EARLY WARNING SYSTEMS DO'S AND DON'TS – MALAYSIA'S EFFORTS TO ADDRESS THE IMPACTS OF GLOBAL WARMING, CLIMATE CHANGE AND A CHANGING MONSOON AND EL NINO SYSTEMS

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Abstract

This paper gives an overview of what should constitutes an effective early warning system, the needs and how it should be implemented in Malaysia and the Southeast Asia Region. The emerging threat of global warming, climate change and a changing Monsoon circulation and El Nino systems that are affecting the Southeast Asia Region cannot be discounted and be taken lightly. Recent events associated with the changing behavior of the northeast winter monsoon and the southwest summer monsoon and the unpredictable behavior of El Niño systems in the Pacific Ocean basin and to a lesser extent the Indian Dipole circulation of the Indian Ocean provided an additional concern on the welfare of Malaysia and the Southeast Asia Region on the emerging threat of hydro-meteorological events and associated climate – weather induced hazards that have affected and would continue to affect millions of lives in Malaysia and the Southeast Asia Region. It is hope that lessons learned, experiences and insights identified from this discussions based on the experiences of the recent 2007 flood events in Malaysia and the 1997-1998 el Nino event that affects the Southeast Asia region and the World would be used to formulate, remind, if not inform, those involved in the whole rubric of environmental hazard management on how to develop and implement an effective warning system. The discussion could also be used to educate the media and the general public on how to interpret and used such warnings and be important stakeholders (components) in the implementation and sustenance of the system. There are many early warning systems in operation today in every country, if not in every community – that involves formal and non formal systems. In this paper, the focus is primarily that on hydro-meteorological anomalies and its manifestations on environmental hazards – that under threat from a changing behavior of the monsoon and el Nino systems in the Southeast Asia Region.

Introduction

The Threat - The IPCC 4th Assessment Report (FAR) on Climate Change (IPCC, 2007) describes a warming Earth (~1.4 to 6.0 ^{o}C) that had intensified and continues to accelerate the process dynamics of the atmospheric-oceanic-land response systems thus the intensification of hydro-meteorological hazards and extreme weather events including hurricanes, cyclones, sandstorms, rainstorms, heat waves, cold snaps, floods, droughts and rapid slope failure processes. In fact, global warming would induced changes to regional pressure systems such as on the monsoon systems of South-Southeast Asia (Chase,T.N. et.al. 2003) and oceanic systems such ENSO (El Nino Southern Oscillation) of the

South Pacific Ocean (WMO, 2005) spawning environmental hazards and disasters on society through floods, droughts and the outbreak of vector borne diseases (Glantz, 2001). Global warming not only intensifies the atmosphere – oceanic – land process system dynamics (Pielke, 2005) but also influences their onset, frequency, duration, decay and spatial impacts. Societies are becoming more exposed to these threats and must remain on the alert and early warning systems provide them with a way to remain vigilant, ability to anticipate and be well prepared (UN, 2006).Early warning of hazards threats combined with the early knowledge of societal vulnerability, inherent problems and limitations can re-enforce the strengthening of society's resilience and a reduction in vulnerability making society to be more prepared on the impending threats (Basher, 2006 ; WMO, 2006). An early warning system is thus an important tool in a government's program to achieve sustainable development (Glantz (ed.) 2001 and 2007; ADPC, 2003; UNIDSR, 2003; UNIDSR, 2006). Environmental hazards are known to have the potential to set back economic development activities for long periods of time, because of the need to divert funds away from development to emergency planning, redevelopment and rehabilitation programs. Thus sustainable development is much more dependent on the successful detections of early warnings and the subsequent communications, actions and implementations than most governments realize (Glantz, 2004).

Early Warning Systems – An Evolving Agenda

Effective early warning systems (environmental hazards) are now increasingly perceived as an integral component of disaster risk reduction programs.

- International Decade for Natural Disaster Reduction (IDNDR, 1990-1999) promoted this concept to raise the profile of early warning accordingly, resulting in,
- Yokohama Strategy for a Safer World, endorsed at the World Conference on Natural Disaster Reduction in 1994
- The International Strategy for Disaster Reduction (ISDR), the successor to the IDNDR introduced a stronger focus on vulnerabilities and to integrate disaster risk reduction into sustainable development planning
- The World Conference on Disaster Reduction adopted the Hyogo Framework for Action 2005-2015 : building the resilience of nations and communities – including developing people centered early warning systems
- Three major international conferences on early warning systems – Potsdam Conference (1998), 2nd and 3rd International Conferences on Early Warning Systems (Bonn, 2003 and 2006) provides guiding principles for effective early warning systems as well as an international program on early warning to reduce disasters
- Global Survey of Early Warning Systems was called by the then Secretary General of UN toward the implementation of Millennium Development Goals

Climate Insecurity – The Challenge for Malaysia and the Southeast Asia Region

Climate is a priceless natural resource not only it is a basic necessity for sustaining life but also it is crucial for through its influence on the regional and local hydrological cycles influences energy development, irrigation and agriculture, recreational activities, aquaculture, and for flushing out the land and river systems of sediment and varied forms of pollution. Climate also through the terrestrial water cycles, plays a very important role in the weathering of bedrocks thus releasing nutrients and minerals into the ecosystems which can then be exploited by man. Climate through its control on the availability of water has been known to influence whether a particular human civilization flourish or perish. Global warming as it induces climate change, variabilities and extremes, would have a significant effect on water resources availability in the future and thus governs existing sustainable environmental development efforts been practiced today. Water resources availability today would influence the needs of future generations to fulfill their own water needs. In Malaysia our traditional and commercial economic enterprises would be severely affected if we are faced with too much water (floods), and too little water (droughts). Malaysia needs to be prepared for any eventual threat to changes in her climate and weather as our water resources availability and quality cannot be compromised and thus the need to take necessary remedial measures to address these threats. One of the major components of threat management is the formulation of warning systems, which can be a

people centered warning systems (warning to the impending threat of a flood hazard for a particular community) or it can also be an activity centered warning system (warning of water shortages to the agriculture and energy industry). In both cases threat management would involve 4 basic components which are continuous in operations, these are (1) Risk Knowledge – Systematically Collect Data and Undertake Risk Assessments, (2) Monitoring and Warning Service – Develop Hazard Monitoring and Early Warning Services (3) Dissemination and Communication – Communicate Risk Information and Early Warnings and (4) Response Capabilities – Building National and Community Response Capabilities. A weakness or failure in any one of these elements could result in the failure of the whole system. There would exists differences, however in (a) practice, (2) capacities, and (3) gaps, however between people centered warnings and activities centered warning.

Early Warning Systems – What it Means

A universally accepted definition of an early warning system does not yet exist. Probably one never will. The formal UN definition is as follows : "The provision of timely and effective information, through identifying institutions, that allow individuals exposed to a hazard to take action to avoid or reduce their risk and prepare for effective response" (UNISDR, 2006). The major question here would be what are the expectations of a warning? How early is early (this relates to the timing of the warning)? What constitutes a warning (monitoring, trend extrapolation, monitoring, and prediction, forecast)? What is meant by a system (formal, informal; quantitative, qualitative or anecdotal)? What are to be its official functions? What else might it do, besides monitor the environment and warn society of harm (educate, prepare societal responses)? What are the levels of warning (outlook, watch, warning, and alert)? There is thus the need to keep the definition of a EWS broad and flexible; broad enough as to allow for a wide range of interpretations and flexible enough to accommodate in time and space the societal recognition of new hazards and the development of new EWS technologies (Glantz, 2003; 2004). Thus, when referring to EWSs, it is important to keep in mind that many of them are not isolated entities with well-defined boundaries. They can be portrayed graphically as cascades, pyramids, networks, and as subsystems.

Earl Warning Systems -Structure and Functions

"The most effective warning systems integrate the subsystems of detection of extreme events, management of hazard information, communication and public response and also maintain relationships between them through continuous appraisal and preparedness" (Glantz, 2003, 2004 and 2007). Differing views exist on how extensive a EWS should be. Should it only produce warnings, full stop? Or, should it have responsibility for issuing a warning to all at risk targets, for assuring that the warning is well communicated to the target audiences and understood by them, and that there are appropriate responses to various levels of warning? It is suggested that the EWS focus primarily on the warning component of early warning process. Although it should be involved in other aspects of the early process, however, others believed that the system incorporates the responsibility for communicating, educating and preparing the public to take appropriate responses. In other words the group providing the warning was not viewed as the one that should have the primary responsibility to reduce societal vulnerability. Nevertheless, each of the stages in the warning process from monitoring to responding must be interactive in such a way as to keep the warning timely, understood, and providing enough lead-time for responses. Various writers have identified what they considered should be the components of a EWS. For example, one suggestion was that a EWS should have five components: selection of indicators; communication of warnings; reception of warnings; early warning education; generation and maintenance of awareness. A risk assessment expert suggested that a EWS should include the following activities: monitoring, risk analysis, dissemination of the warning, and societal preparedness. Yet another suggestion was that a EWS has responsibility for the following: forecasts, warnings, and responses. Other possible components include technical decision-making and responses to warnings and impacts. Obviously, there is no agreement on the ideal structure or function of an early warning system. Perhaps the range of potential functions of a EWS remains one of its most inconclusive aspects. Should it focus solely on providing the best technical warning possible based on quantitative indicators? Should it be viewed as an integral aspect of a country's much broader sustainable development strategy? EWSs need to be treated as subsystems

embedded and integrated into larger socioeconomic, cultural, and political systems. Stakeholders need to be involved in the development of new EWSs or redesigning existing ones. They need to be actively involved in supplying input to the EWS process. In addition, efforts need to be made through capacity building to increase the number of stakeholders (those indirectly as well as directly concerned about the early warning of hazards regardless of cause) within the country affected by the hazard(s) of concern. To do so would help to grow a country's early warning network.

Early Warning Systems – The Characteristics

The characteristics of an early warning system are bounded by the characteristics of the hazard(s) of concern and by the political and cultural setting in which the EWS operates. However, there are generalizations that can be identified as a minimal requirement for an effective EWS regardless of the hazard or its political setting. These include but are not limited to the following: (1) Continuity in operations: A EWS must operate continually, even though the hazard of concern may occur only intermittently, (2) Timely warnings: for a warning to be considered useful, it must provide enough usable lead time for those at risk to decide whether and how to react. A warning should leave time for responses to the warning and to the event. This varies from hazard to hazard. For tornadoes, warning time may only be on the order of minutes. For hurricanes, it might be weeks to hours; for El Niño it could be months to weeks. For global warming it could be years to decades. A balancing act is required of those in a EWS because they must avoid issuing warnings that are too early as well as issuing warnings that are too late. (3) Transparency: the process of early warning, whether the system only issues a warning or is involved in the total process from warning to societal response, needs to be open to the media and public. Transparency can help to minimize the potential for political influence on the various stages of early warning. (4) Integration: A EWS must be integrated into other parts of the warning process, including monitoring and communication; it needs to be viewed as a subsystem within the larger socioeconomic, cultural, and political system, (5) Human capacity: appropriate staffing is mandatory with the expertise of the personnel commensurate to the hazard(s) of concern, (6) Flexibility: A EWS needs flexibility to expand its activities to other hazards and to other functions, if and when the occasions arise, (7) Catalysts: there is a need for a defined "triggering" mechanism; the trigger can be anything from a quantitative indicator to an anecdotal comment, (8) Apolitical: A EWS needs to be apolitical in performing its functions; it is important that the EWS be viewed as objective and uninfluenced by national or international politics.

Managing EWS - Constraints and Effectiveness

Effectiveness of an early warning system refers to the ability of the system to fulfill its designated functions. Early warning systems always work well (efficiently and effectively) in theory, in PowerPoint presentations, and on paper. In the real world, however, constraints restrict the attainment of that efficiency and effectiveness. Constraints vary from one EWS to another. There are, however, some factors in common that tend to reduce the effectiveness of EWSs. For example, early warning system operators face a dilemma: they are often criticized for a missed or erroneous warning, but are infrequently praised for having been correct. People ask: If there were no devastating impacts of a hazard, was it because the warning was heeded and preventive actions were taken, or was it because the hazard was not as extreme as had been expected? In other words can one evaluate an early warning system's effectiveness, in the absence of damage? The following factors are neither comprehensive nor mutually exclusive. They are meant to be suggestive. Many of those factors are affected by uncertainty, (1) measuring EWS effectiveness - what does it mean for a EWS to be effective? One could argue that it is effective if it leads to appropriate and timely societal responses to the advanced warnings (e.g., outlooks, watches, warnings, and alerts). Others might argue that a EWS has to issue a timely warning, one that is correct in that the hazard occurred at the suggested time, location and with the intensity. Still others suggest that EWSs must withstand traditional cost-benefit analyses, even though it is difficult to quantify all the benefits of a EWS, (2) behavioral changes -Yet, it may be that behavior was reinforced by a warning and was not changed by it. The number of deaths provides another quantitative way to assess effectiveness. However, there are likely to be potential victims who turned a deaf ear to the warning and to the hazard. Risk-informed deaths can be expected to occur, even with a perfect, extremely reliable warning. The question of how to evaluate the effectiveness of a EWS continues to be addressed by the ISDR, which acknowledges this as a difficult

ongoing task, (3) quantitative and qualitative EWS information - the information collected is uncertain with regard to the possible onset of a hazardous episode. Various groups use indicators to monitor for the early onset of a hazard, but they do not necessarily use the same indicators. Even with El Niño, for example, some scientists monitor changes in one part of the Pacific Ocean while others focus on measurements in other parts. Some rely on watching for changes in the atmosphere, while others rely on changes in the ocean or in the marine environment (i.e., living marine resources). Some countries consider information on environmental changes to fall under the umbrella of national security and this restricts the flow of information to those involved in early warning and in responses to early warning. It is important to keep in mind that, even with the best information possible, a EWS might not be able to generate optimal responses. Hence, we can expect that there will likely be "risk-informed deaths", (4) timing of the warning - an objective of an early warning is to have it issued at a time when it will capture attention and generate enough confidence to provide usable lead time to spark a useful and appropriate reaction. Those responsible for warnings must make a subjective decision about the warning as well as about when to warn. Getting the timing of the warning 'right' is important for the credibility of the EWS because it will minimize the times that warnings could be viewed as "false alarms." A warning can be too early, when scientific uncertainty may be relatively low or when people will not deem it urgent enough to give it the concern that such a warning should merit. A warning can also be issued so late that it provides little if any usable lead-time for useful reaction, (5) funding - EWSs have a problem with maintaining their long-term sustainability, in part because they have difficulty maintaining a funding level that enables them to meet their objectives. A lack of a stream of adequate funding inhibits the necessary constant review of the EWS procedures and the indicators on which they rely. Governments face crises all the time. They must respond using their finite resources so they have to decide carefully where the funds are most urgently needed. For hazards and disasters that are expected to occur relatively infrequently, early warning systems wax and wane in importance. When a hazard is perceived to be a threat, the EWS receives support; when it has passed, interest in the EWS often dissipates until the next time the hazard recurs. In addition, it is easier to get assistance from the international donor community for post-disaster recovery than for pre-disaster prevention. Sometimes cost-benefit analyses are proposed to evaluate in economic terms the utility of a EWS. However, factors other than destruction of property and the number of deaths are seldom included in the analyses. EWSs warnings are constantly being scrutinized for correctness and for relevance. The funding of EWSs by governments can be influenced in this regard, because EWSs seem to be subjected to more criticism than praise, (6) hazard characteristics - there is uncertainty in the characteristics of a given hazard as to its timing of onset, its intensity, its location and its impacts on environment and on society. Quick, short-, medium- and long-term hazards (e.g., creeping environmental changes) are each surrounded by its own sets of uncertainties. So, it is basically a contest between those issuing early warnings and Mother Nature; the former are trying to reduce the uncertainties that surround a particular hazard of concern to the point where they can decide to issue a warning or not to do so. Even known and expected hazards can exhibit unexpected behavior. In addition, with a changing global climate regime, extreme hydrometeorological events may change their characteristics and they may start to appear in areas where they had not been witnessed in earlier times, (7) vulnerability characteristics - there is uncertainty in the characteristics of vulnerabilities as to timing of appearance and development, intensity, location, and impacts on environment, on society, and on hazards. Quick, short-, medium- and long-term vulnerabilities are each surrounded by its own sets of uncertainties. So, it is basically a contest between those issuing early warnings and societal inertia; the former are trying to reduce the uncertainties that surround a particular vulnerability of concern to the point where they can decide to issue a warning or not. Even known and expected vulnerabilities can exhibit unexpected behavior, (8) communications - warnings are made up of words (sometimes warnings use color coding) and words have different meanings to different people. Because of this, it is not always certain that the warning that is meant to be given will be the warning that is received by the government or the public. A technical group in the EWS will need to provide clear warnings. Avoiding technical jargon is important in this regard. Communication is also a problem between units in the EWS and between the EWS and other components of a broader EWS network, because when information is passed from one group, culture or country to another, it is at risk to imperfect interpretations. Each transmission of information or warning from one group to another introduces uncertainty into the EW process. Uncertainty in communications can be reduced in

part by involving stakeholders, i.e., those at risk to and those interested in early warning of hazards in the early warning process, (9) vague bureaucratic jurisdictions - EWSs require the involvement of many other governmental and non-governmental agencies. Some of them will act as if they were in competition with those responsible for issuing warnings. For example, agro-meteorologists usually work in a nation's meteorological services as well as in its ministry of agriculture. They will likely have different views about whether a drought is taking place. How an EWS is set up structurally and functionally can either increase problems encountered by the EWS or can reduce them. As noted earlier, is the responsibility of a small technical unit only to issue a warning or the responsibility of other groups to communicate and respond to it? Or, is it that the EWS encompasses all of these activities? Bureaucracies have their own set of standard operating procedures (SOPs), guidelines, and paradigms by which they operate. If information comes to them but is not a neat fit with the SOP, then such information might be discarded, even though it may be very important for the early warning process (e.g., the monitoring and belated identification of stratospheric ozone depletion in the Antarctica). In some developing countries, institutions are often in need of strengthening through developing human capacity building of and developing expertise in early warning and in understanding hazards and their impacts, (10) competition - As noted earlier, several ministries of a government might consider information that they collect and analyze as strategic (such as the amount of national food reserves). They may not release it, even though it is important to the effective operations of an EWS. Another constraint on effectiveness is the fact that many organizations outside of a country are likely to be issuing hazard warnings for that country as part of their global monitoring and early warning activities. That can create problems for the EWS (and forecasters) in the affected country. For example, an El Niño forecast disseminated from a government agency in the United States can raise questions by political leaders in other countries about why their own national EWS (or their own forecasters) failed to issue such an early warning. Why should a government fund an EWS if it can get warnings for free from reliable sources in other countries, (11) political context at the time of the warning - The type of political system in general and the domestic political situation at a given point in time affects the effectiveness of an EWS. Governments fund national EWSs, and those systems are subjected to guidance and funding from the government. There are examples where a government failed to act on an early warning given to it about a hazard or even a disaster (e.g., famine). The reasons for inaction were clearly political. Each warning requires responses, and each response generates costs in human and financial resources. Governments may be reluctant to act quickly on warnings that have some degree of uncertainty in them, so they tend to take a "wait and see" position. In many instances, governments want certainty when it comes to hazard warnings. Politics affect EWSs differently for quick onset hazards as opposed to creeping ones. With regard to the former, there is little time for indecision. With regard to creeping problems, government officials may believe that they have time enough to wait for the findings of the next assessment, or the ones that follow.

Early Warning Systems – The Right Direction for Malaysia

The last half decade has witnessed increasing frequencies and intensities of climate induced hazards on Malaysia and the Southeast Asia Region. These hazards are multi-dimensions in nature and have widespread impact. While warning systems look great on paper as organization charts or as input-output diagrams, they run into difficulties (bottlenecks) at various locations (nodes and arrows) in the flow of warning preparation to communication to action. Several honest scientific disagreements exist about what an EWS should do for a government or a society. One officially designated early warning system cannot meet all societal needs. At every stage in the early warning process, there will be ethical and equity issues that must be addressed. Hazards and threats can change over time not only in intensity, frequency, and in location and duration, but also in importance and interest. Those affected by hazards can be far removed from the disaster site and not just in the disaster zone. It is necessary to keep the definition of an EWS broad to allow for a wide range of interpretations and flexible to accommodate for the likely recognition of new hazards and development of new EWS technologies. Scenarios can help to uncover potential impacts of hazards that might otherwise have caught decision makers by surprise. Many early warnings knowingly and unknowingly activate other early warnings, as the time gap between a warning and the onset of a hazardous event shortens. This process can be referred to as a cascade of early warnings. However large or complex the formal early warning system, there exists an even larger early warning network which encompasses many more

elements of society than one might realize. Creeping environmental changes are in need of early warning systems because the impacts of incremental but cumulative changes on society in the long run may be more costly and disruptive than the quick onset hazardous events. EWSs should also report on advances in hazards research, advances in the development of early warning systems, and in new technologies and techniques that can improve the effectiveness of existing EWSs. Each stage in the warning process from monitoring to responding must be interactive in such a way as to keep the warning timely, understood, and providing enough lead-time for responses. As new earlier warning technologies and techniques have been developed or new monitoring methods devised, EWSs have had the opportunity to become more effective in their spatial coverage and in the lead timing of the warning. Because of limited resources (human and financial) in many countries, it is important to distinguish between what is desirable for an effective EWS and what is essential._ EWSs need to be treated as subsystems embedded and integrated into larger socioeconomic and political systems. Stakeholders need to be involved in the development of new EWSs or redesigning existing ones. Stakeholders can provide important insights into how warnings might best be prepared and delivered to the public, the media, and even to the governments at different levels. Transparency is important for building up credibility in the outputs of EWSs. Early warning systems for food security, for example, need to use all kinds of information as inputs, even rumors, to assure that the earliest warning possible can be made for potential food-related problems. The selection of indicators is very important, because monitoring will center on them. The wrong indicators can lead to wasted time, effort, and resources. There will be surprises with respect to hazards with regard to timing of onset, intensity, location and duration and even impact. Early warning system operators face a dilemma: they are often criticized for a missed or erroneous warning, but are infrequently praised for having been correct. The psychological aspects surrounding EWSs are more important than generally realized. The way that people view early warning systems will affect how effective the EWS might prove to be. Discounting the value of information has a negative effect on the many lessons identified from the impacts of previous hazards and disasters. While perceptions of reality may not accurately reflect reality, the actions taken based on those perceptions will have real consequences. The impacts of hazards need not be surprising, if the appropriate warning mechanisms are in place. It is essential to identify societal processes that can affect the impacts of hazards (quick onset and creeping), so that governments and individuals can better warn about and prepare for likely impacts. Each government has the responsibility to identify what it is that makes societies more or less vulnerable and more or less resilient. Early warning of hazards combined with the early warnings of underlying societal problems and processes can lead to a strengthening of resilience and a reduction in vulnerability. How well prepared a society is in order to be proactive in the face of early warning of a looming hazard determines how well people might respond to the hazard. Climate change will have impacts that add to the list of yet-unknown underlying processes that can affect hazards and societal vulnerability to them. It seems that EWSs are more likely to receive blame for missed or erroneous warnings than praise for successful ones. Memories of successes are short-lived and easily overshadowed by the next disaster. There should be multiple expressions of a warning. Foreseeability can be viewed as yet another way to express an early warning of potential harm, even if it is not used in an operational way. It would be useful to collect lessons of the past for evaluation by present and future EWSs. It is important to identify and then apply lessons so that the victims in previous disasters do not become victims without a legacy. Disasters get the lion’s share of attention from the media when compared with “ordinary” adverse impacts resulting from seasonal climate variability. As far as early warnings are concerned, it is useful to talk about the “seasons of disaster.” The seasonality of such hazards already provides policymakers with a clear warning for regions potentially at risk. However, a significant increase in global warming of the atmosphere is expected to alter the characteristics of the seasons in ways that are yet to be determined. Disaster priorities in a given location will likely vary over time as new hazards appear, as old forgotten hazards reappear, and as existing hazards known to inhabitants of one region appear in new unsuspecting areas. While the public might not understand quantitative probabilities, they do understand what it means to “take a chance” or to “take risks”. Early warning systems have an important contribution to make by “warning” that normal conditions are likely to prevail.

Conclusions

An early warning system is an important tool in a government's program to achieve sustainable development. In fact sustainable development prospects are very dependent on the effectiveness of the many early warning systems. Early warning systems must partner with the media in a mutually beneficial way. A key problem is that disasters are media-friendly; creeping changes are not, as climate change. There is a need for an intermediary to act as a translator of the warning's technical contents and background to the media. Not every warning is meant for public consumption and may be only for the eyes and ears of specific target audiences, such as relevant government agencies. The early warning system must take full responsibility for the warning when it presents its messages to the public, the media and the government. Human capacity exists in just about every country. What are needed are a desire and a mechanism to bring people together and to support them as they enhance their existing early warning capabilities.

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