Differences in Disaster Response Due to Varying Data Availability

A Serious Game for Flooding Disaster Research in Surakarta, Indonesia

Thesis submitted to the Double Degree M.Sc. Programme, Gadjah Mada University
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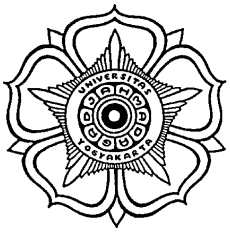

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THESIS

DIFFERENCES IN DISASTER RESPONSE DUE TO VARYING DATA AVAILABILITY; A SERIOUS GAME FOR FLOODING DISASTER RESEARCH IN SURAKARTA, INDONESIA

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DISCLAIMER

This document describes work undertaken as part of a program study at the Double Degree International Program of Geo-information for Spatial Planning and Risk Management, a Joint Educational Program of Faculty of Geo-information and Earth Observation University of Twente – The Netherlands and Gadjah Mada University – Indonesia. All views and opinions expressed therein the sole responsibility of the author and do not necessarily represent those of the institute.

I certify that although I may have conferred with others in preparing for this assignment, and drawn upon arrange of sources cited in this work, the content of this thesis report is my original work.

Jogjakarta, 22 March 2011

Muhammad Syukril

Abstract

On 26 December 2007 until 1 January 2008, flood happened in Surakarta and surrounding areas. The Public Works Office in Surakarta has taken action to lessen and minimize the destructive impact of flooding. It is hard to evaluate the effectiveness local government responses due to flooding, especially when there is no standard method available in that area. Subjectivity and lack of documentation on what actually happened during flooding also became challenge for disaster research.

Many aspects influence the government response in flood disaster. The government unit responses are highly dependent on human resources, financial and legal supports, which strongly influence the action during flooding.

This research aims to propose a method to study the effect of data availability in disaster-response study. This research focused on how to quantify the relation between data availability and actions taken by decision maker. The more specific topic is represented as disaster response due to varying data availability using Serious Game method in the Public Works Unit Surakarta.

In this study, held in 2010, researcher started with literature review to the governmental document and report for flooding in 2007 also historical flood event. Furthermore, a series of user need assessment was done in Public Works of Surakarta and Balai Besar Wilayah Sungai Bengawan Solo (BBWS BS) with respect to the usability of spatial data and flood response activity.

The Serious Game for flood response was build based on real data an involved 34 person from 4 offices in Surakarta to study the relation between responses and data availability. The results for this serious game were recorded using desktop recorder software to store selected actions and response behavior of the player during the game.

The serious game provide scenario to gather data about several issues, e.g. the effect of different information for early warning and information during flooding, Digital elevation model, flood alert stage decision making, and damage prediction information.

Finally, the serious game result was analyzed by comparing with other method e.g. interview, user need assessment and literature review to generate conclusion and recommendation which useful for studying historical flood disaster. This research also could promote as a complement the other method for collecting data and decision-making training program for flood manager.

The result of analysis has shown that there are differences of responses based on the data availability. At low availability, the decision makers ask for more information (28 of 66 ~ 42,42%); at medium availability, response is directed to go to flood post (23 of 78 ~ 29,49 %); while at high availability, most decision makers (27 of 89 ~ 30,34%) confidently taking action prepare sand bag and water pump .

Better responses can be achieved by the improvement of data availability. Number of correct decision raised significantly by the improvement of data availability: 47,06% at low availability , 91,17% at medium availability, 100% at high data availability.

Key word: Disaster response, Data availability, Spatial Information, Serious Game, Flash.

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Yogyakarta, February 2011

Muahammad Syukril

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Acronyms

BAKOSURTANAL	Badan Koordinasi Survei dan Pemetaan Nasional *(National Mapping and Survey Coordinating Board)*
BBWS	Balai Besar Wilayah Sungai Bengawan Solo *(Bengawan Solo Watershed Office)*
BMKG	Badan Meteorologi, Klimatologi & Geofisika *(Meteorology, Climatology and Geophysical Agency)*
BKNPB	Badan Koordinasi Nasional Penanggulangan Bencana *(National Coordination Board for Disaster Management)*
BAPEDALDA	Badan Pengendalian Dampak Lingkungan Daerah *(Local Agency for Environmental Impact Management)*
BAPPEDA	Badan Perencanaan Pembangunan Daerah *(Local Agency for Planning and Development)*
Bapermas P3KB	Badan Pemberdayaan Masyarakat Pemberdayaan Perempuan Perlindungan Anak dan Keluarga Berencana *(Agency for Community Empowerment, Women's Empowerment Child Protection and Family Planning Program)*
BPS	Badan Pusat Statistik *(Statistics Indonesia)*
DSS	Decision Supporting System
GIS	Geographic Information System
GPS	Global Positioning System
MIS	Management Information System
OA	Office Automation
PMI	Palang Merah Indonesia *(Indonesian Red Cross Society)*
PU	Pekerjaan Umum *(Public Works)*
RS	Remote Sensing
SATKORLAK PB	Satuan Tugas Koordinasi dan Pelaksana *(Provincial Coordination Units for Disaster Management)*
SATLAK PB	Satuan Pelaksana Penanggulangan Bencana *(Disrict Coordination Units for Disaster Management)*
UN ISDR	United Nations International Strategy for Disaster Reduction
KESBANG LINMAS	Kesatuan Bangsa dan Pelindungan Masyarakat *(Agency for National Unity and Community Protection)*

Chapter 1. General Introduction

1.1. Background

Within the framework of flood risk management, several aspects need to be considered to mitigate the flood risk, most influential are the cycle of flood and the response against it. The response may vary and influenced by many factors, including the availability of the data. This relationship, the influence of varying degree of data availability toward response, requires a better understanding that could be achieved through the research.

Disaster risk management defined as "the systematic process of using administrative directives, organizations, and operational skills and capacities to implement strategies, policies and improved coping capacities in order to lessen the adverse impacts of hazards and the possibility of disaster" (UNISDR 2009) that require many aspects still need further development using multidisciplinary approach. It includes organizational aspect, technological aspect, social aspect and other points of view.

Based on Asian Disaster Reduction Center (ADRC 2003), disaster management consists of four main elements:

- ***Mitigation*** *is defined as structural and non-structural measures undertaken to prevent or limit the adverse impact of natural hazards, environmental degradation and technological hazards.*
- ***Preparedness*** *is defined as activities and measures taken in advance to ensure effective response to the impact of disasters, including the issuance of timely and accurate forecasts along with effective early warnings and the temporary removal of people and property from a threatened location.*
- ***Response*** *is defined as combined action of coordination and quick & appropriate relief with local participation in assessment through strengthening the local level disaster response ability in order to ensure disaster relief as the platform for disaster recovery.*
- ***Recovery*** *is defined as activities to set the community to normal condition and it could be a good opportunity to improve quality of life as well as ensure sustainable development of the affected areas.*

Figure 1 Disaster management cycle
(Committee on Planning for Catastrophe 2007)

Figure 1 illustrates the response phase in disaster management cycle, which covers all actions taken just before, during, or just after a disaster, the main activities are on providing basic needs of the affected people until comprehensive solutions can be provided (Warfield 2010). In this phase, information about disaster events, risk, vulnerability and risk indicators are essential to provide a better response.

In 2007, 102 people were killed and more than 1 million people were displaced caused by 338 flood events in Indonesia (Febrianti 2010). To reduce the impacts of flood disaster, the local government units must have data about real condition that they deal with, and take actions based on that knowledge or the information, which is available on that time. For instance, the Public Works unit responsible for operating water pump, maintaining flood defense system, sand-bagging and identifying the need for evacuation. The other responses are requesting backup from other area or issuing warning message to other agency is very depends on the quality of information they have at the time.

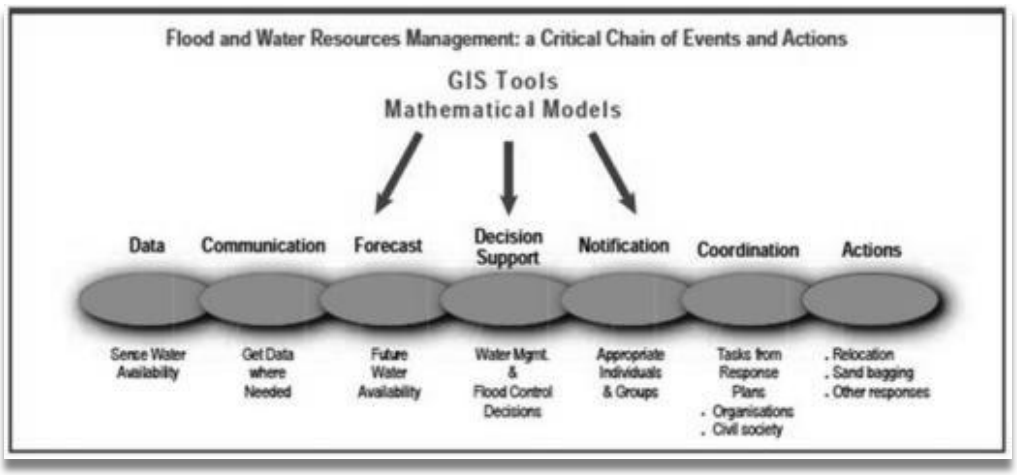


Figure 2. Correlation of Data and Response Actions
(UNISDR 2004)

According to Figure 2, there are great varieties of data and information delivery methods for flood response. For instance, radio communication and cellular phone. However, it is desirable to enhance message delivery at the local level by using geographical information system. Geographical information system, as one "new and progressive" of method, may affect the effectiveness of the disaster response.
The availability of geographical information delivery for government and public domain is not always satisfactory. For local government especially flood defense unit in Public works, geographical information loses value if it adds nothing to the decision making or when there are barriers to accessing the right information, at the right time (Hayes-Roth 2005; Langkamp 2005; Vreugdenhil 2009).

The problems include the amount of time needed to manipulate the required data, inappropriate scales and poor accuracy. Determining what, when and how to use the geographical information that will make a difference is correlating with usability issue (Hunter G.J. 2003) In determining, how to ensure geographical information adds value within the disaster management domain, we can learn from the approaches include in a serious game simulation.

Not all information available is important on disaster response (Hayes-Roth 2005). However, the absence of essential information could cause a serious problem in emergency response phase. To support effective response in public works, the knowledge gap between what people want to know about crucial information and what data is available is important to determine. Flood extent for example, is very crucial and urgent to make damage prediction and action needed.
Many studies have been conducted in the core topics of hazards and disaster but in emergency/disaster response research, lot of scientists have a difficulty to analyze because it needs collaborative works of science, engineering and social techniques (Committee on Disaster Research in the Social Sciences 2006). The challenges on geographical information are to understand user"s needs and behaviors, capturing data and integrating with database and using at many scales then personalizing in many ways for many different users. Therefore, theoretical of potential benefits of spatial information technologies must be followed by evaluating human factor and their knowledge on spatial information.

Figure 3. Core topics of hazards and disaster research
Source: (Committee on Disaster Research in the Social Sciences 2006)

The public works response also could influence by other factor besides data availability. The level of development, the local capacity of flood defense unit and structural organization arrangement can also affecting the effectiveness of flood response. It is important to determine the effect of spatial information especially in disaster management information among others causes. Due to this issue, this research wants to determine the correlation of varying of data and information to disaster response activity. Serious games can be conducted in order to assess the usefulness of spatial information and other data to improve the effectiveness of disaster response. In serious game activity, human knowledge and their response studied in simulated condition to provide feedback database for improving the usability of the data and spatial information.

1.2. Problem Statement

Flood causes damage and economic losses to the Surakarta city in almost every year. Learning from flood on December 2007 in Surakarta, the local government involved to disaster response in public works had difficulties on responding the situation because of limited critical information. Damage prediction and flood extent map was not available just in time they needed. It causes many problems to coordinate flood response. Coordination on distributing of resources after flooding becomes harder because many road access cut off and several important infrastructure damaged by flood while flood happening in this area. Humanitarian assistance from outside the area also had a problem to find a specific location because lack of information available from local officers.

Data availability is crucial for decision maker in disaster response. The local government of public works realizes the urgency of good quality of flood information and coordination among units in disaster response, but the varying data quality and providers lead to diversity response activities. The usability of GIS remains low, and the relation between data availability and the effectiveness response activity is still undefined yet. The situational awareness becomes harder because geographical information system usually did not designed to handle rapid progression of flooding incident.

In flooding situation, the data of flood extent, number of affected population, victims and damaged facilities are important for decision maker, but usually it takes too much time to get and the accuracy sometimes does not good enough. Research is needed to study the usability of spatial information to enhance the response action during disaster. Serious game in scientific and experimental approach developed from user need assessment to make an evaluation of what kind of information actually needed in the response activity.

1.3. Research Objectives

There are two main objectives in this research:

1. Determine what, when, and where information is useful for the Public Works Unit of Surakarta to assist in the response phase of the flood risk-management cycle. An evaluation to measure the usability of geographic information held in form of user needs assessment.

   The more specific objectives of this research are:

   - To evaluate the inventory of existing data related to flooding 2007 in Surakarta.
   - To identify the response activity related to flooding hazards 2007 in Surakarta.
   - To identify the problems of Public Works Department flood 2007 response.
   - To do user need assessment for flood information system.

2. Identify the key elements in decision making for a given task. A serious game is designed in order to identify how geographical information adds value into public works flood response.

   The more specific objectives of this research is to develop a serious game to test the disaster response decision based on flood 2007 with varying data availability.

   By creating situation based on existing data on flood 2007 for scenario and improved data availability, serious game for disaster response simulation will test on which parts of data availability have a significant value for the decisions in response phase for the Public works Department to make further improvement and recommendation.

1.4. Research Questions

There is several research questions needed to achieve the six research objectives that are listed in Table 1.

Table 1. Research Objectives and Research Questions

No	Research objectives	Research questions
1.	To evaluate the inventory of existing data related to flooding 2007 in Surakarta.	a. What is the existing data for decision support in flood 2007 response? b. Was reliable flood information available when disaster happened?
2.	To identify the response activity related to flooding hazards 2007 in Surakarta.	a. What response taken in flood 2007? b. What are factors contributing to the disaster response decision?
3.	To identify the problems of Public Works Department flood 2007 response.	a. What is the problem related to data availability during the flood in 2007? b. What was the response taken at that time?
4.	To do user need assessment for flood information system.	a. How accurate and reliable was the existing flood information in flood 2007? b. What information is needed when flooding occurs? c. How to provide effective flood information for response action?
5.	To implement serious game to test the disaster response decision based on varying data availability.	a. What is the effect of difference data availability?

1.5. Available Data

During the course of the research, several data from different sources had been collected and compiled. The list of the data are presented at Table 2.

Table 2 List of available data

No	Data	Data sources
1	DEM (Digital Elevation Models)	Digital topography map (1:25.000)
2	Landuse Map	Bappeda Surakarta
3	Topographic map of Surakarta scale 1:10.000	Public Work Departement of Surakarta
4	RBI / Administrative map of Central Java Scale 1:25.000	Bakosurtanal (National Mapping and Survey Coordinating Board)
5	Ikonos Image of Surakarta	Puspic UGM
6	Digital base map in ArcGIS format (.shp) consist of street network, hydrographical features and building footprint.	Universitas Negeri Surakarta (UNS) and Universitas Gadjah Mada (UGM)
7	Drainage System Map	Publik Work Departement of Surakarta
8	Flood source, frequency, duration and depth	Previous research and Public Work Departement Surakarta
9	Flood Mitigation Plan	BBWS Solo

1.6. Proposed Innovation

The proposed innovation for this research is a serious game of flood information system used to generate response database from local government unit, especially in Public Works Department, as a new approach in disaster research. The simulation scenario involves officer from public works and other institution dealing with flood related issues. It is build based on real data of Surakarta‟s flood 2007. Additionally, artificial data level were also used in “what if” scenario to provide different responses.

1.7. Benefit of the Research

This research will provide a response database model for local government on flood response system. For addition, it could be used to enhance overall response performance by improving the usability on spatial information system. The output of the research could also increase the insight of decision making in emergency process by using spatial information. The serious games will provide a database of response from public works, which can also applicable into other government institutions for effective response action in a simulation process.

1.8. Research Limitations

This research focuses only on the response phase of disaster management, not all phase of the disaster management cycle to provide a method to test the response action of the local government institute in Public works department. Information and data related to flood extent and flood duration obtained is based on previous research and existing data.

1.9. Thesis Structure

This thesis organized into of nine chapters. Each chapter is described as follows:

Chapter 1 – Introduction

The first part of this thesis introduces the research topic and provides background of the research. The research question is presented and the steps taken to address the research question.

Chapter 2 – Literature Review

This chapter opens with general review about flood response and information system used in emergency. The next part of this chapter discusses about data requirement in decision support system for flood response activity. This chapter closes with the introduction of serious game in disaster management practices.

Chapter 3 – Study Area

Study area section is provide a brief description about Surakarta city, description of flood extent and magnitude, the chronology and explanation of the main cause of the flood in 2007.

Chapter 4 – Methods

This chapter explains the methodology of the research. It describes how data collected and interviews conducted. It also explains how user needs assessment and development of the serious game is held to generate response database from public work officer in Surakarta using the varying data availability.

Chapter 5 – Interview and User Need for Flood Response in Surakarta

Chapter fifth describes the result obtained from data collecting, interview and user need assessment for the public works department in Surakarta. The main objective is to evaluate the usability of spatial information for flood response that used in serious gaming development.

Chapter 6 – Flood Response in Surakarta

Chapter sixth described the result obtained from data collecting, interview and user need assessment for the public works department in Surakarta. The main objective is to observe the practices activities and mechanism in flood response of Surakarta.

Chapter 7 – Design and Implementation of Serious Game for flood Response

This section describes design and flow process of the serious game development for flood response. It consist three main group, programming, GIS manipulation and scenario builder for the game.

Chapter 8 – Evaluation of the Serious Game Result

This chapter provides evaluation results of serious game. Evaluation of information needed and response database from 30 players in Public Works analyzed in statistical approach.

Chapter 9 – Conclusions and Recommendation

This last chapter of the thesis provides conclusions of the research results and recommendation for further research on the usability of spatial information for flood response and serious game development.

Chapter 2. Literature Review

2.1. Flood Disaster Response Research

Flooding is an excessive flow or inundation that comes from rivers or other water sources which is causing or threatening damage. To distinguish between normal discharge and flooding is determine by the level of floodwater, which indicated that exceed the capacity of water flow capacity of the cliffs or embankments of the river that flooded the surrounding area.

Response activities for flooding, in principle, consist of several common activities, e.g. monitoring, early warning, rapid needs assessments, calculating safety factor, implementing priority services, mobilization of resources or any other actions that is necessary.

In flood-disaster research, especially for response phase, **Timing** (when doing the research), **Access** (to the object) and **Method** (technique and approach that used) are very influence the result and level of the successfulness of research(Rodriguez, Quarantelli et al. 2007). Quarantelli states, "*The value of being on the scene at the height of crises cannot be overstated. It is worthwhile to be in such situations for two basic reasons. First, observations can be made and documents collected that cannot be obtained through later interviewing. The social barriers that normally exist to restrict access to high-level officials and key organizations do not exist. A second reason for being on the scene early [is that it] ensures a high degree of access and cooperation. Victims are typically candid, cooperative, and willing to talk in ways far more difficult to get later"* (Quarantelli 2002).

The most common issues in disaster response research grouped into technical issues, inter-agency coordination or sustainability and effectiveness of programs or activities in flood response.

In the development of flood information system, technical issues and human behavior are two of the most challenging for disaster response research. The good quality of information during flood cannot provide guarantee a good response, but lack of

information, almost can be predicted, could worsening the situation in flood emergency. Spatial information for flood response can be used on identification and categorization of the flood extent and type of damage (Committee on Planning for Catastrophe 2007). To reduce the impact of disaster, GIS with communication technologies have a great of potential, especially for framing disaster situation and assisting decisions making process in flood disaster. The quality of data and information during disaster in several aspect will determine the effectiveness of a disaster response (Laefer, Koss et al. 2006) because the developments of spatial data promote the availability, accuracy and reliability of information which needed during disaster.

To do research in flood disaster response, there are several approaches commonly used (Rodriguez, Quarantelli et al. 2007) are field studies, survey research, and documentary research. Each of it has different characteristic and specific purposes.

2.2. Data and Geographical Information System for flood Response

There are specific data needed in response phase (USAID DCHA/OFD 2005). It comes from the incorporation and interpretation of data from various agencies. Two types of data required for flood disaster response classified into static and dynamic data (Boone, 1995). The integration of these static and dynamic data is very useful for flood response information and GIS might be the best solution for flood response requirement.

Geographic Information System (GIS), "as a tool" (Huisman and de By 2009), gives advantages for disaster response. GIS also provides storage of the information and improves information accessibility (Marfai 2003). Along with the development of geographic data processing technology, GIS allows the incorporation of various databases and collected information through maps, satellite imagery, or field survey then displayed in layers of the map.

Visualization of static and dynamic geographic information are very useful in the disaster to aim the situational awareness (Brooijmans, Riedijk et al. 2009). However, it really depends on technologies and coordination that support decision-making process (Borkulo, Scholten et al. 2005). The expertise in the processing of high degree of accuracy input data also needed in spatial information system. It caused real disaster management practice, could not use the potential benefit of it.

As the system will interfere with the various agencies and individuals, the technological aspect of disaster response data for flood response should avoid complexity and high cost on its operation (Mamat, Mansor et al. 2001). The varying sources of data should be used efficiently based on user needs and economic value to determine where incidents occurred, who is at risk and where to put emergency support. The information system use several technology include remote sensing; satellite navigation system; geographical information system (GIS); global positioning system (GPS); satellite communication; amateur and community radio; television and radio broadcasting; telephone and fax; cellular phones; internet, e-mail etc.

To reduce complexity in data integration and dissemination, spatial information usually uses the same base data or common platform on their development. For an example of spatial information system, FEMA has developed two applications to display various flood related data in Google Earth map called Stay Dry and FEMA NFHL (Gowin 2002).

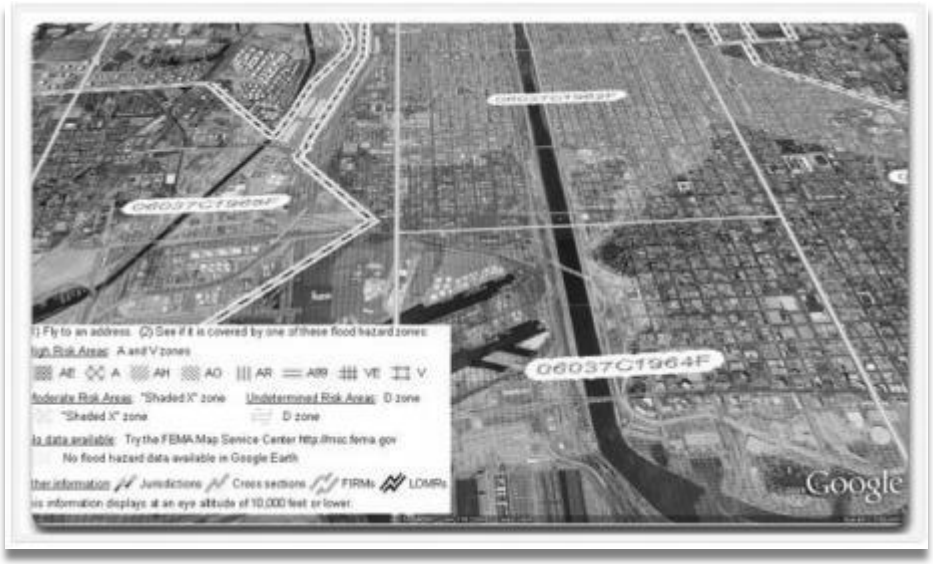


Figure 4. FEMA flood map on Google earth image

Table 3. Static and Dynamic Data in Flood Response

Static Data	Dynamic Data
• Satelite imagery • DEM • Administrative boundary • Demographic data • Building foot print • Roads • River • Other critical infrastructure	• Flood extent and location • Rainfall data • Water level • Number of affected people • Damage to homes and commercial buildings. • Damage to infrastructure and critical facilities. • Emergency activity.

Dynamic data in temporal resolution is important for data collection. A case study of flood information and warning system called FLIWAS developed by NOAH project in the Netherlands. FLIWAS is a web-based system that provides current information about imminent floods (Vreugdenhil 2009). Historical data used to determine the flood-prone area during or immediately after the flood happened. Meanwhile, real time data generated through the disaster operation include emergency call reports in form of street closures and barriers, location of flood impact, flooded areas and damage assessment reports.

By incorporating the potential available data and information system, into disaster response practices, decision maker has a bigger chance to make the right decision at the right time and make a difference to handle destructive flood affects.

2.3. Decision Making in Disaster Response

Decision making process in disaster response can be very difficult because it often dealing with complex situations (Borkulo, Scholten et al. 2005). The nature of disaster is unpredictable event and in a relatively short time span. In that way, Decision Support System (DSS) is could be very useful to manage the information to support decision maker.

Good decision making in an emergency depends on knowledge about the potential threat and resource that exist in the affected area and its surrounding. Information gap during disaster response activity could cause decision-making do not based on knowledge, but often made base on experience and intuition. The field experience for historical disaster and human intuition usually could be useful, however disaster affect cannot be assume always the same pattern and predictable.

Decision support for emergency can be designed for used in flooding (Windhouwer, Klunder et al. 2005). During the disaster event, several organizations coordinate their emergency work to promote an effective response. However, it causes another problem (Zlatanova 2008). DSS “must be simple and robust rather than sophisticated and comprehensive” (WL Delft Hydraulics 2007) if in the limited time decision needed to take. When the DSS takes too long time and have great dependencies to the technical problem, it will be abandoned by disaster management practices especially for the local government. They will use “act first, improve later” method rather than DSS.

According to (WL Delft Hydraulics 2007), the two most important issues for a designing DSS on flooding are "information-needed" and "user requirements".

- Information-needed is the knowledge that needs to be available in order to make a decision based on sufficient information.
- User requirements refer to capability of DSS to deliver certain knowledge for user.

Deltares" Flood Early Warning System (Delft-FEWS) provides one example of a state of the art flood forecasting and warning system in DSS. The system designed for building a flood forecasting system and can be customize to the specific purpose including for flood response (Delft Hydraulics 2005).

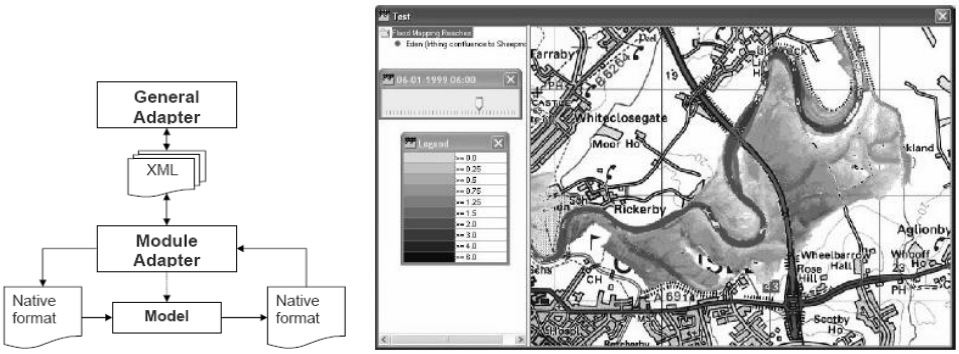


Figure 5. Schematic overview of the Delft-FEWS.
Source: (Delft Hydraulics 2005)

In a project called Flood Control 2015, a Dutch Initiative program, cooperation between Public Works of Indonesia with HKV consultants have made a step forward for development flood control and warning by developing a prototype of web technology (www.banjironline.com). It enables to collect and disseminate information about flooding in Jakarta, especially for water height level, rainfall using gauge meter or using social networks.

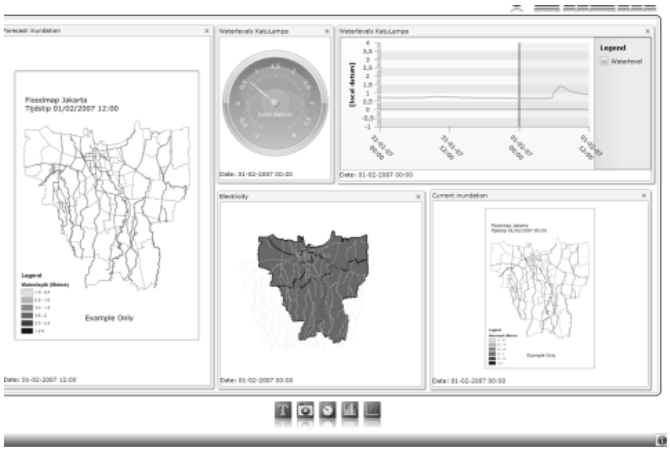


Figure 6. Demo Version of Dashboard BanjirOnline
Source: http://www.floodcontrol2015.com/news/item/12033

The other sample of previous study of Flood Incident Management (FIM) model in **(Stolk 2009)** describes processes at several levels: the FIM end-to-end process and activity diagrams at levels 1, 2 and 3 (Figure 7). Part of the Flood incident management model defines processes related to flood warning and response. A simplified representation of these processes is given in Figure 2.5.

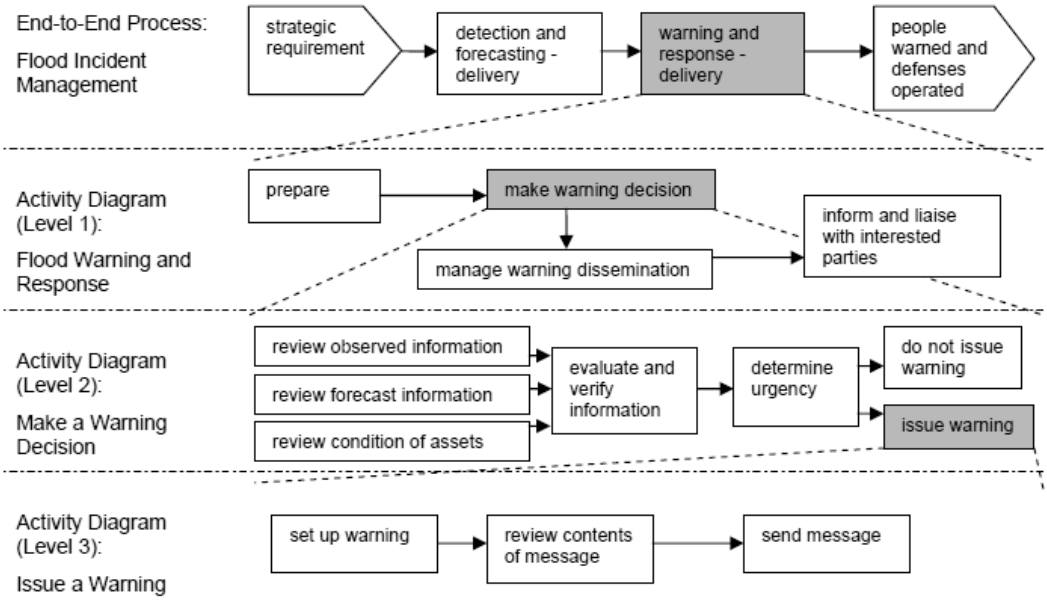


Figure 7. Flood incident management processes
Source: (Stolk 2009)

To justify a decision as right or wrong could be very subjective and hard to evaluate in the real situation especially containing other consideration such us social issue or political, but the flow of information to decision maker should be done in a standard formulation and it is possible to do. The technology can follow, and the people in organization can learn to use DSS to enhance disaster response capability.

2.4. Serious Game for Flood Response

Serious game is a game designed specifically different from common games. This type of game is using "fun factor" to train, investigate and explore human behavior beyond standard games traditions. Serious game (SG) can provide learning opportunity by providing visual and high usability to the player. It build using both real and artificial data as the scenario (Foresight and Governance Project 2002) into specific purpose. In disaster management, simulation is already commonly used, but the development serious game is just become popular in the early year of 2000. Since then, simulation also started to implement on serious game.

Table 4. Simulation and the Phases in Emergency Management

Phase	Aim	Simulation Uses	Simulation types
Before	Preparedness and prevention	• Prediction • Discovery • Organizational and technological design • Planning • Training • Education	Live simulation; Computer/agent-based simulation; VR simulation; Computer simulation as an educational support
During	Rescue victims and reduce losses	Real-time decision making Real-time resource management	Agent –based simulation
After	Learn lessons	Investigation and analysis tools	Computer-based simulation

Source: (Dugdale, Saoud et al. 2010).

Many SG implemented on web browser. It makes the spreading of SG is also become trend in the internet. Standard web browsers or with addition Flash plug-in to run games created with Flash, or Java runtime if the game is develop with Java.

One example of SG using Flash technology is Floodsim. It developed by Norwich Union with cooperation with Playgen in 2008 in order to simulate flooding present to the United Kingdom for educational purposes.

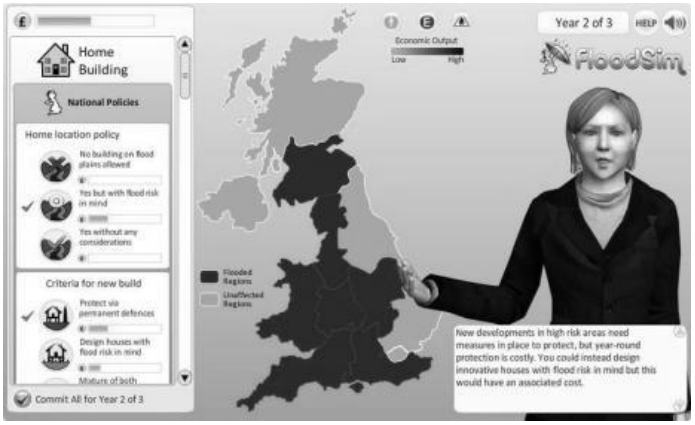


Figure 8. Floodsim
Source: http://en.wikipedia.org/wiki/FloodSim

The SG model could use dynamic digital map to identify real condition. It makes SG are possible to study the important factors of practical geo-information system implementation in flood response. Flood response experience of Surakarta‟s Public works officer in developing country like Indonesia is different from other countries. Although administration and institutional arrangements different from other country, it is significant to discuss some common factors influencing disaster response and decision making when adopting geographical information in disaster management for research and educational purposes.

Serious game can be developed to provide problem and response option in game scenario. With the combination of GIS map which provide situational awareness (ESRI 2000), serious games can be used to study the local flood defense unit for disaster responses and enhance player‟s knowledge and learning activity to deliver an effective emergency response. The other possibility is, SG used to generate response database from many player in disaster response simulation for research purposes.

For other example, a project called „FC2015 Dashboard Jakarta‟ between HKV Consultants, Haskoning, Fugro en Deltares in association with the Indonesian Ministry of Public Works, the Province of Jakarta and Jakarta Red Cross has developed a serious game to simulate complex situations with variables and interaction in flood management. This serious games use meteorological data, and realistic situation to show how the water system and the public interact by linking it with social media such as Facebook. This serious games allows training to be given using adaptable scenario for high tides floods, evacuations and crisis management (Haasnoot 2010)

Chapter 3. Study Area

3.1. General Information about Surakarta

Surakarta is a city in the province of Central Java, also known as Solo City. It is located in the northeast of Yogyakarta, and southeast of Semarang city. The Eastern part of Surakarta meet by the longest river on Java Island, called as Bengawan Solo River. The geographic coordinates of Surakarta (Solo) is $110^0$45‟15” – $110^0$45‟35” E and $7^0$36‟00” - $7^0$56‟00” S.

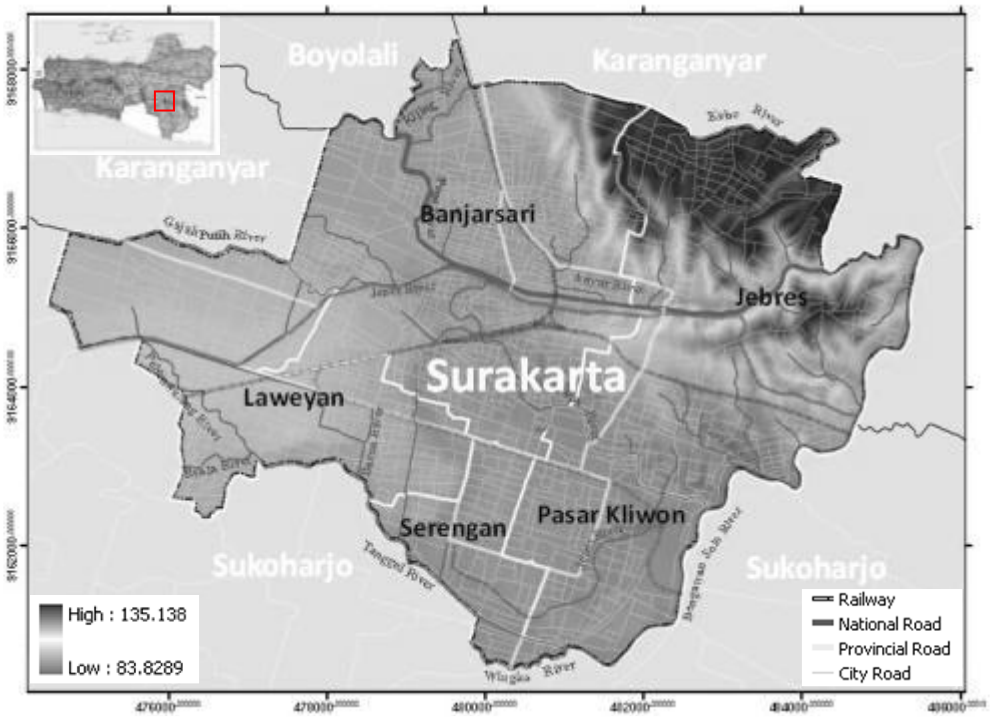


Figure 9. Central Java Province and Surakarta City
(Source: RBI Map)

- North boundary : Boyolali and Karanganyar Regency
- South boundary : Sukoharjo Regency
- East boundary : Karanganyar and Sukoharjo Regency
- West boundary : Karanganyar and Sukoharjo Regency

Surakarta topographically consists of two distinct parts, the North and the South part. Both are separated by Anyar River and upstream Pepe River which flowing from west to east of Surakarta. The southern city is relatively flat lowland with an elevation of about ±92 m. Northern part is the hilly area with elevations ranging between 92 to 135 m from sea level.

Bengawan Solo River has tributaries namely Anyar River, Tanggul River, Premulung/Pelem Wulung River, Boro River and some other small river. The smaller rivers, for example in North West, the Gajah Putih River flows into Jenes River then goes to the upstream of Pepe River and Anyar River.

Surakarta divided administratively into five sub-districts with the total area at 44 km². The names of sub district are Laweyan, Serengan, Pasar Kliwon, Jebres and Banjarsari. Surakarta city has a population of 564.920 people distributed to the five districts. The average density is 12,827 people /km^2. The sub-district with the densest population is Serengan with density of 19,884/km^2. Meanwhile Banjarsari as the sub district with the lowest density have 10,986 people /km^2.

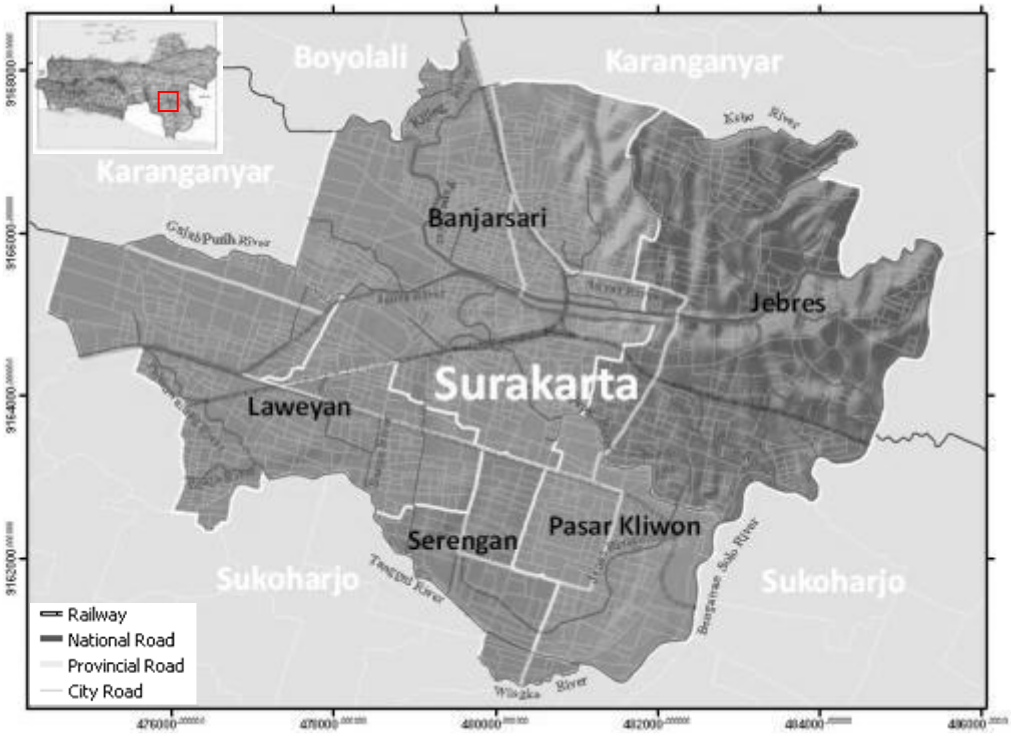


Figure 10. Population of Surakarta City in 2007

Table 5. Demographic of Surakarta

No	Sub-District	Area (km^2)	Inhabitant	
			Amount	Density/km
1	Laweyan	8.64	109,447	12,667
2	Serengan	3.19	63,429	19,884
3	Pasar Kliwon	4.82	87,508	18,155
4	Jebres	12.58	143,289	11,390
5	Banjarsari	14.81	161,247	10,986
	Total	**44,04**	**564,920**	**12,827**

Source: (BPS of Sukarta 2008)

Based on the land utilization (Table 6), residential area is covering 62.01 % from total area of Surakarta. Office, service and commercial buildings area is about 16.24 %.

Table 6. Land Use of Surakarta City in 2007

No	Land Use	Area	
		Km^2	%
1.	Residential areas	27.31	62.01
2.	Manufactures	1.01	2.29
3.	Office, service and commercial building	7.15	16.24
4.	Paddy Field	1.50	3.41
5.	Dry land	0.85	1.93
6.	Cemetery	0.73	1.66
7.	Sport Field	0.65	1.48
8.	Fallow Land	0.53	1.20
9.	City Park	0.32	0.73
10.	Others	3.99	9.06
	Total	**44.04**	**100**

Source: (BPS of Sukarta 2008)

In 2007, the average rainfall in Surakarta is 14.9 mm/day. The highest rainfall months are on December and February. The following data are provided from weather stations of BMG, Lanud Adi Sumarmo Surakarta, from 2004 until 2007.

Table 7. The Number of Rainfalls and Rainy days by Month in 2007

M o n t h	Number of Rainfalls (mm)	Number of Rainy days	Averages of rainfalls mm/days
January	78.9	9.0	8.8
February	595.0	19.0	31.3
March	305.1	20.0	15.3
April	452.0	21.0	21.5
May	67.0	6.0	11.2
June	22.1	4.0	5.5
July	-	-	-
Augustus	-	-	-
September	25.0	1.0	25.0
October	126.4	4.0	31.6
November	112.4	14.0	8.0
December	487.8	24.0	20.3
Total	**2,271.7**	**122.0**	**-**
2006	3,662.5	139	26.4
2005	4,172.10	141	29.6
2004	2,378.60	139	17.1

Source: BMG Lanud Adi Sumarmo

3.2. Description of Flood history in Surakarta City

Floods happened almost every year in this area. Surakarta‟s flood event at the end of 2007 was the biggest flood since 1966. Solo has experienced major floods in 1863, 1904, and in 1966 flood reach over the centre of the city (Setiyarso 2009).

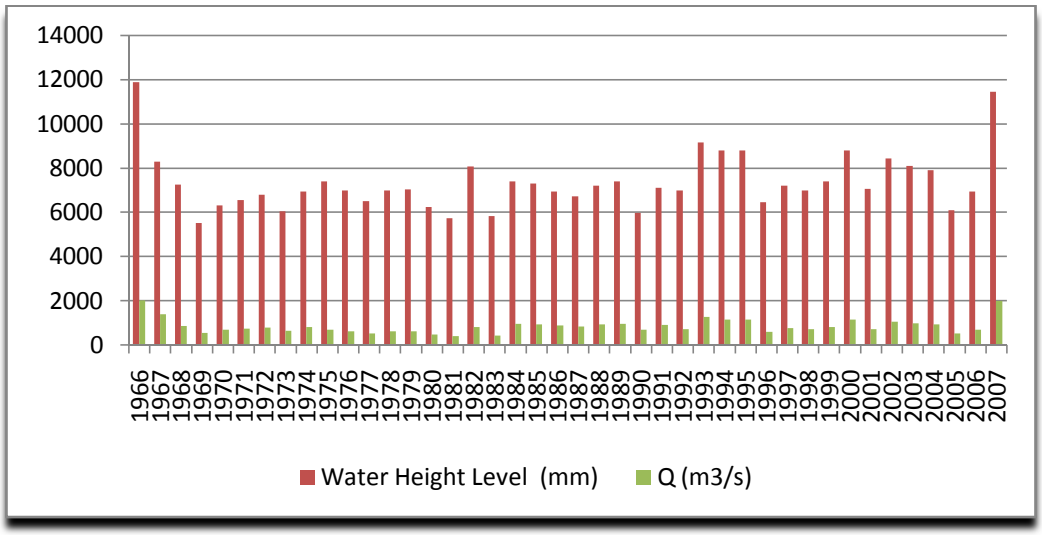


Figure 11. Maximum Height of Water Level and Maximum Discharge of Bengawan Solo River
Source: Jurug Station, Surakarta. BBWS in (Setiyarso 2009)

According to Setiyarso (2009), the changes of land cover in catchment area of Solo cause increased sedimentation in the Gajah Mungkur reservoir. The capacity of the reservoir was reduced, indicated by the decrease of depth from 40 m to 10 m. Gajah Mungkur reservoir unable to retain water from heavy rains in upstream areas causing Bengawan Solo river overflow and cause major flooding in Central Java and East Java.

Surakarta is flood-prone area because located in the depression zone of Lawu, Merapi and Seribu Mountain. Flooding in the Solo watershed at the end of 2007 because of very high intensity rainfall that reached 110-230 mm on 25-26 December 2007 in the area of Mount Lawu, which is the upstream watershed from Surakarta (Setiyarso 2009).

The high amount of rainfall on December 2007 becomes a major cause for flooding in Surakarta. The floods occurred in Surakarta from December 26, 2007 until early January 2008 damaging houses and infrastructures. Almost all area in Sewu and Joyotakan village were inundated, caused by the broken dike, three points located in Joyotakan and one point in Sangkrah (Setiyarso 2009). In the several areas, flood usually lasted three until five days (Febrianti 2010).

In recent years, floods have happened several times in Surakarta. In March 2008, more than 1000 houses were inundated in Surakarta. In the early of 2009, floods happened again in Surakarta City, more than 11,000 houses were inundated (Febrianti 2010).

Table 8. Number of Flooded Houses in Surakarta 2007

No	Village	Outside the Banks		Inside the Banks	Total
		Minor Damage	Severity Damage		
1	Pucang Sawit	342	282	300	924
2	Sewu	121	101	363	585
3	Sangkrah	135	114	294	543
4	Semanggi	101	93	339	533
5	Joyosuran	493	406	57	956
6	Jebres	140	118	218	476
7	Gandekan	10	10	0	20
8	Jagalan	564	464	0	1028
9	Sudiroprajan	40	35	0	75
10	Pasarkliwon	7	0	0	7
11	Kedunglumbu	72	62	0	133
12	Joyontakan	615	505	0	1.120
Total		**2640**	**2190**	**1571**	**6401**

Source: Drainage Division, Public Works of Surakarta

3.3. Causes of Floods in Surakarta 26 December 2007

According to Public Work Office of Surakarta, there were several causes of flood in the region:

- The primary drainage channels in Surakarta actually have catchment city areas across the district. Thus, land and weather conditions especially in Sukoharjo, Wonogiri and Boyolali highly influenced the incidence of flooding in the city of Surakarta.
- The mouth of the Pepe River is not appropriate (different direction) with the direction of flow of the Bengawan Solo River.

Figure 12. The mouth of the Pepe River to Bengawan Solo River
Source : Public Works of Surakarta

- The absence of water pumps at the Plalan water gate (at the mouth of Wingko River).
- The absence of water pumps at the Putat Water gates.
- Some flood control structures in Surakarta been works for more than 25 years and some have built in the Dutch era (Demangan and Jenes water Gates). The leakage in the door leaf door Demangan happened due to its age.
- Solo River water level has exceeded the threshold of the door so that backwater continued to occur despite already pumped.
- Automatic flood control gates, especially in the area of Pucang Sawit cannot open and close perfectly.
- The strength of the dike reduced due to water erosion or lack of levee maintenance. On December 26, 2007 incident damaged embankments in several places, namely Tanggul River in the Village Joyotakan, Solo River in Kampung Klenteng Semanggi Village, Pepe River estuary to Solo in Sangkrah.

Source: Drainage Division, Public Works of Surakarta

3.4. Chronology of Flood 2007 in Surakarta

The flood disaster of 2007 occurred during the end of the year, lasting for at least one week. The chronology of the event presented at Table 9.

Table 9. Chronology of Flood 2007

December 25, 2007	
18:00 pm until 24:00 pm	Surakarta and surrounding districts experienced rainfall with intensity of more than 200 mm/hour with ±60 knots of winds. Saturation occurs at the Solo River makes water surface increased.
18:00 pm until 24.00 pm	The height of water in Demangan Floodway continues to increase reached 2.40 m (Inner Elevation) and 2.35m (Outer Elevation), the water still can flow to the outside (towards the Solo River) by gravity force.
December 26, 2007	
02.00 pm	Water surface level of the Bengawan Solo River continues to rise to 4.5 m at the Demangan floodway while the water level on Pepe River is at the same level. The door is closed.
3:00 pm	Demangan water pump is turned on while the Bengawan Solo River level continues to rise. Puddle started in the area within the dike and other lowlands.
05.00 pm	Dike of Wingko River, Tanggul River and Bengawan Solo River at some point begin to deteriorate. Water Puddle increase to widespread.
12:00 pm	Bengawan Solo River water level reaches the highest point 7.05 m whereas on a typical day only 4 m. The puddles expand to the downtown area with height 0.5 m to 6 m.
December 26, 2007 until January 1, 2008	
	Inundation yet gradually receding because of torrential rains continues to occur with an average duration of 2-4 hours.
January 2, 2008	
	The identified inundation extent is 611 ha.

Source: Head of Operations and Drainage Maintenance of Surakarta Public Works Department

Balai Besar Wilayah Sungai (BBWS) as part of Public Work Department from central government of Indonesia, which responsible for Bengawan Solo Watershed Management reported that in 2007 flood they provide flood material and equipment for Surakarta region to assist local Public Works of Surakarta in table 3.7.

Table 10. Delivery of materials and flooding equipment

NO	DATE	SUB DISTRICT	VILLAGE	FLOOD MATERIALS /EQUIPMENT	TOTAL
1	25-Dec-2007	Pasar Kliwon	Sangkrah	Sand Bag	1.000 sheets
2	26-Dec-2007	Pasar Kliwon	Sangkrah	Rubber boat	1 unit
3	26-Dec-2007	Jebres	Pucangsawit	Sand Bag	1.000 sheets
4	26-Dec-2007	Surakarta	Surakarta	Rubber boat	1 unit
5	28-Dec-2007	Pasar Kliwon	Demangan	Sand Bag	1.000 sheets
6	28-Dec-2007	Jebres	Pucangsawit	Rubber boat	1 unit
7	31-Dec-2007	Serengan	Joyontakan	Sand Bag	3.000 sheets
8	08-Feb-2008	Sangkrah	Joyontakan	Gabion Galvanized	100 sheets

Source: (BBWS 2009)

3.5. Flood Response Mechanism in Surakarta

Preparation in flood response activities (BBWS 2009) consist of :

a. Inventory and allocating the transportation, communication and evacuation devices for the flooding in efficient, well targeted and appropriate use.
b. Inventory and allocation of flood material (sand bags, gabion wire, bamboo, stone etc.).
c. Inventory and allocation of equipment (heavy equipment, transportation equipment, evacuation equipment, tents etc.).
d. Coordination with relevant agencies in the Bengawan Solo River is doing in order to avoid overlap in their handling.

3.6. Flood Alert Stages

There are 3 (three) level for observation of the water level height (TMA) in the observation posts placed along the Solo River and its tributaries namely Siaga (Alert level) I, II and III.

The levels at each location have been determined based on the macro condition on its regional areas. Through observation of water level height in these locations, will provide preliminary information to the picket officer flood to make a decision what steps need to be done. In the figure below shows the location of monitoring the water level, and restrictions on alert level at each location.

Flood warning issued when the condition/elevation/flood elevation showed a tendency to rise and expected to endanger the population in the region and the possibility can cause harm. In these conditions, officers of flooding should stand ready to face the things that might happen.

Figure 13. Flood response activity on 2009
Source: Public Works of Surakarta

Alert Phases 1, 2 and 3 are set as follows in Table 11:

Table 11. Flood Alert Stages

Alert Level	Danger Level	Distance from top of embankmentto water level (m)	Water height Observations	Reporting
1	**Alert, Stand By** (High probability of flood)	1.25 - 1.50	Every 2 hours	Every 6 hours
2	**Preparation** (Flood is inevitable within some hours)	0.75 - 1.25	Every 1 hour	Every 3 hours
3	**Evacuation** (Flood coming any time)	0.50 - 0.75 or when a building in critical	Continuously	Every 15 minute - 1 hour

Source: BBWS Surakarta

On Alert level III Observation of Water height carried out continuously in particular critical control structures that begin to reveal signs of damage, landslide in embankment and so forth.

Observation of the affected area is increased. Coordination improved, all residents evacuated in a safer location. The officer of the flood material is ready for delivery orders. Flood watch officers stand 24-hour in turn ready to take on the task at any time. Flood materials transporter including driver and his crew are stand by when needed. Travel time of floodwater is determined by the velocity flood from a water level observation station one to others observation post shown in the table 12.

Table 12. Time Travel Floods in Bengawan Solo River Area

No.	River	Conditions	Location	Distance (Km)	Time (hour)
I	Bengawan Solo Madiun River	High Low	Jurangempal-Jurug Jurug-Karangnongko Karangnongko-Bojonegoro Bojonegoro-Babat	51 165 80 63	6 – 7 25 – 26 14 – 15 13 – 14
II	Madiun River Bengawan Solo	High Low	Sekayu-Madiun Madiun-Karangnongko Karangnongko-Bojonegoro Bojonegoro-Babat	30 64 80 63	4 – 5 15 – 16 14 – 15 13 – 14
III	Madiun River Bengawan Solo	High High	Jurug-Karangnongko Madiun-Karangnongko Karangnongko-Bojonegoro Bojonegoro-Babat	165 84 80 63	25 – 26 16 – 17 15 – 16 13 – 14

Source: (BBWS, 2009)

Chapter 4. Research Methodology

The approach to investigate the relation between disaster response and data availability consist of literature research, interview, user need assessment and serious game as the proposed innovation. Literature research of the official documents and reports was used as a starting point. More efforts needed to get better understanding the situation for decision making in the historical flooding 2007 in Surakarta.

The methods used in this research divides into six objectives and thirteen research question as shown in the table 13.

Table 13. Research objectives and Methods

No	Research objectives	Research questions	Methods
1.	To evaluate the inventory of existing data related to flooding 2007 in Surakarta.	a. What is the existing data for decision support in flood 2007 response? b. Is reliable flood information available when disaster happened?	Literature review and interview
2.	To identify the response activity related to flooding hazards 2007 in Surakarta.	c. What response taken in flood 2007? d. What are factors contributing to the disaster response decision?	Literature review and interview
3.	To identify the problems of Public Works Department flood 2007 response.	e. What is the problem due to data availability during the flood 2007? f. What was the response taken in that time?	Literature review and interview
4.	To do user need assessment for flood information system.	g. How accurate and reliable was the existing flood information in flood 2007? h. What information are needed when flooding occurs? i. How to provide effective flood information for response action?	Survey to flood defense unit, interview and questionnaire
5.	To implement serious game to test the disaster response decision based on varying data availability.	j. What is the effect of difference data availability?	Implementation of serious game

In general, research activities illustrated in Figure 4.1.

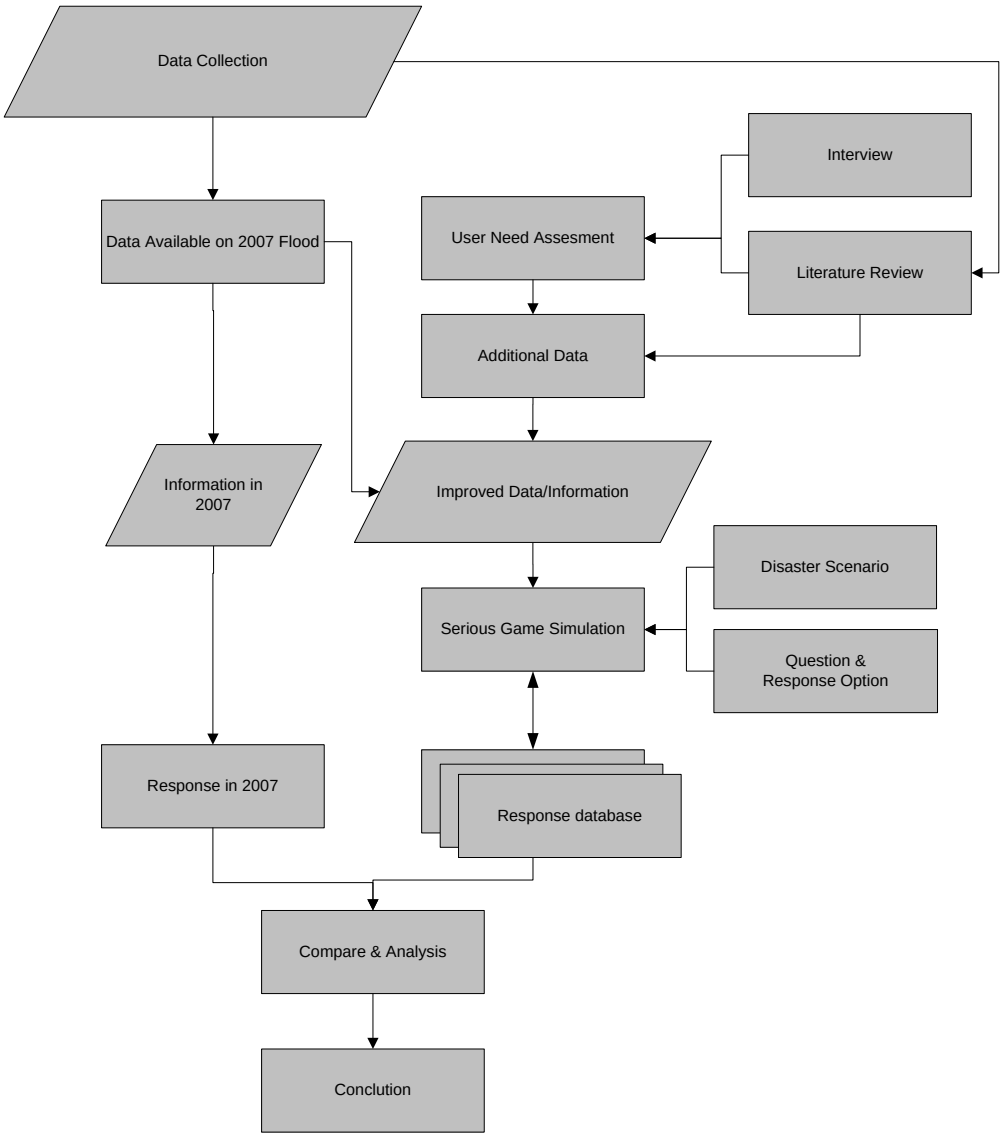


Figure 14. Simplified research framework

4.1. Data Collecting

Data collecting activity was conducted in July until September 2010 to collect available data during flood 2007 response. Public Works Units of Surakarta provides a contour map in paper base at scale 1: 10.000, satellite imagery and flood-susceptibility map of Surakarta 2007. The other result is the official documentation of flood response report from the government and flood 2007 chronology.

The researcher also collected several additional data from related institutions such as Local Agency for Planning and Development (BAPPEDA), Meteorology, Geophysics and Climatology Agency (BMKG), Fire Brigade (as Public Works unit), Bapermas P3KB and Bengawan Solo Watershed Regional Office (BBWS). The handbook of flood mitigation procedure of Bengawan Solo River obtained from BBWS. This additional data also used to validating the data from Public Works Agency.

Because of the availability of spatial data in the local government offices is fairly low (only available in paper format and JPG), the author expand the search of spatial data into local university, Universitas Negeri Surakarta (UNS), to collect additional spatial data. Yusuf and Setiyarso (2008) provided information of the extent of inundated area and contour lines in form of ArcGis shp format.

Figure 15. Data Collecting and Interview process

4.2. Interview

In order to answer research objectives 1 until 4, interview was conducted with the local officers who responsible during disaster response. The main objectives of the interview (in appendix 1) with the local officer in Public Works Office are to collect information about the existing condition of spatial information in public works office, Mr. Sihono as the Head of Drainage Division, and other government offices in Surakarta. The specific objectives are to get information about the impact of flood 2007 in Surakarta, what decisions taken in flood December 2007, the actual response of government institutions, the needs and priorities also problems in flood 2007 response activity.

The other unit from Public Work Department, BBWS offices, Mrs. Susan as the Head of Data and Information division was interviewed about their role in disaster response and their contribution as Public Work regional office in the river management. Mr. Sri Kencana as Fire Brigade officers is also interviewed about data sharing during the flooding.

In BAPPEDA Surakartan offices, Mr. Nunung as the Head of Regional Infrastructure Division also interviewed. The questions are focusing on the coordination mechanism during flooding in Surakarta. Meanwhile, in Dinas Tata Kota office (Mrs. Ida and Mrs. Fitia Eka Sari) and Health Department office (Mr. Wahyu as the Head of Disaster Operational Unit and Mrs. Arthati as the leader of Statistic and Disaster Information for Health Department) became additional sources of the interview to validate the number of victims in flood 2007.

Researcher using structured interview method with predefined question, but in the interviews activities, discussion also produced relevant information about the flood in Surakarta beyond the predefined questions. The interview result can be found in Chapter 5.

Besides answering the question, the interviewees are usually providing their supporting documents about flood report activities and handout of their presentation about flood in Surakarta. From the Health Department, researcher got invitation to follow disaster simulation drill on 29 July 2010 at Balekambang Park Surakarta, together with all Surakarta‟s governmental institution including public works agency. This live simulation provides a brief description of Public Works coordination mechanism to other government institutions during flooding.

4.3. User need assessment

Questionnaire (in Appendix 2.) was used as the main tools in the user need assessment. The objective was to assess the capacity and the usability of GIS for flood response in Public Work Office and the Government of Surakarta in general perspective. The specific objectives were to find out type of data, sharing mechanism, resource requirement and problem in flood response.

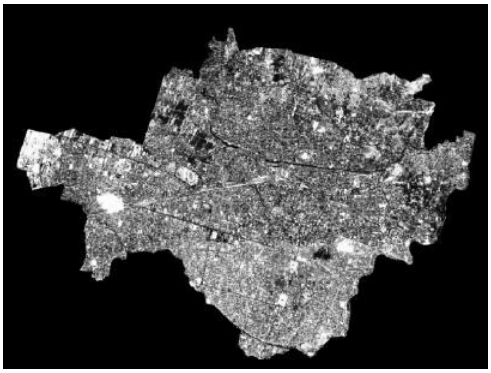
4.4. Spatial Data and Serious Game Development

The next step of this research was done in the studio. The activities were divided into 2 steps; the first was compiling a spatial data from collected data for used in serious games and second was designing a Serious game for Flood Response

4.4.1. Compiling a spatial from collected data.

a. Static Data

Static data is the spatial information represented as points, lines and regions. It could be in raster or vector format, for describing natural or manmade object, which have consistent form in relative short time. The common process in this step was geo-referencing and compiling from various sources.

1. Satelite imagery The satellite images available in the government offices of Surakarta, from research investigation, are Ikonos image. Most of them are in form of JPG format in used as a tool for presentation only but not for spatial analysis. Without GIS operation, this imagery only processed using manual drawing or simply crop and edit operation.	 Figure 16. Ikonos Image

2. Tophographic data and DEM

Topographic map obtained from Public Works of Surakarta. It created with 1:10,000 scale, 1 m contour, in 1991.

Figure 17. Topographic Map of Surakarta, Scale 1:10.000

3. Height Point Map

There are 96 height points available from RBI map, the maximal height is 127.65 m while the minimum is 86.64 m.

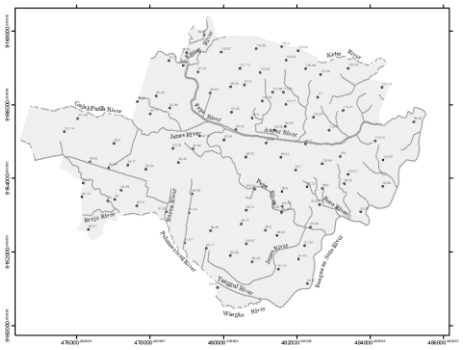


Figure 18. Scale 1:25.000
Source: RBI Map

4. Digitized Map

Derived from the topographic maps produced by the Public Works of Surakarta, researcher uses the digitized maps that are available from the research results Universitas Negeri Surakarta, Yasin Yusuf and Budi Setiyarso, in Arc GIS format.

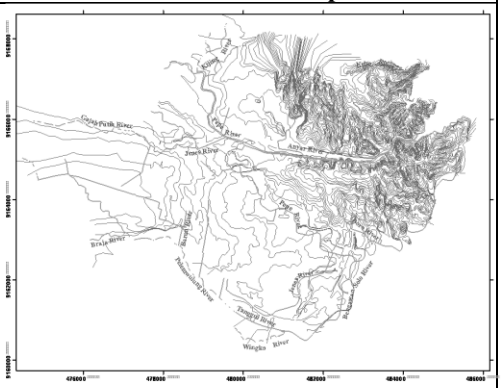


Figure 19. Digitized Map Scale 1:10.000
Source: (Setiyarso 2009)

5. River Networks

The river networks is already done, collected from Yasin Yusuf and Budi Setiyarso, in Arc GIS shp format.

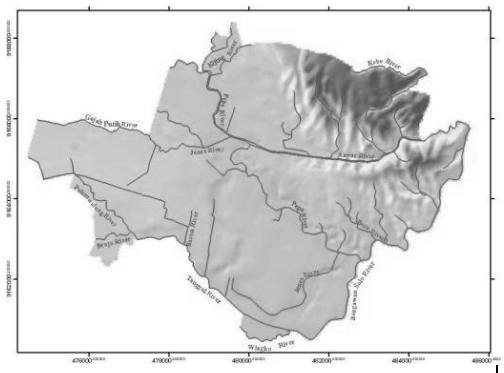
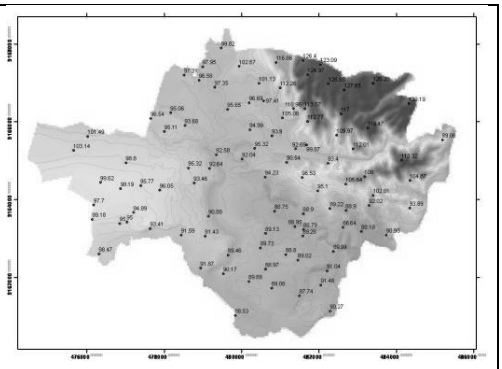
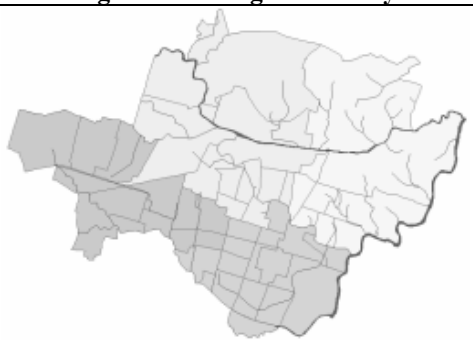
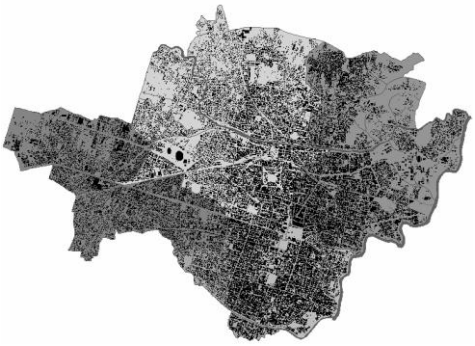
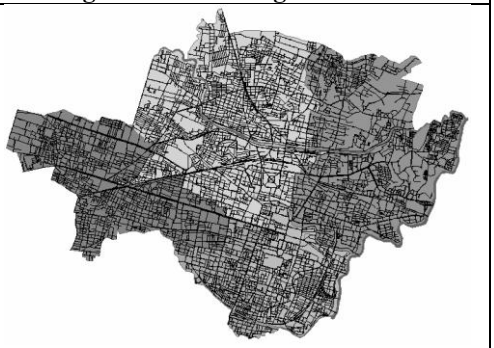


Figure 20. River Networks

6. DEM Map The DEM map was produced by combining height points, contour map and river network in ArGis operation.	 **Figure 21. DEM Map**
7. Administrative boundary The administrative boundary was already done, collected from Yasin Yusuf and Budi Setiyarso, in Arc GIS shp format.	 **Figure 22. Village Boundary**  **Figure 23. Sub District Boundary**
8. **Demographic data** Demographic data is one of the important data. Even though it was available in text format, it failed to use in serious game because of limited time to self-produce in spatial format.	Spatial information was unavailable.

9. Building Foot Print Building Foot Print was provided from GMU spatial database, to make simulated damage estimation combined with flood extent in 2007 in Serious game.	 **Figure 24. Building Foot Print**
10. The road networks The road a network was already done, collected from Yasin Yusuf and Budi Setiyarso Fathurrahman Nur Arromdlony combined in Arc GIS shp format.	 **Figure 25. Road Network**
11. Important Building The tourist map digitized in Corel and imported to Adobe Freehand to produce Street name, Road class, important building name, etc.	 **Figure 26. Important Building**

b. Dynamic Data

Dynamic data are one of the most challenging efforts to provide just in time when flooding happened. It also becomes harder when the public works try to visualize in spatial information. Most dynamic data are not provided and collected during disaster. They usually shown after few hours, days, weeks or even never existed. To have this information are necessary, but spending a lot of resource to get high accuracy is usually something contra productive.

There are several data is not completely success to collected and provided in spatial format due to limited time, but the sample data is depicted in serious game scenario inform of text and point. The data was Water level, Number of affected people, Damage to homes and commercial buildings, Damage to infrastructure and critical facilities.

Meanwhile several data were successfully collected and created during field and studio works described as follow:

1. Flood extent

The flood extent in 2007 event was used in Serious game in static visual, eventhough in real world, they always changing produce uncertainty in analysis.

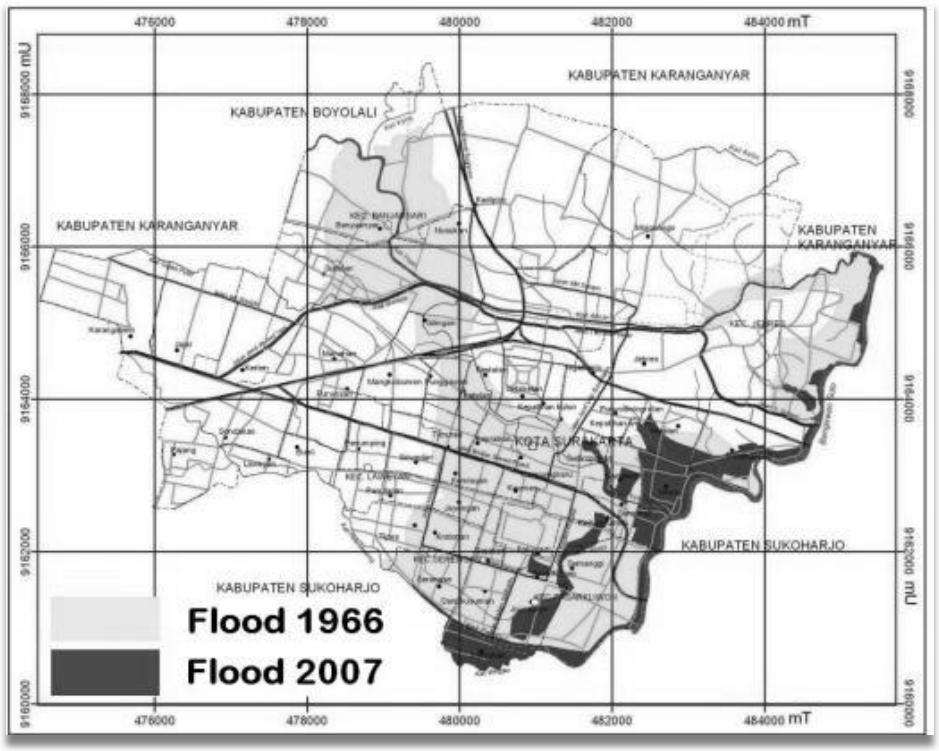


Figure 27. Flood Extent in 2007 and 1966 in Surakarta
Source: (Setiyarso 2009)

2. Rainfall data

The first rainfall data (Figure 28) was available in spatial format. But the problem was the accuracy does not adequaet to fullfill the standard for a city level like Surakarta. In the serious game, i create dummy scenario just to find out wether the spatial information is useful or not.

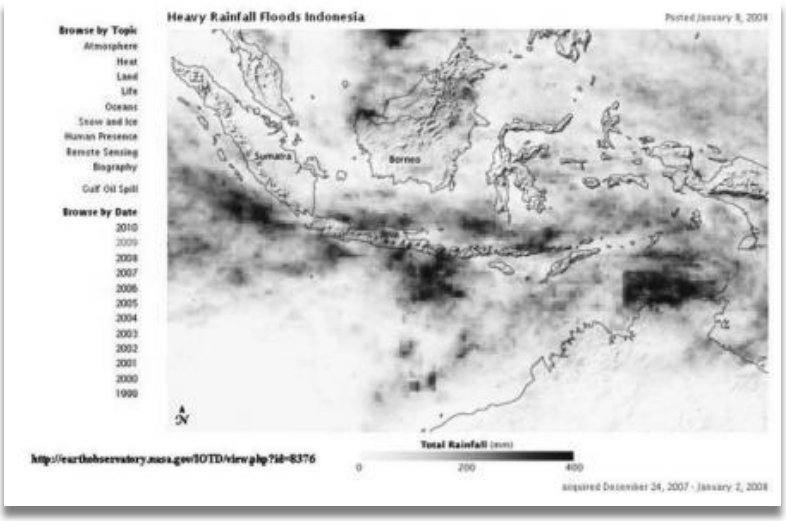


Figure 28. Rainfall in Indonesia December 24, 2007

The second rainfall data (Figure 2929) was also available in spatial format. The accuracy was adequaet to fullfill the standard for a city level like Surakarta. In the serious game, author create dummy scenario just to find out wether the spatial information is useful or not.

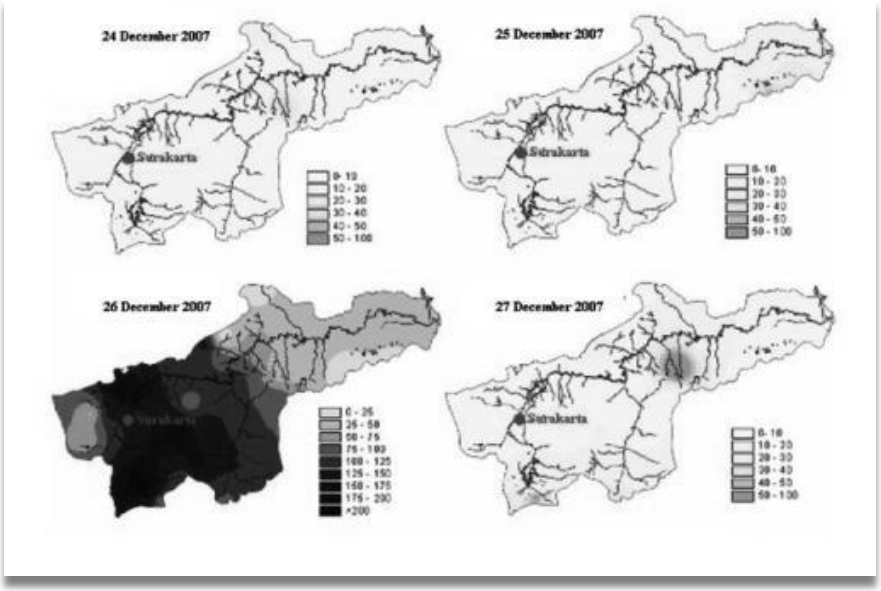


Figure 29. Daily Rainfall in the Solo Watershed
Source: (BBWS 2009)

4.4.2. Designing Serious game for Flood Response

In this step, the main activity was creating a simple prototype of flood information in serious game based on user need assessment in Public Works including disaster scenario and response options

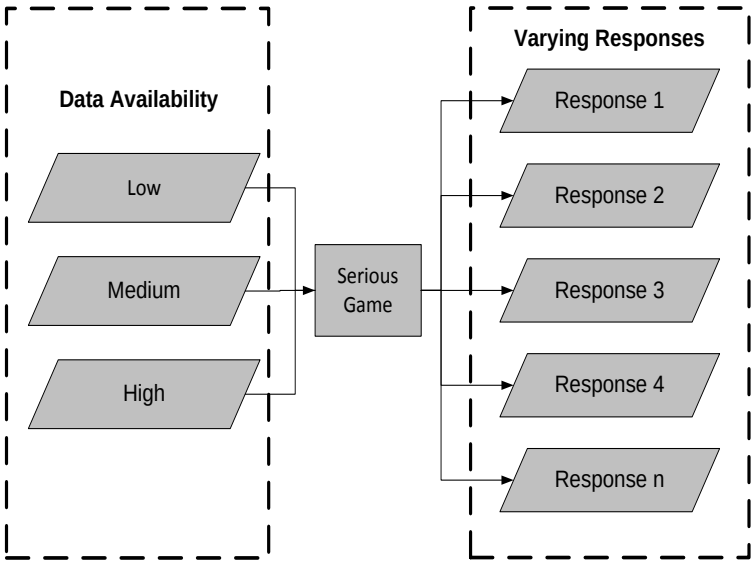


Figure 30. Relation between data availability, serious game and responses

The serious game was developed by combining ArcGIS shape file from many sources such as RBI map scale 1: 250.000 from BAKOSURTANAL, contour map (Scale 1:10.000) provided by Public Works of Surakarta in 1991, fieldwork data from Geographic FKIP Faculty UNS 2008 in (Setiyarso 2009).

Adobe Flash used as animation software to provide dynamic information simulation in serious game. By putting element at risk, varying data availability and dynamic situation in flood 2007 scenario, decision-making process was captured and recorded by Camtasia software to make database of response of the player.

Interaction toolbox provided Adobe/Macromedia **http://www.adobe.com** in (Gowin 2002) combined with idea and technique developed in **http://om4gus.blogspot.com**. The scenario on Appendix 3 provides three level (Low, Medium and High) data to generate different response from 34 players.

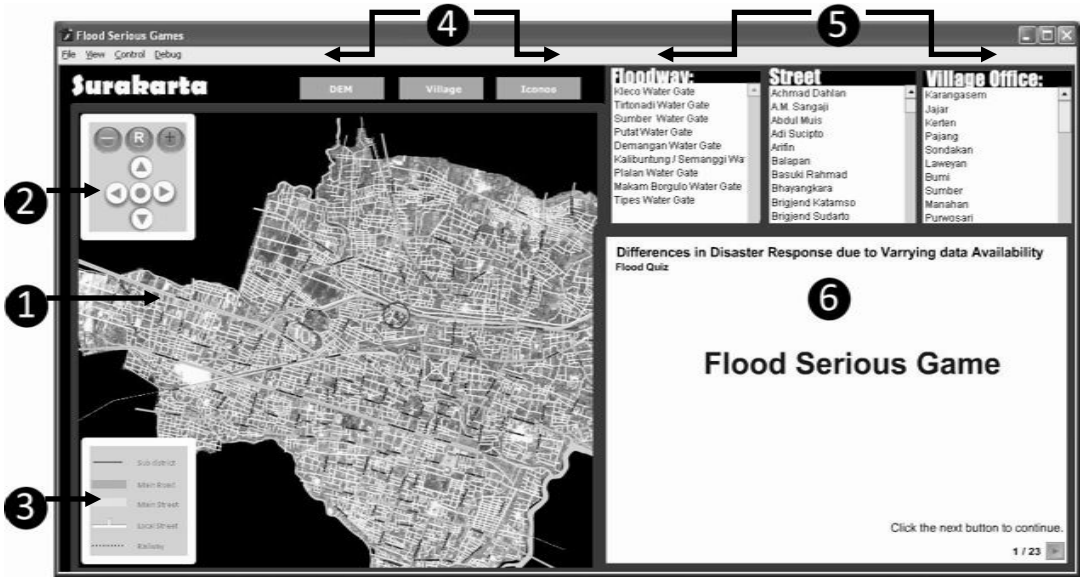


Figure 31. Serious Game Prototype

In the following section, each component of the game will described:

a. Main Window

Figure 32. SG Main Window

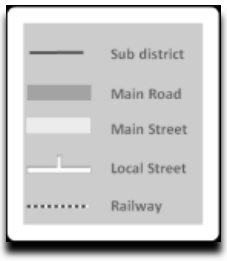
The main window contains streets map, river and drainage networks, sub district boundary, and the animation of flood extent 2007 in Surakarta. This main window allow player to do some action like zooming, panning, dragging and finding location.

b. Control Button

Figure 33. SG Control Button

The Control Button allows player to click it to perform an action. The control button works by action script (in Appendix 4) to zoom in/out, reset, move main windows to up/ down and left/right.

c. Legend



The legend in the main windows is given to help the player understand the different class of the street (Main Road, Main Street and local street also railway). The red line in map used as Sub district boundary.

Figure 34. Legend of Main Window

d. Additional Spatial Data

a. DEM

The Digital Elevation Model of Surakarta derived from contour map, point elevation, river and City boundary in ArcGIS operation with hill shading effect. This information did not available during flooding in Surakarta for 2007. The flooded area was reported from field officer and local community without consider the DEM data.

b. Village Boundary

Village boundary provided in this serious game. Many officers during flooding response, including whom familiar with Surakarta area need precise information about the village boundary.

c. Ikonos

Ikonos image combined with river network provided for the player, especially to whom not familiar with Surakarta and rivers name on this area.

Figure 35. DEM, Village Boundary and Ikonos

e. Search List box

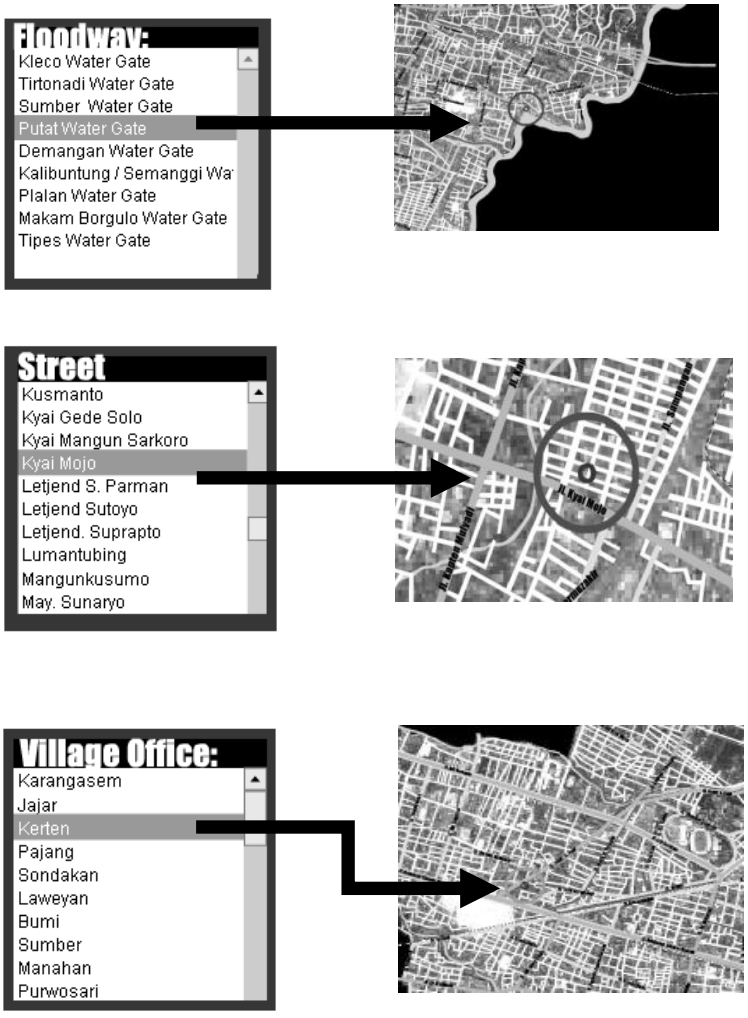


Figure 36. Floodway, Street and Village Office Search List Box

There are there search list box provided in this serious game, fist box (Floodway) to show 9 main water gate in Surakarta, the second box to find location of street in Surakarta. It sorted in alphabetical order. The last search list box is to show the location of Village office. It arranged by its neighborhood location aspect.

f. Flood Serious Game Window

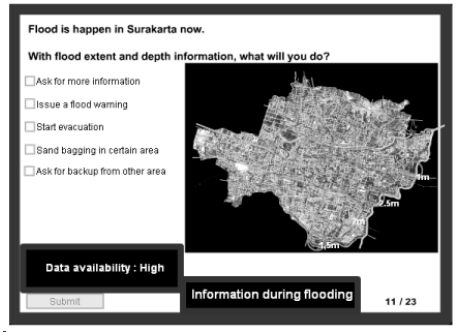


Figure 37. Flood Serious Game Window

In the game window, the response captured using a desktop recording application (Camtasia) (www.techsmith.com/camtasia/). The scenario was use 3 level data availability (low, medium and high). In this window, players choose their response using the data provided during flood response period.

There are six serial scenario with three level data availability was provided.

a. Difference in disaster response from early warning data
b. Difference in disaster response from information during flooding
c. Difference in disaster response in quick response to find a location
d. Difference in Disaster Response in Flood Alert Stage Decision Making
e. Difference in Disaster Response from Digital Elevation Model usability
f. Difference in Disaster Response from Damage Prediction information

In the beginning of the game, the players has to put their name, flowed by their attribute such as place they work, their perception about Surakarta, whether they are familiar or not, and option whether they are familiar using map or not. This data are used in the analysis to explain the answer in hindsight.

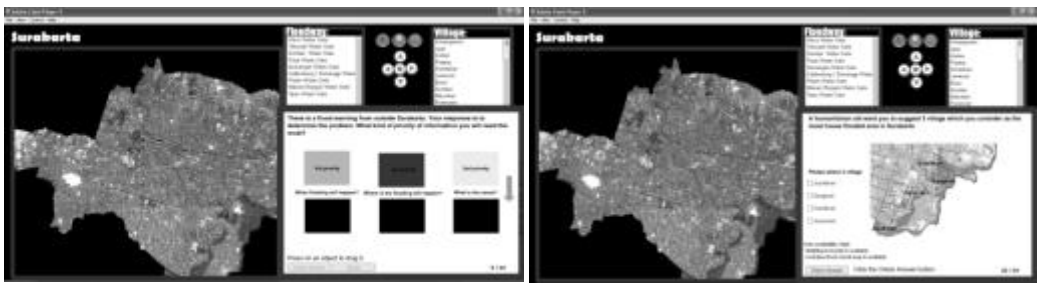


Figure 38. Serious Games development preview

The simulation was build based on user need assessment, existing data review, photo interpretation, additional data and building foot print. The scenario generated from flood 2007 chronology. The simulation was take around one hour for each player, 30 minutes for explanation/discussion and 30 minutes for playing the game. While the

simulation begin, the subject of research was provided several question (see appendix 5) and stored in the data base for generating the data base of response from players.

4.4.3. Flood Serious Game Test Run

In 28 October 2010, research activity was held a test run of prototype flood serious game to the governmental institution to test the spatial information simulation in flood disaster scenario 2007. The test run was tend to find opinion from the flood responder about the problem when playing the game prototype and making adjustment before the real Serious game on November 2010. Several issues from the test run that improved before the real players involved are:

a. The language need to be converted from english into bahasa Indonesia.
b. Some control button need to be adjusted
c. The flow scenario need to be improve

Figure 39. Serious Gaming Prototype test run.

The improvement was done after that, and in the end of December, the serious game will generate subjective decision based on expert judgment. It was collected from actors in Surakarta using the improved Serious Game. It was done in 4 offices, Drainage Division of Public Works in Surakarta, BBWS Regional in Central Java from Public Works Department, and two other local office (Kesbang Linmas and Bapermas P3KB), wich also have a great contribution in flood response.

4.5. The Players

The serious game was doing in December 2010, with 34 participants. Involves four government offices, 2 of them are under Public Works Departement of Indonesia (Public Works of Surakarta and BBWS Bengawan Solo), the others are Bapermas P3KB, which is responsible for flood disaster recovery and Kesbanglinmas as Coordinator during Flood response in City level.

Table 14. Profile of the players

Work	Familiar with Surakarta area		Familiar on using Map	
	Yes	No	Yes	No
Public Works	15	2	10	7
Bapermas	6	1	3	4
Kesbang Linmas	7	3	4	6
Sub Total	28	6	17	17
Total	34		34	

In general, the players were very cooperative during the game. They are very curios and enthusiastic to follow the scenario even though several players complain that the scenario is too much. Some of them are need additional help to follow the scenario, but in general, they can learn the game without further help after short explanation was given to them. Most of them think this game could very useful to train decision maker or a team in disaster simulation.

During the game, researcher asks to the player to think aloud and discuss the issue or the reason why they select their answer. Several players also suggest for game development consider the game control and additional features.

a. Public Works of Surakarta (9 players)

b. BBWS Bengawan Solo (8 players)

c. Kesbang Linmas (7 players)

d. Bapermas P3KB of Surakarta (10 players)

Figure 40. The serious game players

Besides Camtasia Desktop video recorder, signature list and photo during the game, researcher also take note for important issues that rise during the game.

4.6. Data analysis

In this step, research analyze the response database of different people (around 34 people) based on the different data availability in serious game. The main focus of the response data base is the compilation of action were chosen by certain player and list of the variation of actions were taken by other people. The data collected by recorded game in Camtasia then analyzed in statistical approach for generate further conclusion.

In the data analysis, research investigated the three level of data availability (low, medium and high) which contributed to different response. There are aspects was studied such as:

- Maximum response selected for detemining the biggest number of selected response from the player.
- Minimum response selected for detemining the smallest number of selected response fro the player
- Stay the same response is the non changing response for different data availability
- Changing response is the changing response for different data availability
- Cross tabulation : is a joint frequency distribution of cases based on two or more categorical variables.
- Chi Square analysis : test is used to determine whether there is a significant difference between the expected frequencies and the observed frequencies in one or more categories.

4.7. Output

As the result of serious game for disaster response simulation, research will make several conclusions how is the data availability can affecting decision maker in disaster response. By creating situation based on existing data and additional data on field for scenario, serious game will provide scientific evidence on which parts of data availability that affect the decisions.

Based on research questions, the output of this research are:

1. Evaluation of existing data and response activity related to flooding hazards 2007 in Surakarta;
2. Identification of the problem of flood risk response based on existing data;
3. Need assessment results for flood disaster information in flood response;
4. Additional data/information support for Flood disaster response;
5. Evaluation for database of disaster responses from 34 officials based on different level of data availability;
6. Evaluation and recommendation for emergency response of flood hazard in Surakarta.

Chapter 5. Result and Discussion

To find out how real flood response practices in Surakarta and the usability of spatial data researcher conduct interview with the head of Drainage Division, Mr. Sihono, who was very cooperative, in his office at Public Works of Surakarta. The interview also conducted with Mr. Budi Santosa (Direct chief of Mr. Sihono), several people in Drainage Division of Public works, BBWS. Bapermas P3KB and Kesbang Linmas of Surakarta and summarize as follow.

5.1. The existing data related to flooding 2007 in Surakarta.

The availability of spatial data in the Public Works of Surakarta investigated in this research in the context of spatial data relates to flooding. Most of the data are available in non-GIS format. Non-geo referenced pictures in JPG format, manual drawing or combination of both of them are the only spatial data available in this institution. The list of spatial data available in Public Works in Table 15.

Table 15. Spatial data in Public Works of Surakarta

No.	Spatial Data Theme	non-GIS Spatial Data Format (*hardcopy/digital*)	Scale	Year
1.	*Drainage*	*Hardcopy & softcopy*	**-**	**2003**
2.	*Cadastral*	*Hardcopy*	**-**	**-**
3.	*Topography*	*Hardcopy & softcopy*	**1:10,000**	**1991**
4.	*Flood prone area*	*Hardcopy & softcopy*	**-**	**2008**

This department produces their spatial data and stores it in computer document or in paper in multi format. They did not have GIS operator and the spatial data was not arranged in a database.

a. The existing data for decision support in flood 2007 response

Question 1:

What spatial data are available in your institution?

Answer:

Spatial data relating to the management of urban drainage in Surakarta consist of city drainage master plan, topography, cadastral, flooded areas and others, although it is not yet meet the adequate standards.

Question 2:

What is regulation and standard operational procedure spatial data infrastructure at Surakarta Municipality in flood response process?

Answer:

If the regulation you meant as management of data is a matter of drainage spatial data, we have no special regulations. Until now, he administrations simply follow the general procedure.

Question 3:

Which agency has responsibility as the central network of information?

Answer:

Agencies that utilize or deal directly with spatial data in Surakarta such as Regional Planning & Development Board (Bappeda), Local Agency for Environmental Impact Management (Bapedalda), Public Works Department, Department of City Planning (Dinas Tata Kota) and others.

b. Reliability of flood information available when disaster happened.

How is the data sharing and exchange conducted among local agencies?

Answer:

We do it by filling out questionnaires from a particular agency, presentations or other seminar activities and coordination meeting. For the offices outside the city hall, we did not connect online.

Question 5:

What are the problems faced in the data sharing among local agencies?

Answer:

The different database of each agency in a similar topic (e.g. the number of flood victims) because of the many institutions that were involve. The professional backgrounds differences and perspectives in determining the appropriate action are always happen. The Information mostly still in hardcopy makes speed and accuracy of information still needs improvement.

5.2. Response activity related to flooding hazards 2007 in Surakarta.

a. Response taken in flood 2007

Question:

What activities in flood response are conducted in your institutions?

Answer:

The main activities operating sluice gates and pump water for flood control and perform routine maintenance of flood control facilities and infrastructure.

Question:

Which institutions or agencies are involved in those activities? Moreover, what is the role of each institution or agency?

Answer:

We coordinate the estimated time, place and magnitude of flooding with the Bengawan Solo Watershed Office (BBWS BS). For other district agencies, we coordinate about the rivers that enter the city of Surakarta, and also with Kesbangpolinmas, as coordinator of city responses when flooding occurs. Local villages' office in flood-prone area, we coordinate flood response with the local community.

Factors contributing to the disaster response decision?

Question:

What spatial data are needed and available in conducting flood response?

Answer:

Drainage map, high-risk inundation map, map of the population density, maps of roads and embankments

Question:

What spatial data are needed but unavailable in conducting flood response?

Answer:

Land cover data, the accurate rainfall data, nearly all spatial data, especially the updated data of land use change in hinterland areas (neighborhood districts)

Question:

How would you formulate response action during flood?

Answer:

We conduct coordination through handy talkie with floodgate officers of BBWSBS on the rivers that enter the city of Surakarta. If the information says that the water level is high on these rivers, then we estimated when flooding will happen. When the flooding was going to happen, we are coordinating with Kesbang Linmas and villages near the river.

Question:

What are the problems identified in formulating the response plan besides lack of information?

Answer:

The other problems are:

a. ***Budgeting****: floods usually occurred in October to March when budgeting season ended in December and start of January.*
b. ***Flood equipment****: not all water doors have water pump.*
c. ***Authority****: not all the rivers in Surakarta are under the authority of the municipality*
d. *We still have no* ***manuals and procedures*** *regarding flood information: The current system runs on personal initiative.*

The occurrence of flooding can be found in table. 16

Table 16. Floods and inundations in Surakarta City year 2007

No.	Address	Explanation	Watershed	Rain / River overflow
1.	Kadipiro and Nusukan	Inadequate channel capacity	Nayu River	Rain
2.	Sumber	Gajah Putih River must be normalized	Gajah Putih River	Rain
3.	Kampung Kalangan, Jagalan	There are no water pumps at the Putat Floodway.	Boro River	Rain and Bengawan Solo overflow
4.	East Wingko River	Cracks in parapet River Wingko cause leakage	River Wingko	Bengawan Solo overflow
5.	West Wingko River	The absence of the pump at the water gates	Wingko River	Bengawan Solo overflow
6.	Sangkrah Village	The absence of the pump at Sangkrah floodway	Bengawan Solo River	Bengawan Solo overflow
7.	Semanggi Village	The absence of the pump at Semanggi floodway	Bengawan Solo River	Bengawan Solo overflow
8.	Bumi Village, Dr. Radjiman Street	Stagnation in drainage channels and flood effects in Tanggul River	Tanggul River	Rain
9.	Manahan Village	Drainage in Sam Ratulangi and Brengosan Street did not work optimally	Pepe Hilir River	Rain
10.	Slamet Riyadi Street	Drainage and the inlet channel did not work optimally	Pepe Hilir River	Rain
11.	Pertigaan Sriwedari	Drainage and the inlet channel did not work optimally	Tanggul River	Rain
12.	Press Monument, Stabelan	Channel capacity cannot accommodate the volume of rain water	River Pepe Hilir	Rain
13.	Pucangsawit	The flood and inudation is happened in low area	River Bengawan Solo	Bengawan Solo overflow
14.	Sewu	Poor Drainage system	River Bengawan Solo	Rain and Bengawan Solo overflow
15.	Gajahan	Drainage in Yos Sudarso and Resoniten street no longer able to hold water when heavy rain	River Jenes	Rain
16.	Timuran	Channel capacity cannot accommodate the volume of rain water	Pepe Hilir River	Rain
17.	Urip Sumoharjo	Channel capacity cannot accommodate the volume of rain water	Pepe Hilir River	Rain
18.	Yosodipuro Street	Channel capacity is not optimal and bad inlet channel	River Pepe Hilir	Rain
19.	Perintis Kemerdekaan Street	Channel capacity is not optimal and bad inlet channel	River Tanggul	Rain

20.	Dr. Cipto. Mangunkusumo Street	Channel capacity is not optimal and bad inlet channel	River Tanggul	Rain
21.	Joyosuran	Pepe River sluice (the Demangan water door) is closed when the rain so the Jenes river overflowed to the basin area.	River Jenes	Rain
22.	Taman Budaya Surakarta (TBS)	The flood and inudation is happened in low area and inadequate channel capacity	River Bengawan Solo	Rain
23.	Pajang	There are no talud reinforcement, so the overflow of Premulung river water goes into settlement area.	Tanggul River	Rain
24.	Semanggi	The concentration of water in the channel when it was raining	River Bengawan Solo	Bengawan Solo overflow
S 25.	Kedung Lumbu	Pepe River sluice (the Demangan water door) is closed when the rain so the Jenes river overflowed	River Jenes	Bengawan Solo overflow
26.	Gandekan	Leaks in the sluice gates causing leakage flow entering through the gate.	Downstream Pepe River	Bengawan Solo overflow
27.	Jebres	Culvert under the railway tracks has insufficient capacity	Boro River	Rain
28.	Kadipiro	The absence of talud along the embankment of the river, also influenced by the high discharge of upstream Pepe River	Upstream Pepe River	Rain
29.	Banyuanyar	Lack of drainage system and main channel need to improved	Gajah Putih River	Rain and Bengawan Solo overflow
30.	Jebres	The flood and inudation is happened in low area	Anyar River	Bengawan Solo overflow

Source: (Sanitation Team Work of Surakarta City 2008)

5.3. Problems of Public Works Department flood 2007 response.

a. The problem due to data availability during the flood 2007

Based on user-need assessment result, the problems faced in the response phase to get spatial information based on the public works units are summarized in the Table 17.

Table 17. Problems faced in the response phase to get spatial information

Factors	Technical Problems	Non-Technical Problems
Speed of information (Time)	**a.** Lack of equipment **b.** Not all information available when needed (e.g. rainfall prediction on the whole tributary with a potential river flooding)	Human resources in Public works department are not ready for create or maintaining the spatial data. A specific skill needed for dedicated staff especially in response phase.
Truth information (Accuracy)	Inequality in interpretation of field conditions during response.	a. Flood boundary always fickle and indecisive **b.** Climate change affects flood patterns change so that the accuracy of the data decreases
Completeness of information (Details)	a. The information is not yet complete **b.** The information for early warning activities and or operating the water pump is quite enough ,but for handling the impact is not enough	Most data is taken from the village (region) is highly dependent on the ability of local leaders.

The usability of spatial data in Public Work of Surakarta is remaining low. This fact becomes one of main findings in the fieldwork to the Public Works of Surakarta, especially in the drainage division. The big problem lies on the lack of human resources to handle the spatial data and usually there is still no specific regulation how the spatial data and data management relates to flooding response.

During the flood, the information between the officers and the source of information in community is usually using radio communication and cellular phone. These mechanisms have some advantage and disadvantage. The speed of information becomes one of reason why they prefer to use it. It is also easy to use considering this kind of communication regularly used in the daily operation. Most of actors on flooding response have cellular phone device and radio unit in each flooding post.

The potential problems and solution in this kind of communication in the perspective of researcher are as the following:

1. The communication among the personal usually hard to make in form of document in the standard platform, especially in case of the actor did not know the official procedure or the procedure is not available yet.
2. The real time information generally did not adequate to framing the big picture of the whole situation. Usually only provide specific information in one site each one communication. This could generate false understanding in the central operation unit.
3. Double counting and repetition of the same information generate miss calculation of flood response happened because many actors involved with the varying level of expertise and capability.

b. What was the response taken in that time?

   The public works roles in flood response phase are as an early observer before flooding and involved for flood control efforts like closing doors and operating water pumps. This agency also should provide flood map during flooding emergency with cooperation of Kesbang Linmas office but in practice, the community or other stakeholders usually did not get this information just in time they needed. The fire brigade unit, Bappeda, and Health department confirm this fact.

   Public works and all of flood defense unit think that all local agencies involved in response phase should be able to access the data through internet or intranet. It is used for data discovery (provide search and discovery to spatial data) and data visualization (provide visualization images of the actual spatial data) even though radio communication still become the primary communication tool.

   "*Actually the main thing is Handy Talky (HT) or radio communication (for emergency flood and early warning system). Internet used during normal*

conditions for the uniformity of updating the data. The upload process, the limitations of network and human resources are often become an obstacle", Mr. Sihono said.

Discussion:

There are several difficulties in the interview process with some officers during the research. The responders or actor involved in Surakarta who very cooperative in giving information about general issues in flood risk management become defensive and very careful in discussion about what actually their institution do when flooding happened in a specific content. This could be because they do not want to make a statement which potential to harm their position and institution. The unsuccessfully flooding operation or human error off course happened everywhere in the real practice and scientific methods still developed to fill the gap. This is the researcher point of view and persuasive approach in the interview, and the interviewees usually become more cooperative after interviewer explain what is the aims of this research.

In data access and data sharing, the public works department personnel realize the importance of spatial data sharing among local agencies for uniformity and accuracy of information. They usually ask directly to other agencies to get data through cooperation. They claim that they did not have difficulties in accessing spatial data. This is based on one respondent that stated, "*I have friend in almost every agency*". Researcher find it interesting and important clue about the data access and sharing potential problem, what happened if you are a new person or did not have friend in that institution? It might become a problem when there is no regulation for it.

For the question, "Does your department share spatial data with other local agencies?" The public works states that they are do it except for cadastral data. The data sharing is conducted by providing the printed out maps. The problem in handling for spatial data in Public Works of Surakarta happened because lack of human resource who capable in combining spatial data which usually have a different format, different scale and resolution, and the carrying mapping unit and attributes.

The research succeeds to find the chronological situation, before, during and after flooding in the perspective of the water level progress and some critical condition in that time. Interview and user need assessment have been done to increase researcher insight for historical evidence of flooding disaster in Surakarta. From the interview with the respondents in public works unit, and proved in the serious game, researcher concludes that radio communication is used as main communication and data sharing during critical time in flooding response. There are many important information during this period is not well documented because evaluation and data management is still not become priority in disaster management practice in this area. The kind of existing data in flood 2007 response provided in Chapter 3 and 4.

5.4. Evaluation of the Serious Game Results

5.4.1. The usability of data for flood response in Surakarta

A. Content of information (When, Where, Why) the flooding happening?

What kind of information that mostly needed by the actor for flood response in Surakarta? From the serious game, most of the player choose "when question" as the first priority. It means the information about time is the most crucial information during the flooding. Fifteen players from the total 34 players (44%) select it, followed by the "where question" which indicated about the importance of location of the incident, meanwhile the cause of flood is considered as the next priority in the flooding response.

When researcher clarifies these facts to the players, they confirm that flooding in Surakarta mostly caused by the Bengawan Solo water level or the drainage failure in the city, so they did not really need explanation as important as location and time of flooding incident. The more detailed result is can be found in Table 18.

Table 18. Priority Content of Information

	When?	Where?	Why?
Priority 1	15	13	6
Priority 2	12	16	5
Priority 3	7	5	23
Total	34	34	34

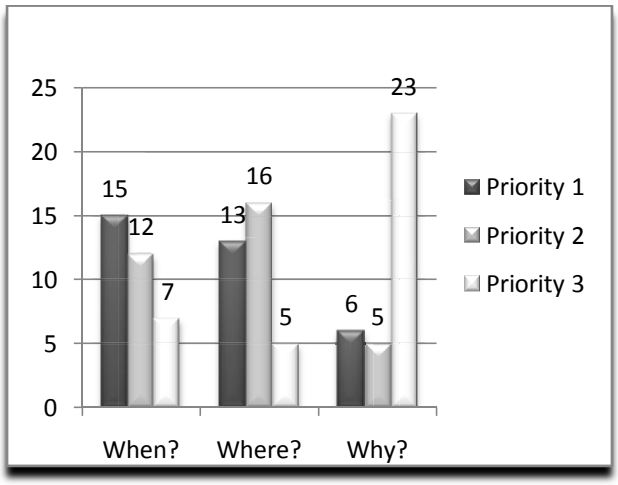


Figure 41. Priority Content of flood information

B. Method for Locating Incidents and address (Street Name, Map, Village)

To locate a specific location, researcher provides option for the player to select 3 method based on their preference. Thirteen players from the total 34 players (38.23%) select "Village name and Important building", followed by "Map" (35,29%) which indicated about the importance of "spatial information", meanwhile "Street Name & Number" was considered as the next priority in the flooding response (26.47 %). The next priority of method for locating Incidents and address can be found in Table 19.

Table 19. Locating Incidents and Addressing Format

	Priority 1	Priority 2	Priority 3
Street Name & Number	9	18	7
Map	12	9	13
Village Name & Important building	13	7	14
Total	34	34	34

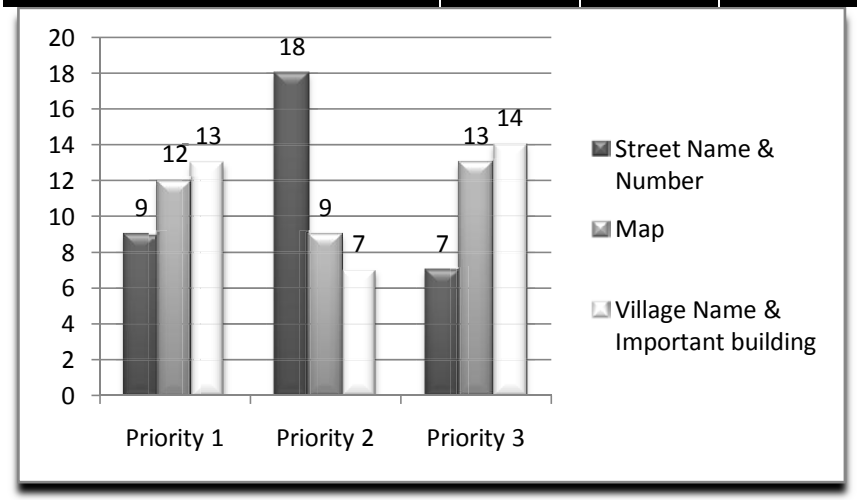


Figure 42. Type of addressing Format

5.4.2. Difference in disaster response from early warning data

In this section, the aim was to study 3 different response based on three levels of early warning data availability. In the low data availability, information available for the scenario was torrential rain known happening, but rainfall extent and magnitude is unknown. The next level data (medium) in the serious game provide rainfall extent and magnitude, but there is no report about damaged water pumps that happening until the next data level (high).

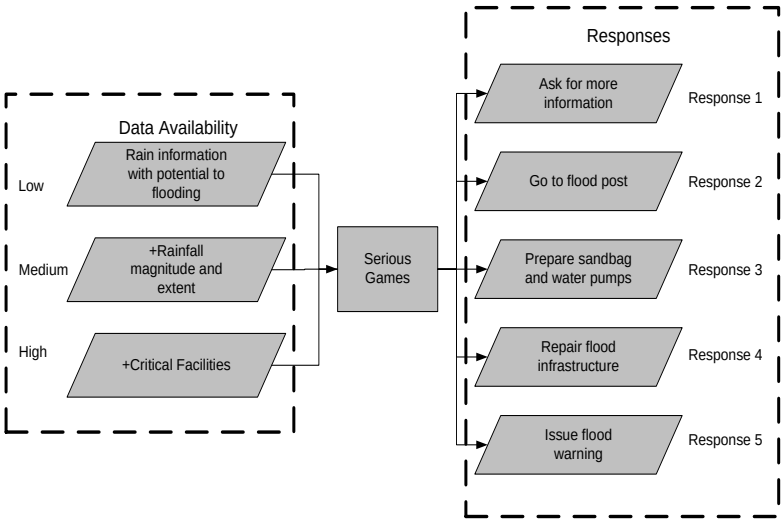


Figure 43. The difference in disaster response from early warning data

Response 1 (ask for more information) and response 2 (go to flood post) are dominating when data availability is low. Response 3 (prepare sandbag and water pump), response 4 (repair flood infrastructure) and response 5 (issue a flood warning) are the most common response in high data availability even though in the medium data availability, response 2 and 5 already reach its maximal value. The number of selected responses increased from 66 to 89 times during low to high data availability (increased 34.84%) describe in Table 20.

Table 20. Difference in disaster response from early warning data

		Data Availability		
		Low	**Medium**	**High**
Ask for more information	**Response 1**	28	19	14
Go to flood post	**Response 2**	22	23	12
Prepare sand bag and water pump	**Response 3**	6	16	27
Repair flood infrastructure	**Response 4**	6	2	19
Issue a flood warning	**Response 5**	4	18	17
Total Response		**66**	**78**	**89**

In the medium data availability (magnitude and extent rainfall data is available), the public works units start activating flood watch in flood post especially when they know that flooding is potential.

The specific information such as broken water pump in high data availability, cause response 3, 4 and 5 goes into the maximal value, while response 1 and 2 to the minimal value.

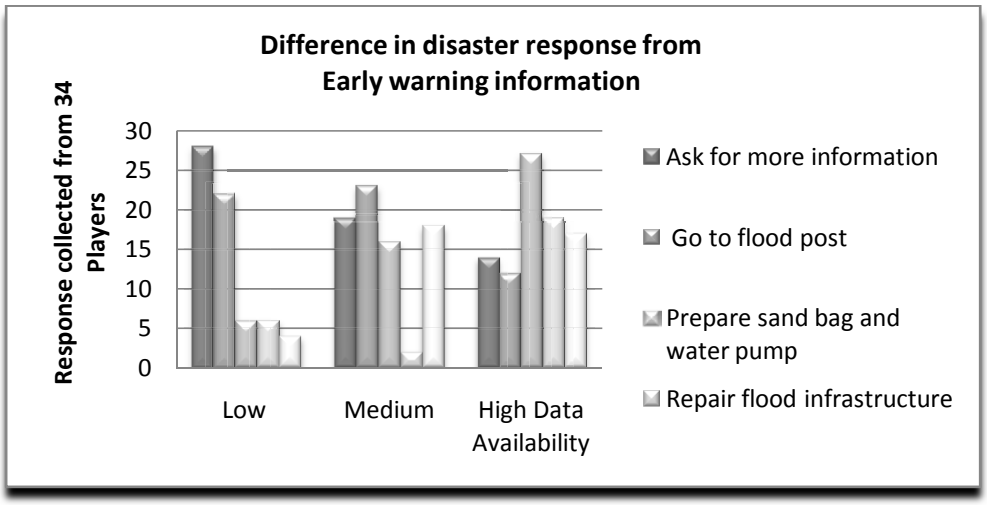


Figure 44. Difference in disaster response from early warning information

Table 21. Early warning information

	Response 1	Response 2	Response 3	Response 4	Response 5
Majority Response	Low Data Availability	Low & Medium Data Availability	High Data Availability	High Data Availability	Medium & High Data Availability
Minority Response	High Data Availability	High Data Availability	Low Data Availability	Medium Data Availability	Low Data Availability
Stay the same Response	48	50	35	6	27
Changing Response	13	7	14	21	12

Many people select the same response even though the data increased in response 1 and response 2. It could be because the activity is in the standard procedure as the basic response and still needed continuously during flooding response and it did not require flooding material allocation, which needed in response 3 or 4. To execute

response such as sand bagging or water pumping, flood infrastructure during emergency and flood warning need high data availability to ensure its effectiveness and its efficiency.

Table 22. Response Behavior for Early warning information

	Data Availability		
	Low	Medium	High
Stay the same	46	66	54
Change	20	12	35
Total Response	66	78	89

From the serious game result, it shows the higher data availability, the number of the similar response with previous selection are increasing from 46 to 54 (+17.39%). This is caused by the total response also increased from 20 to 35 (+75%). It is quite interesting because the number of changing response looks almost keep the same 28 to 27.

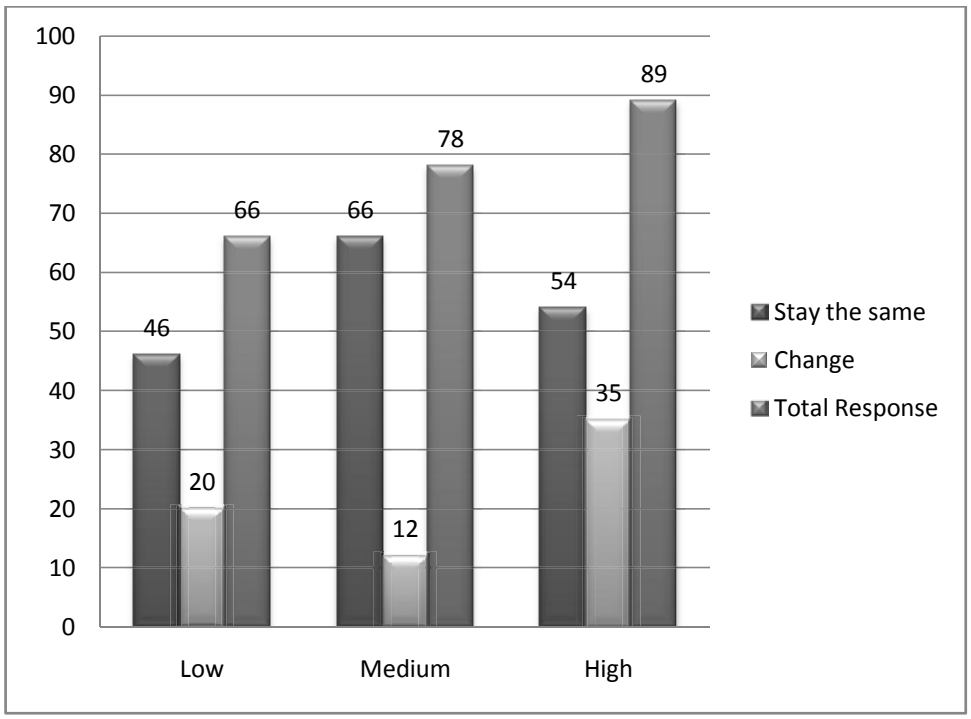


Figure 45. Difference in disaster response from early warning information

Table 23. Cross Tabulation for Early Warning response

Crosstab

			Early Warning Information																				
			1	2	3	4	5	12	13	14	15	23	25	34	35	123	125	135	234	235	245	345	1234	1235	Total
Level	Low	Count	8	3	0	1	1	11	0	2	0	0	0	0	0	5	1	0	0	0	1	0	0	1	34
		% within Level	23.5%	8.8%	0%	2.9%	2.9%	32.4%	0%	5.9%	0%	0%	0%	0%	0%	14.7%	2.9%	0%	0%	0%	2.9%	0%	0%	2.9%	100.0%
		% within Early Warning Information	88.9%	42.9%	0%	20.0%	25.0%	68.8%	0%	100.0%	0%	0%	0%	0%	0%	29.4%	33.3%	0%	0%	0%	100.0%	0%	0%	100.0%	33.3%
		% of Total	7.8%	2.9%	0%	1.0%	1.0%	10.8%	0%	2.0%	0%	0%	0%	0%	0%	4.9%	1.0%	0%	0%	0%	1.0%	0%	0%	1.0%	33.3%
	Medium	Count	1	3	0	0	3	5	0	0	3	2	1	0	2	6	2	2	0	3	0	1	0	0	34
		% within Level	2.9%	8.8%	0%	0%	8.8%	14.7%	0%	0%	8.8%	5.9%	2.9%	0%	5.9%	17.6%	5.9%	5.9%	0%	8.8%	0%	2.9%	0%	0%	100.0%
		% within Early Warning Information	11.1%	42.9%	0%	0%	75.0%	31.3%	0%	0%	75.0%	100.0%	50.0%	0%	50.0%	35.3%	66.7%	28.6%	0%	75.0%	0%	25.0%	0%	0%	33.3%
		% of Total	1.0%	2.9%	0%	0%	2.9%	4.9%	0%	0%	2.9%	2.0%	1.0%	0%	2.0%	5.9%	2.0%	2.0%	0%	2.9%	0%	1.0%	0%	0%	33.3%
	High	Count	0	1	3	4	0	0	1	0	1	0	1	3	2	6	0	5	2	1	0	3	1	0	34
		% within Level	0%	2.9%	8.8%	11.8%	0%	0%	2.9%	0%	2.9%	0%	2.9%	8.8%	5.9%	17.6%	0%	14.7%	5.9%	2.9%	0%	8.8%	2.9%	0%	100.0%
		% within Early Warning Information	0%	14.3%	100.0%	80.0%	0%	0%	100.0%	0%	25.0%	0%	50.0%	100.0%	50.0%	35.3%	0%	71.4%	100.0%	25.0%	0%	75.0%	100.0%	0%	33.3%
		% of Total	0%	1.0%	2.9%	3.9%	0%	0%	1.0%	0%	1.0%	0%	1.0%	2.9%	2.0%	5.9%	0%	4.9%	2.0%	1.0%	0%	2.9%	1.0%	0%	33.3%
Total		Count	9	7	3	5	4	16	1	2	4	2	2	3	4	17	3	7	2	4	1	4	1	1	102
		% within Level	8.8%	6.9%	2.9%	4.9%	3.9%	15.7%	1.0%	2.0%	3.9%	2.0%	2.0%	2.9%	3.9%	16.7%	2.9%	6.9%	2.0%	3.9%	1.0%	3.9%	1.0%	1.0%	100.0%
		% within Early Warning Information	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	8.8%	6.9%	2.9%	4.9%	3.9%	15.7%	1.0%	2.0%	3.9%	2.0%	2.0%	2.9%	3.9%	16.7%	2.9%	6.9%	2.0%	3.9%	1.0%	3.9%	1.0%	1.0%	100.0%

Table 24. Chi-Square Tests for Early Warning response

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	86.931[a]	42	.000
Likelihood Ratio	103.160	42	.000
Linear-by-Linear Association	2.146	1	.143
N of Valid Cases	102		

a. 60 cells (90.9%) have expected count less than 5. The minimum expected count is .33.

5.4.3. Difference in disaster response from information during flooding "Flood Extent and Magnitude"

In this section, the aim was to study 3 different response based on three levels of information during flooding especially "Flood extent and Magnitude" data. In the low data availability, information available for the scenario was flooding known happening, but flood extent and water depth is remain unknown. The next level data (medium) in the serious game provide flood extent, while the flood depth information was just available until the high data availability.

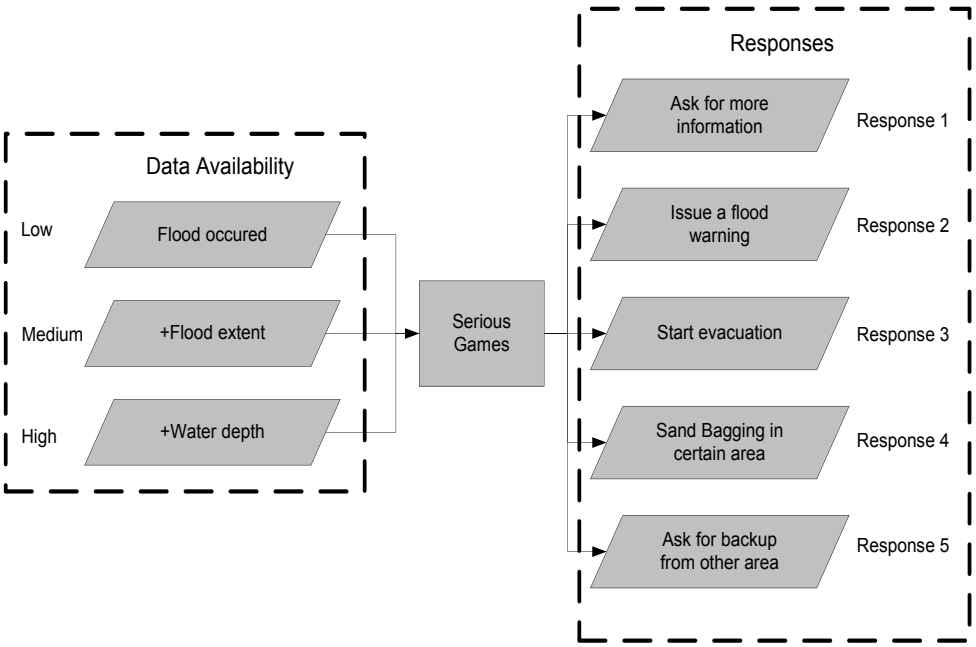


Figure 46. The difference in disaster response from "Flood Extent and Magnitude"

Ask for more information (response 1) and issue a flood warning (response 2) are the dominant responses when the data availability is low. Response 3 (evacuation), response 4 (sand bagging) and response 5 (request backup from other area) are the most response selected in the high data availability. The number of selected responses increased from 86 times during low, 88 in the medium data availability and reach 99 in the high data availability.

Table 5.25. Cross Tabulation for "Flood Extent and Magnitude"

Crosstab

			Information During Flooding (Flood Extent & Magnitude)																						
			1	2	3	4	12	13	14	23	24	34	35	45	123	124	134	135	234	235	345	1234	2345	12345	Total
Level	Low	Count	2	0	2	2	10	0	2	1	0	1	0	0	4	1	1	0	1	0	0	4	0	3	34
		% within level	5.9%	0%	5.9%	5.9%	29.4%	0%	5.9%	2.9%	0%	2.9%	0%	0%	11.8%	2.9%	2.9%	0%	2.9%	0%	0%	11.8%	0%	8.8%	100.0%
		% within Information During Flooding (Flood Extent & Magnitude)	66.7%	0%	22.2%	66.7%	90.9%	0%	100.0%	25.0%	0%	9.1%	0%	0%	57.1%	100.0%	25.0%	0%	100%	0%	0%	33.3%	0%	300%	33.3%
		% of Total	2.0%	0%	2.0%	2.0%	9.8%	0%	2.0%	1.0%	0%	1.0%	0%	0%	3.9%	1.0%	1.0%	0%	1.0%	0%	0%	3.9%	0%	2.9%	33.3%
	Medium	Count	1	1	4	0	1	1	0	1	1	6	1	1	3	0	1	0	4	1	0	3	1	3	34
		% within level	2.9%	2.9%	11.8%	0%	2.9%	2.9%	0%	2.9%	2.9%	17.6%	2.9%	2.9%	8.8%	0%	2.9%	0%	11.8%	2.9%	0%	8.8%	2.9%	8.8%	100.0%
		% within Information During Flooding (Flood Extent & Magnitude)	33.3%	100.0%	44.4%	0%	9.1%	50.0%	0%	25.0%	100.0%	54.5%	100.0%	100.0%	42.9%	0%	25.0%	0%	400%	100.0%	0%	25.0%	100.0%	300%	33.3%
		% of Total	1.0%	1.0%	3.9%	0%	1.0%	1.0%	0%	1.0%	1.0%	5.9%	1.0%	1.0%	2.9%	0%	1.0%	0%	3.9%	1.0%	0%	2.9%	1.0%	2.9%	33.3%
	High	Count	0	0	3	1	0	1	0	2	0	4	0	0	0	0	2	1	5	0	6	5	0	4	34
		% within level	0%	0%	8.8%	2.9%	0%	2.9%	0%	5.9%	0%	11.8%	0%	0%	0%	0%	5.9%	2.9%	14.7%	0%	17.6%	14.7%	0%	11.8%	100.0%
		% within Information During Flooding (Flood Extent & Magnitude)	0%	0%	33.3%	33.3%	0%	50.0%	0%	50.0%	0%	36.4%	0%	0%	0%	0%	50.0%	100.0%	50.0%	0%	100.0%	41.7%	0%	400%	33.3%
		% of Total	0%	0%	2.9%	1.0%	0%	1.0%	0%	2.0%	0%	3.9%	0%	0%	0%	0%	2.0%	1.0%	4.9%	0%	5.9%	4.9%	0%	3.9%	33.3%
Total		Count	3	1	9	3	11	2	2	4	1	11	1	1	7	1	4	1	10	1	6	12	1	10	102
		% within level	2.9%	1.0%	8.8%	2.9%	10.8%	2.0%	2.0%	3.9%	1.0%	10.8%	1.0%	1.0%	6.9%	1.0%	3.9%	1.0%	9.8%	1.0%	5.9%	11.8%	1.0%	9.8%	100.0%
		% within Information During Flooding (Flood Extent & Magnitude)	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	1000%	100.0%
		% of Total	2.9%	1.0%	8.8%	2.9%	10.8%	2.0%	2.0%	3.9%	1.0%	10.8%	1.0%	1.0%	6.9%	1.0%	3.9%	1.0%	9.8%	1.0%	5.9%	11.8%	1.0%	9.8%	100.0%

Table 5.26. Chi-Square Test for "Flood Extent and Magnitude"

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	65.681[a]	42	.011
Likelihood Ratio	75.044	42	.001
Linear-by-Linear Association	.293	1	.588
N of Valid Cases	102		

a. 66 cells (100.0%) have expected count less than 5. The minimum expected count is .33.

Table 27. Summary of response taken during flooding

		Data Availability		
		Low	**Medium**	**High**
Ask for more information	**Response 1**	27	13	12
Issue a flood warning	**Response 2**	24	19	16
Start evacuation	**Response 3**	17	29	33
Sand Bagging in certain area	**Response 4**	15	20	27
Ask for backup from other area	**Response 5**	3	7	11
	Total Response	86	88	99

Table 28. Response Analysis of response taken during flooding

	Response 1	**Response 2**	**Response 3**	**Response 4**	**Response 5**
Majority Response	Low	Low & Medium	Medium & High	High	High
Minority Response	High	High	Low	Medium	Low
Stay the same Response	31	46	72	48	13
Changing Response	21	14	7	13	8

From the serious game result, it shows the higher data availability, the number of the similar response with previous selection are increasing from 58 to 72 (+24,13%). This is caused by the total response also increased from 86 to 99 (+15,11%). It is quite interesting because the

number of changing response looks little bit decreasing 28 to 27(-3,70%) which is not significant.

Table 29. Response Behavior of response taken during flooding

	Data Availability		
	Low	Medium	High
Stay the same	58	80	72
Change	28	8	27
Total Response	86	88	99

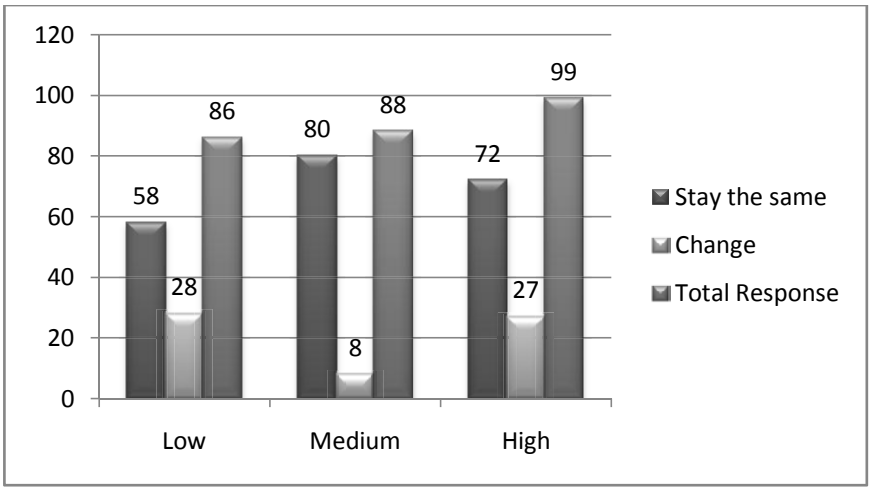


Figure 47. Difference in disaster response in "Flood Extent and Magnitude"

5.4.4. Difference in disaster response in quick response to find a location

In this section, the aim was to study three different response based on three levels of information for supporting flooding response especially in quick response to find a location. In the low data availability, information available for the scenario was only the street name. Village name and exact location on map was remaining unknown. The next level data (medium) in the serious game provide Village name, while the exact location on map was just available until the high data availability.

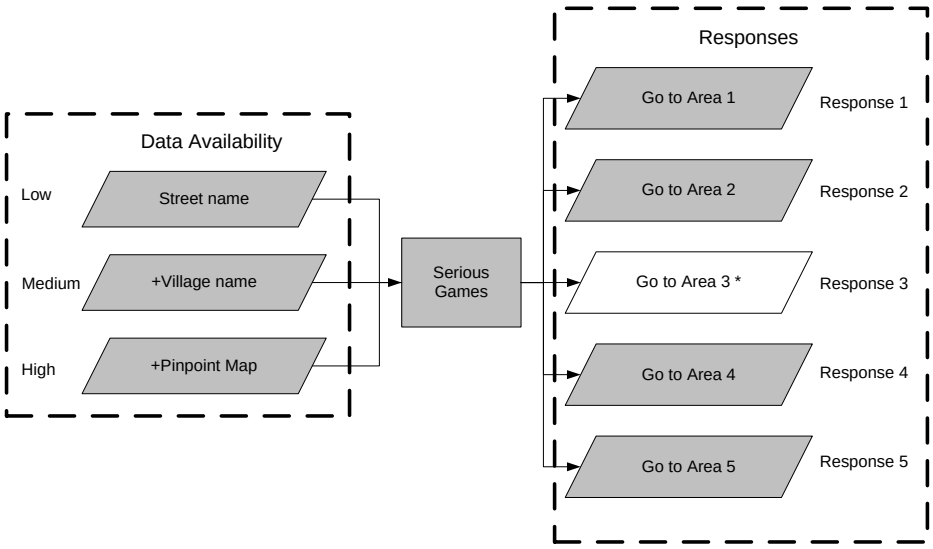


Figure 48. The difference in disaster response in quick response to find a location framework

To test how responder locate an area during flooding, researcher firstly provide information about flooding that cause a street in the area of Surakarta (Gotong Royong Street). 16 people correctly answer the question (with several people who was making correct answer admitted that they only guessing because the area is usually flooded while other is not) and 18 others try to guess but select the wrong location. After the use street locator in game, 33 players succeeds to answer correct with the level confidence increased, while 3 players still do not find the location correctly until the point map provided in the last data level.

Table 30. Quick response to find a location

	Data Availability		
	Low	**Medium**	**High**
Correct Location	16	31	34
Incorrect Location	18	3	0
Total	34	34	34

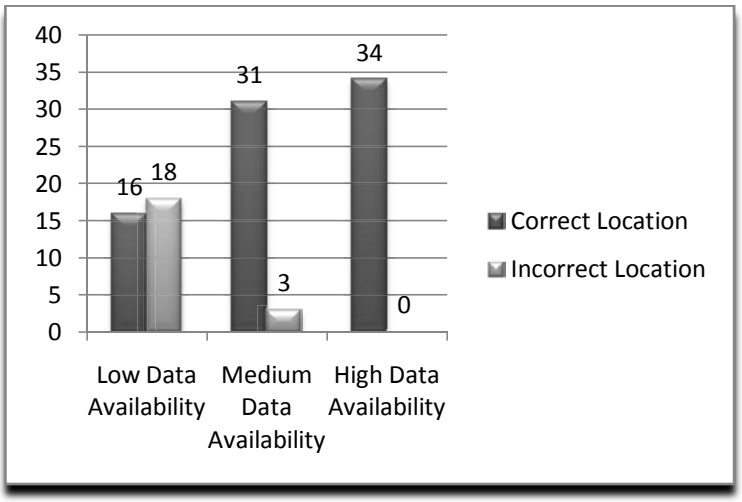


Figure 49. Difference in disaster response in quick response to find a location

Table 31.Cross Tabulation for "Find Location Data"

Crosstab

			Information During Flooding (Find Location)		
			Ok	No	Total
Level	Low	Count	16	18	34
		% within Level	47.1%	52.9%	100.0%
		% within Information During Flooding (Find Location)	94.1%	21.2%	33.3%
		% of Total	15.7%	17.6%	33.3%
	Medium	Count	1	33	34
		% within Level	2.9%	97.1%	100.0%
		% within Information During Flooding (Find Location)	5.9%	38.8%	33.3%
		% of Total	1.0%	32.4%	33.3%
	High	Count	0	34	34
		% within Level	.0%	100.0%	100.0%
		% within Information During Flooding (Find Location)	.0%	40.0%	33.3%
		% of Total	.0%	33.3%	33.3%
Total		Count	17	85	102
		% within Level	16.7%	83.3%	100.0%
		% within Information During Flooding (Find Location)	100.0%	100.0%	100.0%
		% of Total	16.7%	83.3%	100.0%

Table 32. Chi-Square Test for "Find Location Data"

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	34.024[a]	2	.000
Likelihood Ratio	35.875	2	.000
Linear-by-Linear Association	26.840	1	.000
N of Valid Cases	102		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 5.67.

5.4.5. Difference in Disaster Response in Flood Alert Stage Decision Making

In this section, the aim was to study three different "Flood alert stage" decision-making based on three levels of information for flooding response. In the low data availability, information available for the scenario was only the water height level. Alert stage procedure and "Damage report" on map was remaining unknown. The next level data (medium) in the serious game provide "Alert stage Procedure", while the "Damage Report" on map was just available until the high data availability.

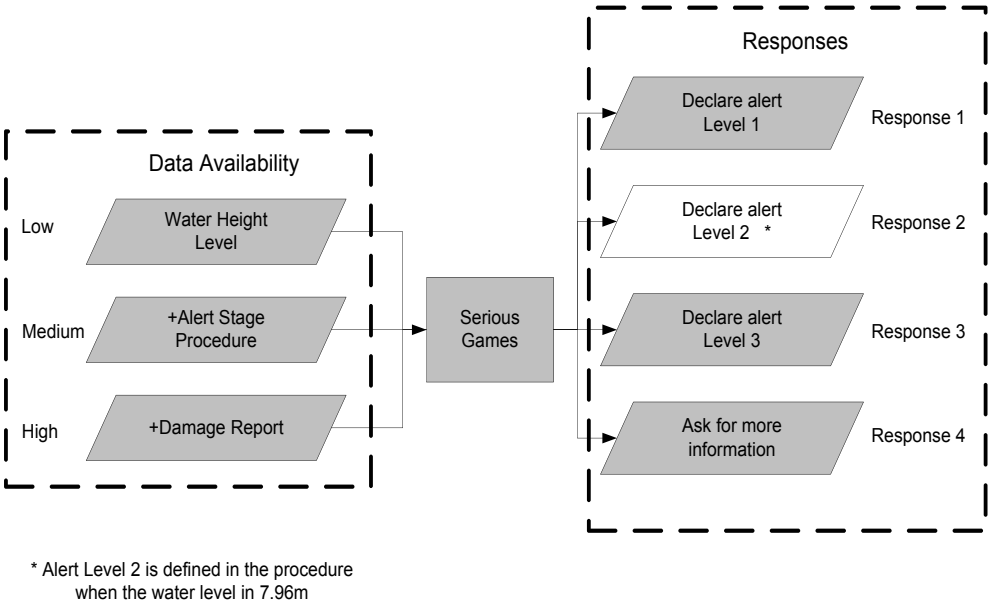


Figure 50. The difference in disaster response in flood alert stage decision-making framework

The first level of data availability was tended to test whether the player can make correct decision based on minimal information (water level at Jurug Station provided = 7.96 m) only based on their intuition and their memory. The result shown 12 persons can make correct prediction while the rest (22 players) make incorrect decision based on flood alert procedure.

Table 33. Alert stage procedure

Jurug Station Water Level Height	
Alert Level 1	6.50 m
Alert Level 2	7.50 m
Alert Level 3	8.50 m

After the flood alert stage provided, the number of correct decision increased to 30 people from 34 players (88%).

Table 34. Alert stage response

		Additional Data & Scenario	
	Water Height Level	Flood Alert Procedure	Damage Report
Correct Decision	12	30	21
Incorrect Decision	22	4	13
Total	34	34	34

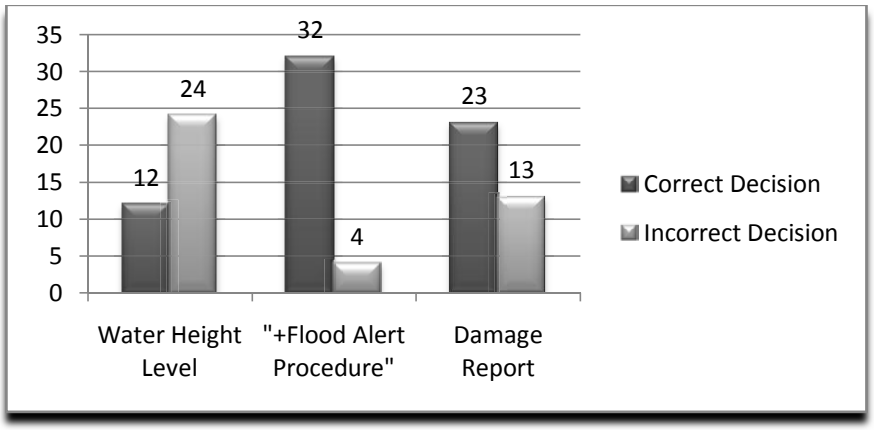


Figure 51. Difference in disaster response in flood alert stage decision making

The next challenge provided in the high data level to test the players, whether they confident to declare alert level 3 if damage reports show great potential to further damage even though the procedure does not say so. This question tested by giving the information about the condition of several point in the levees begin to crack. In the

real scenario, this situation could be a good reason to declare alert level 3. The result is 21 players confident to declare alert level 3 from 34 players (61%).

Table 35. Cross Tabulation for "Water Level and Alert Level"

Crosstab

			Water level and Alert Level										
			1	2	3	4	13	14	24	34	123	124	Total
Level	Low	Count	9	9	6	1	1	3	3	2	0	0	34
		% within Level	26.5%	26.5%	17.6%	2.9%	2.9%	8.8%	8.8%	5.9%	.0%	.0%	100.0%
		% within Water level and Alert Level	90.0%	25.0%	24.0%	33.3%	100.0%	100.0%	18.8%	33.3%	.0%	.0%	33.3%
		% of Total	8.8%	8.8%	5.9%	1.0%	1.0%	2.9%	2.9%	2.0%	.0%	.0%	33.3%
	Medium	Count	0	22	1	0	0	0	8	1	1	1	34
		% within Level	.0%	64.7%	2.9%	.0%	.0%	.0%	23.5%	2.9%	2.9%	2.9%	100.0%
		% within Water level and Alert Level	.0%	61.1%	4.0%	.0%	.0%	.0%	50.0%	16.7%	100.0%	100.0%	33.3%
		% of Total	.0%	21.6%	1.0%	.0%	.0%	.0%	7.8%	1.0%	1.0%	1.0%	33.3%
	High	Count	1	5	18	2	0	0	5	3	0	0	34
		% within Level	2.9%	14.7%	52.9%	5.9%	.0%	.0%	14.7%	8.8%	.0%	.0%	100.0%
		% within Water level and Alert Level	10.0%	13.9%	72.0%	66.7%	.0%	.0%	31.3%	50.0%	.0%	.0%	33.3%
		% of Total	1.0%	4.9%	17.6%	2.0%	.0%	.0%	4.9%	2.9%	.0%	.0%	33.3%
Total		Count	10	36	25	3	1	3	16	6	1	1	102
		% within Level	9.8%	35.3%	24.5%	2.9%	1.0%	2.9%	15.7%	5.9%	1.0%	1.0%	100.0%
		% within Water level and Alert Level	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	9.8%	35.3%	24.5%	2.9%	1.0%	2.9%	15.7%	5.9%	1.0%	1.0%	100.0%

Table 36. Chi-Square Test for "Water Level and Alert Level"

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	63.462[a]	18	.000
Likelihood Ratio	67.141	18	.000
Linear-by-Linear Association	.105	1	.746
N of Valid Cases	102		

a. 21 cells (70.0%) have expected count less than 5. The minimum expected count is .33.

5.4.6. Difference in Disaster Response from Digital Elevation Model usability

In this section, the aim was to study usefulness of DEM data in spatial information. In the low data availability, there was no information available. Satellite image and "Damage report" on map was shown in next level, while the "DEM and Village location" on map was just available until the high data availability.

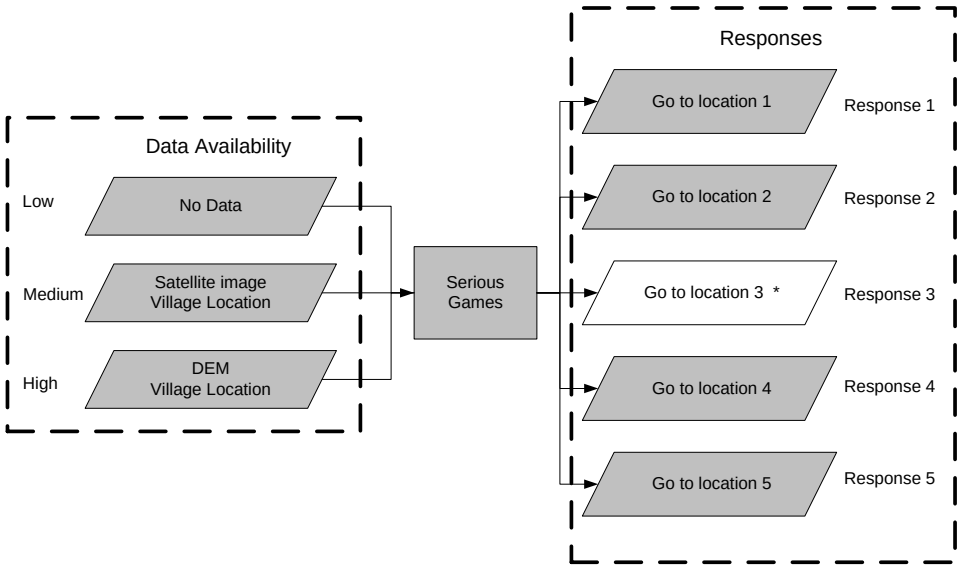


Figure 52. The difference in disaster response for DEM usability framework

A digital elevation model tested in this scenario. The first step is by asking a village which located at the highest area of Surakarta. The correct answer is Mojosongo village (Location 3), while the others are the name three villages, which located in lower area. The researcher finds that eight players failed to select Mojosongo as the answer while there is no spatial data provided. The more data availability provided such as satellite imagery with village name and DEM, the more correct answers produced in the next level scenario.

Table 37. DEM usability and Selected Location

	Data availability		
	Low	**Medium**	**High**
Correct Answer	26	31	33
Incorrect Answer	8	3	1
Total	34	34	34

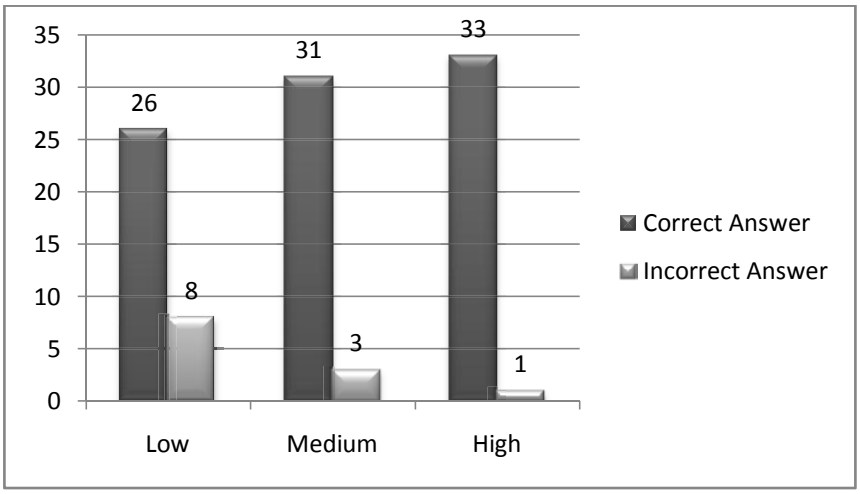


Figure 53. Difference in disaster response from Digital Elevation Model usability

Table 38. Cross Tabulation for "Village and DEM"

Crosstab

			Village & DEM				
			1	2	3	4	Total
Level	Low	Count	4	1	26	3	34
		% within Level	11.8%	2.9%	76.5%	8.8%	100.0%
		% within Village & DEM	100.0%	50.0%	28.9%	50.0%	33.3%
		% of Total	3.9%	1.0%	25.5%	2.9%	33.3%
	Medium	Count	0	1	31	2	34
		% within Level	.0%	2.9%	91.2%	5.9%	100.0%
		% within Village & DEM	.0%	50.0%	34.4%	33.3%	33.3%
		% of Total	.0%	1.0%	30.4%	2.0%	33.3%
	High	Count	0	0	33	1	34
		% within Level	.0%	.0%	97.1%	2.9%	100.0%
		% within Village & DEM	.0%	.0%	36.7%	16.7%	33.3%
		% of Total	.0%	.0%	32.4%	1.0%	33.3%
Total		Count	4	2	90	6	102
		% within Level	3.9%	2.0%	88.2%	5.9%	100.0%
		% within Village & DEM	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	3.9%	2.0%	88.2%	5.9%	100.0%

Table 39. Chi-Square Test for "Village and DEM"

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	10.867[a]	6	.093
Likelihood Ratio	12.339	6	.055
Linear-by-Linear Association	3.052	1	.081
N of Valid Cases	102		

a. 9 cells (75.0%) have expected count less than 5. The minimum expected count is .67.

5.4.7. Difference in Disaster Response from Damage Prediction information

In this section, the aim was to study usefulness of spatial information for "damage prediction". In the low data availability, there was no information available. Satellite image and "Damage report" on map was shown in next level, while the "DEM and Village location" on map was just available until the high data availability level.

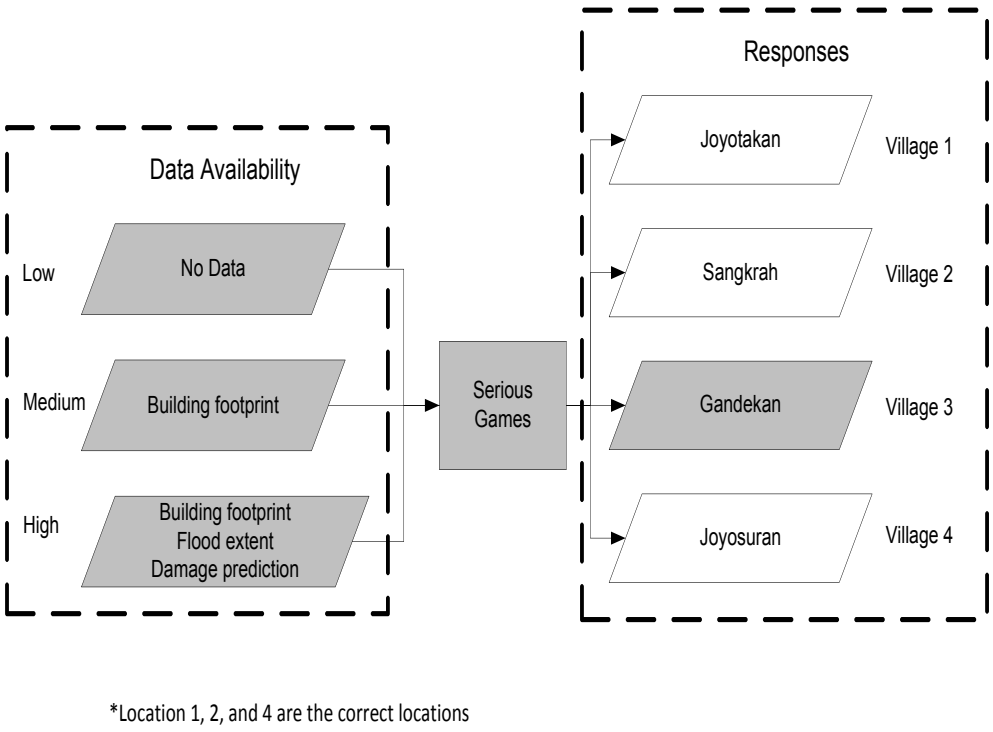


Figure 54. The difference in disaster response from Damage Prediction information

In this scenario, researcher wants to test how different response in making damage prediction based on 3 level data. From flood 2007 report, Gandekan was the least flooded village comparing with other three villages, such as Sangkrah, Joyosuran

and Joyontakan. However, in the game, many players fail to identify this fact. Even though after the data reach the highest level, only 24 players could make correct prediction while 12 others choose the wrong answer.

Table 40. Cross Tabulation for "Village and DEM"

	Data availability		
	Low	**Medium**	**High**
Correct Answer	9	17	24
Incorrect Answer	25	19	12
Total	34	36	36

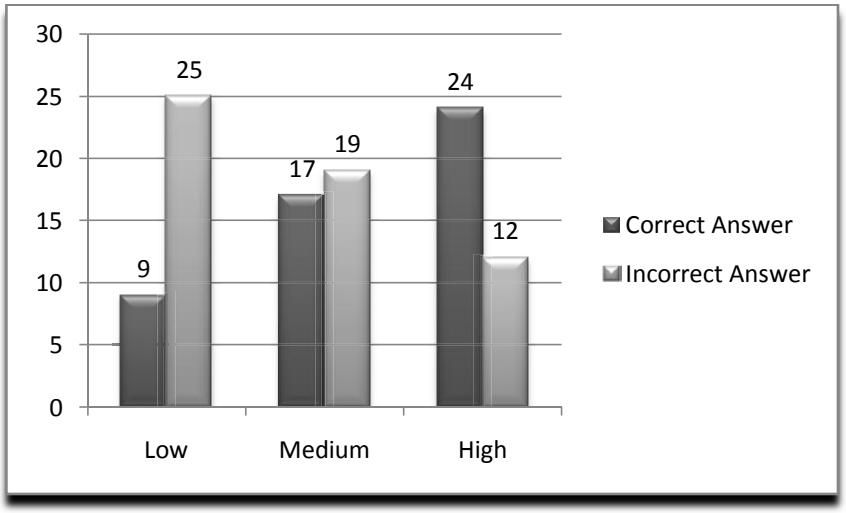


Figure 55. Difference in disaster response from damage prediction information

Table 41. Cross Tabulation for "Damage Prediction Information"

Crosstab

			Damage prediction				
			123	124	134	234	Total
Level	Low	Count	21	9	1	3	34
		% within Level	61.8%	26.5%	2.9%	8.8%	100.0%
		% within Damage prediction	46.7%	19.6%	33.3%	37.5%	33.3%
		% of Total	20.6%	8.8%	1.0%	2.9%	33.3%
	Medium	Count	14	16	1	3	34
		% within Level	41.2%	47.1%	2.9%	8.8%	100.0%
		% within Damage prediction	31.1%	34.8%	33.3%	37.5%	33.3%
		% of Total	13.7%	15.7%	1.0%	2.9%	33.3%
	High	Count	10	21	1	2	34
		% within Level	29.4%	61.8%	2.9%	5.9%	100.0%
		% within Damage prediction	22.2%	45.7%	33.3%	25.0%	33.3%
		% of Total	9.8%	20.6%	1.0%	2.0%	33.3%
Total		Count	45	46	3	8	102
		% within Level	44.1%	45.1%	2.9%	7.8%	100.0%
		% within Damage prediction	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	44.1%	45.1%	2.9%	7.8%	100.0%

Table 42. Chi-Square Test for "Damage Prediction Information"

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	9.122[a]	6	.167
Likelihood Ratio	9.334	6	.156
Linear-by-Linear Association	.162	1	.687
N of Valid Cases	102		

a. 6 cells (50.0%) have expected count less than 5. The minimum expected count is 1.00.

6. Conclusion and Recommendation

6.1. Conclusion

The following point describes of what conclusions have been done during the research. From research question, the research concludes as follow:

6.1.1. The inventory of existing data related to flooding history in Surakarta.

a. The existing data for decision support in flood 2007 response

- From literature review:

  By doing literature review of the official documents and reports are used as the starting point. Several conclusions can be made. Based on Public works of Surakarta survey for inundation happened in year 2007 happened in thirty area with different causes. The type of specific action in specific location remains low. The occurrence of flooding can be find in Table 16.

- From Interview result:

  Spatial data in Public works are city drainage master plan, topography, cadastral, flooded areas although not yet the adequate standard.

- From User need Assessment result:

  Most of the data are available in non-GIS format. Non-geo referenced pictures in JPG format, manual drawing or combination of both of them are the only spatial data available in this institution.

b. The reliability of flood information during disaster

Most of respondents feel the current information is not adequate for operating the flood defense unit, and the reliability of the current information need to be improved.

Additional information is required to assess condition immediately following flooding disaster for response and recovery process. Currently, spatial data used for presentation and additional purposes only, while assessment and area calculation could only be provided after response phase or in recovery stages.

Familiarity of the area and experiences from field is highly influential to the decisional making process in this case.

6.1.2. The response activity related to flooding hazards 2007 in Surakarta.

Response taken in flood 2007

During the 2007 flood, Public works of Surakarta operated sluice gates and pump water for flood control and of flood control facilities and infrastructure.

The agency cooperated with the BBWS Bengawan Solo, as Public Works Unit for regional area of Central and East Java, in flooding response activity. No inundation map provided during flooding in 2007.

Factors contributing to the disaster response decision

As stated above that familiarity of the area and field experience is highly influential to the decisional making in this case. The spatial information usability is remain low in disaster response in this area, caused by its technical requirement especially GIS operator and the availability of spatial data. Because of lack of information for decision maker, many decision in the field taken based on personal initiative and field experience. It caused disaster response decision according theoretical in practice cannot be achieved and evaluation of it after disaster becomes hard to do.

6.1.3. The problems of Public Works Department flood 2007 response.

The problem due to data availability during the flood 2007

Flood disaster 2007 in Surakarta and surrounding area is one of the biggest flooding after 1966. It is unpredictable event in that time, the situation worsened by the Gajah Mungkur Dam has exceed its maximum capacity caused Bengawan Solo River highly influence the drainage in the city of Surakarta. With or without good quality of information, flooding still happened in that time. Lack of preparation in that time caused problems in flooding response. The early warning from upper Bengawan Solo area did not make this city ready for dealing the effect of flooding. It caused 26,000 people evacuated from their homes (according to Health Department of Surakarta), and the public works had difficulties to assess the impact of the disaster because there are no standard procedure and mechanism available to handle this kind of incident. Radio communication as the primary communication need additional support from other tools (such as GIS) to manage and coordinating life support and flood response activity.

Response was taken by Public works in during flood disaster 2007.

During the 2007 flood, Public works of Surakarta took the following response:

- Asking for information
- Issue a flood warning
- Activating flood defense system
- Start evacuation
- Monitoring High of Water level
- Sand bagging in certain area
- Work in cooperation with BBWS Bengawan Solo
- Ask for backup

6.1.4. The flood information system in Surakarta.

Accurate and reliability of the existing flood information in flood 2007

There was no existing flood information system found during the research. Therefore, no answer could be provided.

Information needed when flooding occurs

The type of information divided into static and dynamic data (in chapter 5). They present information about the Hazard (early warning and prediction, flood extent, magnitude, rainfall data, critical infrastructure which potential causing further damage), Vulnerability (base line data, building foot print, population affected, infrastructure, bridge etc) and risk information.

6.1.5. The Difference in disaster response due to varying data availability

From Chapter 5, revealed relation between data availability and disaster response. Several conclusions can be drawn from the experimental flood serious game:

a. The more accurate data and its completeness can help decision maker produce more accurate decision and confident action.

b. To address specific issues during disaster, it is important to adopt one procedure and common term to avoid miss interpretation about data and disaster situation.
c. Specific information can lead to specific decisions, which produce effective and efficient response.
d. Geographical information could give benefit if it provided in time when it needed and used by the capable decision maker.

e. Some data continuously needed during disaster and some data only needed once.
f. Several data need to simplify before it delivered to the decision maker.
g. Type of information can influence decision maker although it contain the same information.

The result of analysis has shown that there are differences of responses based on the data availability:

- For early information (see table 20), at low availability, the decision makers ask for more information (28 of 66 ~ 42,42%); at medium availability, response is directed to go to flood post (23 of 78 ~ 29,49 %); while at high availability, most decision makers (27 of 89 ~ 30,34%) confidently taking action: prepare sand bag and water pump
- For Flood extent and magnitude, better responses can be achieved by the improvement of data availability. Number of correct decision raised significantly by the improvement of data availability: 47,06% at low availability , 91,17% at medium availability, 100% at high data availability (see Table 30). Results presented at table 34 and table 37 provide similar conclusion.

6.2. Recommendation

To provide effective flood information for response action the recommendations to the Public Works of Surakarta are:

a. Make a standard protocol and format for flood information inside of each institution and among institution.
b. The procedure should provide standard minimal information in timely manner.
c. When using spatial data, there should be only one base data used in the common operation.
d. Combination of radio communication, printed document and spatial data needed to enhance response action

For serious game development, researcher suggests several points to consider:

a. To make a serious gaming could be done in various platforms. The realistic scenario and good preparation of visualization data would determine its performance.

   The other factor is how the player interact with the game environment is also important.

b. Multi disciplinary approaches are needed to make a good serious game for simulating the real world phenomena. GIS professional, computer programmer, disaster manager and information analyst experts are needed in a team to make a good serious game. GIS professional is responsible for providing a good spatial data with adequate accuracy, Disaster manager and information analysts needed to determine what information needed and creating scenario for the serious game while the Computer programmer implement the data and the scenario in a chosen platform e.g. Flash, Java, Ajax, C and others.

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Appendix

Appendix 1. Structured Interview Questions.

Structured interview question to investigate the existence of spatial data and flood management activities modified from (Putra 2010).

A. Questions to identify existence of local spatial data at Surakarta government institution

1. What are spatial data available in your institution?
2. What is regulation/standard operational procedure spatial data infrastructure at Surakarta Municipality in flood response process?
3. Which agency has responsibility as the central network of information?
4. How is the data sharing and exchange conducted among local agencies?
5. What are the problems faced in the data sharing among local agencies?

B. Questions to gather information about the flood management activities and institutions/agencies involved, particularly in the flood response (Public Works, BBWS).

1. What activities of risk management are conducts for in your institutions?
2. Which institutions/agencies are involved on those activities?
3. What is the role of each institution/agency?
4. What spatial data are needed and available in conducting flood response?
5. How to formulate response action in flood hazards?
6. What are the steps of response phase of flood hazards?
7. Which institutions/agencies are involved in the response phase?
8. What are the problems identified in formulating the response plan?

Appendix 2. User Need Assessment Questionnaire

Questionnaire of Spatial Data Availability, Sharing and Requirement in Flood Response Phase modified from (Putra 2010).

Researcher	: Muhammad Syukril
MSc. Programme	: Geo Information for Spatial Planning and Risk Management
Research title	: Differences in Disaster Response Due to Varying Data Availability
Contact	: syukrealworld@yahoo.com

Thank you for your time in completing this questionnaire. The result will only be used for scientific research.

Date: _____/_____/2010

a. Profile of Respondent

(Please fill in the blank)

Name	: …….
Name of Agency	: …….
Department	: …….
Position	: …….
Telephone/Email	: ……..….. /……

b. Spatial Data Availability

(Please give cross mark (X) to the multiple choices question)

1. Does your department possess any spatial data (for example print out maps and/or digital maps)?

   a. Yes b. No

   If your answer is "Yes", please specify in the table below.

No.	Spatial Data Theme	Spatial Data Format (*hardcopy*/digital)	Scale	Year
1.				
2.				
3.				
4.				
5.				

2. How did your department own those spatial data?

   a. Self-producing

   b. From other agency (ies)

   c. Other (please specify),

   _____

3. For what purpose those spatial data are used in your department?

a. Problem analysis

b. Instruments in the meeting

c. Tools for field survey

d. Other *(please specify)*,

_____

4. Does your department have a Geographic Information System (GIS)?

   a. Yes b. No

5. Does your department have internet connections?

   a. Yes b. No

6. How many GIS operator are available in your department?

   a. none

   b. 1 – 2 person

   c. 3 – 4 person

   d. more than 4 person

c. Spatial Data Access and Sharing

(Please give cross mark (X) to the multiple choices question)

7. How do you know what spatial data are available at other local agencies?

   a. Through the catalog from each agency

   b. Ask directly to each agency

   c. Other (please specify),

   _____

8. How does your department get spatial data from other local agencies?

   a. Buy it

   b. Through cooperation

   c. Other (please specify),

   _____

9. Do you find any difficulties in accessing spatial data that belongs to other local agencies?

   a. Yes b. No

10. Does your department share spatial data with other local agencies?

    a. Yes b. No

    If your answer is "Yes", please specify in the table below.

No.	Spatial Data Theme	Spatial Data Format (*hardcopy*/digital)	Agency
1.			
2.			
3.			
4.			
5.			

d. Spatial Data Requirement in Response Phase of Flood Disaster

11. What is your agency"s role in the response phase?

    Answer:

    _____

    _____

    __

12. In your opinion, what spatial data are needed to the response phase?

No.	Spatial Data Theme	*Agency which own the data*
1.		
2.		
3.		
4.		
5.		

13. Do you think all local agencies involved in response phase should be able to access the data through internet/intranet?

    a. Yes b. No

14. In your opinion, what web based services are needed to formulate the response phase? *(Please give cross mark (X) to your answer)*

No.	Services	Agree	Disagree
1.	Data discovery *(provide search and discovery to spatial data)*		
2.	Data visualization *(provide visualization images of the actual spatial data)*		
3.	Interactive maps (provide zoom, pan, identify and measure capabilities)		

15. What kind of spatial data visualization is easy to understand?

    a. Print out maps (for example RBI Map)

    b. Digital maps (for example ArcView shapefile)

    c. Satellite images (for example Google maps)

    d. Other (please specify),

    _____

16. What are the problems faced in the response phase to get spatial information?

Factors	Technical Problems	Non-Technical Problems
TIME		
ACCURACY		
DETAIL		

Appendix 3. Flood Serious game Scenario

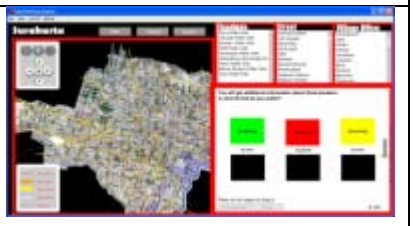
Water Height Level and Maximal Discharge of Bengawan Solo River

No	Date	Water Height Level (m)	Q (m^3/s)	No	Date	Water Height Level (m)	Q (m^3/s)
1	16 March 1966	11.9	2,000	22	20 February 1987	6.72	821
2	28 February 1967	8.3	1,371	23	16 November 1988	7.2	909
3	26 March 1968	7.25	850	24	5 February 1989	7.4	947
4	24 March 1969	5.51	520	25	22 January 1990	5.97	689
5	12 March 1970	6.3	670	26	19 February 1991	7.1	903
6	26 March 1971	6.55	720	27	5 December 1992	7	700
7	16 February 1972	6.79	770	28	3 February 1993	9.16	1,249
8	24 March 1973	6.05	620	29	12 March 1994	8.8	1,146
9	27 February 1974	6.93	810	30	12 February 1995	8.8	1,146
10	21 March 1975	7.39	665	31	13 March 1996	6.45	581
11	16 January 1976	7	594	32	9 February 1997	7.2	744
12	25 January 1977	6.5	509	33	20 March 1998	7	700
13	2 February 1978	7	594	34	20 January 1999	7.4	789
14	5 May 1979	7.04	601	35	9 March 2000	8.8	1,146
15	16 April 1980	6.24	467	36	10 February 2001	7.05	711
16	28 March 1981	5.72	388	37	10 February 2002	8.45	1,051
17	24 January 1982	8.07	798	38	22 March 2003	8.1	960
18	28 February 1983	5.82	403	39	28 December 2004	7.9	909
19	5 February 1984	7.4	947	40	5 April 2005	6.1	517
20	9 March 1985	7.3	928	41	25 January 2006	6.95	689
21	28 March 1986	6.95	863	42	26 December 2007	11.45	1,986

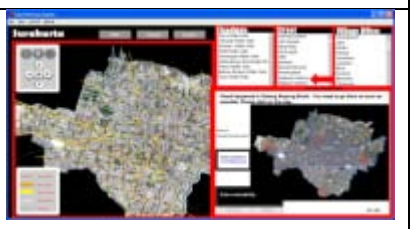
Source: Jurug Station, Surakarta. BBWS in (Setiyarso 2009)

Appendix 3. Flood Serious game Scenario

1. Cover Page	
2. Name Please write down your name... (For data validation)	
3. Profile Please select one • I am working in Public Works Department • I am working in Other office Please select one • I am familiar with Surakarta area • I am not familiar with Surakarta area Please select one • I always use map • I rarely use map (For data calibration)	
4. There is a flood warning from outside Surakarta. Your response is to determine the problem. What information you will need the most? • When the flood will happen? • Where the flood will happen? • What is the cause? (For spatial data usability) Topic: Early Warning Information	
5. Torrential rain happened in Surakarta and its surroundings. With NO magnitude and NO extent available, what will you do? • Ask for more information • Go to flood post • Prepare sand bag and water pump	

• Repair flood infrastructure • Issue a flood warning Data availability: low -No magnitude -No extent Topic: Early Warning Information	
6. Torrential rain happened in Surakarta and its surroundings. Magnitude and extent data available now, it shows a great potential to be flooding. What will you do? • Ask for more information • Go to flood post • Prepare sand bag and water pump • Repair flood infrastructure • Issue a flood warning Data availability : medium +Magnitude and extent data available +Flood prediction Topic: Early Warning Information	
7. Torrential rain happened in Surakarta and its surroundings. Magnitude and extent available, it shows a big potential to be flooding. There is also a report that two water pump at Demangan are broken. What will you do? • Ask for more information • Go to flood post • Prepare sand bag and water pump • Repair flood infrastructure • Issue a flood warning Data availability : high +Magnitude and extent data available +Flood prediction +Critical facilities Topic: Early Warning Information	
8. You will get additional information about flood situation. In what format do you prefer? • sms • phone • map	

(For spatial data usability) Topic: Information During flood	
9. Flood is happening in Surakarta. With magnitude and extent remain UNKNOWN, what will you do? • Ask for more information • Issue a flood warning • Start evacuation • Sand bagging in certain area • Ask for backup from other area Data availability : low -No magnitude -No extent Topic: Information During flood	
10. Flood is happen in Surakarta now. With flood extent information, what will you do? • Ask for more information • Issue a flood warning • Start evacuation • Sand bagging in certain area • Ask for backup from other area Data availability : medium +Flood extent available - No magnitude Topic: Information During flood	
11. Flood is happen in Surakarta now. With flood extent and depth information, what will you do? Data availability : high + Flood extent + Water depth Topic: Information During flood	
12. You have to go as fast as possible to a specific location in Surakarta. There is a critical incident which not determined by now. What information is best for you...? • Street name and number • Map and point • Landmark or village name (For spatial data usability) Topic: Quick response	

13. Flood happened in Gotong Royong Street. You need to go there as soon as possible. Please click on the map. Where is Gotong Royong Street? Data availability : low Topic: Quick response	
14. Flood happened in Gotong Royong Street. You need to go there as soon as possible. It is located on Sewu Village. Please click on the map.. Data availability : medium Topic: Quick response	
15. Flood happened in Gotong Royong Street. You need to go there as soon as possible. Please click on the map Where is Gotong Royong Street? Data availability : high Topic: Quick response	
16. What would you do if you have this information? Data availability : Low Water Height Level Topic: Flood Alert Stage	
17. What would you do if you have this information? Data availability : Medium Water Height Level Alert Stage Procedure Topic: Flood Alert Stage	
18. What would you do if you have this information? Data availability : High Water Height Level Alert Stage Procedure	

Damage Report Topic: Flood Alert Stage	
19. What is the name of a village, which located at the high area in Surakarta? Please select 1 village.... Data availability : low -No data Topic: Digital Elevation Model	
20. What is the name of a village, which located at the high area in Surakarta? Please select 1 village.... Data availability : medium +Satellite image +village name Topic: Digital Elevation Model	
21. What is the name of a village, which located at the high area in Surakarta? Please Select 1 village.... Data availability : high +village name +DEM Topic: Digital Elevation Model	
22. Humanitarian aid officer want you to confirm 3 villages which consider as the biggest number of flooded houses on each village in Surakarta. You don't have building foot print map and real time data of flood extent right now. But you have to confirm... Data availability : low -No Building foot print Topic: Damage prediction	
23. Humanitarian aid officer want you to confirm 3 villages which consider as the biggest number of flooded houses on each village in Surakarta. You have building foot print, but still don't have real time data about flood extent right now. Data availability : medium +Building foot print Topic: Damage prediction	

24. Humanitarian aid officer want you to confirm 3 villages which consider as the biggest number of flooded houses on each village in Surakarta. Data availability : high +Building foot print +flood extent +Damage prediction Topic: Damage prediction	

Appendix 4. Flood Serious game Source Code

Action Scripts for Frame Navigation

```
onClipEvent (load) {
	curQuest = 0;
	if(_root.Options.QuestToAsk < _root._totalframes-2 && _root.Options.QuestToAsk > 0){
		totQuest = "/ " + (_root.Options.QuestToAsk+1);
	} else {
		totQuest = "/ " + String(_root._totalframes-1);
	}
	function updateFrame () {
		curQuest++;
	}
	updateFrame();
}
```

Action Scripts for Credits button

```
on (release) {
	gotoAndStop("Credits");
}
```

Action Scripts for Back to Front button

```
on (release) {
	gotoAndPlay(1);
}
```

Action Scripts for Zoom in

```
on (release) {
	BASEMAP._width += 60;;
	BASEMAP._height += 60;;
}
```

Action Scripts for Zoom out

```
on (release) {
	BASEMAP._width -= 60;;
	BASEMAP._height -= 60;;
}
```

Action Scripts for Reset Zoom

```
on (release) {
	BASEMAP._width =800;
	BASEMAP._height = 600;
}
```

Action Scripts for Center

```
on (release) {
        BASEMAP._x = BASEMAP.center._x + _global.w;
        BASEMAP._y = BASEMAP.center._y + _global.h;
}
```

Action Scripts for Right

```
on (release) {
        BASEMAP._x  += 30;
        BASEMAP._y  += 30;
}
```

Action Scripts for Left

```
on (release) {
BASEMAP._x  -= 30;
BASEMAP._y  -= 30;
}
```

Action Scripts for Main Window

```
_global.w = 401;
_global.h = 301;
_root.Floodw.setChangeHandler("SG");
function SG(component) {
        BASEMAP._width =800;
        BASEMAP._height = 600;
        if (_root.Floodw.getSelectedIndex() == 0) {
                _root.BASEMAP._x = _root.BASEMAP._width-_root.KlecoWaterGate._x;
                _root.BASEMAP._y = _root.BASEMAP._height-_root.KlecoWaterGate._y;
        } else if (_root.Floodw.getSelectedIndex() == 1) {
                _root.BASEMAP._x = _root.BASEMAP._width-_root.tirtonadi._x;
                _root.BASEMAP._y = _root.BASEMAP._height-_root.tirtonadi._y;
        } else if (_root.Floodw.getSelectedIndex() == 2) {
                _root.BASEMAP._x = _root.BASEMAP._width-_root.sumber._x;
                _root.BASEMAP._y = _root.BASEMAP._height-_root.sumber._y;
        } else if (_root.Floodw.getSelectedIndex() == 3) {
                _root.BASEMAP._x = _root.BASEMAP._width-_root.putat._x;
                _root.BASEMAP._y = _root.BASEMAP._height-_root.putat._y;
        } else if (_root.Floodw.getSelectedIndex() == 4) {
                _root.BASEMAP._x = _root.BASEMAP._width-_root.demangan._x;
                _root.BASEMAP._y = _root.BASEMAP._height-_root.demangan._y;
        } else if (_root.Floodw.getSelectedIndex() == 5) {
                _root.BASEMAP._x = _root.BASEMAP._width-_root.kalibuntung._x;
                _root.BASEMAP._y = _root.BASEMAP._height-_root.kalibuntung._y;
        } else if (_root.Floodw.getSelectedIndex() == 6) {
```

```
                    _root.BASEMAP._x = _root.BASEMAP._width-_root.plalan._x;
                    _root.BASEMAP._y = _root.BASEMAP._height-_root.plalan._y;
            } else if (_root.Floodw.getSelectedIndex() == 7) {
                    _root.BASEMAP._x = _root.BASEMAP._width-_root.makambergulo._x;
                    _root.BASEMAP._y = _root.BASEMAP._height-_root.makambergulo._y;
            } else if (_root.Floodw.getSelectedIndex() == 8) {
                    _root.BASEMAP._x = _root.BASEMAP._width-_root.tipes._x;
                    _root.BASEMAP._y = _root.BASEMAP._height-_root.tipes._y;
            }
}

_root.Village.setChangeHandler("SG1");
function SG1(component) {
            BASEMAP._width =800;
            BASEMAP._height = 600;
            if (_root.Village.getSelectedIndex() == 0) {
                    _root.BASEMAP._x = _root.BASEMAP._width-_root.karangasem._x;
                    _root.BASEMAP._y = _root.BASEMAP._height-_root.karangasem._y;
            } else if (_root.Village.getSelectedIndex() == 1) {
                    _root.BASEMAP._x = _root.BASEMAP._width-_root.jajar._x;
                    _root.BASEMAP._y = _root.BASEMAP._height-_root.jajar._y;
            } else if (_root.Village.getSelectedIndex() == 2) {
                    _root.BASEMAP._x = _root.BASEMAP._width-_root.kerten._x;
                    _root.BASEMAP._y = _root.BASEMAP._height-_root.kerten._y;
            } else if (_root.Village.getSelectedIndex() == 3) {
                    _root.BASEMAP._x = _root.BASEMAP._width-_root.pajang._x;
                    _root.BASEMAP._y = _root.BASEMAP._height-_root.pajang._y;
            } else if (_root.Village.getSelectedIndex() == 4) {
                    _root.BASEMAP._x = _root.BASEMAP._width-_root.sondakan._x;
                    _root.BASEMAP._y = _root.BASEMAP._height-_root.sondakan._y;
            } else if (_root.Village.getSelectedIndex() == 5) {
                    _root.BASEMAP._x = _root.BASEMAP._width-_root.laweyan._x;
                    _root.BASEMAP._y = _root.BASEMAP._height-_root.laweyan._y;
            } else if (_root.Village.getSelectedIndex() == 6) {
                    _root.BASEMAP._x = _root.BASEMAP._width-_root.bumi._x;
                    _root.BASEMAP._y = _root.BASEMAP._height-_root.bumi._y;
            } else if (_root.Village.getSelectedIndex() == 7) {
                    _root.BASEMAP._x = _root.BASEMAP._width-_root.sumber._x;
                    _root.BASEMAP._y = _root.BASEMAP._height-_root.sumber._y;
            } else if (_root.Village.getSelectedIndex() == 8) {
                    _root.BASEMAP._x = _root.BASEMAP._width-_root.manahan._x;
                    _root.BASEMAP._y = _root.BASEMAP._height-_root.manahan._y;
            } else if (_root.Village.getSelectedIndex() == 9) {
                    _root.BASEMAP._x = _root.BASEMAP._width-_root.purwosari._x;
                    _root.BASEMAP._y = _root.BASEMAP._height-_root.purwosari._y;
            } else if (_root.Village.getSelectedIndex() == 10) {
                    _root.BASEMAP._x = _root.BASEMAP._width-_root.mangkubumen._x;
                    _root.BASEMAP._y = _root.BASEMAP._height-_root.mangkubumen._y;
            } else if (_root.Village.getSelectedIndex() == 11) {
                    _root.BASEMAP._x = _root.BASEMAP._width-_root.punggawan._x;
                    _root.BASEMAP._y = _root.BASEMAP._height-_root.punggawan._y;
```

```
} else if (_root.Village.getSelectedIndex() == 12) {
        _root.BASEMAP._x = _root.BASEMAP._width-_root.gilingan._x;
        _root.BASEMAP._y = _root.BASEMAP._height-_root.gilingan._y;
} else if (_root.Village.getSelectedIndex() == 13) {
        _root.BASEMAP._x = _root.BASEMAP._width-_root.penumping._x;
        _root.BASEMAP._y = _root.BASEMAP._height-_root.penumping._y;
} else if (_root.Village.getSelectedIndex() == 14) {
        _root.BASEMAP._x = _root.BASEMAP._width-_root.timuran._x;
        _root.BASEMAP._y = _root.BASEMAP._height-_root.timuran._y;
} else if (_root.Village.getSelectedIndex() == 15) {
        _root.BASEMAP._x = _root.BASEMAP._width-_root.sriwedari._x;
        _root.BASEMAP._y = _root.BASEMAP._height-_root.sriwedari._y;
} else if (_root.Village.getSelectedIndex() == 16) {
        _root.BASEMAP._x = _root.BASEMAP._width-_root.kemlayan._x;
        _root.BASEMAP._y = _root.BASEMAP._height-_root.kemlayan._y;
} else if (_root.Village.getSelectedIndex() == 17) {
        _root.BASEMAP._x = _root.BASEMAP._width-_root.panularan._x;
        _root.BASEMAP._y = _root.BASEMAP._height-_root.panularan._y;
} else if (_root.Village.getSelectedIndex() == 18) {
        _root.BASEMAP._x = _root.BASEMAP._width-_root.tipes._x;
        _root.BASEMAP._y = _root.BASEMAP._height-_root.tipes._y;
} else if (_root.Village.getSelectedIndex() == 19) {
        _root.BASEMAP._x = _root.BASEMAP._width-_root.kratonan._x;
        _root.BASEMAP._y = _root.BASEMAP._height-_root.kratonan._y;
} else if (_root.Village.getSelectedIndex() == 20) {
        _root.BASEMAP._x = _root.BASEMAP._width-_root.serengan._x;
        _root.BASEMAP._y = _root.BASEMAP._height-_root.serengan._y;
} else if (_root.Village.getSelectedIndex() == 21) {
        _root.BASEMAP._x = _root.BASEMAP._width-_root.kadipiro._x;
        _root.BASEMAP._y = _root.BASEMAP._height-_root.kadipiro._y;
} else if (_root.Village.getSelectedIndex() == 22) {
        _root.BASEMAP._x = _root.BASEMAP._width-_root.nusukan._x;
        _root.BASEMAP._y = _root.BASEMAP._height-_root.nusukan._y;
} else if (_root.Village.getSelectedIndex() == 23) {
        _root.BASEMAP._x = _root.BASEMAP._width-_root.kestalan._x;
        _root.BASEMAP._y = _root.BASEMAP._height-_root.kestalan._y;
} else if (_root.Village.getSelectedIndex() == 24) {
        _root.BASEMAP._x = _root.BASEMAP._width-_root.tegalharjo._x;
        _root.BASEMAP._y = _root.BASEMAP._height-_root.tegalharjo._y;
} else if (_root.Village.getSelectedIndex() == 25) {
        _root.BASEMAP._x = _root.BASEMAP._width-_root.ketelan._x;
        _root.BASEMAP._y = _root.BASEMAP._height-_root.ketelan._y;
} else if (_root.Village.getSelectedIndex() == 26) {
        _root.BASEMAP._x = _root.BASEMAP._width-_root.setabelan._x;
        _root.BASEMAP._y = _root.BASEMAP._height-_root.setabelan._y;
} else if (_root.Village.getSelectedIndex() == 27) {
        _root.BASEMAP._x = _root.BASEMAP._width-_root.kepatihan._x;
        _root.BASEMAP._y = _root.BASEMAP._height-_root.kepatihan._y;
} else if (_root.Village.getSelectedIndex() == 28) {
        _root.BASEMAP._x = _root.BASEMAP._width-_root.kulon._x;
        _root.BASEMAP._y = _root.BASEMAP._height-_root.kulon._y;
```

```
} else if (_root.Village.getSelectedIndex() == 29) {
        _root.BASEMAP._x = _root.BASEMAP._width-_root.keprabon._x;
        _root.BASEMAP._y = _root.BASEMAP._height-_root.keprabon._y;
} else if (_root.Village.getSelectedIndex() == 30) {
        _root.BASEMAP._x = _root.BASEMAP._width-_root.kampungbaru._x;
        _root.BASEMAP._y = _root.BASEMAP._height-_root.kampungbaru._y;
} else if (_root.Village.getSelectedIndex() == 31) {
        _root.BASEMAP._x = _root.BASEMAP._width-_root.sudiroprajan._x;
        _root.BASEMAP._y = _root.BASEMAP._height-_root.sudiroprajan._y;
} else if (_root.Village.getSelectedIndex() == 32) {
        _root.BASEMAP._x = _root.BASEMAP._width-_root.kauman._x;
        _root.BASEMAP._y = _root.BASEMAP._height-_root.kauman._y;
} else if (_root.Village.getSelectedIndex() == 33) {
        _root.BASEMAP._x = _root.BASEMAP._width-_root.kedunglumbu._x;
        _root.BASEMAP._y = _root.BASEMAP._height-_root.kedunglumbu._y;
} else if (_root.Village.getSelectedIndex() == 34) {
        _root.BASEMAP._x = _root.BASEMAP._width-_root.baluwarti._x;
        _root.BASEMAP._y = _root.BASEMAP._height-_root.baluwarti._y;
} else if (_root.Village.getSelectedIndex() == 35) {
        _root.BASEMAP._x = _root.BASEMAP._width-_root.gajahan._x;
        _root.BASEMAP._y = _root.BASEMAP._height-_root.gajahan._y;
} else if (_root.Village.getSelectedIndex() == 36) {
        _root.BASEMAP._x = _root.BASEMAP._width-_root.semanggi._x;
        _root.BASEMAP._y = _root.BASEMAP._height-_root.semanggi._y;
} else if (_root.Village.getSelectedIndex() == 37) {
        _root.BASEMAP._x = _root.BASEMAP._width-_root.pasarkliwon._x;
        _root.BASEMAP._y = _root.BASEMAP._height-_root.pasarkliwon._y;
} else if (_root.Village.getSelectedIndex() == 38) {
        _root.BASEMAP._x = _root.BASEMAP._width-_root.danukusuman._x;
        _root.BASEMAP._y = _root.BASEMAP._height-_root.danukusuman._y;
} else if (_root.Village.getSelectedIndex() == 39) {
        _root.BASEMAP._x = _root.BASEMAP._width-_root.joyosuran._x;
        _root.BASEMAP._y = _root.BASEMAP._height-_root.joyosuran._y;
} else if (_root.Village.getSelectedIndex() == 40) {
        _root.BASEMAP._x = _root.BASEMAP._width-_root.joyotakan._x;
        _root.BASEMAP._y = _root.BASEMAP._height-_root.joyotakan._y;
} else if (_root.Village.getSelectedIndex() == 41) {
        _root.BASEMAP._x = _root.BASEMAP._width-_root.mojosongo._x;
        _root.BASEMAP._y = _root.BASEMAP._height-_root.mojosongo._y;
} else if (_root.Village.getSelectedIndex() == 42) {
        _root.BASEMAP._x = _root.BASEMAP._width-_root.jebres._x;
        _root.BASEMAP._y = _root.BASEMAP._height-_root.jebres._y;
} else if (_root.Village.getSelectedIndex() == 43) {
        _root.BASEMAP._x = _root.BASEMAP._width-_root.purwodiningratan._x;
        _root.BASEMAP._y = _root.BASEMAP._height-_root.purwodiningratan._y;
} else if (_root.Village.getSelectedIndex() == 44) {
        _root.BASEMAP._x = _root.BASEMAP._width-_root.jagalan._x;
        _root.BASEMAP._y = _root.BASEMAP._height-_root.jagalan._y;
} else if (_root.Village.getSelectedIndex() == 45) {
        _root.BASEMAP._x = _root.BASEMAP._width-_root.pucangsawit._x;
        _root.BASEMAP._y = _root.BASEMAP._height-_root.pucangsawit._y;
```

```
		} else if (_root.Village.getSelectedIndex() == 46) {
			_root.BASEMAP._x = _root.BASEMAP._width-_root.gandekan._x;
			_root.BASEMAP._y = _root.BASEMAP._height-_root.gandekan._y;
		} else if (_root.Village.getSelectedIndex() == 47) {
			_root.BASEMAP._x = _root.BASEMAP._width-_root.sewu._x;
			_root.BASEMAP._y = _root.BASEMAP._height-_root.sewu._y;
		} else if (_root.Village.getSelectedIndex() == 48) {
			_root.BASEMAP._x = _root.BASEMAP._width-_root.sangkrah._x;
			_root.BASEMAP._y = _root.BASEMAP._height-_root.sangkrah._y;
		}
}

_root.Street.setChangeHandler("SG2");
function SG2(component) {
		BASEMAP._width =800;
		BASEMAP._height = 600;
		if (_root.Street.getSelectedIndex() == 0) {
			_root.BASEMAP._x = _root.BASEMAP._width-_root.ADahlan._x;
			_root.BASEMAP._y = _root.BASEMAP._height-_root.ADahlan._y;
		} else if (_root.Street.getSelectedIndex() == 1) {
			_root.BASEMAP._x = _root.BASEMAP._width-_root.AMSangaji._x;
			_root.BASEMAP._y = _root.BASEMAP._height-_root.AMSangaji._y;
		} else if (_root.Street.getSelectedIndex() == 2) {
			_root.BASEMAP._x = _root.BASEMAP._width-_root.AbdulMuis._x;
			_root.BASEMAP._y = _root.BASEMAP._height-_root.AbdulMuis._y;
		} else if (_root.Street.getSelectedIndex() == 3) {
			_root.BASEMAP._x = _root.BASEMAP._width-_root.AdiSucipto._x;
			_root.BASEMAP._y = _root.BASEMAP._height-_root.AdiSucipto._y;
		} else if (_root.Street.getSelectedIndex() == 4) {
			_root.BASEMAP._x = _root.BASEMAP._width-_root.Arifin._x;
			_root.BASEMAP._y = _root.BASEMAP._height-_root.Arifin._y;
		} else if (_root.Street.getSelectedIndex() == 5) {
			_root.BASEMAP._x = _root.BASEMAP._width-_root.Balapan._x;
			_root.BASEMAP._y = _root.BASEMAP._height-_root.Balapan._y;
		} else if (_root.Street.getSelectedIndex() == 6) {
			_root.BASEMAP._x = _root.BASEMAP._width-_root.BasukiRahmad._x;
			_root.BASEMAP._y = _root.BASEMAP._height-_root.BasukiRahmad._y;
		} else if (_root.Street.getSelectedIndex() == 7) {
			_root.BASEMAP._x = _root.BASEMAP._width-_root.Bhayangkara._x;
			_root.BASEMAP._y = _root.BASEMAP._height-_root.Bhayangkara._y;
		} else if (_root.Street.getSelectedIndex() == 8) {
			_root.BASEMAP._x = _root.BASEMAP._width-_root.BrigjendKatamso._x;
			_root.BASEMAP._y = _root.BASEMAP._height-_root.BrigjendKatamso._y;
		} else if (_root.Street.getSelectedIndex() == 9) {
			_root.BASEMAP._x = _root.BASEMAP._width-_root.BrigjendSlametRiyadi._x;
			_root.BASEMAP._y = _root.BASEMAP._height-_root.BrigjendSlametRiyadi._y;
		} else if (_root.Street.getSelectedIndex() == 10) {
			_root.BASEMAP._x = _root.BASEMAP._width-_root.BrigjendSudarto._x;
			_root.BASEMAP._y = _root.BASEMAP._height-_root.BrigjendSudarto._y;
		} else if (_root.Street.getSelectedIndex() == 11) {
			_root.BASEMAP._x = _root.BASEMAP._width-_root.Cokroaminoto._x;
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            _root.BASEMAP._y = _root.BASEMAP._height-_root.Cokroaminoto._y;
} else if (_root.Street.getSelectedIndex() == 12) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.CutNyaDin._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.CutNyaDin._y;
} else if (_root.Street.getSelectedIndex() == 13) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.Demangan._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.Demangan._y;
} else if (_root.Street.getSelectedIndex() == 14) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.DewiSartika._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.DewiSartika._y;
} else if (_root.Street.getSelectedIndex() == 15) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.Dilagan._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.Dilagan._y;
} else if (_root.Street.getSelectedIndex() == 16) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.DrMuwardi._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.DrMuwardi._y;
} else if (_root.Street.getSelectedIndex() == 17) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.DrRajiman._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.DrRajiman._y;
} else if (_root.Street.getSelectedIndex() == 18) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.DRSuharso._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.DRSuharso._y;
} else if (_root.Street.getSelectedIndex() == 19) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.DrSutomo._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.DrSutomo._y;
} else if (_root.Street.getSelectedIndex() == 20) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.DrWahidin._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.DrWahidin._y;
} else if (_root.Street.getSelectedIndex() == 21) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.DukuhanAyu._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.DukuhanAyu._y;
} else if (_root.Street.getSelectedIndex() == 22) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.GadjahMada._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.GadjahMada._y;
} else if (_root.Street.getSelectedIndex() == 23) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.GatotSubroto._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.GatotSubroto._y;
} else if (_root.Street.getSelectedIndex() == 24) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.GotongRoyong._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.GotongRoyong._y;
} else if (_root.Street.getSelectedIndex() == 25) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.Griyan._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.Griyan._y;
} else if (_root.Street.getSelectedIndex() == 26) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.Hasanuddin._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.Hasanuddin._y;
} else if (_root.Street.getSelectedIndex() == 27) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.Honggowongso._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.Honggowongso._y;
} else if (_root.Street.getSelectedIndex() == 28) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.ImamBonjol._x;
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            _root.BASEMAP._y = _root.BASEMAP._height-_root.ImamBonjol._y;
} else if (_root.Street.getSelectedIndex() == 29) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.IrJuandaKartasanjaya._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.IrJuandaKartasanjaya._y;
} else if (_root.Street.getSelectedIndex() == 30) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.IrSutami._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.IrSutami._y;
} else if (_root.Street.getSelectedIndex() == 31) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.JambuRaya._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.JambuRaya._y;
} else if (_root.Street.getSelectedIndex() == 32) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.JayaWijaya._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.JayaWijaya._y;
} else if (_root.Street.getSelectedIndex() == 33) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.Jayengan._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.Jayengan._y;
} else if (_root.Street.getSelectedIndex() == 34) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.JendAYani._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.JendAYani._y;
} else if (_root.Street.getSelectedIndex() == 35) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.JendSudirman._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.JendSudirman._y;
} else if (_root.Street.getSelectedIndex() == 36) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.JokoTingkir._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.JokoTingkir._y;
} else if (_root.Street.getSelectedIndex() == 37) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.KahuripanUtara._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.KahuripanUtara._y;
} else if (_root.Street.getSelectedIndex() == 38) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.KaptPattimura._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.KaptPattimura._y;
} else if (_root.Street.getSelectedIndex() == 39) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.KaptenAdiSumarmo._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.KaptenAdiSumarmo._y;
} else if (_root.Street.getSelectedIndex() == 40) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.KaptenMulyadi._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.KaptenMulyadi._y;
} else if (_root.Street.getSelectedIndex() == 41) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.KaptenTendean._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.KaptenTendean._y;
} else if (_root.Street.getSelectedIndex() == 42) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.Kartini._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.Kartini._y;
} else if (_root.Street.getSelectedIndex() == 43) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.KebangkitanNasional._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.KebangkitanNasional._y;
} else if (_root.Street.getSelectedIndex() == 44) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.Kelud._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.Kelud._y;
} else if (_root.Street.getSelectedIndex() == 45) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.Kenari._x;
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            _root.BASEMAP._y = _root.BASEMAP._height-_root.Kenari._y;
} else if (_root.Street.getSelectedIndex() == 46) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.Kerinci._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.Kerinci._y;
} else if (_root.Street.getSelectedIndex() == 47) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.Ketandan._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.Ketandan._y;
} else if (_root.Street.getSelectedIndex() == 48) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.KHAgusSalim._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.KHAgusSalim._y;
} else if (_root.Street.getSelectedIndex() == 49) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.KHMaskur._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.KHMaskur._y;
} else if (_root.Street.getSelectedIndex() == 50) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.KHWahidHasyim._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.KHWahidHasyim._y;
} else if (_root.Street.getSelectedIndex() == 51) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.KihajarDewantoro._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.KihajarDewantoro._y;
} else if (_root.Street.getSelectedIndex() == 52) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.KolSutarto._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.KolSutarto._y;
} else if (_root.Street.getSelectedIndex() == 53) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.KolSugiono._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.KolSugiono._y;
} else if (_root.Street.getSelectedIndex() == 54) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.Krakatau._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.Krakatau._y;
} else if (_root.Street.getSelectedIndex() == 55) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.KSTubun._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.KSTubun._y;
} else if (_root.Street.getSelectedIndex() == 56) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.Kusmanto._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.Kusmanto._y;
} else if (_root.Street.getSelectedIndex() == 57) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.KyaiGedeSolo._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.KyaiGedeSolo._y;
} else if (_root.Street.getSelectedIndex() == 58) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.KyaiMangunSarkoro._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.KyaiMangunSarkoro._y;
} else if (_root.Street.getSelectedIndex() == 59) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.KyaiMojo._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.KyaiMojo._y;
} else if (_root.Street.getSelectedIndex() == 60) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.LetjendSParman._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.LetjendSParman._y;
} else if (_root.Street.getSelectedIndex() == 61) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.LetjendSutoyo._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.LetjendSutoyo._y;
} else if (_root.Street.getSelectedIndex() == 62) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.LetjendSuprapto._x;
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            _root.BASEMAP._y = _root.BASEMAP._height-_root.LetjendSuprapto._y;
} else if (_root.Street.getSelectedIndex() == 63) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.Lumantubing._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.Lumantubing._y;
} else if (_root.Street.getSelectedIndex() == 64) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.Mangunkusumo._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.Mangunkusumo._y;
} else if (_root.Street.getSelectedIndex() == 65) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.MaySunaryo._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.MaySunaryo._y;
} else if (_root.Street.getSelectedIndex() == 66) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.MayjendDIPanjaitan._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.MayjendDIPanjaitan._y;
} else if (_root.Street.getSelectedIndex() == 67) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.MenteriSupomo._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.MenteriSupomo._y;
} else if (_root.Street.getSelectedIndex() == 68) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.MochHThamrin._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.MochHThamrin._y;
} else if (_root.Street.getSelectedIndex() == 69) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.MochYamin._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.MochYamin._y;
} else if (_root.Street.getSelectedIndex() == 70) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.Monginsidi._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.Monginsidi._y;
} else if (_root.Street.getSelectedIndex() == 71) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.MrSartono._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.MrSartono._y;
} else if (_root.Street.getSelectedIndex() == 72) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.MTHaryono._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.MTHaryono._y;
} else if (_root.Street.getSelectedIndex() == 73) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.MulwoBarat._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.MulwoBarat._y;
} else if (_root.Street.getSelectedIndex() == 74) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.Nangka._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.Nangka._y;
} else if (_root.Street.getSelectedIndex() == 75) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.PangeranWiji._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.PangeranWiji._y;
} else if (_root.Street.getSelectedIndex() == 76) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.PerintisKemerdekaan._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.PerintisKemerdekaan._y;
} else if (_root.Street.getSelectedIndex() == 77) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.ProfDrSupomo._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.ProfDrSupomo._y;
} else if (_root.Street.getSelectedIndex() == 78) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.ProfHKaharmuzakir._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.ProfHKaharmuzakir._y;
} else if (_root.Street.getSelectedIndex() == 79) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.ProfYohanes._x;
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            _root.BASEMAP._y = _root.BASEMAP._height-_root.ProfYohanes._y;
} else if (_root.Street.getSelectedIndex() == 80) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.RMSaid._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.RMSaid._y;
} else if (_root.Street.getSelectedIndex() == 81) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.RSaleh._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.RSaleh._y;
} else if (_root.Street.getSelectedIndex() == 82) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.RDTagore._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.RDTagore._y;
} else if (_root.Street.getSelectedIndex() == 83) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.REMartadinata._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.REMartadinata._y;
} else if (_root.Street.getSelectedIndex() == 84) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.Reksoniten._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.Reksoniten._y;
} else if (_root.Street.getSelectedIndex() == 85) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.RingRoad._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.RingRoad._y;
} else if (_root.Street.getSelectedIndex() == 86) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.RMSaid._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.RMSaid._y;
} else if (_root.Street.getSelectedIndex() == 87) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.RonggoWarsito._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.RonggoWarsito._y;
} else if (_root.Street.getSelectedIndex() == 88) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.Sadewo._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.Sadewo._y;
} else if (_root.Street.getSelectedIndex() == 89) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.SamRatulangi._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.SamRatulangi._y;
} else if (_root.Street.getSelectedIndex() == 90) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.Samanhudi._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.Samanhudi._y;
} else if (_root.Street.getSelectedIndex() == 91) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.Sampangan._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.Sampangan._y;
} else if (_root.Street.getSelectedIndex() == 92) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.SetiaBudi._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.SetiaBudi._y;
} else if (_root.Street.getSelectedIndex() == 93) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.Silir._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.Silir._y;
} else if (_root.Street.getSelectedIndex() == 94) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.Siswo._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.Siswo._y;
} else if (_root.Street.getSelectedIndex() == 95) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.Soropadan._x;
            _root.BASEMAP._y = _root.BASEMAP._height-_root.Soropadan._y;
} else if (_root.Street.getSelectedIndex() == 96) {
            _root.BASEMAP._x = _root.BASEMAP._width-_root.SugioPranoto._x;
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                _root.BASEMAP._y = _root.BASEMAP._height-_root.SugioPranoto._y;
        } else if (_root.Street.getSelectedIndex() == 97) {
                _root.BASEMAP._x = _root.BASEMAP._width-_root.SumpahPemuda._x;
                _root.BASEMAP._y = _root.BASEMAP._height-_root.SumpahPemuda._y;
        } else if (_root.Street.getSelectedIndex() == 98) {
                _root.BASEMAP._x = _root.BASEMAP._width-_root.Suryo._x;
                _root.BASEMAP._y = _root.BASEMAP._height-_root.Suryo._y;
        } else if (_root.Street.getSelectedIndex() == 99) {
                _root.BASEMAP._x = _root.BASEMAP._width-_root.SutanSyahrir._x;
                _root.BASEMAP._y = _root.BASEMAP._height-_root.SutanSyahrir._y;
        } else if (_root.Street.getSelectedIndex() == 100) {
                _root.BASEMAP._x = _root.BASEMAP._width-_root.SutarjoSH._x;
                _root.BASEMAP._y = _root.BASEMAP._height-_root.SutarjoSH._y;
        } else if (_root.Street.getSelectedIndex() == 101) {
                _root.BASEMAP._x = _root.BASEMAP._width-_root.TangkubanPerahu._x;
                _root.BASEMAP._y = _root.BASEMAP._height-_root.TangkubanPerahu._y;
        } else if (_root.Street.getSelectedIndex() == 102) {
                _root.BASEMAP._x = _root.BASEMAP._width-_root.Tanjung._x;
                _root.BASEMAP._y = _root.BASEMAP._height-_root.Tanjung._y;
        } else if (_root.Street.getSelectedIndex() == 103) {
                _root.BASEMAP._x = _root.BASEMAP._width-_root.TentaraPelajar._x;
                _root.BASEMAP._y = _root.BASEMAP._height-_root.TentaraPelajar._y;
        } else if (_root.Street.getSelectedIndex() == 104) {
                _root.BASEMAP._x = _root.BASEMAP._width-_root.TeukuUmar._x;
                _root.BASEMAP._y = _root.BASEMAP._height-_root.TeukuUmar._y;
        } else if (_root.Street.getSelectedIndex() == 105) {
                _root.BASEMAP._x = _root.BASEMAP._width-_root.Transito._x;
                _root.BASEMAP._y = _root.BASEMAP._height-_root.Transito._y;
        } else if (_root.Street.getSelectedIndex() == 106) {
                _root.BASEMAP._x = _root.BASEMAP._width-_root.UntungSuropati._x;
                _root.BASEMAP._y = _root.BASEMAP._height-_root.UntungSuropati._y;
        } else if (_root.Street.getSelectedIndex() == 107) {
                _root.BASEMAP._x = _root.BASEMAP._width-_root.UripSumoharjo._x;
                _root.BASEMAP._y = _root.BASEMAP._height-_root.UripSumoharjo._y;
        } else if (_root.Street.getSelectedIndex() == 108) {
                _root.BASEMAP._x = _root.BASEMAP._width-_root.Veteran._x;
                _root.BASEMAP._y = _root.BASEMAP._height-_root.Veteran._y;
        } else if (_root.Street.getSelectedIndex() == 109) {
                _root.BASEMAP._x = _root.BASEMAP._width-_root.WoraWari._x;
                _root.BASEMAP._y = _root.BASEMAP._height-_root.WoraWari._y;
        } else if (_root.Street.getSelectedIndex() == 110) {
                _root.BASEMAP._x = _root.BASEMAP._width-_root.YosSudarso._x;
                _root.BASEMAP._y = _root.BASEMAP._height-_root.YosSudarso._y;
        } else if (_root.Street.getSelectedIndex() == 111) {
                _root.BASEMAP._x = _root.BASEMAP._width-_root.Yosodipiro._x;
                _root.BASEMAP._y = _root.BASEMAP._height-_root.Yosodipiro._y;
        } else if (_root.Street.getSelectedIndex() == 112) {
                _root.BASEMAP._x = _root.BASEMAP._width-_root.Yudistira._x;
                _root.BASEMAP._y = _root.BASEMAP._height-_root.Yudistira._y;
        }
}
```

Appendix 5. Serious game Participant

1. Public Works (Drainage Division)








2. Public Works (BBWS-BS)








3. Non Public Works (Bapermas)







4. Non Public Works (Kesbang Linmas)