

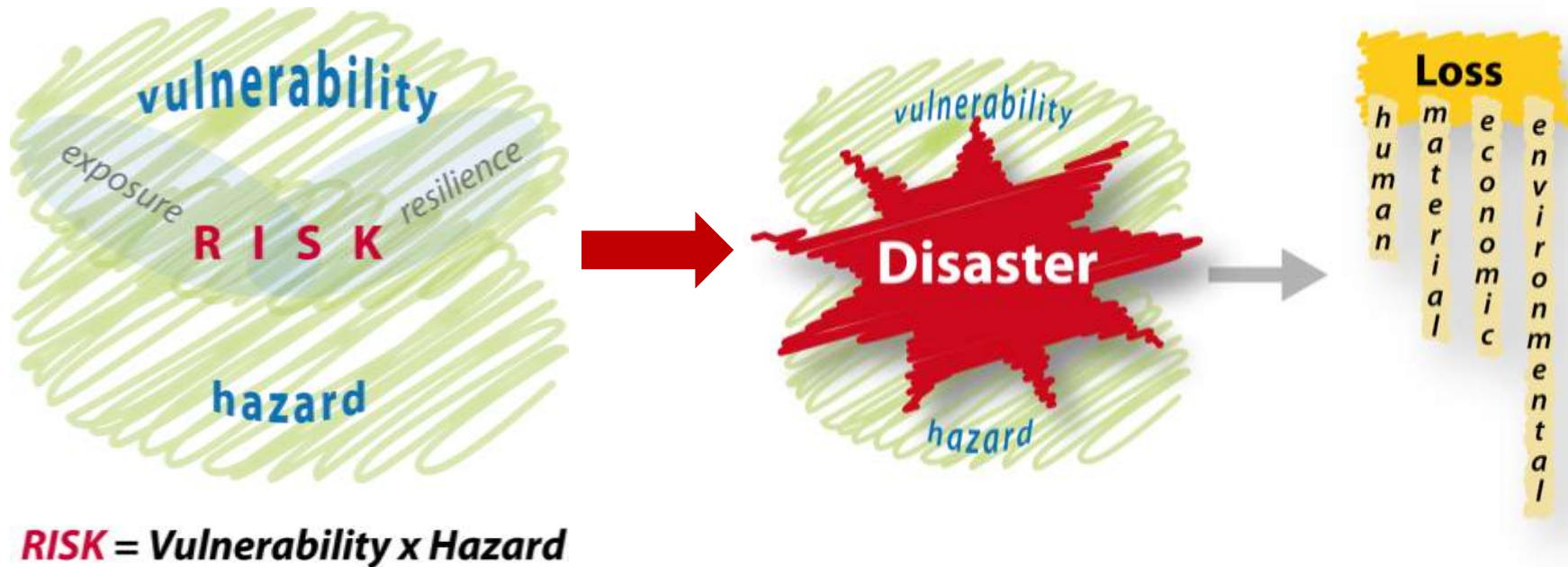
Monitoring Vulnerability

Integration of Earth Observation for enhanced Disaster Risk Reduction

Dr. Stefan KIENBERGER

Centre for Geoinformatics – Salzburg University, Austria

Risk



Kienberger, 2010

Like friction, **vulnerability** only exists when it is **mobilised** by the application of forces

What is vulnerability?

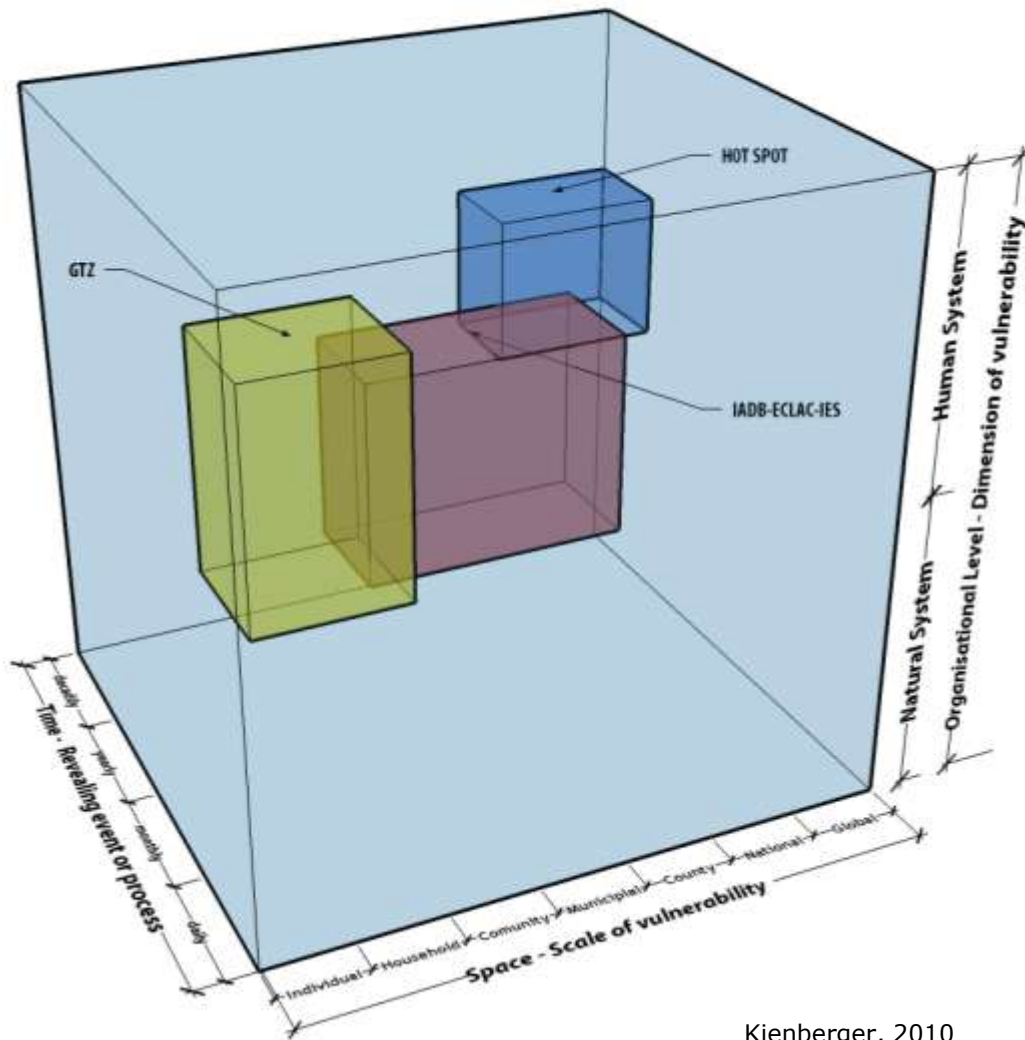
- "the **characteristics** and **circumstances** of a community, system or asset that make it **susceptible** to the damaging effects of a **hazard**".

$$V = f(SU, AC)$$

SU → Susceptibility
AC → Adaptive Capacity

- Dimensions
 - Economic
 - Social
 - Environmental
 - Physical

Vulnerability and its 'root dimensions'



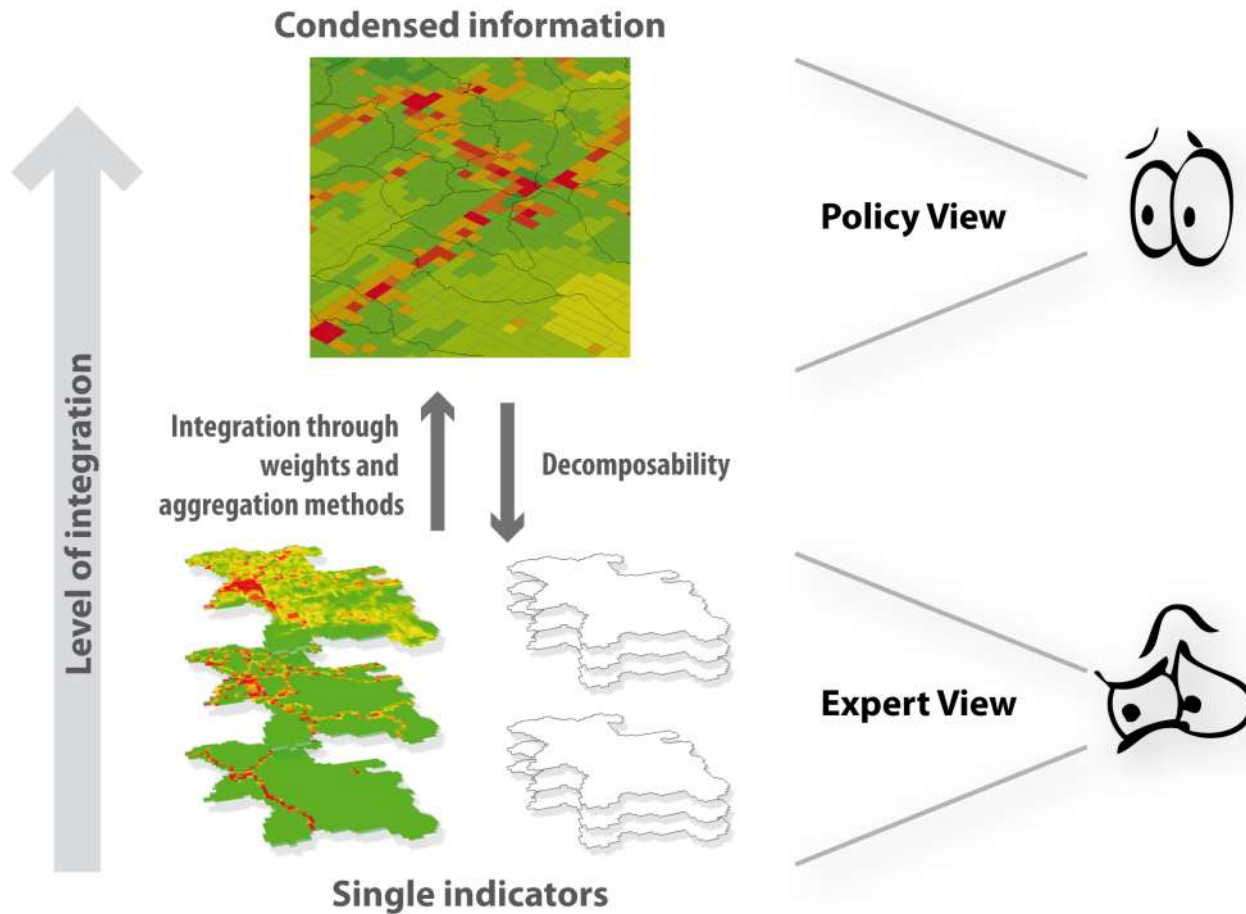
- **Where – spatial dimension!**
- **When – temporal dimension**
- **What – subject dimension**

Kienberger, 2010

Why to conduct a vulnerability assessment?

- **As decision and planning support**
 - *"Vulnerability assessments are action (policy) oriented with the overall objective to mitigate/avoid the negative impacts of hazards"*
 - Reduction of **RISK**
- **Complex, integrated analyses & monitoring**
 - *"Vulnerability is currently measured indirectly and is described through specific indicators which allow to represent and monitor the different dimensions of vulnerability"*

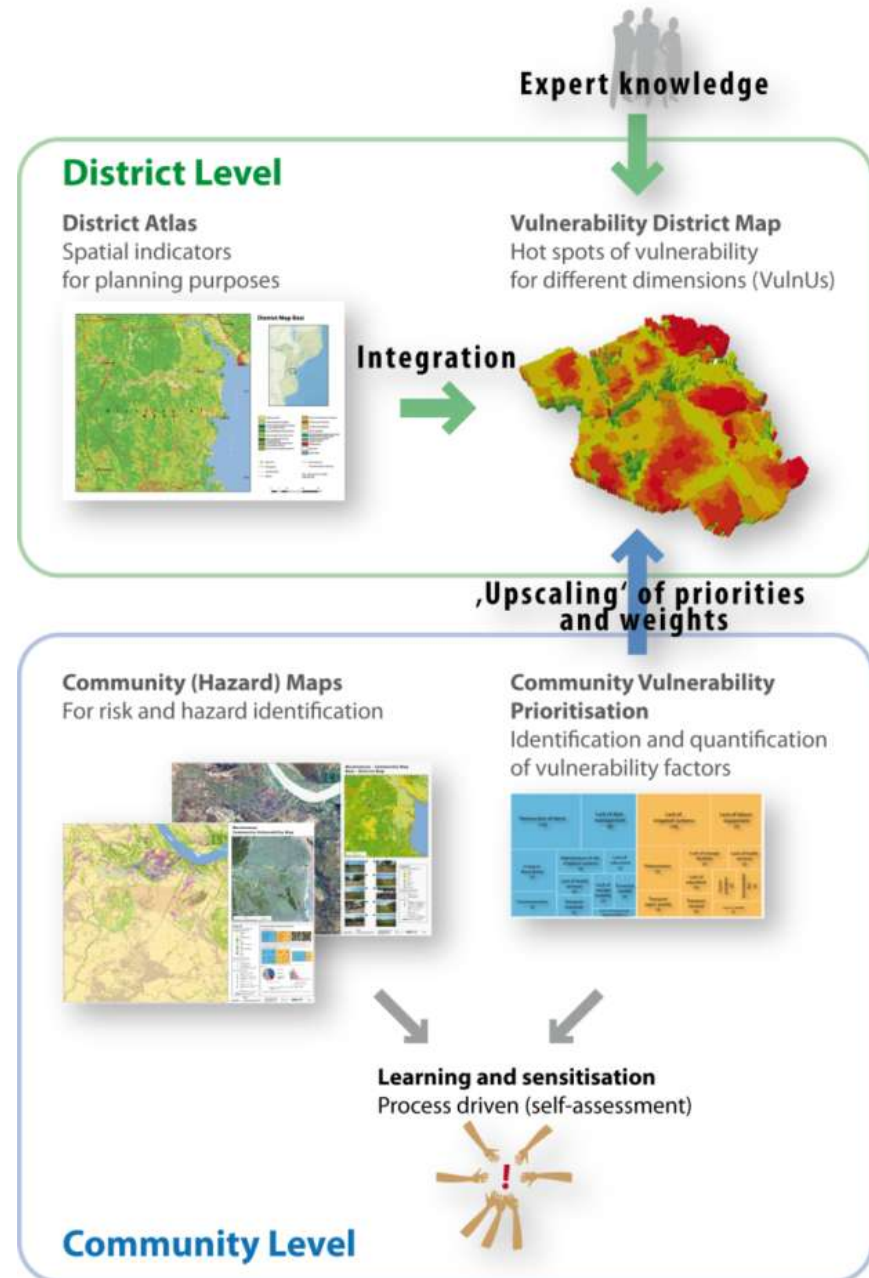
Addressing policy/decision makers



Different needs

→ District Level

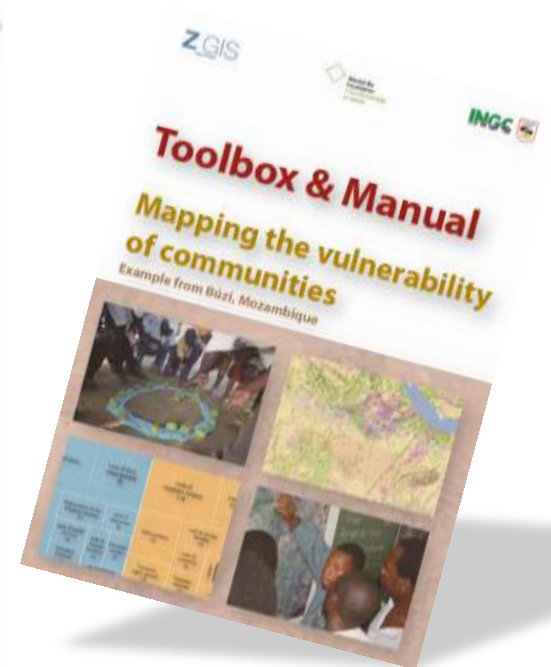
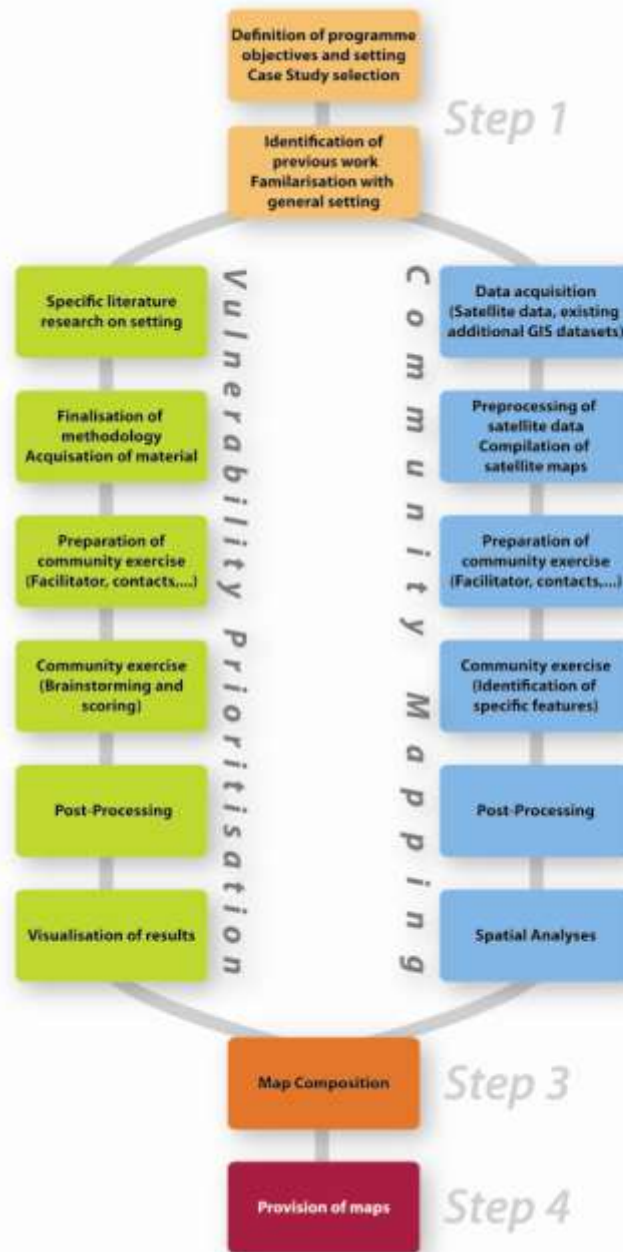
→ Community Level



Community Level

Vulnerability Prioritisation

Community Mapping



Community Mapping

- Working with **Quickbird satellite** imagery (resolution ~0,6m)
- **Identify/Mark important features** and get an **understanding of the community**
 - Risk zones (as perceived by the community)
 - Populated areas (settlements)
 - Agricultural zones
 - Critical infrastructure
 - Boundaries
 - ...
- **Additional collection of locations with GPS device (photographs)**

Mapping



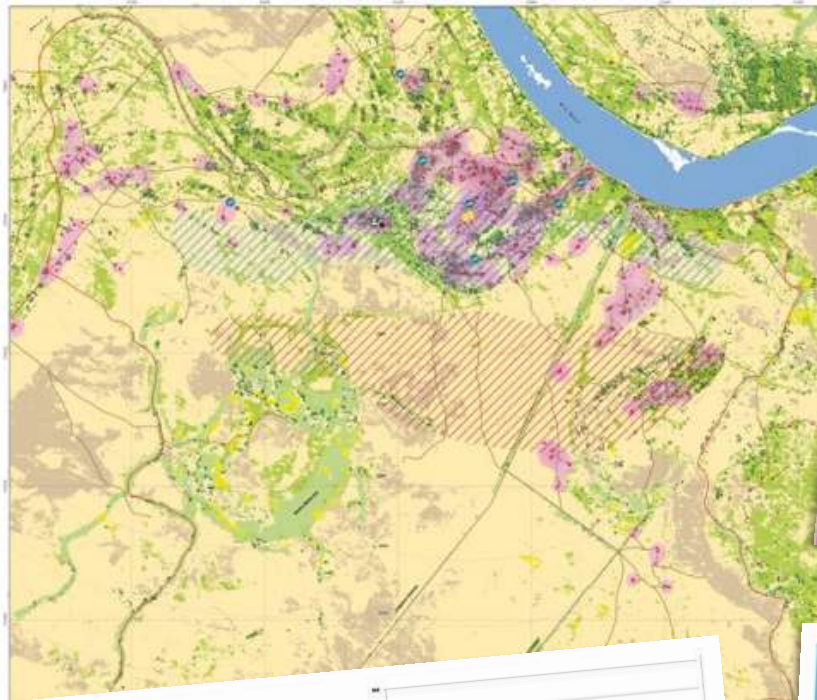
Vulnerability prioritisation

- **Get an understanding of the driving forces from a perspective of the communities** (3 communities)
- **Quantification of factors** (Scoring, ,Delphi exercise',...)
 - With beans, ...
 - Within hazard itself (drought and flood) (40)
 - Comparing hazards (10)

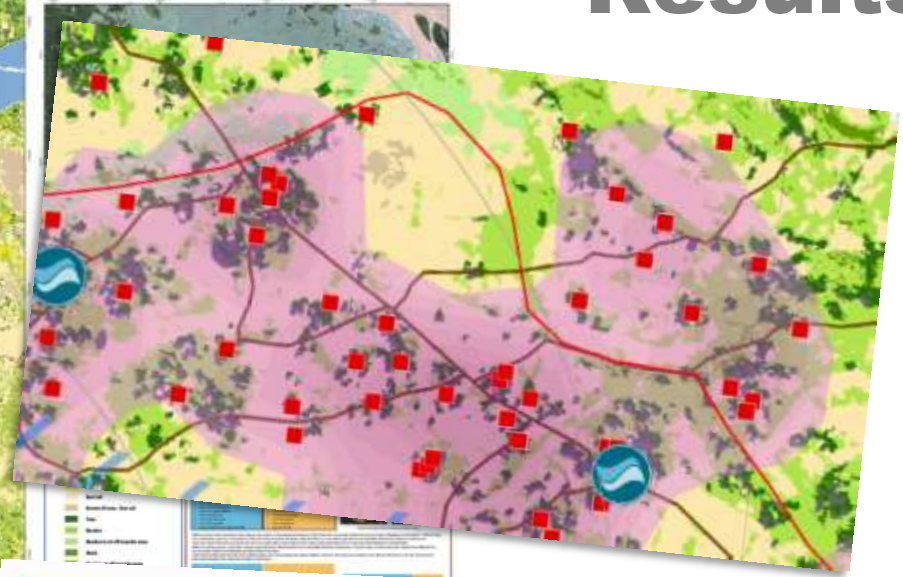
Prioritisation



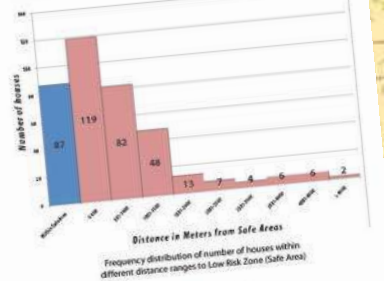
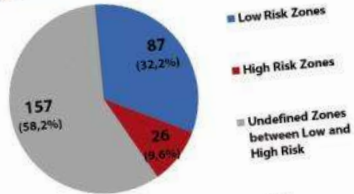
Results



Muchenesa
Community Vulnerability Map

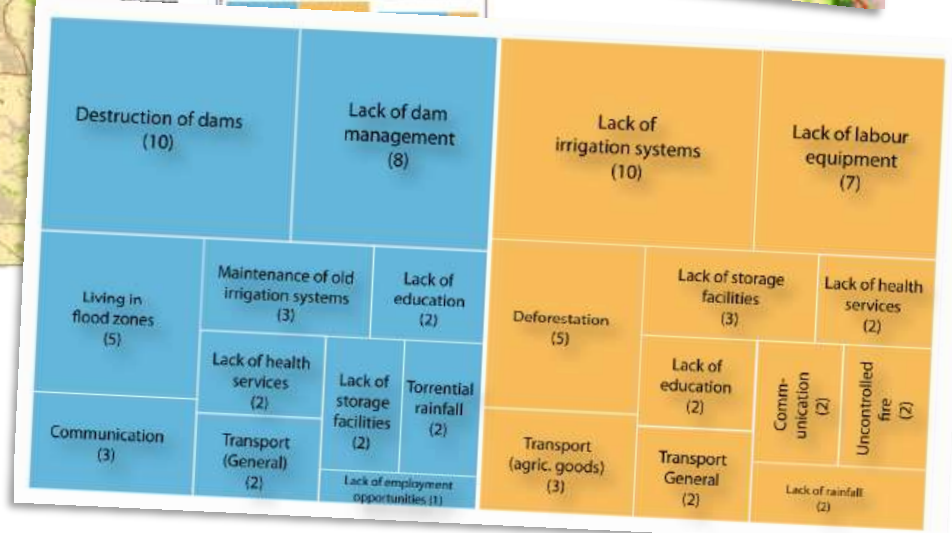


Exposure

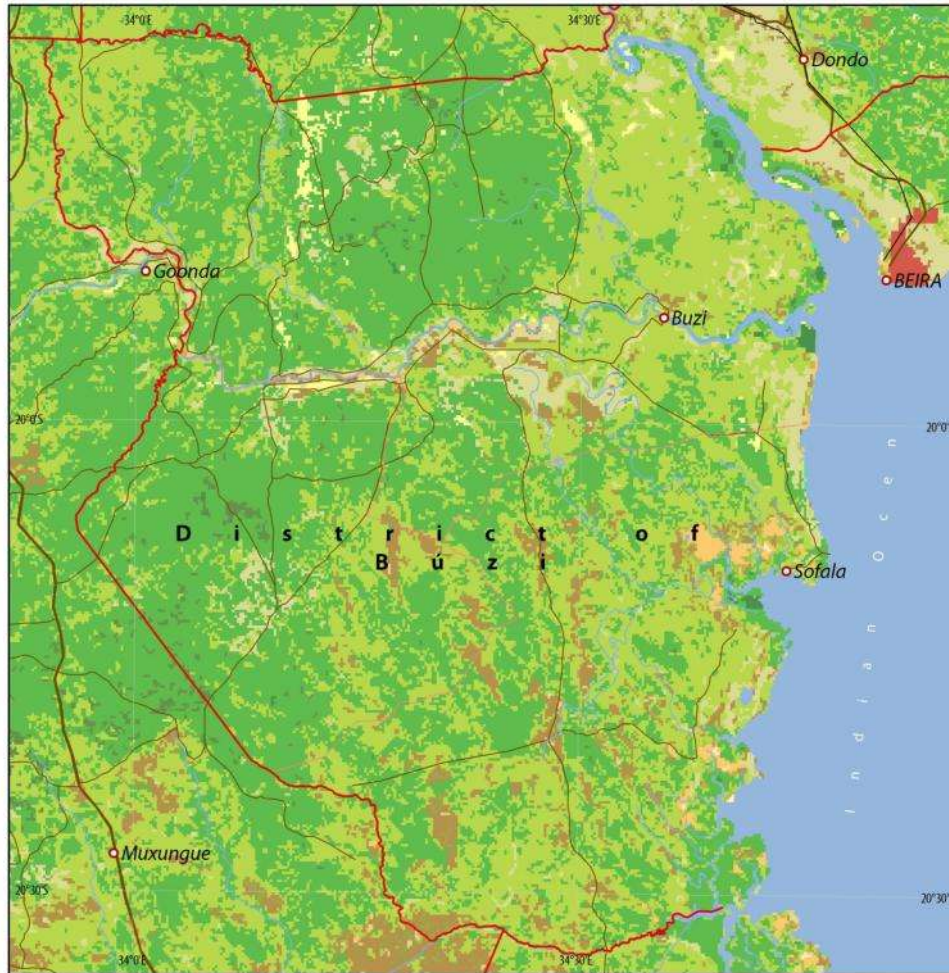


	Women	Men	Low Risk	High Risk	Undefined
Total Population	1255	1210	794	237	1434
Aggregado	494				

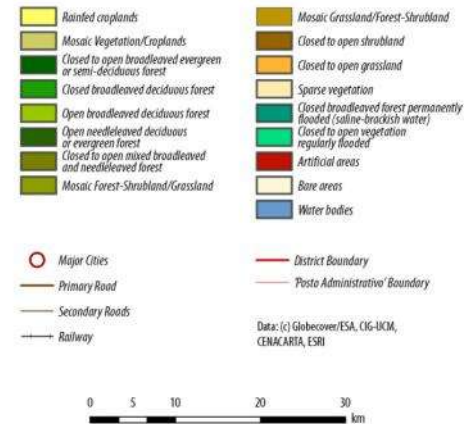
Within the community defined risk zones, 87 houses (32.2%) are located within the Low Risk Zone, 26 houses (9.6%) are within the High Risk Zone, whereas 157 houses (58.2%) are located in the Undefined Zone. The total amount of population is 2465 people (as reported on November, 2 2007 by the head of the community (see table)). Assuming that the distribution among the houses is normal, 794 people live in the 'Low Risk Zone', 237 in the 'High Risk Zone' and 1434 in the 'Undefined Zone'.



District level



District Map Búzi

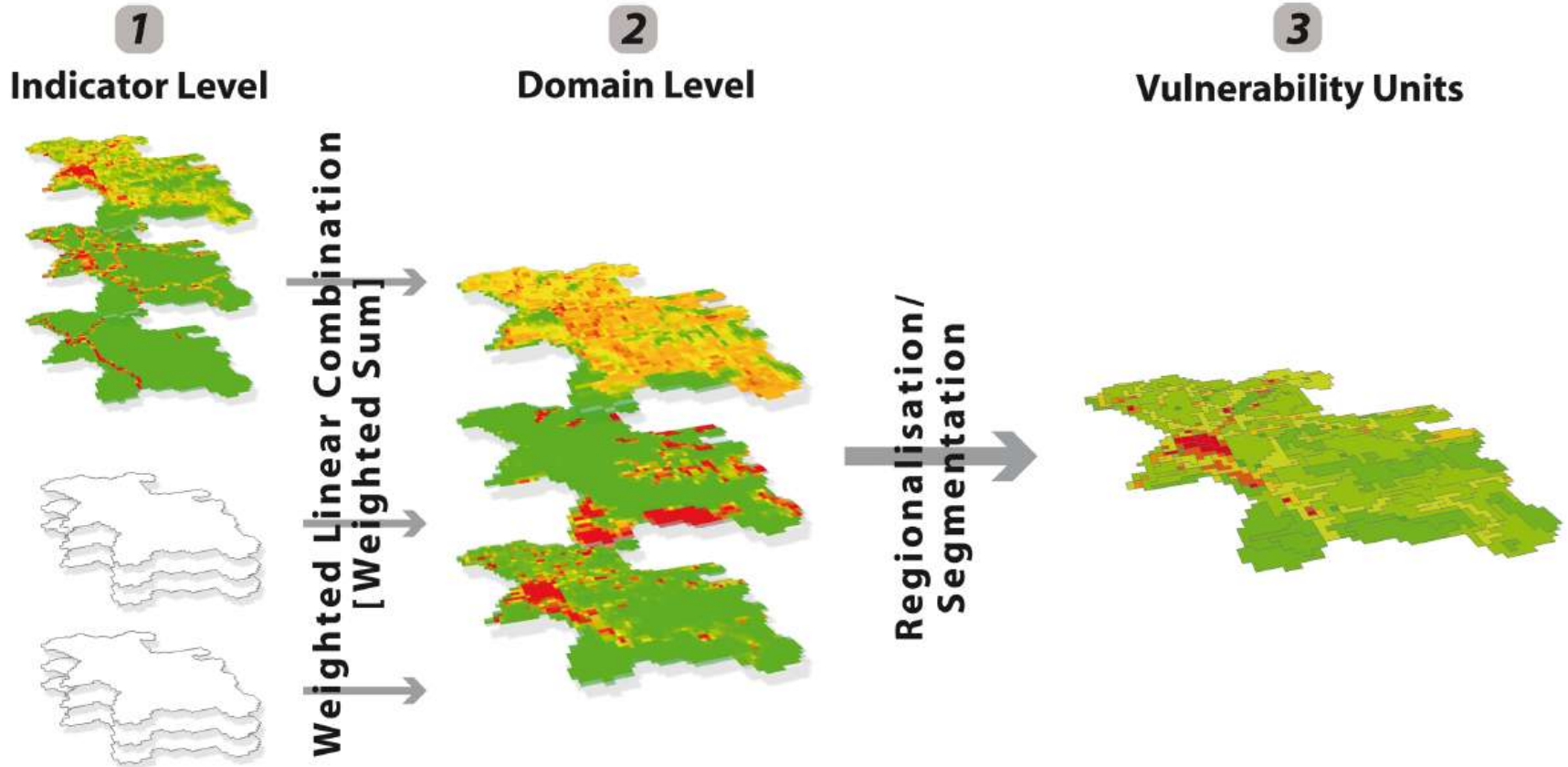


Selection and weighting of indicators

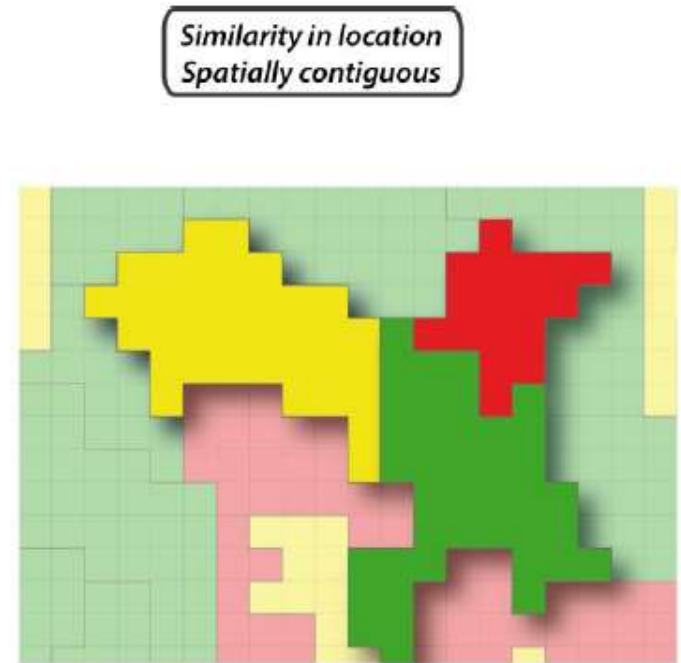
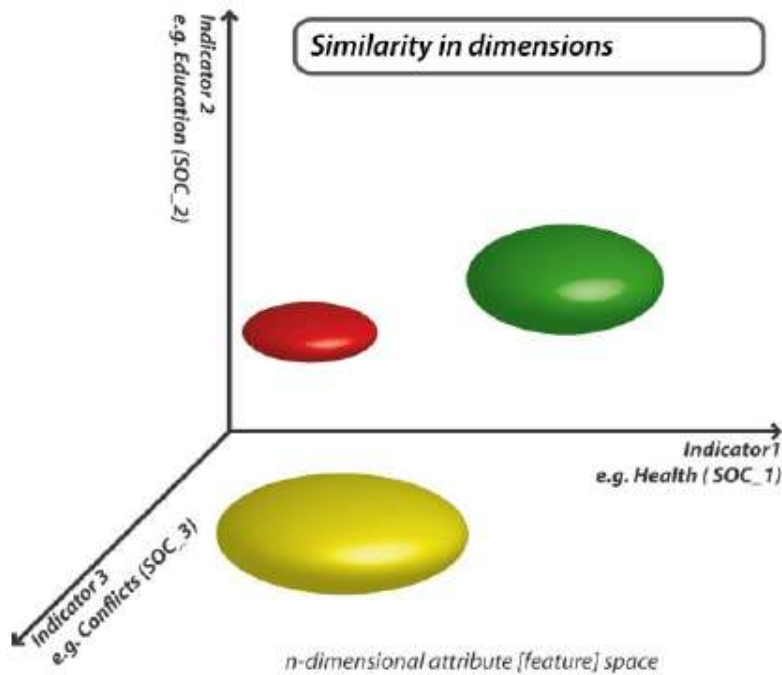
Dimensions	Indicator/Index	Weights	Sub-Indicator	Weights
Environmental	ENV_1 Biodiversity	9,8		
	ENV_2 Structural Diversity	13.2		
			ENV_2_1 Nearest Neighbour	2.25
			ENV_2_2 Proximity	2.45
			ENV_2_3 Fragmentation	2.05
			ENV_2_4 Diversity	3.25
		ENV_3 Loss of Biodiversity	10.6	
		ENV_4 Ecosystem Services	16.4	
			ENV_4_1 Flood Control	4.27
			ENV_4_2 Water regulation	2.82
		ENV_4_3 Soil retention	2.91	
Social	SOC_1 Health	6.91		
	SOC_2 Education	7.36		
	SOC_3 Conflicts	5.55		
	SOC_4 Access to water	8.73		
	SOC_5 Capacity to anticipate	8.18		
	SOC_6 Potential rescue opportunities	7.36		

Proxies mainly based on Remote Sensing data

Vulnerability units

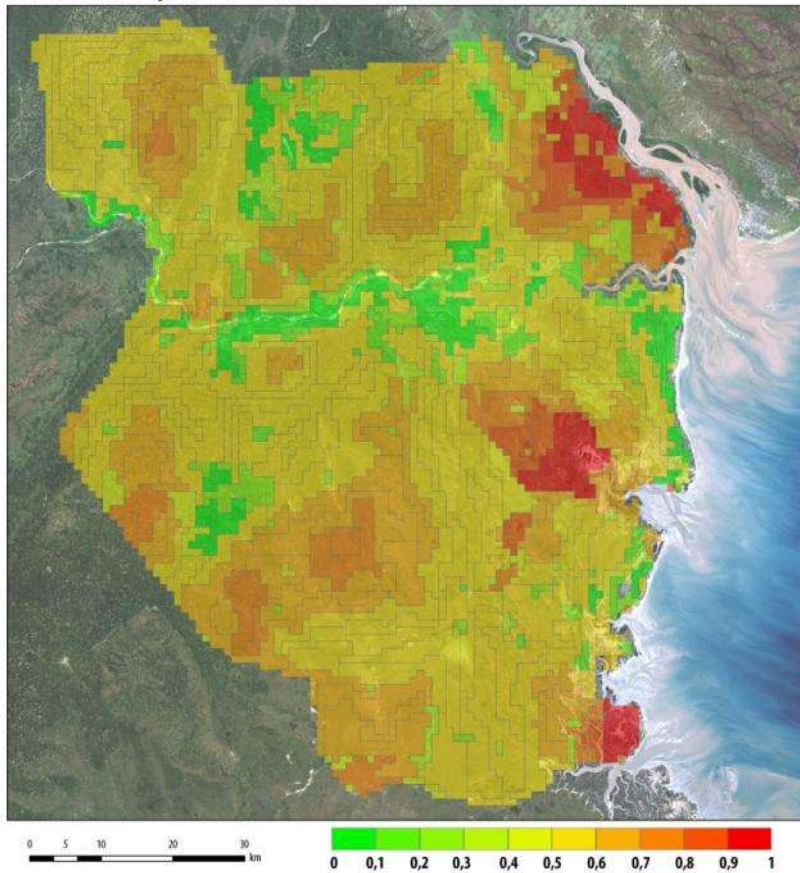


Regions of vulnerability

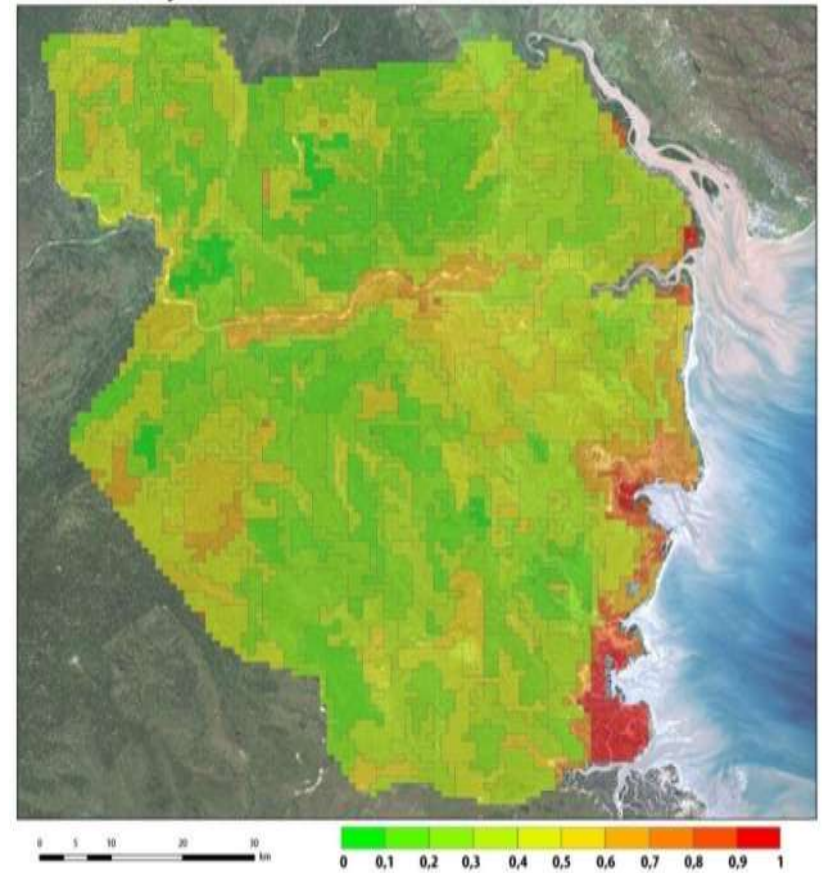


Results - Dimensions

Vulnerability Búzi - Economic Dimension

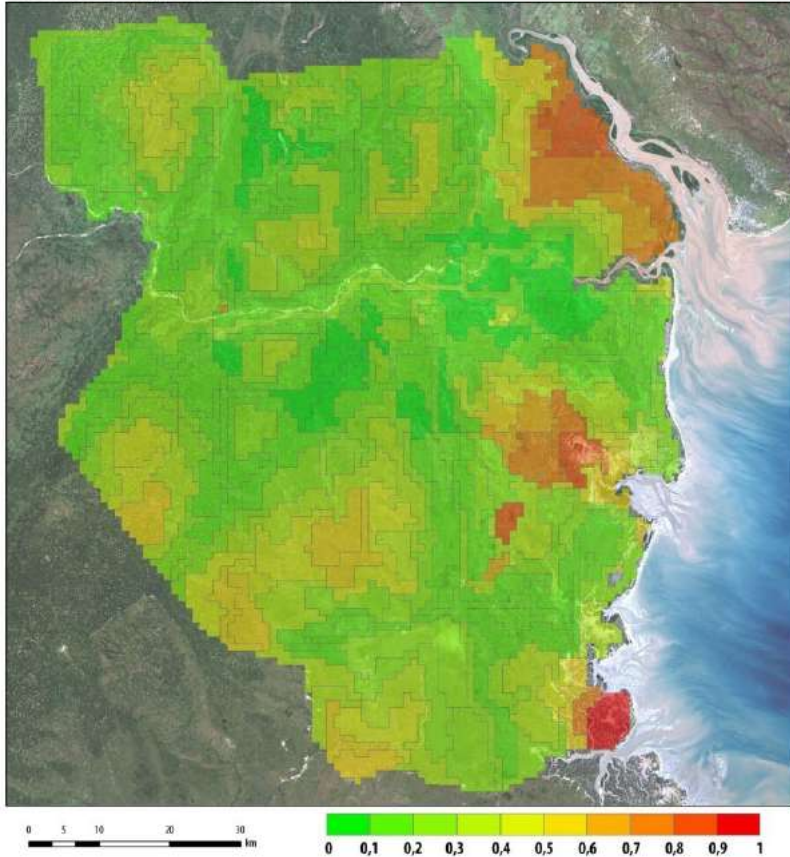


Vulnerability Búzi - Environmental Dimension

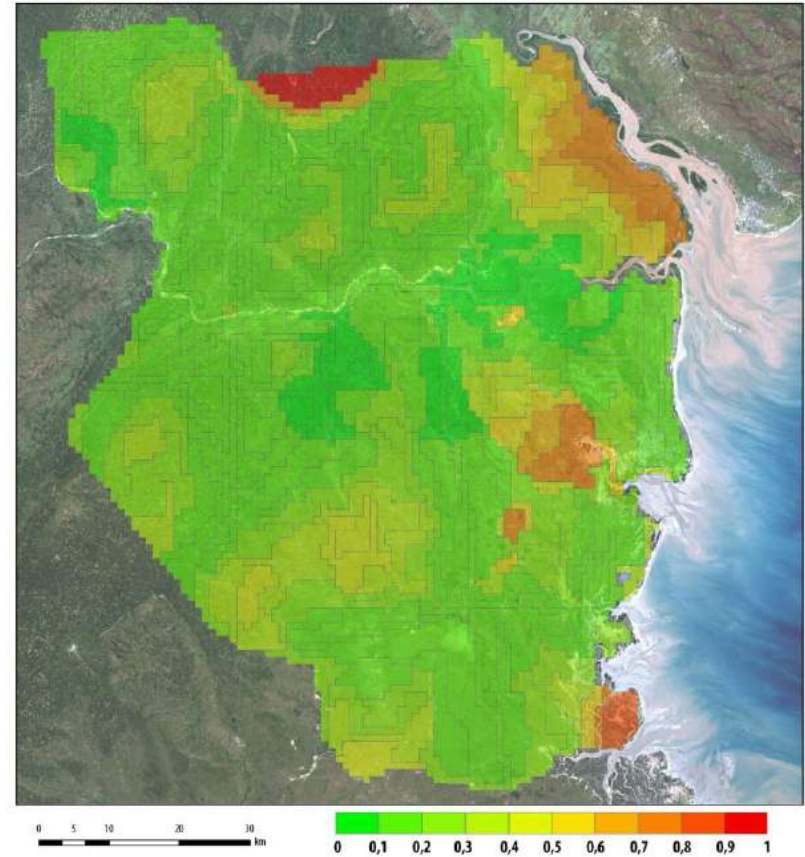


Results – Community vs Expert

Vulnerability Búzi - Expert View



Vulnerability Búzi - Community View



Role of Earth Observation

- **High resolution (satellite) data useful for community based approaches**
- **Provide basis to build proxies if in-situ (e.g. census data) is missing**
 - Population Distribution
- **Essential for environmental dimension, but strong relevance for others as well**
- **Aim of regular monitoring should be maintained**

Conclusions

- **Policy-relevance:** opportunity to visualise and model vulnerability *for all* and facilitates the exploration of intervention options *with all*
- **Monitoring:** Identification of *changes* within *time* and *domains* → basis for intervention
- **Scale:** design vulnerability assessments for the appropriate policy scale; identify differences
- **'Disaster Risk Reduction'** → data access as within response phase?

Thank You!



Workshop announcement



Expert Workshop, co-organized by **Z_GIS** and the **United Nations University Institute for Environment and Human Security UNU-EHS** on

Climate Change and Spatial Vulnerability Assessment

followed by a Discussion Session on

Global Change: Monitoring and Modelling

www.gi-forum.org

Salzburg, Austria – July 4 – 6, 2011