

# **PARTICIPATORY GEOGRAPHICAL INFORMATION SYSTEM (GIS) FOR MANGROVE TOURISM DEVELOPMENT IN TIRTOHARGO, KRETEK, BANTUL**

**N.L Hanum and E.T.W Mei**

Faculty of Geography, Universitas Gadjah Mada

**Email:** windageougmail@gmail.com

Coastal resources in Yogyakarta Special Region can be a leading tourist attraction by highlighting each coastal characteristic. Mangrove conservation and tourism are established in Tirtohargo coastal area, located between the Samas and Depok beaches. Despite the considerable efforts in the mangrove development, there are many problems that are not able to be solved thoroughly. Some key issues include: (i) the development of mangrove has not been systematically arranged, detailed, and well mapped because (ii) the mangrove development program has not run optimally in accordance with the planning programs listed in the Rural Development Planning of Tirtohargo. (iii) Promotion media and information of mangrove tourism are not yet optimally developed being caused by (iv) inadequate human resource capabilities in information management and (v) unattractive people perception of the information management employment (vi) lack of ability and willingness to maintain and update data and information of natural resources and the environment. Those problems can be minimized through community participation approach in example by using participatory mapping. This research aims to map the potential of mangrove ecosystems in Tirtohargo, Kretek using community-based approach and to develop an interactive information system based on the participatory mapping as a media of information and promotion. The data were collected by using focus group discussion and Scaled-2D participatory mapping using large scale image (Worldview2). In addition, to obtain information that can be accessed digitally, Geographic Information System (GIS) is used to create the information system. The preliminary result indicates; (i) Scaled-2D participatory mapping is an effective method to facilitate dialogue or discussions, (ii) The result map provides information listed geographically, easy to understand by the common people with appropriate picture of actual conditions and (iii) the maps can be made into geographic-based interactive information system as appropriate campaign media to increase public knowledge and insight.

**Keywords:** Tourism, mangrove, participatory, mapping, GIS

## **INTRODUCTION**

The natural resources and environment is one of the main capital to support the achievement of national development goals. The effort mastery over water as well as the wealth contained in it is also regulated in The Constitution of the Republic of Indonesia of 1945 Article 33 which the water resources are utilized for the welfare of the people of magnitude. To achieve that goal, public participation efforts are needed both nationally and within the smallest scope in form of the village. After the act number 22 of 1998 and number 25 of 1999 on regional autonomy imposed, different interests increasingly felt among regions and each region strive to meet and to increase income regions.

Coastal resources in Yogyakarta Special Region can be a leading tourist attraction by highlighting each coastal characteristics. Gunungkidul has the potential of white sand beaches and coral reefs while Kulon Progo develop its potential as a port and some form of water attractions. The development of tourism in the southern coastal district of Bantul such as Parangtritis, Depok, and Samas accentuate diverse characteristics. Parangtritis is developed as a maritime nature that highlight aspects of religion, Depok is developed with the potential of fish resources, and Samas is developed specifically for turtles conservation. Baros, Tirtohargo located between the coastal Samas and Depok develops the potential of the coastal area through the development of mangroves initiated since 2001. Based on data from the Central Bureau of Statistics Bantul, a number of nautical tourists in Bantul reach two million visitors in 2012 and 2013, so that the potential development of coastal tourism has a big opportunity.

Various kinds of development can be implemented in the area of mangroves that grow in tropical forest areas, such as of tourism and conservation. Tourism development in the southern coastal district of Bantul has good potential. It can be one effort to improve household incomes and regions in Bantul conducted with the development of coastal areas. Mangroves in Baros, Tirtohargo, Kretek, Bantul, that cover an area of 5-7 ha grow as an interesting study because the development of this area has involved the community in the planning and management of mangrove (Secretariat of Bantul, 2012).

There are still many problems that are not able to be solved thoroughly despite considerable efforts that made in the management of mangrove areas. Some key issues include: (i) the development of mangrove has not been systematically arranged, detailed, and well mapped because (ii) the mangrove development program has not run optimally in accordance with the planning programs listed in the Rural Development Planning of Tirtohargo. (iii) Promotion media and

information of mangrove tourism are not yet optimally developed being caused by (iv) inadequate human resource capabilities in information management and (v) unattractive people perception of information management employment (vi) lack of ability and willingness to maintain and update data and information of natural resources and the environment. These problems can be minimized through community participation in development approach.

This can be realized among others through participatory mapping. Participatory mapping has the purpose to introduce the value of knowledge of local communities in planning and management, including the planning and management of mangrove areas. This statement is supported by the Indonesian Presidential Regulation No. 73 in 2012 on Guidelines for National Strategy Mangrove Ecosystem Management which explains that the community-based mangrove ecosystem management to improve and preserve the value of important ecological, economic, social, cultural, in order to increase incomes and promote sustainable development. The participatory mapping targets is social communities in Tirtohargo which role in the management of mangrove ecosystems.

In this case, these communities have has an important role from the beginning until now as that mangrove ecosystem has been developing as a special interest tours. The active communities which participate in mangrove management, among others kelompok petani “Tani Mangrove”, kelompok nelayan “Mino Tirtohargo”, kelompok nelayan Samas, kelompok kandang “Andini Lestari”, kelompok KWT (Kelompok Wanita Tani) “Baros Maju”, PKK Baros, kelompok Outbond “Garuda”, POKJA mangrove, dan KP2B (Keluarga Pemuda-Pemudi Baros).

In addition, the Indonesian Presidential Regulation Number 73 Year in 2012 also explained that the development of research, science and technology, and information systems are needed to strengthen the sustainable management of mangrove ecosystems. Therefore, the use of large-scale remote sensing image (Worldview 2) selected in participatory mapping because the image has the advantage can cover large areas and can provide a detail two-dimensional picture. In addition, to obtain information that can be accessed digitally, manufacturing information system is done by using a geographic information system (GIS). GIS is developed as an information and a promotion media of regional advantages. Furthermore, information systems can be used as an information media of Tirtohargo village and promotion media of the development of mangrove areas which supporting social media that has been used today.

## **Methodology**

Stages of implementation of activities are described as follows:

### **Phase I Preparation**

At this preparation phase, observation and collection materials are required. This observation is conducted using Rapid Rural Appraisal (RRA) method. Observation using RRA method is applied to get a general overview of the area rapidly. Besides, observation is also conducted to determine the commitment and willingness of the community in the development of tourism in mangrove area. In this case, the mangrove area is in Baros, Tirtohargo, Kretek, Bantul. In this phase, also conducted a study of literature (includes literature in the form of books, journals, and previous research), secondary data collection, and the manufacture of a structured questionnaire.

### **Phase 2 Data collection**

#### 1. Type of data

##### a. Qualitative Data

Qualitative data which is collected is the data in the form of words or sentences, among others, the field conditions data : physic and social conditions, policies application, the potential and problems of development, stakeholder aspirations. The qualitative data is also presented in the form of photographs and descriptions.

##### b. Quantitative Data

Quantitative data is the data in the form of numbers or coding that can be quantified. Data in form of numbers can be exact number and ordinal numbers.

##### c. Remote Sensing Image

Remote sensing image which is used in this research is Worldview2 that image recorded on August 19, 2014

#### 2. Source of Data

##### a. Primary Data

Primary data sources include, speakers, field conditions, and others that are considered relevant to provide the appropriate information for its objectives. Key informants in this research are 1) Tirtohargo local government, 2) social communities, and 3) public figure who committed in mangrove development.

b. Secondary Data

Secondary data source is obtained from the agencies or the departments which is issuing data or information that is appropriate to this research. Originating source data is obtained from the Department of Marine and Fisheries of Bantul, Department of Culture and Tourism of Bantul, The Environment Agency of Bantul, local government of Tirtohargo of Bantul, and Planning and Regional Development Agency of Bantul.

3. Data Collection Technique

a. Primary Data

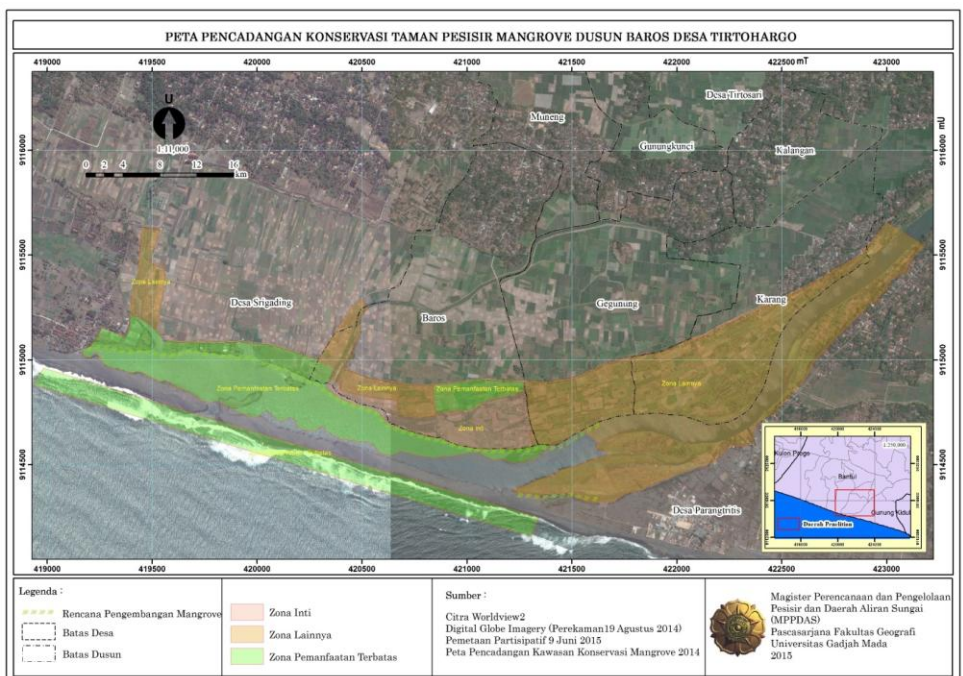


Figure 1. The Proposed Map of Coastal Park Mangrove Conservation Area

**Participatory Mapping method**, this method is widely used to support a variety of activities and to control of space utilization , to define the region , and to set boundaries . Map is a media that contains some data that show spatial patterns and structures . Communities can gradually provided the ability to compose , to read , and to analyze maps for both planning purposes and field activities . The main sources which used in participatory mapping are a remote sensing image (Worldview2) and The Proposed Map of Coastal Park Mangrove Conservation Area , based on The Decree of the Regent of Bantul No. 248 in 2014 (Figure 1).

Then, the type of participatory mapping which is implemented in this research scaled 2D mapping. It method conduct people to draw in base map using colored pen or push pin (Cadag, 2011).

b. Secondary Data

**Literature study** is collection and use of secondary data which relevant to the objectives of this research to complement the primary data. Literature study conducts by examining the results of previous studies , inventory documents of local area, historical reports mangrove area, and policy documents .

**Phase 3 analysis .**

Data analysis is an attempt to obtain the information in field then it is induced into the formulation of the concepts related to the objectives of this research. Each objective has a different way of analysis, each of it has its own characteristics in the measurement. Analytical techniques for each objective is described as follows :

**Objective 1: The Community-Based Mangrove Area Mapping**

Participatory mapping based on The Proposed Map of Coastal Park Mangrove Conservation Area (The Decree of the Regent of Bantul No. 248 in 2014). That map covers the core zone of mangrove areas , other zones and limited use zones. Participatory mapping type which is used is a scaled two- dimensional mapping by using the image Worldview2 as basic image. The information which is mapped, namely 1) the existing condition of mangrove area , 2) Development mangrove location. That variables is divided into some aspects (Table 1)

Table 1. Participatory Mapping Variables

No.	Mapping Variables	
1	The existing condition of mangrove area	Administrative boundary
		Distribution of mangrove
		Infrastructure and accessibility
		Land use
		Land status
		Resource biotic / abiotic
2	Development mangrove location	Potential tourism development location/ point of interest
		Potential conservation development location

Informants are determined based on the objectives of this research with particular consideration that is deemed to provide information. In this case, researchers determined the informants based on recommendation by the head of local government recommendation

which is not out of the requirement criteria. In this research, the number of informants is chosen with considering accuracy aspect (key person, researchers recruited key person to get a more in-depth information) and practical aspect (cost savings, time, energy, and ability). Informants were chosen, among others kelompok petani “Tani Mangrove”, kelompok nelayan “Mino Tirtohargo”, kelompok nelayan Samas, kelompok kandang “Andini Lestari”, kelompok KWT (Kelompok Wanita Tani) “Baros Maju”, PKK Baros, kelompok Outbond “Garuda”, POKJA mangrove, dan KP2B (Keluarga Pemuda Pemudi Baros).

### **Objective 2 : Application Making for Mangrove Development Based on Geographical Information System (Interactive Map and Website)**

Steps of application manufacture based of geographic information system are as follows :

1. Data collection of potential of mangrove areas and community participation in mangrove area development in the form of primary data and secondary data (mapping, interviews, photos, videos)
2. Arranging and processing of primary data and secondary data which have been collected into a database using the software Microsoft Word, Microsoft Excel and GIS (ArcGIS)
3. Drafting for applications based of Geographic Information Systems in Mangrove Development Area
4. Arranging the layout or page layout plan which will be filled by a variety of data that has been compiled and processed
5. Insert all the data that has been compiled and processed (photos, videos, maps, satellite images and participatory mapping results) into the layout multimedia applications
6. The application making using Adobe Flash software
7. Uploading the application to the Village website Tirtohargo and Mangrove Development Area

### **Phase 4 statements .**

In this phase, report drafting and preparation of maps as the final product of research. At this phase of the report drafting is also carried out consultations with relevant stakeholders such as the local government and communities also regional institution. The regional institutions which contribute in mangrove development in Baros, Tirtohargo are Department of Marine and Fisheries, Environmental agency, Department of culture and tourism, and Planning agency and regional development

The consultation process can be performed using workshop media, seminars and or discussion. Based on inputs from the stakeholder will be

a final report. In this research the consultation process using focus group discussion.

### Phase 5 dissemination

At this phase, the dissemination of the results of activities in paper format for national and international journals, posters, leaflets and course material. The following is a detailed objectives, outputs , methods , and the dataset which is used (Table 2).

Table 2. Objectives, Outputs, Methods, and Dataset

No	Objectives	Outputs	Methods	Dataset
1	The Community-Based Mangrove Area Mapping	Community participation in mangrove tourism development and result maps of participatory mapping	Participatory mapping	Remote sensing image , a list of structured questions
2	Application Making for Mangrove Development Based on Geographical Information System (Interactive Map and Website)	Application of interactive maps and website	Application making	Result map of participatory mapping, digital documentation, and secondary data and information

## Results and Discussion

### The Community-Based Mangrove Area Mapping

Participatory mapping was conducted on June 2015 with participants, covering the local government officer , mangrove area managers, and representatives of social community. This participatory mapping aims to determine how the views of local people about the mangrove ecosystems condition that develop all this time. Participatory mapping that applied was a two-dimensional mapping scale (2D-Scaled) using Worldview2 printed image size of 3 meters x 2 meters with a scale of 1 : 2000. Other equipments that are needed were transparency, color markers , erasers . The activity has lasted for 3 hours.

The results that is obtained in participatory mapping 2D-scaled is still a tentative map in hardcopy. Furthermore , data conversion is conducted manually or digitized on screen using GIS application. Accuracy and perception is required in data conversion of mapping



results process. All data is inputted in the application of GIS and is processed into a map image which is made based participatory mapping variables. Those maps among others, the administrative boundary map, mangrove distribution map, accessibility map, infrastructure map, land use map, and map land status. In addition, the development plan map which consists of a tourist route map, and map of mangrove conservation development.

### The Administrative Boundary Map

The administrative boundaries map is delineated based on local people knowledge. Administrative boundary mapping aims to determine the scope of the people knowledge against its own territory. It consists of administrative boundaries of villages and hamlets. It can be the basis for subsequent thematic mapping. Administrative boundaries is the foundation of knowledge in regional planning. Therefore, in this case, the administrative boundary information is information that can be used as a reference for the development of the mangrove ecosystem in the village Tirtoharjo.

Tirtoharjo village consists of six hamlets, namely Muneng, Baros, Kalangan, Karang, Gekunung, and Gunungkunci. Based on the results of mapping, a total area of Tirtoharjo is about 34.44 Ha. The widest Hamlet is Baros with an area of 909.269 square meters. Baros hamlet located in the west of the village where dominated by agricultural land. Besides, Kalangan Hamlet is the smallest area where located in the east of the Tirtoharjo administration area with an area of 277.494 square meters or 27.74 Ha.

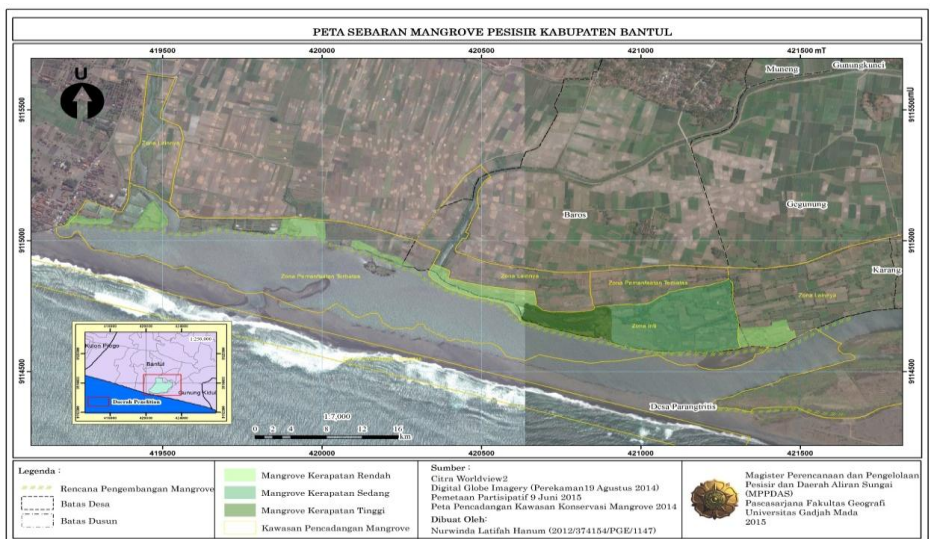


Figure 2. The Man of Mangrove Distribution

### **Mangrove Distribution Map**

These classes are limited qualitatively. The proposed map of coastal park mangrove conservation area and administrative boundary map are used as a basis for mapping. Community participatory mapping results showed that the highest width of mangrove area is mangrove with medium density in the core zone while the mangrove that has a high density in the core zone only reaches approximately 1/3 of the mangrove area of medium density (Figure 2).

### **Infrastructure and Accessibility Map**

Based on participatory mapping, availability of infrastructure facilities in the village Tirtohargo is sufficient. The condition of the road network in Tirtohargo is in good condition with asphalt. The condition of the road network that are included in category of village road, on the border of settlements and agricultural land, is still a corblock road and the road to the location of mangrove ecosystems still a sement road. In addition, the availability of electricity network has spread throughout the village Tirtohargo. Electrical energy also needs to support community activities.

Physical infrastructure and building development in the area of mangrove ecosystem to support activities in there must have the criteria that must be considered. The development is based on an understanding of the potential of the local area, the local culture, the characteristics of the visitors, and the value of conservation (Nugroho, 2011). Physical building design should be planned with the concept that will be highlighted in the mangrove ecosystem development, in this case, the area of mangrove ecosystem development in Tirtohargo. The concept of infrastructure development can be directed to the concept of culture and the environment.

### **Land Use and Land Status Map**

The result of land use participatory mapping shows that agricultural land has the largest land area. It shows that agricultural land has great potential to be developed as well. Agricultural land is currently the main source of livelihood of the majority of the society. In addition, the development of settlements in the village Tirtohargo has now reached 854.380 m<sup>2</sup>. Expansion of mangroves in the coastal of Tirtohargo not easy to do. Land status be a factor to consider in the use of land in the zones that have been established in the area of coastal park mangrove conservation .

The result of participatory land status mapping illustrates that large parts of the coastal village of Tirtohargo the ground sultan (Figure

3). Associated with the proposed map of coastal park mangrove conservation area in Tirtohargo, there is a freehold land and sultan ground which are included in it. Freehold land in the proposed zone becomes the primary consideration in determining utilization in mangrove ecosystem development. Participatory mapping related to land status is intended to provide basic information of land status ownership, especially in the area of development so that the obstacles in the implementation of development programs can be anticipated.

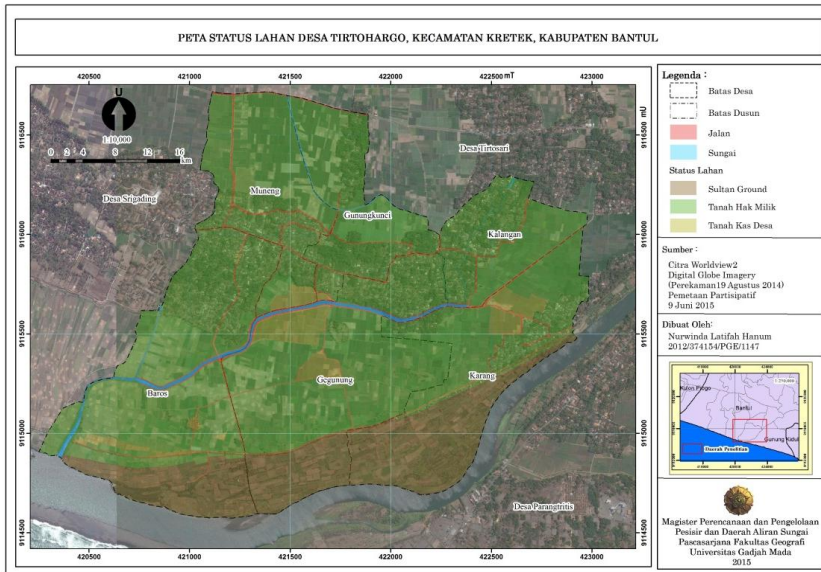


Figure 3. The Map of Land Status

Further, focus group discussion ( FGD ) was conducted to obtain the aspirations of the community about what are society wanted and needed in mangrove development planning (Figure 2). The results of this activity will be a consideration material for planning of recommendations and an indication of mangrove development program as a bottom-up implementation of a policy planning. The results summary is described on table 3.

Table 3. The Results Summary of Participatory Mapping and FGD

Plans	Priority
Mangrove expansion by intensive planting	Improving road and irrigation infrastructure
Improvement of infrastructure, especially access to the tourist areas and mangrove conservation .	Human resource development in the field of economy and education : 1. Entrepreneur Training( capital and management ) a. Entrepreneurship in the field of animal husbandry , agriculture , and fisheries b. Packaging of local culture and souvenirs c. Training of tourist services 2. Development of research , training , education
Improvement of tourist facilities and supporting infrastructure .  The closest program is a parking lot with the concept of parking lot and village markets .	Mangrove expansion by intensive planting

Source : Focus Group Discussion , Participatory Mapping , June 2015

The benefit from advantages of the use of participatory mapping method is that people can contribute directly to the development of mangrove ecosystem which is the implementation of bottom-up method policy. Moreover can directly increase the capacity of spatial knowledge of local communities, especially in developing mangrove ecosystem. Results map of the participatory mapping provides information which is listed geographically and easily understood by society which present a picture that is in accordance with the existing conditions. Therefore, the results of participatory mapping can be used as a discussion tool or policy determination.

The challenge of shortage of the scaled-2D participatory mapping application method is the utilization of remote sensing imagery is a new thing for the common people , especially for elder people, in particular in the village of Tirtohargo .Therefore, in participatory mapping, adjustment and harmonization is needed between communities and facilitators. In addition , the results map is in form of hardcopy that is not easily disseminated.



Figure 4. FGD of Mangrove Development Area

1). The Result of FGD ; 2). Social Communities Participant

Source : Focus Group Discussion , Participatory Mapping , June 2015)

### **Application Making for Mangrove Development Based on Geographical Information System (Interactive Map and Website)**

Participatory mapping produces maps related to the development plan of mangrove . Map is used for visualizing spatial data , ie data relating to the location or attributes of an object or phenomenon in the earth's surface ( Kraak , 2007). In addition , the map can be used as a tool for planning and discussion to help spatial policy making process. Therefore , the presentation of the map should be easy to understand and interesting with regard to the rules of making a good map so that information can be conveyed to the general public , especially local people who lay on the map .

One way that can be developed in the map visualization to make it more interesting , interactive , and accessible is the use of multimedia and websites . The use of multimedia in the map visualization will provide more extensive information is not just a static

image but it can also add information in the form of video , text , audio , and animation . Interactive maps that are created in this research are interactive static maps. Called static and interactive maps because maps that made in the form of raster which is designed using the interactive multimedia software adobe flash cc. Map in raster form only serves as a display that can not be changed in accordance with the scale that is desired by the user . Interactive map which is packaged in the form of multimedia can be disseminated more interesting by using web media . Web is a media delivery map that is interesting because the information is presented in the web with virtual display and independent (Kraak, 2007) . Therefore , multimedia and web applications used in this activity to make it more attractive

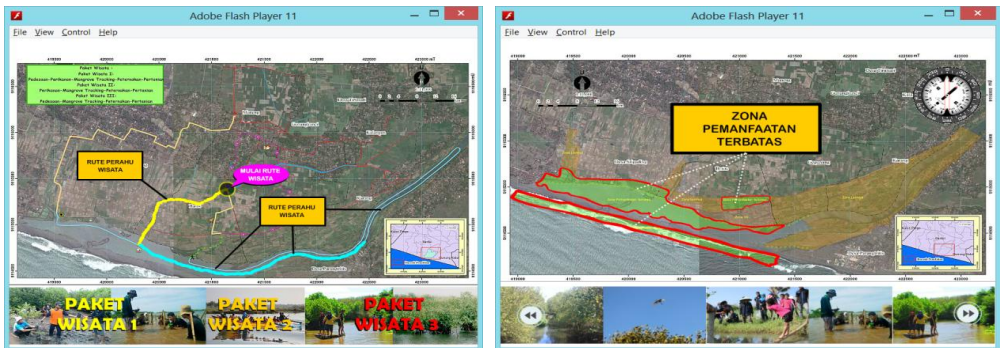


Figure 5. Interactive Map

## CONCLUSIONS

The preliminary result indicates;

1. Scaled-2D participatory mapping is an effective method to facilitate dialogue or discussions.
2. The result map provides information listed geographically, easy to understand by the citizens with appropriate picture of actual conditions, and it can be a tool for considering of decision making.
3. The maps can be made into geographic-based interactive information system as appropriate campaign media to increase public knowledge and insight.

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Environmental Agency of Bantul (BLH Bantul), Department of Culture and Tourism (Dinas Kebudayaan dan Pariwisata Bantul), and Planning Agency and Regional Development (BAPPEDA), and Digital Globe Foundation that support the Worldview2 image.

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