

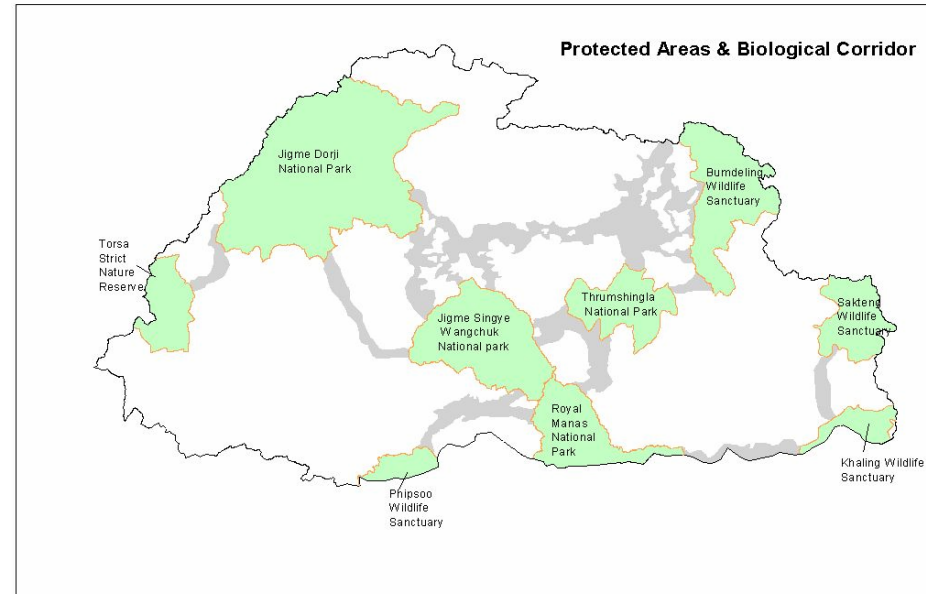
# Water Management in Bhutan



Earth Observation in the service of water  
management, Bangkok, Thailand  
26-28 September, 2006

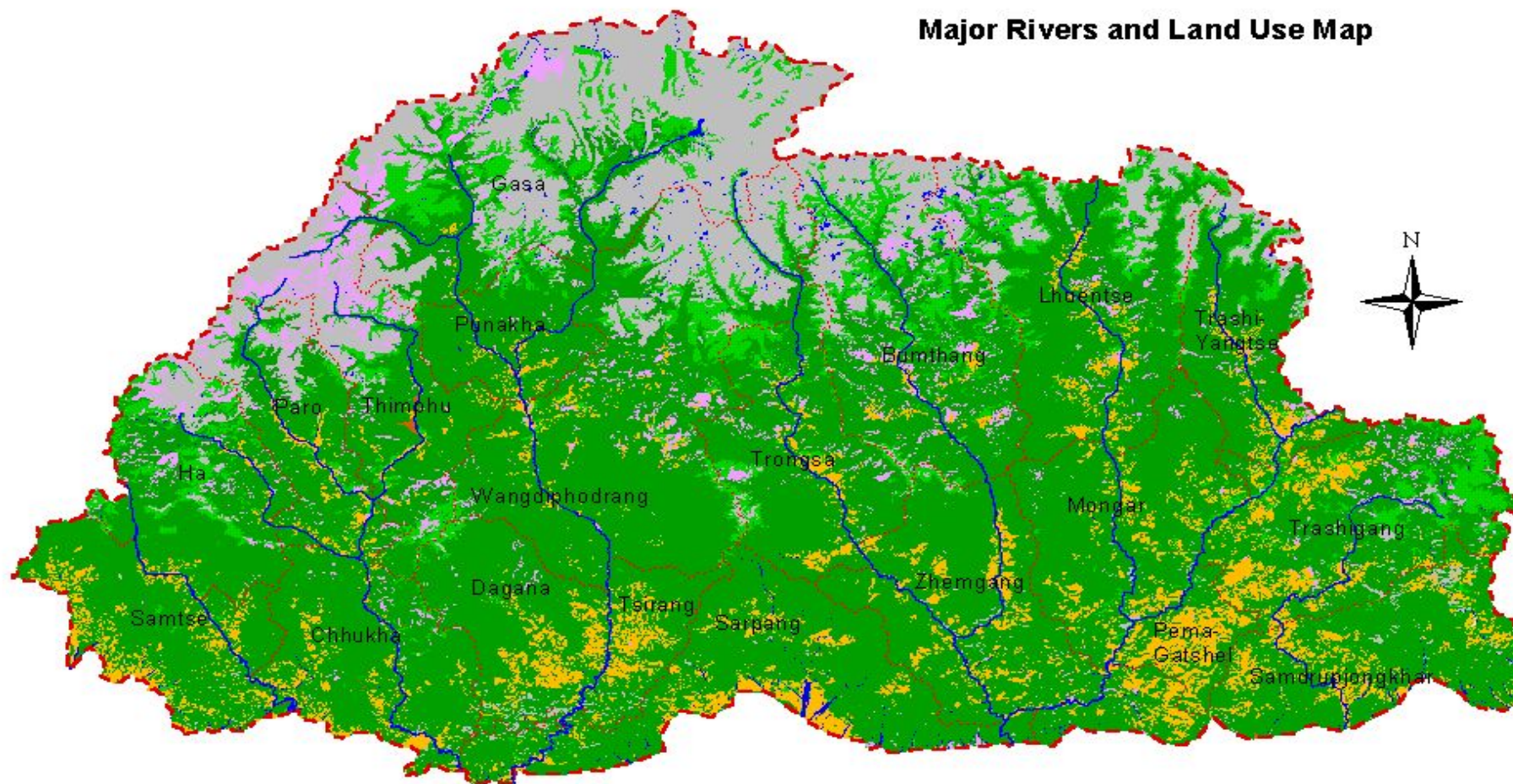
# State of Environment

- o High-level political commitment
- o Pristine Environment
  - o 72.5% forest cover
  - o 60% forest cover for all times
  - o 26.23% protected area
  - o 9% biological corridors
- o Flora and fauna
  - o >300 medicinal plants, 50 species rhododendron, >40 species of orchids, 770 species of birds
- o Annual SoE report to the parliament



# Water Resources in Bhutan

Major Rivers and Land Use Map

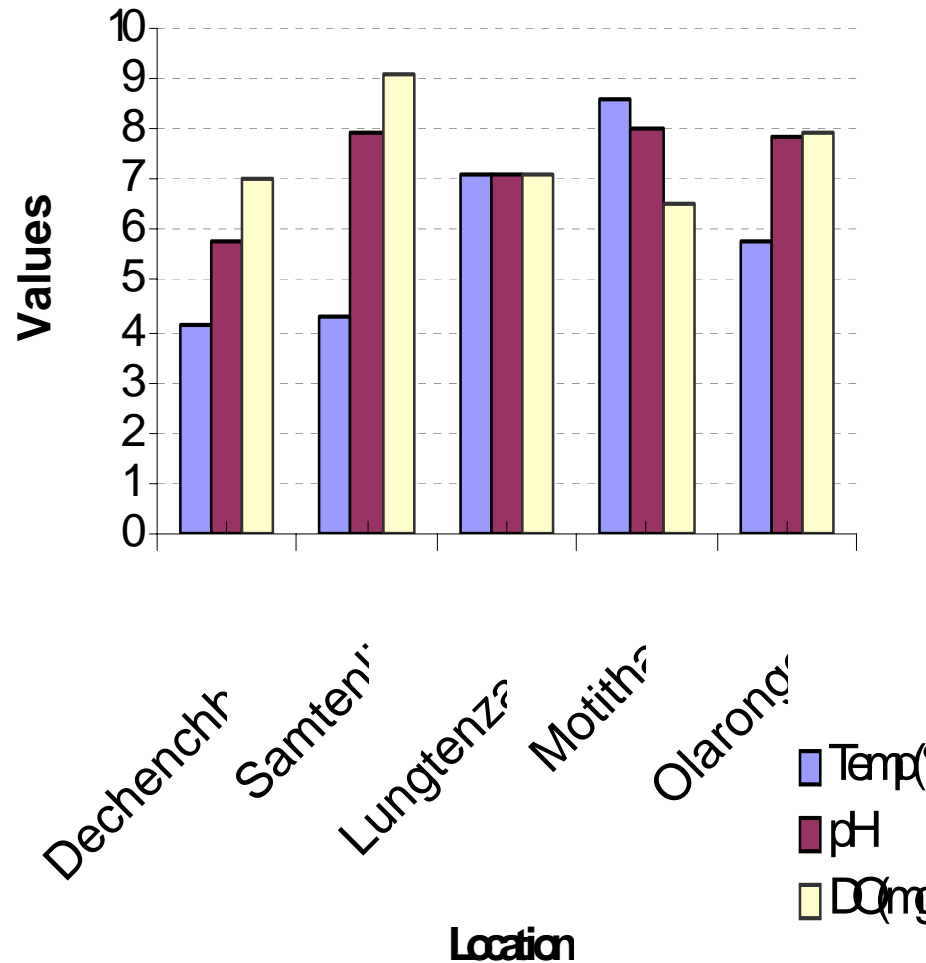


- Agricultural Land (including Horticulture)
- Forest (Broadleaf, Coniferous and Plantation)
- Forest Scrub
- Natural & Improved Pasture

- Rock outcrop, Snow cover, Open Eroded & Marshy Areas
- Water Spreads
- Settlement

# State of water

- On a macro scale Bhutan's water resources is very healthy
- Highly oxygenated
- Slightly alkaline
- Low conductivity
- No salinities



Preliminary data for Thimphu streams

# Water Resources in Bhutan

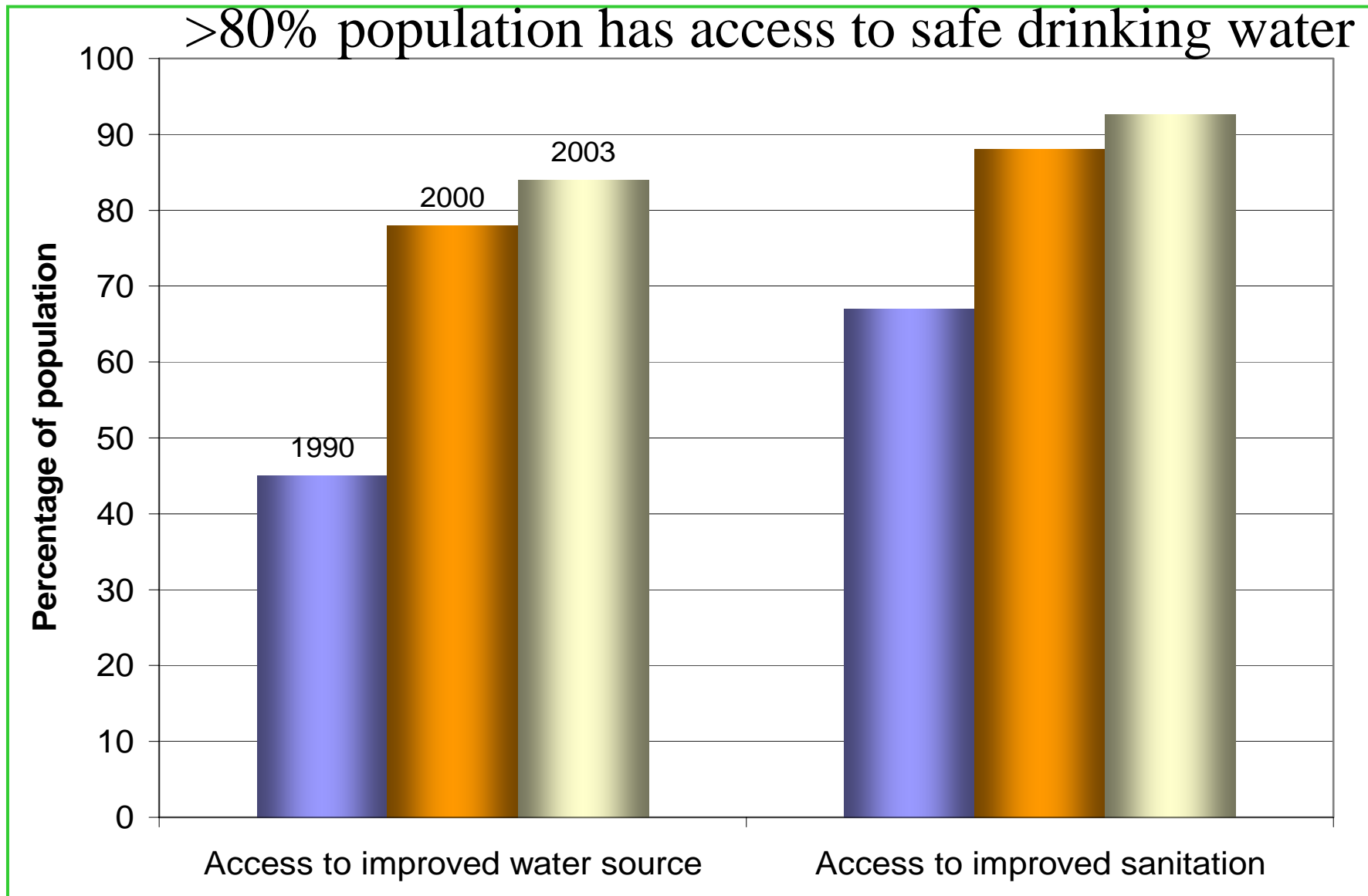
- Endowed with rich water resources
- Per capita availability of water per annum is 75,000 m<sup>3</sup>
- Average flow 1,600 m<sup>3</sup>/sec
- Good potential for hydropower development
- Only 1.4% of the country's hydropower potential is harnessed

# Water Resources in Bhutan

- Only 7.8% of the country's land area is arable
- 12.5% of the arable land is irrigated
- Clear priorities govern the planning, management and use of water resources
  - Water for human consumption, health and hygiene
  - Water for agriculture, energy, industry, tourism and recreation
  - Water for nature conservation, including prevention of natural disasters and emergencies shall always be a guiding element in all water allocation decisions



# Access to Improved water & improved sanitation



# The Changing Scenario

Bhutan has abundant water resources, but this resource will face new, complex and pervasive challenges caused by population growth and socio-economic development.

These challenges have to be faced. They must be effectively addressed through defined policies, acts, regulations, public education, stakeholder participation and well designed development programmes with efficient management strategies.

# Current Problems and Needs

- Seasonal fluctuations in flow
- Increasing sediment load – floods/landslides
- Competing demands at localized level
- GLOF
- Weak functional linkages at policy, planning and programming levels
  - Urban water supply – MoWHS
  - Rural water supply – MoH
  - Agriculture – MoA
  - Hydropower & GLOF – MTI
- Legal Instruments
  - Some provisions in Land Act/FNCA/EA Act/BEA/Municipal Act.
  - No comprehensive act on water

# Current Problems and Needs

- A common framework for water resources assessment. An inventory of water resources (quality and quantity) needs to be developed
- Coordinated efforts on water resources development and building of an institution for integrated approach in the management of water resources and its sustainable utilization
- Carefully conservation & management - to promote development without compromising the integrity of the natural ecosystem - IWRM
- Water for human sustenance has direct linkage with poverty

# Capacity Building

- Training of planners, managers, implementers and the users
- Awareness and advocacy
- Training of the existing technicians
- Refresher course
- Update of technical know-how and new innovative knowledges
- ASSESS-HKH Project
- State-of-art bioassessment
- A well equipped environmental lab

# Best Practices & Solutions

- Institutional Development for Water Resources Mgt.
- NEC – Coordination and Regulation
  - Planning of water resources at national level
  - Formulation of water policy and required legislation
  - Monitoring and evaluation
  - Setting water quality standards and guidelines
  - International water co-operation
  - Licensing and regulating activities
- Bhutan Water Partnership
  - ❖ Advisory body to the Royal Government
  - ❖ Members from ministries concerned, NGOs and private sector

# Emerging Env. Issues...

## Urbanization

- growth rate 10%-15% per annum
- Rural-urban migration

## Pressure on natural resources

- Land use change
- Pressure on limited resources (water, sanitation, energy etc.)
- Forestry (timber use)
- Housing
- Satellite towns
- Increase in number of automobiles
- Increase in wastes generation



# Emerging Env. Issues...

## Solid Waste Management

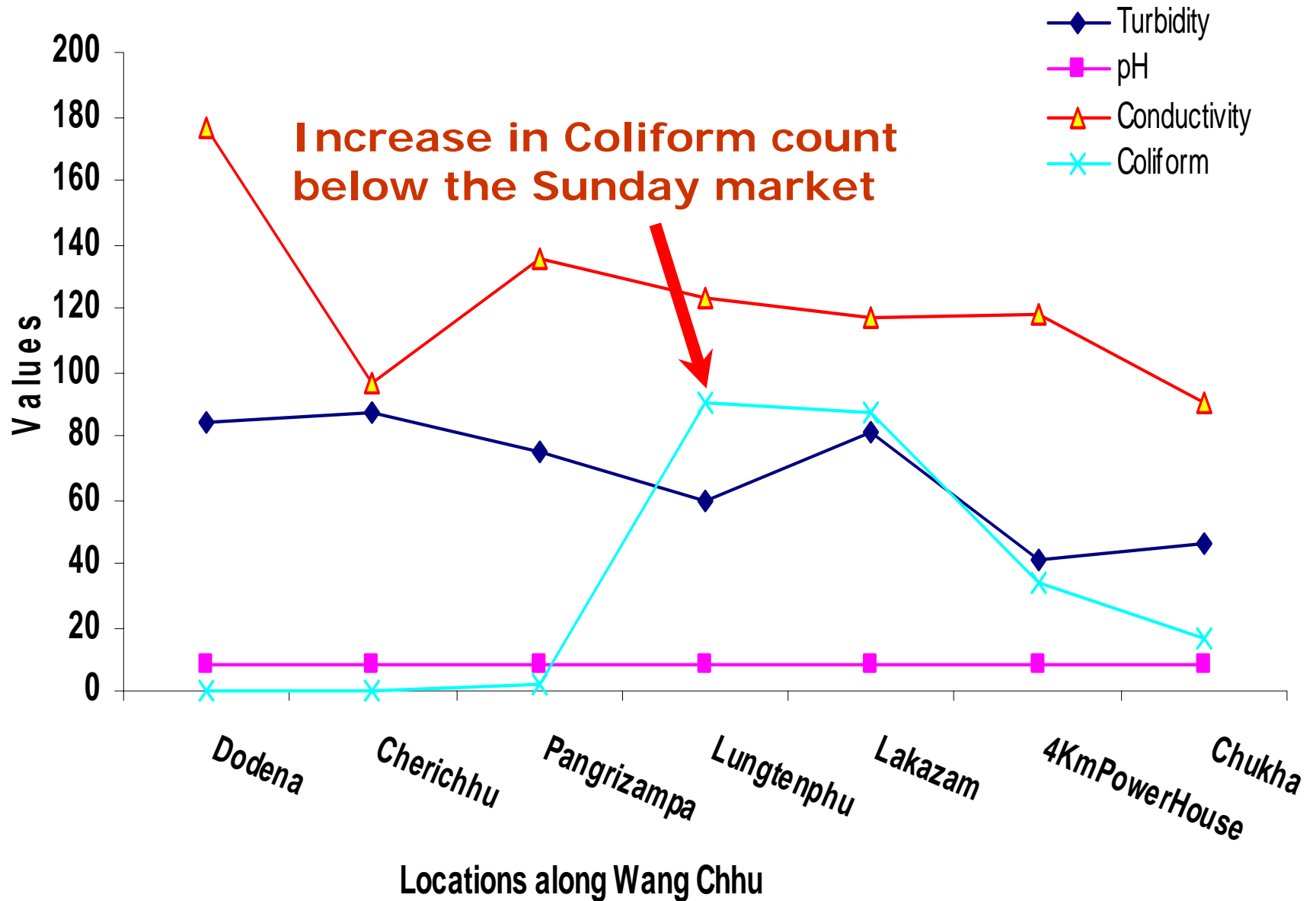
- Generation of wastes
  - 36 tons/day – Thimphu (3–4 tons/day 1980s)
  - 21 tons/day – Phuntsholing
- No segregation of wastes



# Water Pollution

- Localized pollution problems; unsanitary conditions along the banks
- Exacerbated at urban locations - surface drainage, oil and grease spills, grey water sullage from domestic households and uncontrolled seepage/overflow from septic tanks and piping flow straight into the river

# Thimphu River Quality



# Activities

- First water quality monitoring in 1997
- Water quality monitoring being conducted in the major river basins



# Bjee zam: Trongsa



**sampling sites:**

- ❖ Wangchhu basin - 20
- ❖ Mangdechhu Basin - 9
- ❖ Punatsangchhu Basin - 22
- ❖ Dangmechhu Basin - 11

# Parameters measured

- Temperatures (water and Air)
- Color
- Turbidity
- Total Hardness
- PH
- Dissolved Oxygen
- Conductivity
- Fecal Coli form
- COD
- BOD
- Ammonia
- Nitrate
- Phosphate
- Chloride
- Calcium
- Iron
- Arsenic
- Magnesium
- Silicon dioxide
- Boron
- Fluoride
- Zinc
- Manganese
- Chromium
- Copper

# Prevention methods

- Recycle materials whose production creates pollution
- Proper sewage treatment before release into rivers
- Act responsibly with household wastes and their disposal
- Education about protecting water
- Inculcating **civic sense**
- Regulate the use of pesticides





**Environmental Advocacy**

**Inculcating civic sense**



# Prevention methods

- Subject all activities through EA Process (EA Act 2000 & Regulation)
- Monitoring of industries & mines
- Vehicle Emission Standards
  - bi-annual tests by RSTA
- Industrial Discharge & Emission Standards
- Monitoring of Air & Water Quality



# Critical challenges



CAN WE SAVE THE FOREST  
WHILE USING THE TREES?

# Challenges

- ❑ Conserving the quantity and protecting the quality of water resources as a national asset
- ❑ Managing growing demands for water and energy at higher service levels
- ❑ Improving productivity and viability of rural livelihood support base in the face of increasing urbanisation



# Challenges

- ❑ Achieving adequate institutional and human resources capacity
- ❑ Anticipating, preventing and managing conflicts between competing uses and users of water resources
- ❑ Nurturing representative, responsive and transparent governance at all levels





*Thank You*  
*Tashi Delek*

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