Disaster Risk Management: prevention and urgent repair procedures for infrastructure and facilities

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Natural disasters-new trends

- **Natural disasters: Hurricanes, storms, floods, wild fires, earthquakes, droughts.**
- **Irreversible impacts:** El Nino-in Peru and Ecuador (1998) to 2000, Hurricanes & Tropical Storms in Jamaica and Haiti(2008)
- **Increase in the frequency and severity** (World wide trend)?
- **Long term objective: breaking the cycle of destruction and reconstruction (more preparedness, maintenance and preventive works and less repair or remediation works)**

High rainfall records: Significant damages and degradation of surface and sub-surface drainage characteristics:

- Hurricane Mitch-1998: **Honduras**: 6600 killed, 8052 missing, 11,9989 injured, 1,939,669 affected, 2,100,721 evacuated & **Nicaragua**: 2,823 killed, 885 missing, 386,261 affected

- Hurricane Georges –1998: **Haiti**: **147 killed, 47 missing**, 34 serious injuries and 4500 homeless & **Dominican Republic** : **70 killed,** 10,000 homeless

Haiti and DR: high rainfall records and significant damages,including degradation of surface and sub-surface drainage characteristics:

- Haiti 4-FGHI storms-2008:More than 793 people were killed, 301 injured, 11,000 houses destroyed and 35,000 damaged.

- Haiti: Hurricane Jeanne 2004: **850,000 to 1 million people were affected**

- Haiti: Hurricane Georges –1998 **147 killed, 47 missing**, 34 serious injuries and 4500 homeless; **Dominican Republic** : **70 killed,** 10,000 homeless

Issues related to management of Geo-Hazards (natural disasters);

- Seismic forces, heavy rainfalls, inadequate surface and sub-surface drainage facilities aggravate the frequency and severity of infrastructure damages.

- **Flooding is the most significant source of infrastructure damages, it caused over 72% of the damages in countries such as Haiti and Peru.**

- Comprehensive designs & monitoring procedures significantly reduce Geo-hazards damages.

- Technology, proper culture and QC/QA procedures significantly reduce Geo-hazards damages (example Japan). However, often they are not used in USAID member countries.

Destroyed Ennery bridge and the new Ford

Risk management issues

1. Sufficient funding and reliable cost recovery (public and private sectors)

2. Reliable risk assessment and quantitative prediction performance of infrastructure in USAID member countries

3. Adequate administration of routine and preventive maintenance services (institutional & technical terms)

4. Timely and affordable mitigation/remediation (M/R) designs and related baseline information such as **unit cost analysis** of M/R works.

Risk management issues:

5. limited participation of the private sector in infrastructure financing (Toll roads, bridges)
6. Roll and responsibilities of the execution agencies and of the **ministry of finance**
7. Roll and responsibilities international agencies (donors)
8. On time availability of adequate technical & institutional capacities (National and local governments, military units)

Finance Ministries:

1. **Finance ministries are important players in disaster management systems in terms of economic planning and financial decisions**.

2. The participation of finance ministries is essential to ensure funding, facilitate the incorporation of disaster management into development policy, and provides incentives for financing mitigation projects (private & public sectors).

Risk assessment issues:

1. Reliable risk assessment is essential (not sufficient) to secure private and public infrastructure financing

2. Adequate culture of prevention, **maintenance** and mitigation of natural disasters and adequate institutional capacities of the execution agencies and of **the ministries of finance**

Execution agencies capacities issues: Jamaica- Education & Agriculture; Haiti: Transportation

- Adequate **institutional capabilities** for administration of planning, programming, construction, **maintenance, quality control (QC), reporting** & monitoring procedures of cost effective disasters-resistance codes. **Most of these activities are contracted out.**

- Availability of funds and adequate engineering tools (agency, contractors and consultants) **to ensure cost effectiveness and cost reliability within 10%-15% of actual or affordable costs**

Possible donors support for Natural and unexpected disasters

1. **Before a disaster**, Donors assistance focuses on disaster preparedness and disaster prevention including measures undertaken to prevent potential hazard from having harmful effects on persons, infrastructure or the environment.

2. **During the emergency**, the prime goal is to minimize the loss of life and property.

3. **After the emergency**, Support infrastructure repair and rehabilitation, improve safety for the population and guarantee the normalization of economic activities

Reliable risk assessment considerations: Institutional capacity of execution agencies

- **Survey of populated areas**: affected people, poverty classification, accessibility
- **Land use mapping and vulnerability assessment of:** deforestation, erosion, sedimentation, etc
- **Prediction of the type and severity of of a possible disaster**: flooding, landslide, debris flows, structure failure.

Reliable risk assessment: Institutional capacity of Execution agencies:

1. **Use proper engineering tools to evaluate**: soils, geology, **drainage/flooding**, topographical and geotechnical characteristics

2. **Collect meteorological and rainfall records**

3. **Evaluate surface and sub-surface drainage capacities**

4. **Evaluate slop stability(failures** & **debris avalanche)**

Reliable risk assessment: engineering tools & institutional capacity

- **3-D Satellite imaginary plans-scale-1:10^6**
- **Aircraft 3-dimensional detailed images and topographical maps in adequate scales**
- **Geological maps (high-risk areas:1:250,000)**
- **Topographical maps (1:50,000), with geological data**
- **Seismographs to monitor earthquakes**
- **New air-pressure and temperature gauges to monitor volcanic eruptions.**

Reliable risk assessment- Engineering tools Institutional capacity

- **Inclinometers & gauges to monitor landslides and debris-flows**

- **<u>Meteorological and rainfall records & predictions</u>**

Reliable risk assessment: prevention & remediation designs

- **Design Redundancy or Factor** of **Safety (FS)**=1.1-1.2 (low risk), 1.2-1.3 (significant risk) and 1.3-1.4 (high risk)
- Use affordable **FS** to design: drainage capacity, flood and erosion control to reduce：
  - slop failures
  - rock and soil fall and slide
  - debris avalanche and uncontrolled water flows
  - large scale flooding

2009 flood

The ford requires equipment-based maintenance to remove debris from floods/storms

Hydrology: Hydraulic Analysis

•Actual conditions: Flow Characteristics with the Ford Bridge

Return Period	Discharge (m^3/s)	Water level (m)	Flow velocity at the exit of the culverts (m/s)
1 : 2 years	80	313.45	2.81
1 :10 years	150	313.92	3.40
1 :25 years	240	313.96	3.96
1 :50 years	350	314.23	4.47
1 :100 years	470	314.66	4.90

Remarks :

- Elevation of the Ford : about 313.3 m
- The annual flood (2 years) reach the top of the Ford Bridge
- Besides, if the openings of the culvert are clogged, the flow pass over the Ford
- This situation has been observed this year

Donors disaster prevention support strategy

Strategy: Assist countries to take an integrated approach to reducing and managing their risk to natural hazards before a disastrous event through:

1. risk identification and forecasting**;**

2. mitigation to address the structural sources of vulnerability;

(3) preparedness;

(4) building risk transfer measures to spread financial risks over time and among different actors**;**

(5) establishing effective national and regional systems for risk reduction.

Preparedness

- Preparedness involves building an emergency response and management capability before a disaster occurs. Key disaster preparedness activities include training programs, informing citizens through education programs, hazard detection and warning systems and **using proper engineering tools for risk assessment and prevention designs.**

A good reference of preparedness (Japan:1945-2000, after JICA-Japan: 2001)

- The number of fatalities from typhoons in Japan had gone down from 45,000 to almost zero during the last 50 years, due to adequate collaboration of government, universities and private sector in development and implementation of cost effective planning, design, construction, reporting and monitoring procedures of preventive measures.

- IADB (Costa Rica, Dec 2001) " we (Donors) should reduce the number of fatalities of member countries at a rate of at least 20%, during the next decade. We must do so, because the alternative is not acceptable!"

Possible support to USAID missions (engineering group of EGAT/I&E)

The EGAT/ I&E engineering group could support the missions to accelerate and reduce the costs of the implementation of the “Before & After the natural disaster/emergency activities” , (Example: Haiti and Jamaica) **using, among others, Urgent/ Emergency job order contracting procedures.**

Urgent/Emergency job order (UEJO) contracting procedures

- Definition: The combining of many contracts or many urgent works into one contract administrated by one project **team**.

- The projects are competitively bid, indefinite quantity, indefinite delivery but using fixed unit prices or fixed costs with performance indicators (after NINO in Ecuador)

- Lesson learned: Using and UEJO Could save 50% of the time and approximately 40% of cost to implement the Haitian Ennery Ford construction works Nov/2008-March/2009.

How do UEJOs differ from traditional contracts?

- They may cover all types of works, construction, repair, maintenance and rehabilitation of different facilities (roads, bridges, schools, slope stability, seawalls, docks, water supply etc.) under a single contract (Bahamas)
- The contracts are in place, using competitive unit prices, before the completion of the design
- Quality indicators are more agile, such as shorter project life expectancy (Ecuador-NINO-2 roads were designed for a life expectancy of only 3-5 years and the Ennery Ford was designed for a life expectancy of 2 to 3 years)
- Using risk sharing procedures with incentives for collaboration among stakeholders

Advantages of urgent job order contracting:

- Competitive procedure of fixed unit prices or fixed costs **reduces significantly total project cost (Ecuador: over 50%).**

- Contractors have incentives to produce **good quality** products in order to receive more quantity of works.

- **Opportunity** for participation of **small businesses** that can not compete for larger projects (**Peru: rural roads**, Ecuador: Nino1 and Nino2, emergency/ accelerated roads and bridge rehabilitation/ reconstruction works).

Risk sharing procedures of Geo-Hazards (incentives for collaboration)

1. Define in the contract who, when and to what extent is responsible for the preparedness, mitigation and the remediation works.

2. Example, for possible flooding damages caused by el Niño phenomenon: Define the responsibility of each party, including the road agency, the civil defense department and the contractor (Ecuador, Peru-Amazonian road corridor).

3. In case of non-compliance of one party, the contract specifies when and what the other parties must do to avoid damages.

Risk sharing procedures of Geo-Hazards (incentives for collaboration)-continue

4. The contract rewards initiatives of collaboration; the contractor receives additional compensations when he assumes the responsibility of the civil-defense department to mitigate flooding risks outside the road right of way (ROW). However, the contractor must show that flooding was imminent.

5. The contractor receives additional compensations when he uses state of the art technology to monitor possible Geo-hazards and when he produces cost effective preparedness works of slop stability, river training and flood preventions.

In Sum: achievable targets for infrastructure disaster prevention and urgent repair procedures

1. Develop and maintain reliable data-base of risk assessment and infrastructure performance, including construction and routine & preventive maintenance unit cost analysis.

2. Promote more preventive works and less repair or remediation works

3. Improve and enforce safer land use programs

In Sum: achievable targets

4. Develop adequate institutional capacity in terms of Sustainable funding and adequate cost recovery for the design and implementation of affordable prevention works, especially improve surface and sub-surface drainage capacities.

5. Secure sustainable funding and maintain continuous dialog with ministry of finance and other donors

6. Expand the participation of the private sector

In Sum: achievable targets**: Promote good governance**

7. Promote preparedness and environmental protection strategy.

8. Reduce hazard vulnerability such as uncontrolled deforestation, erosion, sedimentation and contamination.

9. Develop a strategic plan to reduce the number of fatalities from natural disasters, at a rate of 20% to 50%**,** during the next decade (IADB-Costa-Rica 2001-conference)

Thank you very much
Any questions?

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