The Added Value of Geospatial Information in Disaster and Risk Management: A Case Study on the 2009 Flooding in Namibia

Summary

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Objective and Approach

Whereas worldwide natural disaster related mortalities have decreased, economic losses are increasing. Reasons for this continuing expansion could be greater exposure to natural hazards, better reporting of damages and losses, or both. Projections on future disaster risk, being a product of vulnerability, exposure and hazard, foresee huge challenges for Disaster and Risk Management (DRM), due to rapidly growing cities (affecting vulnerability and exposure) and climate change (affecting the characteristics of hazards).

The potential value of geo-information in DRM is high because it can improve the quality and speed of decision making, which may result in lower damages and losses. Quantifying the value of specific geo-information products for different aspects of DRM would help to focus and justify investments in products that with high potential to reduce costs and to minimize damages and losses. Thus, an explicit value of the benefits can contribute to a more rational basis for policy makers and programmatic deciders. Therefore the aim of this case study is to propose and illustrate an innovative method for assessing the added value of geospatial information in DRM.

The 2009 flooding in Namibia was chosen as study case in order to test and illustrate a method for the economic valuation of geospatial information in DRM. A questionnaire specifically designed for this purpose was distributed to expert stakeholders. Systematic analysis of the results provided a template to chart the economic value of a given geospatial information product (an early warning system). Furthermore, case study specific issues were addressed such as the geo-information products used at the time of the flood, what caused the relatively low level of response to the early warning, what improvements have taken place since 2009 regarding early warning and what future developments the participants would like to see.

Major results

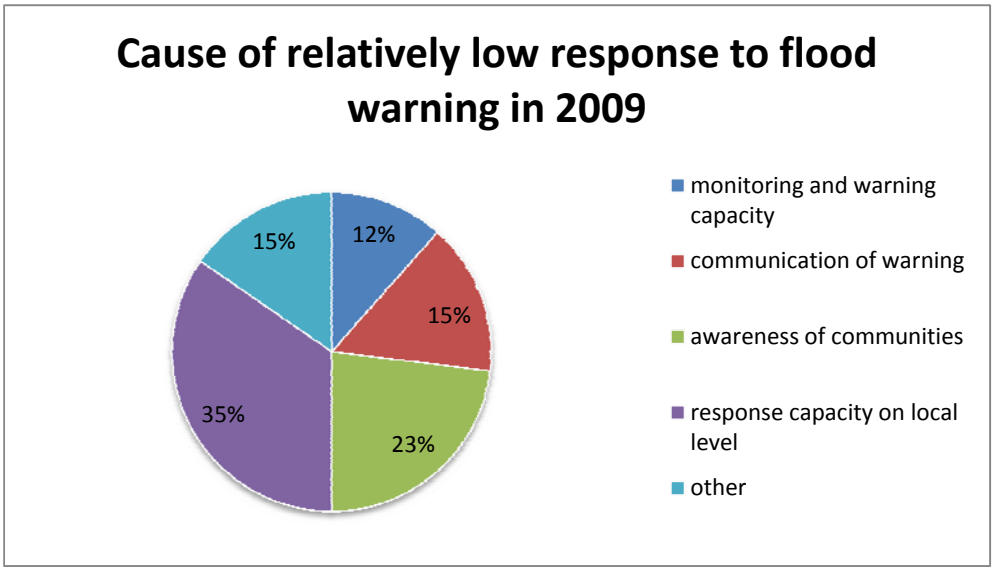
Application of geo-information products:

Out of 14 received questionnaires, 6 indicated they made active use of geo-information products or had been involved with the creation of these products during the flooding event. They have provided an estimate of the impact, as defined by the questionnaire: "How much do you think the product improved decision making and resulting actions during the 2009 flood, compared to NOT having this type of product?" Also, actions supported by the geo-information products used were indicated.

Geo-information product:	Average impact: *(1=low, 5=high)*	Supported action(s):
Satellite based flood maps	3.6	Flood detection, measurement of flood size/extent, support response efforts (including evacuation and basic needs supply), evaluate damages, reference for future events, raise public awareness and mitigation measures
Satellite based rainfall estimates	4	Early warning purposes, preparation for disaster managers for upcoming event, Estimates of which areas are flooded.
Digital Elevation Model	2	Assist modeling of potential flood-affected areas
Baseline: Administrative boundaries or pre-flood water bodies extent	4	Important for production of accurate maps, estimate affected population
(Hydrological) ground data	4.3	Calibration and validation of modeled estimates of water levels and verification of satellite imagery

Response to early warning:

13 out of 14 respondents indicated what in their opinion caused the relatively low response to the flood warning provided in 2009.

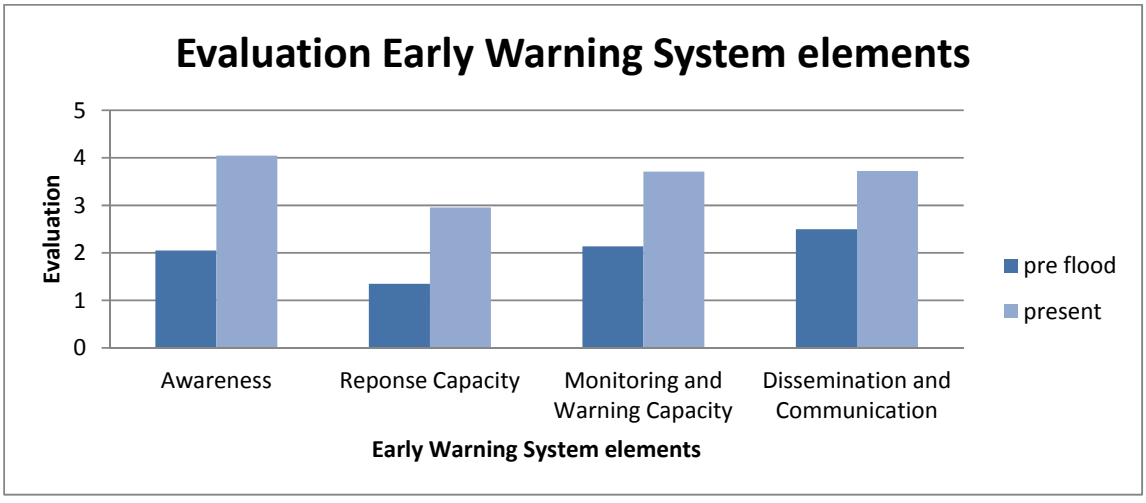


Present situation:

Since 2009 the flood management was judged to have improved regarding:

- Communication of water levels
- Awareness, understanding and reliance in warning system of communities
- International cooperation
- Monitoring & forecasting of water levels and flooding
- Internal capacity of local flood management organization

Out of 14 responders, 9 provided figures for all these categories, pre flood and at present. Three delivered a partial fill in due to the fact that the felt they could not judge the local situation from a distance or because they felt only the current situation could be judged from their perspective. The table below illustrates how participants feel the four elements of an effective early warning system have developed in a positive manner since the flooding in 2009.



Economic impact of Flood Early Warning System: The Cost Avoidance Approach

The impact assessment was based on the following reference scenario and accompanying question:

In order to make a valuation of a flood early warning system, it is important to assess what damages could have been avoided resulting from the 2009 flood. Therefore, please consider the following scenario:

- Imagine there is a flood information system in place that provides you the following information:
  - A *spatial component* showing the up-to-date flood extent.
  - A *temporal component* proving an early warning approximately 10 days in advance that a flooding event is expected.
- Assume you have ***all the capacities*** needed to respond (materials and human resources).

Question: What percentage of the damages and losses in 2009 could have been avoided if there was such a flood information system in place assuming:

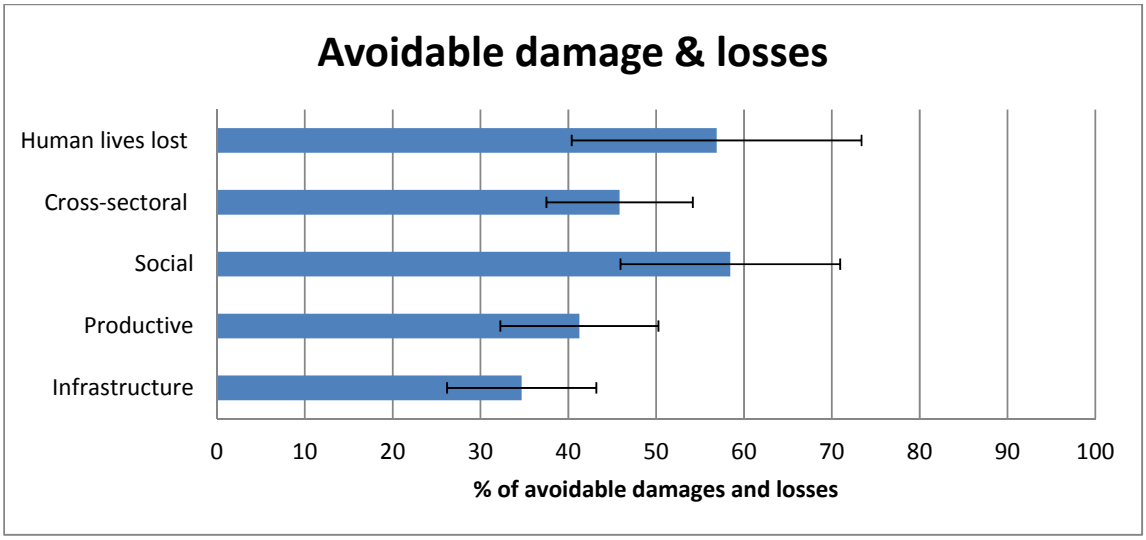
- Effective communication
- Adequate follow-on actions

Please provide the upper and lower boundary of your estimate: for example: 20-35%

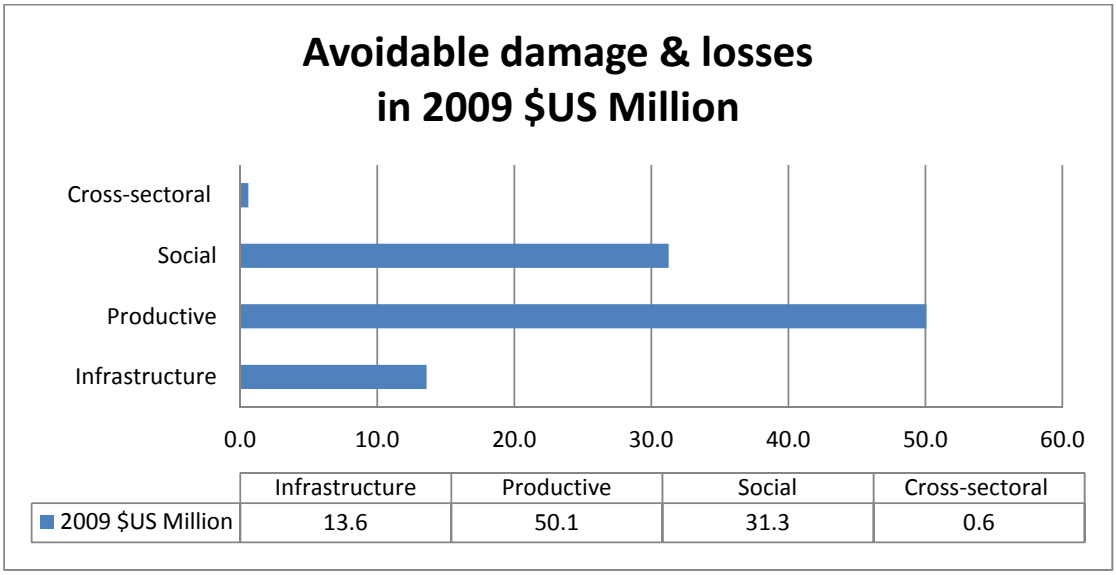
Participants were asked to assess this question for four different sectors:

1. Infrastructure (water supply, sanitation, transport, energy)
2. Productive (agriculture, industry, commerce, tourism)
3. Social (housing, health, education)
4. Cross-sectoral (environment)

Out of 14 respondent, 8 were able to fill in the economic valuation part. The results illustrate the following: The blue bars show the average amount that was indicated of damages and losses that could have been avoided (assuming the scenario), the narrow black lines show the average range accompanying this.



When coupling these percentage numbers to actually occurred damage and losses monetary figures, this leads to data presented below:



Apart from the losses of human live, economic valuation of which is a sensitive topic, the other four sectors add up to a total of 95.54 Million $US that could have been avoided had there been an effective early warning system.

Conclusions:
The geo-information products used at the time of the Namibia flooding in 2009, except for the DEM, were estimated to have had a higher that average impact on decision making processes related to the flooding compared to NOT having these products available.

All elements of an effective early warning system (awareness , response capacity, monitoring and warning capacity, and dissemination and communication) are said to have improved since the 2009 flooding disaster.

Nevertheless, the questionnaire results also highlight early warning system issues that still need attention, such as the improvements of communication of the warning message in several ways (e.g. including coloured maps with risk zones) and further exploration and implementation of modelling capabilities for flood forecasting.

Due to the relatively low number of responders this study does not claim to have found a 'final' or 'concluding' monetary figure of the value of geospatial information in the 2009 flooding disaster. However, the 'Cost Avoidance Approach' was illustrated as a systematic method for assessing the added value of geospatial information in DRM, thus providing a template for future research on this topic.