# InaSAFE for Flood Contingency Planning in Bengawan Solo

## Background

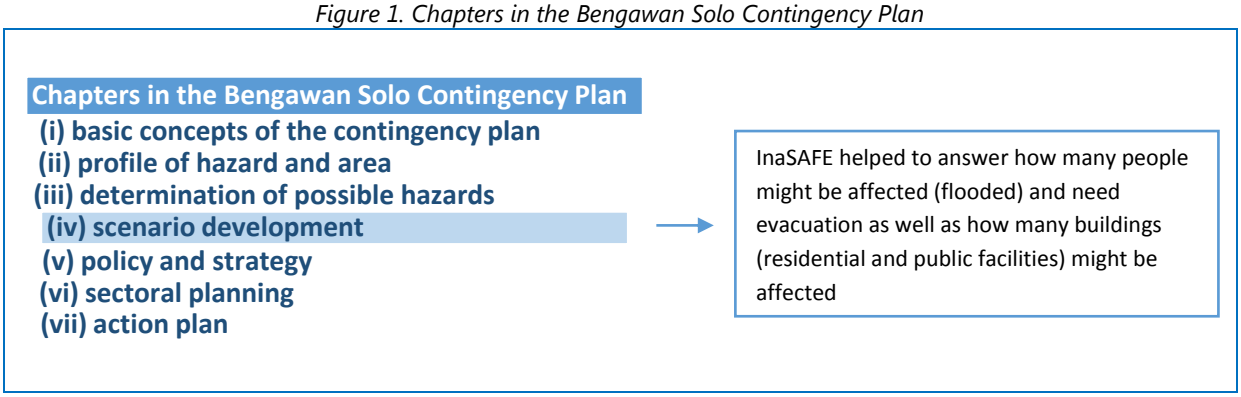
Bengawan Solo river is the biggest, longest, and oldest river in Java island. Bengawan Solo also poses a risk for 300,000 people, who live on and around the riverbank area due to the frequent flooding. The last flood in January 2013 inundated approximately 26,229 hectares and caused an economic impact, which was estimated at 47 billion rupiahs (4.7 million USD).

On the same year, the Australia - Indonesia Facility for Disaster Reduction (AIFDR) and the United Nations Office for the Coordination of Humanitarian Affairs (UN OCHA) provided support to the Humanitarian OpenStreetMap Team (HOT). This support has enabled the provision of spatial data and InaSAFE tools to produce a more realistic flood contingency plans in the Bengawan Solo river basin as a key disaster risk reduction instrument. InaSAFE is a tool that produces realistic natural hazard impact scenarios, aligning perfectly with the need to help emergency and disaster managers develop written contingency plans.

## Implementation

InaSAFE played a key role in the scenario development section, which was one of the chapters in Bengawan Solo Flood contingency plan. InaSAFE helped to answer how many people might be affected and need evacuation, as well as the number of buildings (residential and public facilities) that might be affected. The Bengawan Solo Flood contingency plan document consists of 7 chapters as described in the figure below.

*Figure 1. Chapters in the Bengawan Solo Contingency Plan*




The implementation was started with data collection, followed by data analysis and integration of the results of the analysis into the contingency plan document. The data collection activity was coordinated by the Capacity Development Support Program (CDSP) of AIFDR in collaboration with Humanitarian OpenStreetMap Team (HOT) Indonesia, East Java Disaster Management Agency, and Indonesian scouts. HOT was in charge of the data analysis, while UN OCHA and CDSP were in charge of integrating spatial data and analysis results into the contingency plan document and using them for further analysis.

Two layers, hazard layer and exposure layer, were used to determine the number of affected people. On the hazard layer, the team used data from a flood event recorded by BPBD of East Java combined with field survey and participatory mapping data. As for the population data that is required for the exposure layer, InaSAFE proposed to BPBD to use AsiaPop data as the initial data before being processed further, instead of the formally recognized data from the National Statistical Agency (BPS), to avoid the extensive works it would require of converting BPS' data from tabular into vector and raster data format. Prior to the decision, a comparative analysis of the population data was conducted between AsiaPop and BPS, and it was found that the difference between these two datasets was only 10%. Based on such circumstances, it was then agreed to use AsiaPop data.

Since disaster not only affects people, but also the social and economic infrastructure that they depend upon, InaSAFE also tried to produce data of damage on the infrastructures. Buildings (residential, public facilities, economic center, and government properties) that might be affected were calculated using InaSAFE's hazard and exposure layer. The hazard layer was provided from the process as described earlier, while to have an updated exposure data, users were instructed to use their own data or utilize OpenStreetMap (OSM) data. Unfortunately, as a new web mapping "provider" in Indonesia, only few people had utilized OSM, which made the platform only contained limited building and infrastructure data in the area of interest. To solve this problem, 5 days of field mapping were implemented in collaboration with 50 scouts to map public facilities and residential building located in flood prone areas.

*Figure 2. Field mapping survey in collaboration with 50 scouts in 5 districts*

## Results / Output of the Implementation

InaSAFE had successfully produced several data of the disaster impacts by mapping out the affected area, people and infrastructure, which led to decision making concerning the size and designation of the relief efforts.

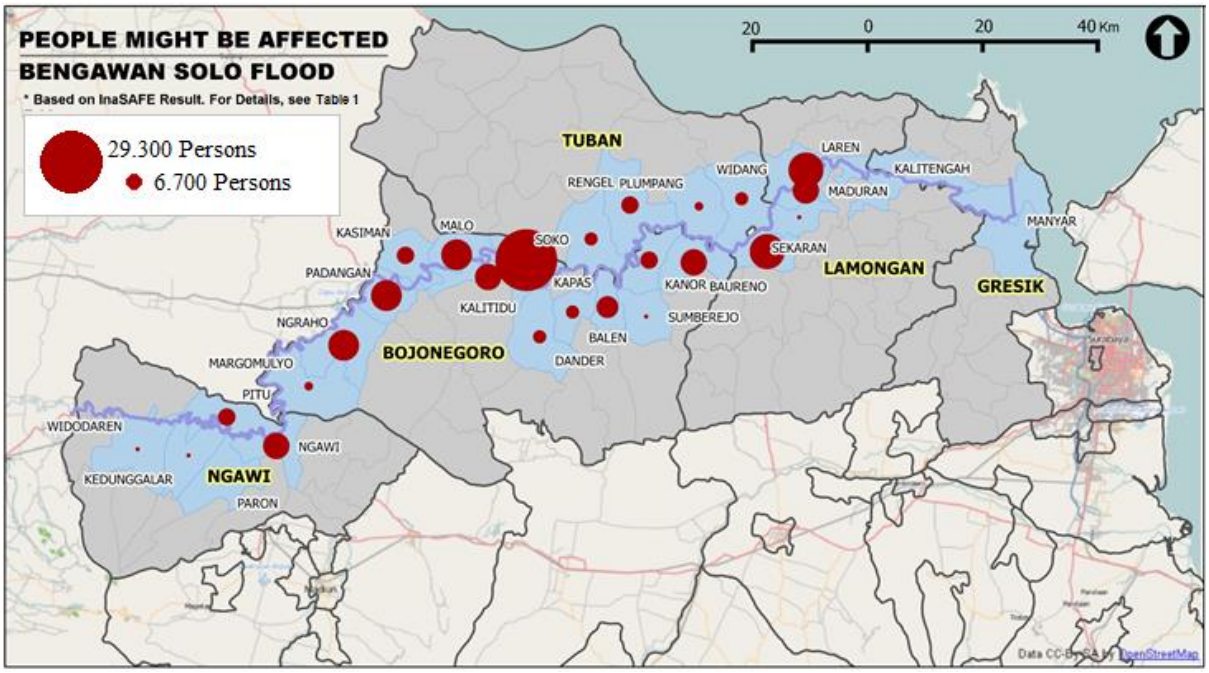



*Figure 3. Map of people that might be affected at the village level (calculated by InaSAFE)*

Based on InaSAFE results, it was estimated that about 275,000 people, who lived on and near the Bengawan Solo river bank, might be affected by the flood (see Figure 1). Using 1% evacuation threshold, it was predicted that about 2,700 people might need evacuation. InaSAFE also not only generate the number of people affected, but also disaggregates the number by area, sex, and age, as could be seen in Table 1.

*Table 1. People who might be affected by a Bengawan Solo flood**

| District | The number of people might be affected | The number of people might need evacuation ** | Population Details | | | The number of female population *** |
|---|---|---|---|---|---|---|
| | | | Child | Adult | Elderly | |
| Bojonegoro | 202,821 | 2,000 | 53,342 | 133,659 | 15,802 | 101,411 |
| Ngawi | 13,701 | 130 | 3,603 | 9,029 | 1,069 | 6,851 |
| Tuban | 3,669 | 30 | 965 | 2,418 | 286 | 1,835 |
| Gresik | 803 | 8 | 211 | 529 | 63 | 393 |
| Lamongan | 54,540 | 540 | 14,344 | 35,942 | 4,254 | 27,270 |
| **TOTAL** | **275,534** | **2,708** | **72,465** | **181,577** | **21,474** | **137,760** |

* Calculated by InaSAFE 1.1.0 in QGIS 1.8

** 1% threshold of population that might need evacuation

InaSAFE also calculated that around 20,064 buildings might be flooded. This number consisted of 43 places of worship and 22 schools, and the rest of them were composed mainly of residential buildings.

Once the number of people and buildings that might be affected was known, InaSAFE users were also able to calculate how many basic relief items might be needed (see Table 2), which dramatically improved the ability of disaster managers to plan relief efforts and resources required.

*Table 2. The number of basic needs to be prepared for a week**

| District | Rice (kg) | Drinking Water (Liter) | Clean Water (Liter) | Family Kits | Toilets |
|---|---|---|---|---|---|
| Bojonegoro | 5,600 | 35,000 | 210.000 | 400 | 100 |
| Ngawi | 364 | 2,275 | 13.650 | 26 | 6 |
| Tuban | 84 | 525 | 3.150 | 6 | 1 |
| Gresik | 22 | 140 | 6 | 1 | 0 |
| Lamongan | 1.512 | 9.450 | 1 | 108 | 27 |

* Calculated by InaSAFE 1.1.0 in QGIS 1.8

## Lessons Learned

**1. Data Availability and Mapping Strategy**

InaSAFE is a powerful tool, though it could increase its effectiveness if it is supported by a robust hazard and exposure data. Ensuring that infrastructure in the hazard prone area has been mapped is part of the key to success. If field mapping is going to be implemented, public facilities and key infrastructure should be prioritized as opposed to residential buildings.

**2. Community and Civil Society Organization (CSO) Involvement**

Involving community and CSO has several benefits such as: (i) it is often faster and simpler than mobilizing government staffs, (ii) they have strong motivation and less formal relationship, and (iii) such community involvement also helps them to gain more awareness of the hazard around them. To organize an activity with government agencies requires several days to process the permission letters and managing with competing priorities including regular duties that must be carried out. Some agencies have limited staff, so they could not easily give permission to their staff to attend training or field mapping. It is also limited by working hours (8am to 4pm). In contrast to this, working with community volunteers or a CSO typically means more flexibility and less restrictions regarding permission letters, regulations and working hours. Once someone is not able to attend, they can easily be replaced with someone else. Thus, mapping activities have better result and achievement when community/CSO is involved in addition to government agencies.

**3. Involving Scouts as Volunteers**

To map and complete the attribute data of public facilities, volunteers were involved. There were about 50 scouts and none of them were familiar with OSM. Some of them were familiar with other types of mapping activities, and previously they had organized mapping in a conventional (paper-based) format, instead of digital mapping. Involving scouts helped us to improve map data, while also improving their digital mapping skillset and building experience in the use of digital mapping for their future endeavors.