Flood hazard and risk assessment in Yen Bai city: a case study for riverine-and flash-floods

by

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Yen Bai city

- A low mountainous urbanized area, flood plain of Red river in Northern Vietnam
- Political, economic, cultural centre of Yen Bai province
- Rapid urbanization

Old city (expansion in 2002):
~ 78,000 people in ~ 56 km²

New city (expansion in 2008):
~ 94,000 people in ~ 108 km²

High density in city centre:
~ 70,000 people in ~ 20 km²
Flood hazard and risk in Yen Bai city: Why & How?

Always threatened by floods every rainy season:

- riverine (alluvial) flood from Red River may come from other provinces (inside and outside Vietnam)
- urban (local) flood due to heavy rain in the city and blocked drainage system
- flash flood from torrent upstream flow of two upstream catchment

City center: most prone to flood hazards ➔ High risk to flood

(main causes?) Red river Heavy rains&upstream flows Heavy rains&upstream flows Heavy rains&upstream flows Red river Combination
Floods: consequences

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City center: most prone to flood hazards
⇒ High risk to flood
Floods: consequences

Market, school, road, farmland, houses... in Yen Bai city after Kummari typhoon on 8-9/8/2008
Flood Risk = Hazard x Vulnerability

Flood hazard assessment:
- What cause floods? How, when and where floods happen?
- Can we predict / monitor flood hazard? prevent a flood? How?

Vulnerability assessment:
- What are consequences if a flood occurs?
- How much damage & loss can we expect?
- Can we reduce the risk (damage & loss) of a flood? How?

A disaster is a past event.
Risk is the probability of a future disaster.
Methodology

- Flood hazard assessment:
  - Flash floods from upstream: hydrological modelling.
  - Red river floods: hydraulic modelling.

- Vulnerability assessment:
  - Element at risk mapping (buildings)
  - Using local knowledge and past experiences
    - PGIS approach: mainly for 2008 flood reconstruction
    - Household samples to assess
      - the vulnerability of elements at risk (people, properties, infrastructures)
      - perception of risk, coping capacity of individual family
    - Workshops with groups of key people (representatives from flood prone areas, communal and municipal authorities)
Measurements for flood hazard assessment
Flashfloods from Cuong No stream

Upstream: Flash flood

City center:
- lowest land
- high population
- well-infrastructures

→ high flood hazard and risk

Downstream: Red River flood
Flow is compressed in narrow valley before it enters the city.

Rice field buffer the runoff for some time, then overflow into one massive water.

Runoff from slopes to rice fields.

Sometimes dikes failed.

Some bottle necks appear along the channel.

Conceptual of rice field in the model.
The effect of rice paddy dam-breaks on the flash-floods

- Main outlet - non-terraced field
- Main outlet - terraced field without dike break
- Main outlet - terraced field with dike break

Flood depth map
Downstream: Red river flood

Hazard assessment + Vulnerability analysis

Hazard Assessment

Data Analysis
- DSM generation
- Roughness map, Building
- Hydrographs, Flood height
- Flood simulation
- Historic flood data
- Model calibration

Building inventory → Hazard Assessment
Community Participation → Vulnerability Assessment
Participatory mapping → Elements at Risk

Risk Assessment

Map of red river flood area with flood boundary and city boundary.
Red river flood hazard assessment

Return period scenarios for rising Red River water level

Maximum flood depth

Maximum flood velocity
Vulnerability assessment: inhabitants

Measurement of water depth of the 2008 flood using water marks on buildings
Vulnerability assessment: Community involvement

2008 flood extent and depth by key people
Flood Risk

Example of a combined modelling/community based Flood risk map
Flood hazard assessment: focusing on factors that increase abnormal floods nowadays

- Riverine and local floods: heavy rains
  - need attention in urban planning by authorities, perception of risk by local community
- Flash-flood: strong influence of terraced fields and local topography
  - need attention in farming practices
Flood risk assessment for Yen Bai

- Local knowledge is useful in a data scarce environment.
- Drainage is problematic during high-intensity rains.
- Hazard mitigation is difficult and expensive; to achieve risk reduction, vulnerability must decrease (awareness and preparedness must increase).
  - River flood: lowland along the Red river ➔ need to re-locate dwellers to other places, or create.
- Hazard mitigation (e.g. dike construction) may increase the hazard elsewhere (e.g. downstream).
Thank you very much for your attention!