Economic Aspects of Disaster Prevention
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Synopsis

Natural disaster events cannot be avoided, but the effect and damage resulting from such phenomenon can be minimised. This paper looks at ways to minimise the economic costs and losses resulting from such disasters. The paper draws on experiences in Indonesia, PNG, Philippines, and Australia to provide valuable lessons from natural disasters, such as earthquake, fire, cyclone and volcanic eruption.

The paper looks at economic benefits of steps taken in the design and construction stages of a project to minimise the effect of such natural disasters The cost of additional requirements at this stage are small – often less than 1-2% of the capital cost – and yet the benefits are immense.. A major mining facility in PNG was able to continue operation, without stoppage, or significant damage through two major earthquakes of 7.3 and 6.8 on the Richter scale. Mining and process facilities suffered minimal damage and were able to immediately recommence operation after a cyclone with winds of 120 mph – almost 200 kph hit the area in N. W. Australia.

The paper also draws on experiences from the restructuring necessary resulting from a major earthquake of 7.5 on the Richter scale and resulting tidal wave in Flores in 1992 which killed over 3000 people and damaged many roads,, and buildings. Over 200 km of road restructuring, and 340 schools and 170 health clinics were replaced, with many more requiring repair. Research on the results and damage from the earthquake, and in the rectification and repair resulted in techniques being developed for replacement, with recommended building practices being introduced in the region, including a far more extensive use of local materials, including bamboo. The paper looks at lessons learned, and economic aspects resulting from those lessons.

Finally the paper presents details of the recently formed Disaster Management Facility within the World Bank

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Economic Aspects of Disaster Prevention
Some World Bank Experiences

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Natural Disasters - cost money

Prevention of damage is better than paying the bills of reconstruction.

We cannot prevent natural disaster but we can minimize, or reduce the resultant costs rather than "curing the damage" by paying huge bills after the disaster has occurred. To quote a previous speaker, " these events don't have to become social and economic disasters."

I would also like to postulate here that we are partly responsible for the magnitude of the effect of many of the disasters as a result of our own stupidity. To quote again Terry Jeggles comment of yesterdays opening address., That mankinds involvement has also contributed greatly to many natural disasters.

We were given a long list of statistics about the disasters of the decade, flood, fire tidal wave tsunami, drought volcanic eruption, earthquake that have occurred since 1990. We were told yesterday that insurance costs resulting from natural disasters in 1998 alone were over $90 billion, and the disasters resulted in over 50,000 deaths, over 7000 in floods alone

How can these costs and losses be minimised?

Today I want to draw from my personal experiences and disaster minimization activities, drawing an experience mainly in Indonesia, with added data from PNG, Philippines and Australia. Finally I would like to conclude by speaking for a few minutes on recent measures the World Bank are taking with the introduction of a Disaster Management Facility which has just recently been formed.

Natural disasters cannot be prevented But their devastating effect can be minimized. We have all seen photos of bridge collapses, of overturned buildings. These are the major catastrophes. They are hard to minimize, and if they could be costs would be huge.

But there are the 'minor catastrophes' the ones that cause less damage, but just as much inconvenience. Damage to buildings may not be total but the necessary repair often takes the building, or the facility out of service for some time. These inconveniences are expensive and can be minimized by designing in advance, planning and preparation.

We have already talked extensively about preparedness for natural disasters. Every speaker has talked about awareness, better coordination, early warnings, etc. I would like to share with you a special such "preparedness" that everyone followed under a potential disaster alert situation.

In PNG, I recall playing golf at Rabaul by the harbour and close to a major volcano which eventually erupted in 1990 effectively eliminating the village of Rabaul. Here we had a local rule that if the ball, or your golf stroke was affected by steam vents, or the ball lost in a volcanic vent, you were allowed to drop without penalty. That was one form of 'local preparedness'.

But back to the subject in hand. I want to talk about some design application developed as a result of earthquake damage in Flores in 1992. I will also quote examples of design modification done on projects in PNG and Australia which enabled building to continue functioning after severe earthquake and wind/cyclone occurrances without significant damage

The earthquake in Flores in December 1992 had a rating of 7.5 on the Richter Scale and resulted in a tidal wave of over 5 m high. Almost 3,000 people died as a result of the event, many as a result of liquifaction of the sand flats before the tidal wave came.

Loan funds from IBRD, ADB and Australian government totalling almost US$ 75 million were spent in repairs. The earthquake damaged over 25,000 houses, 600 schools, 6 hospitals, 177 health clinics, 750 km of roads, bridges and water supplies all in government sector. It is estimated at least US$ 50 million was spent in repairs in the private sector as well.

In addition, and as part of the corrective measures, significant emphasis was placed on training the community in preparedness, and in adapting building practices to minimize damage in future incidents. In summary, under the loan funds, 279 km of roadworks, 357 m of bridgeworks, 2 hospitals, 342 schools, 177 health clinics, a new market, water supply for 6,600 people at New Wuring (relocated village) were repaired or renewed. Over 4,000 people were given preparedness training and 46 given overseas training in earthquake engineering and disaster management over the 4 years of the loan fund implementation.

Many of the failures in Flores were in masonry block work structures You can see some excellent examples of the failures in the accompanying slides. In general all blockwork was unreinforced. Many countries require reinforcing in all blockwork wire ties every 4 rows of block and embedded reinforced column every 3 meters. These precautions add minimal additional costs, but can provide the safety net to save the building.

Flores is a provincial, remote area and almost all structures were single storey. Many of the schools and health clinic were masonry structures and were completely destroyed. It was noted that invariably, timber and sheet structures withstood the earthquake, timber structures better than steel, and bamboo structures, even better than timber.

In exploring this, and in conjunction with bamboo research association bamboo test structures were fabricated and tested in Bandung for simulated earthquake resistance. This enabled principles for design and construction to be developed and in the closing years of the project over 130 bamboo or part bamboo school were constructed. The use of bamboo reduced the cost of a 3 classroom school to 41% of the cost of an equivalent steel and timber classroom, for full bamboo construction, and 48% of a steel and bamboo classroom A steel and bamboo classroom costs 80% of the original designed steel, timber replacement classroom.

The use of bamboo required special treatment to discourage insect attach (Boracic Acid Imersion) and required detailed attention to the timing of the initial cutting of the bamboo culms or poles, (just after shooting) but bamboo was a readily available natural material and proved useful, and acceptable in the repairs.

As a result of the research in Bandung and experience gained in the village schools, guidelines were developed which provided cheaper, more acceptable and safer construction for the majority of housing accommodation for the local population With the training given to the local people, many have now adopted this suggested form of construction in their villages.

I might at this stage draw a comparison between the initial schools which suffered heavy/total damage and the replacement schools. All the badly damaged schools were masonry construction, either concrete block or local clay brick cement rendered with a conventional timber roof. Without exception, the masonry cracked, and in many cases collapsed allowing the roof to fall in on classrooms. Only the early timing of the earthquake saved many children from death or serious injury.

In the replacement buildings, the column and roof truss structure is integral, and of a material which will not fail under earthquake i.e. steel, timber and bamboo and collar beams were incorporated at

floor and roof level. Particular attention was paid to the roof/column connection. This costs no more, except the time of care and supervision, yet provides a much safer construction approach.

The same approach was used in the design of replacement houses. Many of the inhabitants stated a preference for masonry construction - "looked better", had an air of permanence about it compared to timber or bamboo they claimed. We allowed masonry to be used up to window level. From window level up - we used solid frame windows, with timber or bamboo panel inserts. We effectively made a non structural feature of the infill. All structural resistance was provided by the column, and roof frame. These were tested in the research centre in Bandung for simulated earthquake and have since withstood mild earthquakes (4.5 R.S.) without damage.

The cost of the revised structures is marginally cheaper (2-5%) than the original damaged masonry constructed houses, partly because they now use less masonry block work.

I would like to spend a few minutes and share with you some other economic aspects and experiences of preparedness for natural disasters from both PNG and Australia. I was associated for almost 10 years with Bouganville Copper Mine on Bouganville island in PNG. The island is in a highly active earthquake belt, and frequently had "shakes".

We went to great pains to ensure latest earthquake design technology was followed at all times. In a major extension carried out in 1985 an upgrade was made of the earthquake bracing in the earlier erected building because of improved design technology from New Zealand and Japan, and recent 1980-85 experiences. The total extension works cost about US$ 35 million. The improved earthquake bracing added less than US$ 300,000 to the cost - less than 1% of the cost of the construction. And yet in December 1985 the plant continued to operate through a 7.3 R.S. earthquake and only minor damage was experienced in miscellaneous areas. By observing good practice in the early stages, or updating earlier structures based on latest technology minor costs can represent significant economic savings both in damage to structures, and loss of life in such situations.

Similarly in Australia in cyclone areas, housing and infrastructure facilities in the northwest mining towns are all designed for cyclone conditions in excess of 200 MPH. Additional construction costs have been estimated at 2% over the "non cyclone proof" housing. The main additions are window/door shutters, and roof ties ensuring a better connection to the wall frames. The houses are slightly different in floor layout to give an internal box structure to ensure rigidity to resist the increased windforces. The adds nothing to construction costs.

The major aspect in the northwest community is preparedness, and community involvement All new-comers are required to attend cyclone preparedness meetings, and standard procedures are in place for cyclone alert monitoring including garbage covering, storage of small items around a household etc Anything which might otherwise be moved by strongwinds.

All schools have standard procedures, and the children have "practices" monthly. It is a game they all enjoy, but they all know the rules.

All these activities cost nothing in terms of real money. They require administration and follow-up. To date there have been many cyclone alerts, and a number of actual "hits" but there have so far been no losses of people or damage to structures, and importantly, no loss of production times as a result of the various cyclones through the areas.

I could go on with other examples, but time does not permit. I want to turn my attention now to recent measures being taken by the World Bank in disaster management, that I mentioned briefly yesterday.

World Bank lending for agencies has increased greatly over the last decade, now totalling about $8.8 billion in response to both the sudden onsett of events, earthquake, flood hurricane volcanic eruption, and forest fire in every region of Bank involvement. Some examples of assistance for natural disasters currently under preparation or implementation include: El-nino related projects in Argentina, Bolivia, Ecuador Guyana Paraguay and Peru, projects in response to forest fires in Brazil, Central America, and Mexico, an earthquake and flood project in Turkey, an earthquake project in India, and a Caribbean Disaster Mitigation and Reinsurance project

It is fair to say in the past, some components of Bank funded projects designed to reduce vulnerability to natural disasters have not always received the attention they deserve. The Bank's Disaster Management Facility was established to address this issue in July, 1998. Its objective is to:

1. assist the World Bank in providing a more strategic and rapid response to disaster emergencies
2. ensure disaster prevention and mitigation initiatives are mainstreamed into all Bank activities.
3. Act as a collector, and receptacle of data world wide

Developing countries suffer greatest costs when disaster hits. more than 95% of all deaths caused by disaster occur in developing countries. And losses due to natural disasters are 20 times greater. (as a percentage of GDP) in developing countries than in industrialised countries.

Added to this, a poorly planned development can turn a reoccurring natural phenomenon into a human and economic disaster. Allowing dense population on a floodplain, or allowing poor or unenforced building codes in earthquake zones is as likely as a natural event to cause causalities and losses. Similarly, allowing degradation of natural resources increases the risk of disaster.

Implementing this disaster management program, and in particular the disaster prevention and mitigation initiatives requires action. The DMF targets this by providing operational support, promoting capacity building and establishing partnerships with international and scientific communities working on disaster issues.
The key activities in Disaster Management Facility include:

Market Incentives for Mitigation Investment: This project aims to establish partnerships between the insurance/reinsurance community, the government, and private sector to promote market incentives for risk reduction.
The private sector partners will provide valuable expertise, information and support to assist in research, examination of alternative mechanisms and potential policy development work.

Provide support to member countries and World Bank staff in operation, in lending, and on the preparation of Country Assistance programs and city assistance strategies to reduce risk from natural disasters.

Review of World Bank disaster assistance programs to extract lessons for future operations and provide a data bank of information.

Review of World Bank policy on emergency assistance. The World Bank's current operational policy on assistance after disasters, which currently includes post-conflict reconstruction assistance, will be reviewed and updated.

Identification and dissemination of World Bank and other agencies Best Practices.

Promote regional conferences on incentives for risk management. already the Bank has co sponsored a meting in September 1998 on "Financial Risk Management of High Severity Risk" and further meeting is planned for June 1999

Ladies and Gentlemen, In concluding, I would like to summarise ways that the cost and losses resulting from natural disasters can be minimised by sensible, easy to follow low cost disaster mitigation policies:

1) Take advantage of latest world wide technology and codes of practice and build in the knowledge from the start or update whenever possible. The costs are very small compared with the losses that can otherwise result.

2) Be prepared!!! Preparedness training beforehand, community involvement in understanding dangers, and the form such a natural disaster event can take, and what to do when such a disaster does occur can be the saving of much heart-ache and trouble during and after the event.