
Integrated Riverine Flood Risk Management

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We have heard a lot this morning and yesterday about the principles and theory of Total Disaster Risk Management, and about how this approach must be holistic, comprehensive and integrated. In this presentation I will attempt to illustrate what a comprehensive and holistic flood mitigation program might include, and how the principles of TDRM can be applied to reduce flood disaster vulnerability. This same approach can be applied to flash floods, to typhoons, and even to earthquakes, but slow-onset river flooding is perhaps the easiest to demonstrate the way in which a broad range of activities can be integrated to achieve the best results.

Climate forecasts

Climate forecasts—by which we mean forecasts of meteorological events more than nine days in the future—are critical elements in reducing economic losses to river floods. The U.S. National Oceanic and Atmospheric Administration (NOAA) is already working with national Hydro-Met Departments in Asia to downscale global climate forecasts to specific countries and even to specific regions within countries. These forecasts are typically expressed in terms of probabilities of rainfall patterns and amounts but, even so, most Hydro-Met Departments are reluctant to express their forecasts in more than general terms, such as "there is a 45 percent chance of above normal rainfall for the next three months". If pressed by national leadership and if provided critical threshold information by other departments, however, the Hydro-Met Departments could provide more user-friendly forecasts. Such forecasts could be expressed in terms such as, "there is a 40 to 55 percent chance of enough rainfall over the next three months to grow Rice Variety A; a 45 to 60 percent chance of enough rainfall to grow Rice Variety B; a 55 to 80 percent chance of enough rainfall to grow maize, etc.". Or, "there is a 50 to 60 percent chance of steady rains

beginning in 15 to 20 days" or "there is only a 35 to 55 percent chance of enough rainfall to provide XX megawatts of hydro power over the next three months." If these are the types of forecasts that you want, then you must **insist** that your hydro-met agency provide them to you.

Climate forecast applications

Climate forecasts expressed in user-friendly terms can be used in obvious ways to reduce the impact of severe events, such as El Nino and La Nina. Forecasts of probable drought conditions, for example, can influence farmers to save their seeds for the following season, or to plant a drought-resistant crop, or to plant earlier or later than normal. Also, the number, the paths and the severity of typhoons striking Vietnam and the Philippines are greatly influenced by severe climate events, so disaster managers can prepare accordingly. Based on forecasts of a severe El Nino, hydro-electric power managers may choose to conserve water and reduce electrical generation early rather than face more sever disruption later on. Since both climate and the incidence of cholera, for example, are greatly influenced by sea surface temperatures, climate forecasts can be used to alert health professionals to the increased likelihood of certain disease epidemics.

As climate forecasts improve, they can also be applied to great advantage, even in non-disaster years, to increase economic output or to increase the efficiency of resource utilization. If rice farmers can use climate forecasts to time their planting so as to maximize moisture in the air at the time the rice plant is generating its spikes, for example, the farmer can increase his yield by as much as ten percent. If a rice farmer can time his planting to assure a ten-day dry period just prior to harvest, he can increase his yield by as much as 15 percent. Such increases in production, particularly since they require no additional financial inputs from the farmer, have enormous implications for poverty alleviation and growth in national GDP. The routine application of climate forecasts in this way also helps to establish their credibility with the end-users, increasing the chances of the forecasts being used to minimize adverse impacts during disaster years.

Flood forecasts

River flood forecasts, utilizing river flow monitoring, actual and predictive rainfall measurements, and water runoff are rapidly being developed for a number of major river systems in Asia, most notably the major rivers in China and the Mekong. These already can, or shortly will, provide three to nine days advance notice of potential flood disasters. There remain, however, a number of gaps in the predictive capacity, due mainly to the reluctance or inability of upstream countries to share real-time information on river flow with their neighbors downstream. This is most notable—and must most urgently be addressed—in respect to the Red River and to the Ganges-Brahmaputra-Megma river system. The rapid progress in developing river flow information recently demonstrated by the Mekong River Commission and its constituent and partner countries (Thailand, Cambodia, Laos, Vietnam, China and Myanmar) highlights the benefit of having a single, basin-wide organization assume responsibility for data collection, analysis, modeling, and forecasting. A similar approach, possibly utilizing ICIMOD, should be considered for the Ganges-Brahmaputra-Megma system, and a joint China-Vietnam commission should be considered for the Red River.

Flood mapping/referencing

While good progress has been made in forecasting the height of water at various points along some major rivers, this information has little meaning to villagers who live on the flood plain but at some distance from the main river channel. Yesterday, we saw a presentation regarding the benefits of using GIS to develop maps showing what areas of a flood plain would be inundated, and to what levels, under certain conditions. The maps presented were very attractive indeed, but they are also very expensive to develop and very difficult to keep up-to-date. An alternative system, which is being piloted in Africa by the U.S. Geological Survey (USGS) and in Central Vietnam by UNDP, involves village-level volunteers in monitoring and reporting flood levels against established benchmarks erected in the village. Flood levels in specific villages are then referenced back to river height at specific gauging stations which, over time, allows accurate forecasting of the depth and timing of floods in the village

based upon the data recorded at the river gauging stations. Such a flood referencing system requires a fair amount of organization, but would cost only a fraction of what would be required for digital mapping. The flood referencing system also has the added advantages of involving local people in the forecast exercise and of being relatively easy to keep up-to-date as flood levels are influenced by the construction of infrastructure such as roads or levees.

Early warning

Just as with climate forecasts, flood warnings must be sufficiently specific as to time, location and depth of water as to be **actionable**, they must be disseminated to reach all potential victims of flood, they must be credible, and they must be consistent regardless of the dissemination channel used.
The flood referencing (or flood mapping) that I just mentioned should provide governments sufficient information to issue warnings along the lines of: "Flood waters will gradually rise in Villages A, B, C, F, L, M, etc. on Tuesday, will reach Flood Level 3 (as marked on the village benchmarks) on Friday, and then are expected to subside over the next five days." This type of warning allows villagers to determine whether they should harvest as much rice as possible, even if it has not fully ripened, whether they should evacuate their families, whether they should evacuate or sell their livestock, etc.

To assure consistency, only one agency should be responsible for making flood forecasts and only one agency (the same or different) should determine that a warning is appropriate, but many agencies should be involved in disseminating the warning. All possible channels for communicating a flood warning—media, government officials such as police and village leaders, and voluntary agencies—should be used to disseminate **exactly the same warning** to every potential flood victim. The most effective early warning system I have seen anywhere is the cyclone early warning system in Bangladesh, which involves 20,000 volunteers who go from house to house to urge villagers to evacuate to cyclone shelters when the signal is given by the government. Bangladesh authorities have found that warnings are much more likely to be taken seriously if the warning is delivered in person. Similarly, flood warnings broadcast over radio and television in Vietnam are reinforced by members of the village Flood

and Storm Control Committee, who personally deliver the same message to each family in their community.

Watershed management

The integrated management of watersheds not only reduces the rate of runoff, and hence the impact of flood, it also helps establish strategic alliances with government agencies and elements of civil society concerned about sustainable forestry, water resource management, land use planning, wildlife conservation, and so on.

Urban land use planning

The rapid rate of urbanization, particularly in secondary cities and throughout Asia, has resulted in greatly increased occupation of marginal lands such as flood plains and steep slopes. This has put much greater numbers of people and many more physical assets at risk of flooding. In addition, the conversion of peri-urban areas from agricultural to residential use has caused more rapid water runoff, making floods more frequent and more severe. There is an urgent need in most secondary cities to carry out flood mapping, and to use flood maps to enact and enforce strict zoning regulations governing land use and standards of construction. Specialized training courses, such as ADPC's Urban Flood Mitigation Course, should be made widely available for urban managers and planning officials.

Structural interventions

Structural interventions, such as levees and dams, which impede the flow of water should be undertaken only after very careful study and analysis since, most often, such interventions merely shift the flood hazard from one area or community to another and sometimes result in prolongation of the flood situation. There is greater scope for interventions, such as road culverts and drainage canals, that actually facilitate the flow of flood waters.

More thought must be given to the design and construction of public facilities,

such as schools, clinics, religious sites and public buildings. At the moment, there appears to be a tendency among officials responsible for the design, siting and construction of these facilities to view their responsibility as simply assuring that the building in question is constructed above flood level. To the extent they are successful in this endeavor, however, that building will then serve as an evacuation center for those whose homes and property remain subject to inundation. Accordingly, the design of such buildings must take their dual function into account. Schools in flood-prone areas, for example, should have wider verandahs than normal so that the cooking of food can take place outside the classrooms but protected from the rain. They should also have sufficient toilets and potable water sources, both of which should be above flood level and readily accessible from the school, to serve the evacuee population. Failure to incorporate these features into school construction will not prevent their use as evacuation centers, but will result in unnecessary damage to the school building and will pose unnecessary health risks to the evacuee population and to the school's pupils even after flood waters recede.

Education

Basic safety measures that should be taken during floods should be incorporated into the primary school curriculum in flood-prone areas. Along these lines, it is gratifying to note the "Living with Floods" series produced for Vietnamese primary students. (The Philippines and Nepal have produced good educational materials relating to earthquakes, but I am not aware of similar materials in respect to floods in those countries.)

Community-based disaster management

Significant progress has been made in recent years in helping villages better prepare to deal effectively with floods at the family and community levels. Of note, both the Cambodian Red Cross (CRC) and the Philippine National Red Cross (PNRC) have initiated programs that utilize volunteers to help villages develop plans to cope with floods. Villagers are helped to be aware of and to interpret flood warnings, to plan their evacuation to safe havens, to identify and prepare for their food and potable water needs, to plan for the evacuation and

feeding of their livestock, etc. In process, villages often identify small projects—such as elevated livestock pens, sealed or raised wells, boats for commuting to school, etc.—that the volunteer then assists in organizing the village to implement or in presenting the proposal to the relevant authorities. ADPC has developed a course on Community-based Disaster Preparedness, but much remains to be done in pulling together the lessons learned from on-going CBDM efforts and in compiling a menu of possible interventions that can be taken at the village level to mitigate the adverse impact of floods.

Residential flood proofing

Residential flood proofing typically involves raising an entire earthen homestead, accommodating one to six homes, above flood level, using geo-textiles, vegetation or bamboo fencing to prevent erosion. ("Homestead" here is taken to mean the ground on which a house, water well, vegetable garden, grain storage, livestock pen and latrine are situated.) Residential flood proofing requires readily available quantities of earth, and so is most suitable to rural areas. It has achieved good success in rural areas of northern Bangladesh and is being implemented by some individuals and provincial governments in the Mekong Delta of Vietnam. Residential flood proofing does not address the problem of agricultural losses, but can greatly reduce loss of life and property and almost eliminate the need for emergency relief assistance during a flood period.

Implementation of flood proofing programs must take into account both hydrological considerations and local attitudes. Accordingly, "ribbon" type earthen elevations, which impede the flow of water, should be avoided in favor of small, scattered "island" type elevations. Also, farmers typically prefer living close to their fields and, in some cultures, close to the graves of their ancestors; they should not be pressured to move to areas more convenient to government officials, such as along roadways.

In cultures where people prefer to live in houses that are elevated off the ground, consideration should be given to providing subsidies, dependent on need, for the purchase of concrete pillars. This is to assure that all families can protect at least their lives and their household items from the ravages of floods.

Flood disaster response

In the past decade, many countries in the region have made very substantial progress in meeting the emergency needs of flood victims, but some improvement is still required. Most progress has been made in the provision of emergency shelter and the distribution of relief food, and the introduction of rescue boats and trained crews is a relatively recent and important intervention in the Philippines and Vietnam.

Other important interventions, such as the provision of potable water and sanitation facilities, remain weak. Both water and sanitation can perhaps be most easily provided by upgrading these facilities at evacuation centers, or by developing such facilities alongside elevated roads where flood victims often gather. In Vietnam, CARE has recently introduced relatively small, mobile water treatment units that can serve populations up to 30,000. These units cost approximately $22,000 each, and are manufactured by the LMS Corporation in Lyons, France.

Another overlooked but important need during floods is the provision of fuel, probably charcoal, for cooking purposes. Floods make the gathering of firewood extraordinarily difficult, and the massing of large numbers of people in small areas often results in severe environmental degradation and even the destruction of some infrastructure as flood victims are forced to avail of any source of fuel.

Insurance

The insurance industry, particularly related to property insurance, is not well developed in Asia. Given the present level of loss caused by floods, moreover, it is doubtful that insurance premiums could be made low enough to be affordable to most victims. However, implementation of a comprehensive flood management program, as outlined above, could reduce flood risk to a level that is tolerable to insurance companies. It is not too early to begin discussions with the insurance industry along these lines, perhaps initially focussing on the minimal requirements to develop a program of crop insurance, with household

insurance programs left to a later stage.

Conclusion

My mention of these components of a flood risk mitigation programme is not meant to be exhaustive. Indeed, depending on the situation in your own country, you might also identify the need for policy reform or the enactment of specific legislation, for example.

Nor am I suggesting that these activities are not already being done to some extent in your countries. Indeed, I have seen clear evidence that virtually all of these activities are being carried out by some agencies, in some locations, some of the time. But, just as clearly, there are some significant gaps.

What I have tried to demonstrate is that a holistic, comprehensive and effective flood risk mitigation programme must **actively involve** many segments of society—hydro-meteorological, agricultural and fisheries agencies, forestry and watershed management, water resource management, electric power generation, lifelines such as roads and telecommunications, education and health ministries, land-use planning and urban planning, the media, the national Red Cross/Red Crescent and other members of civil society, local government and, of course, the citizens themselves. Also, those responsible for disaster mitigation and management in each country must actively seek to **integrate** these activities, most readily by encouraging and facilitating dialogue between and among the various players so that, for example, the hydro-met office formulates forecasts in language and detail that is most useful to agricultural extension workers, or so that conservationists and urban planners jointly demand better watershed management.