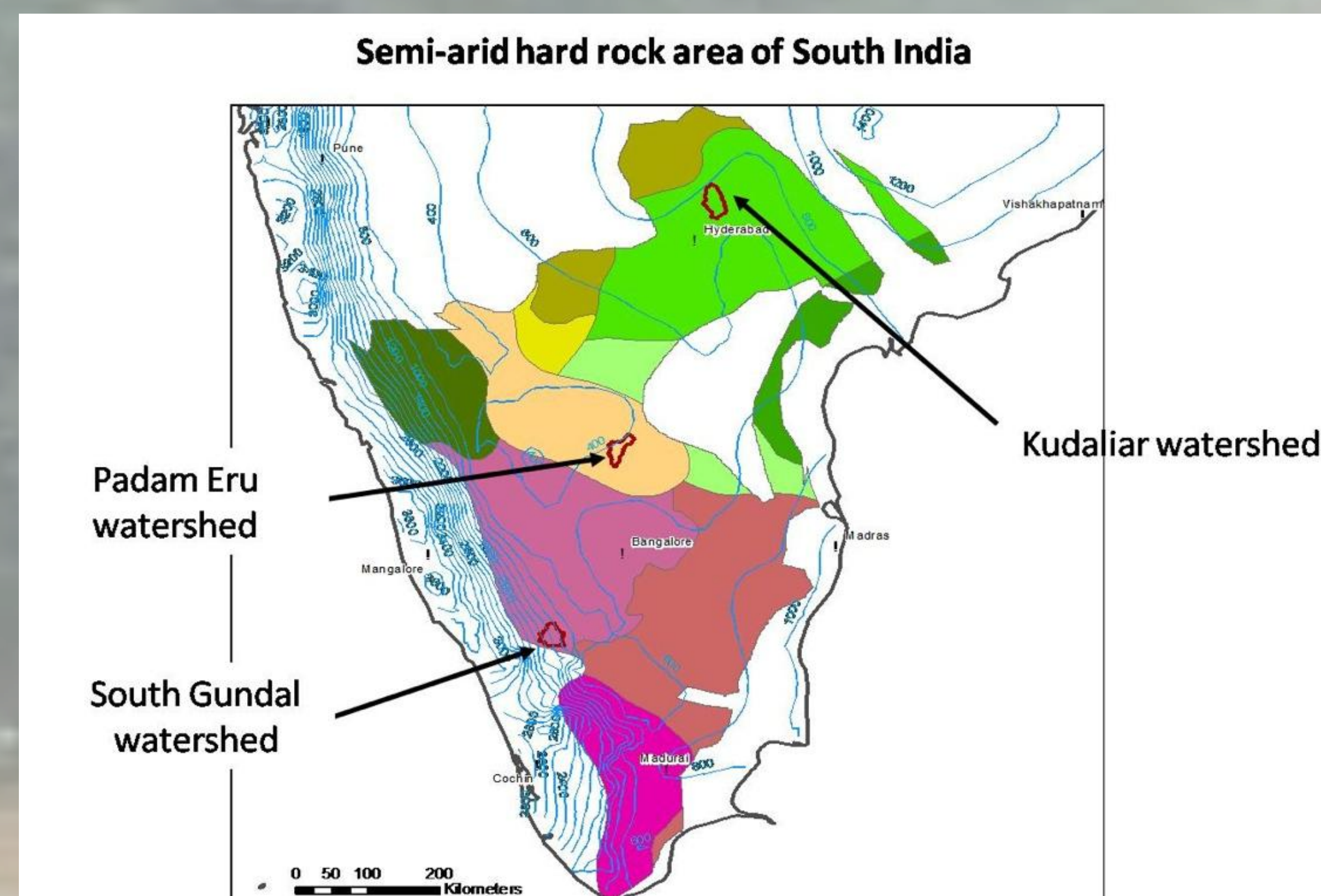


## Socio-economic Assessment of the rural Vulnerability of water users under stressors of global changes in the Hard rock area of South India

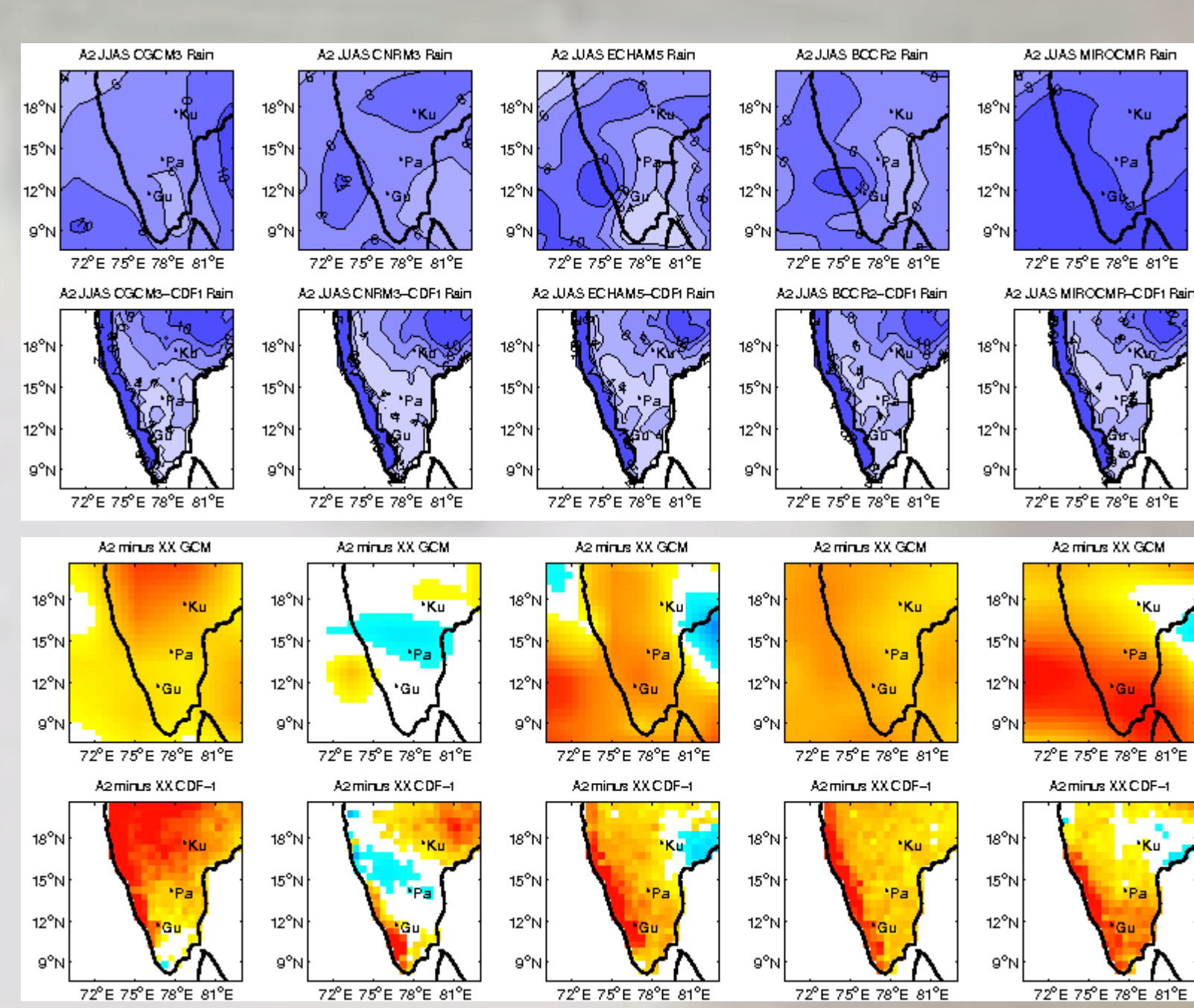
**Objectives:** The SHIVA-ANR project (2009-2013) aims at estimating the vulnerability of farmers to both climate and human changes by 2030 and 2050, assessing the impacts of vulnerability in terms of costs and/or benefits and evaluating the possibilities to modify rural vulnerability trends through adapted water management policies or initiatives.



The project focuses on hard rocks area of South-India as in this geological context, both surface and groundwater resources are naturally limited. It also targets farmers' population as they are the main water users of the area and they rely exclusively on groundwater for irrigation. By the end, the area covers the semi-arid zone of South-India, with a rainfall gradient from 1100 mm to 600 mm.

### Method and Results:

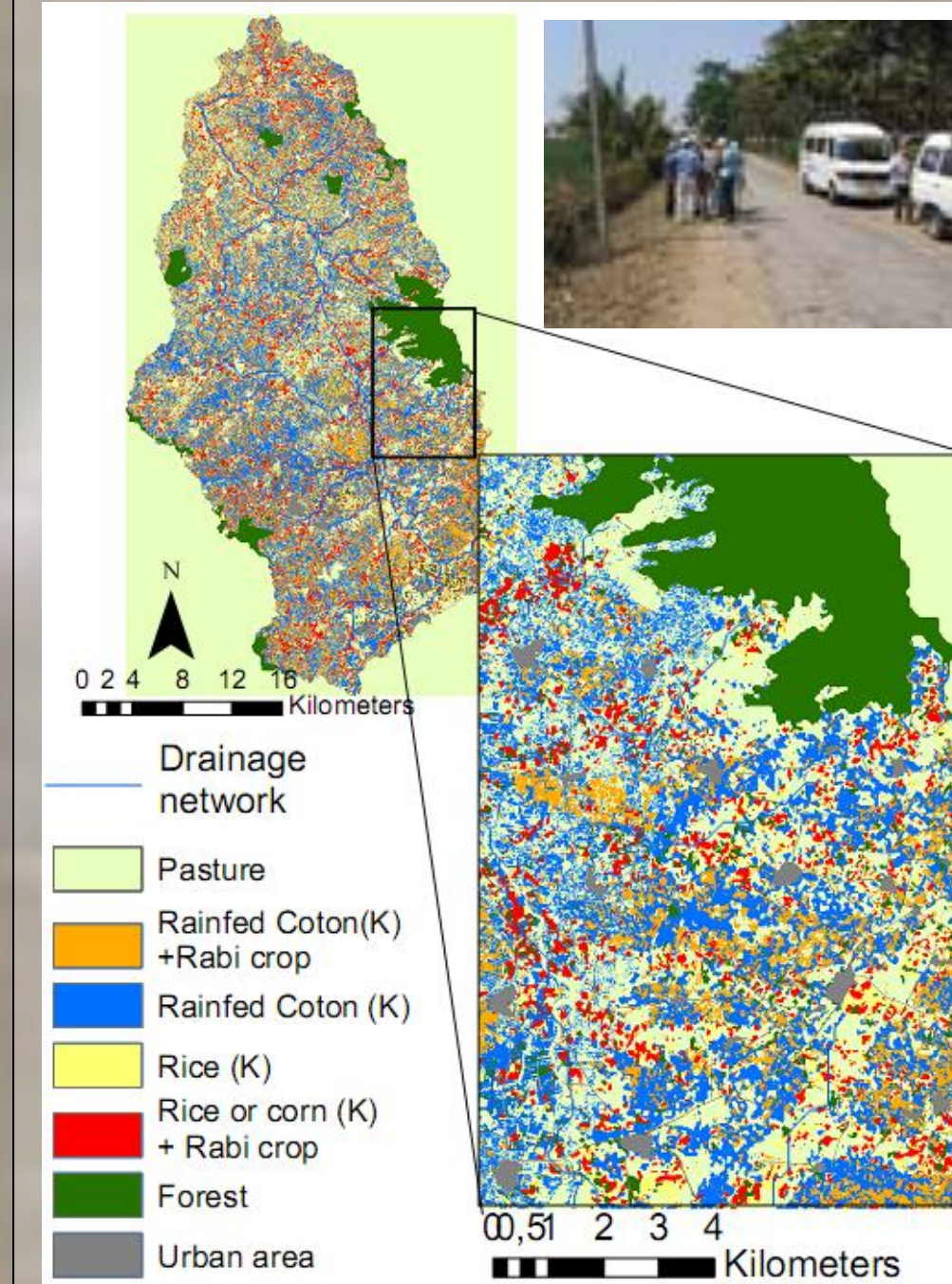
#### Climate change downscaling:



Mean June to September original and downscaled (2nd line) GCMs rainfall for the A2 scenario (2046-2065) over southern India.

Original and downscaled (2nd line) GCMs monsoon rainfall differences between future and past for the A2 scenario (2046-2065) over southern India.

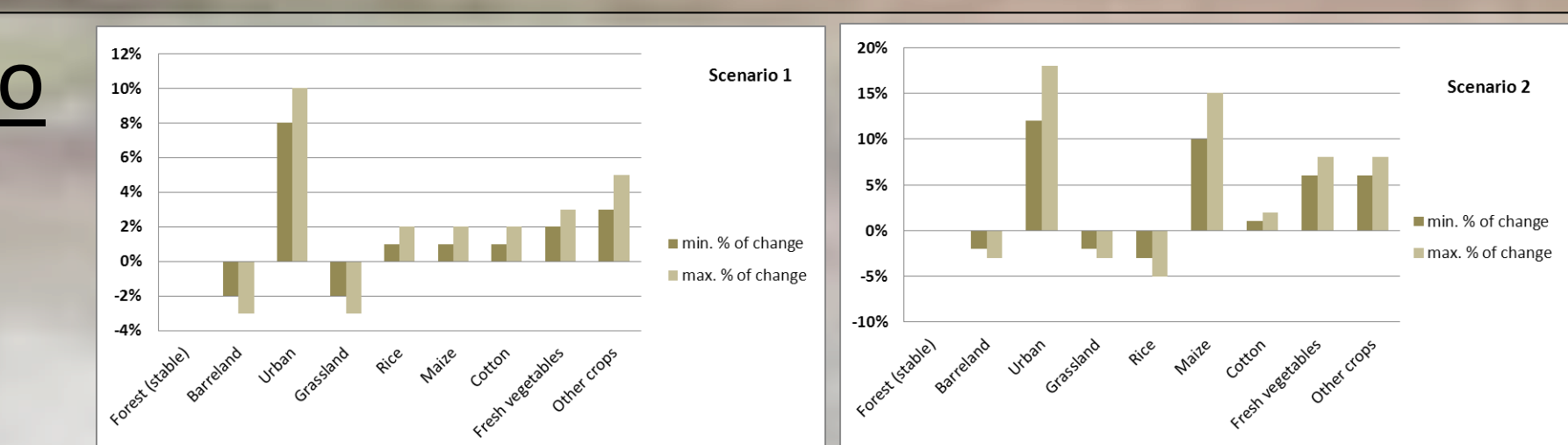
#### Landuse/landcover classification



Field surveys carried out for 2 seasons  
Land use map for 2009-2010

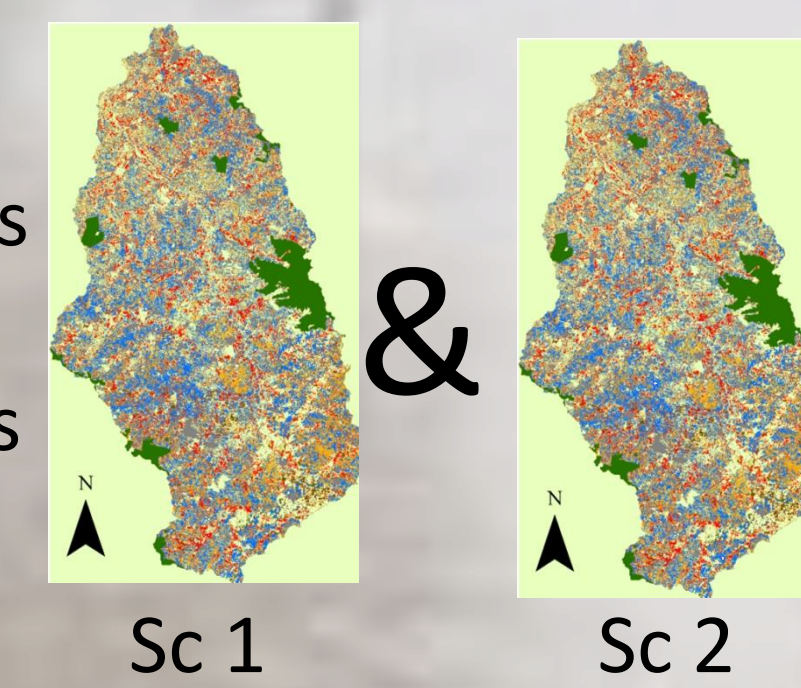
#### Scenario

Building rules of land use evolution



Sc 1: Rural basis (% of LU change 2010-2030) Sc 2: Urban attraction (% of LU change 2010-2030)

Building new maps from the nowadays LU



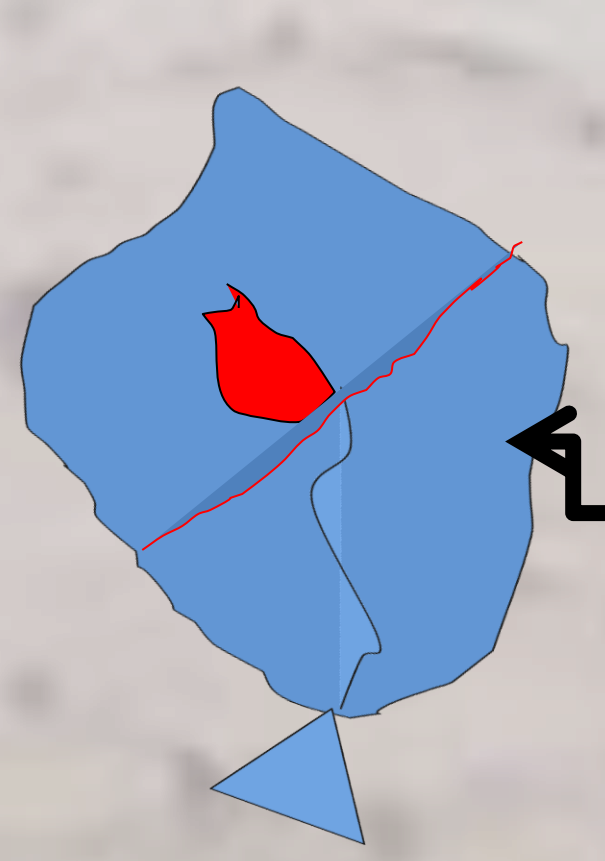
**LandSFACTS**  
LANdscape Scale Functional Allocation of Crops Temporally and Spatially (The Macaulay land use research institute)  
Crop reallocation under scenario constrains

#### Agro-Hydrological modeling:

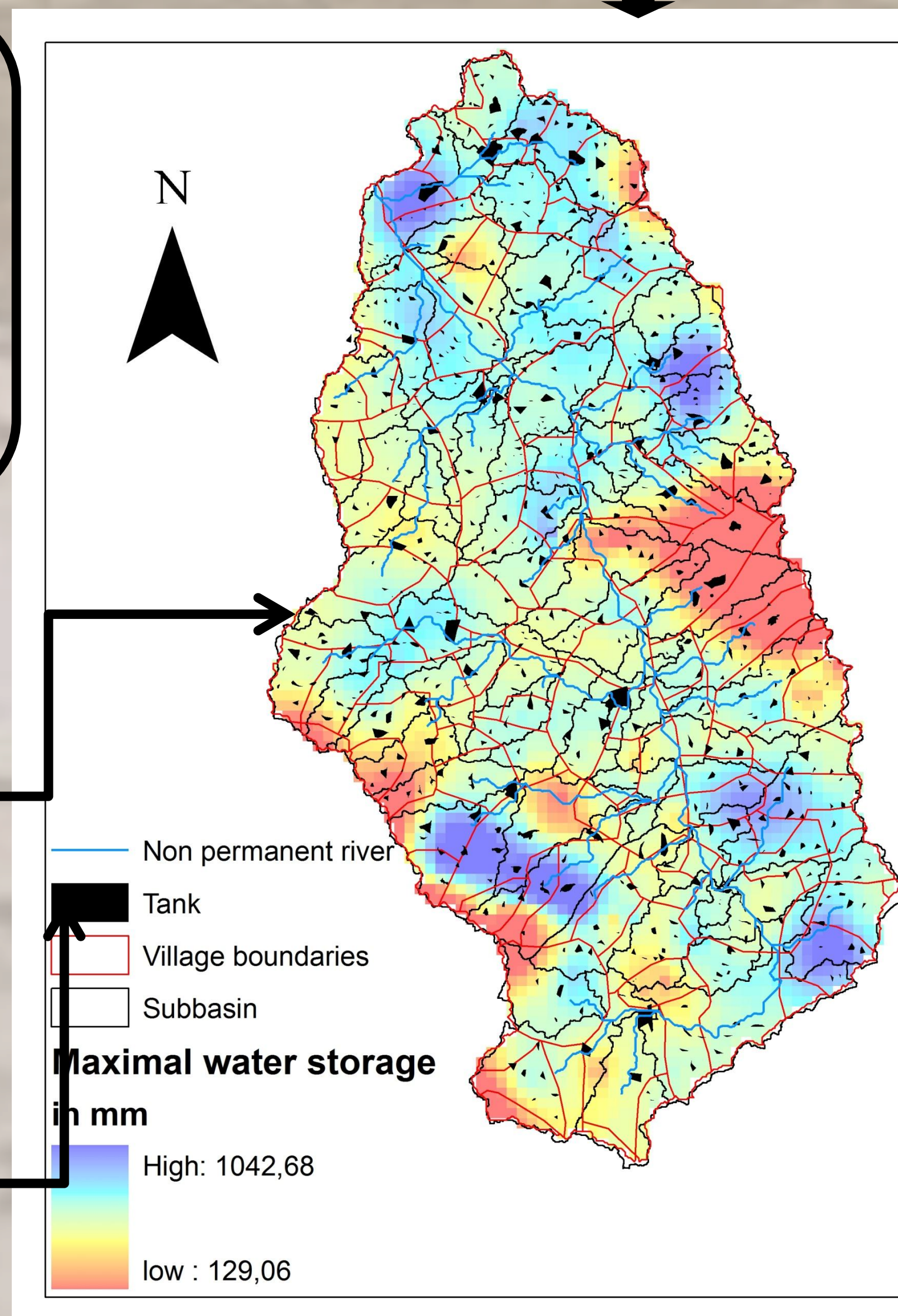
##### Hydro-geological survey

- 322 Dugwells, 30 Borewells with resistivity logging
- ✓ Saprilitic thickness
- ✓ Fissured layer thickness
- ✓ Water level recorded in 200 bore well (nov09, June 2010)
- Spatial potential GW storage

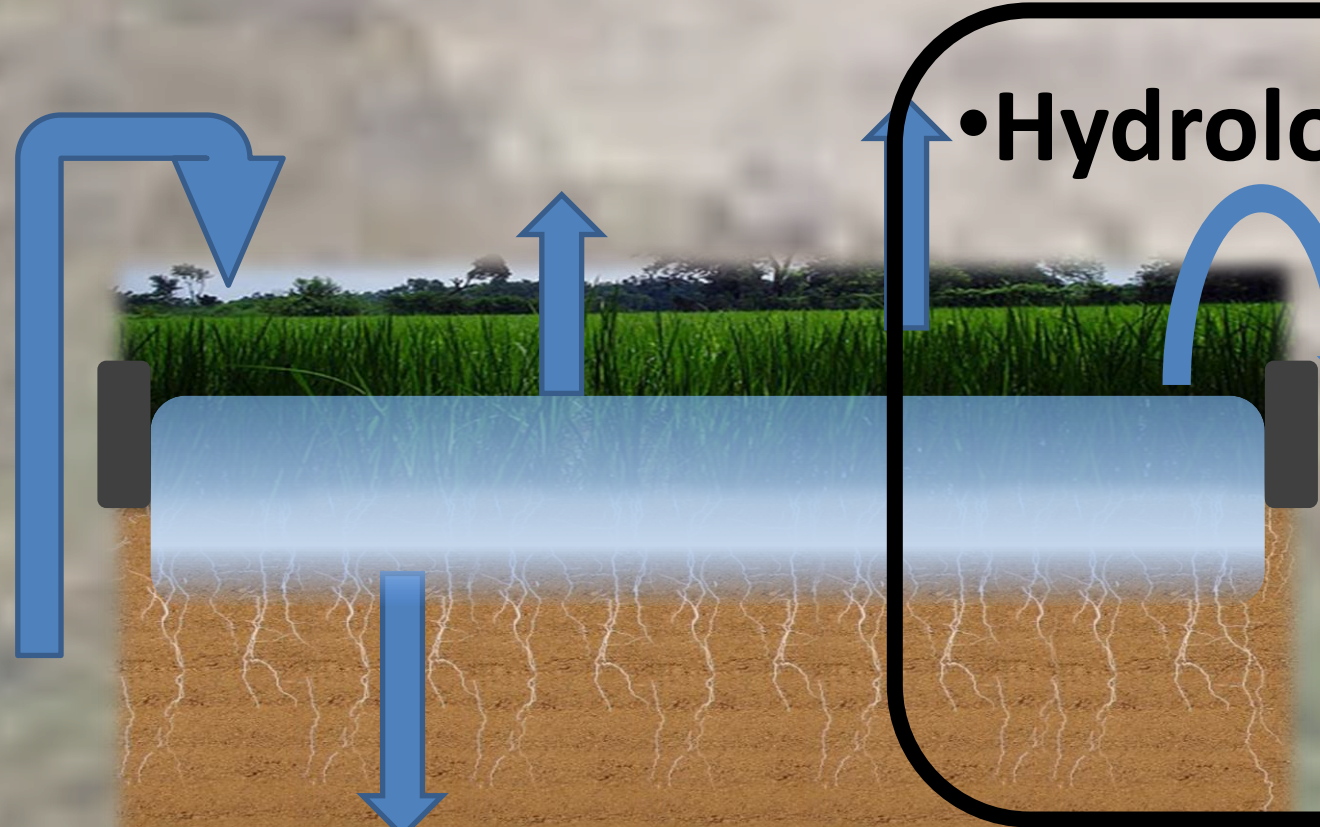
##### Soil Water Assessment Tool



- Groundwater Storage capacity Sub-basin scale
- Hydrological Response Unit Crop succession + soil type Village scale
- Reservoir
- ∑ surface of tank in sub-basin Water Harvesting System



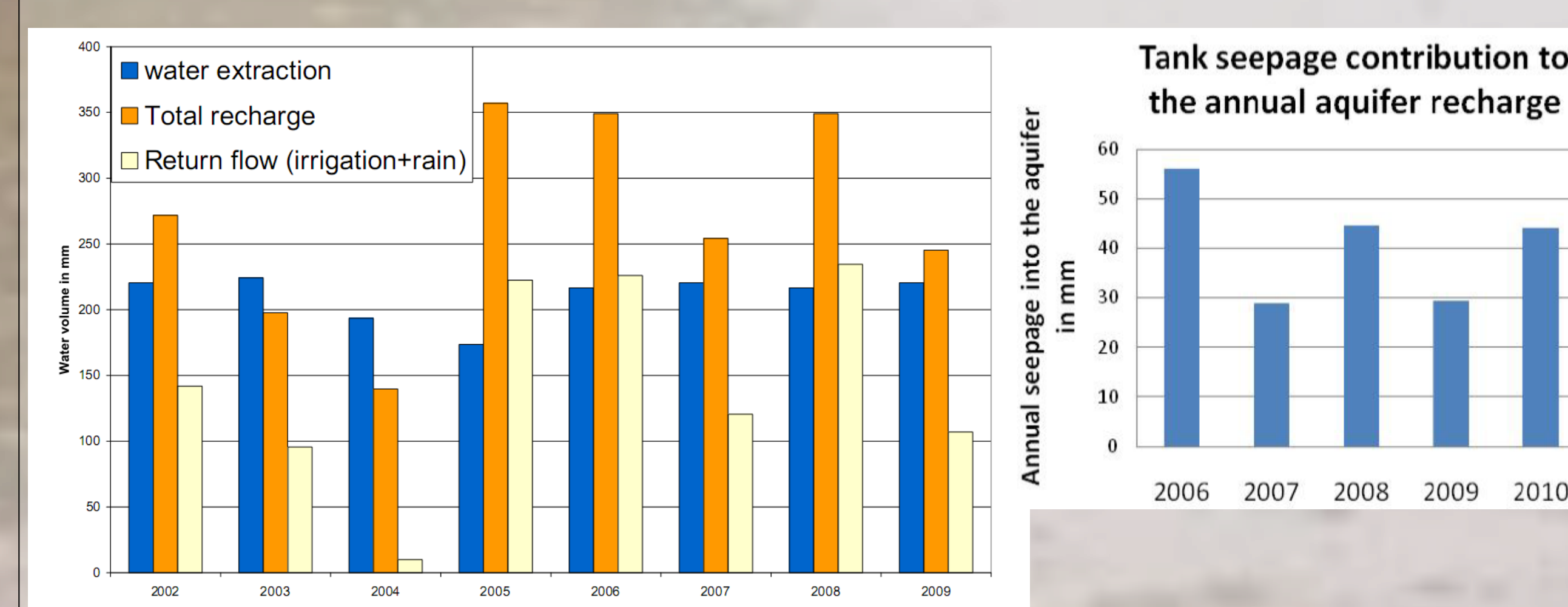
Irrigated HRU water budget under climate variability is calibrated on field observations and literature estimates.



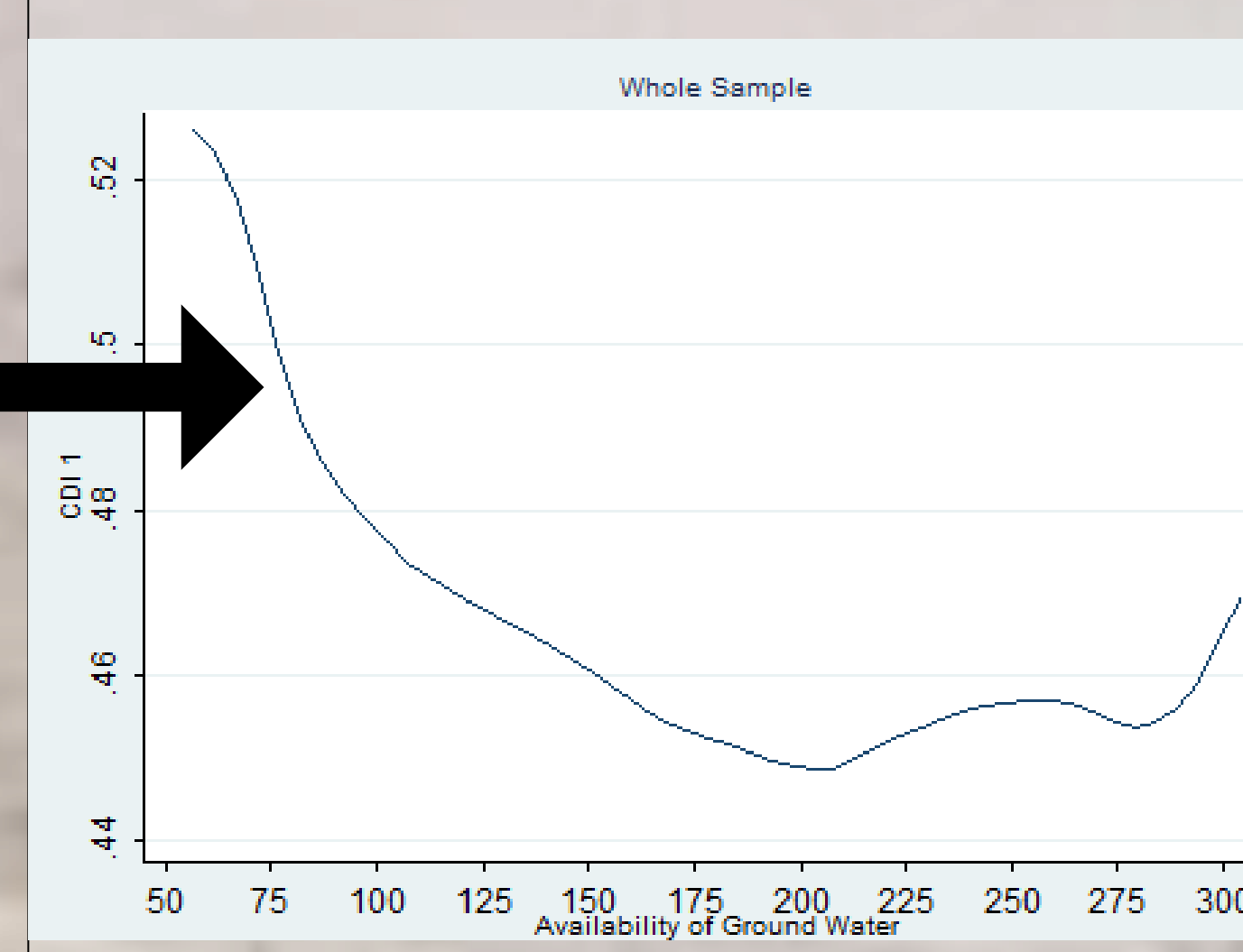
##### Hydrology

- No permanent river, monsoon runoff is:
- ✓ Stored in tanks
- ✓ Cascading from upstream to downstream tanks
- ✓ Discharged at the outlet as overflow
- Water harvesting system

#### Water budget under nowadays water uses:



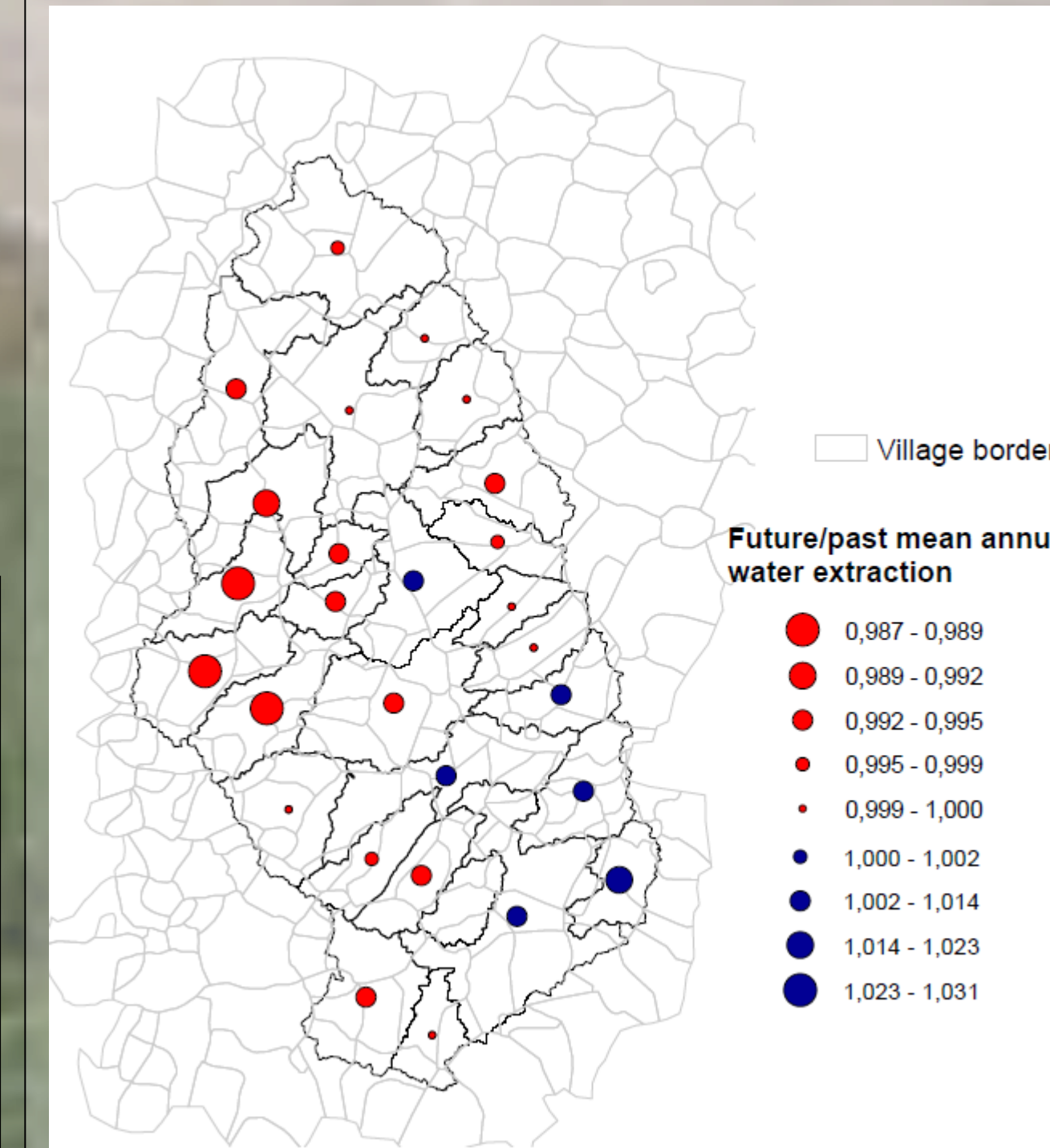
Annual groundwater budget against climate variability and water extractions



**Herfindhal Index:**  
 $H = \sum P_i^2$  where  
 $P_i = A_i / \sum A_i$ ;  $A_i$  area under  $i^{th}$  crop. Crop diversification is measured by (1-H).

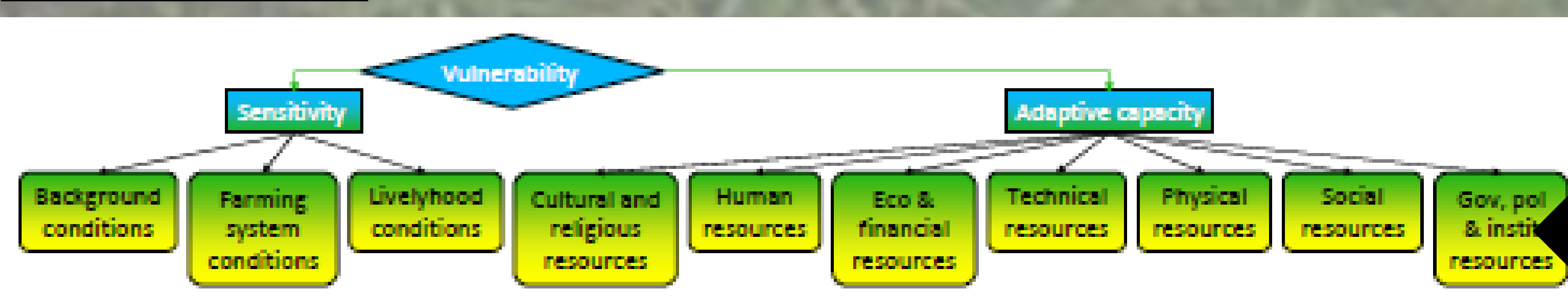
Crop diversification decreases with growing groundwater availability

#### Global changes impacts on water extractions:



Future climatic extremes frequency and amplitude will cause worst limitations of pumping in some areas. From a homogeneous Climate change, Groundwater extraction shows spatial opposite trends: from an increase to a decrease by around 20mm/year of the local annual extraction. Vulnerable areas to Climate change are identified in term of irrigation apportionment.

#### Vulnerability index:



Farmers' vulnerability to global change in South-India is described through 63 components characterizing farmers' sensitivity and adaptation capacity to global change. They are organized into a hierarchical matrix. Local experts (government, NGOs, research areas) carried out a weighting procedure through pair wise comparisons according to Analytic Hierarchy Process. A vulnerability score is calculated for each situation.

#### AUTHORS:

Aulong S.1, Borne F.4, Bouzit M.1, Caballero Y.2, Chaudhuri B.5, Dazin F.6, Dewandel B.2, Dinis L.3, Ferrant, S.12, Galab S.7, Guerrin J.3, Himanshu5, Ladouche B.2, Maire E.8,9, Maréchal J.C.2,9,12, Muthusankar G.4, Perrin J.2,3, Prudhvikar Reddy P.7, Ramesh BR.4, Sannier, C.6, Sekhar M.9,10, Shakeel A. 3,11, Vigaud N. 2

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