table*

Id_indicator	Nm_indicator	Unit
I01	Harvested Area	HA
I02	Production	TON
I03	Productivity	Ku/HA

g. Year table, this table shows the usage of year. Example of Table 8 contains Y01: shows of 2008 related to the data obtained from Ministry of Republic Indonesia and so on.

Table 8: *Plant Table*

Id_Plant	Nm_ Plant
Y01	2008
Y02	2009
Y03	2010

h. Primary table is relation table between multiple tables above. At the primary table, there is *primary key* of each table, and new field is the value. *Field Value* can function to enter amount of agricultural data into database, as shown in Table 9. Table 9 consists of Id_primary, Id_state, Id_region, Id_province, Id_regency, Id_plants, Id_indicator, Id_year, and Value.

***Table 9:** Primary Table*

Id_primary	Id_state	Id_region	Id_province	Id_regency	Id_plant	Id_indicator	Id_year	Value
U000001	N01	R0101	P010102	K010102001	T01	I01	Y01	65,94
U000002	N01	R0101	P010102	K010102002	T01	I01	Y02	64,11
U000003	N01	R0102	P010201	K010201001	T01	I01	Y01	169
U000004	N01	R0102	P010201	K010201002	T01	I01	Y03	43

3. Results

The following is display of interface design Web GIS *"Digitalization Application Development Crop-Based Geographic Information System (GIS) Commodity Featured in Java and Sumatera"*.

(1) On the Web index page, there are 7 menus consisting of *Home, Profile, Maps, Tables, E-book, and About Us.*
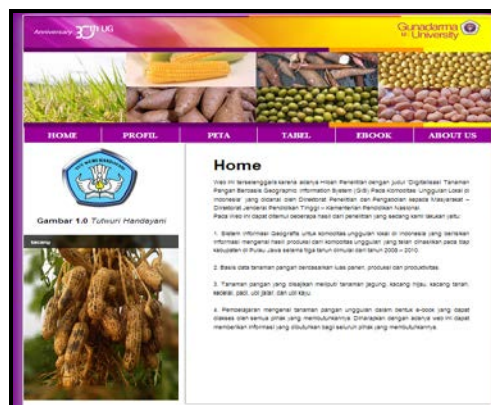

***Figure 3a:** Home Page*

(2) On the profile page, there is detailed explanation of function and performing of all the existing content on the Web GIS "*Digitalization Application Development Crop-Based Geographic Information System (GIS) Commodity Featured in Java and Sumatera*".

***Figure 3b:** Profile Page*

(3) On the map page, there is standard view of Indonesia country. Accessible Island is Java and Sumatera. Additionally user can show data mapping across districts based on category indicators, Crop, Regional, and year which can be chosen in advance.
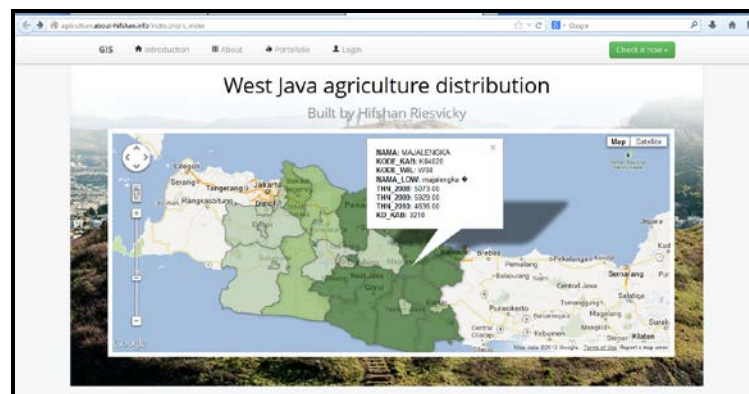

Figure 4: Distribution Data of West Java Province using Google Map

(4) On the Table page, it shows information data of each district in form of tables by category indicators, Plants, and area that can be selected in advance. Here is a sample table in Yogyakarta Province, with production indicators, in maize, in 2008, 2009, 2010.

Figure 5a: Table Page

(5) In Figure 5b, About Us page shows information about the design team within the Research Grants program titled "*Digitizing Crop-Based Geographic information System (GIS) at Local Commodities in Indonesia*".
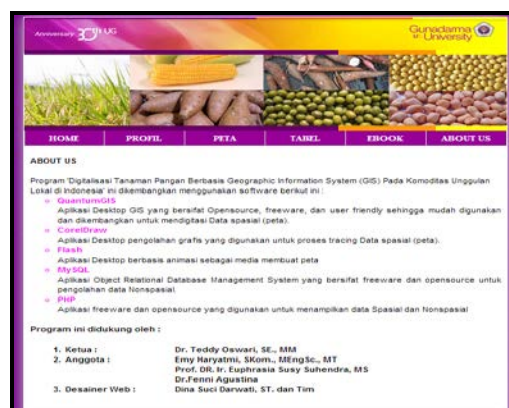

Figure 5b: About Us Page

(6) On *E-book* page shows information about excellent crops, such as corn, green beans, peanuts, soybeans, rice, sweet potato, and cassava. This information shows ranging from plants, how to grow crops, harvest time, to benefits for humans. (Constraints *e-book* exe file can't be displayed on the web, another alternative is to create a link so that users can download and access that *e-book*).

4. Conclusion

This application can be accessed by internet or mobile phone. This application was made to determine distribution of food plants in Java and Sumatera, then society can find out information about location which has the desired crops.

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