Flood Risk Assessment of Xiang River Basin in China

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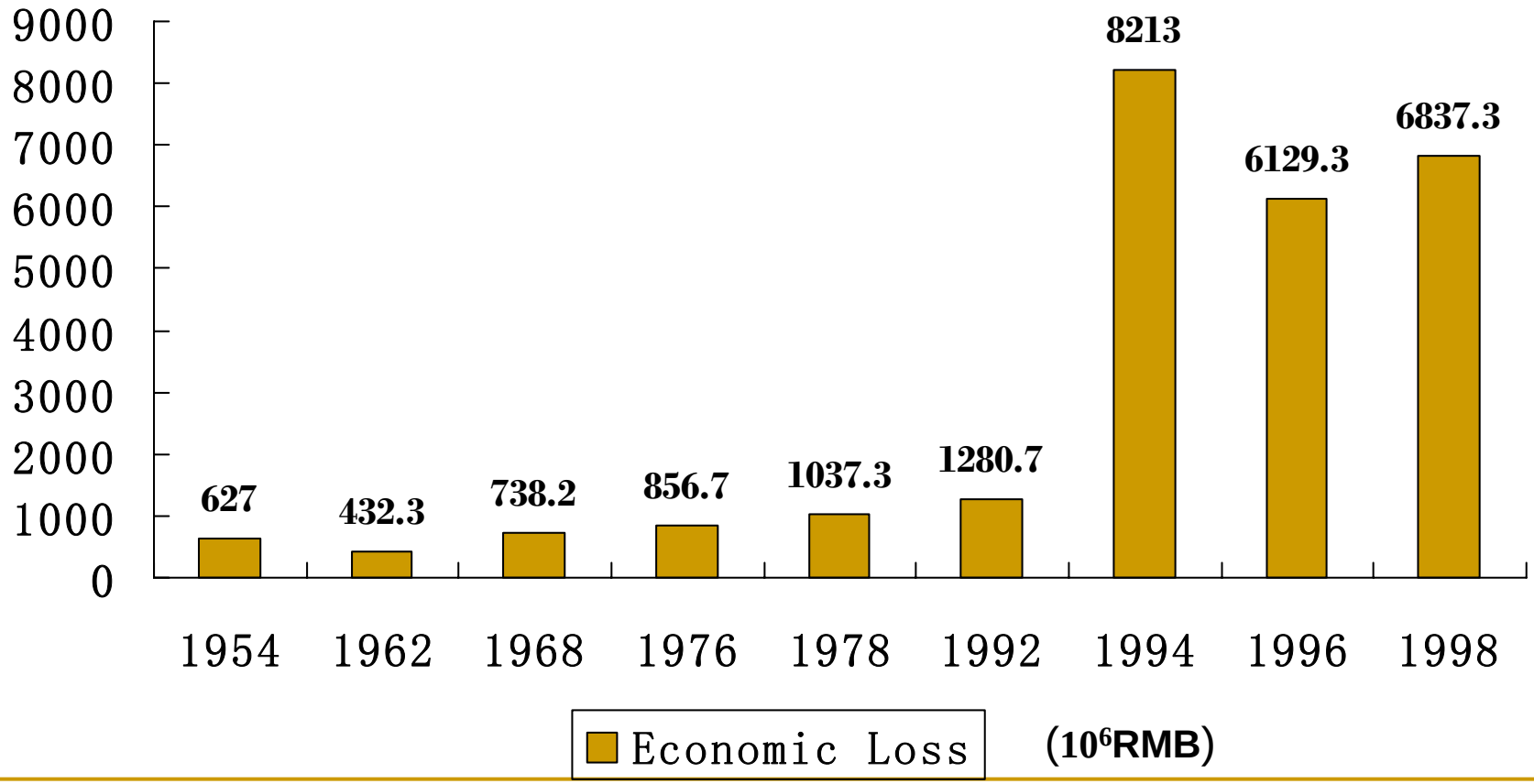
Flood Disaster

Flood is the most serious disaster and be paid much attention as it:

- **cause most economic loss**, accounting for 70% of loss caused by all natural disaster in China.
  - In 1991, direct loss is about 10 billion dollars
  - In 1994, it is more than 20 billion dollars
  - In 1998, it is more than 30 billion dollars

Direct Economic Loss of Floods in Typical Years in Xiang River Basin (unit: million RMB)

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Issues of Xiang River Basin in China

- **Physical environment:**
  - One of the largest tributaries of Yangtze River
  - Length: 844 km
  - River basin area:94660 km^2
  - Average annual rainfall 1400mm
  - Average annual temperature 17.6℃

Socio-economic status:

- Large population densities and large town densities
- one of the most important bases for food supply
- important industry bases and innovative & high technology industrial development zones

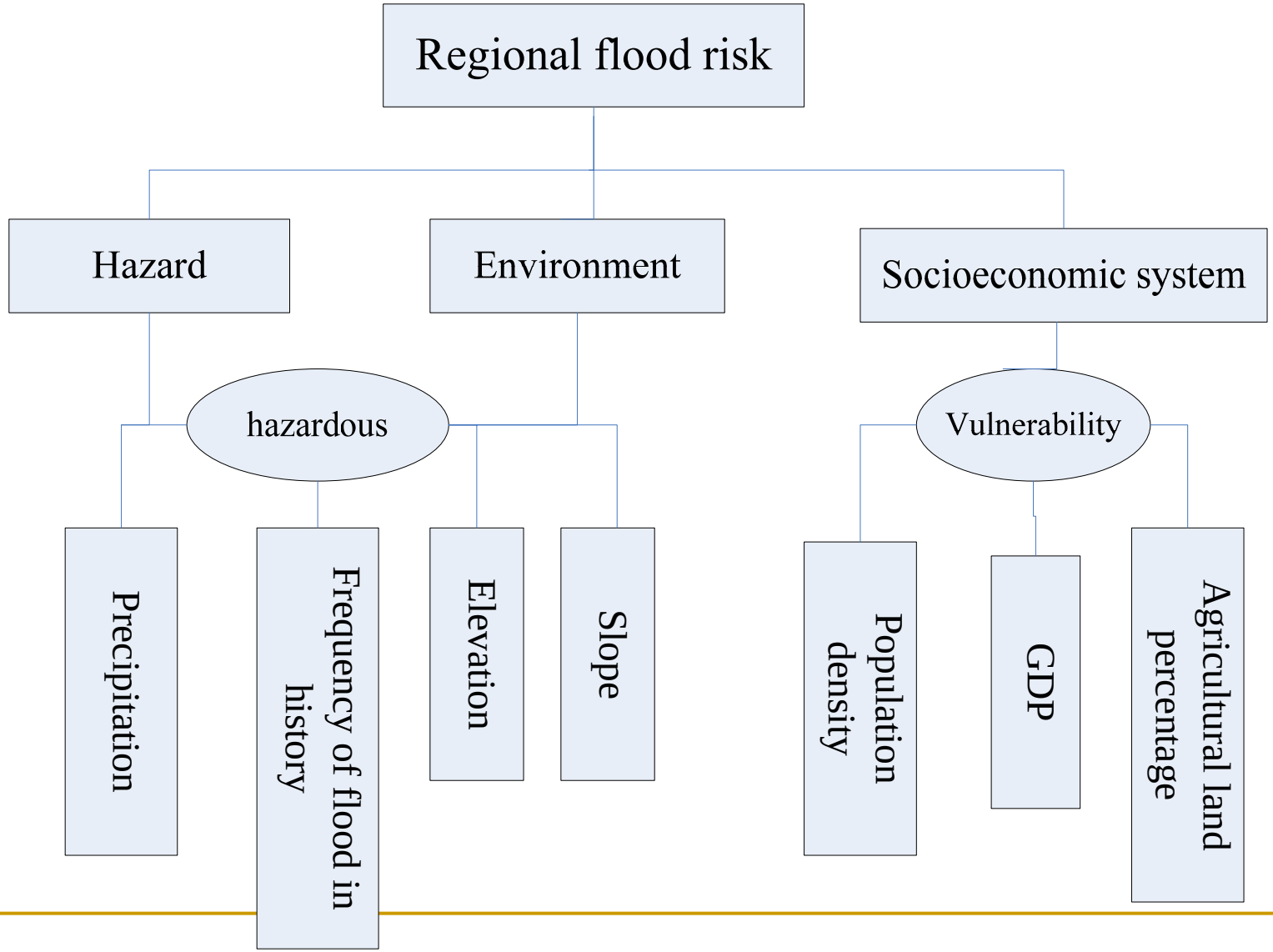
Map of Location

The boundary of Dongting Lake Region

The boundary of Hunan Province

The boundary of Xiang River Basin

Technical flowchart

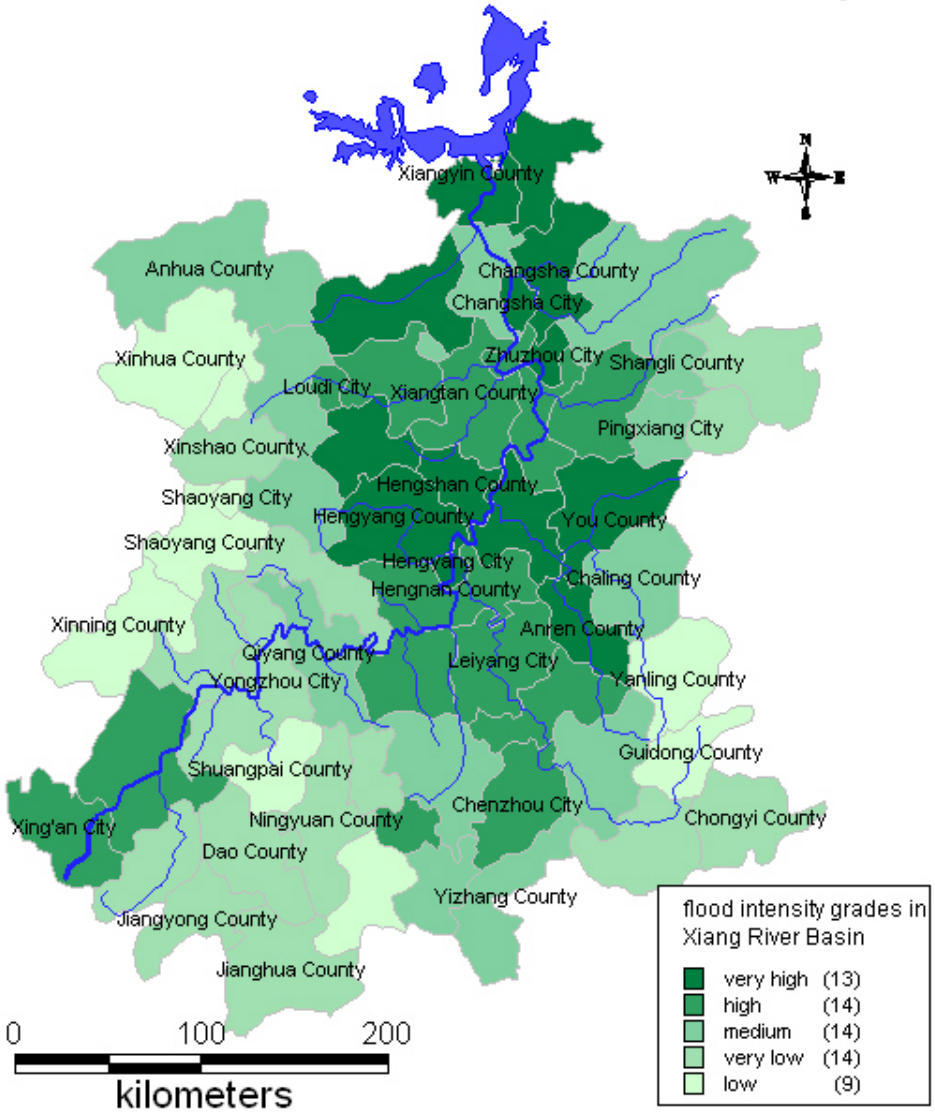


Flood hazard critical assessment in Xiang River Basin- based on GIS

Hazard division and given values of factors

Average Annual rainfall (mm)		Elevation (m)		Slope (degree)		Frequency of flood in history (time)	
classification	value	classification	value	classification	value	classification	value
>1600	5	< 100	5	0 ~ 4°	5	>8	5
1400-1600	4	100~200	4	4° ~ 8°	4	6-8	4
1200-1400	3	200~400	3	8° ~ 12°	3	4-6	3
1000-1200	2	400~600	2	12° ~16°	2	2-4	2
< 1000	1	>600	1	>16°	1	< 2	1

Map of flood hazardous grades in Xiang River Basin



Flood Vulnerability assessment of Xiang River Basin-based on fuzzy comprehensive evaluation model

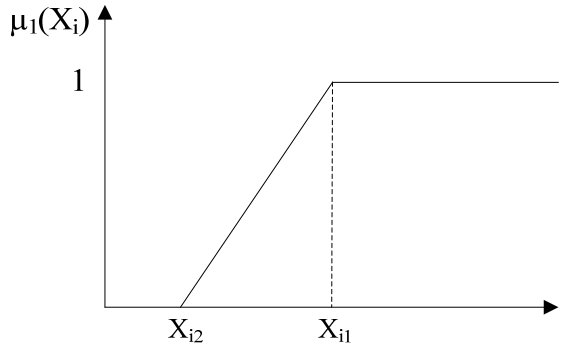
- The factor sets U={density of population, GDP, agricultural land percentage}
- The evaluation sets V={v1, v2, v3, v4, v5}={ very high vulnerability，high vulnerability，medium vulnerability，low vulnerability，very low vulnerability}。
- The weight sets W={0.54，0.3，0.16}

Single factor division standard of flood vulnerability

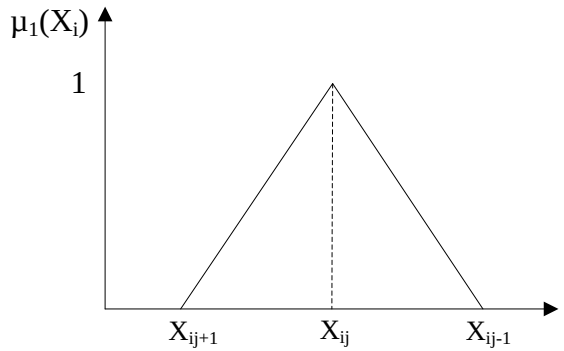
No	factor	V1	V2	V3	V4	V5
1	Density of population	0.65	0.55	0.45	0.35	0.2
2	GDP	0.65	0.5	0.4	0.3	0.2
3	Agricultural land percentage	0.85	0.7	0.55	0.4	0.25

The subjection functions

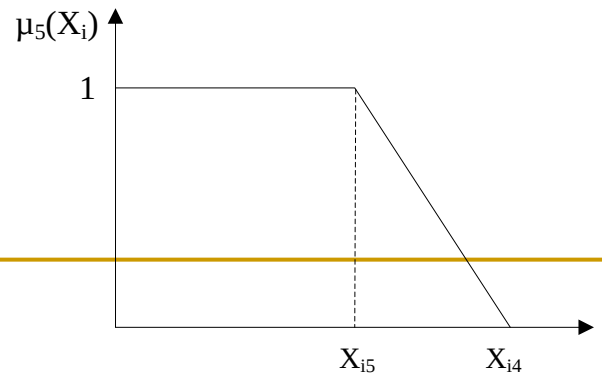
$$\mu_1(x_i) = r_{i1} = \begin{cases} 1 & x_i \geq x_{i1} \\ \left| \dfrac{x_i - x_{i2}}{x_{i2} - x_{i1}} \right| & x_{i2} < x_i < x_{i1} \\ 0 & x_i \leq x_{i2} \end{cases}$$



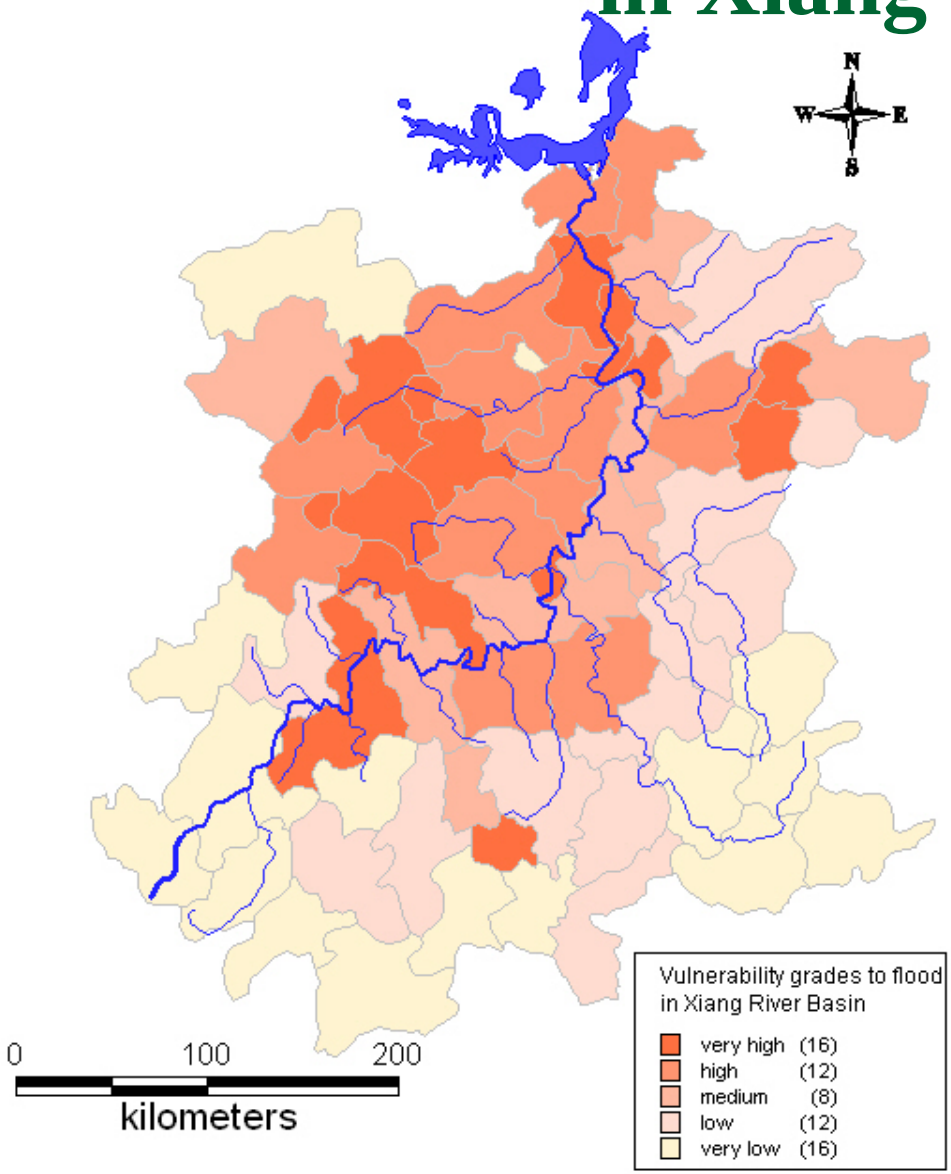
$$\mu_j(x_i) = r_{ij} = \begin{cases} \left| \dfrac{x_i - x_{i,j-1}}{x_{i,j} - x_{i,j-1}} \right| & x_{ij} < x_i < x_{ij-1} \\ \left| \dfrac{x_i - x_{i,j+1}}{x_{i,j} - x_{i,j+1}} \right| & x_{ij+1} < x_i \leq x_{ij} \\ 0 & x_i < x_{i,j+1}, x_i \geq x_{ij-1} \end{cases}$$



$$\mu_5(x_i) = r_{i5} = \begin{cases} 1 & x_i \leq x_{i,5} \\ \left| \dfrac{x_i - x_{i,4}}{x_{i,5} - x_{i,4}} \right| & x_{i,5} < x_i < x_{i,5} \\ 0 & x_i \geq x_{i,4} \end{cases}$$



Map of flood Vulnerability grades in Xiang River Basin

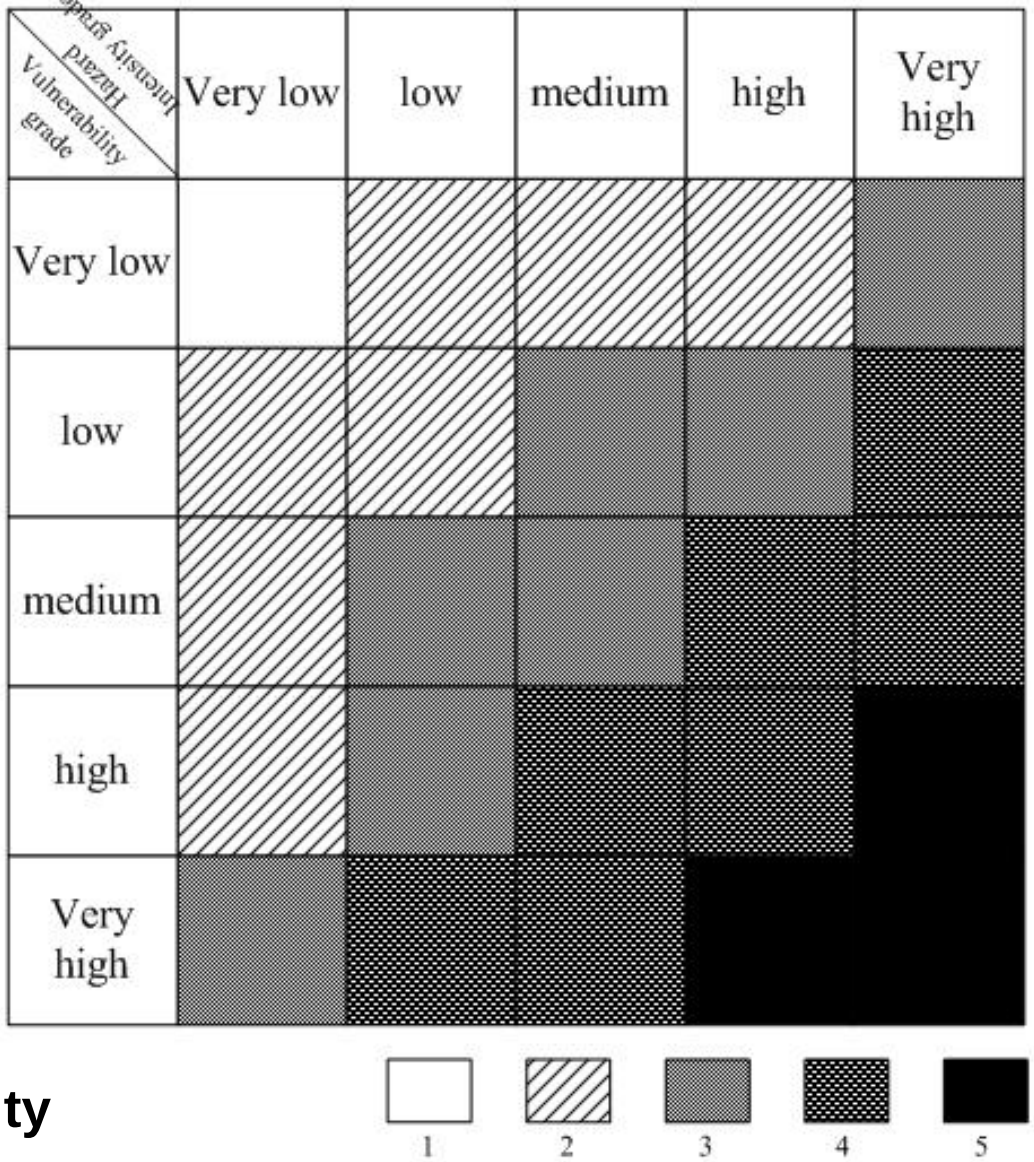


Flood Risk Assessment of Xiang River Basin

Classification matrix of flood risk level of Xiang Rive Basin in China

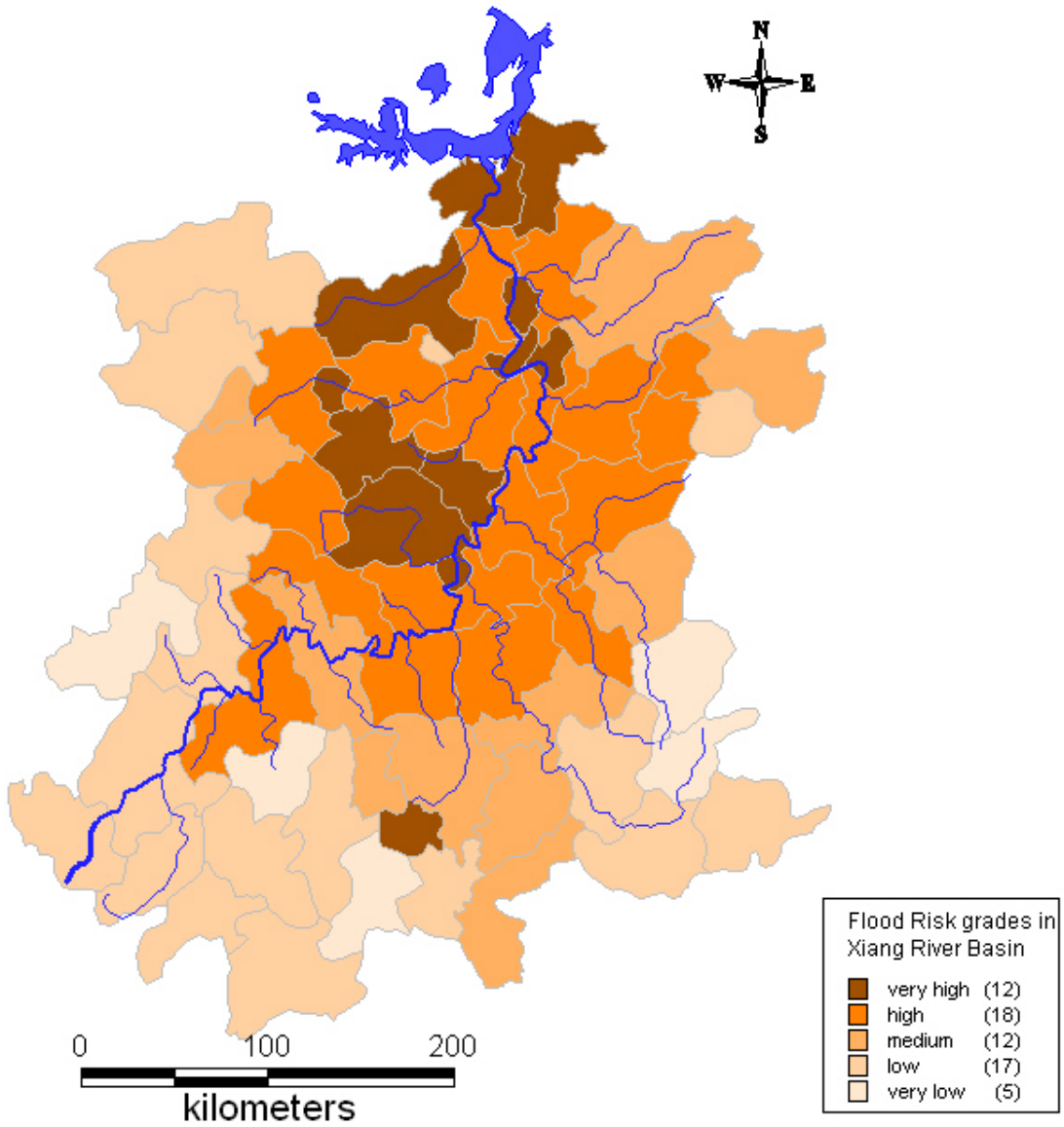
The risk level is classified with regard to both the flood vulnerability grades and the flood hazardous grades.

1. **Very low risk level**
2. **Low risk level**
3. **Medium risk level**
4. **High risk level**
5. **Very high risk level**



Risk = Hazard × Vulnerability

Flood Risk Distribution Map of Xiang River Basin



Conclusion and discussion

- Flood risk assessment of Xiang River basin is carried out with an integrated consideration of flood hazard and flood vulnerability.

- The model of R= H * V is used to get the flood risk grades in Xiang River Basin. The results fit the fact well.

- “Multiply” model is used to calculate relative risk degrees.

Conclusion and Discussion

- Purpose of this research:

- to provide basis for the government and insurance companies to manage the flood risk of Xiang River Basin;

- to provide a reference for government to make land use policies and long-term program for social-economic development.

Conclusion and discussion

- **Further study should focus on**

  - Understanding the behavior, process and dynamics of regional disaster system.
  - Improving methodology of flood hazard critical assessment and flood vulnerability assessment.
  - Developing objective methods on weight determination.
  - Testifying the results by mathematical methods.

Thank you for your attention!