

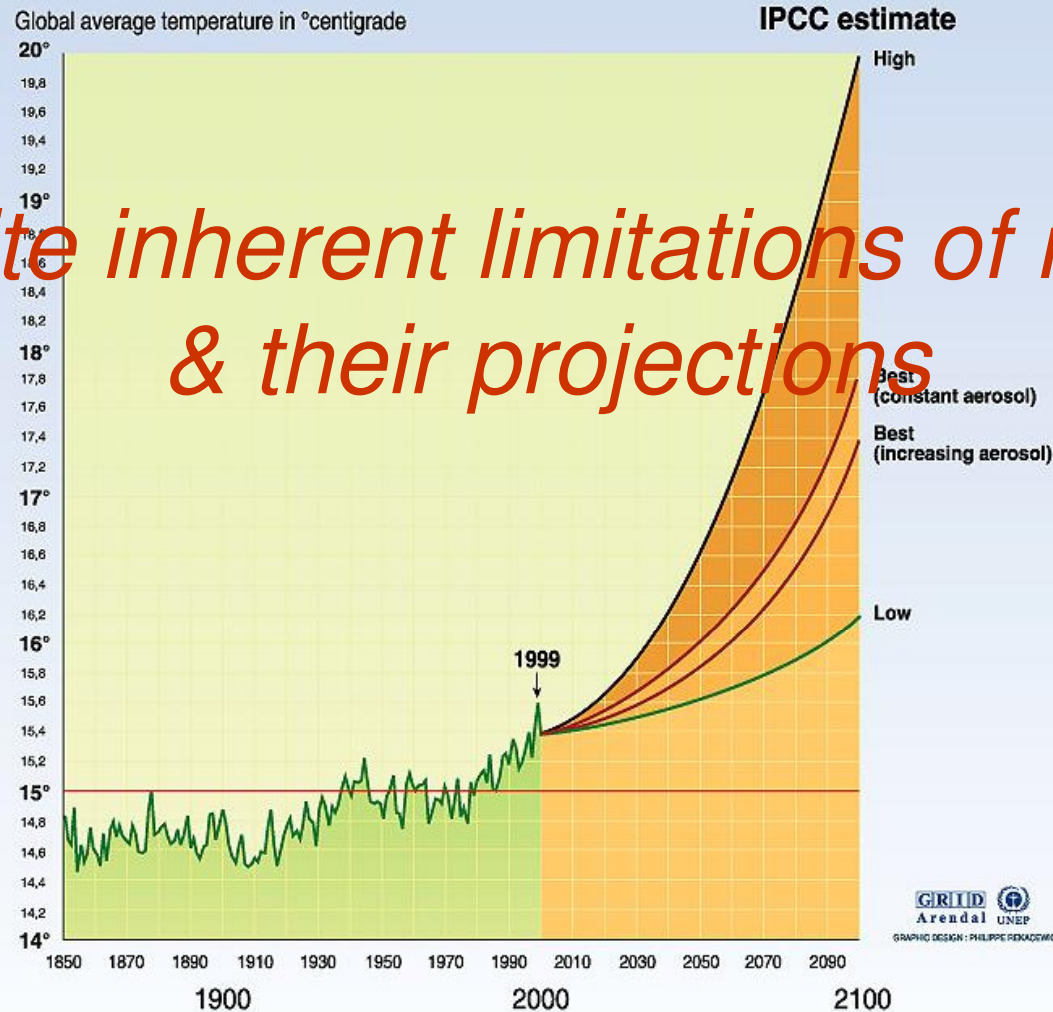
Climate Change Adaptation in India: Damages and Economic Assessments

Suruchi Bhadwal, TERI

OECD Experts Workshop on Adaptation

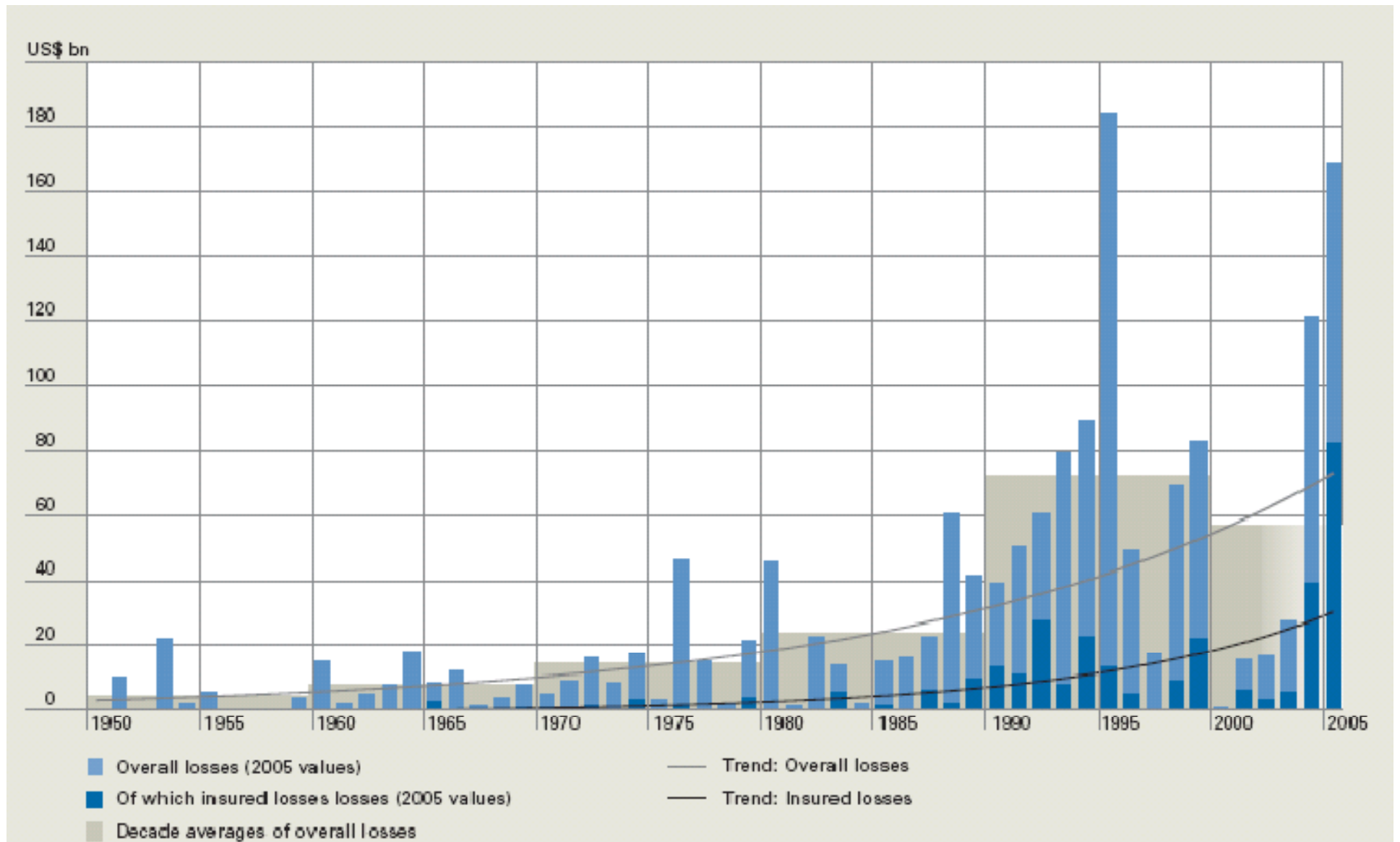
7th April 2008, Paris

Projected changes in global temperature:
global average 1856-1999 and projection estimates to 2100



*Despite inherent limitations of models
& their projections*

*An urgent need to respond with no time lag
IPCC AR4 quotes a narrow window of
opportunity available*



Economic losses due to extreme events (adjusted to present values)

Source: Munich Re

Developing countries: background and issues

- Vulnerability of developing countries and the poor within *clearly earmarked*; with their *inabilities to cope/ respond* to changes in the climate
 - Lack enabling environments with weak institutional infrastructure, technical and financial support systems
- Economies weather sensitive, largely agrarian in nature
 - High dependencies on climate sensitive sources to derive livelihoods - agriculture, forestry, fishery etc
 - Numbers (people) as high as 700 million in India alone, excludes impacts at the secondary stage

- Despite this there are no comprehensive studies that are reported on cost benefit estimations to assess the implications at the local level eg.,
 - global estimates; IPCC AR4, Stern Review 2006
 - other estimates; Ross Garnaut, Stephen Howes et. al., Garnaut assessment ANU
- Interested clients
 - Bilateral sources -IDRC, World Bank, DEFRA assist in research and carrying out the assessments
- International funds
 - GEF funds – SCCF, AF, WBCIF targetted towards implementation
- Integration into the national sustainable development framework
 - Various plans and programmes of the government wherein the climate risk factor is absorbed

India and current understanding on risks

- Has experienced about *300 catastrophes* in the last three decades, the largest in numbers in the region with casualties equally large (UNEP, 2002).
- It ranks as one of the most worst-hit countries in the world in terms of disasters
- With its growing populace, low-lying coastline, economy linked closely to its natural resource base the country is highly vulnerable to the consequences of climate change

Damage and cost estimations

Major Categories of Natural Disasters in India 1900-2007

Category	No of Events	People Killed	People Affected (Million)	Damage (US\$M)
Drought	11	4,250,300	711.84	942
Extreme Temperatures	41	13,148	--	544
Flood	198	55,243	747.93	21,355
Wind Storm	141	163,318	87.67	12,719

40 million hectare land mass is vulnerable to floods

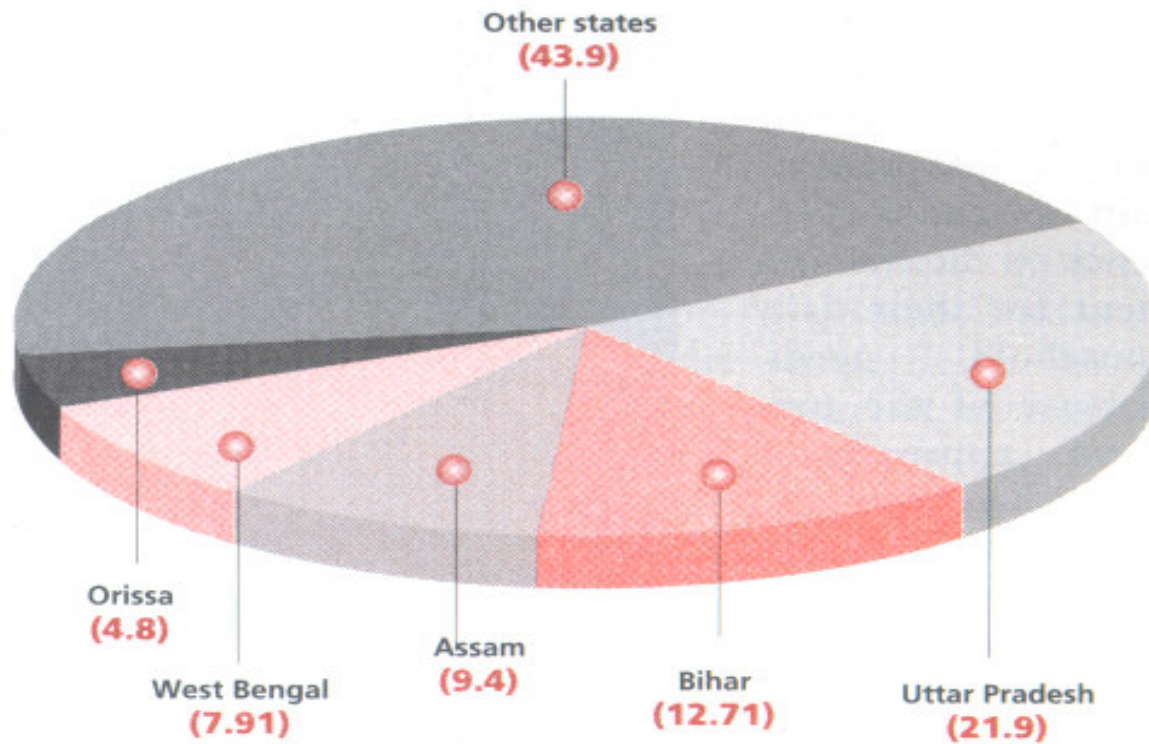
68% of net sown area is vulnerable to drought

Andhra Pradesh, Orissa, West Bengal and Gujarat are vulnerable to cyclones

Source: The OFDA/CRED International Disaster Database

Flood Prone States

Area distribution (in percentage) of the 40 million hectare flood prone area in the country

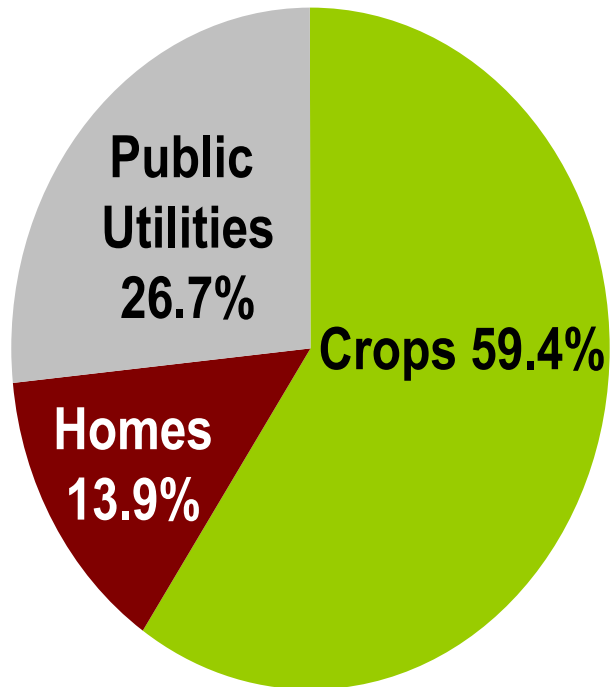


Flood Impact On Crop, Housing & Public Utilities (1961-2002)

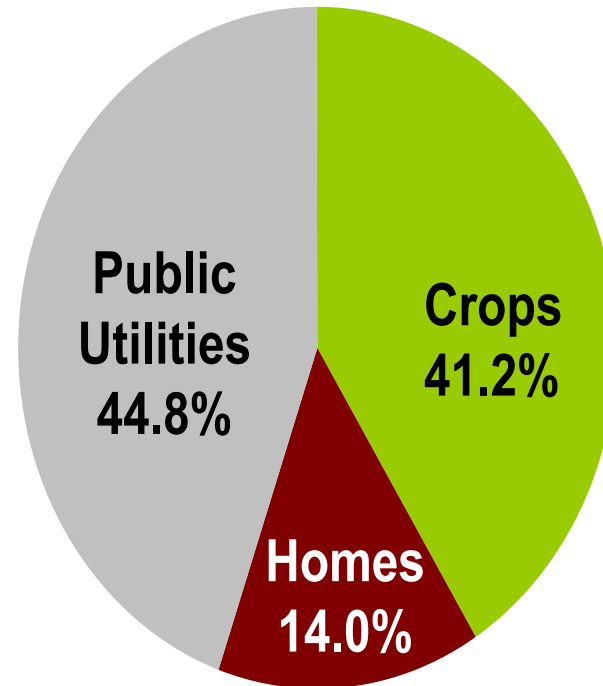
Average Flood Losses

- 8 million hectares flooded annually
- 1,504 lives lost
- Public utilities: INR 1186 cr
- Crop damaged 1095 cr
- House damage 370 cr

Value Damage Due To Floods/Heavy Rains



Annualized Average 1961-1981



Annualized Average 1982-2002

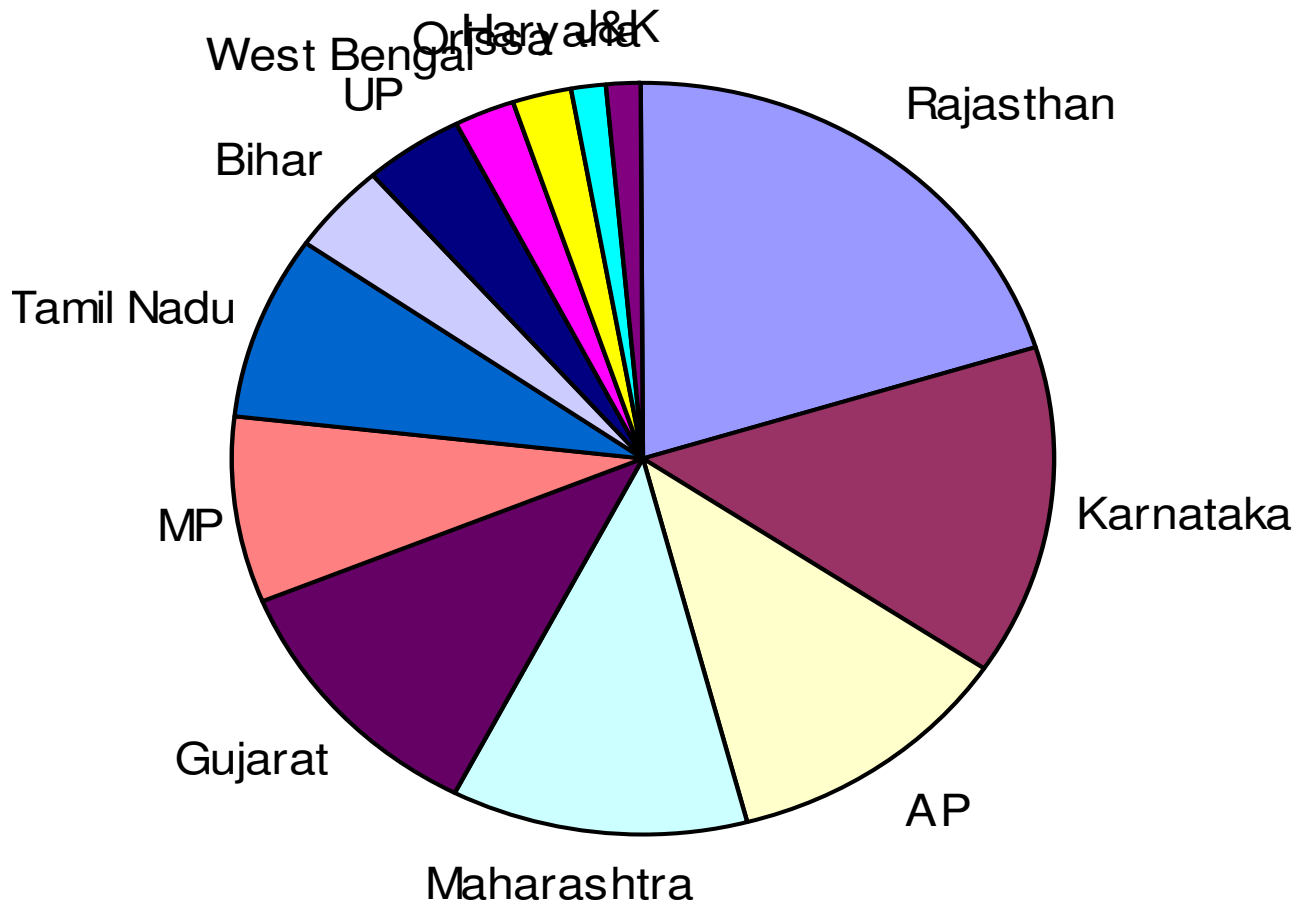
Drought in India

- 68% of the country is prone to drought
- 33% chronically drought prone (<750 mm per annum)
- 35% border line (750-1125 mm per annum)

Period	Frequency
1801-1825	6
1826-1850	3
1851-1875	6
1876-1900	5
1901-1925	7
1926-1950	2
1951-1975	6
1975-2000	9

Source: IMD

Drought Prone States



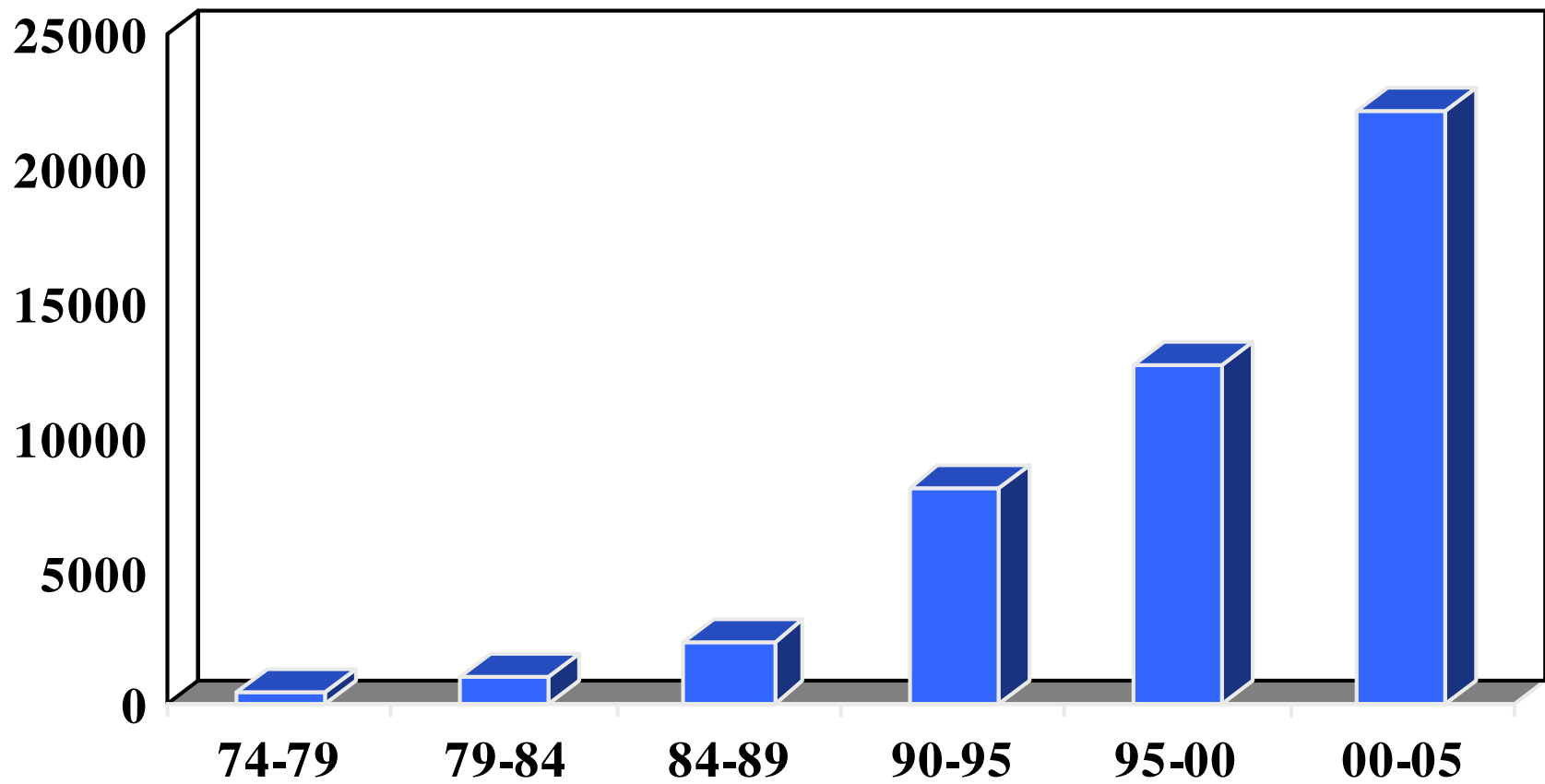
Source: NIDM

Agriculture and Climate Change

- 62% of cropped area depends on rainfall
- Kumar and Parikh (1998) estimated loss in net revenue (7%- 25%) with rise in 2 degree C and 3.5 degree C
- Mendelson (2005), estimated huge losses to the crops
 - \$1.1 to 86.7/ \$1.5 to 47.8 billion;
following an increase in temperatures and precipitation patterns

Sea Level Rise

- 1994, JNU study
 - under no protection scenario: 7.1 m people will be affected because of land loss
- 1996, TERI, at 1 meter sea level rise, 2100:
 - Economic cost
 - INR 2287 billion in case of Mumbai (Maharashtra)
 - INR 3.6 billion in case of Balsaore (Orissa)



Expenditures Rs Millions on Rehabilitation/ relief operations

Source: NIDM

Lessons From The Past

- 2003 World Bank report
 - \$30 billion in direct losses in last 35 years
 - Natural disaster direct losses of 2% GDP
- 2004 Mumbai floods losses stood at \$1.25 billion
- 1999 Orissa cyclone \$2.5 billion
- 1994 Gujarat losses \$1.5 billion

Select interventions and cost
benefit assessments – Climate
Risk Screening of Infrastructure
Projects

Programme selection

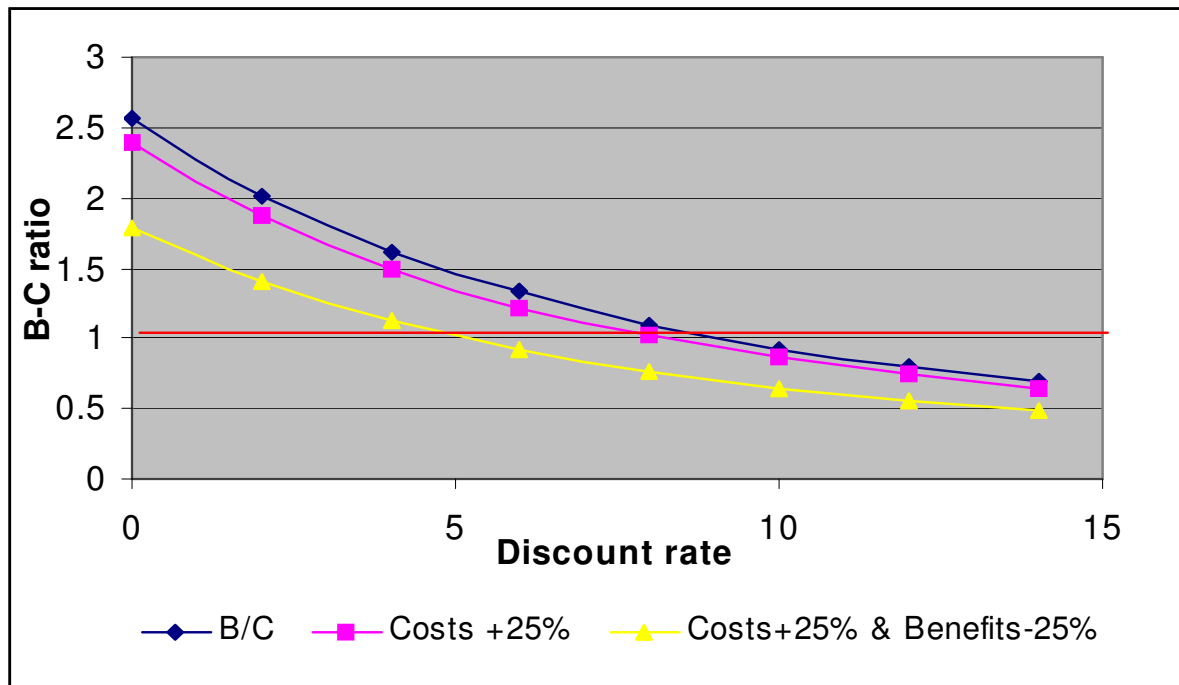
- Reducing the burden of water borne disease (diarrhoea), resulting from water logging due to flooding and poor sanitation conditions in Kolkata slums, under the KUSP program
- Improving water supply to schools through water harvesting in selected drought prone areas, under SSA program

1. Kolkata Urban Services for the Poor

- Under the KUSP program two strategies were analysed:
 - Re-enforced concrete construction of private twin pit toilets (S1).
 - Raising the floor level of community and private toilets (S2)
- Rupee value of total avoided losses (Income and health expenses) considering the beneficiaries served and probabilities of above average rainfall.

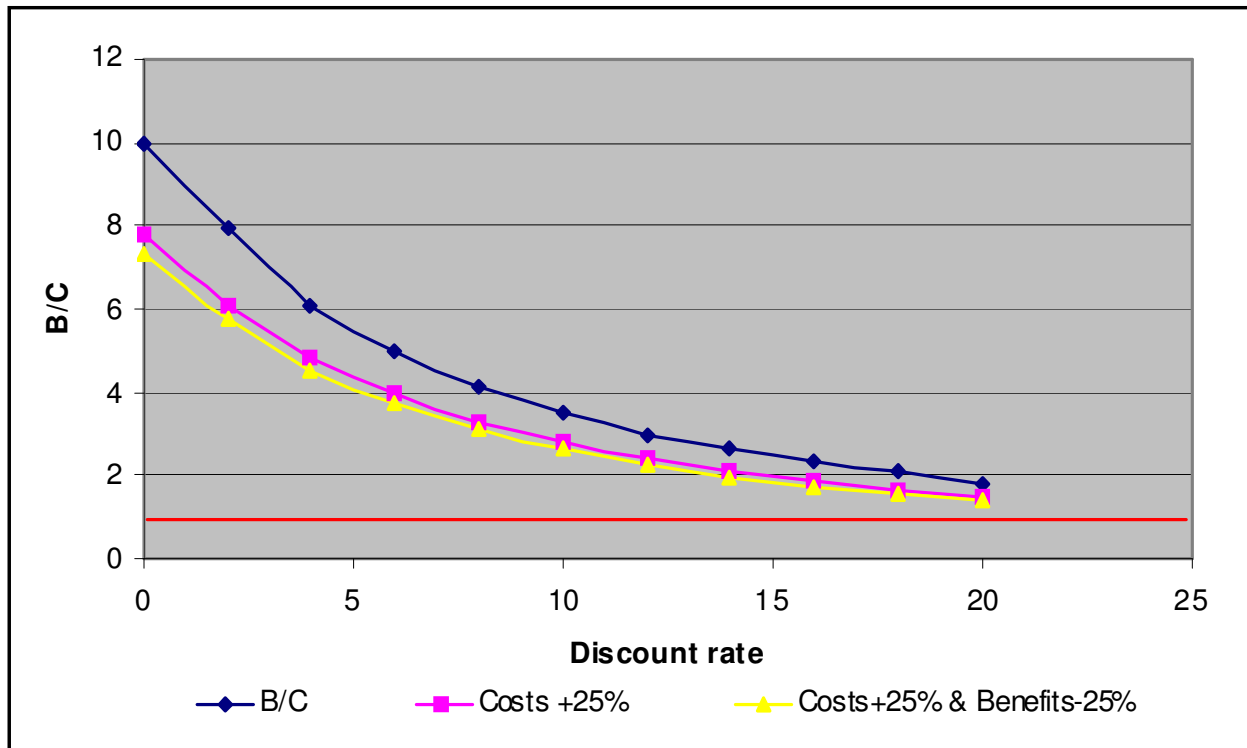
CBA results for S1 under KUSP

- The NPV of the recommended adaptation strategy for next 25 years is Rupees 10.29 million
- Benefit cost ratio is 1.091
- Estimated IRR is 0.953%



CBA results for S2

- The NPV of the recommended adaptation strategy for next 25 years is Rupees 93.41 million
- Benefit cost ratio is 3.8
- Estimated IRR is 29%

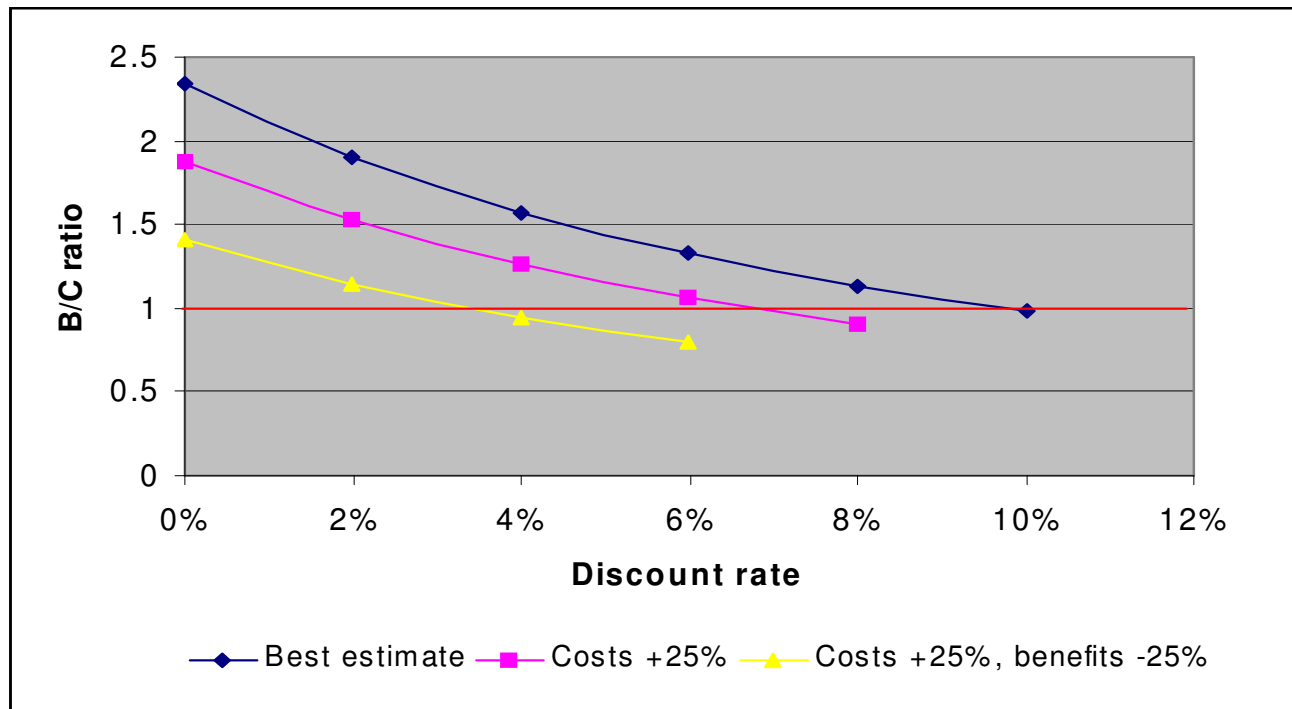


Sarva Sikshya Abhiyan

- Under the Sarva Sikshya Abhiyan one adaptation strategy is analysed:
 - rainwater harvesting in primary schools

CBA results for rain water harvesting

- The NPV of the recommended adaptation strategy for next 25 years is Rupees 19,050
- Benefit cost ratio is 1.136
- Estimated IRR is 9.84%



Limitations

- Benefits estimates based on primary and secondary data
- Does not estimate other direct and indirect benefits - paucity of relevant data.
 - Reduced contamination and improved ground water quality
 - Improved sanitation conditions
 - Reduced overall disease burden
 - *Improved general well-being of the residents*
- Single model outputs used

Thank You!