

# Agriculture Strategy Refresh

## South Asia Workstream

### Appendix

November 24, 2010

BILL & MELINDA  
GATES *foundation*

# Appendix

- **South Asia**

- India

- Bangladesh

# South Asia is defined as 8 countries according to the World Bank

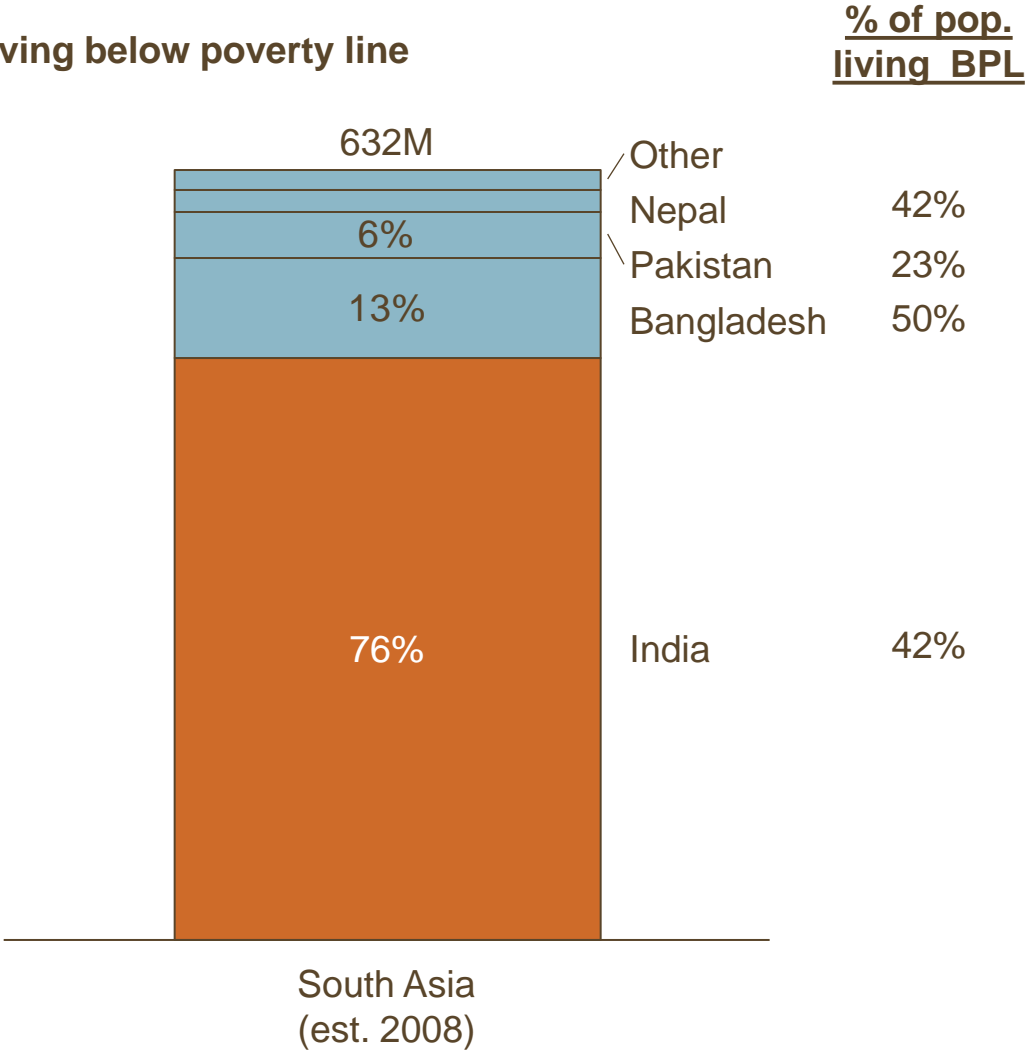


## Description

- According to the World Bank, consists of 8 countries:
  - Afghanistan
  - Bhutan
  - Bangladesh
  - India
  - Maldives
  - Nepal
  - Pakistan
  - Sri Lanka
- 1.9 million sq miles
- 1.6 billion people
- Average GDP per capita in the region: \$750

# Poverty in South Asia

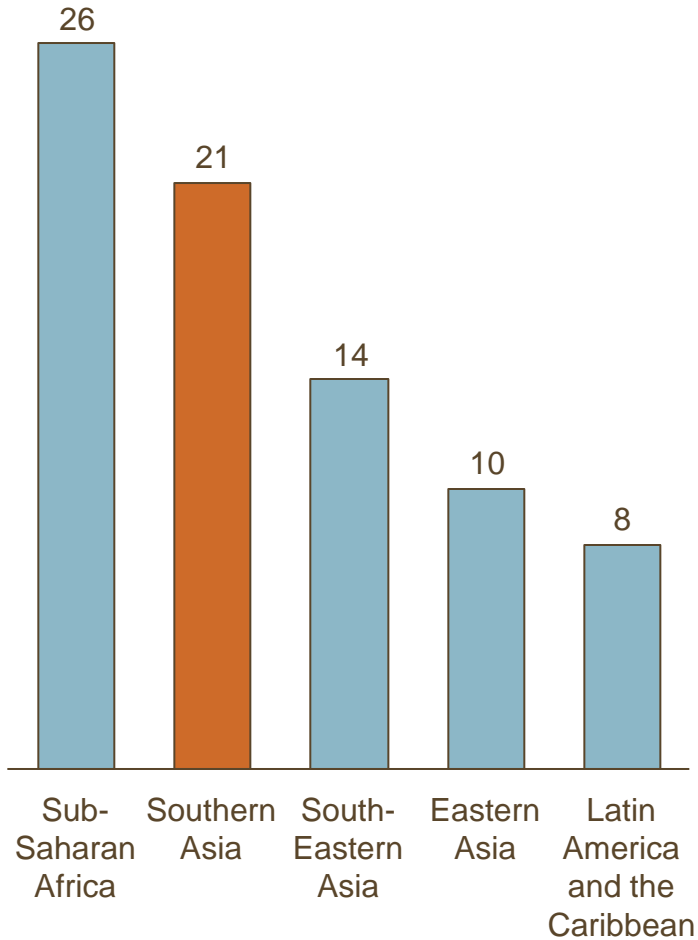
Population living below poverty line



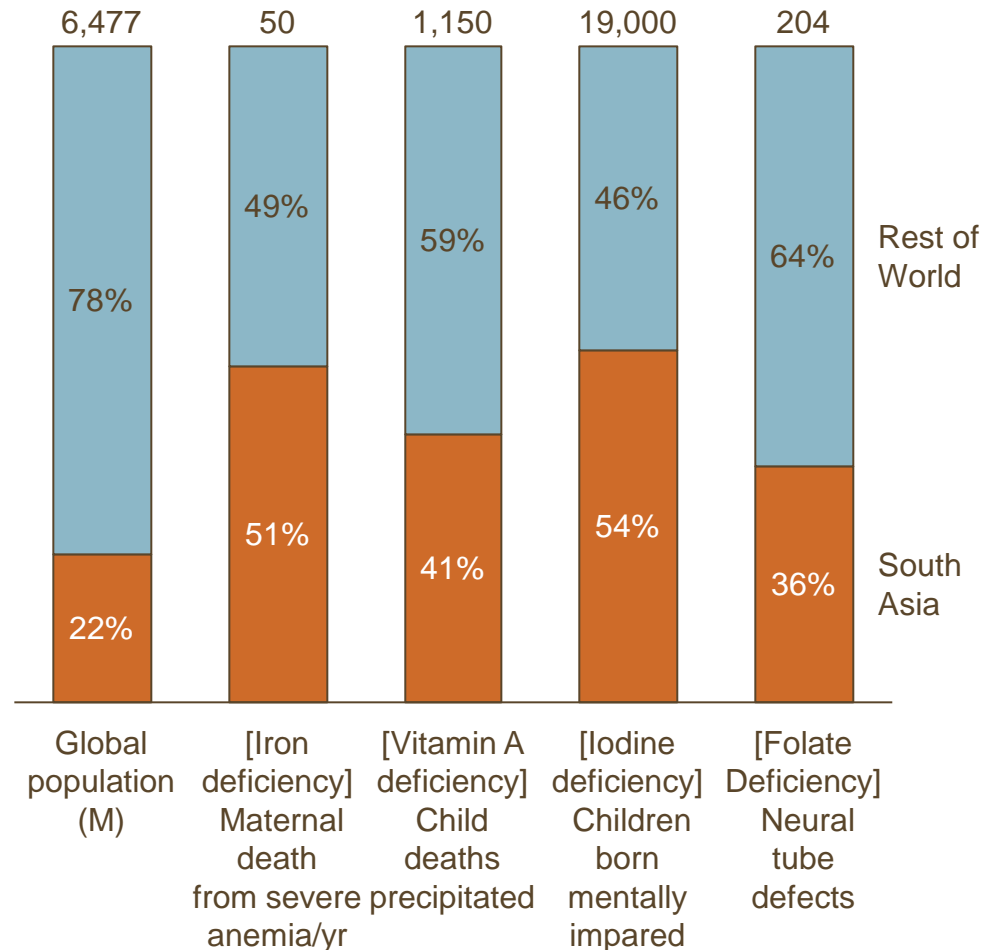
Note: Below poverty line: less than \$1.25 / day (PPP 2005); other includes Bhutan, Maldives, Sri Lanka and Afghanistan;  
Source: World Bank

# Undernourishment and related deficiencies in South Asia

Prevalence of undernourishment in total population (%)



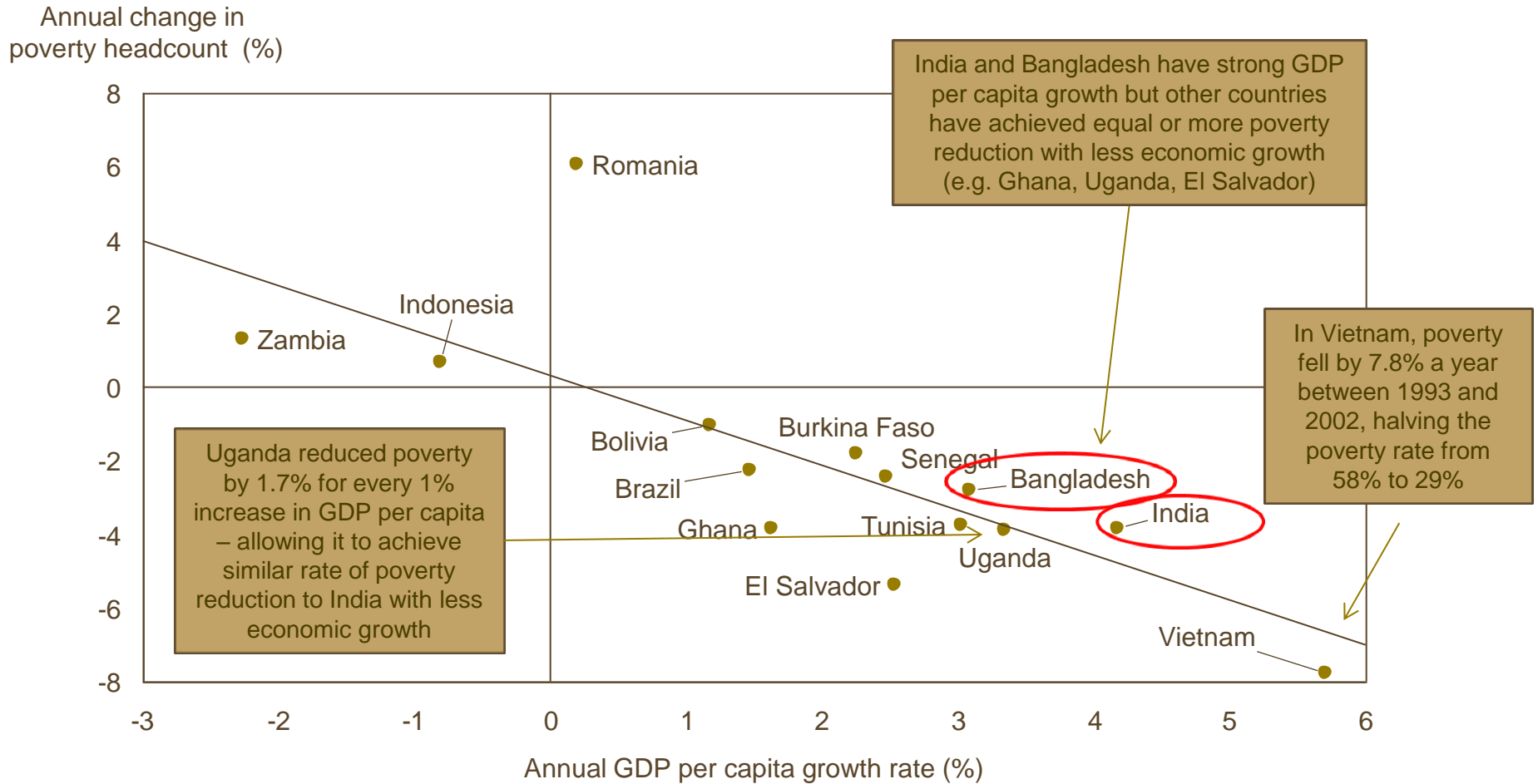
Incidence of selected micronutrient deficiency related health outcomes (000)



Source: FAO Statistics Division; Gragnoli, et al. 2005. "India's Undernourished Children: Call for Reform and Action." Health, Nutrition and Population, World Bank.

# Growth and poverty reduction in developing countries

Annual change in growth and poverty across 14 developing economies in the 1990s



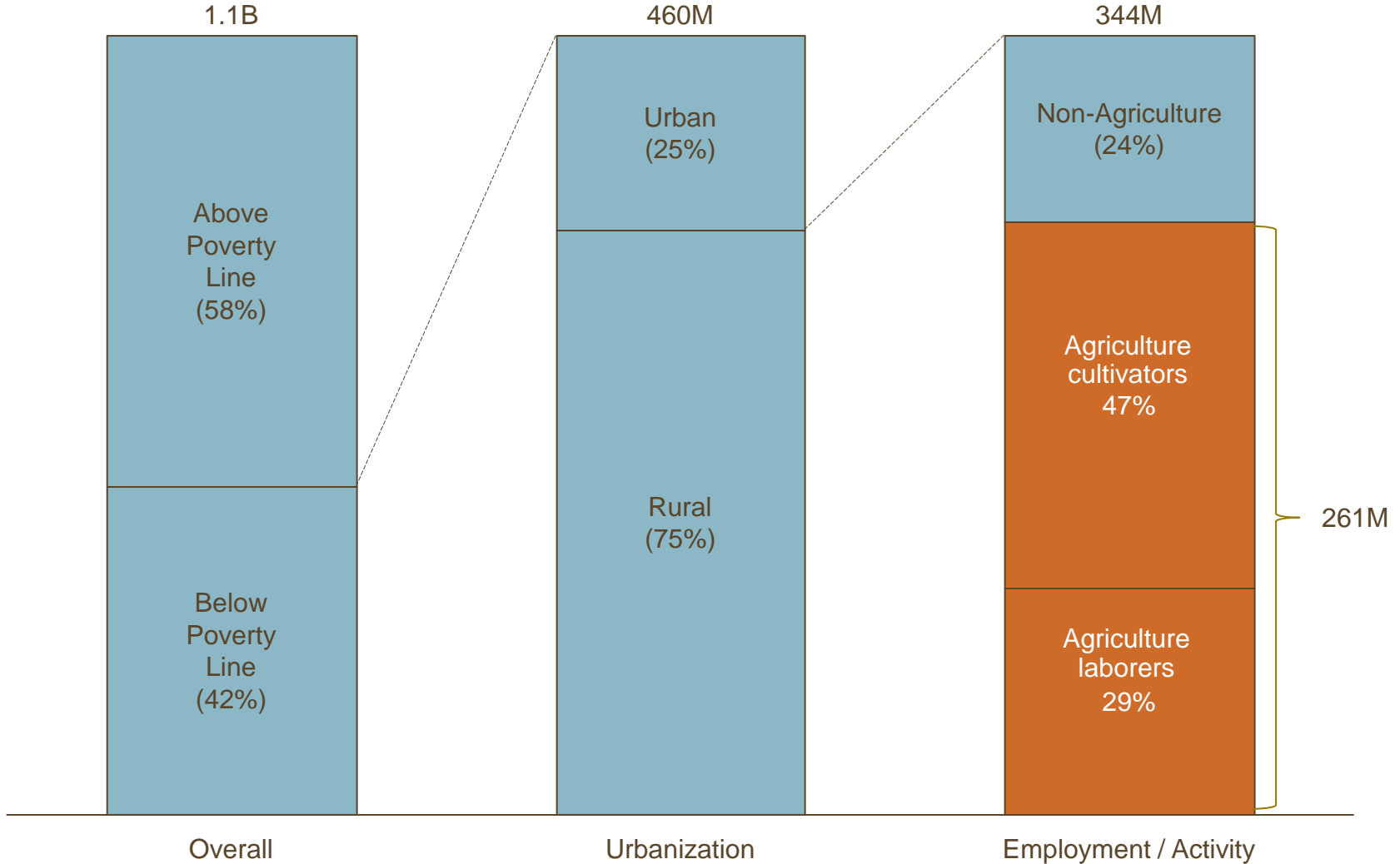
Note: Survey years for each country varies.  
 Source: World Development Indicators; GOI; "Pro-poor growth in the 1990s," IBRD, 2005;

# Appendix

- South Asia
- **India**
- Bangladesh

# Poverty in India

## Indian Population (2005)



Note: BPL = "Below Poverty Line" defined as less than \$1.25 / day (PPP); Rural poor calculated using national rural poverty line; percentage of rural poor involved in agriculture labor estimated using ratio of cultivators and laborers in economic classification of workers from census 2001

Source: World Bank; Jha B. (2006) *Rural non-farm employment in India: Macro-trends, Micro-evidences and Policy options*, Institute of Economic Growth Working Paper.

Statistical Abstract India 2007.

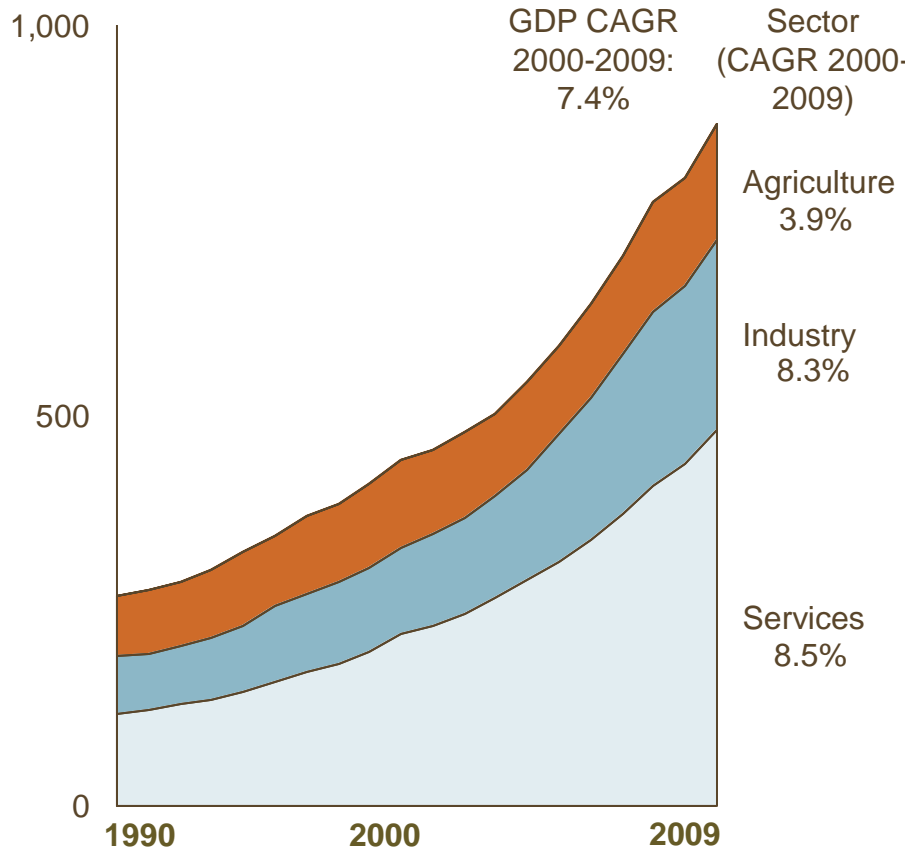


# India's economic growth

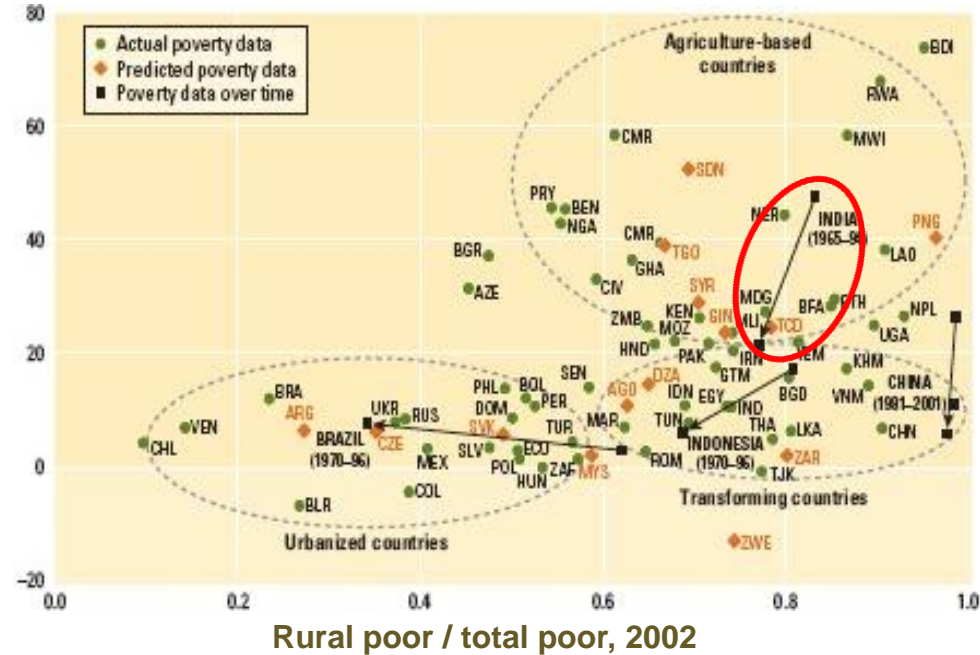
India's economy grew by 7.4% annually over the last 10 years

India has been moving away from an agriculture-based economy

Indian Real GDP (USD BN 2000 prices)



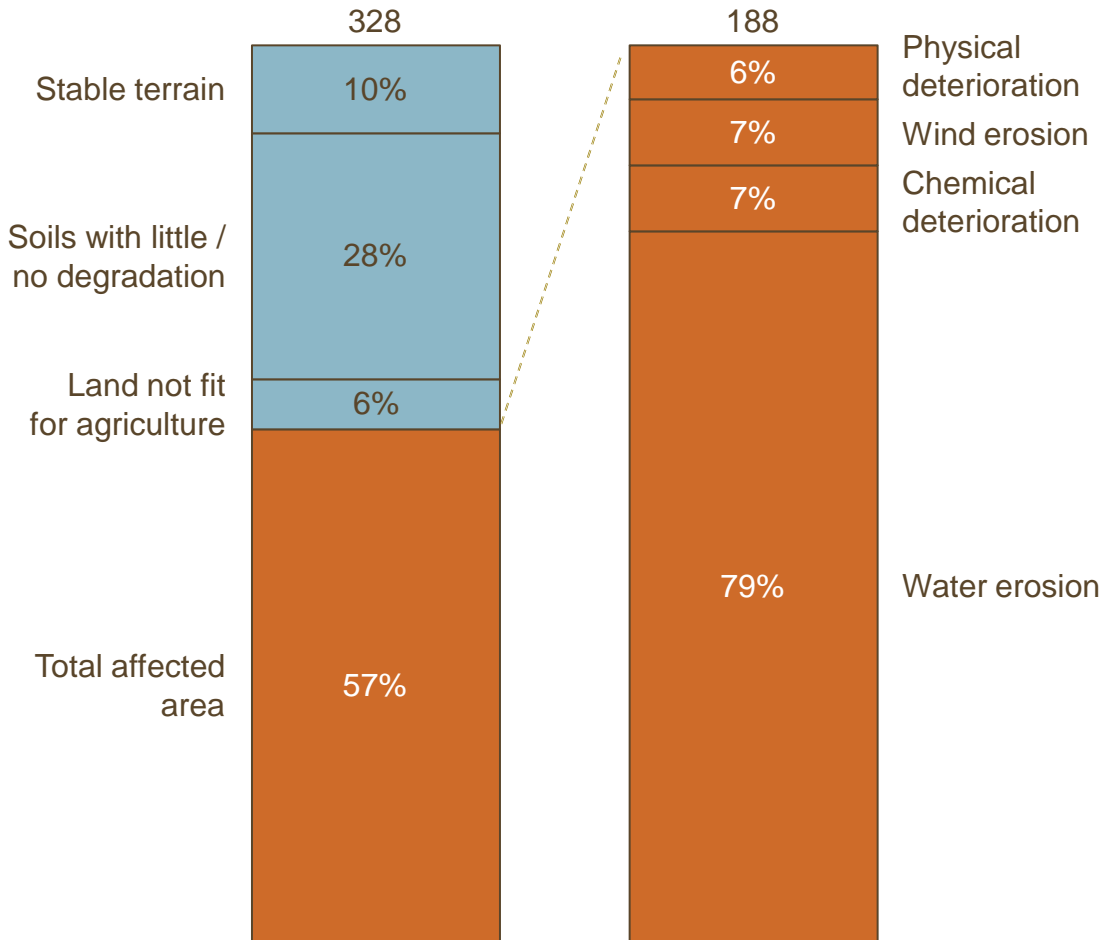
Agriculture's contribution to growth, 1990-2005, %



- World Bank report distinguished 3 country types based on agriculture's contribution to growth and the rural share in poverty: agriculture-based, transforming and urbanized
- India moved from agriculture-based group to the transforming group over the past 20 years

# India's environmental problems related to agriculture

## India's human induced soil degradation (millions of hectares)

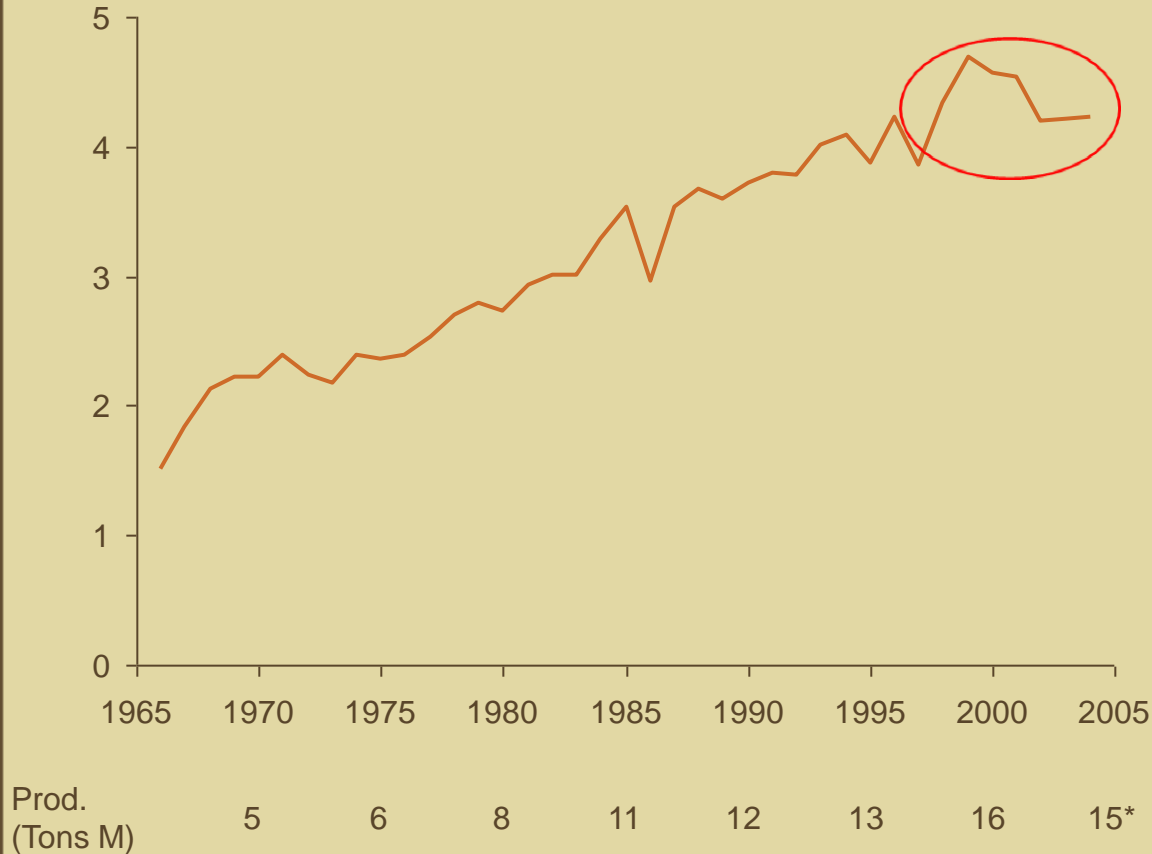


- India loses an estimated Rs. 285.5 billion annually at the current level of land degradation
- Andhra Pradesh, Gujarat, Karnataka, Maharashtra, Madhya Pradesh, Rajasthan, Tamil Nadu and West Bengal account for nearly 73% of total loss in the land
- Water erosion (including loss of topsoil and terrain deterioration) is the most significant soil degradation problem, affecting 45% of the land
  - Distributed throughout India
  - UP, MP, Rajasthan and Gujarat are most severely affected
- Wind erosion (including loss of topsoil, and terrain deformation) is confined to Rajasthan and Gujarat
- Salinity problems (chemical deterioration) afflicts mainly irrigated areas

# Declining wheat yields in Punjab

Wheat yield in Punjab have seen recent decline in recent years

Annual wheat yields in Punjab (Tons / Ha)



## Potential drivers of yield decline

- **Slackening of infrastructure**
- **Slow-down in research investments**
- **Reduced policy support**
- **Degradation of lowland resource base** due to intensive use
  - Build-up of salinity and water logging
  - Depletion / pollution of ground water resources
  - Formation of a hardpan
  - Changes in soil nutrient status, nutrient deficiencies and increased incidence of soil toxicity
  - Increased pest buildup, pest-related yield losses and associated consequences of increased pesticide use

# Investing in Indian agriculture is complicated by multiple agroclimatic zones, state influence and cultural/linguistic differences

## 4 agroclimatic zones are represented in India



Climatic ZONES

- Arid
- Humid
- Semi-Arid Temperate
- Semi-Arid Tropics

## Each of 28 states has a significant influence over agriculture within its boundaries

- States have constitutional mandate to administer agricultural affairs
- Services and schemes are often administered through state departments of agriculture, which presides over several functional directorates
- Each state manages its own agricultural expenditures
  - E.g. Orissa spent USD\$36 M on agricultural programs in 2007-08
- State agricultural universities are responsible for applied and adaptive research to meet local demands

## This is further complicated by linguistic and cultural differences

- 1.1 Billion people
- 22 officially recognized languages
- 3.3 M Sq.KM: mountains, in north, deserts in west, upland plains in south, flat plains along Ganges
- Tribal people make up 8.1% of the population

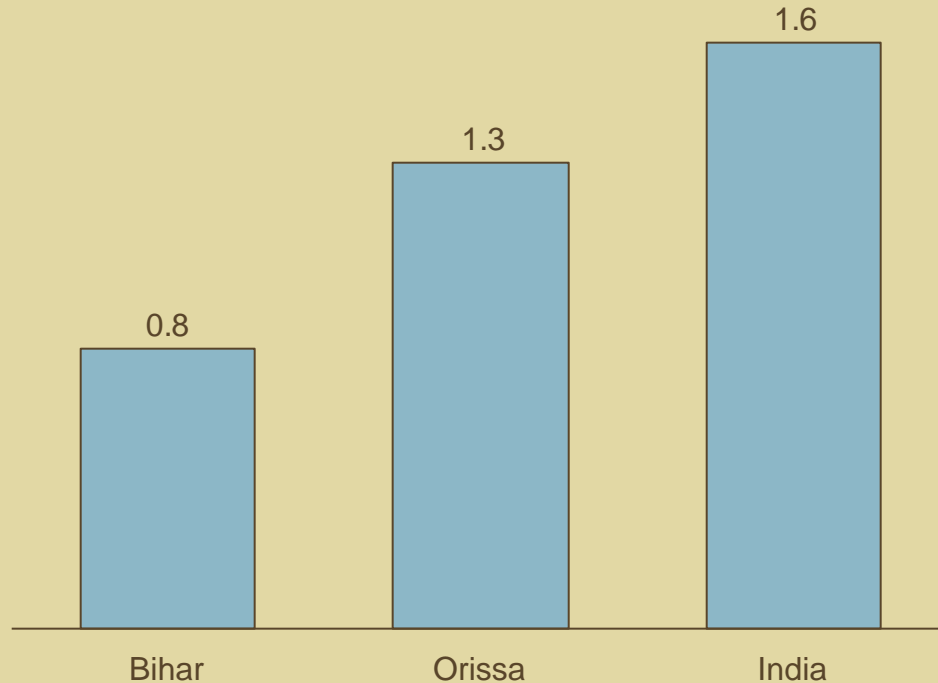
# Key trends relevant to agriculture

	Description	Implications for smallholders
<b>A</b> <b>Small and fragmented holdings</b>	<ul style="list-style-type: none"><li>Operational land holdings in East Asia are small and fragmented (Avg. size in Bihar is 0.75 ha)</li></ul>	<ul style="list-style-type: none"><li>Greater number of rural people relying on agricultural income from smaller plots of land</li><li>High incidences of landlessness (~32% of India's landless live in East India)</li></ul>
<b>B</b> <b>Lack of input use</b>	<ul style="list-style-type: none"><li>East Indian farmers adopted little of Green Revolution's technology advances</li><li>East India lags behind the rest of India in crop productivity due to limited usage inputs</li></ul>	<ul style="list-style-type: none"><li>Farmers cannot access useful information about new technologies or markets</li><li>Farmers continue unsustainable and low-yield farming practices</li></ul>
<b>C</b> <b>Climate-related natural disasters</b>	<ul style="list-style-type: none"><li>A significant amount of cultivated land in East India is vulnerable to flooding and droughts</li></ul>	<ul style="list-style-type: none"><li>Farmers are exposed to farm losses and income fluctuations</li><li>Food supply is often at risk</li></ul>
<b>D</b> <b>Weak extension services delivery</b>	<ul style="list-style-type: none"><li>Extension services offered at the central and state government levels are ineffective at informing and training farmers</li><li>Existing technologies are not delivered to farmers</li></ul>	<ul style="list-style-type: none"><li>Farmers are not utilizing new technologies to improve crop yield</li><li>Outputs from research and development are not being adopted</li></ul>
<b>E</b> <b>Weak agricultural research capacity</b>	<ul style="list-style-type: none"><li>R&amp;D in agriculture has declined since the Green Revolution</li><li>SAUs do not have enough funding</li></ul>	<ul style="list-style-type: none"><li>Farmers are unable to utilize new innovative technologies to improve their crop yields</li></ul>

# Small and fragmented holdings

## East India's operational land holdings are small and fragmented

### Average land holdings size (hectares)



- There is also high land fragmentation in Bihar (average 18-20 parcel per holding)

### Situation

- Over 80% of land holdings are less than 2ha
- Farming on small holdings are primarily subsistent
- Often difficult for state to deliver information and extensions to smallholders

### Implications for smallholders

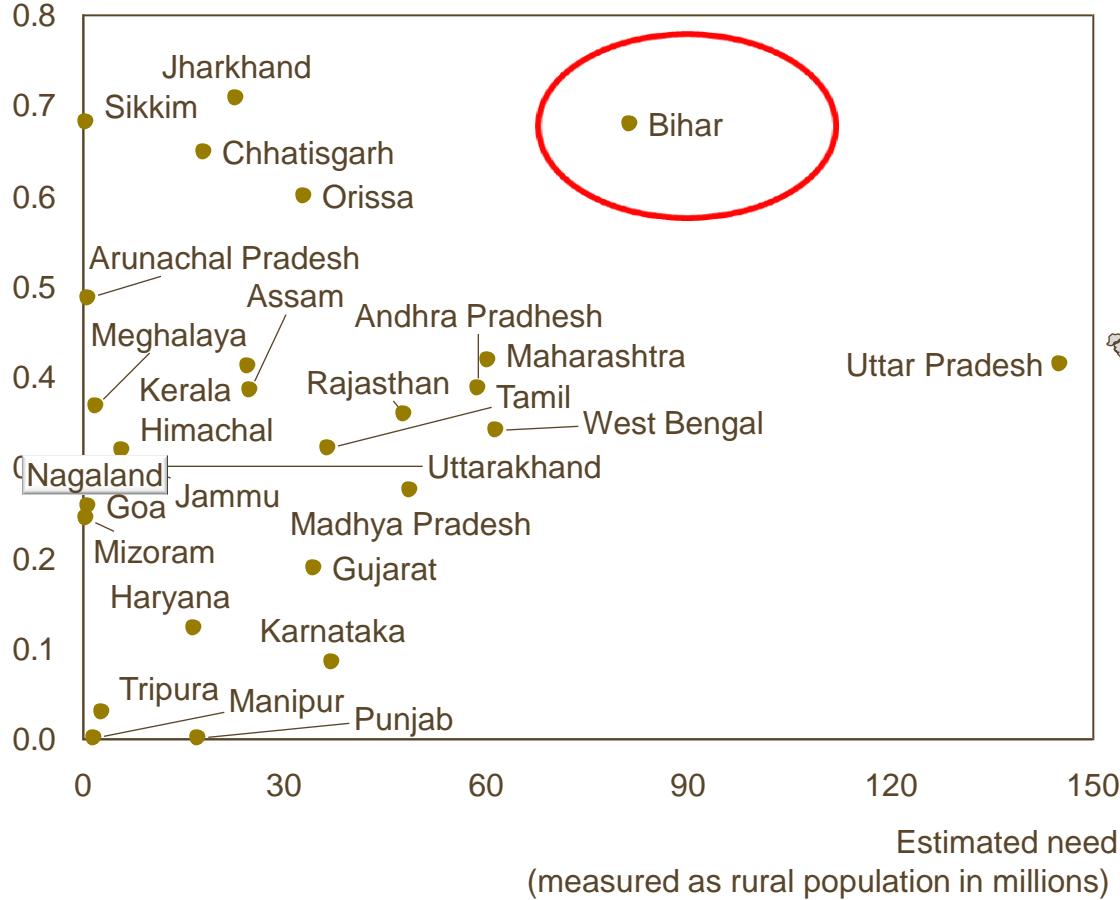
- Difficult for farmers to generate enough income from landholding to support a household
- Smallholders may not access information and services as easily
- More farmers are becoming landless or nearly landless

# Preliminary analysis of need and potential impact suggests a focus on Bihar and nearby states with linkages

## Estimation of potential impact vs. need, by state

Untapped potential

(measured as percentage yield gap)



- Surrounding states have similar agroclimatic conditions
- Exposed to similar challenges
- Often linked by regional markets and investments

Note: this analysis uses rural population estimates to measure need

1. Yield gap is used as a proxy for *potential impact*. The axis represents each state's average yield gap for its major crops, relative to the yield of other states in its agro-ecological zone. States are grouped into agro-ecological zones based on their physical terrain, soil quality and climate. Each state's yield for its major crop is compared against the maximum yield of its agro-ecological zone group.
2. Rural population headcount in 2006 serves as a proxy for *estimated need*. It is calculated by applying the proportion of rural population to total population from 2001 census to a 2006 population projection.

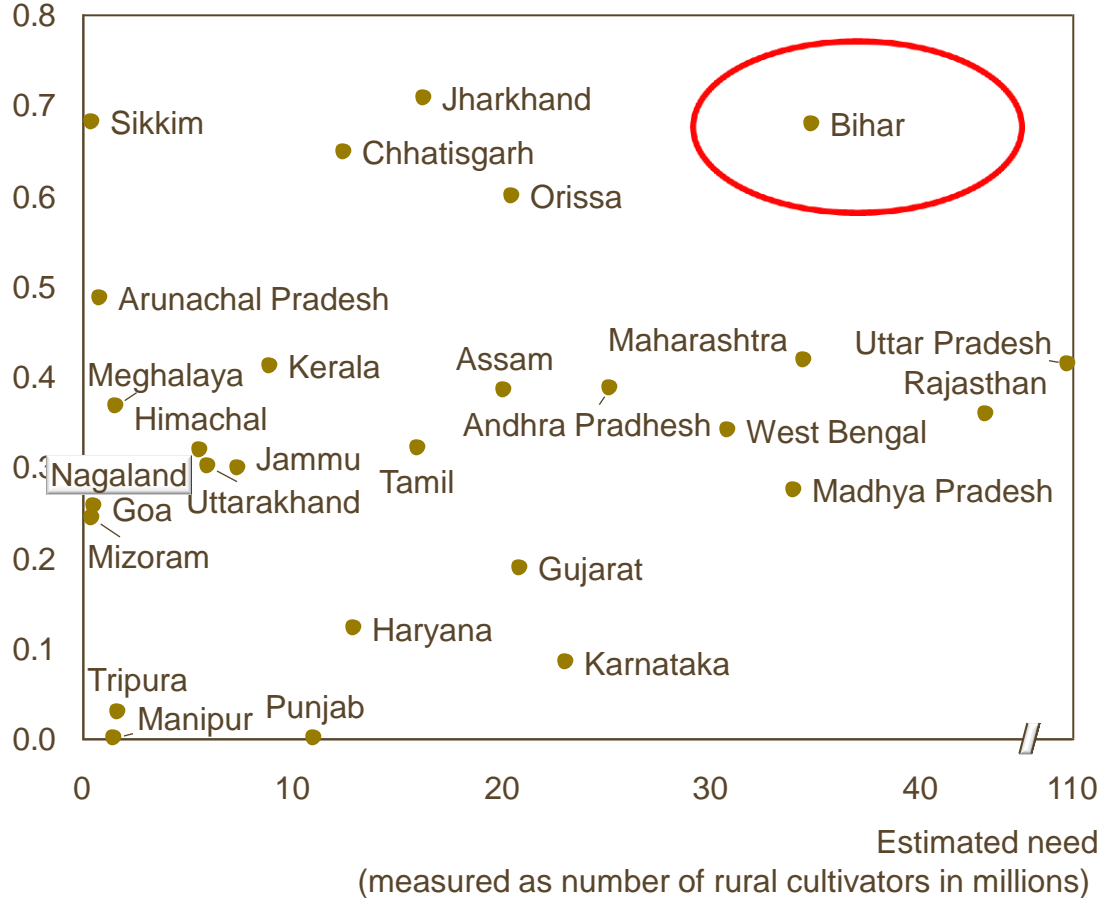
Source: State-level data for crop yield is sourced from India's Statistical Abstract 2007; Report of the technical group on population projects constituted by the National commission on Population, May 2006.

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2. Number of rural cultivators serves as a proxy for need. The "Rural cultivators" axis represents each state's number of rural smallholder farmers. It is estimated by applying an economic classification of workers in each state from the 2001 census, to a state-level population estimate from 2006.

Source: State-level data for crop yield is sourced from India's Statistical Abstract 2007; Rural cultivators data is sourced from the 2001 census and the "Report of the technical group on population projects constituted by the National Commission on Population," from May 2006



# Notes and methodology on the state-level analysis

## Background

- The analysis on potential impact and estimated need was prepared by Dalberg for the Gates Foundation, in an effort to show which states in India have the highest untapped potential and the greatest need for agricultural interventions.
- The backup analysis consists of state-level analyses, using yield gaps for major crops as a proxy for untapped potential and the number of rural cultivators as a proxy for estimated need.

## Methodology

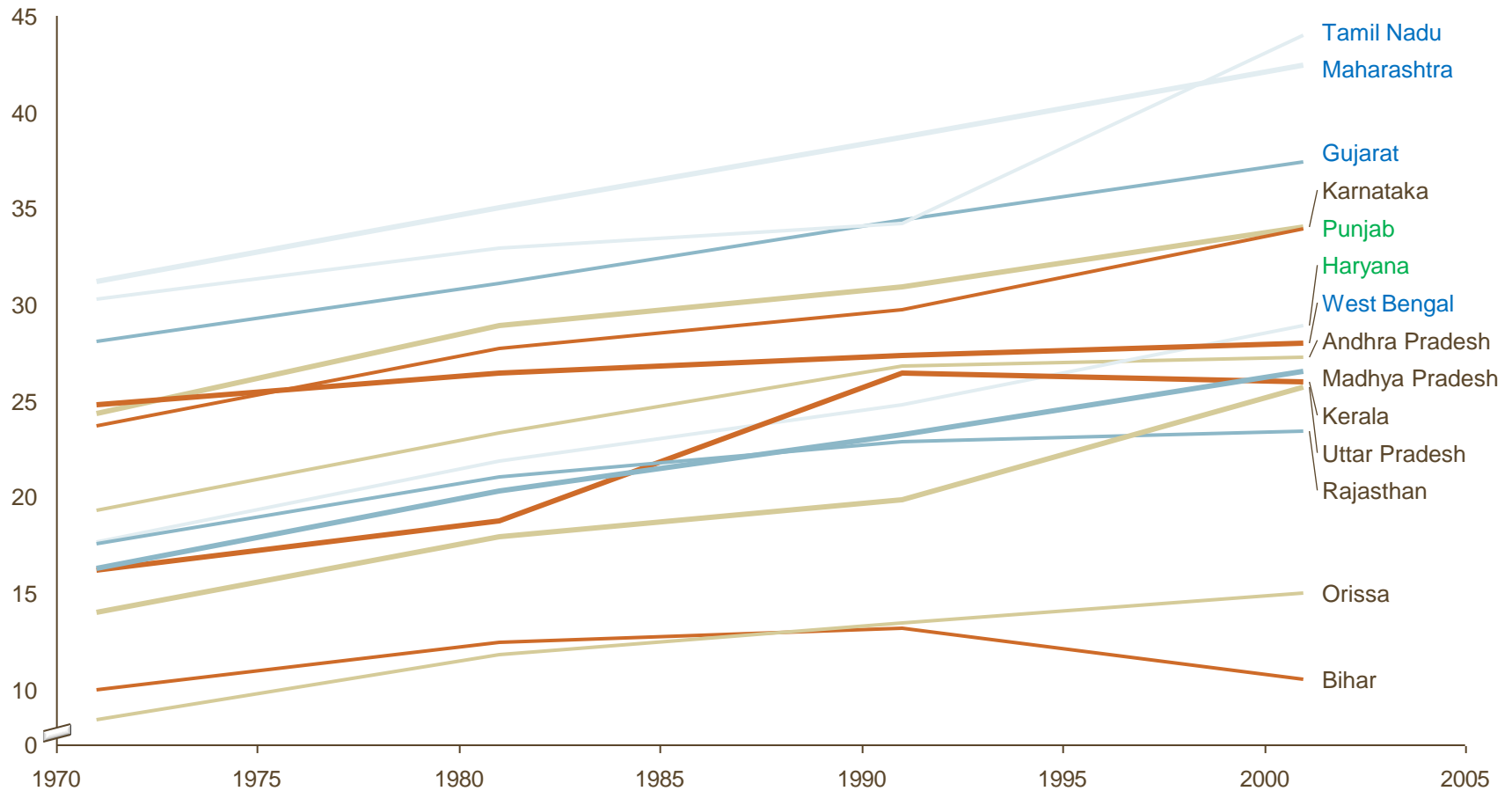
- **Step 1:** Yield for each crop is calculated as: production for crop x / area used for crop x
- **Step 2:** Each state is assigned an agro-ecological zone (AEZ) number, based on its geographical, agro-climatic and ecological situation.
- **Step 3:** Each state is sorted by AEZ group. For each AEZ group, the maximum yield for each crop is calculated.
- **Step 4:** Each state's top 2 crops are determined, as measured by volume. For each of its 2 top crops, its "yield gap ratio" is calculated. Yield gap ratio of each crop for each state is calculated as follows: "State's yield for crop x" / "Maximum yield for crop x within the state 's AEZ group"
- **Step 5:** Then, the "weighted yield gap ratio" for the state is calculated by weighing the yield gap ratio for each crop by its volume
- **Step 6:** The potential impact score is calculated as: 1- "weighted yield gap ratio"

## Issues

- Agro-ecological Zones (AEZ) assignments at the state-level were made based on Dalberg analysis and interviews notes with Indian agriculture experts
- Estimated need is based on an estimated number of rural cultivators, which is calculated using census 2001 classification of workers. We believe the number of workers is underreported. Thus, we arrived at the total rural cultivators number through the following steps: 1) Getting the ratio of cultivators / Total agricultural workers for each state. 2) Applying the ratio to the total headcount of rural population.

# Urbanization in India

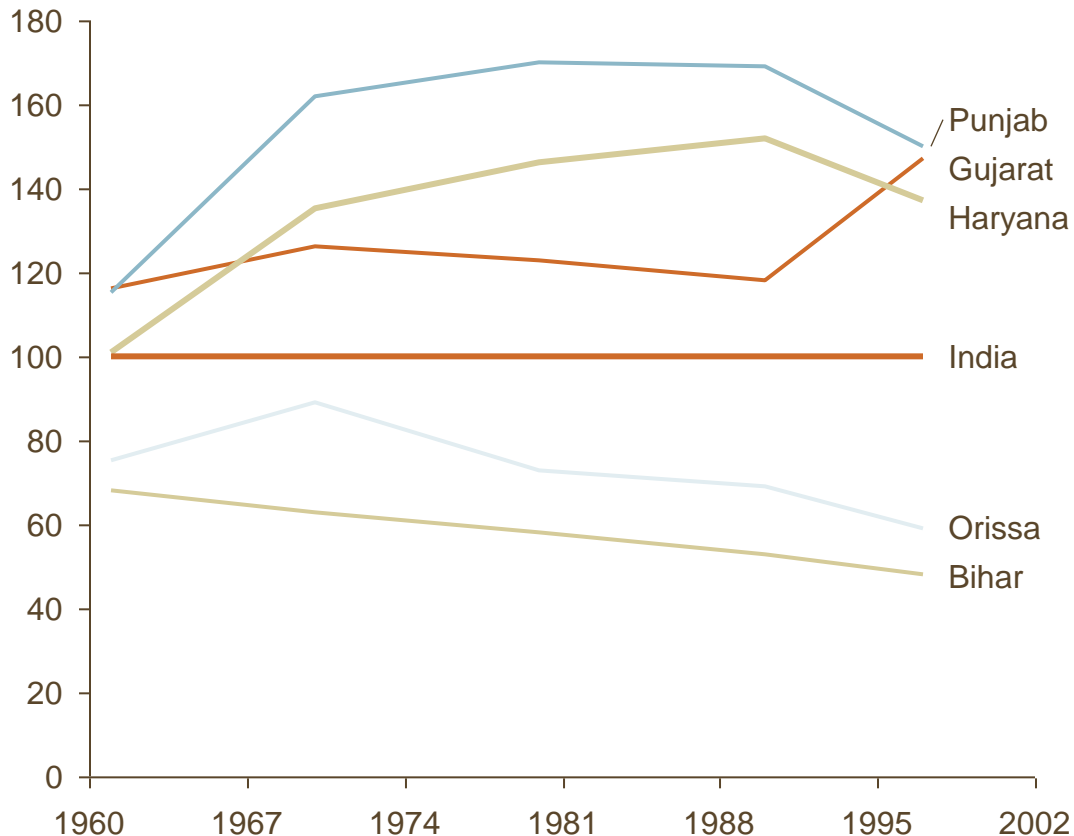
Urbanization rates (%) in the 14 largest Indian states (1971-2001)



Source: Sachs, Jeffrey, "Understanding Regional Economic Growth in India," Center for International Development (CID), Harvard University.

# Index of Per Capita State GDP

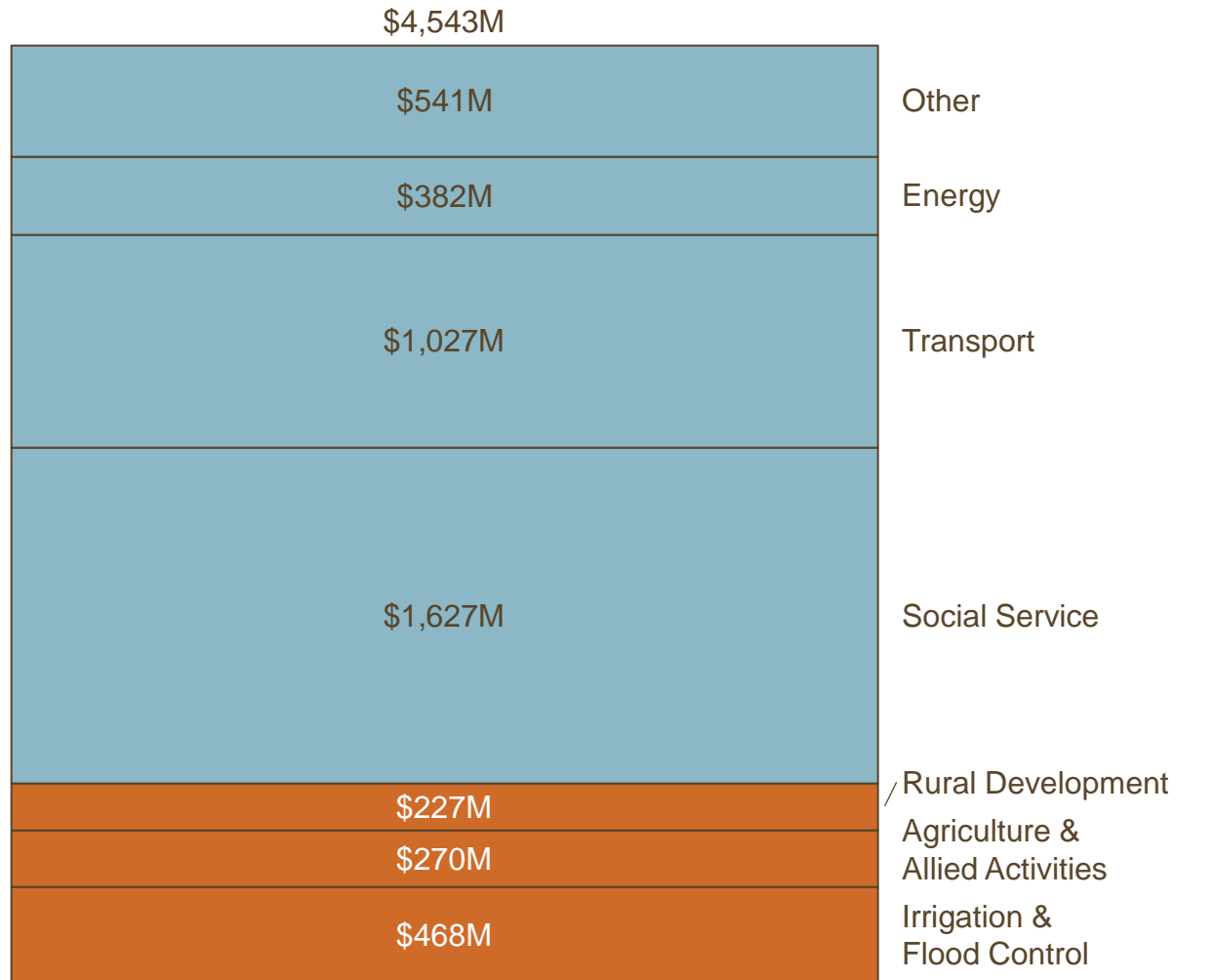
Index of Per Capita State GDP at Constant Prices (All India = 100)



- The Green Revolution's high-yield wheat seed varieties required fertilizer use and more water than natural rainfall could provide
- New technology was implemented only in regions with adequate irrigation and access to fertilizers
- Wealthier states with irrigation infrastructure and assured supplies of fertilizers, such as Punjab and Haryana, benefited disproportionately from the Green Revolution

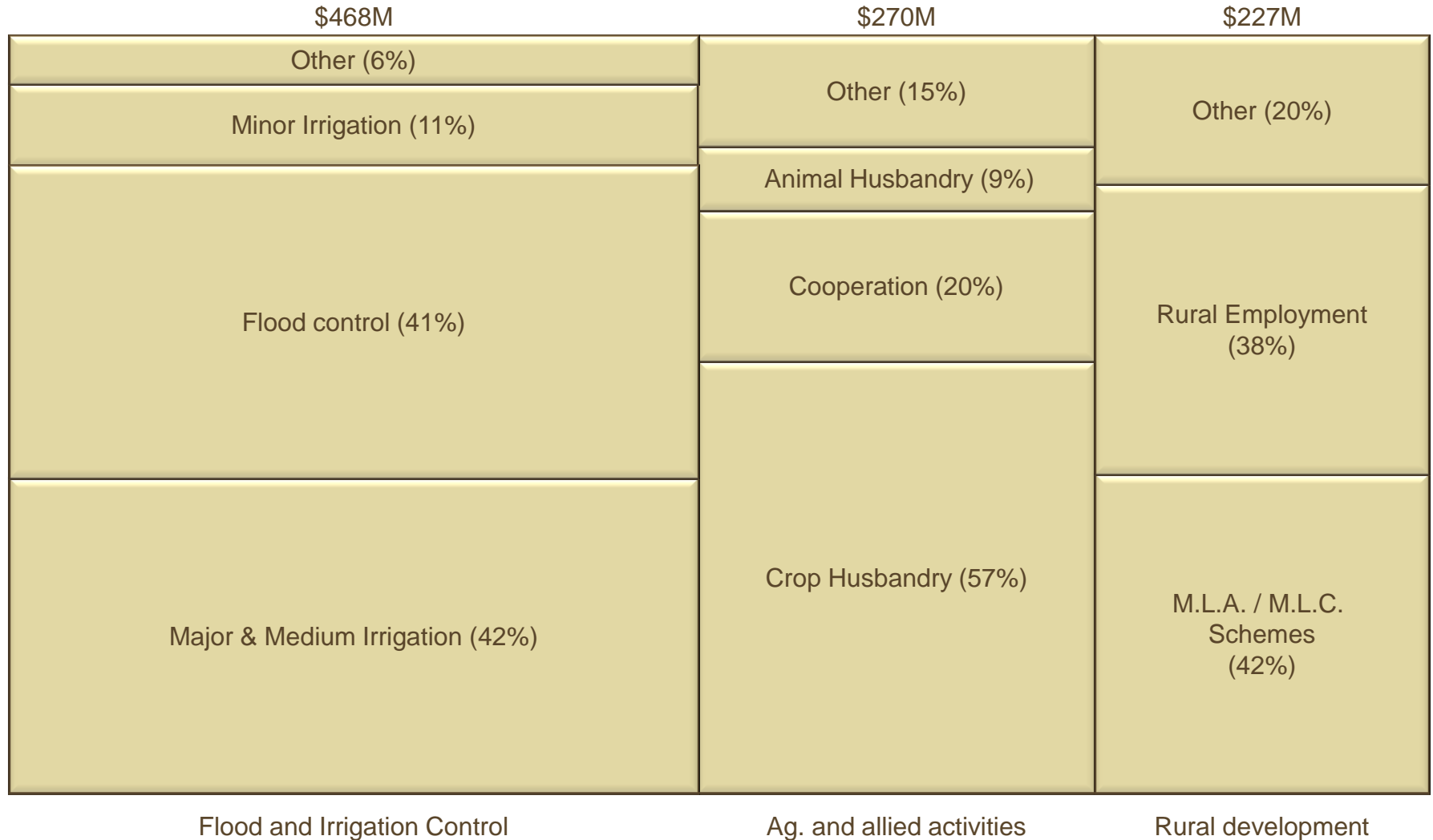
# Bihar Planned Outlay in agriculture and rural development almost \$1B

## Bihar Planned Outlay (2010-11)



# Bihar Planned Outlay in Agriculture / Rural Development Programs (2010-11)

Bihar Planned Outlay in Agriculture / Rural Development Programs (2010-11)



Source: GOI, Planning Commission;

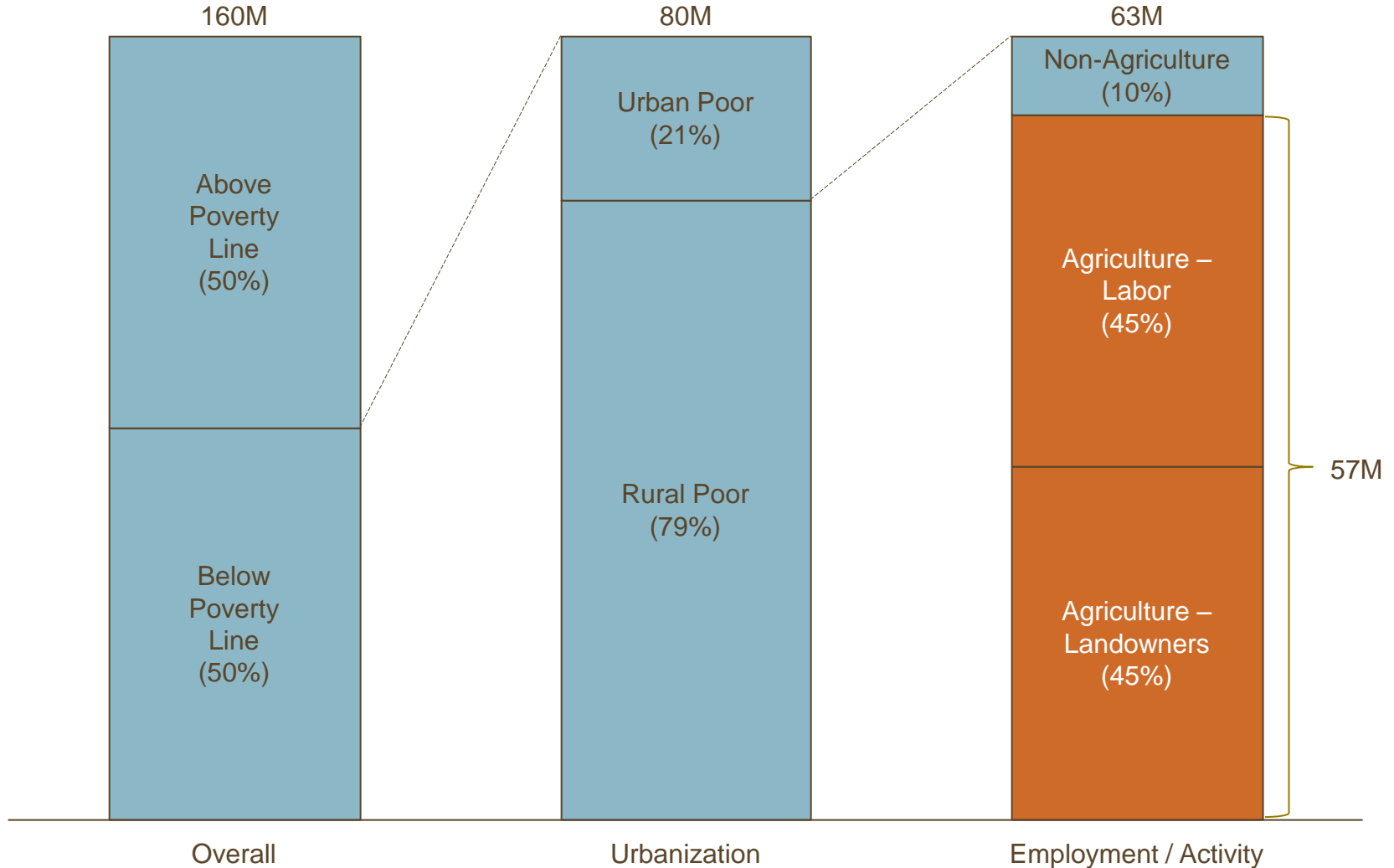
# Appendix

- South Asia
- India
- **Bangladesh**

# Poverty in Bangladesh

## Bangladesh Population (2008)

*Estimates*

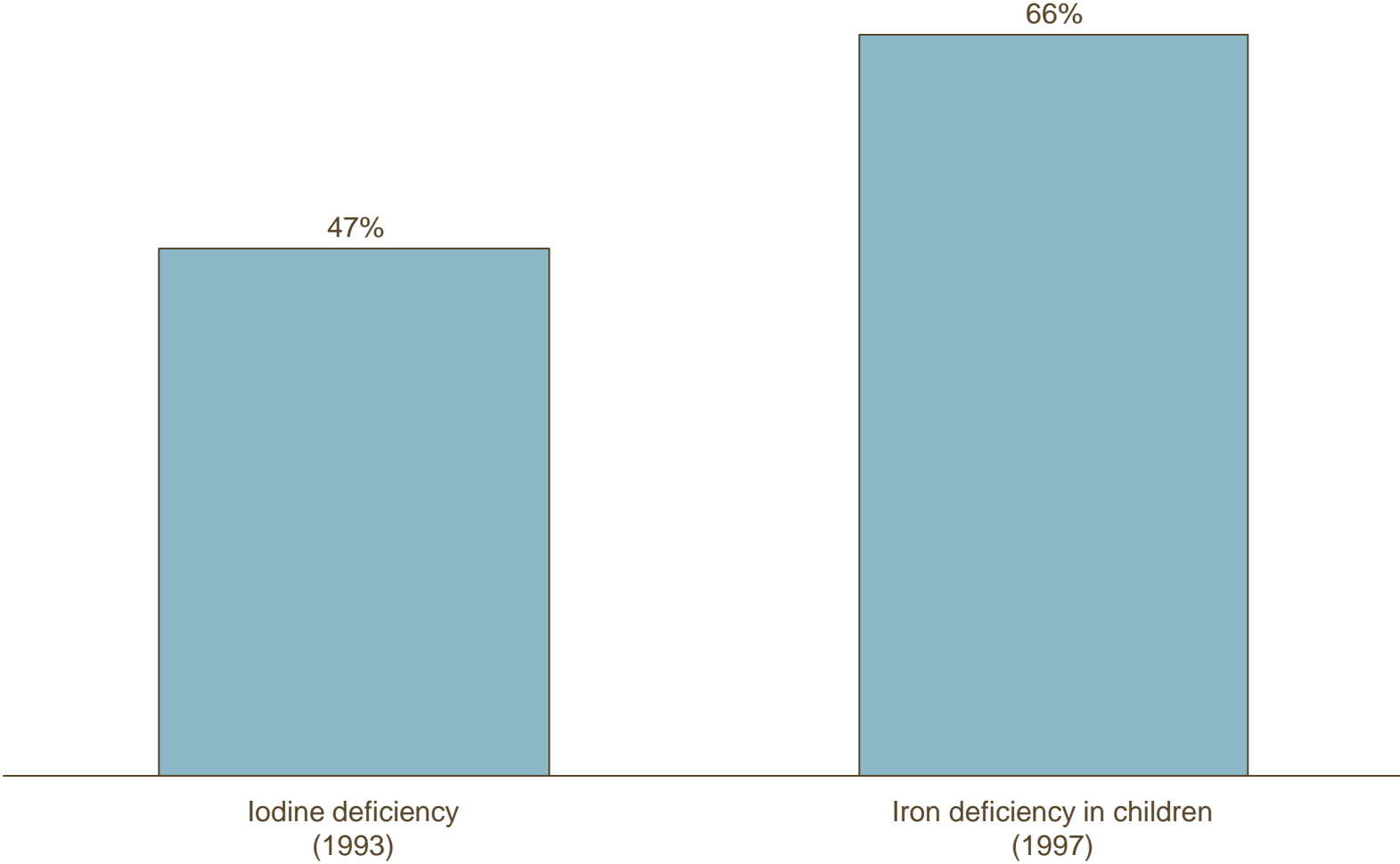


Note: BPL = "Below Poverty Line" defined as less than \$1.25 / day (PPP); Rural poor calculated using national rural poverty line; percentage of rural poor involved in agriculture estimated using percent of rural population involved in agriculture in 1982;

Source: World Bank; ADKN report;; Centre for Policy Dialogue; Expert interviews (3); Dalberg analysis

# Micronutrient deficiencies in Bangladesh

## Micronutrient deficiencies

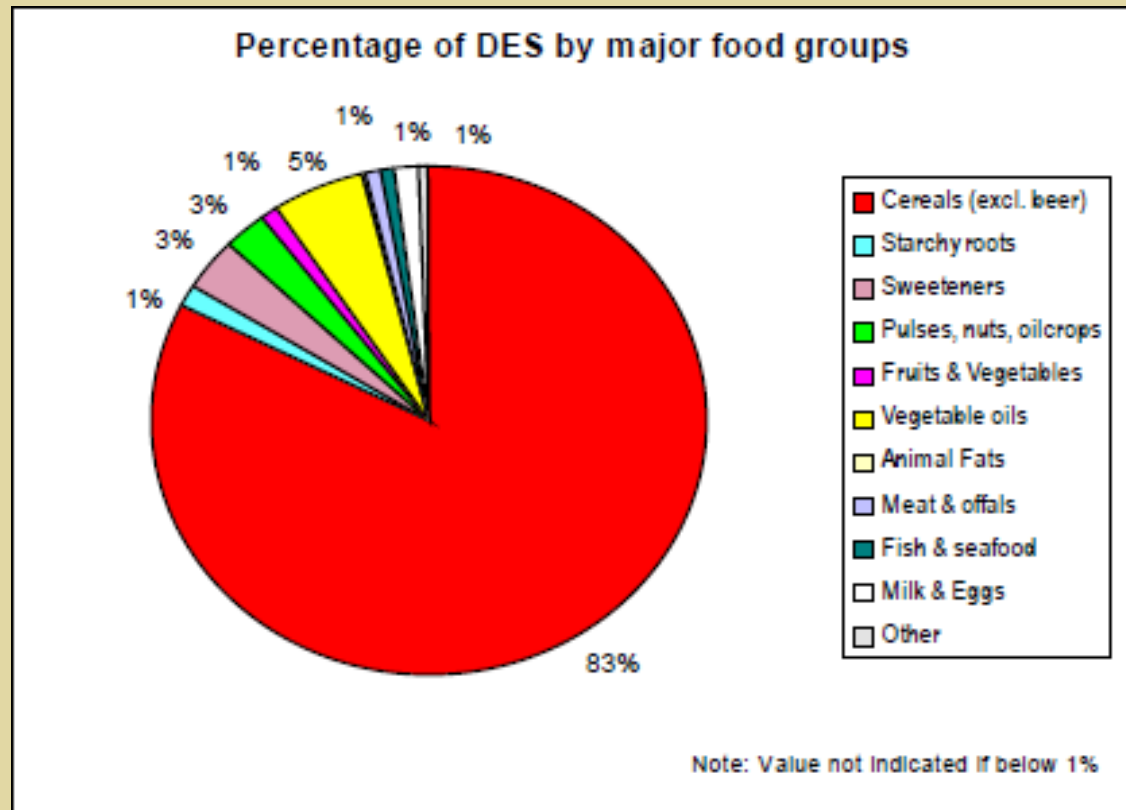


Note: Stunting/Wasting/Underweight based on <-2 SD; Iodine based on TGR; Iron based on Hb<11.0g/dl  
Source: FAO



# Dietary energy supply (1994 – 1996 Kcal / caput / day) and current trends

Dietary energy supply (1994 – 1996 Kcal / caput / day)

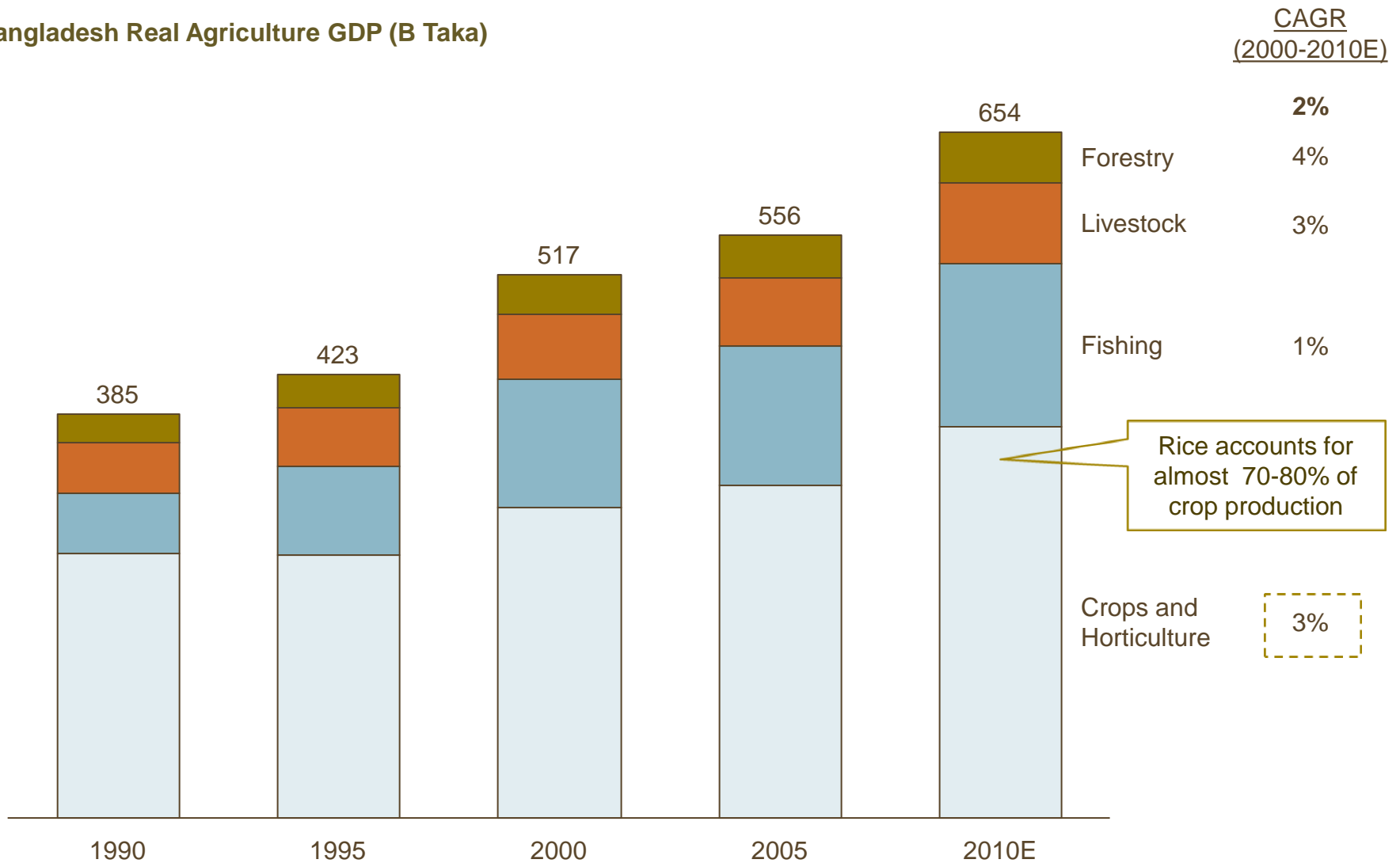


## Current trends

- Government of Bangladesh recently started to **encourage non-cereal food production and consumption along with food self-sufficiency**
  - Greater attention being given to supportive policies for agriculture input, research on non-cereal crops
  - Commercial and homestead **promotion of poultry and fruits/vegetables** are receiving greater attention
- **Clear need to diversify food sources** both in terms of land/environmental sustainability, development of the rural economy and increased consumption
- More than 50 percent of **women suffer from chronic energy deficiency** and studies suggest that there has been little improvement in women's nutritional status over the past 20 years.

# Bangladesh Real Agriculture GDP by category

Bangladesh Real Agriculture GDP (B Taka)



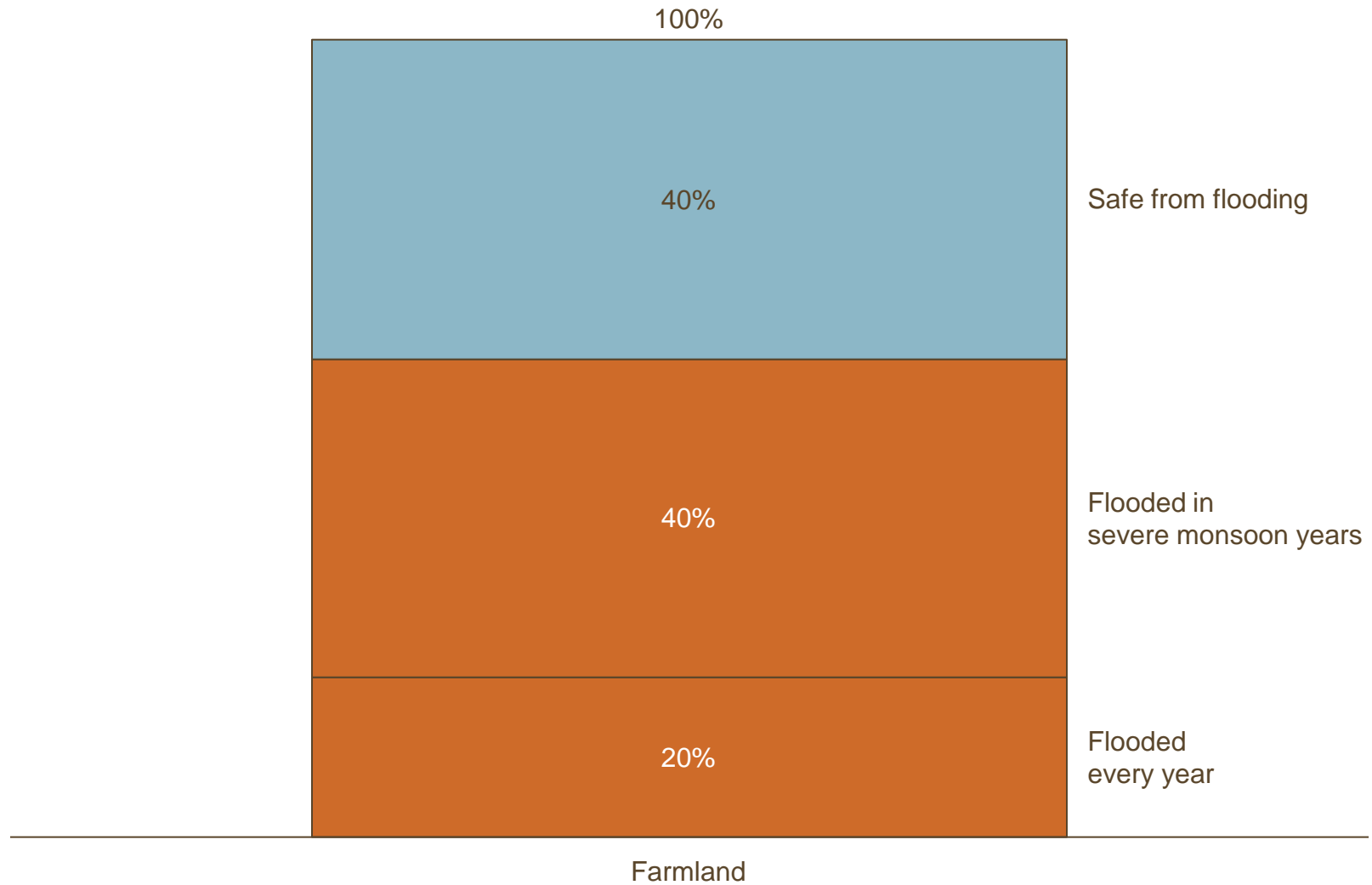
Source: Bangladesh Bureau of Statistics; Yearbook of Agriculture Statistics; Monthly Statistic Bulletins (multiple issues); Center for Policy Dialogue Reports (2004, 2009); USAID (2001)

# Challenges important in the context of Bangladesh that impact smallholder farmers

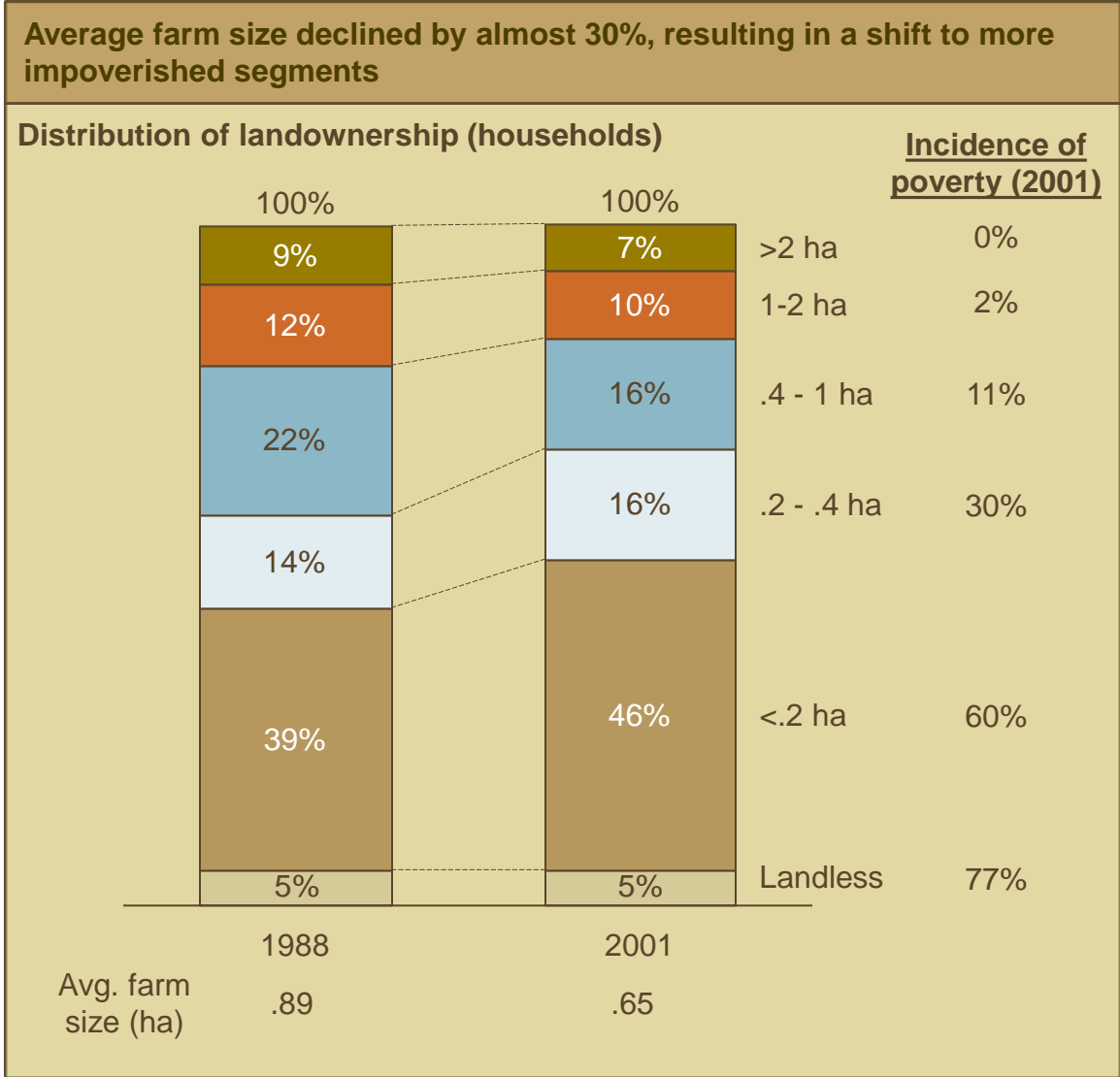
	Description	Implications for smallholders
<b>A</b> Looming threat of climate change and natural disasters	<ul style="list-style-type: none"> <li>• 20% of country regularly flooded during monsoon seasons; 60% in severe years</li> <li>• Bangladesh identified as most vulnerable to CC</li> </ul>	<ul style="list-style-type: none"> <li>• Farmers bear significant production risk</li> <li>• Significant probability of additional land loss and decreased rice production</li> </ul>
<b>B</b> Scarcity of land and diminishing plot sizes	<ul style="list-style-type: none"> <li>• 50-70% of rural households are functionally landless</li> <li>• Average plot sizes currently only .7 ha; declined from .9 ha average in 1980s</li> </ul>	<ul style="list-style-type: none"> <li>• Need diversity of income sources, both non-crop agriculture and non-agriculture</li> <li>• Prioritize non-crop agriculture (e.g., dairy, poultry) and non-production steps in value chain</li> </ul>
<b>C</b> Water scarcity and diminishing resources	<ul style="list-style-type: none"> <li>• Water table has declined in recent years due to intensive irrigation of Boro rice</li> <li>• India and China diverting of waterways / damming</li> </ul>	<ul style="list-style-type: none"> <li>• Dry season rice production has limited growth potential</li> <li>• Medium/long-term risk of further agricultural and health decline due to lack of water</li> </ul>
<b>D</b> Lack of access to credit for farmers	<ul style="list-style-type: none"> <li>• Only 35% of farmers have access to credit despite Bangladesh being “home of microfinance”</li> </ul>	<ul style="list-style-type: none"> <li>• Smallholders often unable to currently make investments necessary for technologies to increase production efficiency (see B)</li> </ul>
<b>E</b> Significant gaps in rural electrification	<ul style="list-style-type: none"> <li>• Only 40% of Bangladesh has access to electricity</li> <li>• Rural areas with access subject to load-shedding and rationing</li> </ul>	<ul style="list-style-type: none"> <li>• Lack of access to markets (e.g., processing, storage) due to unreliable / expensive energy</li> <li>• Immature value chains with limited capacity for labor / employment due to cost of electricity</li> </ul>
<b>F</b> Diminishing research and technical capacity	<ul style="list-style-type: none"> <li>• Bangladesh’s research institutions no longer “world-class”</li> <li>• Significant “brain-drain” due to international opp.</li> </ul>	<ul style="list-style-type: none"> <li>• Slower pace of agricultural innovation in recent years</li> <li>• Lower-quality extension services</li> </ul>

# Looming threat of climate change and natural disasters

## Farmland vulnerable to flood risk



# Scarcity of land and diminishing plot sizes



## Implications for smallholders

- As plot sizes are too small to sustain livelihoods alone, **smallholders have and need a diversity of income sources**
- **Non-crop agriculture (e.g., fisheries, poultry) could be high-potential opportunities to increase income** as they are less land-intensive
- **Smallholders have a significant need for credit**
  - Productivity growth is vital for smallholder income generation via crop agriculture
  - Productivity growth generally requires investment in new technologies
  - Due to small plot sizes, smallholder working capital is fairly limited, often much less than required for key investments

Note: Incidence of poverty calculated as percentage of households that are considered to be "moderate and extreme poor" by IRRI – BIDS survey, likely based on the national rural poverty line  
 Source: Centre for Policy Dialogue report (2004); IRRI – BIDS survey