Case Study from Nepal

A Presentation by:
Kathmandu University (KU)

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Department of Biological Sciences and Environmental Sciences, KU
The Kathmandu University

The University is a:
* Independent, non-profit, non-govt., public institution created through private initiative
* Established in Dec. 1991
  - chartered by an Act of Parliament
  - Governed by Senate (apex body)
  - Executive Council, headed by VC; carries out policy decisions of Senate
  - Board of Trustees assists EC
  - Academic Council focal body dealing with educational matters

LOCATION:
Dhulikhel Municipality of Kavre District, Nepal
28 km east of capital city Kathmandu
Website: http://www.ku.edu.np
KU Student Enrolment by Category

<table>
<thead>
<tr>
<th>Category</th>
<th>Approx. Enrolment</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>I.Sc. (Diploma)</td>
<td>410</td>
<td>1435</td>
</tr>
<tr>
<td>Undergraduate</td>
<td>870</td>
<td></td>
</tr>
<tr>
<td>Graduate</td>
<td>155</td>
<td></td>
</tr>
<tr>
<td>Medical</td>
<td>135</td>
<td>335</td>
</tr>
<tr>
<td>Nursing/Health care</td>
<td>200</td>
<td></td>
</tr>
<tr>
<td>Affiliated colleges*</td>
<td>3000</td>
<td>3000</td>
</tr>
</tbody>
</table>

TOTAL = 4,770

*5 Affiliated Medical colleges; 5 other affiliated colleges (Social work, Management)
Programme of Study at KU

To be launched in 2004:
- Bachelors in Envir. Engg./Tech.

Collaborative Efforts to Initiate Disaster Management and Sustainable Development Centre

- Technical collaboration & exchange with North Umbria University, UK
- MOU with NSET for future collaborative efforts in course development, case-studies, and research

On-going cooperation with ADPC/NSET in order to:
Incorporate/integrate DM within existing courses
- At Master’s level
- At Bachelor’s level

Development of new courses within:
- B.Sc. Environmental Engg./Tech. Programme
- M.Sc. Environmental Science Programme
- M.A. Human & Natural Resource Management Programme

Case study on earthquake hazard/risk/vulnerability assessment for Dhusikhel & Panauti Municipalities
Incorporation of DM into existing courses

• M.Sc. Environmental Science
  • MESN 514: Land Evaluation & Integrated Mountain Resource Management (3 credits)
  • To be incorporated into sections:
    – Data sources, types & manipulation
    – RS/GIS (ILWIS) applications in LE & DM
    – Mountain hazards and mitigation

• B.Sc. Environmental Science
  • ENVS 337: Hazards and Disaster Management
  • ENVS 431: Applied Soil Science and Land Management (3 credits)
  • To be incorporated into sections:
    – Land classification & land use planning
    – Principles of DM; hazard, risk & vulnerability assess.; mitigation
    – Introduction to ILWIS and applications in LUP & DM

• Course to be taught in 2005/06

Existing course at KU dealing with DM

• ENVS 337 Environmental Hazards and Disaster Management
  – 3rd year B.Sc. Level (Environmental Science/Engineering Tech.)
  – 3 credit course [48 contact hours per semester]

Course description:
  Basic concepts on risk & vulnerability to natural hazards/disasters
  Special focus on mountain areas: landslides, avalanches, floods, GLOF, mud flows, etc.
  Disaster awareness, preparedness and response
  Mountain hazard inventory and mapping
  Disaster mitigation & risk reduction
  Human induced hazards at local and global scales
  Ecological impacts of human induced disasters; sustainable development
KU and CASITA

- KU entered into CASITA Project formally signing an MOU with ADPC on June 2003

Objectives
- Training and capacity building in disaster management
- Adaptation and institutionalization of courses on disaster management
- Exchange and sharing of information

NSET

- National Society for Earthquake Technology-Nepal (NSET) – Estd. 1994
- A technical NGO working as a professional organization focused on Earthquake Risk Management
- Vision for 2020 A.D. – Earthquake Safe Communities in Nepal
- Through
  - Awareness, training, education
  - Demonstration projects
- Working in partnership with many national and international organizations
  - including ADPC, ITC
KU-NSET Joint Effort

- KU and NSET have been partners for disaster management since long time
- The relation has been formalized in the form of MOU
- Objectives of partnership
  - Conduct joint research and scientific dissemination activities
  - Development of disaster-related curricula (short and long) and implement
  - Share information, experience, expertise, resources and facilities

The Banepa Case Study

- This case study
  - has been initially carried out as a component of Banepa Municipality Earthquake Risk Management Project (BERMP) jointly implemented by Banepa municipality, NSET and ADPC
- KU has been important stakeholder and participant during the whole process of BERMP
- Referenced and further consolidated during this CASITA Study
The Banepa Case Study

- Hazard Assessment – Earthquake
- Vulnerability Assessment
  - Building Inventory
  - Inventory of Lifelines and Critical Facilities
- Risk Assessment
  - RADIUS Tool
  - ILWIS
- Outcomes
  - Thematic Maps of Existing Environment
  - Risk Maps
- Planning
  - Risk Perception Survey
  - Analysis and Planning
  - Presentation in GIS

Location of Banepa
Seismic Hazard of Banepa

Active Fault Near Banepa

Map source: Building Code Development Project (BCDP), 1994
Map source: BCDP, 1994
Building Inventory

Part A: GENERAL INFORMATION
1. Name of owner: .................................................. 2. Building No.: .............................................
5. Tel.: ............................................................

Part B: BUILDING INFORMATION
1. Date of building construction (B.S.):
2. Use of building:
   - Residential
   - School / Training Institute
   - Office
   - Restaurant / Hotel / Lodge
   - Hospital / Dormitory
   - Shop / Departmental Store
   - Clinic / Hospital
   - Factory / Workshop
   - Others ........................................
3. Process of Construction:
   - Owner built
   - Purchased
   - Constructed by contractor
4. Design and supervision of building construction:
   - Designer
   - Supervisor
   - Self
   - Technician
   - Contractor
   - Mason

Building Inventory

Part A: GENERAL INFORMATION

Part B: BUILDING INFORMATION
1. Date of building construction (B.S.): 2. Use of building:
   - Residential  - Restaurant / Hotel / Lodge  - Clinic / Hospital
   - School / Training Institute  - Hospital / Dormitory  - Factory / Workshop
   - Office  - Shop / Departmental Store  - Others ........................................
3. Process of Construction:
   - Owner built
   - Purchased
   - Constructed by contractor
4. Design and supervision of building construction:
   - Designer
   - Supervisor
   - Self
   - Technician
   - Contractor
   - Mason

Building Inventory

5. Position of buildings:
   - Free Standing
   - Confined by other buildings in one side
   - Confined by other buildings in two adjacent sides
   - Confined by other buildings in two opposite sides
   - Confined by other buildings in three sides
6. Type of foundation subsoil:
   - Rock
   - Gravel / Sand
   - Soft / Medium soil
   - Unknown
7. Number of stories:
8. Building material and structural system:
   - 9. Condition of building:
     - Good
     - Satisfactory
     - Bad
     - Very bad

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Building material / structural system</th>
<th>Floor</th>
<th>Roof</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rigid</td>
<td>Flexible</td>
<td>Rigid</td>
</tr>
<tr>
<td>1.</td>
<td>Adobe</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Stone in mud</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Brick in mud (Fired brick)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Stone in cement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Brick in cement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>RC framed ordinary</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>RC framed - structural designed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>Timber frame with BM/BM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>Wooden</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>Hollow Concrete Block</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11.</td>
<td>Others</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(if flexible roof mention – Tile/CGI/Jhingati/Thath)
Social Information

Part C: SOCIAL INFORMATION

1. Number of occupants:

<table>
<thead>
<tr>
<th>Type</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owner</td>
<td>Day</td>
</tr>
<tr>
<td></td>
<td>Night</td>
</tr>
<tr>
<td>Tenant</td>
<td></td>
</tr>
</tbody>
</table>

2. Age group:

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infants</td>
<td>4-12 years</td>
</tr>
<tr>
<td>13-20 years</td>
<td>20-40 years</td>
</tr>
<tr>
<td>40-60 years</td>
<td>60 above</td>
</tr>
</tbody>
</table>

3. Education:

<table>
<thead>
<tr>
<th>Level</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Literate</td>
<td></td>
</tr>
<tr>
<td>Literate</td>
<td></td>
</tr>
<tr>
<td>Primary</td>
<td></td>
</tr>
<tr>
<td>Secondary</td>
<td></td>
</tr>
<tr>
<td>Higher Secondary</td>
<td></td>
</tr>
<tr>
<td>Graduate and above</td>
<td></td>
</tr>
</tbody>
</table>

4. Occupation:

<table>
<thead>
<tr>
<th>Occupation</th>
<th>No.</th>
<th>Occupation</th>
<th>No.</th>
<th>Occupation</th>
<th>No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td></td>
<td>Labour</td>
<td></td>
<td>Mason/Plumber</td>
<td></td>
</tr>
<tr>
<td>Student (School/College)</td>
<td></td>
<td>Teacher</td>
<td></td>
<td>Mechanic/Electrician</td>
<td></td>
</tr>
<tr>
<td>Housewife</td>
<td></td>
<td>Social service</td>
<td></td>
<td>Engineer/Overseer</td>
<td></td>
</tr>
<tr>
<td>Doctor/Nurse</td>
<td></td>
<td>Scout/Redcross</td>
<td></td>
<td>Army/Police</td>
<td></td>
</tr>
<tr>
<td>Self Business</td>
<td></td>
<td>Others</td>
<td></td>
<td>Others</td>
<td></td>
</tr>
</tbody>
</table>

Earthquake Information

Part D: EARTHQUAKE AWARENESS

Respondent's Name: .......................................................... Age: ..........................
Sex:  □ Male  □ Female

1. Do you have any experience of past earthquake?
   □ Yes  □ No
   If yes:  □ 1988  □ 1934  □ Other  .................

2. Do you know about the possibility of large earthquake in Nepal/Kathmandu in near future?
   □ Yes  □ No
   If yes, from where, do you know about?
   □ Newspapers  □ Television  □ Radio
   □ Books  □ Internet  □ Talking with others

3. What do you do when earthquake happens, if you are inside a building?
   □ go and stay in a safe place inside the building
   □ run outside the building
   □ I don't know

4. Is your house safe to earthquakes?
   □ Yes  □ No
   □ I don't know

5. Do you talk about earthquake safety in your family?
   □ Yes  □ No
Building Distribution

Households In The Municipality

No. of households

Ward No.

<table>
<thead>
<tr>
<th>Ward No.</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Houses</td>
<td>253</td>
<td>127</td>
<td>217</td>
<td>278</td>
<td>259</td>
<td>326</td>
<td>130</td>
<td>124</td>
<td>76</td>
<td>304</td>
<td>374</td>
</tr>
</tbody>
</table>

NSF-NEPAL

Source: CBS 2002

Building Typology

Construction Type of Buildings In The Municipality

- Adobe: 17%
- Pillar: 21%
- Brick in mud: 50%
- Stone in mud: 1%
- Wooden: 0%
- Concrete: 11%

NSF-NEPAL

Source: Field Survey July 2002
**Agewise Building Distribution**

Age of Buildings in Banepa Municipality

<table>
<thead>
<tr>
<th>Age of Buildings</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 10 years</td>
<td>18%</td>
</tr>
<tr>
<td>10-20 years</td>
<td>19%</td>
</tr>
<tr>
<td>More than 20 years</td>
<td>63%</td>
</tr>
</tbody>
</table>

Source: Field Survey July 2002

**Transportation System**

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Lifeline System</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Local Roads</td>
<td>41 km</td>
</tr>
<tr>
<td>2</td>
<td>Highways</td>
<td>3 km</td>
</tr>
<tr>
<td>3</td>
<td>Bridges/Culverts</td>
<td>9 Nos.</td>
</tr>
</tbody>
</table>
Risk Assessment Tools

- RADIUS
- ILWIS
- Arc View

Outcomes of the Study
Banepa Municipality

Intensity Distribution
(Scenario Earthquake)

- VIII: Damage to masonry buildings.
- IX: Poorly built masonry structures collapse; all structures are damaged. Underground pipes broken.
- X: Most well-built masonry and frame structures and bridges are destroyed.
Building Damage Estimation
(for Scenario Earthquake)

40% of the Total Building Stock Could be Damaged

Casualty Scenario
(Night time)
Casualty Scenario (Day time)

Injury Scenario (Night time)
Injury Scenario
(Day time)

Casualty Estimation
(for Scenario Earthquake)

<table>
<thead>
<tr>
<th>Earthquake Occurrence</th>
<th>Death (Nos.)</th>
<th>Injury (Nos.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>in Daytime</td>
<td>180-250</td>
<td>980-1250</td>
</tr>
<tr>
<td>in Nighttime</td>
<td>400-600</td>
<td>2250-2800</td>
</tr>
</tbody>
</table>
Potential Damage to Water Supply System
(for Scenario Earthquake)

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Lifeline System</th>
<th>Total</th>
<th>Damage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Water Supply Pipeline</td>
<td>17 km</td>
<td>2-3</td>
</tr>
<tr>
<td>2</td>
<td>Storage Reservoir / Elevated Tank</td>
<td>3 Nos.</td>
<td>7-8</td>
</tr>
<tr>
<td>3</td>
<td>Pumping Station</td>
<td>2 Nos.</td>
<td>12-14</td>
</tr>
</tbody>
</table>

Water Supply Hazard Map
Disaster Management Course in the M. Sc. Environmental Science and/or Human & Natural Resource Management Programmes at Kathmandu University

Course Title: Applying Land Use Planning Techniques and GIS Tools for Disaster Management.
Duration: One semester (~16 weeks)
Credit/Hrs.: 4 credits [4 hrs./week]
Pre-requisites: Introductory GIS course; socio-cultural & economic aspects; policy, planning & legislative processes.

Possible Constraints:
- The need to adapt course for non-science (Arts) students; scope limited to a more basic level.
- Competition with other topics/subjects – may limit course credits to less than 4 credits.
- Logistic and financial constraints – computer lab/GIS facility requires augmentation and up-grading.
- Need strengthening of instructor capacity in GIS/ILWIS.

Education Methods/Evaluation Techniques:
- Lectures (Theoretical): 30 to 40 % of course time.
- Practical work – case study or project; done in groups of 2-3 emphasizing teamwork. [equivalent to 1 credit/hr. of time + field excursions (3-4 days)].
- Homework assignments (2)
- Mid-term and Final Exams (1 each).
**Course Objectives:**

Upon completion of the course students will:

- Have a working knowledge of ILWIS-GIS (or other software, e.g., ArcView/Info) and be able to apply it as a planning tool for disaster mitigation.
- Gain knowledge of all the data input parameters/requirements for using ILWIS/Arcview.
- Be able to gather the requisite data (both primary and secondary), and know where to look for/obtain it.
- Be able to process, transform and manipulate the data using ILWIS (or ArcView/Info) and produce required outputs.
- Acquire the ability to communicate and present findings, i.e., to produce a report of findings and recommend courses of action.

**Schedule for course**

<table>
<thead>
<tr>
<th>Topics</th>
<th>Week During the Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>1. Introduction/Background</td>
<td></td>
</tr>
<tr>
<td>2. Basic concepts, Principles</td>
<td></td>
</tr>
<tr>
<td>3. Hazards types/assess ment</td>
<td></td>
</tr>
<tr>
<td>Mid-term test</td>
<td></td>
</tr>
<tr>
<td>4. Risk &amp; Vulnerability assess</td>
<td></td>
</tr>
<tr>
<td>5. Mitigation Measures</td>
<td></td>
</tr>
<tr>
<td>6. RS/GIS: Intro to ILWIS</td>
<td></td>
</tr>
<tr>
<td>Assignments</td>
<td></td>
</tr>
<tr>
<td>7. Project (Case Study)</td>
<td></td>
</tr>
<tr>
<td>Final Examination</td>
<td></td>
</tr>
</tbody>
</table>
Further Case Studies

- Earthquake hazard assessment for Dhulikhel and Panauti Municipalities, Kavre, Nepal (near KU)
- Objectives:
  - Prepare an earthquake hazard map for Dhulikhel and Panauti Municipalities
  - Determine the risk and extent of damage that can be expected in the different areas (based upon building type/conditions, population distribution, etc.)
  - Assess the vulnerability of different areas and segments of society
- The outputs can be used to predict estimated damage; loss of property & lives
Flowchart of Case Study Development

- Input data:
  - Geologic map
  - Land use
  - Building
  - Demographic
  - Socioeconomic
  - Earthquake

- Digitize, convert, georef., attrib.

- Thematic maps:
  - Building type acc/ to LU
  - Building type acc/ to geol.
  - Pop. Density acc/ to LU
  - Pop. Density acc/ to geol.

- Scenarios: earthquake intensity, epicenter, time

- Outputs:
  - Hazard map
  - Risk map
  - Vulnerability map

Further,

- Consolidation of proposed courses
- Internal and External support for implementation of courses
Clock House before 1934 Earthquake

Clock House after 1934 Earthquake
Epicenter distribution around Nepal from 1255 to 2001

THANK YOU!