Trans. Nat. Acad. Sci. Technol. 14:80-87.1992

RESEARCH AGENDA FOR DISASTER MITIGATION

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ABSTRACT

Disaster mitigation encompasses the whole gamut of activities aimed at reducing the damaging effects of disaster-causing events, including hazards assessment and zoning, protection and risk reduction, monitoring and prediction, preparedness planning, emrgency response, recovery, rehabilitation, reconstruction and resettlement. Each of these aspects requires certain R & D inputs in varying degrees of depth and breadth. Research efforts during the rest of the decade should focus on: generation of data needed for hazards assessment and zonation; development/adaptation of technologies for disaster protection and risk reduction; identification and testing of reliable monitoring and generation/adaptation of monitoring and forecasting techniques; impact studies; and evaluative and policy studies towards improving preparedness, response, recovery and rehabilitation systems. An interdisciplinary approach to research is essential in order to develop a coherent and focused disaster mitigation program. Equality important is the need for a National Center for Disaster Research.

Introduction

For the past three years, Nature has been driving home the fact that the Philippines is prone and vulnerable to such natural disaster-causing phenomena as earthquakes, volcanic eruptions, typhoons and floods. We, in the disaster management community, have been echoing and even underscoring Nature's point in an effort to promote hazard awareness and disaster preparedness. Lately, however, there has been a growing uncomfortable feeling the disaster vulnerability of the country has been over dramatized or played up to the point of rendering it unattractive to developers and investors. Our disaster awareness promotion efforts may have been so successful as to engender not only awareness but fear as well. Worse, these may have been inadvertently endorsing the prophesies of Armageddon or doomsday criers. Consequently, our efforts to advance disaster reduction as a means towards disaster-less development, has created an undesirable side effect – the intimidation of development.

As typhoons, lahars and volcanic eruption continue to loom over the country's rice granary or breadbasket, it is deemed wise to counteract this side-effect before our countrymen succumb to fatalism, a congenital affliction associated with our race. We need to shift gears in our disaster awareness promotion activities – play down our disaster vulnerability and play up our capabilities and imperatives to take up Nature's challenges. We are bound to end up as losers if we allow ourselves to be intimidated by megadimensions and megascales of Nature's attempts to overpower us. With all the recent breakthroughs in disaster mitigation technology, there is no reason to feel helpless against nature and natural hazards. We only have to understand, anticipate/predict and prepare for Nature's occasional destructive moods.

DISASTER MITIGATION R & D

The dictionary definition of mitigation is the act of "softening or alleviating", in the context of natural disasters, disaster mitigation thus means those activities that would soften the disaster's impact on society and its physical environment. It encompasses the whole set of disaster-related activities before, during and after the event, namely: hazards assessment and zoning, protection and risk reduction, monitoring and prediction, preparedness planning, emergency response, recovery, rehabilitation and reconstruction and resettlement.

Each of these aspects requires certain R & D inputs, in varying degrees of depth and breadth as each varies in level of development and application for each of the different hazards in the Philippine setting.

Hazard Assessment and Zonation

Hazards assessments and the resulting hazard zone maps are useful as: 1) guides for long-range land use planning taking into account potential hazards from future geotectonic events; and 2) guides for deciding our areas to be evacuated and avoided during geologic crises, ideally before the onset of disaster-causing phenomena.

Hazards assessments are usually based on the assumption that the same general areas will likely be affected by future and similar events, at about the same average frequency and intensity as in the past.

For volcanic hazards assessment, research must be undertaken to generate the following essential data:

- records of historical eruptions
- prehistoric eruptive activities deduced from the geologic record; geologic (especially stratigraphic), petrologic, and geochemical data on the nature, distribution and volume of the eruptive products; and
- dating of the volcanic products and events interpreted from them.

Volcanic disaster mitigation thus requires a strong foundation of long term basic studies which ideally should be carried out systematically before the volcanoes show signs of restiveness. These long term studies should generate information that would unravel the past eruptive behavior of each high risk volcano and enable us to understand its present behavior and predict its future behavior. The focus of such researches should be on eruptive processes, eruptive products, eruption-related phenomena and frequency/recurrence intervals;

PHIVOLCS has produced hazards zone maps for six of the country's active volcanoes-Taal, Mayon, Bulusan, Canlaon, Hibok-Hibok and Pinatubo. These, however, are still wanting in depth and detail and remain to be reviewed/updated with the discovery of new information and additional understanding of the volcanoes' past and present patterns of behavior.

Other high risk volcanoes like Banahaw, Matutum, Iraya, Kalatungan, Talisay Caldera and Ragang should also be included in the hazards assessment agenda for the next five years.

For earthquakes and related hazards, macrozonation maps have been produced identifying the major earthquake generators, and areas prone to landslides and liquefaction. These definitely lack sufficient detail and require verification to be useful for development planning and implementation purposes.

A Meeting of Experts on Earthquake Risk Mitigation sponsored by UNESCO in March 1992 recommended among others, the following for research and development: active fault studies; review of historical earthquakes; geotechnical/geological surveys; regional seismic hazard mapping; microseismic zonation; earthquake-related hazard zonation-for earthquake related landslides, liquefaction, tsunami and fire.

Delineation of landslide prone areas starts with identification of the geologic factors that influence the occurrence of landslides. These factors are generally well known but they have to be applied to the terrain and rock formations of a given area to determine its landslide potential. Detailed mapping, soil analysis, field and laboratory investigation have to be conducted. Once potentially hazardous conditions such as ground water erosion and slope instability are identified, preventive measures can be undertaken. Initial work toward landslide hazard assessment yielded maps showing the landslides generated by the July 16, 1990 Luzon earthquake and based on the July 1990 experience identified certain geologic factors that trigger landslides. More work must be done to consider other factors such as precipitation, soil conditions, etc.

General areas prone to tsunami are known and a hazard map for tsunami has been produced by the Institute, but further effort is needed to prepare hazard maps delineating the reasonably expected limits of inundation, particularly for populated coastal areas.

Hazard assessment for typhoons come in the form of typhoon paths. Because of the frequency of typhoons, the prone areas and those subject to storm surges are quite well known. For flooding, hazard maps are known to exist and

have been used by public works and infrastructure people. The adequacy of these maps remains to be evaluated.

Areas which are flood prone are known but how inundated these shall be, given a precipitation rate and amount, is not known. There are no available maps to describe how flooded these flood prone areas shall be considering the worst case scenarios. Even for Metro Manila, some portions of which are known to lie close to sea level and are highly vulnerable to flooding after short duration heavy downpours, no map exists to delineate areas perennially affected by floods. A flood map of parts of Metro Manila was produced by Rene Solidum of PHIVOLC'S after looking for and measuring watermarks left by the floodwater of 15-16 August 1986. Considering the magnitude and persistence of the problem, flooding hazard assessment/mapping should be given high priority. Of particular interest to us, to avoid repeats of the 1991 Ormoc disaster -- human settlements along and downstream of rivers draining mountain ranges of isolated mountain peaks should be assessed in terms of their vulnerability to flash floods. Then appropriate land use zoning should be generate and then implemented seriously even for those areas falling under the low vulnerability category.

Protection and risk reduction measures

Once the areas prone to disaster causing phenomena are identified and delineated, ways could be found and effected to reduce the vulnerability of people and property to damaging effects of rapid onset natural hazards. The most effective risk reduction measure would be to avoid building in or developing high danger zones. But this would be impractical and unfeasible in the case of the Philippines which is rich in danger zones. We therefore have to devise programs to reduce risks without impairing economic development. Options include land use planning and regulation, formulation and enforcement of standards for design and construction of buildings and other structures, engineering protective structures to reduce the severity of hazards, and economic protection measures like insurance.

Land use planning is itself a young field and techniques for planning and mechanisms for implementation are subjects for serious study specially in societies the development of which has hitherto proceeded in a largely unplanned manner. One recently introduced tool for land use planning-the GIS-could greatly facilitate and boost planning practice in the country. GIS application is right now being pilot tested at the NEDA-3 in the database establishment and formulation of rehabilitation and resettlement plans for the Piratubo affected areas. Its application in other aspects of disaster mitigation should be explored.

There is also a need for a program of engineering research and development directed at the analysis, design, construction and maintenance of disaster-resistant structures, utility lines and transportation facilities. Such a program should include ash- resistant, typhoon-resistant and earthquake-resistant buildings, lahar-

resistant infrastructures, lahar protective and containment structures, flood control, landslide prevention/control structures.

A wide array of disaster protection technologies is available in developed countries like Japan and USA. These are, however, capital intensive and their adaptation/importation into the Philippine setting must be studied carefully. The cost-benefit of these technologies compared to the resettlement alternative is an important consideration.

Monitoring and Prediction

Monitoring provides the primary data for short-medium term forecasts (hours-months ahead), if possible, of disaster-causing events. It is, however, a still-developing aspect of disaster mitigation and as such depends on R & D for its advancement.

For volcanic eruptions, there is a need to identify and test reliable monitoring parameters and generate/adapt monitoring techniques. Eruptions are usually preceded and accompanied by measurable geophysical and/or geochemical changes in the volcano's condition. At the moment, seismicity and ground deformation are the most widely used parameters for volcano monitoring. Current and future research and development activities on volcano monitoring are geared towards the development and adaptation of other geophysical monitoring techniques such as microgravity, geomagnetic, geoelectrical, radar and thermal radiation, and geochemical monitoring techniques like measurements of temporal variation in the amount and/or rate of emission of certain volcanic gases (e.g. sulfur dioxide, carbon dioxide, hydrogen, radon, helium and mercury).

For earthquakes and earthquake-generated landslides and tsunami; precise prediction of the timing and extent are not currently feasible, although the potential for such events in many areas is known. More instrumentation for monitoring and detecting dynamic forces within the earth is required to generate better understanding of these phenomena and formulate theories and systems for prediction

The PHIVOLCS seismological network has 14 seismic stations for monitoring and describing earthquakes occurring within and outside the Philippine Archipelago. Given this limited number of seismic stations, there is no way of positioning them so that the nine highly mobile zones in the Philippines can be properly monitored and characterized to obtain the required quantity and quality of seismic data for earthquake prediction purposes. Still to be emplaced are ground deformation stations across active faults for determining selective stress buildups and tendencies for generating earthquakes along these zones of weakness. Hopefully, a suitable ground deformation network shall have been established within ten years for reinforcing the data obtained thru the other monitoring networks of PHIVOLCS. This additional network shall place PHIVOLCS in a better position to predict or forecast the occurrence of earthquakes, volcanic eruptions and even landslides. Right now, we have yet to establish a truly

functional ground deformation network in the Philippines. Hence, for the moment, we leave earthquake prediction to the more developed countries that have the capability facilities-wise and expertise-wise.

Extremely destructive, tsunami are rare events and are generally confined to the Pacific Ocean basin. The possibility of detecting tsunami waves generated by distant earthquakes is quite high and there is an existing detection network and warning system centered at Honolulu. What remains to be done in the Philippines is to improve our link up to the International Tsunami Warning System and conceptualize our own system for detecting locally generated tsunami.

In the atmospheric sciences, substantial progress has been achieved toward predicting the occurrence of disaster-causing phenomena. The meteorological network of PAGASA is highly capable of monitoring weather variations, amount and rate of precipitation, percent cloudiness and typhoon tracks. With the recent developments in space technology, PAGASA's capability to forecast and characterize typhoons threatening the country has been greatly enhanced. Still, there is an obvious need to improve understanding of causes and mechanisms and of forecasting techniques that would yield more accurate forecasts as to cause, landfall and force. With new knowledge and improve methods, emergency protection and evacuation could be undertaken with more confidence and efficiency.

Flood forecasting is still in its infancy in the Philippines. Flood-prone areas can be identified and delineated through topographic and natural drainage analyses, but a runoff gauging network is required to monitor and determine increasing or decreasing flood risks and forecast possible extent and frequency of flooding in these areas. PAGASA, as part of its flood forecasting network, has been operating runoff gauging stations but only in some major river basins. The present setup may be inadequate and hence the need to expand it to cover other flood prone areas in the country.

Preparedness Planning, Emergency Response and Post Disaster Activities

The recent disasters that hit the country: the July 16, 1990 Luzon earthquake, the Ormoc tragedy, the Pinatubo Volcano 1991 eruption and the ongoing Pinatubo lahar crisis put to test existing disaster preparedness plans, response systems and recovery-rehabilitation-reconstruction systems. Evaluative studies are in order to determine how these systems performed and identify areas for improvement and rectification. Other problems/issues which need to be studied include:

1) response to warning. studies on why certain groups responded appropriately and why others defied/ignored warnings should be undertaken.

2) impact assessment. There is an obvious need for concerned agencies to agree on techniques for inventorying casualties and estimating damages. The impacts of the various destructive processes/agents like lahars and ashfalls on health,

agriculture, fisheries and other aspects of life have to be understood in order to determine appropriate recovery and rehabilitation measures as well as preparedness actions for future events.

3) relief management. The confusion, mismanagement and scandals that were reported in connection with the recent disasters indicate the need to look into this aspect of disaster response. Another question is the extent of relief that should be extended to victims without fostering overdependence.

4) cost benefit and socio-economic as well as political implications of relocation and/or construction of protective measures, specifically for the Pinatubo affected areas.

5 appropriate/more effective organizational and institutional framework for disaster management.

6) role of NGOs in disaster management.

INTERDISCIPLINARY APPROACH TO DISASTER MITIGATION R & D

The forecited partial list of research imperatives for disaster mitigation encompasses a large number of and diverse disciplines — in the natural sciences, social sciences, medical sciences, engineering and even arts. The challenges posed by disasters seem to have been so designed as to compel us to unite and put our heads together.

To date, institutions involved in disaster mitigation research have been working separately and independently. There is no complete inventory of all the disaster-related researches that have been completed or are ongoing but cursory reviews indicate that efforts have leaped quantitatively these past two years. Instances of duplication have surfaced. Considering the country's limited resources-funding wise and expertise wise-for research as well as the need for immediate results to reduce disaster tolls, it is imperative that a coherent (and therefore interdisciplinary) and focused research and development program for disaster mitigation be developed.

Taal Volcano can be used to test and demonstrate how such an interdisciplinary disaster mitigation program shall work. The International Association of Volcanology and Chemistry of the Earth's Interior (IAVCEI) Task Group for the International Decade of Natural Disaster Reduction (IDNDR) has chosen Taal Volcano as one of ten active volcanoes throughout the world where "Decade Volcano" Demonstration Projects shall be conducted during the rest of the 1990s or the IDNDR. As a decade volcano, it shall be the subject of in-depth, integrated, multidisciplinary, multinational cooperative demonstration work on all phases of volcanic hazards mitigation. Activities at the decade volcano shall ideally include: establishment of state-of-the-art monitoring and mapping techniques, related research on eruption impacts on man and his environment, development of contingency plans, warning systems, practice drills by civil defense officials and community leaders, and development of appropriate engineering counter meas-

ures for mitigating adverse effects. People from various disciplines shall be involved: natural scientists to study the physical phenomena; social scientists to understand and influence the way people respond to volcanic threat; engineer and agricultural scientists to document and determine ways of lessening the impact of eruptions.

Equally important is the need for an entity-a National Center for Disaster Research that shall:

-formulate and update a coherent R & D program for disaster mitigation and generate as well as manage funds for its implementation;

-serve as a disaster research clearing house, to include private as well as government research undertakings;

-coordinate/link the specialized disaster research efforts of the various agencies/organizations involved;

-serve as a national conduit for international disaster organizations and counterpart organizations in other countries;

-sponsor and conduct interdisciplinary disaster research; and

-provide a center for professional development of disaster management officials.

The actual form of such an entity is, of course, a matter for further study.