

# 14

*by* Denny Trias Utomo

---

**Submission date:** 10-Apr-2022 04:20PM (UTC-0400)

**Submission ID:** 1806770397

**File name:** 2-Utomo\_2022\_IOP\_Conf.\_Ser.\_Earth\_Environ.\_Sci.\_980\_012057.docx (8.29M)

**Word count:** 3885

**Character count:** 26143

PAPER • OPEN ACCESS

## Modeling the Potential of Cereal Crops with a Smart Village-Based GIS Approach to Support Food Security

To cite this article: Denny Trias Utomo *et al* 2022 *IOP Conf. Ser.: Earth Environ. Sci.* **980** 012057

View the [article online](#) for updates and enhancements.

### You may also like

- [Modeling the effect of climate on na-oogst tobacco production in Jember](#) | Harlianingtyas, M Azizah, S I Kusuma *et al.*

- [Benefits of literation information against improvement of mushroom agriculture in Rambipuij, Jember District](#)

S Rengganata, S Kantun and Sukidin

- [Exploring ethnomathematics activities to tobacco farmers' community at Jember, East Java, Indonesia](#)

Suwarno, N D S Lestari and W Murtafiah

**ECS** The Electrochemical Society  
Advancing solid state & electrochemical science & technology

242nd ECS Meeting  
Oct 9 – 13, 2022 • Atlanta, GA, US

Abstract submission deadline: **April 8, 2022**

Connect. Engage. Champion. Empower. Accelerate.

**MOVE SCIENCE FORWARD**

Submit your abstract

# Modeling the Potential of Cereal Crops with a Smart VillageBased GIS Approach to Support Food Security

Denny Trias Utomo<sup>1\*</sup> , Bety Etikasari<sup>1</sup> , Jumiatusun<sup>2</sup>

<sup>1</sup>Information Technology Department, Politeknik Negeri Jember, Indonesia

<sup>2</sup> Crop Production Technology Department, Politeknik Negeri Jember, Indonesia

\*denny\_trias@polije.ac.id

**Abstract.** Since 2015, government projects related to national food security have been implemented so far. This article will write a study that uses the GIS method to model the potential of food crops. The GIS web application development method uses the prototyping method with input in the form of spatial and non-spatial data which includes data on potential rice, corn, and soybeans in the Jember district, where the data was obtained from a survey at the Jember Regency Agriculture Service in the period January - August 2021 and data statistics from the book Jember in Figures 2020 and the official website of the Jember Regency BPS.

Keywords: *Geographic Information System, smart village, Food security*

## 1. Introduction

The development of main cereal crops needs namely rice, corn, and soybeans (pajale) for high-level domestic products has been the government's main goal since 2015. This is an effort to achieve national food security. This achievement is highly dependent on the results of agricultural production in Indonesia. One of the factors that affect agricultural production is climate change. Research shows that one of the impacts of climate change is an increasing temperature which causes a decrease in rice production from 68.1% to 92% [1]. The impact of climate change on agriculture is important, so strategies and technologies need to be applied to maintain food availability in Indonesia.

Agricultural system solutions in Indonesia must be based on data accuracy for developing information systems in this 4.0 technology era. Research shows that new technology system uses a spatial database and use artificial intelligence (AI) to generate food insecurity information [2]. From developing AI perspective based on the Territorial Information System (GIS) in obtaining data, UAV (unmanned aerial vehicle) technology can be used for collecting data spatial in the wider area [3].

Applied research internet of things has also been carried out in smart agriculture to get real-time data on agricultural land conditions [4]. The purpose of this research is the implementation of AI and internet of things technology for agriculture which is made in the smart village concept. The Smart village program was built by integrating GIS spatial data, a database of cereal crops potential by utilizing AI on a Web-based platform. The smart village concept refers to that villages can solve their problems intelligently.



Content from this work may be used under the terms of the [Creative Commons Attribution 3.0 licence](https://creativecommons.org/licenses/by/3.0/). Any further distribution of this work must maintain attribution to the author(s) and the title of the work, journal citation and DOI.

Published under licence by IOP Publishing Ltd

## 2. Literature Review

### 2.1. Modeling the Potential of Cereal Crops

The development of superior cereal crops commodities (rice, corn, and soybeans) based on production areas can be carried out using a GIS system. Mapping of cereal crop production areas is carried out using the Hot Spot Getis-Ord  $G_i^*$  analysis method to recommend the potential of superior cereal crops in a specific area [5]. The modeling system for cereal crop production potential is influenced by several factors. So proper data and analysis are required during implementation. After doing an analysis of potential soil fertility and climate in a specific area, so that area can develop a cereal cropping system itself. Plant growth and production factors become the focus of studies to develop modeling systems.

The results showed that the significant factor effect was harvested area and rainfall [6].

### 2.2. Smart Village-Based GIS Approach to Support Food Security

The smart village concept in this study is the application of modern agricultural technology in the specific area so the conventional agricultural systems and have less measurable results can be optimized using several technological approaches such as Geographic Information System (GIS), Decision Support System (DSS)[7]–[9].

GIS is a computer-based system that is used to store and manipulate geographic information. Geographic information system aims to collect, store and analyze objects or phenomena where geographic location is an important characteristic for analysis. GIS illustrated into a map form. It becomes an effective presentation tool and geographical data storage. The stored information will be processed and presented by changing the presentation form, a map always provides images or symbols of geographic elements with a fixed or static shape even though it is for different needed [5], [7], [8], [10].

This research is the first step for the studies series development that integrates GIS with DSS. The integration of data input into the GIS system will produce useful information that will be used for the next research to develop DSS where one system that applied to the Smart Village concept is collecting data in real-time so that the information provided to farmers is accurate.

## 3. Methods

These research stages use the prototype method for the software development stage. The stages include system requirements analysis, system design, system design evaluation, system coding, and alpha version system testing by the team. The prototype method is shown in Figure 1

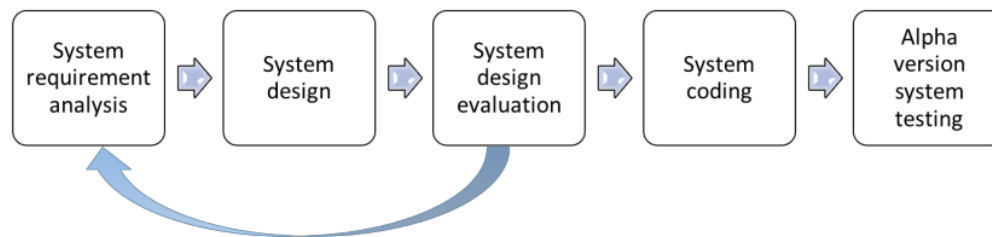


Figure 1. Prototype Method for System Development

The reason for using the prototype method is because the designing system of GIS, DSS, and aerial images for the smart village concept is complex. This smart village concept needs an evaluation stage during the coding stage for the system to become easier [11].

### 3.1. System requirement analysis

The system requirement analysis stage is done by using observation, interview, and documentation techniques. Observations and interviews were conducted with several farmers in

Jember Regency. Observation and interview technique purpose to comparative data from the Badan Pusat Statistik (BPS) documentation to complete the data needed. The secondary data documentation technique from BPS was taken from the Jember Regency Book in 2020.

### 3.2. System design

The system design stage is done by using an image processing application like diagram.net and adobe illustration. Prototyping is made according to the business process of the GIS concept the smart village that will be developed. The flowchart of the GIS application is shown in Figure 2.

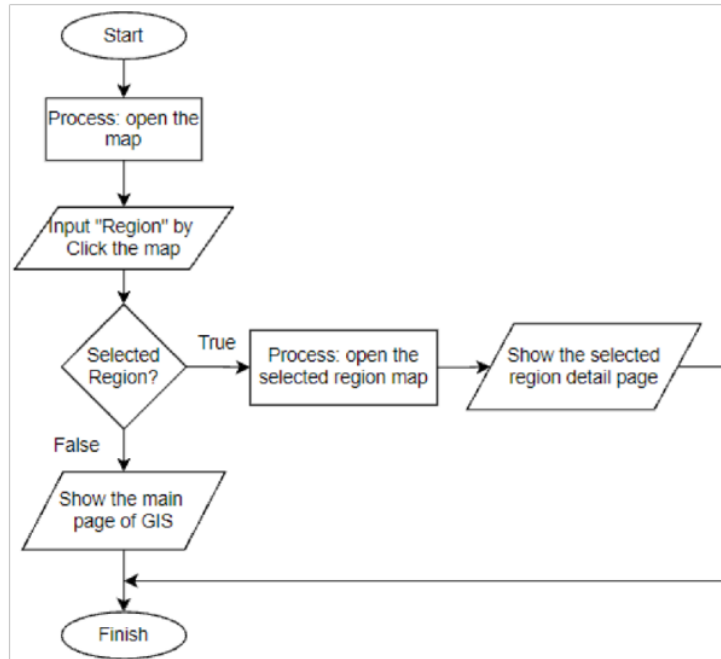


Figure 2. Flowchart of Web GIS

### 3.3. System design evaluation

The system design evaluation stage purpose to test the results of the prototype that has been developed. This is to determine whether there is still a need for a redesign before the system coding stage is done.

### 3.4. System coding

The system coding stage of the GIS system is done using PHP programming with Laravel framework, MySQL database, composer, and Github. The coding of then is system is done according to the prototype that has been developed in the system design stage.

### 3.5. Alpha-version system testing

The alpha version system testing stage is done using the User Acceptance Test (UAT) method. Testing is done on users who have contributed to agriculture. The form of the instrument used is a questionnaire with 5 answer choices on the Likert scale.

## 4. Result and Discussion

This section discusses applications development according to the research stage described in the Methods section above and also discusses the verification testing of an application program. The webbased GIS application prototype that has been developed can be accessed on the webpage <https://www.smart-agrotech.com/> page.

#### 4.1. Application development

The application development stage had two stages. The first stages are making a logical database design and physical database then the second stage is making a complete application. The logical database is shown in Figure 3 and the physical database is shown in Figures 4 to 13.

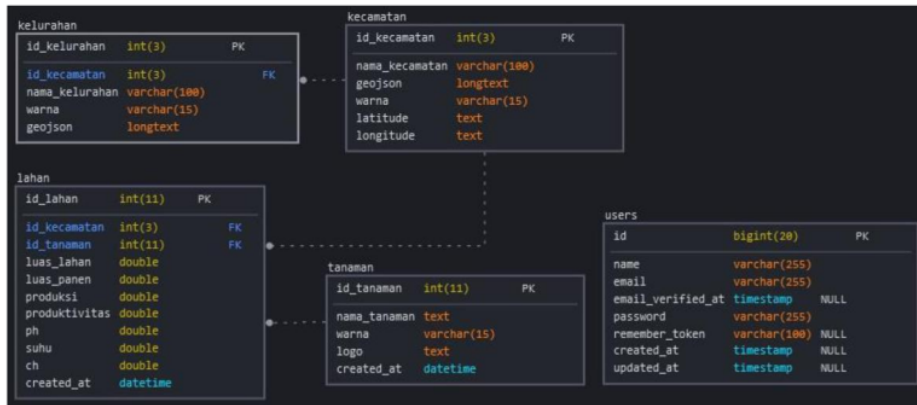


Figure 3 Database Diagram Design

Figure 3 shows the logical database is consists of 4 main tables that are interconnected with each other, namely the “lahan” table, “tanaman” table, “kecamatan” table, and “kelurahan” table. The “tanaman” table and the “kecamatan” table have a relation to “lahan” table which linked by primary key and foreign key, namely id\_tanaman and id\_kecamatan. The “kecamatan” table has a relation to “kecamatan” table which linked by the primary key and foreign key id\_kecamatan. In addition, there is one table that is used to store user data, namely the “users” table. This logical database was made from the database design stage and fulfill the normalization principle.

#	Name	Type	Collation	Attributes	Null	Default	Comments	Extra	Action
1	id_kecamatan	int(2)			No	None		AUTO_INCREMENT	Change Drop More
2	nama_kecamatan	varchar(100)	utf8mb4_general_ci		No	None			Change Drop More
3	geojson	longtext	utf8mb4_bin		No				Change Drop More
4	warna	varchar(15)	utf8mb4_general_ci		No	None			Change Drop More
5	latitude	text	utf8mb4_general_ci		No				Change Drop More
6	longitude	text	utf8mb4_general_ci		No				Change Drop More

Figure 4. Table structured in “kecamatan” table

	id_kecamatan	nama_kecamatan	geojson	warna	latitude	longitude
<input type="checkbox"/>	1	Kecamatan Ajung	{ "type": "Polygon", "coordinates": [ [ [ [ 113.68484462797...	#ffff	-8.222823118407701	113.64428354002413
<input type="checkbox"/>	2	Kecamatan Ambulu	{ "type": "MultiPolygon", "coordinates": [ [ [ [ 113.58284...	#ffff	-3.345758650256132	113.60599757220882
<input type="checkbox"/>	3	Kecamatan Arjasa	{ "type": "Polygon", "coordinates": [ [ [ [ 113.77298165897...	#ffff	-8.111865195115351	113.73682662631333
<input type="checkbox"/>	4	Kecamatan Balung	{ "type": "Polygon", "coordinates": [ [ [ [ 113.56882607386...	#ffff	-8.27489299490978	113.53416051601032
<input type="checkbox"/>	5	Kecamatan Bangsalsari	{ "type": "Polygon", "coordinates": [ [ [ [ 113.60432420090...	#4a100	-8.17754309803353	113.53837712042558
<input type="checkbox"/>	6	Kecamatan Gumukmas	{ "type": "Polygon", "coordinates": [ [ [ [ 113.45697000036...	#ffff	-8.297230818583614	113.41630748651455
<input type="checkbox"/>	7	Kecamatan Jelbuk	{ "type": "Polygon", "coordinates": [ [ [ [ 113.78410960377...	#ffff	-8.088837149671866	113.749444114665343
<input type="checkbox"/>	8	Kecamatan Jenggawah	{ "type": "Polygon", "coordinates": [ [ [ [ 113.69814999962...	#ffff	-8.25841485294082	113.67433161705121
<input type="checkbox"/>	9	Kecamatan Jombang	{ "type": "Polygon", "coordinates": [ [ [ [ 113.39992999957...	#ffff	-8.24456928429861	113.36541327037854
<input type="checkbox"/>	10	Kecamatan Kalisat	{ "type": "Polygon", "coordinates": [ [ [ [ 113.83298999988...	#ffff	-8.12707487834376	113.80927658419
<input type="checkbox"/>	11	Kecamatan Kaliwates	{ "type": "Polygon", "coordinates": [ [ [ [ 113.70537982132...	#00ac69	-8.179242253752724	113.66609441363838
<input type="checkbox"/>	12	Kecamatan Kencong	{ "type": "Polygon", "coordinates": [ [ [ [ 113.38194999959...	#ffff	-8.262491983089246	113.38058448631998
<input type="checkbox"/>	13	Kecamatan Ledokombo	{ "type": "Polygon", "coordinates": [ [ [ [ 113.85873834369...	#ffff	-8.140839569527067	113.87605003732726
<input type="checkbox"/>	14	Kecamatan Mayang	{ "type": "Polygon", "coordinates": [ [ [ [ 113.85012142476...	#ffff	-8.188842347461605	113.80026357111404
<input type="checkbox"/>	15	Kecamatan Mumbulsari	{ "type": "Polygon", "coordinates": [ [ [ [ 113.78578999960...	#ffff	-8.285255184891327	113.75321814660737
<input type="checkbox"/>	16	Kecamatan Pakusari	{ "type": "Polygon", "coordinates": [ [ [ [ 113.77142679501...	#ffff	-8.179836956543436	113.76249208254312

Figure 5. Data in "kecamatan" table

#	Name	Type	Collation	Attributes	Null	Default	Comments	Extra	Action
1	id_kelurahan	int(3)			No	None		AUTO_INCREMENT	Change Drop More
2	id_kecamatan	int(3)			No	None			Change Drop More
3	nama_kelurahan	varchar(100)	utf8mb4_general_ci		No	None			Change Drop More
4	warna	varchar(15)	utf8mb4_general_ci		No	None			Change Drop More
5	geojson	longtext	utf8mb4_general_ci		No				Change Drop More

Figure 6. Table structured in "kelurahan" table

	id_kelurahan	id_kecamatan	nama_kelurahan	warna	geojson
<input type="checkbox"/>	2	21	SIDOMULYO	#86B4D7	{ "type": "Feature", "properties": { "KECAMATAN": ...
<input type="checkbox"/>	4	2	KASIYAN TIMUR	#88073f	{ "type": "MultiPolygon", "coordinates": [ [ [ [ 113.30101...
<input type="checkbox"/>	5	9	PADOMASAN	#594370	{ "type": "Feature", "properties": { "KECAMATAN": ...
<input type="checkbox"/>	6	9	SARIMULYO	#39e221	{ "type": "Feature", "properties": { "KECAMATAN": ...
<input type="checkbox"/>	8	12	PASEBAN	#9b6693	{ "type": "Feature", "properties": { "KECAMATAN": ...
<input type="checkbox"/>	9	12	KENCONG	#baef82	{ "type": "Feature", "properties": { "KECAMATAN": ...
<input type="checkbox"/>	10	12	WONOREJO	#745514	{ "type": "Feature", "properties": { "KECAMATAN": ...
<input type="checkbox"/>	11	25	JAMINTORO	#da2c43	{ "type": "Feature", "properties": { "KECAMATAN": ...
<input type="checkbox"/>	12	25	JATIROTO	#52dadc	{ "type": "Feature", "properties": { "KECAMATAN": ...
<input type="checkbox"/>	13	25	YOSORATI	#c05180	{ "type": "Feature", "properties": { "KECAMATAN": ...
<input type="checkbox"/>	14	23	UMBULSARI	#561fe7	{ "type": "Feature", "properties": { "KECAMATAN": ...
<input type="checkbox"/>	15	19	WONOSARI	#0a0366	{ "type": "Feature", "properties": { "KECAMATAN": ...
<input type="checkbox"/>	16	25	PRINGGOWIRAWAN	#2ba1e7	{ "type": "Feature", "properties": { "KECAMATAN": ...
<input type="checkbox"/>	17	6	TEMBOKREJO	#e7f9df	{ "type": "Feature", "properties": { "KECAMATAN": ...
<input type="checkbox"/>	18	6	PURWOASRI	#da0d13	{ "type": "Feature", "properties": { "KECAMATAN": ...
<input type="checkbox"/>	19	6	BAGOREJO	#0f43b0	{ "type": "Feature", "properties": { "KECAMATAN": ...
<input type="checkbox"/>	20	6	KARANGREJO	#fc3ffa	{ "type": "Feature", "properties": { "KECAMATAN": ...

Figure 7. Data in "kelurahan" table

#	Name	Type	Collation	Attributes	Null	Default	Comments	Extra	Action
<input type="checkbox"/>	1	<b>id_lahan</b>	int(11)		No	None		AUTO_INCREMENT	Change  Drop  More
<input type="checkbox"/>	2	<b>id_kecamatan</b>	int(11)		No	None			Change  Drop  More
<input type="checkbox"/>	3	<b>id_tanaman</b>	int(11)		No	None			Change  Drop  More
<input type="checkbox"/>	4	<b>luas_lahan</b>	double		No	None			Change  Drop  More
<input type="checkbox"/>	5	<b>luas_panen</b>	double		No	None			Change  Drop  More
<input type="checkbox"/>	6	<b>produksi</b>	double		No	None			Change  Drop  More
<input type="checkbox"/>	7	<b>produktivitas</b>	double		No	None			Change  Drop  More
<input type="checkbox"/>	8	<b>ph</b>	double		No	None			Change  Drop  More
<input type="checkbox"/>	9	<b>suhu</b>	double		No	None			Change  Drop  More
<input type="checkbox"/>	10	<b>ch</b>	double		No	None			Change  Drop  More
<input type="checkbox"/>	11	<b>created_at</b>	datetime		No	None			Change  Drop  More

Figure 8. Data structure in “lahan” table

	id_lahan	id_kecamatan	id_tanaman	luas_lahan	luas_panen	produksi	produktivitas	ph	suhu	ch	created_at
	5	5	4	0	8080	51693	63.97	7	0	0	2021-09-08 20:51:37
	8	12	4	0	6689	42950	64.23	0	0	0	2021-09-15 17:14:29
	9	6	4	0	6885	45567	66.19	0	0	0	2021-09-15 17:27:56
	10	19	4	0	5912	39853	67.41	0	0	0	2021-09-15 17:28:28
	11	31	4	0	4731	35798	75.67	0	0	0	2021-09-15 17:28:55
	12	2	4	0	3633	26004	71.58	0	0	0	2021-09-15 17:30:24
	13	26	4	0	3441	21426	62.26	0	0	0	2021-09-15 17:31:01
	14	22	4	0	4411	24319	55.13	0	0	0	2021-09-15 17:36:04
	15	14	4	0	4976	30016	60.32	0	0	0	2021-09-15 17:36:33
	16	15	4	0	6128	37714	61.54	0	0	0	2021-09-15 17:36:58
	17	8	4	0	6934	47096	67.92	0	0	0	2021-09-15 17:37:35
	18	1	4	0	7681	48446	63.07	0	0	0	2021-09-15 18:08:31
	19	26	4	0	6664	40191	60.4	0	0	0	2021-09-15 18:10:15
	20	4	4	0	5666	39466	69.65	0	0	0	2021-09-15 18:11:10
	21	23	4	0	3078	19082	62	0	0	0	2021-09-15 18:11:41
	22	21	4	0	4781	28625	59.87	0	0	0	2021-09-15 18:12:32
	23	9	4	0	6775	35719	52.72	0	0	0	2021-09-15 18:13:05

Figure 9. Data in “lahan” table

#	Name	Type	Collation	Attributes	Null	Default	Comments	Extra	Action
<input type="checkbox"/>	1	<b>id_tanaman</b>	int(11)		No	None		AUTO_INCREMENT	Change  Drop  More
<input type="checkbox"/>	2	<b>nama_tanaman</b>	text	utf8mb4_general_ci	No				Change  Drop  More
<input type="checkbox"/>	3	<b>warna</b>	varchar(15)	utf8mb4_general_ci	No	None			Change  Drop  More
<input type="checkbox"/>	4	<b>logo</b>	text	utf8mb4_general_ci	No				Change  Drop  More
<input type="checkbox"/>	5	<b>created_at</b>	datetime		No	None			Change  Drop  More

Figure 10. Data structured in “tanaman” table

	id_tanaman	nama_tanaman	warna	logo	created_at
	4	Padi	#4a100	assets/tanaman/1gRJvhe1zH.png	2021-06-18 10:35:44
	5	Jagung	#76400	assets/tanaman/XKpS7ppDSU.png	2021-06-19 11:35:31
	6	Kedelai	#00ac69	assets/tanaman/2eFLoE53Of.png	2021-06-19 11:38:24

Figure 11. Data in “tanaman” table



#	Name	Type	Collation	Attributes	Null	Default	Comments	Extra	Action
1	id	bigint(20)		UNSIGNED	No	None		AUTO_INCREMENT	Change Drop More
2	name	varchar(255)	utf8mb4_unicode_ci		No	None			Change Drop More
3	email	varchar(255)	utf8mb4_unicode_ci		No	None			Change Drop More
4	email_verified_at	timestamp			Yes	NULL			Change Drop More
5	password	varchar(255)	utf8mb4_unicode_ci		No	None			Change Drop More
6	remember_token	varchar(100)	utf8mb4_unicode_ci		Yes	NULL			Change Drop More
7	created_at	timestamp			Yes	NULL			Change Drop More
8	updated_at	timestamp			Yes	NULL			Change Drop More

Figure 12. The data structure in the “users” table

Options	id	name	email	email_verified_at	password	remember_token	created_at	updated_at
Edit Copy Delete	1	Yudha	yudha@gmail.com	NULL	S2yS10S90X4SqeXPYJuuN0iSHV0cagkFYqUxT0tjCbnC2TA...	NULL	2021-06-12 02:55:13	2021-06-

Figure 13 The data in the “users” table

In addition to building the application databases, a GIS website is also built. The GIS website that has been developed consists of two main pages, namely the main page which contains maps of all areas of Jember Regency, and the detailed land view page which contains detailed data for each region. On the main page, a map of Jember Regency is displayed by labeling the first layer, when the label is clicked, the user can see detailed data about the conditions in the specific district. On the map, there are also different colored markings in 3 areas which are the focus of research conducted this year, namely Bangsalsari District, Panti District, and Kaliwates District. The color of the area according to the "legend" on the map that yellow indicates rice commodities, orange indicates corn commodities, and green indicates soybeans commodities.

The data displayed in this GIS get from Badan Pusat Statistik of Jember Regency and observation with farmers. The purpose of observation to farmers is to ensure that the data are real by actual field conditions. Therefore, the focus of detailed data displayed in this web GIS is still from one location point in the 3 sub-districts. In addition to the map, this home page also displays data on total harvested area, data on total rice harvested area, total corn harvested area, and total soybean harvested area. The

initial view of the GIS web page is shown in Figure 14.

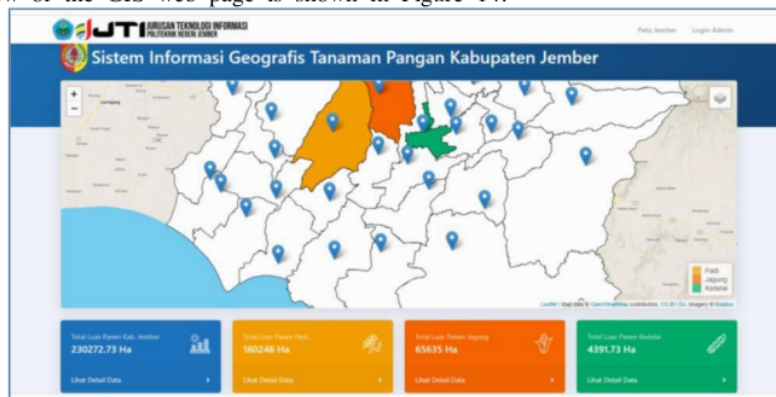


Figure 14. Main Page of WebGIS

The data detail page displays detailed sub-district data including harvested area, production, productivity, average temperature, soil pH, drainage, and soil texture. In addition, it also displays data on harvested area, production, and productivity for each cereal crop that can be produced. The data detail page display is shown in Figure 15.

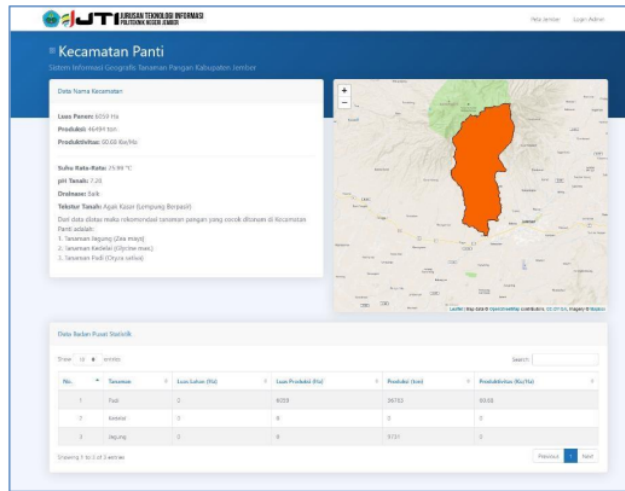


Figure 15. Data detail page displays each district

#### 4.2. Verification result and application testing

In the final stage of this research, testing and verification of this Web GIS application were done using the User Acceptance Testing method [12] [13] [14] [15] [16]. The test instrument was done using the google form as shown in Figure 16.



Figure 16. Verification using User Acceptance Testing in WebGIS

This test uses the Linkert scale because based on several papers it is shown that to verify web applications, you can use a the Likert scale [17]–[25] with scoring rules as shown in Table 1.

Table 1. Linkert scale in WebGIS Smart Village Evaluation

No	Linkert scale	Score
1	Very Complete	5
2	Complete	4
3	Quite Complete	3
4	Less Complete	2

5 Incomplete Not Easy 1

Based on the questionnaire instrument, the testing result is shown in Table 2.

Table 2. Verification Result of User Acceptance Testing

No	Question	Very complete	Complete	Quite Complete	Less complete	Incomplete	Score %
		Very Simple	Simple	Quite Easy	Less Easy	Not Easy	
		5	4	3	2	1	
1	Is the appearance of each sub district location in Jember Regency on this geographic information system website complete according to the map?	24,4	31,7	36,6	7,3	0	100
2	Is the map display easy to identify each sub-district name with a color label?	34,1	34,1	24,4	7,3	0	100
3	Do you find it easy when you "want to see detailed data on total production land in Jember Regency on the geographic information system web"?	32,5	42,5	12,5	7,5	5	100
4	Do you find it easy when you "want to see detailed data on total rice land in Jember Regency on the geographic information system web"?	36,6	29,3	17,1	12,2	10	100
5	Do you find it easy when you "want to see detailed data on total maize land in Jember Regency on the geographic information system web"?	39	26,8	22	7	4,9	100
6	Do you find it easy when you "want to see detailed data on total soybean land in Jember Regency on the geographic information system web"?	37,65	32,5	20	5	5	100
7	Do you find it easy when you "want to find recommendations						

for plants that can be grown in your area of planting”?

No	Question	Very Simple	Simple	Quite Easy	Easy	Less	Not	%	Score
8	Do you find it easy to “find cropping characteristics such as soil pH, average temperature, drainage, and soil texture in your area in the application”?	29,3	39	14,6	12,2	2	100		
		29,3	22	34	9,8	4,9	0		
		Very Complete	Quite Complete	Less complete	Incom				
		5	4	3	2	1			
9	Do you find it easy to “find production data for rice, soybeans, and maize in certain areas in this application”?	34,1	31,7	22	7,3	4,9	0		
10	Does this application have an attractive appearance?	26,8	5	17	22	7,3	2,4	0	

Based on the results of an online survey by Google Form application with 41 respondents, the following results show that: “Very Simple” and “Simple” or “very Complete” and “Complete” 80%, this indicates that the application or web that built in this study under user expectations (Verified).

### 5. Conclusion

This research produces another solution in agriculture to increase the production of cereal crops. Modeling the potential of cereal crops based on Web GIS in smart villages which in detail can be concluded that the Web GIS application for modeling the potential of web-based food crops by integrating the database in the display design can be developed and the results of the trial of the web GIS application using the User Acceptance method. The testing online survey results using the Google

Form show that “Very Simple” and “Simple” or “Very Complete” > 80%, this indicates that the application or web that built in this study is under user expectations (Verified).

### 6. Suggestion

This research still requires development and improvement, including the following: (1) applicable suggestions aimed at the industry: considering that the developed application is still a prototype, it is better then this application be further developed into a professional application that will benefit the agricultural industry in Indonesia, and (2) academic suggestions for further research is that further research is needed to test the possibility of this GIS system prototype in other districts outside Jember Regency and further research is needed that can provide added value to the information generated by this GIS, such as DSS for cereal crop

modeling that is most suitable in certain areas that collecting data from IoT integrated big data.

### Acknowledgment

The authors would like thank to The Head of P3M State Polytechnic of Jember, Head of the Information Technology Department and its Staff, Head of the Engineering and Information Systems Laboratory, Head of the Computer Control System Laboratory, Lecturer Staff and Technicians of the Information Technology Department, and the Respondents who have helped complete the questionnaire in this study. The authors also thank the Jember State Polytechnic for providing funding for the PNPB program for the implementation of this research.

### References

- [1] Jumiatur, A. Junaedi, I. Lubis, C. M.A, and M. A, "Morphological, Physiological and Yield Responses of Some Rice Varieties (*Oryza sativa* L.) as Exposed Under High Temperature in Indonesia," *Am. J. Plant Physiol.*, vol. 11, pp. 33–41, 2016.
- [2] D. T. Utomo, "Studi Pendahuluan Sistem Informasi Pangan Untuk Mengatasi Kerawanan Pangan Menggunakan Artificial Intelligence Berbasis Data Spasial," *J. Teknol. Inf. dan Terap.*, vol. 1, pp. 17–22, 2014.
- [3] B. Etikasari, H. Husin, S. Kautsar, H. Y. Riskiawan, and D. P. S. Setyohadi, "Wireless sensor network development in an unmanned aerial vehicle (UAV) for water quality monitoring system," *IOP Conf. Ser. Earth Environ. Sci.*, vol. 411, no. 1, pp. 0–7, 2020, DOI: 10.1088/1755-1315/411/1/012061.
- [4] H. M. Kaidi *et al.*, "Internet of Things: A Monitoring and Control System for Rockmelon Farming," *Int. J. Integr. Eng.*, vol. 12, no. 6, pp. 55–61, 2020, DOI: 10.30880/ijie.2020.12.06.007.
- [5] A. Jauhari, "Pemanfaatan SIG untuk Pemetaan Kawasan Produksi Komoditas Unggulan Tanaman Pangan di Kabupaten Pacitan," *J. Reg. Rural Dev. Plan.*, vol. 4, no. 3, pp. 154–171, 2020, DOI: 10.29244/jp2wd.2020.4.3.154-171.
- [6] I. Maulana, T. A. Rumiati, and O. E. Permatasari, "Analisis Faktor-Faktor yang Mempengaruhi Produksi Padi di Provinsi Jawa Timur Menggunakan Regresi Semiparametrik Spline," *J. Sains dan Seni ITS*, vol. 5, no. 2, 2016, DOI: 10.12962/j23373520.v5i2.16992.
- [7] M. Rao, G. Fan, J. Thomas, G. Cherian, V. Chudiwale, and M. Awawdeh, "A web-based GIS Decision Support System for managing and planning USDA's Conservation Reserve Program (CRP)," *Environ. Model. Softw.*, vol. 22, no. 9, pp. 1270–1280, Sep. 2007, DOI: 10.1016/j.envsoft.2006.08.003.
- [8] H. Xianjin, L. Huan, H. Jinliao, and Z. Yueguang, "2.20 - Application of GIS-Based Models for Land-Use Planning in China," in *Comprehensive Geographic Information Systems*, B. Huang, Ed. Oxford: Elsevier, 2018, pp. 424–445.
- [9] M. D. M. Kadiyala, S. Nedumaran, P. Singh, C. S., M. A. Irshad, and M. C. S. Bantilan, "An integrated crop model and GIS decision support system for assisting agronomic decision making under climate change," *Sci. Total Environ.*, vol. 521–522, pp. 123–134, Jul. 2015, DOI: 10.1016/j.scitotenv.2015.03.097.
- [10] B. Röpke, M. Bach, and H.-G. Frede, "DRIPS—a DSS for estimating the input quantity of pesticides for German river basins," *Environ. Model. Softw.*, vol. 19, no. 11, pp. 1021–1028, Nov. 2004, DOI: 10.1016/j.envsoft.2003.11.005.

- [11] M. Bolung and H. R. K. Tampangela, "Analisa Penggunaan Metodologi Pengembangan Perangkat Lunak," *J. ELTIKOM*, vol. 1, no. 1, pp. 1–10, 2017, DOI: 10.31961/eltikom.v1i1.1.
- [12] F. Davis, "A technology acceptance model for empirically testing new end-user information systems: Theory and results," 1985, Accessed: Oct. 11, 2021. [Online]. Available: <https://dspace.mit.edu/bitstream/handle/1721.1/15192/14927137-MIT.pdf>.
- [13] K. Ganesh, S. Mohapatra, S. P. Anbuudayasankar, and P. Sivakumar, "User Acceptance Test," pp. 123–127, 2014, DOI: 10.1007/978-3-319-05927-3\_9.
- [14] K. Ganesh, S. Mohapatra, ... S. A.-E. R., undefined 2014, "User acceptance test," *Springer*, Accessed: Oct. 11, 2021. [Online]. Available: [https://link.springer.com/chapter/10.1007/978-3319-05927-3\\_9](https://link.springer.com/chapter/10.1007/978-3319-05927-3_9).
- [15] H. Ho, S. Fong, Z. Y.-2008 I. I. C. one, and undefined 2008, "User acceptance testing of mobile payment in various scenarios," *ieeexplore.ieee.org*, 2008, DOI: 10.1109/ICEBE.2008.70.
- [16] I. Otaduy, O. D.-J. of S. and Software, and undefined 2017, "User acceptance testing for Agiledesigned web-based applications: Empowering customers through wikis and mind maps," *Elsevier*, Accessed: Oct. 11, 2021. [Online]. Available: <https://www.sciencedirect.com/science/article/pii/S016412121730002X>.
- [17] A. Voutilainen, T. Pitkäaho, ... T. K.-J. of advanced, and undefined 2016, "How to ask about patient satisfaction? The visual analog scale is less vulnerable to confounding factors and ceiling effect than asymmetric Likert scale," *Wiley Online Libr.*, Accessed: Oct. 11, 2021. [Online]. Available: <https://onlinelibrary.wiley.com/DOI/abs/10.1111/jan.12875>.
- [18] H. T.-H. Taherdoost and undefined 2019, "What is the best response scale for a survey and questionnaire design; review of different lengths of rating scale/attitude scale/Likert scale," *papers.ssrn.com*, vol. 8, no. 1, pp. 2296–1747, 2019, Accessed: Oct. 11, 2021. [Online]. Available: [https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=3588604](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3588604).
- [19] T. Nemoto, D. B.-J. 2013 conference proceedings, and undefined 2014, "Likert-scale questionnaires," *jalt-publications.org*, Accessed: Oct. 11, 2021. [Online]. Available: [https://jalt-publications.org/sites/default/files/pdf-article/jalt2013\\_001.pdf](https://jalt-publications.org/sites/default/files/pdf-article/jalt2013_001.pdf).
- [20] J. Croasman, L. O.-J. of A. Education, and undefined 2011, "Using Likert-type scales in the social sciences.," *ERIC*, vol. 40, no. 1, 2011, Accessed: Oct. 11, 2021. [Online]. Available: <https://eric.ed.gov/?id=EJ961998>.
- [21] H. Van Laerhoven, ... H. van der Z.-A., and undefined 2004, "A comparison of Likert scale and visual analog scales as response options in children's questionnaires," *Wiley Online Libr.*, 2004, DOI: 10.1080/08035250410026572.
- [22] J. B.-S. J. T. & E. S. Newsletter and undefined 2000, "What issues affect Likert-scale questionnaire formats," *jalt.org*, Accessed: Oct. 11, 2021. [Online]. Available: [http://www.jalt.org/test/bro\\_7.htm](http://www.jalt.org/test/bro_7.htm).
- [23] O. Ivanov, V. Ivanova, A. S.-I. J. of, and undefined 2018, "Likert-scale questionnaires as an educational tool in teaching discrete mathematics," *Taylor Fr.*, vol. 49, no. 7, pp. 1110–1118, Oct. 2018, DOI: 10.1080/0020739X.2017.1423121.
- [24] Y. Gu, "How Often Is Often? Reference Ambiguities of the Likert-scale in Language Learning Strategy Research.," *J. Adult Educ.*, vol. 40, no. 1, 1995, Accessed: Oct. 11, 2021. [Online]. Available: <https://eric.ed.gov/?id=ED391358>.
- [25] A. B.-J. of A. S. Research and undefined 2013, "Methods for decision-making in survey questionnaires based on Likert scale," *academia.edu*, vol. 3, no. 1, pp. 35–38, 2013, Accessed: Oct. 11, 2021. [Online]. Available: <https://www.academia.edu/download/33013876/35-38.pdf>.

## ORIGINALITY REPORT

**10%**

SIMILARITY INDEX

**10%**

INTERNET SOURCES

**5%**

PUBLICATIONS

**5%**

STUDENT PAPERS

## PRIMARY SOURCES

1	<a href="http://www.hybrid-analysis.com">www.hybrid-analysis.com</a> Internet Source	3%
2	<a href="http://erebos.sakura.ne.jp">erebos.sakura.ne.jp</a> Internet Source	2%
3	Submitted to University of Hull Student Paper	1%
4	<a href="http://astro.wku.edu">astro.wku.edu</a> Internet Source	1%
5	S.-B. Qian. "Deep, Low Mass Ratio Overcontact Binary Systems. VI. AH Cancri in the Old Open Cluster M67", The Astronomical Journal, 06/2006 Publication	<1%
6	<a href="http://freedomfellowshipofnwa.com">freedomfellowshipofnwa.com</a> Internet Source	<1%
7	<a href="http://www.e-mesitis.com">www.e-mesitis.com</a> Internet Source	<1%
8	Submitted to Erasmus University Rotterdam Student Paper	<1%

9	Submitted to Guru Jambheshwar University of Science & Technology Student Paper	<1 %
10	media.towntv.ca Internet Source	<1 %
11	www.google.com Internet Source	<1 %
12	Submitted to Coventry University Student Paper	<1 %
13	digital.library.unt.edu Internet Source	<1 %
14	www.tandfonline.com Internet Source	<1 %
15	Sirong Yi. "Railway Plane and Profile Design", Elsevier BV, 2018 Publication	<1 %
16	www.gonia.com.cy Internet Source	<1 %
17	Submitted to Bindura University of Science Education Student Paper	<1 %
18	archive.org Internet Source	<1 %
19	ebin.pub Internet Source	<1 %



20

WWW.medicalnewstoday.com

Internet Source

<1 %

---

21

repositorio.ucv.edu.pe

Internet Source

<1 %

---

22

www.hawaii.edu

Internet Source

<1 %

---

23

dspace.nbu.gov.ua

Internet Source

<1 %

---

Exclude quotes Off

Exclude matches Off

Exclude bibliography Off