

# Water Poverty Analysis

## IGB Basin Focal project

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## IGB Riparian countries

- 1.3 billion people in IGB riparian countries in 2000
  - 29% or 380 million are poor
- 72% or 942 million in rural areas in 2000
  - 36% or 340 million are poor

## IGB

- 605 million live in IGB in 2000
    - 32% or 191 million are poor
  - 75% or 454 million in rural areas in 2000
    - 33% or 151 million are poor
- IGB boundary  
Country boundaries

# Water-Poverty Analysis Setting the Context

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**In IGB - 150 million rural population are poor!**

- Many depends their livelihood on agriculture
- Natural resources, especially renewable water resources are under tremendous pressure
- Droughts and floods are recurrent phenomenon
- Spatial variation of poverty is high
- Spatial variation of natural resources is also high
- What is the extent of water-land-poverty nexus in the IGB?

## Water-Land-Poverty Nexus in the IGB

- Extent of adequate access to land and water resources helped poverty alleviation?
- Extent of inadequate access to water and land are constraints to poverty alleviation?
- Extent of degradation of natural resource base due to extensive irrigated agriculture, causes poverty?
- The coping mechanisms in places under such adversity?

## Objectives of Water-Poverty Analysis in the IGB Basin

### Focal project:

- Map sub-national poverty in the IGB
- Identify the determinants of poverty, with a special focus on water, land and poverty nexus, and
- Identify the coping mechanisms of the people living under poor conditions of water and land.

## Agreed outputs and progress

- Literature synthesis (Completed. Upali A.)
- Poverty mapping (In progress)
  - Small area estimation method (R. Srinivasulu)
  - Non-parametric density estimation method (Upali A.)
- Analysis of water-land-environment poverty nexus and coping mechanisms in the IGB (In progress)
  - District level (Upali A.)
  - Household level (Stefanos Xenarios)



# Water-Land-Poverty Nexus in the IGB

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# Water-Land-Poverty Nexus in the IGB Literature Synthesis

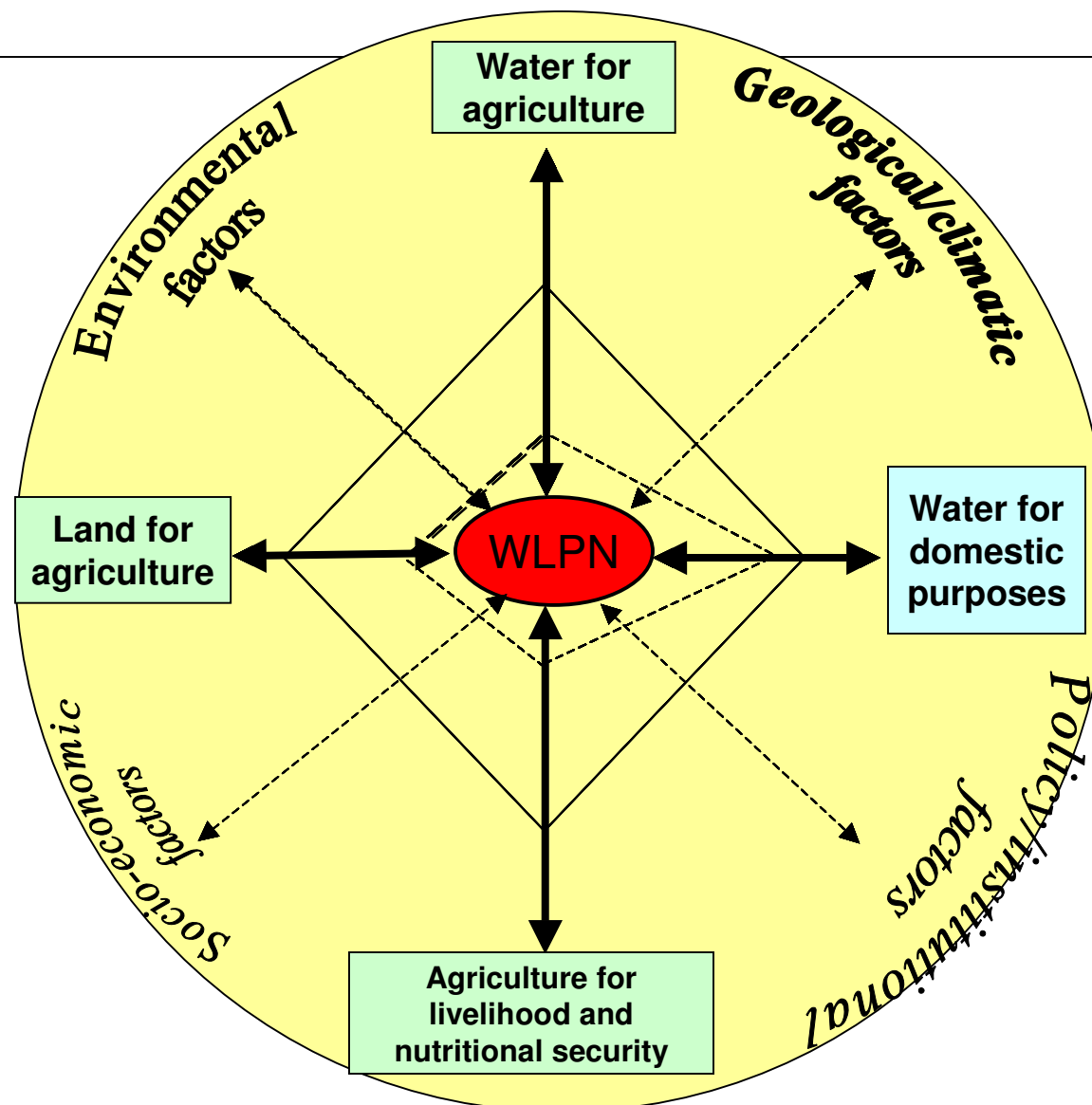
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## Outline

- Framework
- Spatial variation of poverty in the IGB
- Linkages of agriculture growth, water and land with poverty
- Econometric analysis of the water-land-poverty nexus
- Future activities



# Water-Poverty Analysis- Framework



# Water-Land-Poverty Nexus in the IGB Literature Synthesis

## Agriculture and rural poverty

To what extent does agriculture  
contributes to income?

Where are the potential locations?

## Water for agriculture and poverty

What are the linkages of water and  
rural poverty?

- Availability?
- Access?
- Quality?

## Land for agriculture and poverty

What are the linkages of land  
and rural poverty?

- Access (Tenure)?
- Availability (Size)?
- Quality (Type/soil)?

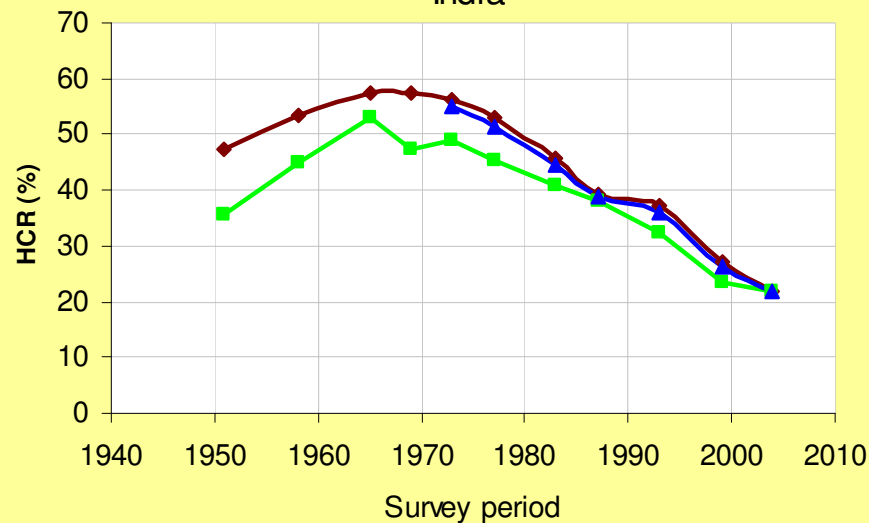
## Water for domestic purposes

What are the linkages of drinking  
water/health and rural poverty?

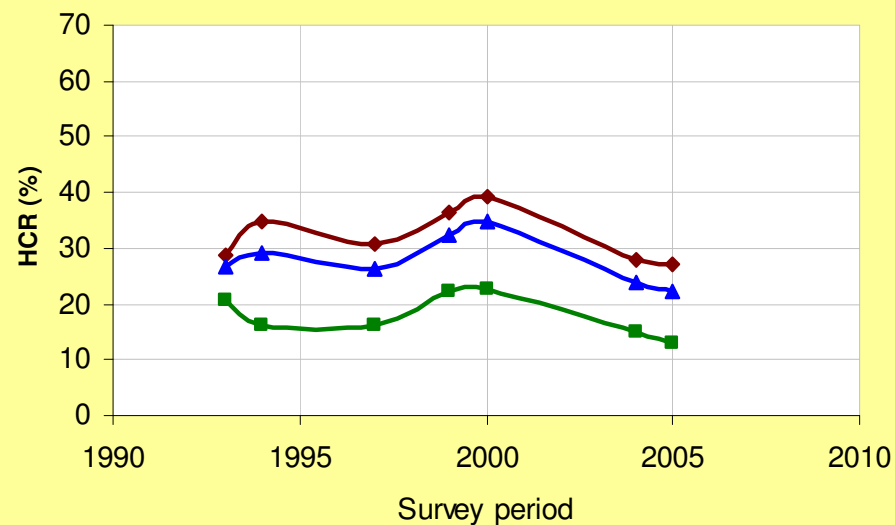
- Access?
- Availability?
- Quality?

# Trends of poverty

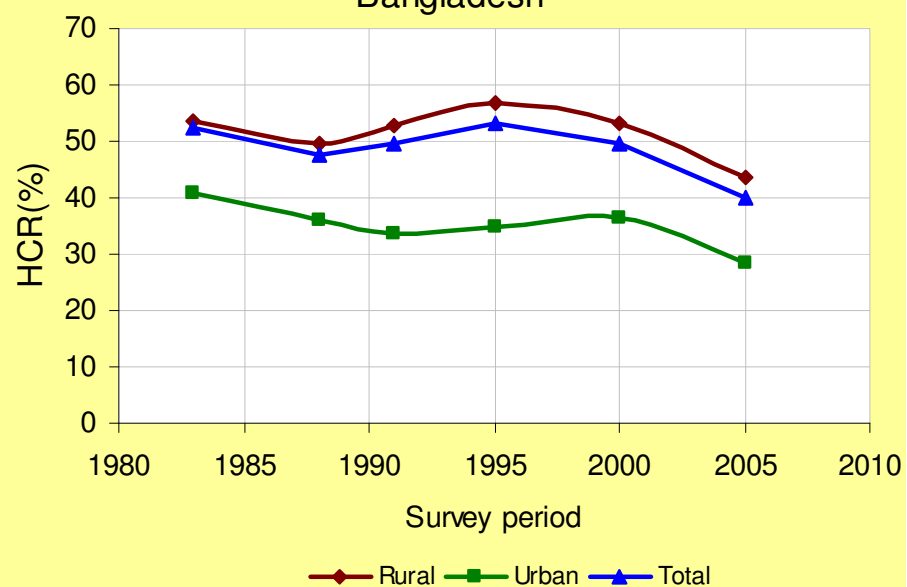
India



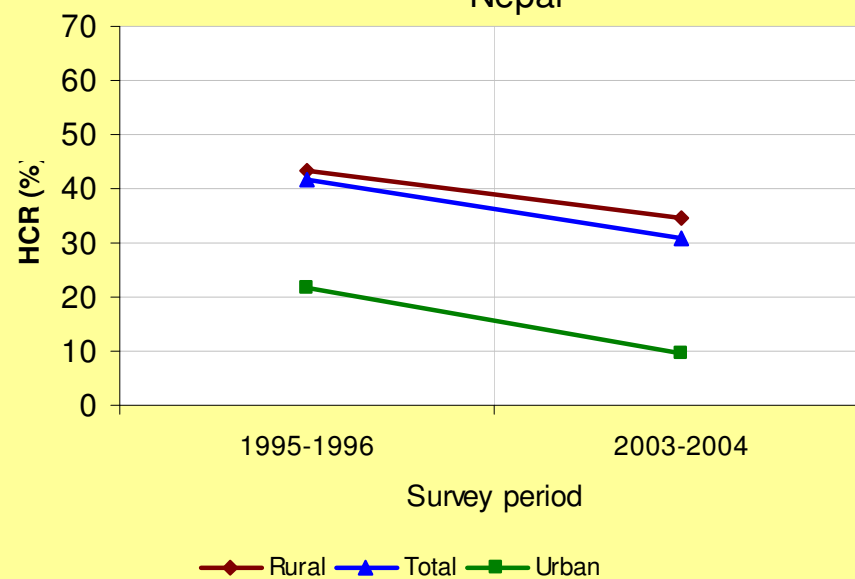
Pakistan



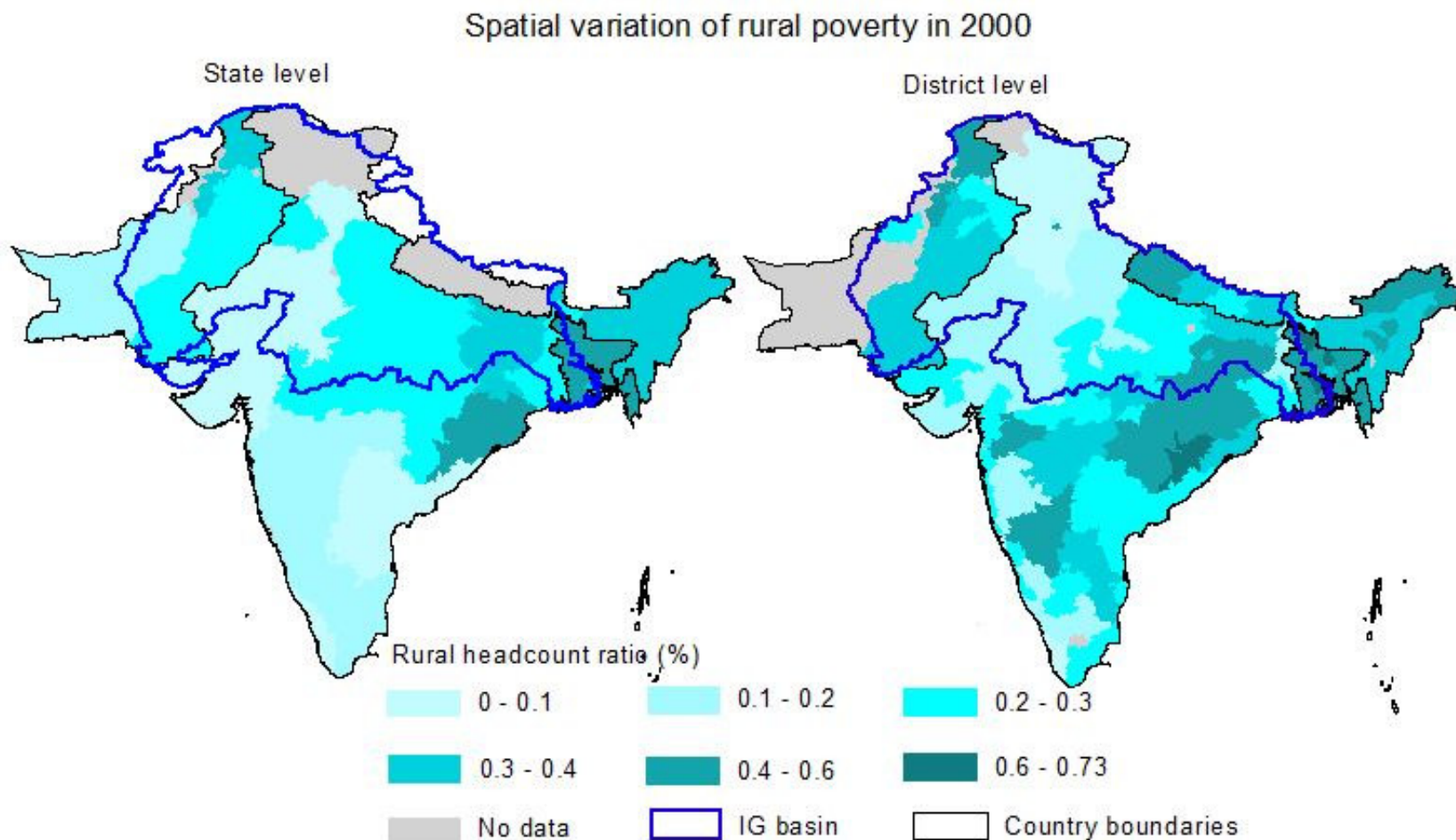
Bangladesh



Nepal

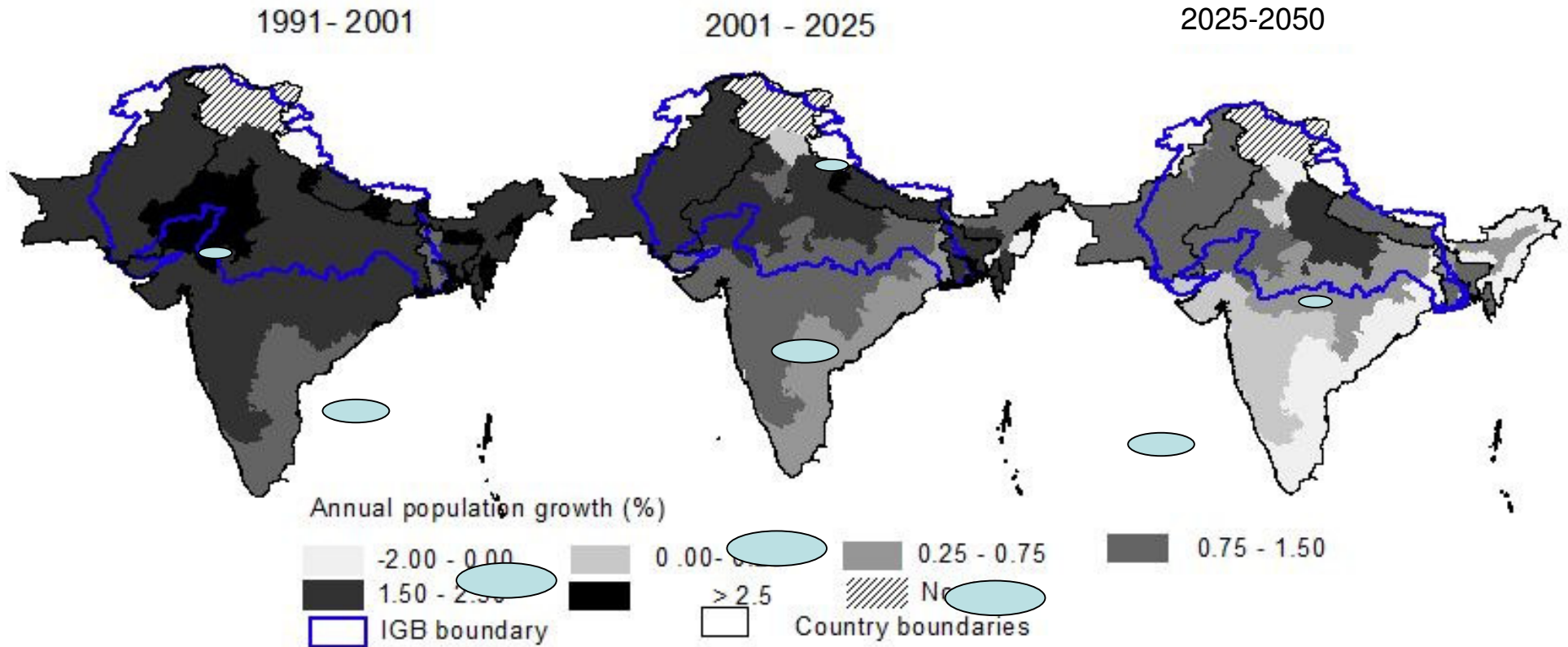


# Spatial variation of rural poverty



- Low poverty in the north to north-west
- High poverty in the east to north-east and west
- IGB has the both the least and the highest poverty areas in south Asia

# Spatial variation of population growth in IGB riparian countries



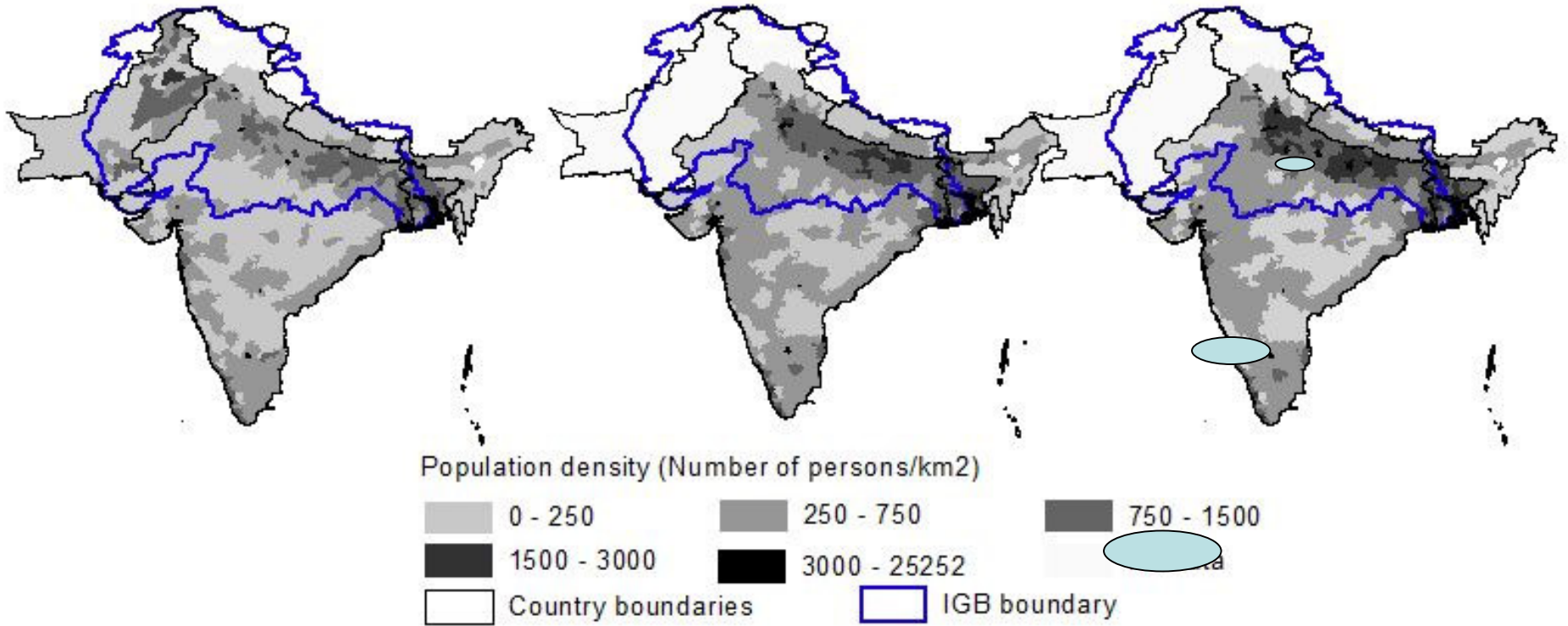
IGB has one of highest population growth in Asia

## Population density

2001

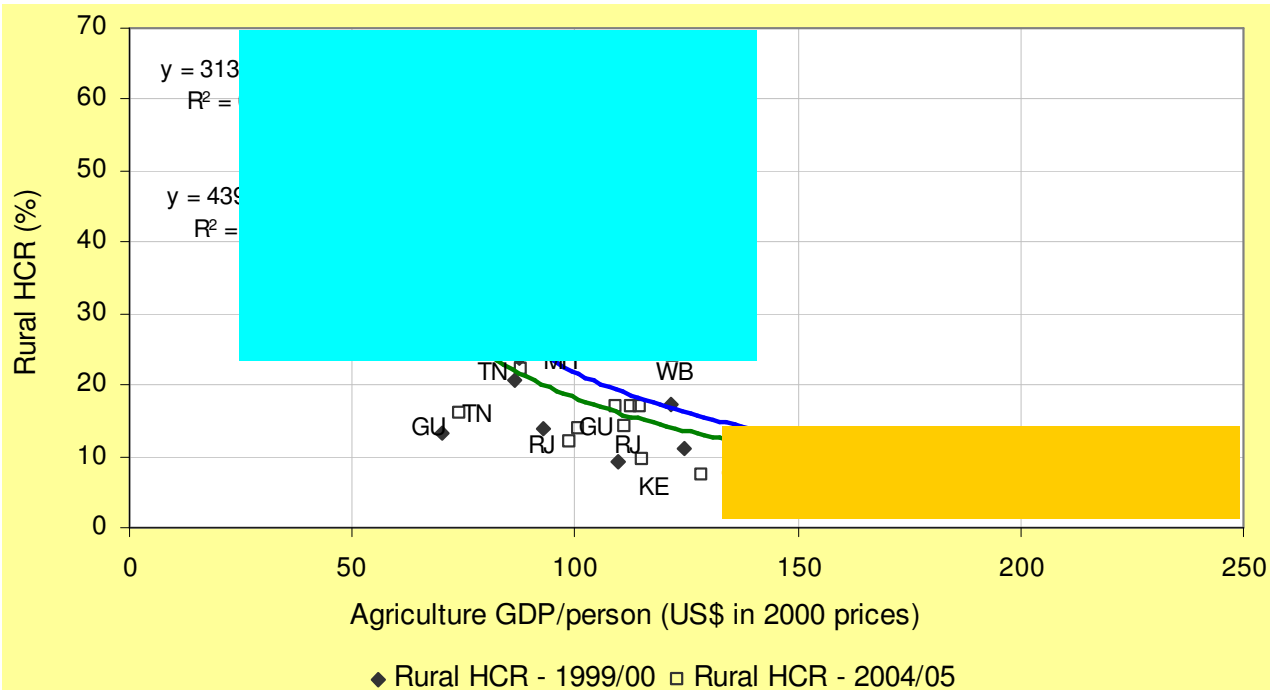
2025

2050

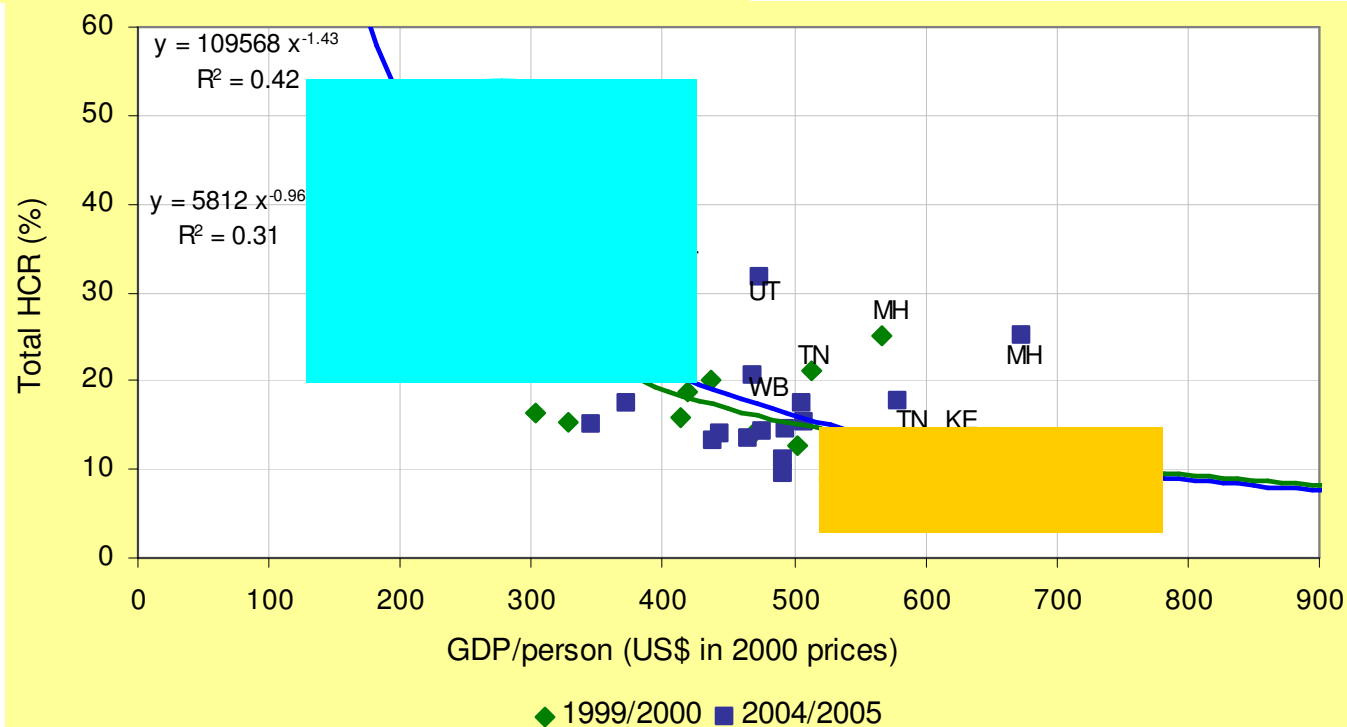


IGB has the most densely populated areas in south Asia



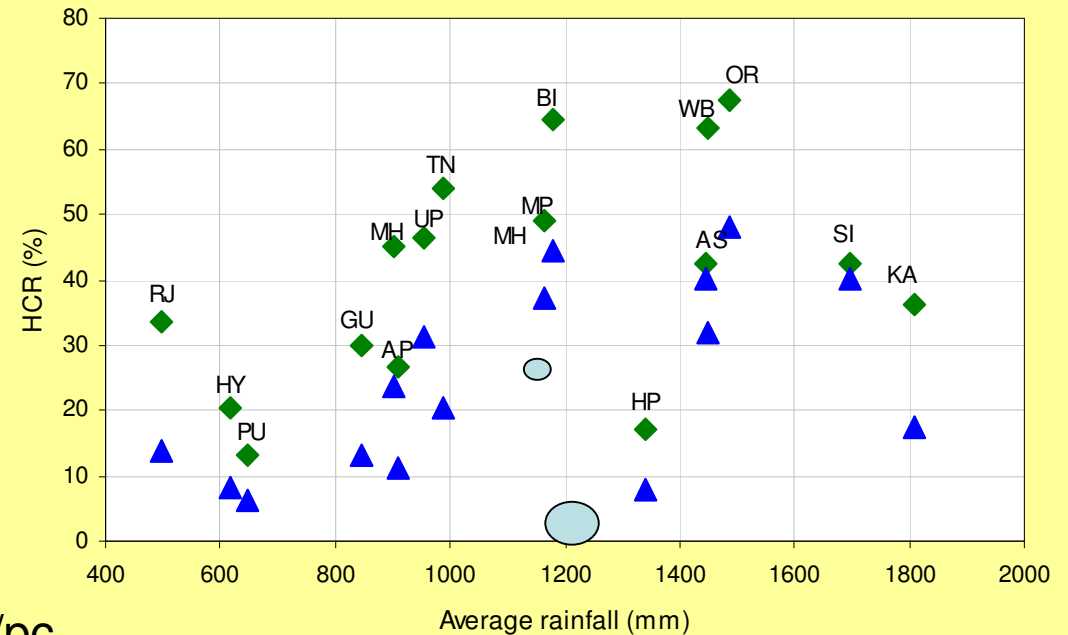


Hypotheses 1:  
Strong potential for  
poverty alleviation in  
the IGB with agriculture  
growth



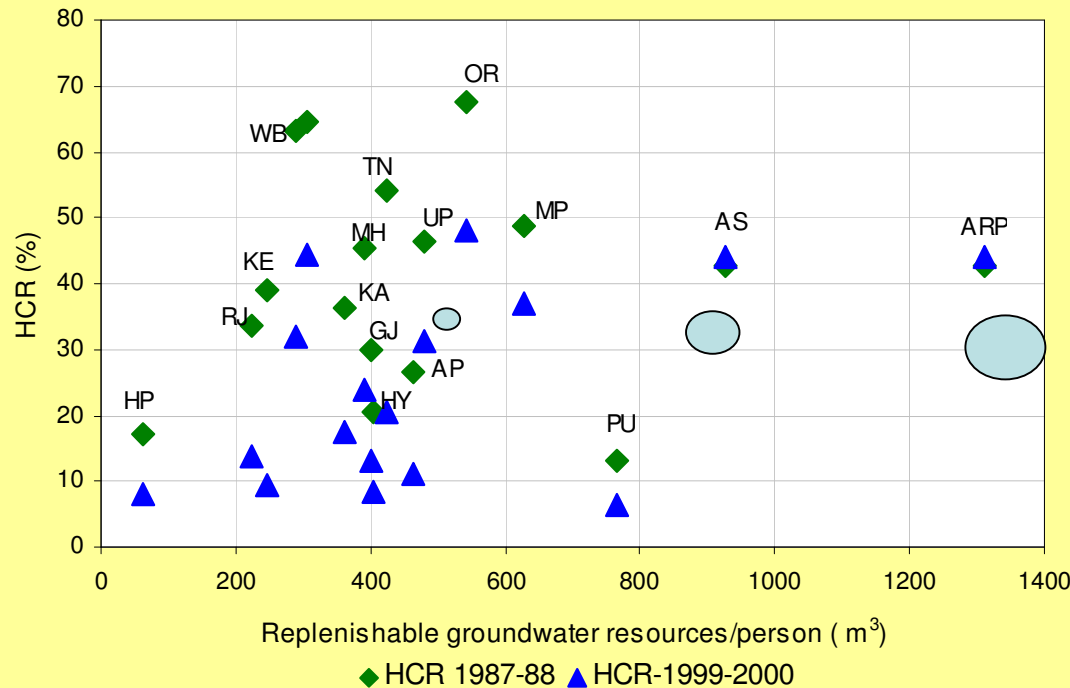
Hypotheses 2:  
Water is still a strong  
determinant in rural poverty  
alleviation

Rural HCR vs Ranfall



◆ HCR 1987-88 ▲ HCR-1999-2000

Rural HCR vs Groundwater availability/pc



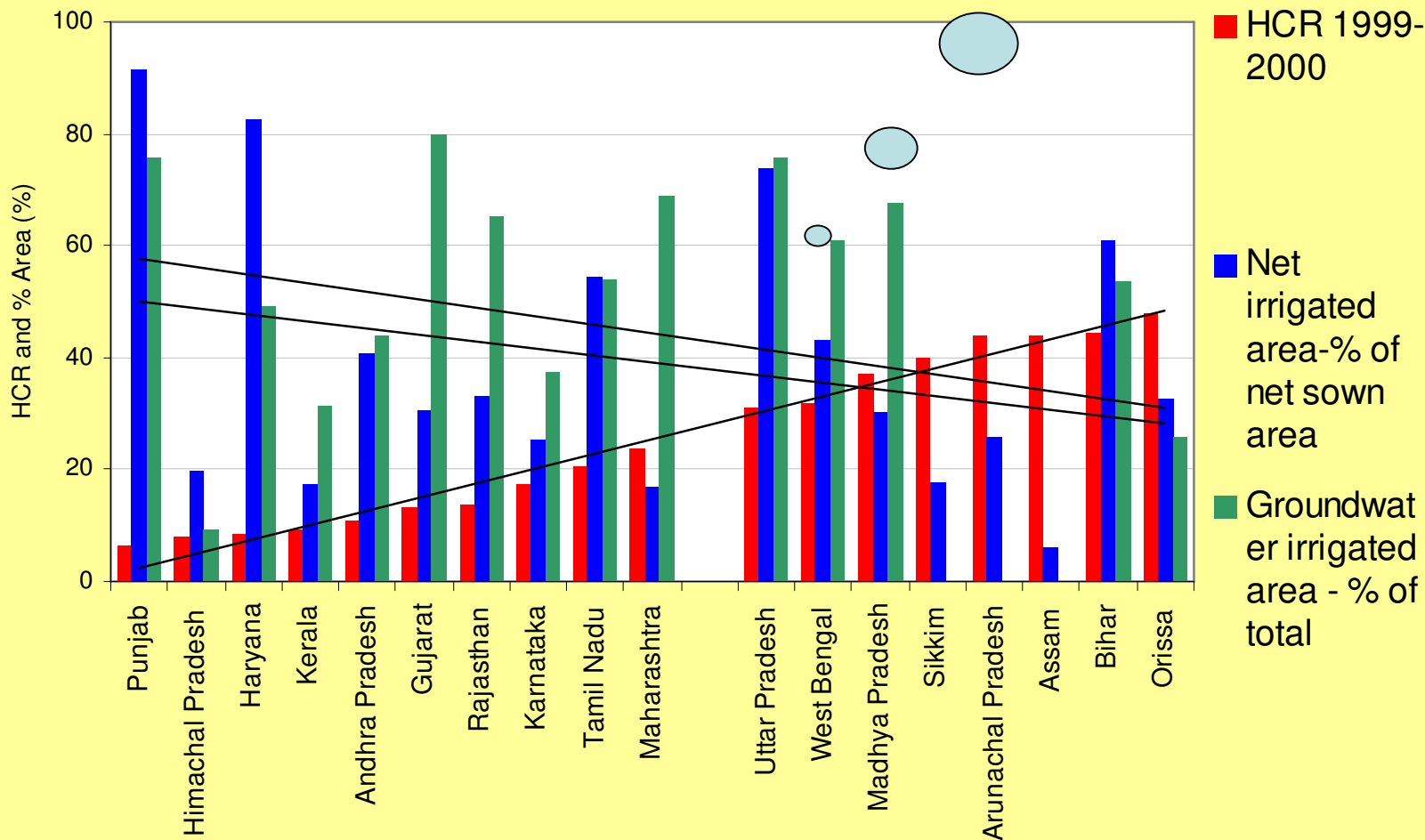
◆ HCR 1987-88 ▲ HCR-1999-2000

No  
relationship  
with water  
availability

Hypotheses 2:  
Water is still a strong  
determinant in rural poverty  
alleviation

But rural  
poverty has a  
strong linkage  
with access to  
irrigation

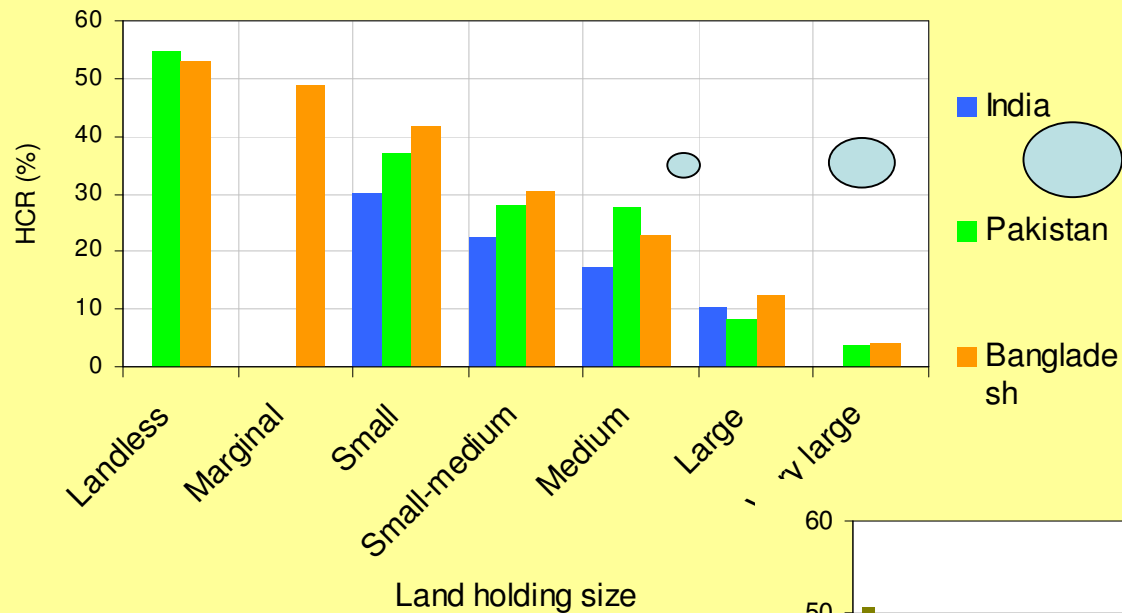
## Rural HCR vs access to irrigation



### Hypotheses 3:

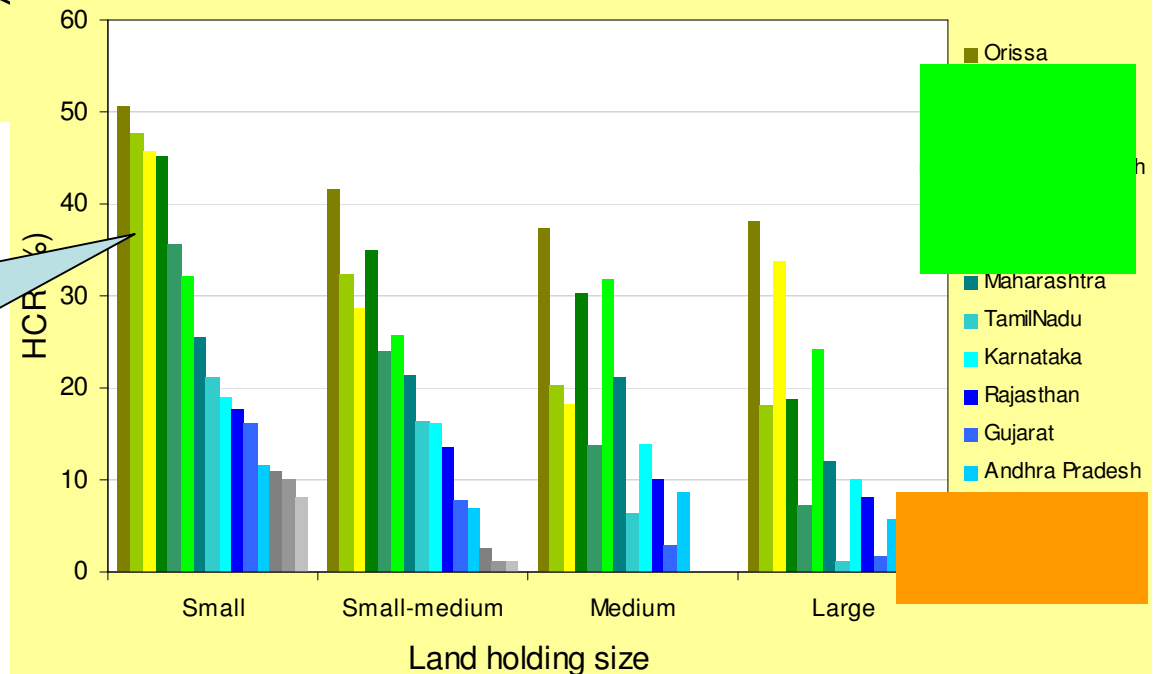
Access to land is still a strong determinant in rural poverty alleviation

#### Rural HCR vs land holding size



Rural poverty has strong linkages with access to Land and land holding size

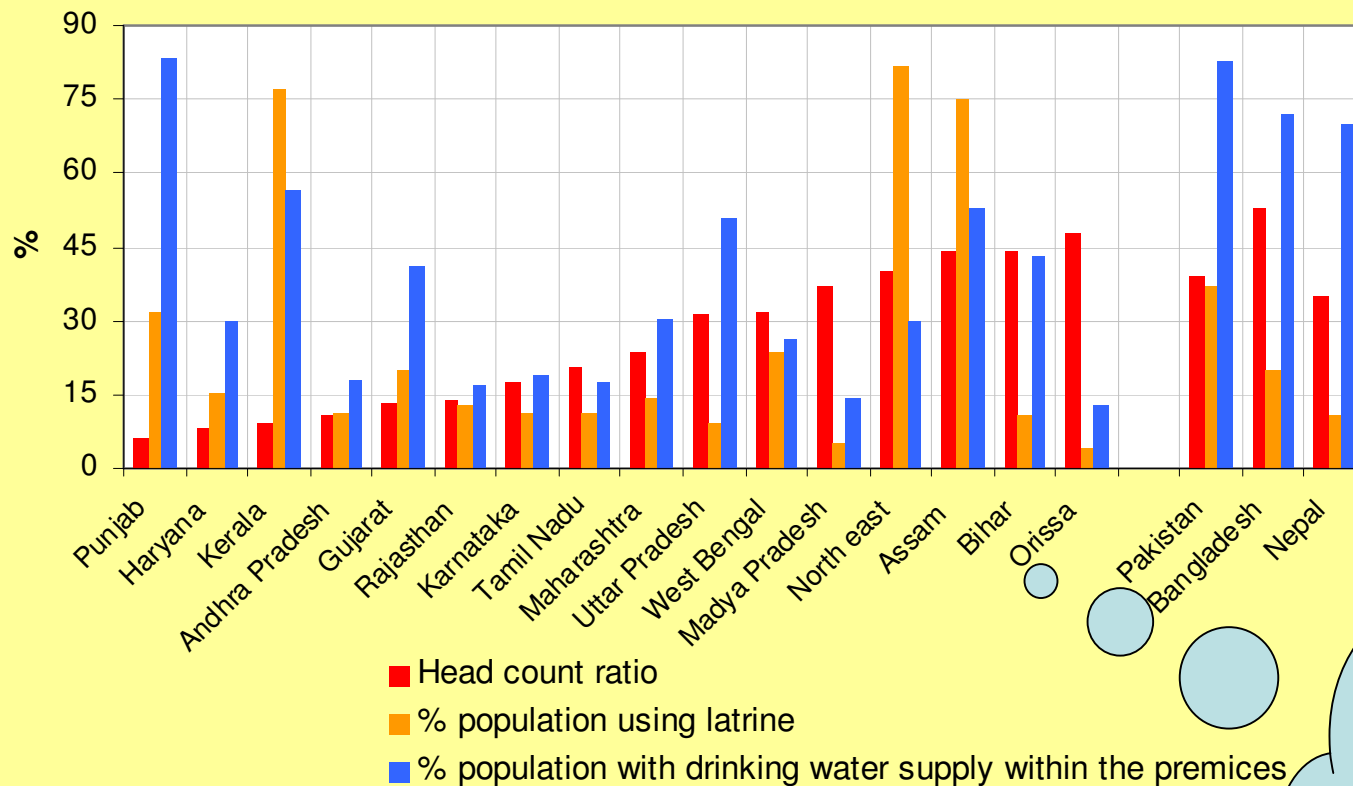
Strong linkage in the poor parts of the IGB



## Hypotheses 4:

Access to domestic water supply is a cause and effect of poverty

### HCR vs access to safe sanitation and drinking water supply



•No apparent linkages

•Data are too aggregate to find any relationship

## Dependent variable- Ln (Rural head count ratio)

	Coefficient	Standard Error
Constant	-1.60	1.3
Ln (Water productivity)	-3.42	0.5*
(Ln (Water productivity)) <sup>2</sup>	-1.52	0.3*
Ln (% CWU from irrigation)	-0.17	0.08*
Ln (% of groundwater irri. area)	-0.18	0.1*
Ln (Net sown area/person)	-0.19	0.09*
Ln (% rural population)	0.58	0.3*
R <sup>2</sup>	75%	

## Determinants of rural poverty

1. Water productivity,
2. irrigation quantity,
3. Reliability of irrigation,
4. Land holding size,
5. agriculture dependent population



# End of the Literature Review

Thank you

# Poverty Mapping of the IGB Using Small Area Estimation

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# Issue

- Can we estimate poverty mapping at district level?  
Yes! But it requires more time and sufficient econometric model
- Do we have sufficient data sources?  
Yes!
- What are the data sources are available? and time period?  
NSS, Census and other secondary sources
- Is there any study?  
India - Bigman and Srinivasan (2002), N S Sastry (2003), Indira et al, (2002), Bigman & Deichmann, (2000), Dreze and Srinivasan (1996)
- What are the methodology has been adopted by the literature?  
Pooling Data from NSS and Census, Small Area Estimation (SAE), other secondary data set at regional level and Primary survey
- The present study's methodology and future plan

# Methodology Available

- Small Area Estimation (SAE)
- Pooling Data from Census, NSS, Agricultural Survey, Cost of Cultivation Survey and various Geographical Surveys (Bigman and Srinivasan, 2002)
- Pooling Data from Census and NSS
- Region-wise Analysis

# Small Area Estimation

- The term *small area* usually denote a small geographical area, such as a county, a province, an administrative area or a census division
- From a statistical point of view the small area is a *small domain*, that is a small subpopulation constituted by specific demographic and socioeconomic group of people, within a larger geographical areas
- Sample survey data provide effective reliable estimators of totals and means for large areas and domains. But it is recognized that the usual direct survey estimators performing statistics for a small area, have unacceptably large standard errors, due to the circumstance of small sample size in the area

# Small Area Estimation (SAE)

- The small area statistics are based on a collection of statistical methods that “borrow strength” from related or similar small areas through statistics models that connect variables of interest in small areas with vectors of supplementary data, such as demographic, behavioral, economic notices, coming from administrative, census and specific sample surveys records
- Small area efficient statistics provide, in addition of this, excellent statistics for local estimation of population, farms, and other characteristics of interest in post-censal years



# Type of Approaches

- The most commonly used techniques for small area estimation are the empirical Bayes (*EB*) procedures, the hierarchical Bayes (*HB*) and the empirical best linear unbiased prediction (*EBLUP*) procedures (Rao, 2003)
- Some utilization of this techniques in agricultural statistics are related to the implementation of satellite data, and, in general, of differently-oriented sample surveys in model-based frameworks
- There are two types of small area models that include random area-specific effects: in the first type, the basic area level model, connection through response and area specific auxiliary variables is established, because the limited availability at such type of data at unit level
- The second type are the unit level area models, in which element-specific auxiliary data are available for the population elements (Ghosh and Rao, 1994; Rao, 2002)

# Bigman and Srinivasan (2002) Model

- Step 1: Econometric Estimation of the Impact of district-specific characteristics based on the probability that the households residing in a given district are poor
- Step 2: predictions of the incidence of poverty in all the districts of the country based on the characteristics of these districts.
- Step 3: First validation of the prediction - predicted and actual value from NSS
- Step 4: Ranking and Grouping
- Step 5: second validation of the prediction: comparison of predicted values and actual values