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Original paper

Improving the Governance Context and Framework Conditions of Natural Hazard Early Warning Systems

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Abstract Early Warning Systems (EWSs) are a major element of disaster reduction. They provide resilience to natural hazards, protect economic assets and development gains. Until now, most EWS have focused mainly on hazard detection and the immediate warning and evacuation processes with an effort of saving lives in the context of an extreme event. However, the incidence of global societal calamities and losses continue to grow. Risks, crises and disasters are becoming more and more intricate, complex and multi-faceted. Some of the key challenges of EWSs include lack of an end to end and people-centred approach, and major weakness in terms of governance and institutional arrangements as the cross-cutting issues of EWSs. In this context, the governance aspect and framework conditions of EWSs need to be revisited. The paper reviews and analyses various concepts and frameworks related to EWSs in order to present ideas about how to systematise characteristics and dimensions of governance for an improved conceptual governance framework for EWSs. In this regard, the framework conditions and the governance context of EWSs are outlined in order to improve EWSs.

The review process shows that EWSs framework to this point has evolved from the traditional three phase linear chain typology to a more complex and integrated cyclic model framework incorporating risk knowledge and appropriate response elements. Additional aspects include participation, feedbacks from different actors and the community and the required driving incentive structures for sustainability. A number of governance related weaknesses are identified in the existing concepts and frameworks. In addition, EWS do not systematically or methodologically take into account hazard-social ecological conditions. The governance aspects and framework conditions proposed in this paper include the four core EWS elements (risk knowledge, monitoring & warning, dissemination & communication, and response). Communication should be a central element operating at all times, levels and scales of the process. Additional aspects include: (1) the social-ecological system governance perspective (2) the governance perspectives directly related with the EWS in terms of architectures, the actors and the community, and (3) the broader systems of governance (i.e. political, economic, social and technological); to emphasis the driving incentive structures required for implementing and supporting an effective and sustainable EWS.

Key words: Early Warning Systems; Natural Hazards; Governance; Institutions; Framework

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1. Introduction

The incidence of global societal calamities is growing and escalating in losses (ProventionConsortium 2004: 3, MunichRe, UN-ISDR 2011). The cost of disaster recovery far exceeds the cost of effective and sustainable hazard management. Disaster impacts are generally increasing as a result of the combination of increasing populations, greater concentrations of people and assets in vulnerable areas, and the modification and degradation of natural environments, such as floodplain settlement, coastal exploitation, wetland destruction, river channeling, deforestation, soil erosion and fertility decline. Vulnerability to hazards is exacerbated by poverty, disease, conflicts and population displacement (Basher 2006). Overall, risks, crises and disasters are becoming more and more intricate, complex and multi-faceted; particularly in the light of climate change.

EWSs are a major element of disaster reduction. They should empower societies and communities to prepare for and confront the power and the uncertainties of both natural and climate change-driven hazards. EWS provides resilience to natural hazards, and protects economic assets and development gains (IEWP 2006). Early warning systems exist for natural hydro-meteorological-geophysical hazards, biological hazards, socio-political emergencies, industrial hazards, personal health risks and many other related risks (Chang Seng&Birkmann 2011).

On the other hand, the escalating losses associated with these extreme natural hazards indicate that most governments have yet to find affective ways of reducing and managing risks they pose (UN-ISDR 2011). The absence or lack of an effective EWS also explains why disaster impacts are increasing such as in the case of the December 2004 Indian Ocean tsunami and Hurricane Katrina in the United States in 2005. Globally, many countries and millions of people are not protected by effective early warning systems (EWSs) (IEWP 2006). Some of the key challenges of EWSs include lack of an end to end and people-centred approach and major weakness in terms of governance and institutional arrangements as the cross-cutting issues of EWSs (United Nations, 2006). In addition, a United Nations Development Program (UNDP 2004) report entitled: “Reducing Disaster Risk: a challenge for development” highlighted that the critical cross-cutting issue of governance remains a key unresolved challenging problem and there is the need to further strengthen institutional and legislative systems for disaster risk management. In addition, the UN Survey requested by Annan (2005) on a global EWS for all natural hazards confirmed that there is inadequate institutional and governance commitment. In this context, the governance aspects and framework conditions of EWSs deserves a closer attention of analysis.

Therefore, the aim of this paper is to review and analyse various concepts, characteristics and frameworks related to EWSs. Secondly, it presents the governance context and framework conditions for improving EWSs. The current work will contribute towards the better framing, understanding, assessment, design and governance of EWSs.

The key research questions are as follows:

1. What are the existing typology, concept, design, and framework of natural hazard EWSs?
2. What is an effective and sustainable EWS?
3. What are the current governance related gaps, and weaknesses in the framework conditions of EWSs?
4. What additional governance aspects and framework conditions are required to improve EWSs, and how are EWSs factored in the Integrated Disaster Risk Management Spectrum?

2. General Typology, Concepts, Designs and Frameworks of Natural Hazard EWSs

It is underscored that Lassa (2008) reported on five existing typology of EWS models. The EWS chain model (Figure 1 a) focuses on flows of sources/resources or 'materials/objects through a sequence of steps which emphasize movement and transformation through a series of stages that are often ordered and linear simple steps' (Sobal et al. 1998:855). Moreover, it includes a chain of decision and actions that follow 'input through output' sequences. The cycle model (Figure 1 b) for single hazard is similar to the chain model. It addresses a specific hazard along a time continuum, but it flows in a clockwise direction. In contrast to the single-cycle model, a multiple-cycle model (Figure 1 c) is used to illustrate the coexistence of different units of EWS addressing different types of hazards. On the other hand, the network model (Figure 1 d) can be considered as an architecture and social network, characterized with human nodes connected by ties, which are values, visions, mandates, technological instruments, governance etc. Isolated EWS models (Figure 1 e) has its own mechanism of knowledge transfer, particularly through cultural and traditional experiences as a result of repeated events, and is embedded in a society and can exist only in a specific social-ecological context.

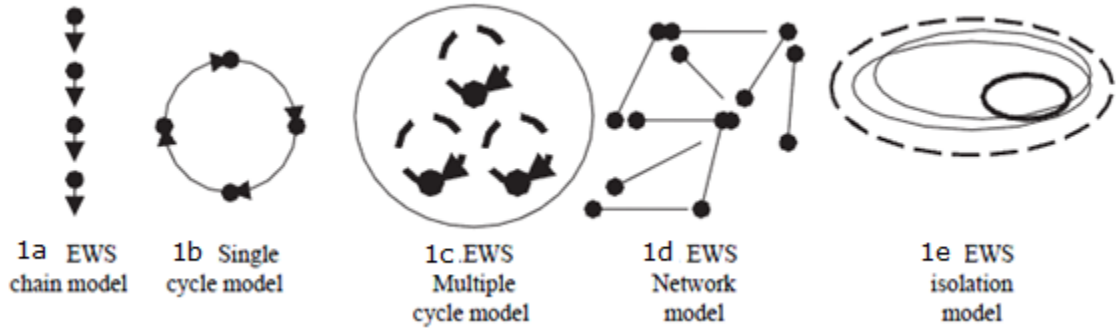

Figure 1: Typology of EWS Model (source: Lassa 2008)

2.1. The Traditional Three Phase Early Warning System Framework

The traditional framework of EWSs is composed of three phases (see Figure 2): monitoring of precursors, forecasting of a probable event, and the notification of a warning or an alert should an event of catastrophic proportions take place (Villagran 2006). It is essentially a linear top down warning chain typology model (See Figure 1 a), that is expert-driven and hazard-focused from observation through warning generation and transmission to users (Basher 2006).

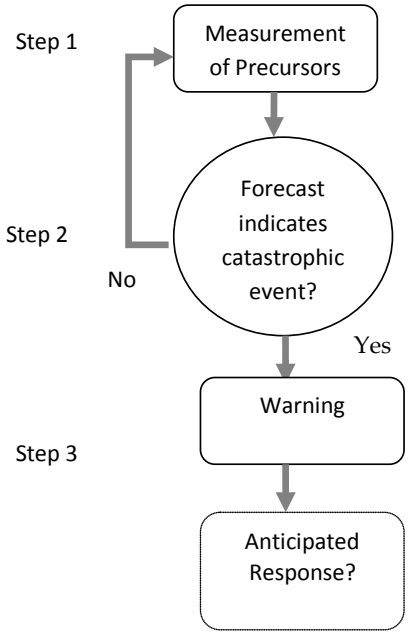

Figure 2: Three Phases of Early Warning Systems -Linear Chain Model (Source: Adapted from Villagran 2006)

2.2. Four Phase People-Centred Early Warning System Framework

Currently, one of the most widely known EWS framework is the four phase EWS (Figure 3), promoted by the International Strategy for Disaster Risk Reduction (ISDR) and partners. It is promoted to enhance the effectiveness and efficiency of EWSs. ISDR underlines that for an EWS to be effective, it must be people-centred and should integrate and span four elements as defined by the ISDR model: (i) a knowledge of the risks faced; (ii) a technical monitoring and warning service; (iii) the dissemination of meaningful warnings to those at risk; and (iv) responses which depend on public awareness and preparedness (refer to IEWP 2006 for further details regarding the specific elements). In relation to the people-centred approach, a key outcome of the World Conference on Disaster Reduction, in January 2005, in Kobe Japan, describes the core components of people-centered EWSs as follows: a combination of 'bottom-up' and 'top-down' elements, involvement of local communities in the Early Warning process, building awareness into the structure of communities. The four phases people-centred EWS follows a single 'clockwise 'oriented cyclic model (see Figure 1 b). This implies that risk knowledge component feeds into the monitoring and warning component, which in turn feeds into the dissemination and communication which then triggers or activates the response component. While this set of four elements appears to have a logical sequence as described above, in fact each element has a direct two-way linkage and interaction with each of the other elements as indicated with the double arrows.

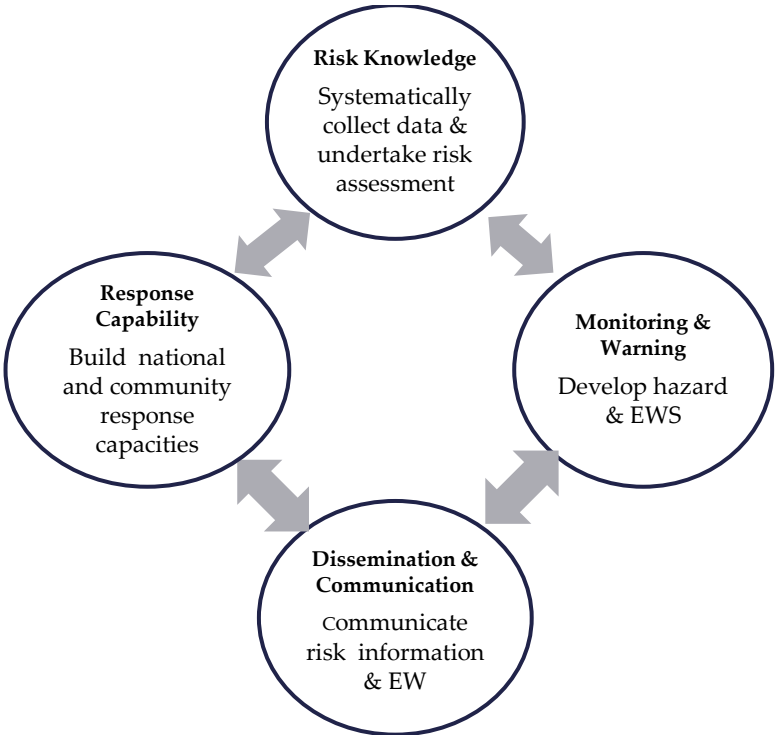

Figure 3: The Four Elements for an Effective People Centred EWS Framework (Source: International Early Warning Programme 2006)

2.3. An Integrated System Model for EWS

Another interesting view of EWS was proposed by Basher (2006). According to Basher, the integrated model proposed (see Figure 4), includes the core warning system elements, but in addition contains two new key features. The first is the inclusion of actors that often are not recognised as part of the warning system, most notably the political-administrative supporting entities, the district and community actors, and the research community. The second feature is the explicit inclusion of multiple linkages and feedback paths, particularly from affected populations through their organisations to the political and technical actors. The model could be elaborated further for the particular circumstances of countries, for example, to better specify the district-level and community-level elements or the collaborative roles of different discipline-based technical institutions (e.g. such as seismological, oceanographic and meteorological organisations in a tsunami early warning system). In this context, the model does not seem to follow any specific typology as described in Figure 1, but the integrated model for EWS is viewed as a very important step towards improving the concept of EWS.

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