The Research on Flood and Drought Disasters Reduction of NCDR

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I. Basic Feature of Taiwan
II. Introduction of NCDR
III. Research of Flood and Drought
    - Disasters Reduction Division, NCDR
IV. Future Works
Basic feature of Taiwan
Basic Feature of Taiwan

• Geographic features
  400 km from north to south
  145 km from east to west
  Area: 36,000 Km², over 70% being slope-land

• Population (in June, 2006)
  22,900,00 in total, 67.7% living in urban areas
  Density: 633/ Km², only lower than Bangladesh

• Tectonic Conjunctions:
  • Philippine Sea plate
  • Euro-Asia Plate

• High risk of tropical cyclones
  • 3.6 typhoons/year
Natural Disasters in Taiwan

- Earthquake
- Landslide
- Typhoon
- Flood
- Debris flow
Why Taiwan Suffers More than Others

### Countries Most Exposed to Multiple Hazards

<table>
<thead>
<tr>
<th>Country</th>
<th>Percent of Total Area Exposed</th>
<th>Percent of Population Exposed</th>
<th>Max. Number of Hazards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taiwan</td>
<td>73.1%</td>
<td>73.1%</td>
<td>4</td>
</tr>
<tr>
<td>Costa Rica</td>
<td>36.8%</td>
<td>41.1%</td>
<td>4</td>
</tr>
<tr>
<td>Vanuatu</td>
<td>28.8%</td>
<td>20.5%</td>
<td>3</td>
</tr>
<tr>
<td>Philippines</td>
<td>22.3%</td>
<td>36.4%</td>
<td>5</td>
</tr>
<tr>
<td>Guatemala</td>
<td>21.3%</td>
<td>40.8%</td>
<td>5</td>
</tr>
<tr>
<td>Ecuador</td>
<td>13.9%</td>
<td>23.9%</td>
<td>5</td>
</tr>
<tr>
<td>Chile</td>
<td>12.9%</td>
<td>54.0%</td>
<td>4</td>
</tr>
<tr>
<td>Japan</td>
<td>10.5%</td>
<td>15.3%</td>
<td>4</td>
</tr>
</tbody>
</table>

Source: World Bank, 2005
Loss Analysis of Natural Disasters

- Total loss due to natural disasters

![Pie chart showing loss distribution]

- Typhoon: 71.4%
- Flood: 17.4%
- Earthquake: 8.0%
- Other: 3.3%

Direct loss caused by typhoon
Seismicity and Active Faults in Taiwan

Seismicity in Taiwan during 1990 to 2001.
(Focal depths distribution)

42 active faults in Taiwan
1999 Chi-Chi Earthquake

Vertical Rupture = 9.0m

Death toll: 2,505
Economic loss: US$11.5 billions
Losses due to Typhoons in Taiwan

- In average, there are 3.6 typhoons per year
- In 2001, 8 typhoons attacked
- In 2004, 6 typhoons swept
- In 2005, 3 category-4 typhoons
- In 2006, 7 typhoons swept
- In 2007, 5 typhoons swept

<table>
<thead>
<tr>
<th>Typhoon</th>
<th>Death</th>
<th>Injure</th>
<th>Agri. Loss ($US M) (A)</th>
<th>Constr. Loss ($US M) (B)</th>
<th>Total ($US M) (A+B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chebi</td>
<td>30</td>
<td>124</td>
<td>22.3</td>
<td>0.7</td>
<td>23.0</td>
</tr>
<tr>
<td>Trami</td>
<td>5</td>
<td>-</td>
<td>2.2</td>
<td>4.9</td>
<td>7.1</td>
</tr>
<tr>
<td>Toraji</td>
<td>214</td>
<td>188</td>
<td>235.7</td>
<td>170.6</td>
<td>406.4</td>
</tr>
<tr>
<td>Nari</td>
<td>104</td>
<td>265</td>
<td>126.5</td>
<td>56.7</td>
<td>183.1</td>
</tr>
<tr>
<td>Utor</td>
<td>1</td>
<td>6</td>
<td>2.9</td>
<td>7.6</td>
<td>10.5</td>
</tr>
<tr>
<td>Total</td>
<td>354</td>
<td>583</td>
<td>389.6</td>
<td>240.5</td>
<td>630.1</td>
</tr>
</tbody>
</table>
Debris flows and urban flooding have become the most severe hazards in Taiwan area during typhoon season.
Historical Flood Disaster

In Taipei Downtown, subway and main streets were flooded.

Typhoon Nari (2001)
Debris Flow Disaster

2004, Central Taiwan

敏督利颱風松鶴部落土石流災害

1,080位居民撤離，68棟房屋毀損，1人死亡。

資料來源：中興大學水保系
Debris Flow Disaster
Introduction of National Science and Technology Center for Disaster Reduction (NCDR)
What Taiwan Learns in Past Decades

The four lessons we have:

1. **Legislation**: Specific Law will help to conduct all necessary measures, policies and plans for reduction, preparedness, response and recovery.

2. **Teamwork**: Cooperation and collaboration from inter- and intra-government sectors will be the solid foundation to implement designed plans.

3. **Bottom-up**: Local government and community need the empowerment from central government and require a well-defined regional plan.

4. **Technology**: Academic supports and research results with practical concerns and fulfilled implementation will provide the best reference of policy making.
Infrastructure against Disaster

Laws for Disaster
- Disaster Protection and Response Act (2000.07)
- Coverage of four stages of disaster management
- Emphasis on the priority of law enforcement

Administrative Framework
- Central Government Level
- County Level (25)
- Township Level (309)

Plans for Disaster Reduction & Emergency Response
- Basic Plan (Towards All-Hazard Approach)
- Operational Plan
- Regional Plan

Science and Technology Development with implementation
- National Science & Technology Program for Hazard Mitigation (1999-2006)
- National Science & Technology Center for Disaster Reduction (2003.7)
History of System Development and Technology Innovation

- No official law and regulation: 1945-1964
- Regulation for Natural hazards & Response: 1965-1994
- Disaster Prevention and Response Act: 2000.7～

Before 1996:
- Less collaborative issue
- Less implementation

1999-2006
- NAPHM (I) and (II)
- 2003.7 NCDR founded

(NAPHM) National Science & Technology Program for Hazard Mitigation

Coordinate
Implement
Framework of Current Disaster Management Organizations in Taiwan

According “Disaster Prevention and Response Act”, enforced in 2000
Headquarters for Emergency Response & Disaster Response

Union Development Building

- Communication Center (17F)
- Conference Room (15-16F)
- Architecture and Building Research Institute (12-13F)
- Aviation Safety Council (11F)
- Airborne Service Corps (10F)

NCDR (9F)
- Nation Fire Agency (6-8F)
- Disaster Prevention and Protection Commission (5F)
- Emergency Operation Center (3-4F)
Analysis & Evaluation Division of CEOC

Discussion of Analysis & Evaluation in NCDR

Discussion of Analysis & Evaluation in CEOC
Report of Analysis & Evaluation at CEOC
Organization of NCDR
Research of Flood and Drought Disasters Reduction Division
Flood and Drought Disasters Reduction Division

- **Research and development**
  - Devote to science research in flood and drought disasters
  - Develop the hazard mitigating technologies

- **Technical support**
  - Assist to the planning and operation of the agencies for flood and drought disasters prevention and rescue
  - Decision making supports to the emergency and water management authorities during disasters

- **Practical application**
  - Establish the practicable procedures for flood and drought disasters reduction
  - Staff training for other agencies and public education in flood and drought disasters prevention technologies
The inundation potential maps of Taiwan

- The flood-and-drought mitigation research group published the island-wide inundation potential maps in 2001.

Applications of the inundation potential maps:
- For floodplain managements
  - Evaluation for the land resources
  - Avoid the inappropriate land uses
- For flood mitigations
  - Establish the flood prevention strategy
  - Set the flood response measures
- Incorporation with social-economic information
  - Analyze the loss and damage of flood hazard
  - Determine the flood insurance premium rates
Inundation potential maps of Taiwan
Estimation of Inundation and Warning

Real-time Rainfall Records + Rainfall Forecasting

Flood Potential:
- Highest (avg. depth > 1.5 m)
- Higher (avg. depth 1.0m – 1.5m)
- High (avg. depth 0.5m – 1.0m)
The User Interface for the Forecast of Inundation Potential Areas
The inundation potential database can be used to propose the local disaster prevention & response basic plan for local governments. Applications are following:

- Design the defense scope of flood disaster for county,
- Allocation of rescue resources,
- Planning of shelters and evacuating routes,
- Improvement of the drainage system for high risk inundation areas,
- Land resources evaluated and identified by the IPMs to avoid inappropriate land use,
- Planning inundation warning system.
- Integrated historical flood events and inundation potential data to design the maximum defense scope of flood disaster.

- Example in Taipei
  - Typhoon Nari event
  - 600 mm/day inundation potential data
The planning of shelters

- The zoning of flood risk and emergency shelters in Mujha area, Taipei
• **Check the suitability of shelters**

Use the design maximum defense scope map of flood disaster to check the suitability of shelters that have been planned before the Typhoon Nari event.

- **Inside the inundation areas** (14 points)
- **Outside the inundation areas** (26 points)
For these high risk inundation areas, high priority should be given to improve the drainage system.
An incorrect example

• Because the location of high-tech Science Park did not refer to the inundation potential analysis information at the beginning, so now the government must spend much more money to improve the flood-protect system.
The distributed map of monitors stations network for sewer warning system in Taipei city.

For high risk inundation areas, to plan the sewer inundation warning system.
Flood Hazard Scenario Simulations

- Flood and Drought Disasters Reduction Division of NCDR did the flood hazard scenario simulations of 0612 torrential rain and Haitang typhoon in Yen-Shui Creek Basin by using the updated DEM.
Flood scenario simulations

- The results of scenario simulations were used for determining the flood prevention strategies and the emergency response procedures.
Flood-mitigation projects of Keelung River

- The study evaluates the effect of flood mitigation projects proposed by the Keelung River Regulation Committee on alleviating flooding hazards for both preliminary stage and long-term plan of engineering regulations.
International collaboration

- The collaboration enhanced the functions of inundation model and accomplished the Graphic User Interface (GUI) of the inundation model.
Field investigation of Chi-Chi earthquake

The field-survey group was teamed up right after the earthquake to investigate the damage of hydraulic facilities caused by the Chi-chi earthquake.
Reinforcing the Hydrologic Monitoring System for Landslide Lake

- Evaluated and strengthened the hydrologic monitor networks.
- Established the rainfall-runoff forecast system for Tsao-Ling landslide lake watershed.
Flood potential analysis for the downstream area of the landslied lake caused by the Chi-chi earthquake
The main purpose of design defense scope of inundation disaster is to help the cooperation teams of NCDR to carry out the defense scope of inundation disaster for local governments.
The research of drought mitigation is a new work of the Flood and Drought Disasters Reduction Division. The main object is to collect related references, analyze the cause of drought in Taiwan and provide response policies for the decision maker.
Real time rainfall information system

- The real time rainfall information system was built and used for emergency operations.
Real time rainfall information system

- The system collects the national wide precipitation records and provides value-added information.
River stage forecasting model

The dynamic routing model with real-time roughness updating and stage correction technique can provide a useful tool for flood forecasting.
Inundation impact index for disaster risk assessment

- The purpose of this study is to develop a methodology through the application of inundation impact index, which can be used to estimate the severity and the probability of inundation disaster.
Development of E-investigation technique

- 執行進度
  - 勘災作業機制之研擬
  - 電子勘災技術研發
    - 提供全部縣市勘災點查詢模式
    - 強化系統畫面美編
  - 複合性資料庫建置
    - 全台易致災區域分析
    - 近5年重大颱洪事件災害資料
    - 展示查詢系統之開發
  - 國内外重大天然災害綜合評估
Investigations and analyses of historical disasters
Improvement of Inundation Warning Technology

- Rainfall warning technology
- Flood warning technology
- Landslide and debris flow warning
- Disaster remote sensing technology

Central Disaster Management Center

Mastectomy/Map: Case study for inundation warning level
Disaster Reduction Strategies Against Climate Change

- Implement application methods
  - Comprehensive water management strategies and climate change factors policy assessment and suggestions
  - Reservoir soil and sand disaster management policy assessment and suggestions
  - Climate change disaster vulnerability map application

- Understanding climate change
  - Water vulnerability
  - Water resources vulnerability
  - Depressed area vulnerability
  - Urban flooding vulnerability

- Environment change

Government major policies determination reference (20-50 years)

- Land use
- Regional planning
- Disaster management
- Key facilities
- Industry policies
- Population policies
Integrated Water Governance on Watershed

- 強風暴雨潮汐
- 雨水
- 平地
  - 都市化地區（發展化）
  - 果園
  - 河川、排水系統
- 海洋
- 土地超限利用
- 都市化程度增強
- 农地開放、用途變更
- 集中降雨，災害強度增強
- 河川流域諸多課題

- 潮汐
- 海水上升
- 海岸
- 河口
- 放水、排水
  - 堤防
  - 閘門
  - 抽水站
Integrated Water Governance on Watershed
Future Works
Future Works

• 1. Information update, risk classification and further applications of the inundation potential maps
• 2. Application of the flood forecasting and warning model in Taiwan
• 3. Establishment of the drought index and the forecasting model for the reservoirs during drought period
• 4. Help to set up the disaster morning and advanced warning systems
• 5. Enhancement of the abilities of local governments for disaster prevention and emergency rescue
• 6. Support of emergency response actions
• 7. Help to build the flood and drought disaster information sharing and maintenance systems
• 8. Assistance of setting up of the standard operation procedures for flood and drought disaster prevention and rescue
• 9. Evaluation of the effectiveness of research and development plans for flood and drought disaster reduction and mitigation
Thanks for your attention.