StIRRRD:

A disaster risk reduction program in Indonesia

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Abstract

The Strengthening Indonesian Resilience: Reducing Risk from Disasters (StIRRRD) program, funded by the New Zealand Aid Program, aims to reduce the impacts of natural disasters in Indonesia through increasing the disaster risk reduction (DRR) capability of local government and local universities. This program is being jointly implemented by Universitas Gadjah Mada Indonesia and GNS Science New Zealand. The program is assisting ten selected districts/cities and associated universities to understand their hazards and risks, and manage these through developing prioritised Disaster Risk Reduction Action Plans and implementing components of the plans. Stakeholders in this program include the community, central and local governments, local universities, NGOs and the private sector. Developing relationships between local government and local universities is a key component, with the universities developing teaching and research programs to support their local government and communities in aspects of disaster risk reduction. Activities consist of study visits, focus group discussions, action plan workshops, training, education, a district peer support network and research. Specific technical training has included Base-Isolation, Risk Modelling, and Hazard and Risk Mapping. Future implementation projects will be more community-focused and are likely to include research, education and community response planning for tsunami; increasing community engagement with and understanding of the environment including local active faults and integrated catchment management; empowering women to become DRR actors in their communities; earthquake resistant building construction techniques for local artisans; and community involvement in landslide and debris flow management and early warning systems.

Keywords: Disaster Risk Reduction; Local Government; Indonesia; Action Plans; technical training; base isolation; risk modelling; hazard and risk mapping; community.

1. INTRODUCTION

Indonesia's proximity to the equator and the "Pacific Ring of Fire" means its population of over 240 million people is subject to many natural hazards that often result in loss of life, livelihoods, property, infrastructure, and can cause widespread environmental damage. Earthquakes and tsunamis are responsible for the largest disasters in Indonesia. The 2004 Aceh earthquake and tsunami caused hundreds of thousands of casualties (Satyarno 2013), partly caused by the lack of understanding by the community on how to react to either natural or official warnings (Satyarno. 2012, Satyarno 2013). The 2006 Yogyakarta earthquake caused around 5000 casualties, and highlighted the vulnerability of houses to earthquake shaking, as more than 200 000 were damaged (Satyarno. 2007, Satyarno 2011a). In 2009, a major earthquake in Padang demonstrated that engineered buildings, including hospitals, are also vulnerable to earthquake (Satyarno *et al.* 2009). Other recent disasters, like the eruptions of Merapi Volcano in 2006 and 2010, and forest fires of 2015 have also contributed to the large number of losses and casualties in Indonesia.

Successful risk reduction requires consideration of risk by all agencies, sharing responsibility for reducing risk, and empowering communities to be involved in risk management decisions. Successful risk reduction practice results in better construction and location of infrastructure, effective warning systems and land use appropriate to the level of risk.

In 2007 a new central government authority called BNPB (Badan Nasional Penanggulangan Bencana or National Disaster Management Authority - UUD 24 2007) was established in response to Indonesia's vulnerability. One year later the same authority was initiated at the local government level called BPBD (Badan Penanggunalan Bencana Daerah or Local Government Disaster Management Authority – Permendagri 46 2008). The 2007 and 2008 law reforms were the start of the process of achieving the Indonesian government's overall goal to reduce losses (economic, human, infrastructure, environmental etc.) from natural disasters. However, it has been recognised that the capacity of local government and other agencies with a role in DRR, at a district level, (e.g. spatial planning, utilities, universities, health agencies, emergency services, NGOs etc.) is low and considerable effort is required to build up the capacity of local government and get appropriate actions, plans, policies and regulations in place and enforce them.

Universitas Gadjah Mada (UGM) is partnering with GNS Science in implementing the Strengthening Indonesian Resilience: Reducing Risk from Disasters (StIRRRD) Program, funded by New Zealand Aid Programme of the Ministry of Foreign Affairs and Trade. The Program aims to reduce the impacts of natural disasters through increasing the disaster risk reduction (DRR) capability of Indonesian local government in ten districts and cities. Key Indonesian Government agency partners involved are the National Disaster Management Agency (BNPB) and the Ministry of Rural Development of Disadvantaged Regions and Transmigration (Kemendesa). As well as having a direct involvement in the Program (staff time and resourcing complimentary and linked activities) these National Agencies will continue building resilience after the 5 year funding of the Program ends.

2. THE StIRRRD PROJECT

The StIRRRD Program evolved from a pilot project conducted in Padang and Palu from 2011 to 2013. The success of this pilot project led to a larger program extended to eight other cities and districts (Table 1). The Program focuses on improving local government's ability to understand and manage its hazards and risks, improving institutional approaches to reducing risk and improving engagement among partners. It involves a 3 year engagement with each district, staggered over five years from 2014 to 2019 (Fig 1).

Table 1. Characteristics of the StIRRRD districts.

City/District (kota/kabupaten)	Population (2013)	'disadvantaged' District	Risk Index 2013 (Rank/496)	Province	Supporting University
Palu	356 280	No	110	Central	Tadulako
Donggala	287 920	Yes	80	Sulawesi	(UNTAD)
Morowali	108 870	Yes	136		
Padang	876 680	No	33		Andalas
Agam	467 000	No	35	West Sumatra	(UNAND)
Pesisir Selatan	440 740	No	79		
Bengkulu City	334 500	No	168	Bengkulu	Bengkulu
Seluma	181 170	Yes	73		(UNIB)
Mataram	419 640	No	302	Nusa Tenggara	Mataram
Sumbawa	426 130	Yes	293	Barat	(UNRAM)

Years 1 and 2 involve the districts developing DRR Action Plans through training workshops, as well as training in New Zealand, to learn about different approaches and solutions to similar hazard and risk issues. The training focuses on enabling local government and local universities to develop effective and sustainable DRR structures, plans and projects for their districts. Training covers policy and implementation frameworks for DRR as well as risk assessment, risk communication, community engagement and risk management methodologies. Districts are encouraged to share projects through workshops and meetings to create a shared learning environment. Developing relationships between local government and local universities is a key component of the Program, with the universities developing teaching and research programs in aspects of disaster risk reduction to support their local government and communities.

Year 3 involves assisting districts to implement Action Plan activities that are common across a few districts. Specific Action Plan activities identified from Padang and Palu during the Pilot Project included expert training in Base Isolation and Risk Modeling. These have since been implemented and included participants from other StIRRRD districts and universities. New implementation projects have yet to be fully identified or scoped, but will be less technical and more community engagement/education focused.

2.1. The StIRRRD Districts and Stakeholders

The StIRRRD districts were selected using a number of criteria including having a "high" risk index (IRBI 2013 - see Table 1), already having an established local disaster management agency (BPBD), and having well established connections between UGM and the local university. The districts represent a reasonable spread geographically, vary in area

and population, have a range of hazards (Table 2) and risk, and are a mix of urban and rural areas. Four of the districts are classified as “disadvantaged”.

Stakeholders involved in the Program include:

- Central Government: BNPB, BAPPENAS, KEMENDESA
- Local Government: BPBD, BAPPEDA, PU, and other related local government agencies (SKPD)
- Local universities: Universitas Andalas, Universitas Bengkulu, Universitas Tadulako, and Universitas Mataram
- NGOs and Private Sector
- The community.

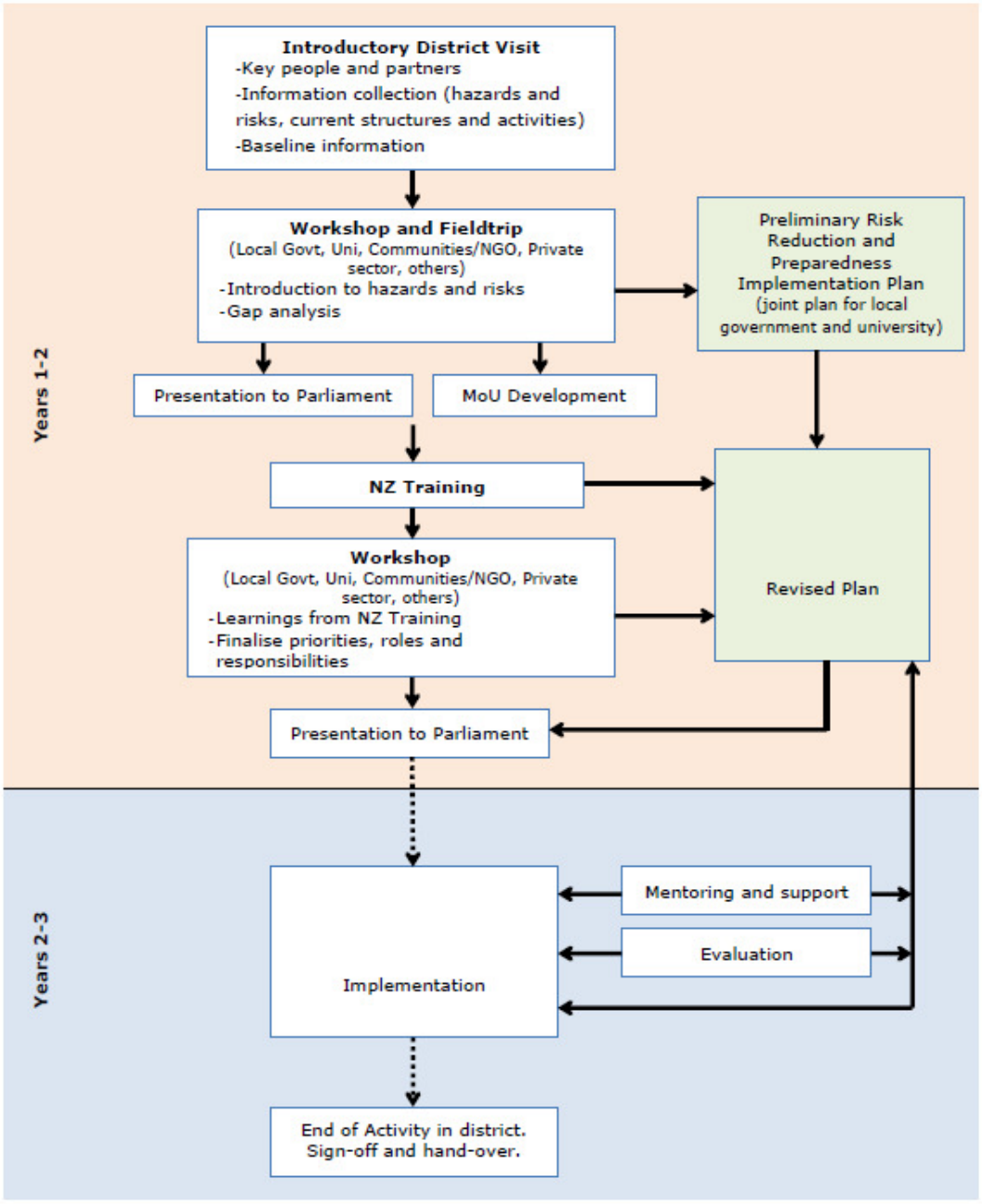


Fig. 1. Summary of the StIRRRD Program

2.2. District Vulnerability Profiles

The frequency of hazard events in each district from 2003 to 2015 is given in Table 2 (DIBI, 2015). The most common hazard events are floods, followed by landslides, earthquakes, drought and extreme waves and erosion.

Table 2. Frequency of hazards in StIRRRD districts between 2003-2015.

District	Flood	Landslide	Earthquake	Drought	Storm Surge and Erosion
Padang	29	12	4	0	8
Agam	14	20	3	1	2
Pesisir Selatan	21	3	6	1	3
Bengkulu City	10	0	2	1	0
Seluma	6	0	13	0	1
Mataram	4	0	0	0	5
Sumbawa	30	1	1	17	2
Palu	6	1	1	0	0
Donggala	14	3	0	2	2
Morowali	14	2	0	0	0
TOTAL	**148**	**42**	**30**	**22**	**23**

The range of hazards in a region is dependent on its geographical position and physical characteristics such as (1) topography, (2) hydrology, (3) climate, (4) geology, and (5) morphology. These unique physical characteristics and cultural conditions of each district can result in a variety of risk and potential disasters. Understanding the hazards and the vulnerability are important components of risk reduction and influence the selection of an appropriate suite of risk treatment options to reduce risk.

The StIRRRD Program has developed a Local Government–Self Assessment Survey (LG-SAT-DRR) tool focused solely on disaster risk reduction (Anantasari *et al.* in prep) which measures the strengths and weaknesses of the DRR efforts and understanding in each district. Figure 2 summarises results for Seluma District in Bengkulu Province.

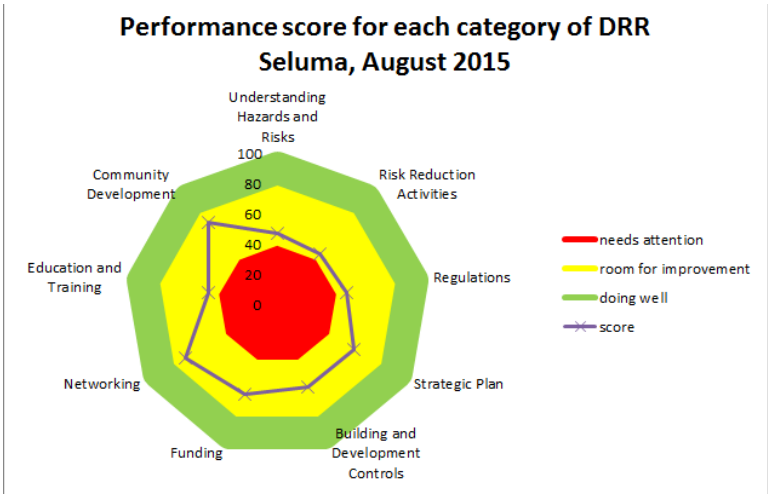


Fig 2: Summary of Self Assessment Survey for the Seluma District (Bengkulu Province) plotted on a radar diagram.

Available information for each district has been summarised into Vulnerability Profiles (Fig 3), which provide a snapshot of the Natural, Social and Cultural, Built and Economic environments, and the vulnerability of each to natural hazards (https://stirrrd.org/district-vulnerability-profiles/). They also describe the current Disaster Risk Reduction (DRR) capability in each district. These are being used to plan and guide DRR investment into risk reduction actions. The Vulnerability Profiles' intended audience is local government as well as the universities. Some local governments intend using the profiles as supporting information to help attract investment into their districts. Providing information in this way encourages transparency and engenders trust between local government and the private sector.

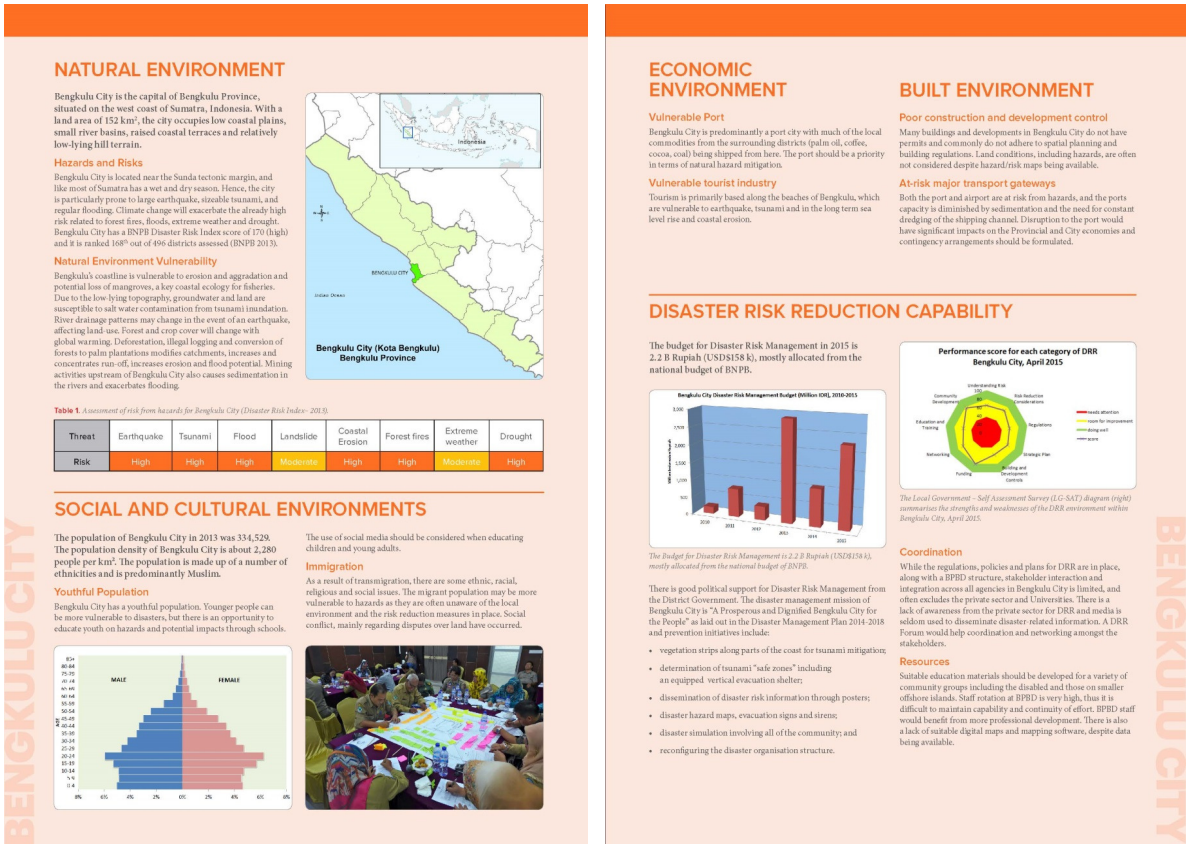


Fig 3: Summary Vulnerability Profile for the Bengkulu district

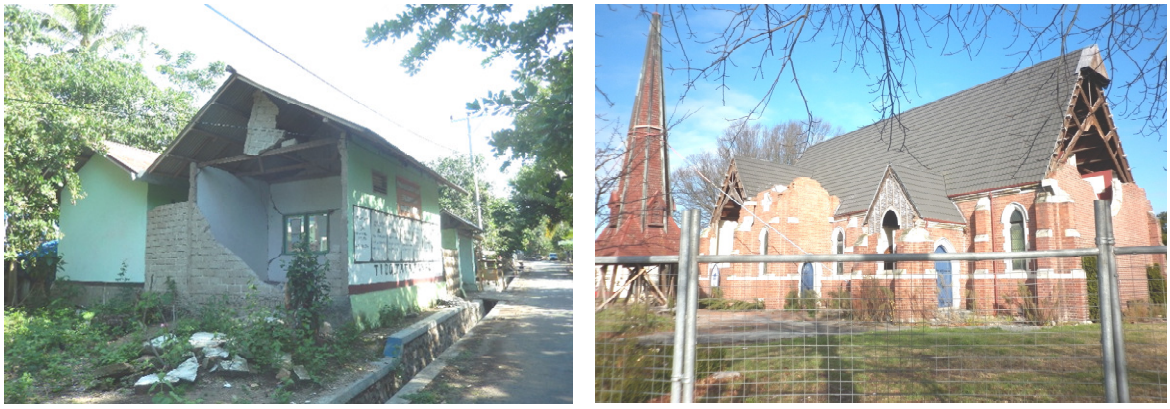
3. ACTIVITIES OF THE StIRRRD PROGRAM

Activities in the StIRRRD program consist of study visits, focus group discussion, developing DRR action plans, training, and education. Some of these activities are explained as follows.

3.1. Site and study visits

Site and study visits to places vulnerable to hazards, that regularly experience disasters, or where mitigation measures have been put in place, are an important part of learning within the Program. The visits can be within districts, in other districts, or in New Zealand. Examples include visiting the remains of buildings damaged by an earthquake in North Lombok in West Nusa Tenggara as shown in Figure 4(a), and in Christchurch City in New

Zealand as shown in Figure 4(b). A visit to Wellington Hospital in New Zealand, constructed using base isolation (Fig. 5) is an example of mitigation measures to reduce disaster risk. From these visits it is hoped that the participants can increase their comprehension about hazard impacts and possible risk reduction measures relevant to their district.



(a) (b)

Fig. 4. Site visit to the remains of damaged buildings due to (a) 22 June 2013 North Lombok Earthquake (b) 22 February 2011 Christchurch Earthquake

Fig. 5. Base isolation in the Wellington Hospital (NZ) designed to keep it operational during and after a major earthquake.

3.2. Action Plan Workshops and Focus Group Discussions

Discussions among stakeholders about DRR include Action Plan workshops and Focus Group Discussions (FGD), where stakeholders can express and discuss potential disasters, how they affect people locally, and how disaster risk can be reduced. The discussions include the what, who, when, and how of disaster risk reduction and how the district agencies coordinate with each other. A number of tools were used to facilitate discussions such as the Yonmenkaigi action plan development process (Yonmenkaigi, 2013) (Fig. 6(a)), and the comparative risk assessment and risk ranking SMG approach (MCDEM, 2015; Daly, 2015).

In addition, specific focus group discussions were held in each district on vulnerable groups. Discussion here focussed on who the local government had identified as their vulnerable groups, and what measures, if any, were in place to specifically reduce their vulnerability to disasters. While not a comprehensive discussion, the sessions served to raise awareness of an issue that is often overlooked in terms of planning and preparations for a disaster, and almost certainly in reducing risk.

Focus group discussions with women were held in each district, i.e. 8 separate groups, to explore the role of women in disaster risk reduction (Fig, 6(b)). It was found that women are often excluded from a role in disaster risk reduction and are not privy to information about how to reduce risk for their families or communities.

The ideas discussed during the action plan and focus group discussions are collated and formulated into a disaster risk reduction action plan which is presented to the local parliament for endorsement and funding to implement.

(a) (b)

Fig. 6. Action Plan Workshops showing (a) the Yonmenkaigi action plan development process (Mataram, March 2015), and (b) women's focus group discussions (Mataram, March 2015).

3.3. Expert Training

Disaster risk reduction activities require relevant knowledge, expertise, and technology and the local universities are ideal for providing these through education and research. A vehicle for knowledge transfer to the stakeholders is expert training led by these local universities. Expert training carried out as part of the StIRRRD program to date is outlined below.

Base Isolation Training

One technology that can be used to secure important buildings like hospitals from disruption of operation due to earthquakes is base isolation (Satyarno, 2011b). The lead rubber bearing (Fig. 5, Fig. 7a) that were designed in New Zealand are one example, and are now included in many buildings worldwide, including many new buildings in Christchurch being constructed as part of the rebuild following the recent earthquake sequence.

Utilising New Zealand knowledge, training in base-isolation technology was carried out in Padang in February 2015 (https://stirrrd.org/technical-training/base-isolation-training/). This was delivered in a collaborative effort by Universitas Gadjah Mada (UGM), Universitas Andalas (UNAND), Beca New Zealand and GNS Science. Participants came from local government, national government, private consultants and universities. The training involved a series of lectures and discussion sessions, practical group design work and a half–day field visit to three base-isolated buildings in Padang, including a tour of the base-isolated features

of the Ibis Hotel (Fig. 7b), where the training was held. Topics included concepts of base isolation, design of new buildings and retrofit of structures including bridges, details of isolation systems, service facility connections, base isolation of tsunami shelters, and treatment of base isolated buildings after earthquakes.

A retrofit base-isolation design of Palu Hospital was used as an Indonesian example, and the proposed design of the new Mayor's Office in Bengkulu City was used as an impromptu group design exercise. It is hoped that the training will assist local government in earthquake–prone districts to argue the case for base-isolation for new critical facilities such as hospitals, and retrofit existing ones. The additional cost of base isolation was one of the constraints identified and there is need for ongoing education of Public Works engineers and facility funders, at national, provincial and district levels, to consider base-isolation early in the design phase and argue the long term cost benefits of the additional expenditure (about 10% when incorporating base isolation into new buildings).

(a) (b)

Fig. 7: (a) a lead rubber base isolator bearing on display in the basement of the hotel and (b) the base-isolated Ibis hotel in Padang where the base isolation training was held in 2015.

RiskScape Training

RiskScape (https://riskscape.niwa.co.nz/) is a risk and loss modeling tool developed and used in New Zealand by NIWA and GNS Science that provides a modular framework to estimate impacts and losses for assets and people exposed to natural hazards (Fig. 8). The tool can inform decisions regarding natural hazard risk reduction activities.

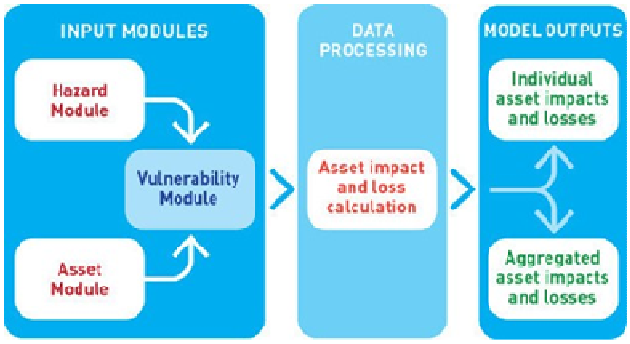


Fig 8. The schematic of RiskScape Software in calculating impacts and losses due a hazard

Risk modeling training (https://stirrrd.org/technical-training/risk-modelling-training/) was held over 5 days in Palu, October 2015, using RiskScape to illustrate various risk concepts and show how risk models are created. The training was organised by UGM, Universitas Tadulako (UNTAD), Palu City Spatial Planning, NIWA and GNS Science. Participants came from local government, representing 4 provinces and 9 StIRRRD districts, and four StIRRRD universities. The training involved a series of presentations, discussion and group work sessions, practical tutorials, and half–day field visit to collect asset data needed for risk modeling. Topics included concepts of risk modeling; hazard models, exposed assets and the vulnerability of those exposed assets to the various hazards. Groups devised disaster scenarios for their districts that they would like to model to determine losses. In particular, it is hoped that the universities could acquire and develop risk modeling data for these scenarios, as well as hazard modules for a number of perils.

Hazard and Risk mapping

During the initial phase of the StIRRRD Program, it was identified that many BPBD staff did not fully understand hazard maps, how they were generated or how to utilise them to assess risk and develop relevant policy and actions. As a result, a Hazard and Risk mapping course was delivered to StIRRRD districts representatives by UGM in January 2016. The participants came from local government (representing the ten StIRRRD districts), and the four StIRRRD universities.

The concepts of risk, hazards (threats), vulnerability (physical and social), exposure, and capacity, as regulated in Perka BNPB No 2 2012 (Perka BNPB 2012), were introduced. Several hazards were discussed, such as earthquake, landslides, and floods. The parameters used to design thematic maps were outlined and tutorials and guided practice on hazard and risk mapping were conducted using GIS. A day field trip to disaster prone areas around Yogyakarta and nearby places was included. The training provided knowledge on hazards and risk concepts, and then visualised them on thematic maps. From this is it hoped that hazard and risk maps can be fully utilised by the local government in formulating policy. Further, that they have the confidence to update or develop new risk maps in their districts, with assistance from universities as required.

4. COMMUNITY DISASTER RISK REDUCTION PROJECTS

New implementation projects in the Program will start in 2017 and will be identified from the District Action Plans. Preferably, the projects will be selected where they are common to a few districts, and multi-district participation in the projects can be facilitated. Whereas previous implementation projects have had a technical training focus (see above), it is intended these projects will have a community engagement/education focus. It is important that efforts to reduce risk focus increasingly on community led initiatives. Risk reduction strategies often focus on technical solutions such as engineering structures, technology-based warning systems, hazard-based land-use planning and hazard-based risk awareness campaigns, and benefits may not always ‘trickle down’ to the local communities threatened and affected by disasters (Gaillard, 2010).

Possible projects identified to date include research, education and community response planning for tsunami; increasing community engagement with and understanding of the local environment including local active faults and integrated catchment management; empowering

women to become DRR actors in their communities; earthquake resistant building construction techniques for local artisans; and community involvement in landslide and debris flow management and early warning systems.

5. OUTCOMES OF THE STIRRRD ACTIVITY

To date the StIRRRD Program has achieved significant and measurable outcomes, including:

- Four Districts in Central Java Province are considering funding a version of the Program.
- Action Plans have been finalised in all 8 districts (including Padang and Palu).
- The Budget for Disaster Risk Management in Palu City has increased 10%.
- A Disaster Risk Reduction Network (for peer support) has been established by the 10 Districts and participating universities.
- Kemendesa are rolling out a program similar to StIRRRD in a number of districts and are adopting components of StIRRRD into a 'Resilient District' concept, including utilising the StIRRRD vulnerability profile templates.
- Local risk reduction regulations and bylaws have been developed in three districts.
- As a result of the comparative study visit to New Zealand, BNPB are initiating a pilot Tsunami Blue Line project (http://www.getprepared.org.nz/tsunami-blue-lines/) in Pesisir Selatan, based on the community initiative in Island Bay, New Zealand.

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