Decision support system for flood preparedness and response

Authors

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PROJECT SUMMARY

Floods in Mexico

- In 2011, nearly 3.7 million people were affected by disasters in Mexico, and between 1999 and 2007 almost 90% of the disasters were water-related
- The 2007 flood in Tabasco represented losses about 31,800 million pesos (US $2.4 Billion)
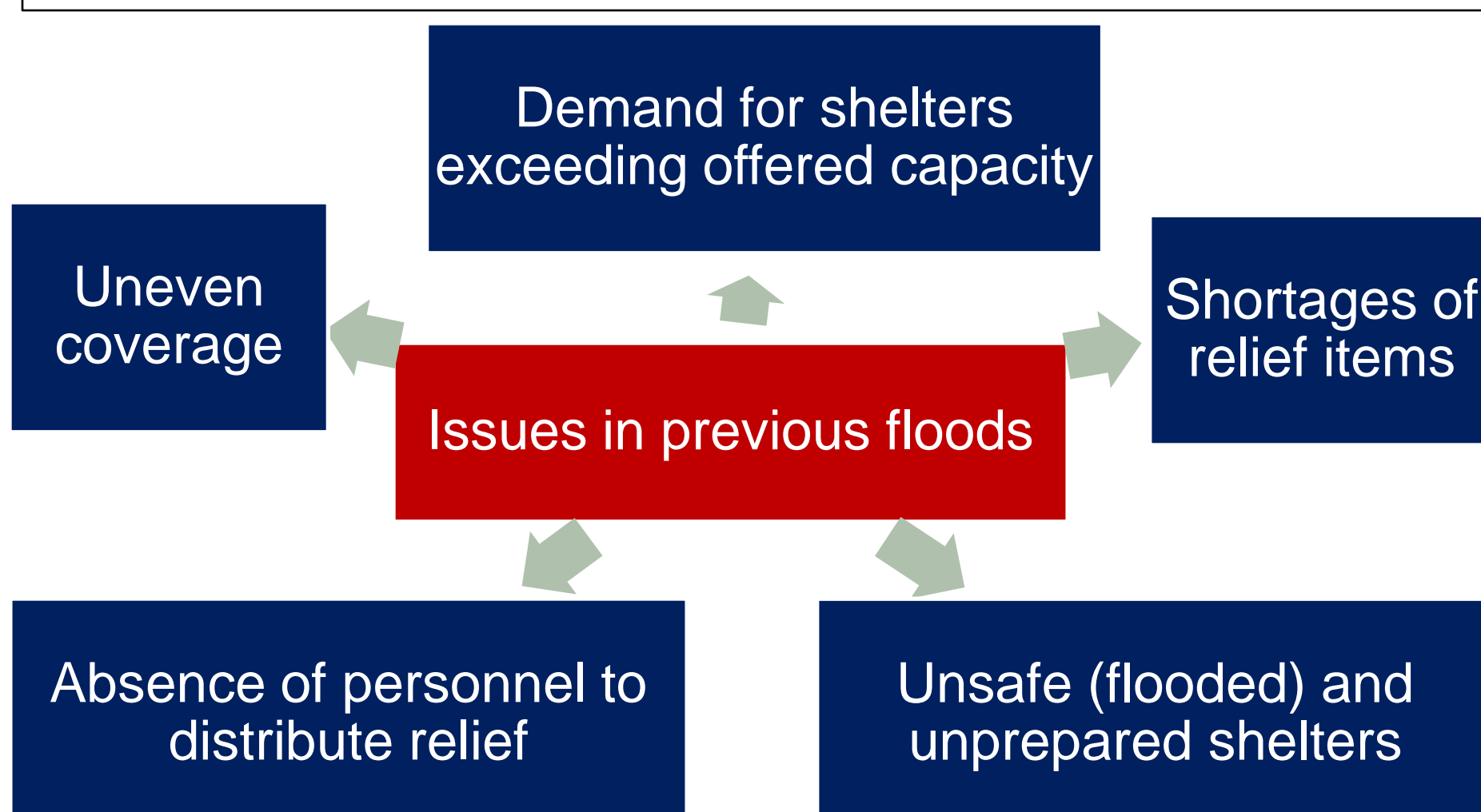- Mexico has the second largest economy in Latin America but nearly 50% of the population lives in poverty

Disaster management in Mexico
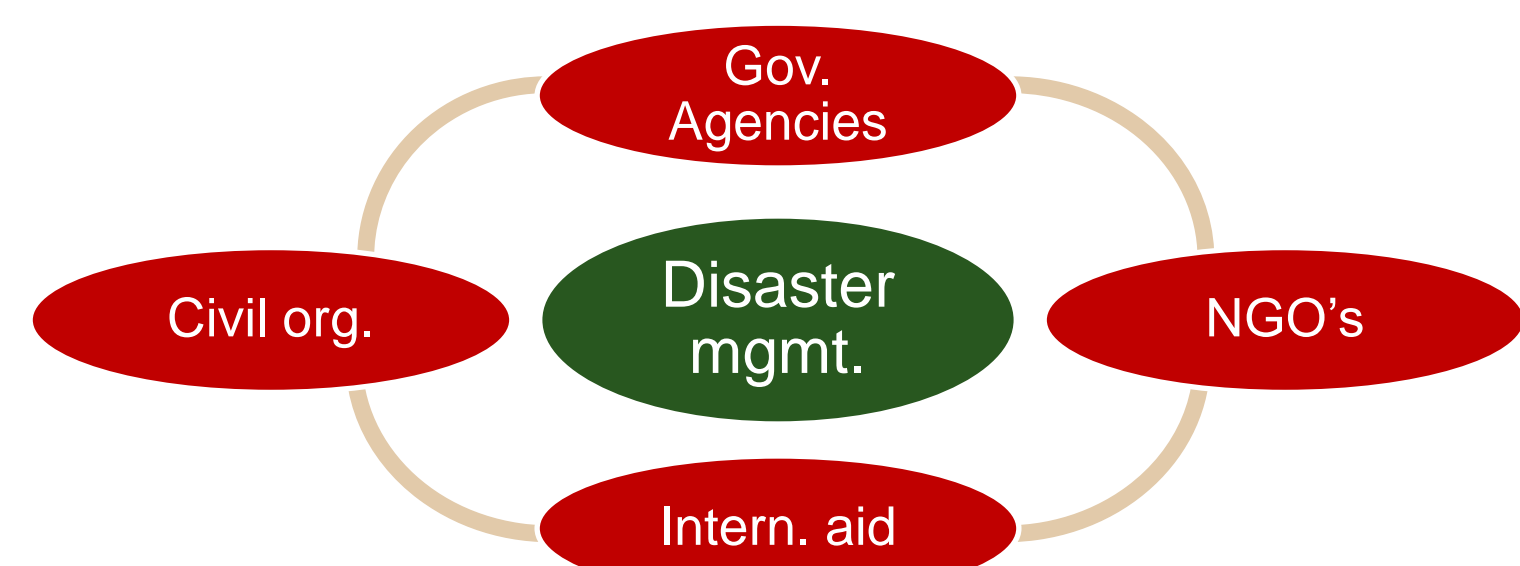
Agency	Material resources			Human resources			
	Food	Med.	Vehicles	Mobile kitchens	Shelter care	DC man.	Health care	Dist.
SEDENA			☑	☑	☑	☑	☑*	☑
SEMAR		☑	☑					
S.SALUD		☑	☑		☑		☑	
IMSS			☑		☑		☑	
CIVIL P.	☑		☑		☑	☑	☑*	
DICONSA	☑		☑			☑		☑
DIF	☑					☑		☑
SEDESOL			☑		☑	☑		☑
R. CROSS	☑		☑		☑	☑		☑

* Pre-hospital attention

Improvement areas

- Demand for shelters exceeding offered capacity
- Uneven coverage
- Shortages of relief items
- Issues in previous floods
- Absence of personnel to distribute relief
- Unsafe (flooded) and unprepared shelters

Objective

- Develop a decision-support system for multi-agency disaster management using optimization and geographical information systems (GIS) to aid decision-making regarding the location of emergency facilities (shelters and distribution centres), the amount of pre-positioned stock of relief items and the distribution plan for floods in Mexico.
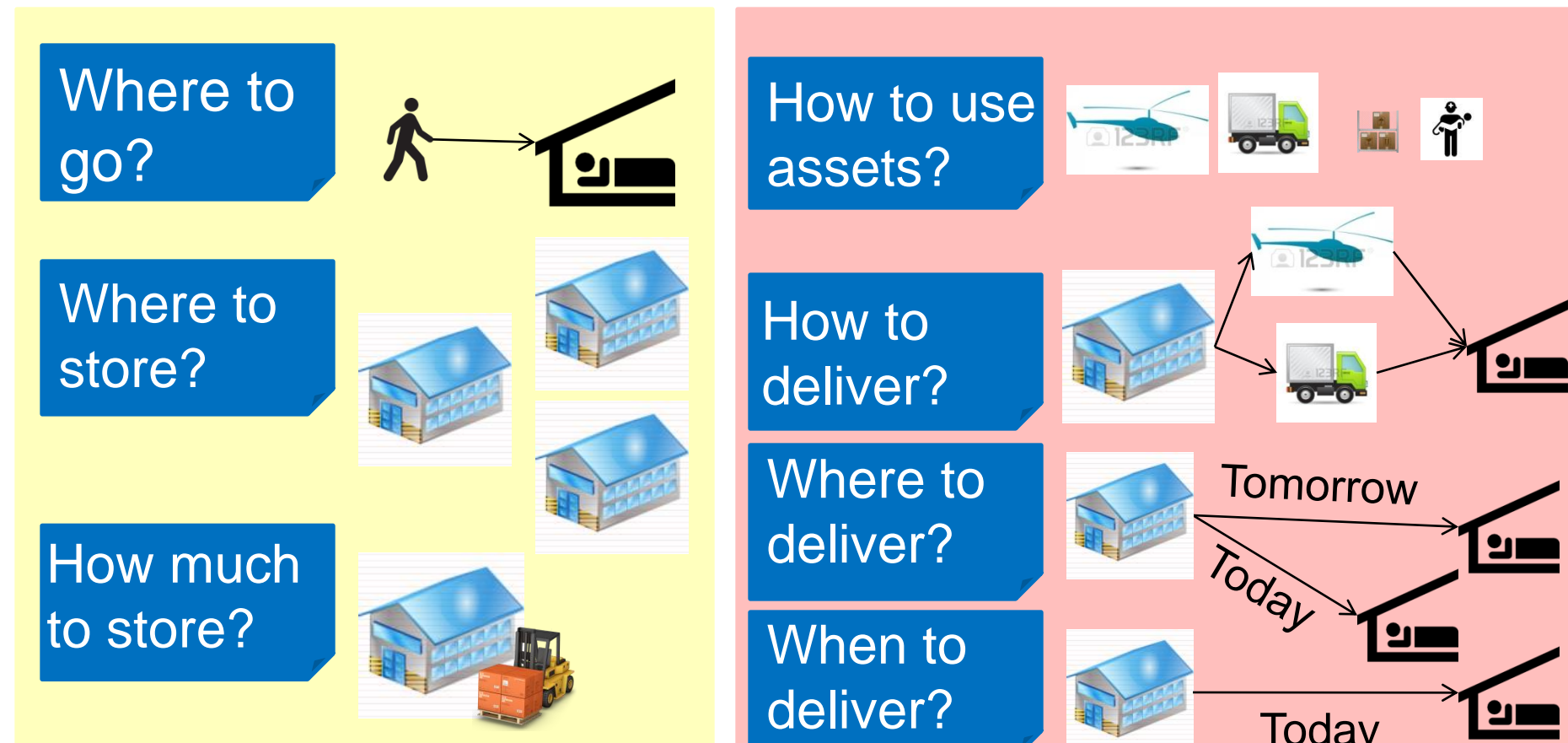
RESEARCH QUESTIONS

Analysis

- Is the system developed appropriate to aid decision-making in different regions in Mexico?
- Does the use of raster GIS provide useful insights for disaster management?
- Can the system developed improve the activities currently performed by Mexican agencies in flood situations?
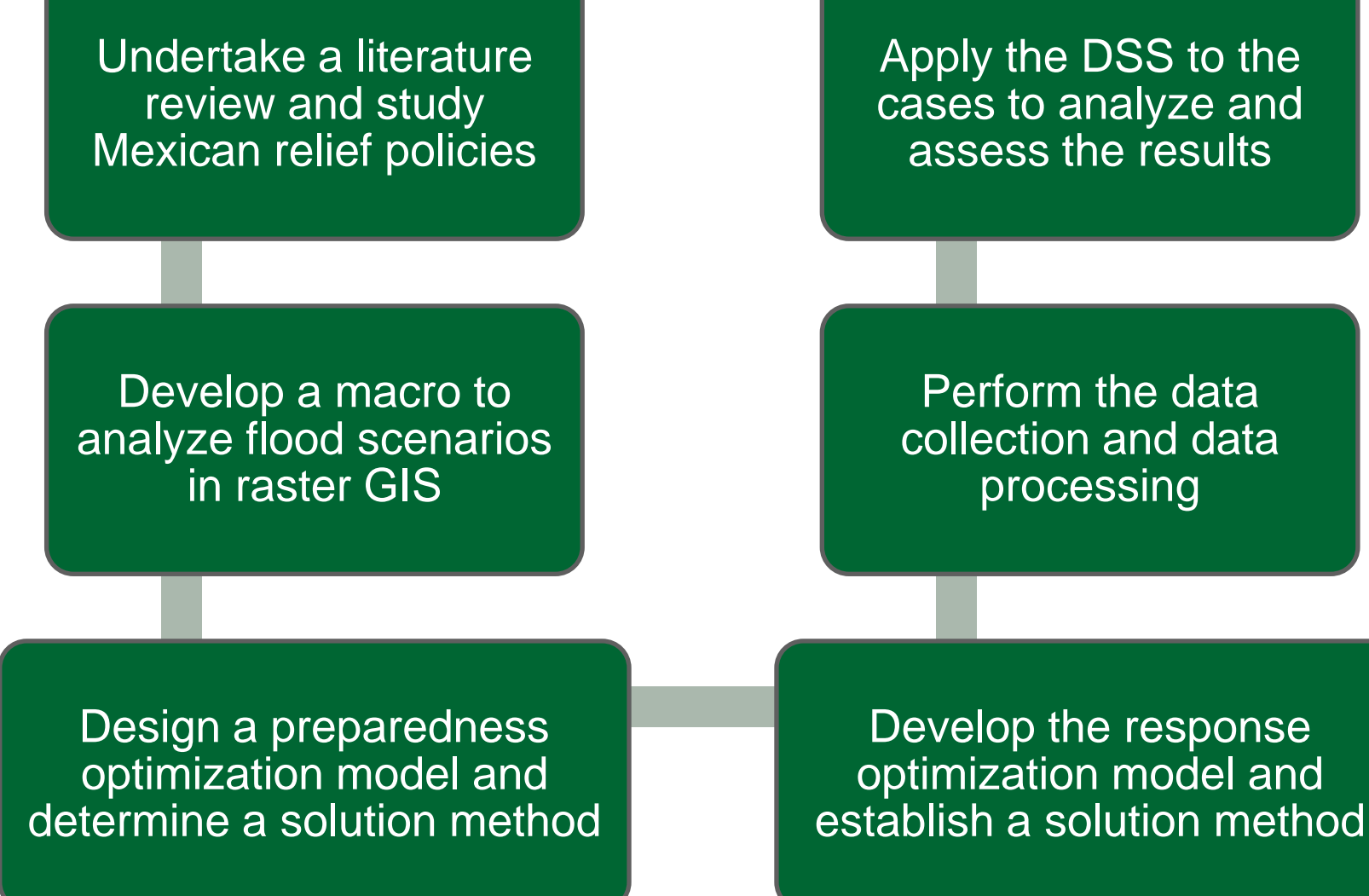
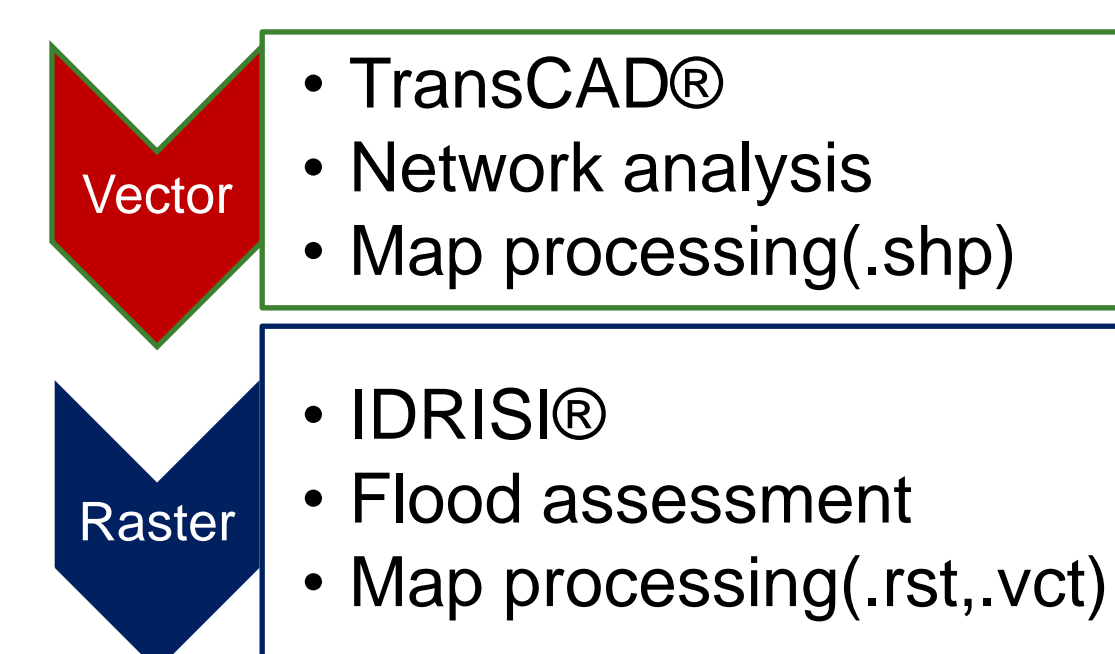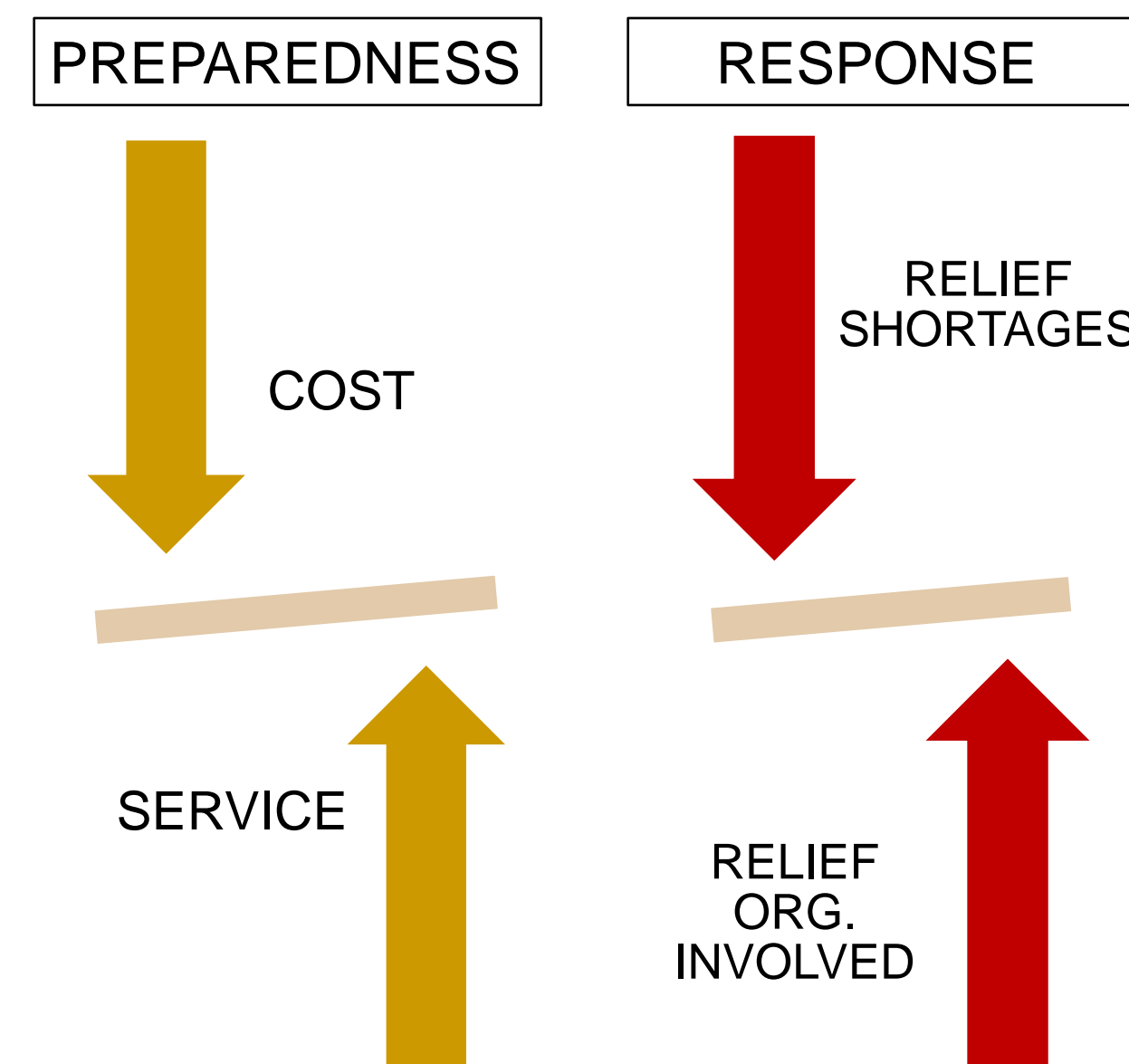## OPERATIONS RESEARCH IN EMERGENCY LOGISTICS

Who should do what?

- Where to go?
- Where to store?
- How much to store?
- How to use assets?
- How to deliver?
- Where to deliver?
- When to deliver? — Tomorrow, Today

Efficiency? Effectiveness? Fairness?

METHODOLOGY

- Undertake a literature review and study Mexican relief policies
- Apply the DSS to the cases to analyze and assess the results
- Develop a macro to analyze flood scenarios in raster GIS
- Perform the data collection and data processing
- Design a preparedness optimization model and determine a solution method
- Develop the response optimization model and establish a solution method

GIS

Vector
- TransCAD®
- Network analysis
- Map processing(.shp)

Raster
- IDRISI®
- Flood assessment
- Map processing(.rst,.vct)

OPTIMIZATION MODELS

PREPAREDNESS
- COST
- SERVICE

RESPONSE
- RELIEF SHORTAGES
- RELIEF ORG. INVOLVED
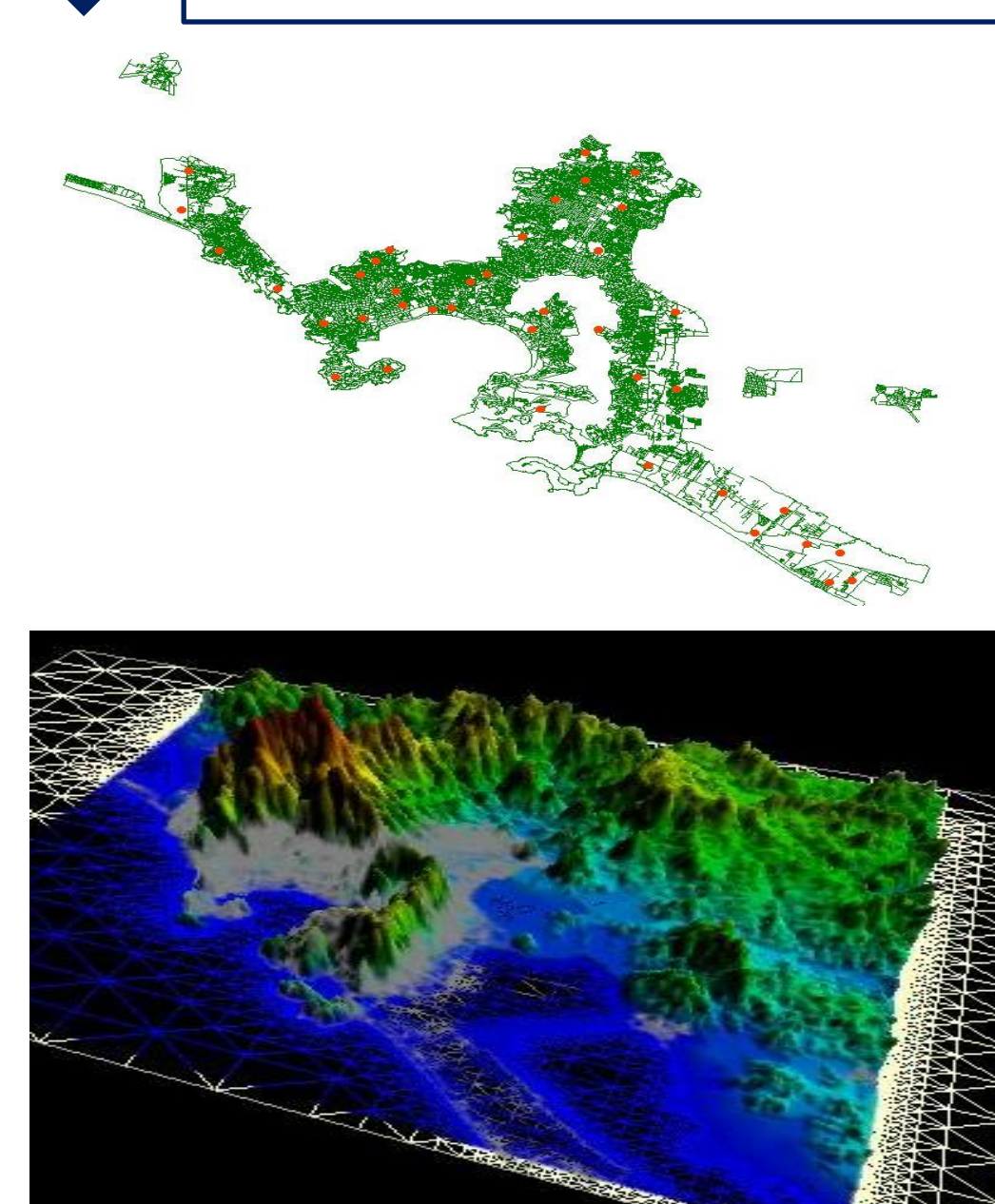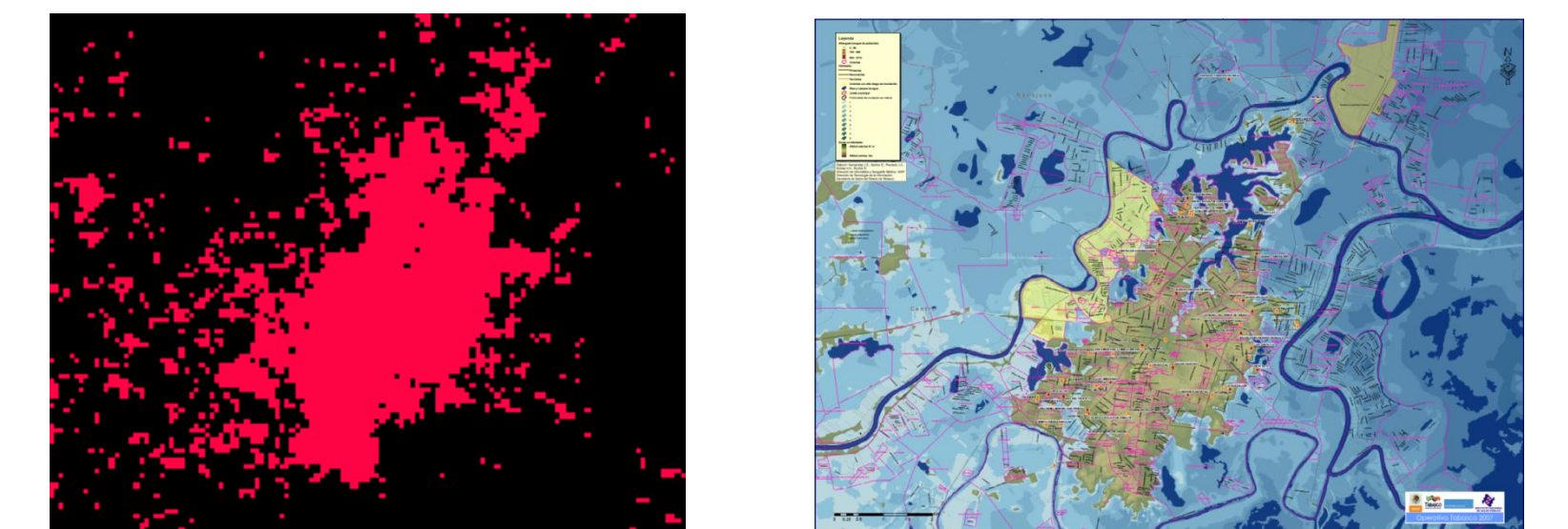

CASE STUDIES

RESULTS

Source: S. de Salud (2007)

Use: 20%
Use: 97%
Use: 37.5%
Use: 20%
Use: 87%
SEDENA
CP SEDENA

Use: 100%
Use: 50%
Use: 0%
Use: 100%
Use: 100%

Shelter care: 56%
Healthcare coverage: 99.8%
Medicine coverage: 74%
Food coverage: 80%
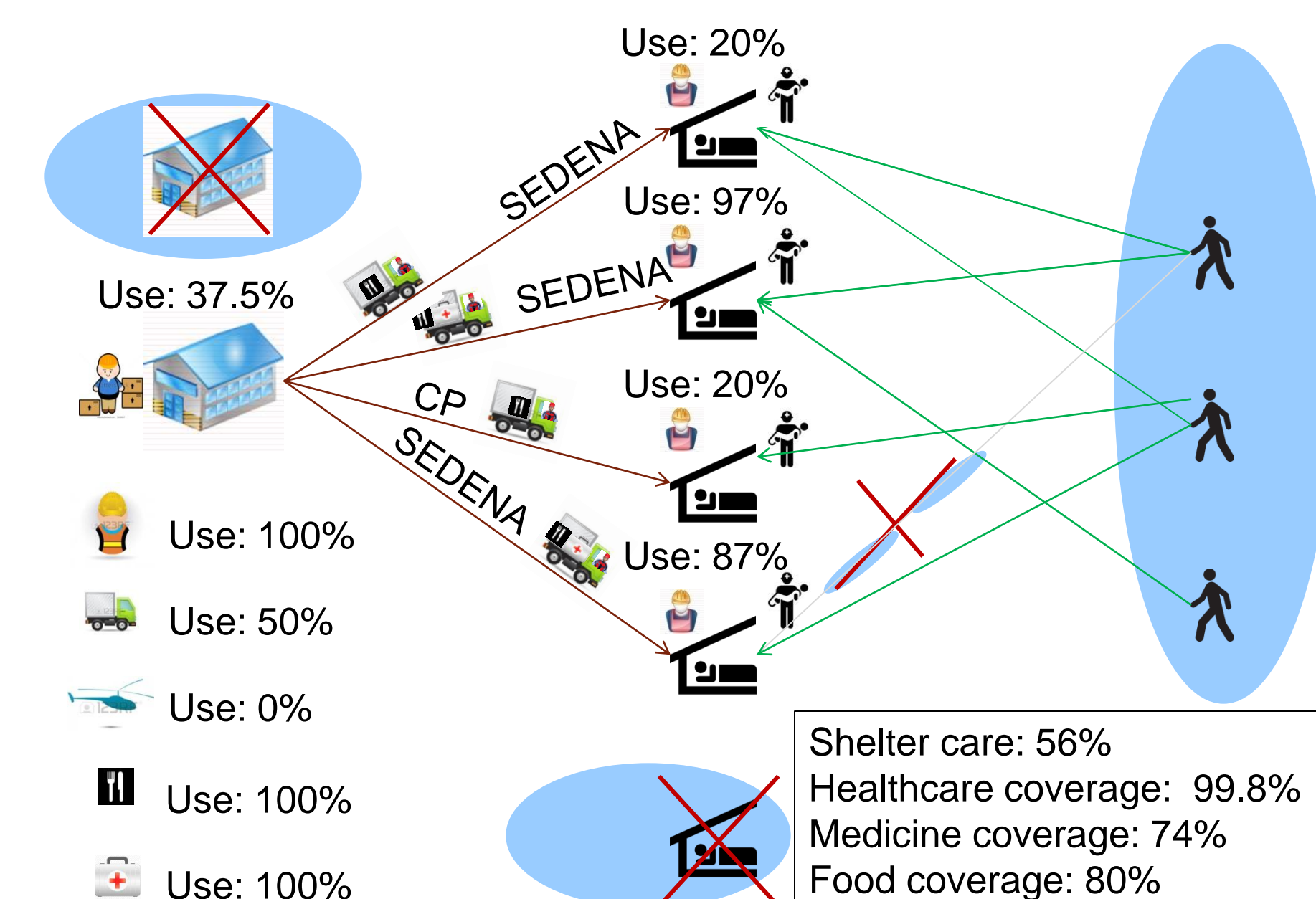
CONCLUSIONS

- Integrated system for support from preparedness, through the duration of the catastrophe until the final stage of the flood
- Inclusion of a multi-agency perspective based on Mexican relief policies
- Use of multi-objective optimization to balance efficiency and effectiveness
- Use of raster and vector GIS to yield a comprehensive analysis
- Academic and practical relevance