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▶ **To cite this version:**

Nicolas Taillefer, S Fraser, A Burzel, Nicolas Chauvin, Audrey Hohmann, et al.. ThinkHazard! – Giving decision makers access to multi-hazard information for safer projects. IDRIM 2016 : 7th International Conference on Integrated Disaster Risk Management Disasters and Development: Towards a Risk Aware Society, Oct 2016, Isfahan, Iran. hal-01349286

HAL Id: hal-01349286
https://brgm.hal.science/hal-01349286

Submitted on 27 Jul 2016

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ThinkHazard! – Giving decision makers access to multi-hazard information for safer projects

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ABSTRACT: Building a safer society requires accurate information about natural hazards. Many countries are affected by multiple hazards, which need to be considered carefully in development projects like infrastructure, construction, educational or agricultural programs. When defining programs or planning investments, it is of great importance to be aware of potential natural threats that could adversely affect projects during their lifetime. Considering the impact of climate change, it is also vital to anticipate future evolution of these hazards in a context of changing conditions. One of the major challenges to ensure sustainable development is to engage in disaster and climate proof approaches at early stages of the projects. A step forward this purpose is achieved when decision makers can access to easily understandable and reliable information on hazards as well as recommendations about how to translate this knowledge into appropriate actions for their project. The Global Facility for Disaster Reduction and Recovery developed a new hazard screening tool named *ThinkHazard!* to contribute to bridging the gap between existing scientific knowledge and decision makers' practical need. It consists in an open-source, simple and robust online tool that provides the hazard level at the user's location for eight widely encountered hazards. The tool also releases first level information on how to cope with hazards in projects' early decisions, and guides the users to other sources of more detailed information about hazards and risk management good practices.

Keywords: Hazard, screening, planning, development, decisions, risk reduction

1. INTRODUCTION

Natural hazards are affecting every country in the world, and many places have to face multiple ones. Despite years of growing awareness, natural disasters still adversely impact the environment and communities, who continue to pay heavy toll each year. To reduce the impacts of natural hazards is the red lead of the 7 objectives of the 2015 Sendai Framework, the new global policy for disaster risk management. Turning these objectives into practice goes through a growing awareness of natural hazards locally and through the dissemination of good practices for project design and risk management integrated approaches.

Many practitioners acknowledge that a great challenge on the field is to provide decision makers with accurate but easily understandable information about existing hazards. Decades of research programmes and fast growing scientific knowledge have produced valuable and high level scientific information. But information is spread across many organizations in various forms from technical reports to maps or academic papers. Most of this information is before all dedicated to specialists, and the correct interpretation of the results requires a strong background in very technical fields. On the opposite, many decision makers do not have this background, nor time and expertise required to find and interpret information when designing development projects or deciding whether to finance them. As a result, many projects are still developed without properly taking into account natural threats, which jeopardize their mid-term sustainability, and many programs fail to produce expected long-term outcome when disasters ruin built infrastructures.

Considering the vital challenges raised by this statement, the Global Facility for Disaster Reduction and Recovery (GFDRR) developed a new hazard screening tool, *ThinkHazard!* (www.thinkhazard.org), which pursue three objectives to bridge the gap between presently available knowledge and decision makers' needs: (i) to provide easily available, robust and understandable knowledge on hazard level for eight natural perils, (ii) to become a place for

users to understand risks and obtain appropriate guidance about how to implement efficient measures in projects, (iii) to offer opportunity to maintain cutting-edge information and growing coverage on natural hazards worldwide.

2. CONCEPT FOR *THINKHAZARD!*

In order to reach the three objectives of the tool, it was decided to develop an open-source, online application, which deals with publicly available hazard data provided by many organizations involved in development projects or in disaster reduction. The user enters its project's location, then the tool displays a simple hazard level based on an intuitive rating scale (very low, low, medium and high) with consistent meaning for all the hazards: river flood, earthquake, water scarcity, cyclone, coastal flood, tsunami, volcano and landslide. When appropriate, information on the expected impact of climate change on this statement is provided. The hazard level is associated with practical guidance for decision makers and project planners to incorporate disaster risk management in their project. Additional information is also available on the same page to help the user to go a step forward in the understanding of risks and risk management measures for the selected hazard. Feedback from the user or suggestions of complementary hazard datasets is highly encouraged by GFDRR. Feedback can be made directly from the user interface. GFDRR can also support institutions and sectorial groups to develop more specific and targeted version of *ThinkHazard!* to better meet different stakeholder needs.

Basic concept of *Thinkhazard!* consists in providing a repository of geospatial hazard data and information that can be used by actors of the development sectors, who do not necessarily have advanced expertise in natural hazards. It is designed to help the user rapidly and effectively find information to get aware of the potential threats and answer fundamental questions for his project: "What hazards are resent in my project location?", "Which might have a negative impact on my project in its lifetime?" and "How can I address the risks or find support to minimize the impacts on my project?".

An innovative approach has been developed in order to implement an efficient analytical engine into a powerful communication tool with a user friendly interface optimizing advantages of maps, text information and links. Extensive work has been done to make the results consistent for all hazards and as accurate as possible without losing simplicity. One of the major features of *ThinkHazard!* is to deliver the user with a series of recommendations on how to reduce the risks of natural hazards in his project. Guidance has been tailored to each hazard, and adapted to the hazard level, with contributions of best experts of the DRM community. Content has been written in simple yet accurate words with a special focus on project development needs. In addition to this first source of information, data sources supporting the results and additional information are delivered to the user, comprising reports and public documents, tools or websites offering complementary information relevant to both the hazard searched and the project location.

3. OUTLOOK OF THINKHAZARD MAIN FEATURES

3.1 Design

The design of the tool fosters intuitive and short workflow, organized around three main pages. On the home page users enters the project location name (administrative unit). It corresponds to boundaries from the FAO Global Administrative Unit Layers dataset. Users are then directed to hazards overview page where levels of the eight hazards handled in *ThinkHazard*! are displayed. Users access the final level of pages (hazard report) by clicking on a hazard icon or a hazard name in the overview. Detailed information is available in the report about the hazard level, recommendations and addition resources. Each time a map is shown, users can navigate through the administrative levels directly by clicking on the boundaries. They can also navigate through the different hazards just by clicking on the hazard icon, and they will be provided with results for the administrative unit they are searching. FAQ and About pages give useful general information about the tool purpose and terms used to describe hazards. A link to suggest feedback is available at the bottom of the result pages.

The engine of the tool is able to handle different datasets for each administrative unit, and select best available information to deliver hazard rating to the user, at the location of interest. All datasets are stored on the Geonode system, an open source geospatial platform.

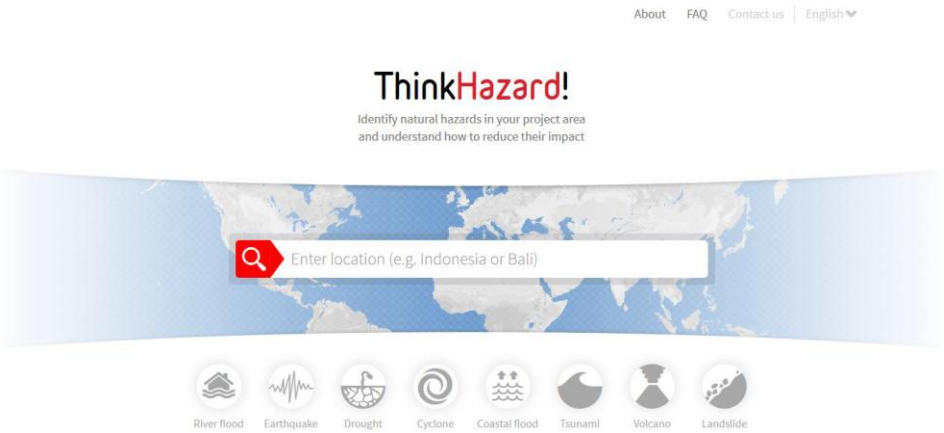

Fig. 1: Screenshot of the home page where the user enters its project location

3.2 Methodology

Tool's process is designed to make different scales available. All input data are required to be georeferenced grids (raster), if possible in the form of probabilistic intensity values. Data are stored externally to the tool in a Geonode, and open access data can be directly accessed via the user interface. A quality scoring procedure has been implemented to select the best dataset for each location. A special effort has been made to get global coverage for each hazard, but when more precise data are available locally, they are processed in priority.

ThinkHazard! is an open-source tool, its code is hosted on Github and available for developers to improve or adapt under GNU general Public license. The tool retrieves data (and data updates) from the data storage server, identifies return period and parameters required to apply data processing, and copies the data in a processing server. Then the hazard categorization procedure is applied on the lower administrative level and results are stored on a production server. A decision tree selects the most appropriate results for each unit. Then results are copied on a display server, on which the queries of users are searched. Each information and recommendation displayed on the user interface are associated to an administrative unit and a hazard level and linked together through the hazard level categorization procedure.

Table 1: Intensity parameters, units, and thresholds for the hazard categorization process

Hazard	**Intensity parameter**	**Unit of the intensity parameters**	**Value of the intensity threshold**		
			High	*Medium*	*Low*
Earthquake	Acceleration (PGA)	g	0.2	0.1	0.1
Flood	Mean value of water depth (local data)	cm	100	100	100
	Mean value of water depth (global data)	m	0.5	0.5	0.5
Cyclone	Mean wind speed per Admin 2 unit	km/h	80	80	80
Tsunami	Coastal maximum amplitude (wave height)	m	2	0.5	0.5
Coastal Flood	Inundation depth at the coast	m	2	0.5	0.5
Volcanic	Volcanic explosive index (VEI)	-	4	4	4
Water Scarcity	Water available per capita	m3/capita/year3	1700	1000	500
Landslide	Landslide Susceptibility Index	-	5	5	5

Hazard level categorization is the key step of the tool. Its specificity is that it communicates the hazard level on the basis of "how frequent an area is likely to experience a hazard with damaging intensity". This meets directly the concerns of the decision makers, better than an approach where the intensity of an event is delivered. To do this the

tool processes intensity parameters together with return periods, when probabilistic data are available. The procedure has been adapted for hazards that are not commonly studied following a probabilistic approach. The procedure is run on two sets of parameters: intensity and frequency. The intensity threshold is the level of the intensity parameter (for example peak ground acceleration for earthquake) for which an event is considered damaging. The value is chosen to be relevant for a large range of project (not only infrastructures). A set of three data files are considered, corresponding to parameters' value for three return periods (475, 975 and 2475 years for earthquake), expressing decreasing frequency of events. For the selected location, an incremental procedure is run to grade hazard level: for the shorter return period, if intensity exceeds the threshold, the level is rate "high". If not, data for the medium return period is screened. If the intensity exceeds the threshold the level is rated "medium". If not, data for the longer return period is considered. If the intensity exceeds the threshold, the level is rated "low", otherwise it is rated "very low". Table 1 shows the value of the thresholds for the eight hazard considered in the tool.

3.3. Recommendations and additional information

From a user point of view, the most important outcome of "*Thinkhazard!*" is guidance provided to help reducing the impact of disasters on the projects. Guidance encompasses hazard specific recommendations, and further resources. Recommendations are displayed on a three stage basis, comprising (i) a core recommendation that explains the meaning of the hazard level and encourage the user to take it into account in an appropriate way, depending on the level of hazard, (ii) a brief statement on the impact climate change might have on the hazard level, (iii) technical recommendations consisting in a list of actions to be taken during the project development to reduce risks.

Technical recommendations have been developed in close cooperation with experts of each hazard largely involved in development projects. Actions are ranked according to their relevance for each hazard level, and some are specific to a given level. Special attention has been paid to write them with minimum technical language. They are displayed either in the form of a short summary or an extended text via a hyperlink. Additional information box gives access to a series of valuable information in various format (reports, data, advices, guidelines) stored on Geonode. They are filtered by hazard and location and displayed in the chronological order to help finding quickly appropriate information.

4. CONCLUSIONS

ThinkHazard! is a new, innovative, open-source tool enabling practitioners in the development sector to access natural hazard information for any location. It provides users with recommendations on how to deal with the associated risks from those hazards. The tool brings together publically available and privately developed hazard datasets in one interface, and focusses on the pertinent question for project development: 'What impact could this hazard have at this location?' *ThinkHazard!* is a communication tool, which promotes greater sharing and understanding of hazard and risk information within and outside of the DRM community. Its ultimate aim is to facilitate mainstreaming of disaster risk information into development project planning. It is designed to grow with input from the disaster risk management community, and we encourage feedback (via the tool) to aid its ongoing improvement.

5. AKNOWLEDGEMENT

ThinkHazard! was developed by GFDRR with a consortium comprising Bureau de Recherches Géologiques et Minières (BRGM), Deltares, and Camptocamp. Several other experts and expert groups have been involved in development of recommendations and validating hazard categorization methodologies: University of Canterbury, GNS Science, David Petley (UEA), Peter Dailey, SSBN, Geohazards International, and University of Amsterdam IVM.

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