2. Rev Tnt Prosiding managing flood Haz

by Putri Budi

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Managing flood hazard and risk in a changing climate
The Indonesian and Peruvian experiences

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Short Abstract

Climate change increases the frequency and the intensity of extreme weather such as flooding. Facing such hazards, many developed and developing countries adapted their practices by implementing integrated risk management systems. We focus on two disaster-prone countries, Indonesia and Peru, presenting the institutional schemes they use to cope with natural disasters. Information were collected using field surveys, press and literature reviews before, during and after the occurrence of floods on the slopes of Mt. Merapi, Indonesia, and in the city of Arequipa, Peru. We consider the organisation and functioning of management systems with an emphasis on the role of prevention and compensation. While coordination between risk management institutions has been substantially improved, more could be done towards a sustainable financing of disaster relief and recovery.

Keywords: Flood risk management, Institutional Response, Prevention policies, Compensation policies, Indonesia, Peru

1. Introduction

According to the Intergovernmental Panel on Climate Change (IPCC, 2007), there has been a fast increase in climate disasters over the last thirty years. This trend concerns both the number of events and their associated losses. For the period 1980 - 2003, the IPCC estimates the economic losses due to natural disasters reach USD 1 trillion. In many tropical countries positioned around the Pacific Ocean, climate is deregulated by El Niño weather system which generates contrasted episodes of drought and heavy rainfall.

Indonesia and Peru are two disaster-prone countries located in this area. They face a large number of natural disasters such as earthquakes, tsunamis and volcanic eruptions in addition to floods and landslides (Degg and Chester, 2005; Marfai et al., 2007). The occurrence of natural hazards is frequent and it often causes many casualties due to the vulnerability of the population. Demographic pressure associated to poverty of large sections of the population lead many people to settle in dangerous areas, e.g. riverbeds (Satterthwaite, 2003).

Facing such constraints, both countries have decided to manage natural risks through an integrated system. They aim at protecting more efficiently the population while reducing the scope of the damages (O'Brien et al., 2006). Strategies used encompass hazard assessment, spreading of prevention practices, planning and zoning, warning systems as well as financial and

material compensation. The approaches towards natural hazards are comparable as they follow the recommendations of international institutions such as the United Nations. Yet, practices differ as the governance system and the culture of the risk change between the countries and more generally between the areas (South-Eastern Asia and Latin America).

The study of these two experiences and dynamics presents a major interest as it provides information about the way similar risks are managed. We make a special focus on the global schemes that are implemented, concentrating on two essential components: prevention and compensation. Their implementation implies a participation of all the stakeholders involved in risk management so as to ensure a higher efficiency (Thomalla et al., 2006). Participation of the population to the schemes increases its awareness of potential hazards and improves its reaction in case of emergency.

Our approach of the comprehension of the Indonesian and Peruvian systems lies on different sources of information so as to understand what is already done to cope with flood risk. We also consider in detail two case studies: (1) floods and lahars that followed the eruption of Mt. Merapi, Indonesia, in November 2010 and; (2) heavy rainfall and floods in Arequipa, Peru, in February 2011.

In addition to existing literature, we used many sources including: (1) administrative documents such as the official flood hazard zoning and risk prevention schemes. They provide current information about national and local regulations and practices; (2) interviews of people in charge of risk management from the most important institutions: Civil Defence, national and local governments, municipalities and non-governmental organisations. Semi-structured interviews were performed in March and April 2011 in Indonesia and in July and August 2010 and in February 2011 in Peru; (3) records about the disasters in Indonesia and in Peru from official institutions, NGO reports and newspapers.

These documents include information about victims and damages, as well as means used to face the disasters and to provide support to the population. They give useful indications about ways the responses to flash floods are prepared and implanted in practice. Cross-sourcing allows to replace the events and their management in their cultural, institutional and economic contexts.

The paper is organised as follows. In a first part, we present Indonesia and Peru which are disaster-prone countries. In a second part, we detail the risk management schemes both countries have developed in line with recommendations of international institutions. In a third part, we present two major flood crises Indonesia and Peru faced. In a fourth part, we conclude by offering some essential perspectives for the management of floods and natural disasters.

2. Two countries affected by floods: Indonesia and Peru

In this section we present in detail the situation of Indonesia and Peru facing natural disasters, especially floods.

2.1 General facts

Indonesia is an Asian archipelago country consisting of 17,508 islands with an 81,000-km coast line. It hosts the fourth most populous nation in the world (almost 250 million inhabitants according to the 2010 census). This country is therefore the largest economy in southwest Asia. Peru is a Latin-American country located between the Pacific Ocean and the Andes towards the Amazonian lowlands. Its population reaches

more than 30 million inhabitants in 2011 (39th rank in the world) who are mainly located on the coast.

Figure 1. Location of Indonesia and Peru in the world

Although they differ by their size, these countries encounter many common situations, especially regarding their exposition to disasters. According to the UN Framework Convention on Climate Change (UNFCCC), Indonesia and Peru are among the most disaster-prone countries in the world (Harmeling, 2010).

2.2 Hazards

Indonesia and Peru are positioned around the equator area. Due to the geography and the land relief, the type of weather is not uniform. The Indonesian climate is entirely tropical, meaning the country is often subjected to intense and long-lasting rainfalls. According to the World Health Organisation, there are over 5,000 rivers throughout Indonesia, of which at least 30% drain and cross major population centres. The Peruvian climate is more diversified: tropical on the coast, arid in the Andes and equatorial in the Amazonian forest. For both countries, the alternation of dry and rainy seasons leads to different exposition to climatic hazards, such as floods, over the year.

Other risks threaten both countries which are located on the Pacific Ring of Fire. This area is the most active in the world regarding volcanic activity, tsunamis and earthquakes. From time to time, hazards combine. For instance, the associated effects of intense rainfall with volcanic material generate landslides, flash floods and lahars during the rainy season.

2.3 Vulnerability

The extent of damages due to floods is a direct consequence of the demographic and economic dynamics of these developing countries. The growth and the modernization of their economies lead to significant changes in their societies. A major consequence is rural flight and urban sprawl. The majority of new arrivals settle in recent districts around the city centres where space is still available. In this poor-quality built environment, the population claims for basics such as clean water, edible food and reliable electricity.

The worst, perhaps, is the location of the new settlements. The historical centres of the cities have been traditionally built to face most natural hazards. By contrast, the recent suburbs expand from safe areas to the river beds (e.g. in Arequipa) and to the slopes of the mountains (e.g. in Lima). In Indonesia and especially in Java, the context is different as the population is spread into densely populated villages located on the slopes of volcanoes which are very fertile areas for agriculture.

In both countries, the population pays the heaviest cost each time the elements unleash their fury. Climate change increases the magnitude and the frequency of hazards, while the socio-economic changes increase vulnerability. As a result, risks due to natural events are multiplied (Figure 2).

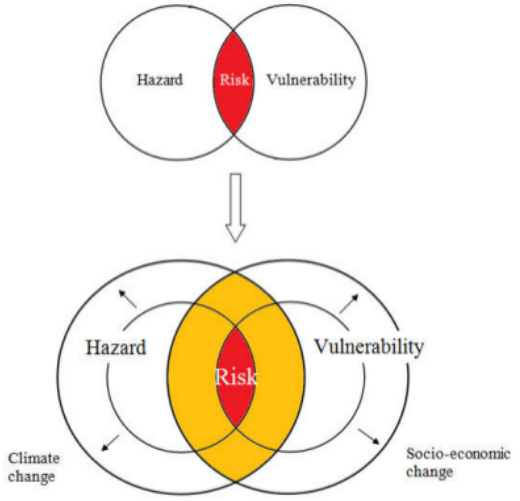

Figure 2. Evolution of natural risks in developing countries

3. Models of disaster risk management

The management of disaster risks has been debated for a long time within the countries and more recently by international institutions.

3.1 International frameworks

Many international institutions, such as the United Nations and the World Bank, have launched programs aimed at promoting a better development, through a better planning against natural disasters and an involvement of local communities in risk management.

The United Nations launched the Sustainable Cities Programme (SCP) in 1995 which encourages the building of strong capacities able to face environmental challenges in urban contexts. The tsunami which devastated the coasts of many Asian countries in December 2004 led to the creation of a specific action plan, the Hyogo Framework for Action (HFA). In association with 168 Members States, the United Nations adopted in 2005 a 10-year plan to make the world safer from natural hazards.

Setting up and financing actions against natural hazards is a crucial point, either for prevention or recovery. Accordingly, the World Bank created a Disaster Risk Management (DRM) group which aims at improving the response to disasters for its members (Kreimer and Arnold, 2000).

Changes in risk management provided by international frameworks can be summarised by Table 1.

	Before	After
Philosophy of action	Emergency response	Integrated risk management
Right to protection	Depends on governments	Human right
Handling disasters	Extraordinary issue	Daily task
Ways of management	Government	Local communities, international support, private sector
Financing	International support, reserve funds	Financial instruments

Table 1. Changes in risk mitigation as a result of international frameworks

3.2 The national risk management system in Indonesia

Natural risks have been specifically taken into account in Indonesia since 1966 when an Advisory Board for Natural Disaster Management was established. The extent of human losses and the difficulties to rescue the population after the 2004 tsunami led to the Law Nr.24/2007. The text defines precisely the aims of risk mitigation as well as the ways to perform it. This includes the roles and responsibilities of government and stakeholders as well as funding sources for disaster management.

Regarding the importance of the objective assigned by the law, the whole management system is directly placed under the supervision of the President of the Republic. In fact, the power is devoted to a specific institution known as the National Board for Disaster Management (BNPB, *Badan Nasional Penanggulangan Bencana*), which was established by the same law. BNPB is directly responsible before the President who directly appoints its chairman.

The missions devoted to BNPB encompass recognition and study of disaster threats, analysis of the vulnerability of the communities, study of potential disaster impact and options for reducing disaster risk. In practice, BNPB implements a selection of mechanisms for alert (Early Warning system) and for disaster impact management, such as allocation of tasks, authority, and available resources.

In each of the 33 Provinces and 325 Regencies, BNPB is represented by local agencies named BPDB (*Badan Penanggulangan Bencana Daerah*). BPDB agencies work in association with other governmental and non-governmental institutions such as research centres and NGOs for planning.

The management system mixes bottom-up and top-bottom communications respectively for alerts and emergency requests. Taking into account the information provided by BNPB and BPBDs, the Province mobilizes the relevant departments, which coordinate with their own local agencies. Following the local participation principle, villages and hamlets play a leading role in transmitting information about their basic needs. They also distribute the resources provided by upper levels. According to our surveys, the Regency level plays a major role in summarising the needs and financing the help in all villages of a same affected area.

3.3 The national risk management system in Peru

The first National System for Civil Defence (SINADECI) was created in Peru by the Law 19338 of 29 March,1972. This organisation has been structured as a part of the National Defence policy in order to create an integrated and permanent structure able to face disasters, whatever their origin. It also aimed at creating a culture of risk common to institutions in charge of Civil Defence.

The dramatic earthquakes that affected Chile on 27 February 2010 emphasized the need for an improved risk management strategy at the Peruvian scale which could be concretely implemented at local levels. As a result, the law 29664 of 26 May 2011 created a new organisation, the National System for the Management of Disasters (SINAGERD). This national scheme, which includes SINADECI, aims at planning risk management. Its priorities are to identify and evaluate hazards as well as to define norms and procedures protecting population from disasters. If a hazard occurs, Civil Defence must supply direct help while supporting resilience of the affected areas.

SINAGERD is directly under the supervision of the President of the Council of Ministers. Each ministry prepares national plans to face disasters in coordination with the National Centre for Strategic Planning (CEPLAN), Civil Defence (INDECI) and the private sector. National regulations are then transmitted to local Civil Defence committees which elaborate regional and local plans adapted to each territory. Noteworthy the committees are organised following the Peruvian administrative scales (regions, provinces, municipalities, districts).

Civil Defence is also involved in many companies and sectors of the economy.

4. Two crises and lessons to be gained on management practices

We study two major flood crises that occurred in 2010 and 2011 in order to understand how the schemes exposed previously have been implemented in terms of prevention and compensation.

4.1 The crises

Mt. Merapi is considered as one of the most active and dangerous Indonesian volcanoes (Thouret et al., 2000). The population is aware of the risks and the volcano is even part of the local mythology. On 25 October 2010, Mt. Merapi erupted. Despite the evacuation, 386 persons died and 115 were severely injured according to official figures of BNPB. At the peak of the eruption, 272,164 persons were evacuated. In addition to these initial damages, rainfalls during the rainy season (December 2010 – April 2011) caused daily lahars and mud flows which progressively devastated the valleys within a 40 kilometre radius around the volcano. The extent of the floods forced many people to flee again even if their house had been more or less preserved from the eruption. A large number of houses were destroyed, as well as many bridges and roads, isolating villages.

In Peru, the city of Arequipa is located on the foothills of the Andes. As the second economic centre of Peru, the city has a global population of 1 million inhabitants. A notable feature of Arequipa is also to be built on the slopes of El Misti, an active volcano which has produced large quantities of ashes and volcanic materials over the years. When sudden rainfall occurs, ashes and other volcanic debris are mobilised in runoff. They form flash floods and mudflows called huaycos (locally) which converge towards the centre of the city damaging the houses located in and around the riverbeds. Sudden and intense rainfall on 11-12 and 23 February 2011 got transformed into flash floods which induced large material losses in the city and surprised people who had installed their houses in the river channels. The reason of this abnormal activity could be explained by the climatic phenomenon El Niño. In the city of Arequipa, the Civil Defense (INDECI) observed that nobody was killed but 150 people were injured. 40 houses were destroyed while 3,100 were affected either by the rainfall or the floods. Many walls collapsed and some streets were completely ruined. In addition to these losses, Arequipa suffered from a 2-day disruption of water distribution.

4.2 The role of prevention and short-term actions

Both Indonesia and Peru give the responsibility of implementing a precise zoning of risks to local authorities (regions, provinces and municipalities). Zoning exists on the Indonesian and Peruvian volcanoes and rivers (Vargas Franco et al., 2010) and it is updated after major disasters. The main stake is to diffuse zoning and to enforce it in practice. For instance, expulsions and relocations are never used before a disaster occurs due to the strong opposition of the population. Surveys made on the field emphasize people's attachment to their land, sometimes the only valuable property they have. Failing to secure the most vulnerable areas, the authorities have created evacuation routes, which are materialised by maps and road signs. All the roads converge to safe areas and emergency camps. They have also built observatories, dams and weather stations that provide information in real time.

The description of both catastrophes proves that prevention allows to alleviate human tolls thanks to a precise monitoring of rivers associated to an adequate decision making. On the slopes of Mt. Merapi, the system combines video cameras, weather stations and sirens all along the main rivers. It provides enough time for people to flee. As a result, the number of casualties specifically due to lahars is very low even if the material damages are high. The same conclusions can be made regarding the situation in Arequipa. The existence of an Early Warning system for precipitations and the diffusion of information using the Media and Civil Defence teams facilitated the progressive information of the population and its final evacuation in safe areas.

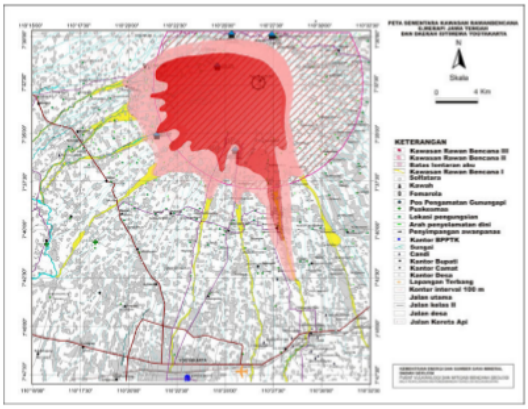

Figure 3. Updated map of Mt. Merapi hazards with location of prevention and recovery resources (Source: BNPB)

Mitigation is essentially a matter of organisation. Before the catastrophes, both Indonesian and Peruvian had worked on the disasters they faced a few months before they occurred. In Peru, a Management Plan against Heavy Rainfall was issued in Arequipa while in Indonesia each valley was surveyed to collect essential information such as the number of inhabitants and their occupations, as well as the potential needs and available resources and propositions for future command centres and shelters (see Figure 3). In this country, after the first crises, 2,367 container of a 350-litre capacity were quickly installed, which could compensate the destruction of water supply network by ashes and floods.

4.3 The role of compensation and long-term recovery actions

During both crises in Indonesia and Peru, compensation essentially took a material form, even if this effort had to be financed. As soon as the evacuation began, people who fled needed to receive housing, food as well as access to minimum facilities to preserve their safety, health and hygiene. Most of them were also granted some money even if only for moving. After the crises, funds were needed for recovery in the long term.

Among the ways to compensate expelled people, Indonesia gave priority to construction of shelters which were given free of charge to the refugees. They consisted in groups of tents, houses in bamboo or concrete located in safe areas close to the evacuated villages as people did not want to move far from their home. The coordination needed to build and administrate the shelters was essentially made by the Red Cross and other humanitarian institutions. They collected funding from the central and the local governments as well as from international fundraising.

In the long run, the reconstruction will not be possible in the most dangerous areas as the creation of a National Park is now enacted around the volcano and the main valleys. People would not live within the park but they would still plant crops and

fruits and breed cattle. In counterpart, the government plans to give support for new settlements in safe areas.

Funds needed for recovery come from the national budget and a special fund of 3 trillion rupiahs. Due to the lack of an insurance system, the authorities act as their own insurer. In the villages, the inhabitants proceed the same way (Lewis and Nickerson, 1989). For instance they are used to stock rice which is redistributed in case of emergency.

In Arequipa, Peru, Civil Defence and NGOs such as the Red Cross and Predes provided a strong support into the most affected areas, building shelters and providing basic needs to the population. This material support was mainly financed by international donations and funds from the region. In fact the limited extent of the losses allowed a quick reconstruction.

Compared to Indonesia, no global strategy has been adopted for the recovery of the flooded areas. In the months following the crisis, Civil Defence teams focused on heightening public awareness of rainfall-related issues. While many valleys were cleaned from the debris, reconstruction in these areas could not be prevented. As of September 2011, a significant part of the areas damaged or destroyed in February are already reoccupied. This experience proves that even if people suffered from disasters in a dangerous area, they come back again if no other alternative choice is offered to them.

5. Conclusion and perspectives for flood hazard and risk management

Over the last decades, the number and the violence of natural disasters has dramatically increased. Among them, floods represent a serious threat for population and activities. Facing such risks, many countries have decided to build a unified framework for the management of natural disasters. The experiences of Indonesia and Peru prove the way ahead is long but strong actions are already operating, especially regarding prevention.

The existence of frameworks for risk management led by international Institutions such as the United Nations or the World Bank is very useful for countries willing to build a sustainable system. These schemes are even more efficient if their objectives and their implementations are shared by authorities and population. In particular, there is a need for confidence and stability in risk management practices. The development of risk planning goes hand in hand with the creation of a common culture of risk.

However, much work remains to be done. Demographic pressure around riverbanks represents a latent threat for the population. Displacing the most exposed people remains very difficult unless the area is evacuated by force or severely damaged. Changing mentalities takes time, especially among poor people, which emphasises the role of prevention and education.

If the current processes continue their development, increased cooperation between local and national authorities as well as collaboration between public and private sectors should lead to a better risk management. This issue concerns many cities and many types of hazards. As a result, both local and national communities should be able to cope with major risks. In this context, progress in financing natural disasters will play a paramount role. The development of insurance and reinsurance will constitute one of the keys for a sustainable development, able to face disasters.

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