APPLICATION DESIGN GEOGRAPHIC INFORMATION SYSTEM OF FLOOD LOADING MAPPING IN TULUNGAGUNG REGENCY REGION

Mohammad Panji Romadhoni
Islamic University of Balitar; Jl. Majapahit No.04, Telp. (0342) 813145
Program Stud Teknik Informatika, FTI Universitas Islam Balitar, Blitar
e-mail: panjiromadhoni78@gmail.com

ABSTRACT*:*

Tulungagung Regency has a history of experiencing floods, which damaged infrastructure and claimed lives in Tulungagung Regency due to the lack of facilities, knowledge and initial handling of flood disasters to be one of the contributing factors. This study uses primary data and secondary data in the form of slope data, soil type and rainfall. The results of the analysis obtained the level of flood vulnerability in the Tulungagung district area resulting in three levels of classes, namely vulnerability is very vulnerable, vulnerable, and not vulnerable. Making the system using ArcMap PHP web programming and using the MySQL database offline. To process map data used GIS tools (geographic information system), namely the spatial analysis tool of flood hazard level with a visual mapping model. The results of this study are expected to be useful in providing information on flood-prone areas in Tulungagung Regency and it is hoped that the Tulungagung Regency government and the private sector will routinely conduct disaster socialization, especially for communities in flood-prone areas.

Keywords: Flood Prone, GIS, Tulungagung Regency

I. INTRODUCTION

Flooding is not a new phenomenon in Indonesian society. It has become a routine annual sight in the capital city and several cities in Indonesia when the rainy season comes. The impact of flooding can vary, from the spread of disease outbreaks, property losses, to damaging infrastructure structures such as roads, buildings, and bridges. Almost all regions in Indonesia have the potential for flooding, the island which is often affected by flooding is Java. Flooding has the potential to cause aftershocks such as landslides, depending on the slope of the land through which flood water passes, the density of soil constituent particles and the speed of soil cracks. During 2013-2017 the death toll from the most flooding occurred in 2016 (Suprapto, 2011).

Topographically, Tulungagung is located at an altitude of 85 meters above sea level (asl). The northwest is a mountainous region that is part of the Wilis-Liman mountain range. The middle part is the lowlands, while the southern part is a mountain range from the Kidul Mountains. To the

northwest of Tulungagung, precisely in Sendang Subdistrict, there is Mount Wilis as the highest point in Tulungagung Regency which has a height of 2,552 meters above sea level (asl). Tulungagung Regency is divided into 19 sub-districts, 257 villages, and 14 sub-districts. From the results of interviews with one of the Villages and from data collection obtained from the BPBD of Tulungagung Regency, Tulungagung Regency needed a geographic information system in flood-prone areas in Tulungagung Regency.

Geographic Information Systems according to Prahasta (2002: 55) are computer systems that are used to collect, examine, integrate, and analyze information relating to the surface of the earth. Basically, the term geographic information system is a combination of three main elements, namely system, information, and geography. Geographic Information Systems (GIS) as computer systems used to manipulate geographic data. This system is implemented with computer hardware and software which functions to acquire and verify data, compile data, store data, change and update data, manage and exchange data, manipulate data, call and present data and analyze data. (Bernhardsen 2002), ArcMap is one of the desktop software Geographic Information Systems and mapping that has been developed by ESRI.

The author builds Geographic Information System Applications Mapping Flood-Prone Locations in the Tulungagung District to find out flood-prone areas. From this application system, it is expected to be able to help the community in knowing where flood-prone areas are in Tulungagung Regency.

2. RESEARCH METHODOLOGY

a. Time and Place of Research

This research takes place from the first week of August 2018 to the fourth week of September 2018. The time of the study includes the preparation phase, the implementation phase until the preparation stage of

the thesis. This research was conducted in Tulungagung District. Area area which is the object of research, Research Location in the Regional Disaster Management Agency (BPBD) of Tulungagung Regency which has a sub-district coverage which is the research area is Besuki, Bandung, Pakel, Campurdarat, Tanggunggunung, Kalidawir, Pucanglaban, Rejotangan, Ngunut, Sumbergempol, Boyolangu , Tulungagung, Kedungwaru, Ngantru, Karangrejo, Kauman, Gondang, Pagerwejo, Sendang, are coverage of the District in Tulungagung Regency.

b. Data Collection

Collecting data and information can be through direct observation or observation of situations and conditions that occur in the research area. Data types can be divided into:

Primary data in this study was conducted by interview method, namely through interviewing the head of the Tegalrejo Village Head in one village in Rejotangan District, Tulungagung Regency on January 22, 2018. Interviews are useful for studying and re-selecting information that has been obtained from journals, books, or papers scientific. After studying and selecting information that has been obtained, questions can be arranged about the theme concerned with this thesis to the resource person. The interview data will be used as the background of the thesis. As follows :

No.	Interview
1.	Is there a history of flooding in Tegalrejo Village and what are the losses?
2.	Has there been a flood in the village of Tegalrejo?
3.	Are there early warnings for floods that occur?
4.	Has there been a software application that maps out flood-prone areas in Tulungagung itself?

From table 3.2, which contains a number of questions addressed to the leaders of the Tegalrejo Village Head, one of the villages in Rejotangan District, Tulungagung Regency. Later results can be used to help design the geographic information system that will be designed.

Secondary data is supporting data that already exists so only need to find and collect the data. Secondary data in this study was obtained by visiting the office of the Regional Disaster Management Agency in

Tulungagung Regency. Secondary data in the form of documents and reports covering basic aspects of data, namely:

Data on basic physical aspects include:

Type of Soil

No	Kecamatan	Tekstur tanah				
		Halus	Agak Halus	Sedang	Agak Kasar	Kasar
1	Tulungagung	-	-	√	-	-
2	Boyolangu	-	-	√	-	-
3	Kedungwaru	-	-	√	-	-
4	Ngantru	√	-	√	-	-
5	Kalidawir	-	-	√	-	-
6	Pucanglaban	√	-	√	-	√
7	Rejotangan	-	-		-	-
8	Sumbergempol	-	-	√	-	-
9	Ngunut	-	-	√	-	-
10	Besuki	√	-	√	-	-
11	Bandung	√	-	√	-	-
12	Pakel	√	-	√	-	-
13	Campurdarat	√	-	√	-	-
14	Tanggunggunung	-	-	√	-	-
15	Gondang	-	-	√	-	-
16	Kauman	-	-	√	-	-
17	Karangrejo	-	-	√	-	-
18	Sendang	√	-	√	-	-
19	Pagerwojo	√	-	√	-	-

Slope

Tulungagung Regency area can be grouped into 6 (six) land slope classifications as follows:

a) Slopes between 0-2% are flat areas with an area of 46,971.24 hectares or 40.8% in almost all sub-districts, except for Sendang, Pagerwojo and Tanggunggunung Subdistricts.

b) Slopes between 2-8% are flat to gentle areas with an area of 5,637.01 hectares or 4.9%, found in almost all districts except Tanggunggunung, Sendang, Pagerwojo, Tulungagung, Pakel, Kedungwaru, Sumbergempol, Ngunut and Ngantru.

c) Slopes between 8-15% are sloping to choppy areas with an area of 8,317.46 hectares or 7.2%, found in almost all sub-districts except Tulungagung, Pakel, Kedungwaru, Ngantru, Sumbergempol and Ngunut.

d) Slopes between 15-25% are wavy to wavy areas with an area of 15,875.66 hectares or 13.8% in Karangrejo District, Kauman, Sendang, Pagerwojo, Gondang, Bandung, Boyolangu, Campurdarat, Besuki, Tanggunggunung, Kalidawir , Pucanglaban, and Rejotangan.

e) Slopes between 25-40% are weak corrugated areas with strong waves with an area of 22,985.19 hectares or 19.98% in Gondang, Pagerwojo, Bandung, Besuki, Campurdarat, Boyolangu, Kalidawir, Pucanglaban, Gondang and Rejotangan Districts.

f) Slopes of more than 40% are strong corrugated areas with an area of 15,254.44 hectares or 13.26% in Sendang District, Pagerwojo, Besuki, Campurdarat, Kalidawir, Gondang, Rejotangan, Tanggunggunung, Bandung, and Pucanglaban.

c. System Requirement Analysis

Hardware

Hardware specifications used to design and run geographic information system applications mapping the flood-prone areas in Tulungagung Regency as follows:

a) 1. Procesore   : Intel(R) Core(TM) i7-5500U CPU
           @ 2.40GHz 2.40 GHZ

b) RAM   : 4.00 GB
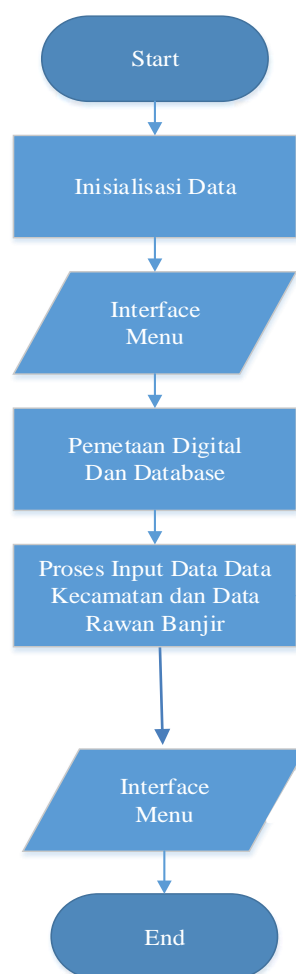
c) Hardisk   : 1.00 T

Software

The software specifications used to design and run geographic information system applications mapping the flood-prone areas in Tulungagung Regency are as follows:
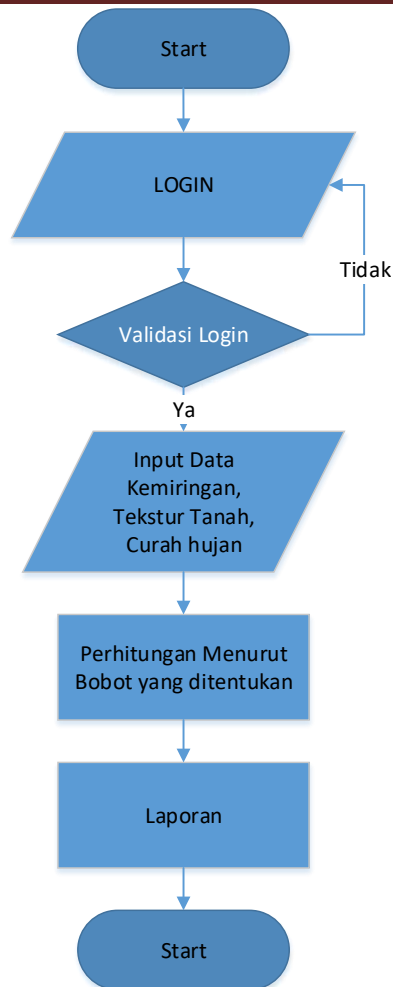
a) Sistem Operasi Windows 8

b) XAMPP tools which consists of Apache as a WEB database viewer server and MySQL as its database

c) Sublime Text 3

d) Web Browser Mozila Firefox

**d. System Design**

1. Flowchart (Flowchart of System Design)

Start

Inisialisasi Data

Interface Menu

Pemetaan Digital Dan Database

Proses Input Data Data Kecamatan dan Data Rawan Banjir

Interface Menu

End

Flowchart of System Design

Flowchart Admin

2. Context Diagram

The description of the system is explained by the context diagram in the figure below. In this context diagram there are 2 external entities, namely admin that manages data on flood-prone areas and visitors who can request information regarding flood-prone areas.
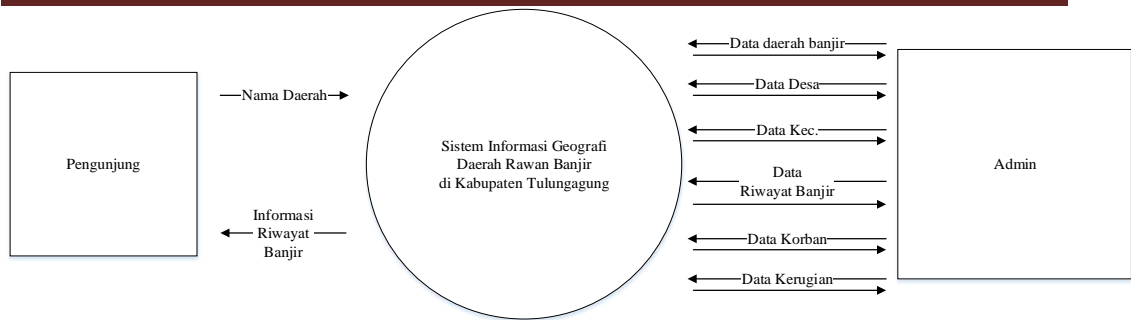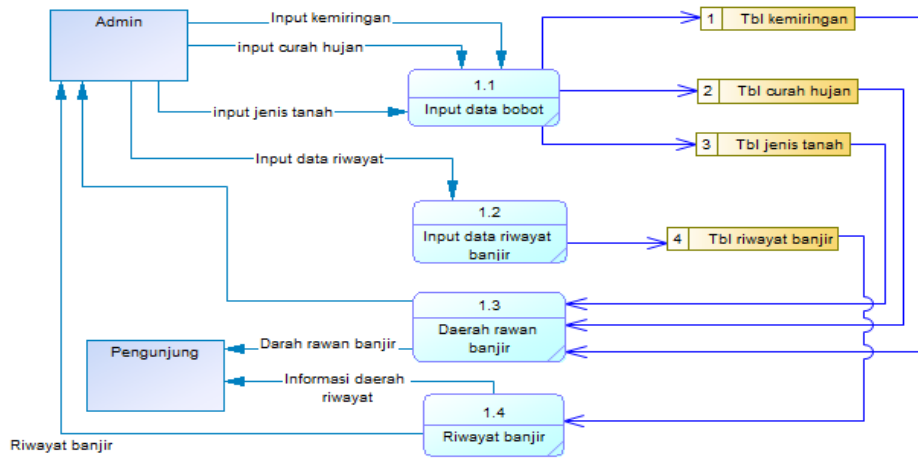
Context Diagram

3. Data Flow Diagram

Data Flow Diagrams (DFD) is a graph that uses symbols to explain the course of a system by describing interconnected processes. the flow of information systems for flood-prone areas in tulungagung district can be seen in the following figure:
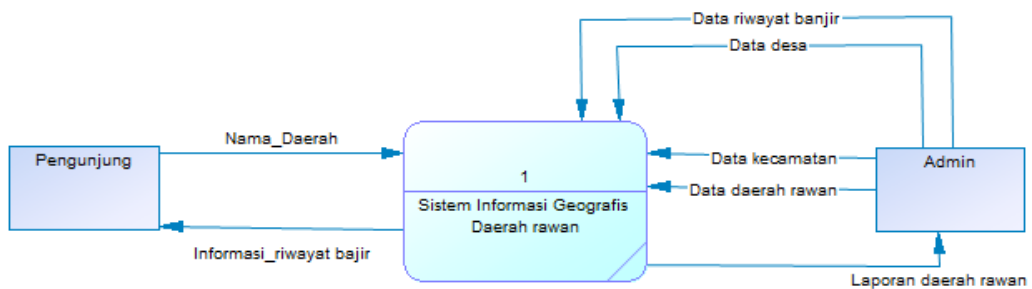
Data Flow Diagram level 0

Data Flow Diagram level 1

II. Result and Discussion

The research succeeded in creating a system that could help map out flood-prone areas in Tulungagung Regency. Calculation of the Sturges Formula on the system is in accordance with the results of manual calculation using the conformity test as follows:

$$\frac{(BK \ x \ SK) + (BC \ x \ SC) + (BJ \ x \ SJ)}{bobot \ keseluruhan}$$

Keterangan :

SK : skor kemiringan   SJ : skor jenis tanah

BK : bobot kemiringan   SJ : bobot jenis tanah

SC : skor curah hujan

BC : bobot curah hujan

The results of the application of flood-prone areas were obtained from data collection from the Regional Disaster Management Agency (BPPD) of Tulungagung Regency and the following data could be generated:

No		Kecamatan	Tahun	Kemiringan	Curah Hujan	Tekstur Tanah	Kerawanan	Opsi
#		-- Select --						GO
1		BOYOLANGU	2010	3	6	3	4.125 (Tidak Rawan)	
2		KEDUNGWARU	2010	3	9	3	5.25 (Tidak Rawan)	
3		NGANTRU	2010	3	3	3	3 (Tidak Rawan)	
4		KALIDAWIR	2010	3	3	3	3 (Tidak Rawan)	
5		PUCANGLABAN	2010	3	3	3	3 (Tidak Rawan)	
6		REJOTANGAN	2010	3	6	3	4.125 (Tidak Rawan)	
7		SUMBERGEMPOL	2010	3	9	3	5.25 (Tidak Rawan)	
8		NGUNUT	2010	3	3	3	3 (Tidak Rawan)	
9		BESUKI	2010	3	6	4	4.375 (Tidak Rawan)	
10		BANDUNG	2010	3	6	4	4.375 (Tidak Rawan)	
11		PAKEL	2010	3	6	4	4.375 (Tidak Rawan)	
12		CAMPURDARAT	2010	3	6	4	4.375 (Tidak Rawan)	
13		TANGGUNGGUNUNG	2010	9	6	9	7.875 (Rawan)	
14		GONDANG	2010	3	3	3	3 (Tidak Rawan)	
15		KAUMAN	2010	3	6	3	4.125 (Tidak Rawan)	
16		KARANGKREJO	2010	3	6	3	4.125 (Tidak Rawan)	
17		BENDANG	2010	9	12	4	8.875 (Rawan)	
18		PAGERWOJO	2010	3	6	4	4.375 (Tidak Rawan)	
19		TULUNG AGUNG	2010	3	9	1	4.75 (Tidak Rawan)	

Keterangan :
- nilai 3 - 7 = tidak rawan
- nilai 8 - 11 = rawan
- nilai 12 - 15 = sangat rawan

20 ▾ Sort ▾ Order ▾ GO   Menampilkan : 1 Sampai 19 Akhir 19

Flood-Prone Areas

After obtaining sub-district vulnerability data in Tulungagung District according to data obtained from the Regional Disaster Management Agency (BPPD) of Tulungagung Regency, the next step is mapping using ArcGISMap which will later be attached to the application page. And map display as shown below:
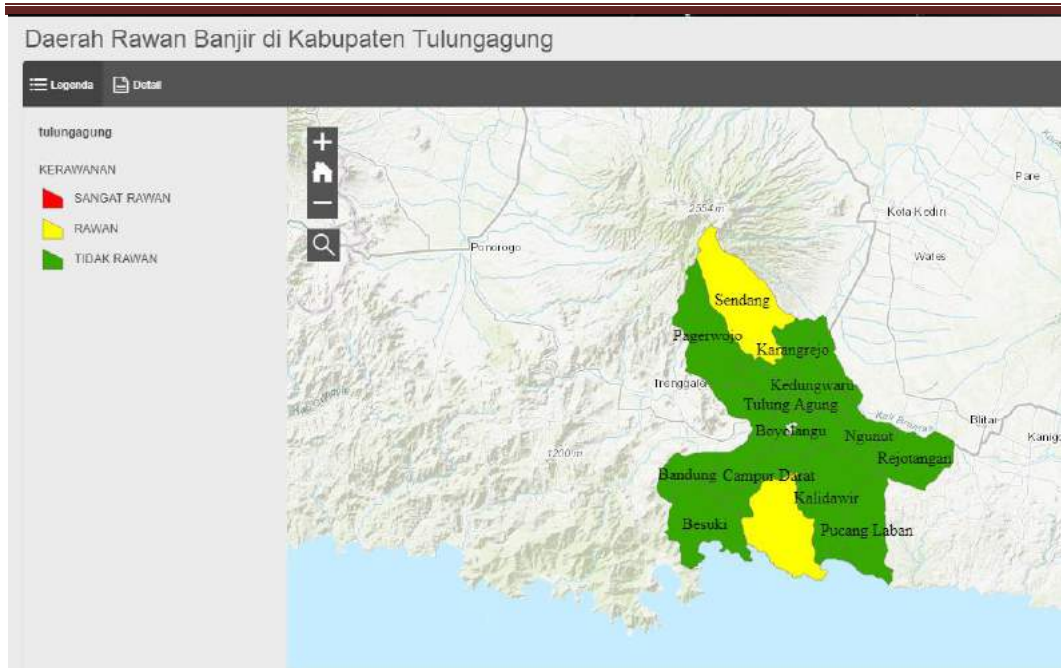
Maps of Flood-Prone Areas

In the picture of the Flood-Prone Area Map, it is known that the Sendang and Campurdarat sub-districts are categorized as flood-prone areas marked in yellow and the Pagerwojo, Karangrejo, Kedungwaru, Tulungagung, Boyolangu, Ngunut, Rejotangan, Bandung, Besuki, Kalidawir and Pucanglaban sub-districts are categorized as areas that are not flood prone is marked in green on the map.

Blackbox Testing

Testing this system aims to test whether all functions are running as expected. Test plan is needed by using the black box method found in the table as follows:

Planning of Black Box Testing

No	Kelas	Butir Uji	Jenis Pengujian
1.	Login	Pengecekan admin terdaftar	Black Box
2.	Pengisian Data	Pengisian data	Black Box

a. Login Testing

In testing the login, only the admin can log in, as follows:

Login Testing

Data Hasil Uji (Data Normal)				
No	Data Masukan	Hasil yang diharapkan	Pengamatan	Kesimpulan
1.	Username : admin@mail.com Password : 123123 Klik tombol login	From menampilkan halaman admin	Dapat masuk halaman admin	V
Data Hasil Uji (Data Salah)				
No	Data Masukan	Hasil yang diharapkan	Pengamatan	Kesimpulan
2.	Username : aaa Password : aaa Klik tombol login	Tidak dapat login dan tetap pada halaman login	Tetap pada halaman login	V

Based on the results of testing the admin login system successfully if it matches the username and password in the database, the user table will store the results of the system input. Description V is obtained if the login is successful with the percentage results as follows:

Successful presentation

$$\text{Login \%} = \frac{\sum \text{Keterangan V or NV}}{\sum \text{Keterangan menu or tombol}} \; x \; 100\% = \frac{2}{2} \; x \; 100\% = 100\%$$

If the percentage of the success of the login system is 100%

$$\text{False \%} = \frac{\sum \text{Keterangan V or NV}}{\sum \text{Keterangan menu or tombol}} \; x \; 100\% = \frac{2}{2} \; x \; 100\% = 100\%$$

If the percentage of success of the system incorrectly entered the login username and password data is 100%

b. Input data Testing

In testing data only the admin can fill in as follows:

Input, Delete, Update Testing

No	Data Masukan	Hasil yang diharapkan	Pengamatan	Kesimpulan
Data Hasil Uji (Halaman Riwayat Banjir)				
1.	Input data riwayat banjir	Data riwayat banjir di inputkan dan tersimpan di database dan dapat di tampilkan di halaman riwayat bajir	Data berhasil di inputkan	V
2.	Delete data riwayat banjir	Data riwayat banjir terhapus	Data berhasil dihapus	V
3.	Update data riwayat banjir	Data riwayat banjir diubah dan dapat tersimpan di database	Data berhasil diupdate	V
Data Hasil Uji (Halawan Daerah Rawan Banjir)				
No	Data Masukan	Hasil yang diharapkan	Pengamatan	Kesimpulan
1.	Input data kerawanan	Input data kemiringan, curah hujan, jenis tanah dan tersimpan di database	Data berhasil di inputkan	V
2.	Delete data daerah kerawanan	Data terhapus	Data berhasil dihapus	V
3.	Update data	Merubah data daerah kerawanan dan tersimpan pada data base	Data berhasil diupdate	V

Based on the results of testing the successful data filling system if it matches the form in the database, the input table will store the results of

the system input. Description V is obtained if filling success with the percentage results as follows:

Percentage of successful input, delete, update flood history data

$$= \frac{\sum \text{Keterangan V or NV}}{\sum \text{Keterangan menu or tombol}} \; x \; 100\% = \frac{3}{3} \; x \; 100\% = 100\,\%$$

Jika presentase keberhasilan pengisian data adalah 100%

Percentage of wrong input, delete, update data weight value calculation of prone areas and flood history area in tulungagung district

$$= \frac{\sum \text{Keterangan V or NV}}{\sum \text{Keterangan menu or tombol}} \; x \; 100\% = \frac{3}{4} \; x \; 100\% = 75\%$$

Jika presentase keberhasilan pengisian data adalah 75 %

After doing some testing on the main page of the system using the blackbox method, the results of the average success of each key function in this decision support system are as follows:

$$\text{Blackbox Testing} = \frac{\text{Uji (i)} + \text{Uji (i)} + \cdots}{\text{Jumlah data yang diuji}} = \cdots$$

$$\text{Blackbox Testing} = \frac{100 + 100 + 100 + 75}{4} = 94\%$$

From the results of testing blackbox it can be concluded that the system built is free of syntax errors and functionally produces results with success values of key functions of 94%.

III. Conclution

Based on the design analysis, implementation and testing of the system, it can be concluded as follows:

1. The system has been successfully designed and will be continued at the stage of building the system
2. The system has been successfully built using hardware and software according to system requirements
3. The system has been successfully tested. The test results show that the system can work and can display flood-prone areas in

Tulungagung Regency from rainfall data, slope and soil types according to the formula used.

IV. Reference

Sujitno, Endang, Mesky Dianawati. 2015. Produksi panen berbagai varietas unggul baru cabai rawit (*Capsicum frutescens*) di lahan kering Kabupaten Garut, Jawa Barat. *Pros Sem Nas Masy Biodiv Indon.* Volume 1, Nomor 4: Halaman: 874-877.

Pressman, R.S. 2010. Software Engineering : a practitioner 's approach, McGraw-Hill, New York, 68.

Jogiyanto. 2005. Analisis dan Desain Sistem Informasi. Yogyakarta: Penerbit Andi.

Badan Penanggulangan Bencana Daerah Kabupaten Tulungagunng. 2010. Program Percepatan Pembangunan Sanitasi Permukiman (PPSP) POKJA Sanitasi Kabupaten Tulungagung, Tulungagung. Halaman: 1 – 7.

Wirawan Rachmad. 2014. KONDISI GEOLOGI TULUNGAGUNG. Malang. Halaman : 1 – 33

Badan Perencanaan Pembangunan Daerah (BAPPEDA). 2010. Tulungagung. Halaman : 1 – 20

Sutarman. 2009. Pengantar Teknologi Informasi. Jakarta: Sinar Grafika. Offset.

Hamka, Akhmad Qashlim, Syarli. 2017. SISTEM INFORMASI GEOGRAFIS KAWASAN BENCANA ALAM KABUPATEN POLEWALI MANDAR DENGAN GOOGLE MAPS, Sulawesi Barat. Jurnal Ilmiah Ilmu Komputer, Vol. 3, No

Sutrisno Muh Lukman. 2011. APLIKASI SISTEM INFORMASI GEOGRAFI UNTUK PENENTUAN TINGKAT KERENTANAN LONGSOR LAHAN DI KECAMATAN IMOGIRI KABUPATEN BANTUL, Yogyakarta.

Meriana, A. Haidar Mirza, A. Mutatkin Bakti. 2015. Perancangan Sistem Informasi Daerah Rawan Kriminalitas di Kabupaten Lahat, Palembang.

Sholahuddin Muhamad. 2015. SIG UNTUK MEMETAKAN DAERAH BANJIR DENGAN METODE SKORING DAN PEMBOBOTAN (STUDI KASUS KABUPATEN JEPARA)

Jeffi Annisa, Sigit Sutikno, Rinaldi. ANALISIS DAERAH RAWAN LONGSOR BERBASIS SISTEM INFORMASI GEOGRAFIS (Studi Kasus : Kabupaten Lima Puluh Kota, Sumatera Barat), Sumatera Barat. JOM FTEKNIK Volume 2 No. 2 Oktober 2015.

Alief Rusli Putra Muh. 2017. PEMETAAN KAWASAN RAWAN BANJIR BERBASIS SISTEM INFORMASI GEOGRAFIS (SIG) UNTUK MENENTUKAN TITIK DAN RUTE EVAKUASI (Studi Kasus : Kawasan Perkotaan Pangkep, Kabupaten Pangkajene dan Kepulauan) Makasar. 26 Oktober 2017

Darmawan Kurnia, Hani'ah, Suprayogi Andri. 2017. ANALISIS TINGKAT KERAWANAN BANJIR DI KABUPATEN SAMPANG MENGGUNAKAN METODE OVERLAY DENGAN SCORING BERBASIS SISTEM INFORMASI GEOGRAFIS. Semarang, Januari 2017