# ‘River Basin Management with Emphasis on Inter-linking of Rivers in India’

# RIVER BASIN MANAGEMENT

- **Systematic & Integrated Development considering River Basin as a Unit**
- **Optimum Development of Water & Land for National Objectives accounting for Opportunities & Limitations**
- **To Integrate Views of Society & Affected People**
- **Development to be Multi Objective satisfying Economic, Socio & Environmental concerns in Orderly Manner**
- **Realistic Solution for Large Demands in Sustainable Manner**

## ----Contd

- **Judicious Allocation of Water Resource Between Various Uses**
- **Match Growing Demands With Supplies for Optimum Development**
- **Interaction Between Engineers, Planners,Policy Makers & Stake Holders**
- **Co-ordination Amongst Various Central and State Agencies**

# Elements/components of River Basin Management

- Planning
- Potential assessment and requirement
- Projects development
- Periodical Reassessment
- Prioritisation of Projects
- Integrated Operation
- Renovation & Modernization

- ✓ Allocation of Water for competing Uses
- ✓ Conjunctive Use of Surface & Ground Water
- ✓ Inter-basin Water Transfer
- ✓ Inter-state and International Issues
- ✓ Water Quality Management
- ✓ Pollution Control
- ✓ Reuse and recycling of precious water

- **Water for Ecological Security**
- **Water for Food Security**
- **Water for Health**
- **Resettlement and Rehabilitation**
- **Catchment Area Treatment**
- **Watershed Development**
- **Rain Water Harvesting**

# Management Aspects

- Improving Water Use Efficiencies
- Reservoir Operation and Management
- Participatory Irrigation Management
- Private Sector Participation
- Equity in Gender Participation
- Watershed Management
- Integrated River Management
- Setting River Basin Organisation ?

# NATIONAL WATER POLICY

## MAXIMISING AVAILABILITY

- *Plan Water Resources Considering Drainage Basin As A Whole*
- *Set up Multi-Disciplinary Units for Preparing Comprehensive Water Plans*
- *Make Water Available to Deficit Areas*

## WATER ALLOCATION PRIORITIES

- *Drinking Water Use*
- *Irrigation Needs*
- *Hydro Power*
- *NavigationIndustrial and Other Uses*

## SCIENCE & TECHNOLOGY AND TRAINING

- *Intensify Research Efforts In The Field Of Water Management*
- *Standardised Training Be Integral Part Of Water Management*

# NATIONAL WATER POLICY CONTD.

## INFORMATION SYSTEM

- *Establish Standardised National Information System*

## SAFETY OF STRUCTURES

- *Create Dam Safety Organisation At National And State Level*

## MAINTENANCE AND MODERNISATION

- *Maintain Structures In Good Health*
- *Undertake Modernisation And Rehabilitation Of Structures*

## OTHERS

- *Involve Farmers And Voluntary Agencies In Water Management And Collection Of Rates*
- *Promote Water Conservation*
- *Formulate Master Plan For Management For River Basins*
- *Minimise Land Erosion By Sea And River*
- *Drought Prone Area Be Made Less Vulnerable To Drought*

## INTEGRATED WATER RESOURCES DEVELOPMENT &MANAGEMENT – INDIAN PECULIARITIES

- ❖1/6th of World's Population
- ❖1/6th of Worlds Cattle
- ❖1/50th of World's Land
  - ➢Large extent in mountains & desserts
  - ➢1/8th Land prone to floods – can only be moderated
  - ➢1/3rd Land prone to droughts – no more famines
- ❖1/25th of World's Water – highly uncertain
  - ➢Mostly locked in Brahmputra Ganges system
- ❖Low education level for awareness & extension
- ❖Poor developing country

# Indian Per Capita Annual Water Availability (cu.m / capita / year)

- The Past
  - 1951 – 5177
  - 2001 – 1820
- Future Estimates
  - 2025 : 1341
  - 2050 : 1140

# Water Scarcity & Cost of Water Pollution

- International criteria for classification:
  - Water Stressed : Less than 1700 (cu.m / capita / year)
  - Water Scarce : Less than 1000 (cu.m / capita / year)
- 70% of global area including large parts of India will become water stressed by 2025
- **Impacts on Water quality & health are crucial**
- In India, health impacts by water pollution is over $30 billion; as large as 60% of total environmental damages

- By 2050, 90 BCM water will be required for Urban areas
- Use of ground water for human consumption poses serious quality and health related problems.
- Excessive use of ground water has several impacts on:
  - Cost - Health
  - Environment - Power consumption
- Lowering ground water deteriorates water quality
- Quality water supply need to be ensured through:
  - Water sensitive urban planning
  - Water Conservation
  - Adequate water storage in Indian monsoonic climate

# WATER VAILABILITY IN MAJOR COUNTRIES

**Five principal river basins: Amazon (16%), GBM, Congo, Yangtze, & Orinoko : together contribute 28% of world run-off.**

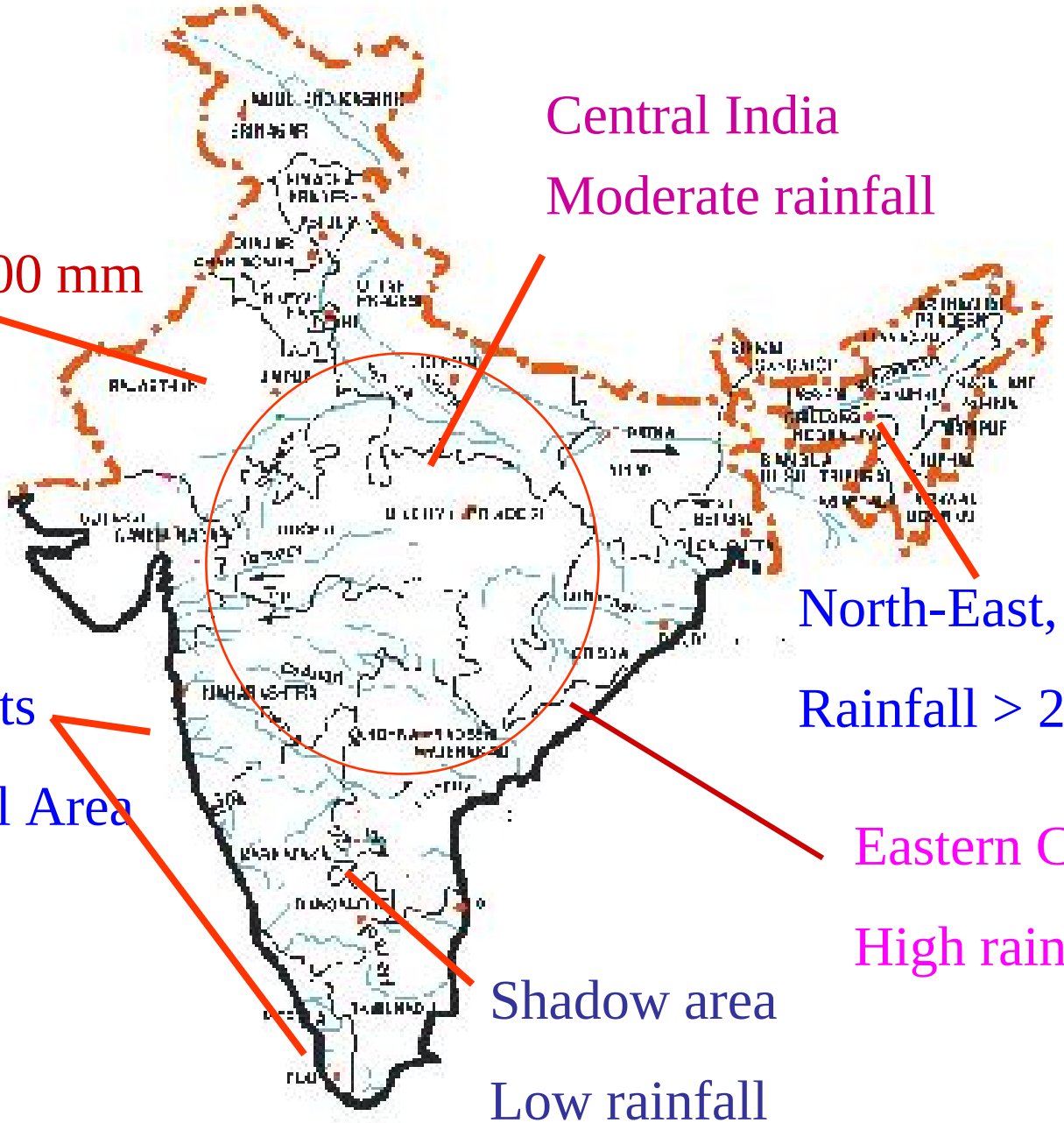
**Six countries account for 40 % of world run-off, as arranged in descending order of potential water availability (PWA) in per capita / year for 1995.**

| No. | Country | Area m sq km | Population million | PWA BCM/Yr | PWA 1000cu m/cap/yr |
|---|---|---|---|---|---|
| 1. | Canada | 9.98 | 31 | 3420 | 110 |
| 2. | Brazil | 8.55 | 170 | 8120 | 48 |
| 3. | Russia | 17.08 | 148 | 4300 | 29 |
| 4. | USA | 9.36 | 262 | 3080 | 12 |
| 5. | China | 9.60 | 1253 | 2700 | 2.2 |
| 6. | India | 3.29 | 1009 | 1900 | 1.9 |

# PECULIARTIES OF WATER AVAILABILITY IN INDIA

- Highly uneven in space & time.
- Rain fall in only 3 to 4 months.
- Brahmaputra – Barak – Ganga system alone carries 60% of total surface water resources.
- Brahmaputra – Barak – Ganga system is also rich in ground water.
- Western and Southern regions experience severe deficit in both Surface and Ground water.
- 2/3rd area experiences water deficit, while 1/8$^{th}$ area suffer from floods
- Drought-Flood-Drought Syndrome.

# Spatial Distribution of Rainfall



Rajasthan

Rainfall < 100 mm

Central India

Moderate rainfall

North-East, Very high

Rainfall > 2,500 mm

Western Ghats

High Rainfall Area

Eastern Coast

High rainfall

Shadow area

Low rainfall

# Precipitation in India

**Average Annual Precipitation 4000 Billion Cubic Meters**

**However, distribution of rainfall is very uneven**

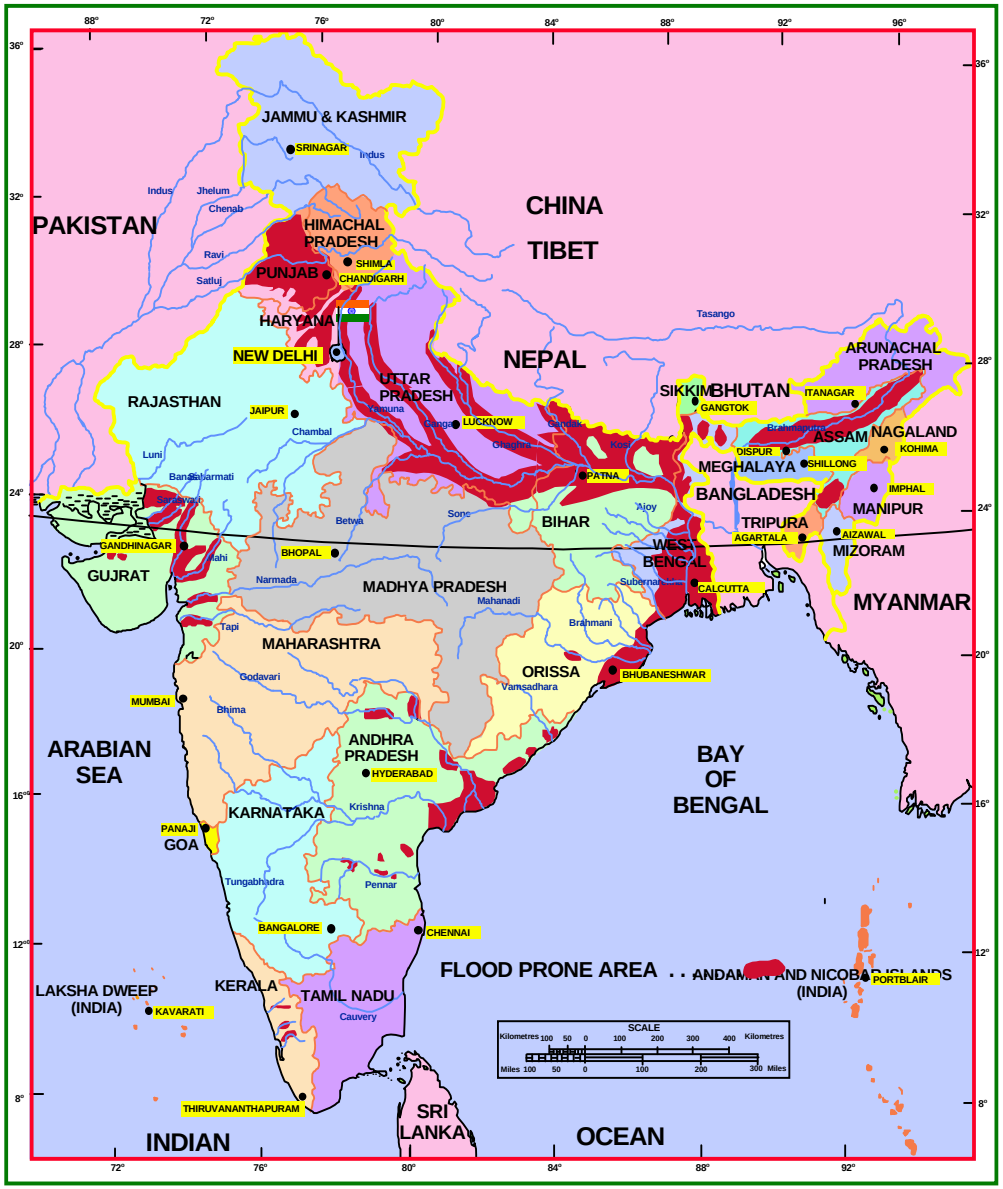
- **In space**
- **In time**

**And there is also very high variability from year to year.**

- **Most of rainfall occurs in about 4 monsoon months in a few spells**
- **Total rainfall hours about 100 hours.**

# INDIA

## AREA LIABLE TO FLOODS

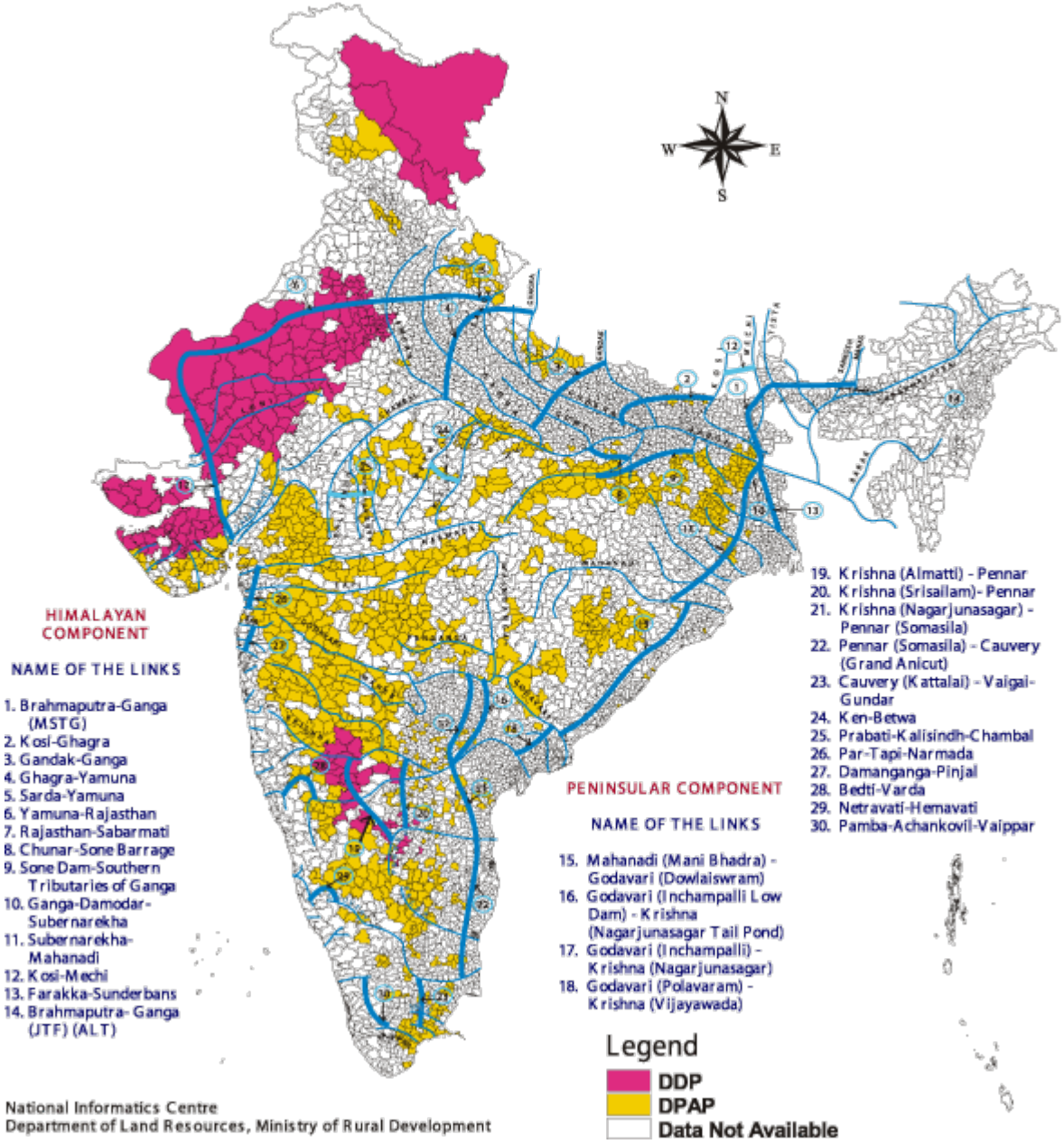



CWC/FMP/3043

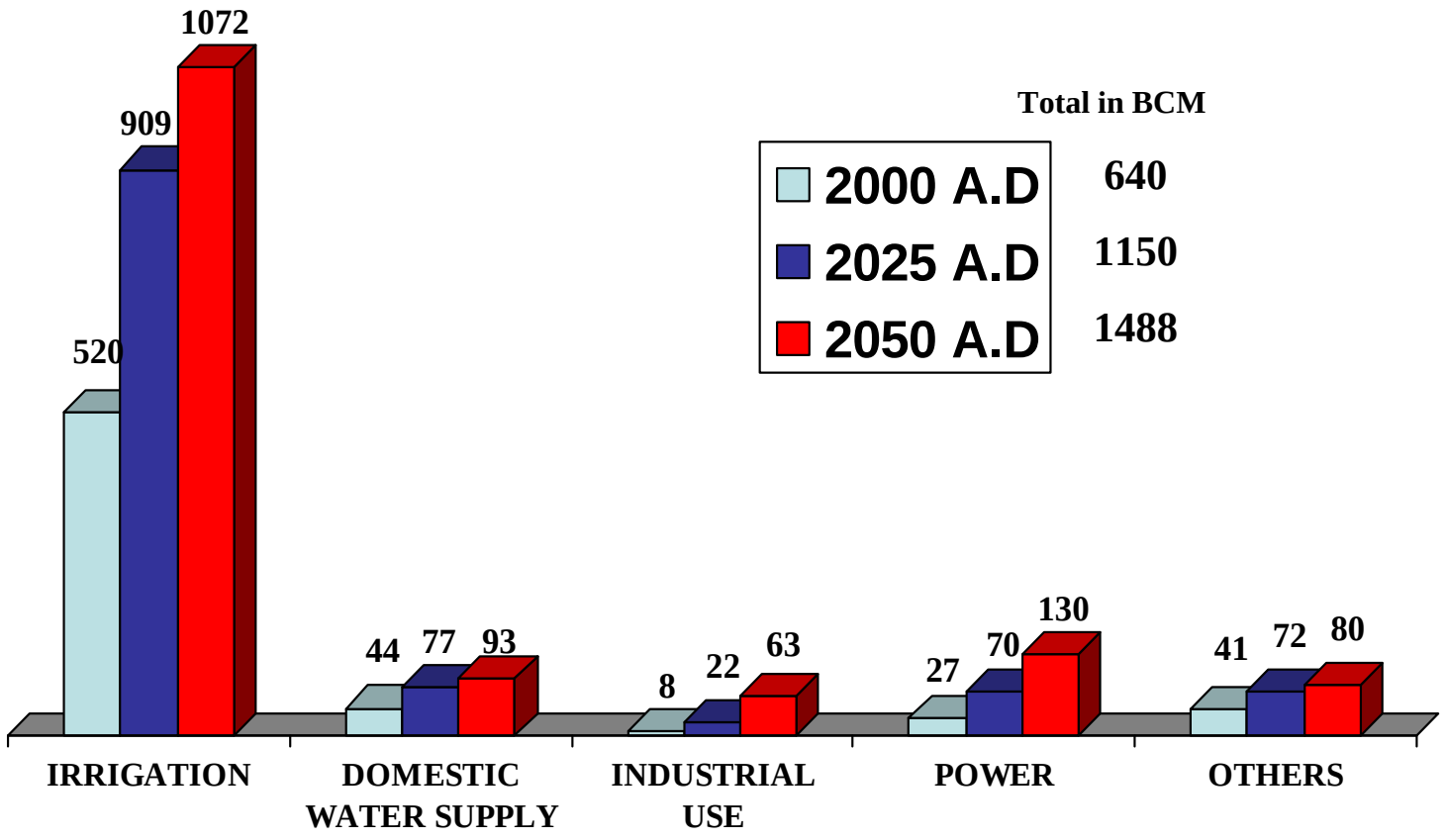
# AVERAGE ANNUAL FLOOD DAMAGE (1953-1999)

- **TOTAL DAMAGE : Rs.13,400 million**
- **AREA AFFECTED : 8.11 million hectare**
- **CROP AREA AFFECTED : 3.57 million hectare**
- **HUMAN LIVES LOST : 1579 Nos.**
- **CATTLE LOST : 95000 Nos.**

# Drought Prone Area Programme (DPAP) and Desert Development Programme (DDP)



# PROJECTIONS OF WATER DEMAND



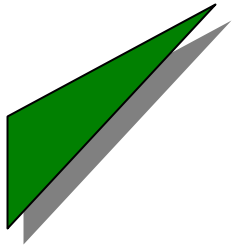
# Water Requirement

**Present Utilization** **650 bcm**

**Requirement by AD 2025** **1050 bcm**

**by AD 2050 1300 bcm**

**All data in billion cubic meters**



**Compare this with total availability**
**1122** bcm

# INDIA
# WATER AVAILABILITY

| | |
|---|---|
| TOTAL PRECIPITATION | 4000 BCM |
| RIVER RUNOFF | 1869 BCM |
| UTILISABLE FLOW | |
| SURFACE WATER THROUGH | |
| A) CONVENTIONAL MEANS | 690 BCM |
| B) INTER-BASIN TRANSFER | 200 BCM |
| GROUND WATER | 432 BCM |

# Water Scenario in India

**Average Annual Flow** **1869 bcm**

Utilizable quantity

- Surface sources 690 bcm
- Replenishable Ground Water 432 bcm

**Total Water Resources Availability 1122 bcm**

# CONCENTRATED WATER NEEDS IN INDIAN URBAN AREAS

**During last 50 years urban population increased from 14% to 33% & may reach 50% of total population by 2050.**

**Drinking Water requirements shall rise from 15 BCM to 60 BCM.**

**Supply of safe water to such a large urban population and WASTEWATER MANAGEMENT - a Herculean task**

**Watershed management,**
**Rooftop harvesting,**
**Check dams & tanks**
**Groundwater exploitations**

} **Can meet very little concentrated demands. Are such alternates cost effective & quality conscious? Effect of WSD on floods in himalayan catchments? Can hydropower be generated?**

**Already acute scarcity of water even for municipal uses in cities like Chennai, Bangalore, Delhi, Mumbai, Kolkata & Hyderabad. Water already transmitted from dams in neighbouring basins. Alternates must be technically feasible, economically viable and environmentally sustainable.**

# ISSUES FOR WATER MANAGEMENT IN INDIA

- Food Security & Political Stability
- Need for Increased Hydropower
- Socio-economic & environmental impacts of droughts
- Socio-economic & environmental impacts of floods
- Obstructions due to Activism
- Need of scientific awareness
- wastewater management more essential than polio-eradication

**Effects of Climate Change -**Climate change is no longer a *possibility*, it is a *certainty*.

- **Intensification of hydrologic cycle**
- **Increase in total rainfall, but a shift towards winter.**
- **More intense rainfall in fewer months and fewer hours**
- **More intense floods, more frequently.**
- **Longer and more intense summer ⇨ More demand for water.**
- **Slight increase in average temperature ⇨ Large increase in agricultural requirement.**
- **Fewer rainfall months ⇨ water will have to be stored for longer durations.**

# Indian River Basins

- Grouped in 20 River Basins
- 12 Major and 8 Composite River Basins
- Projects developed mostly for Specific and Limited Purpose
- Most River Basins are Inter-state
- Many Projects blocked due to Inter-State Disputes

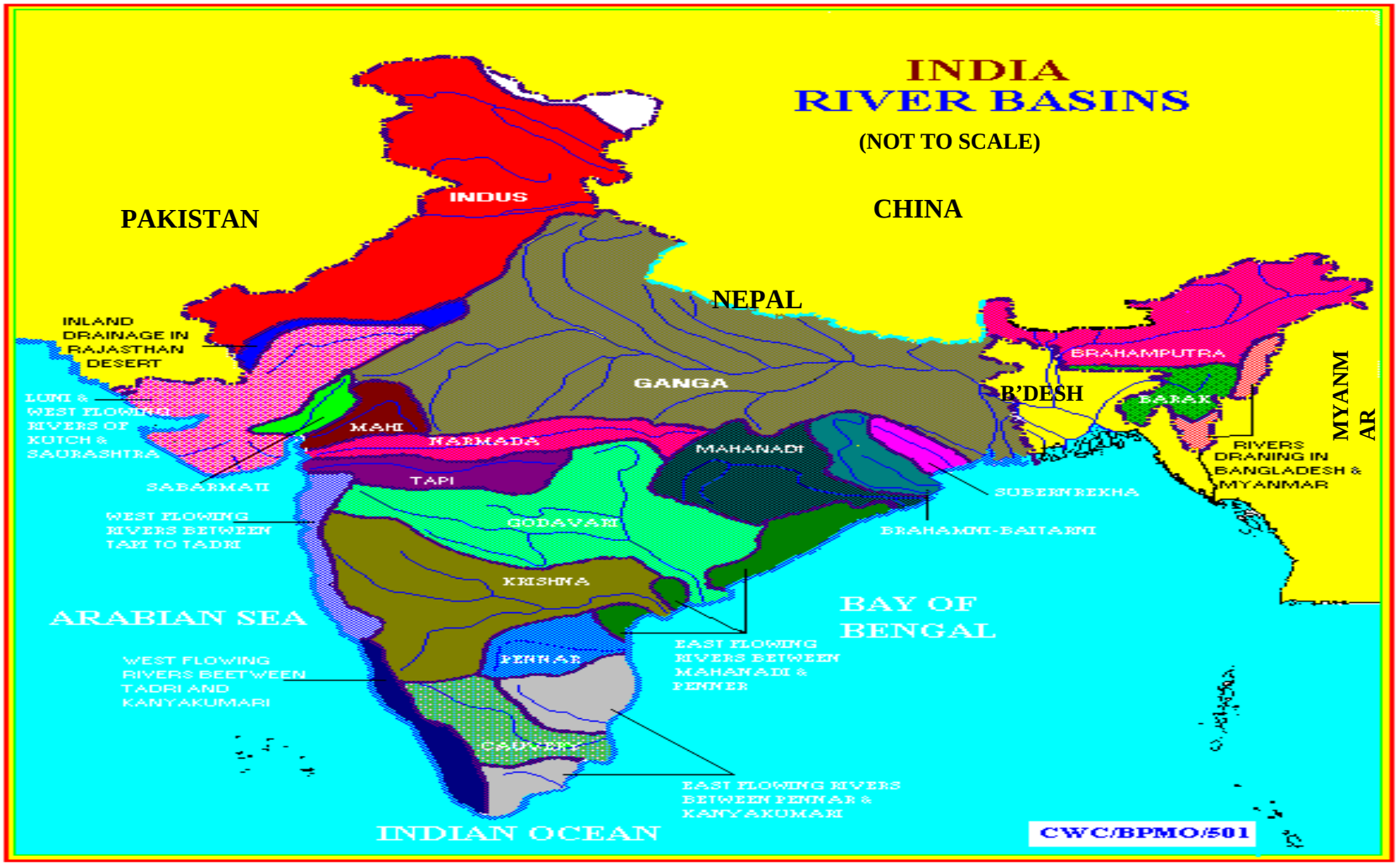
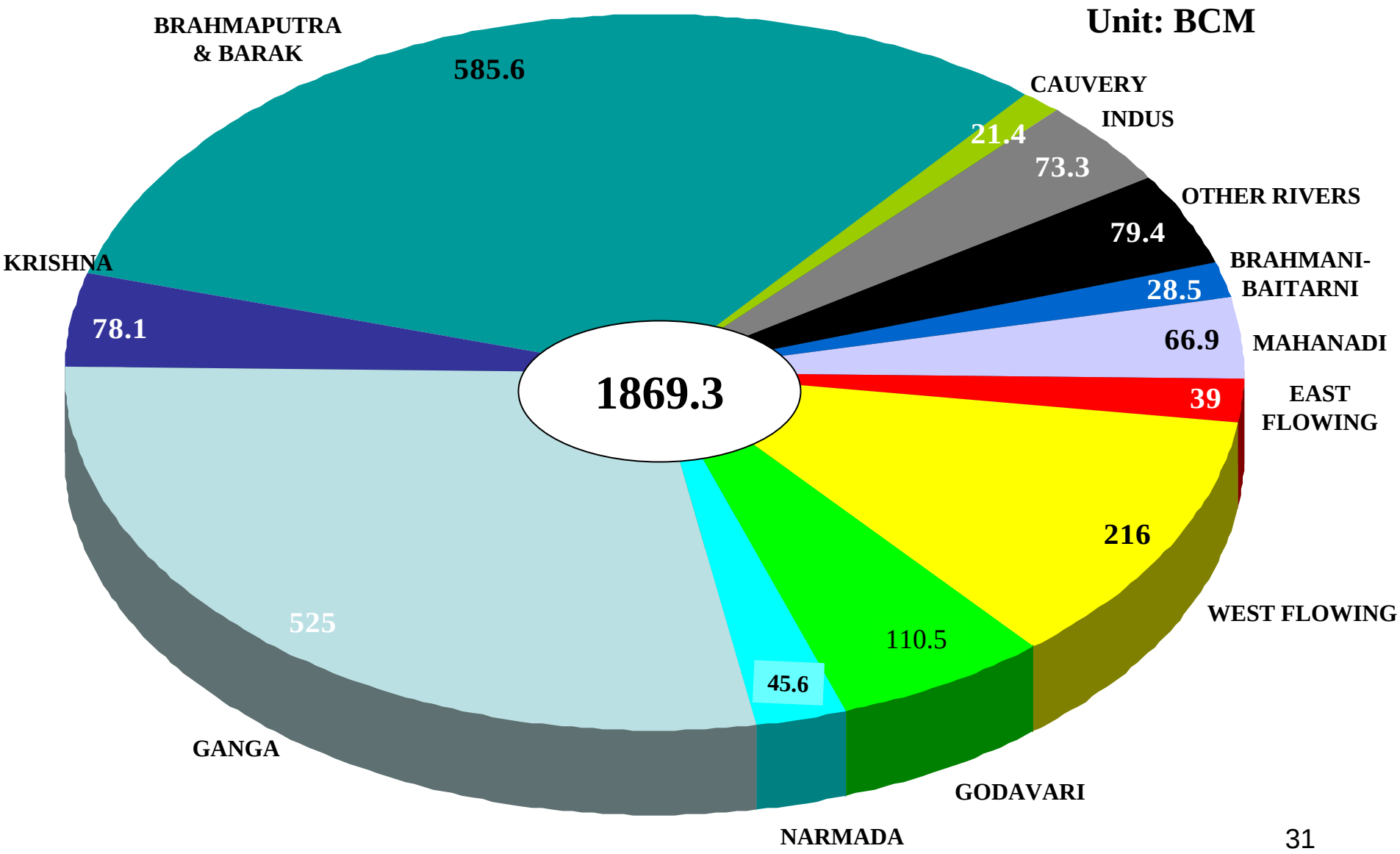

INDIA
RIVER BASINS
(NOT TO SCALE)
PAKISTAN
CHINA
NEPAL
B'DESH
MYANMAR
INDUS
GANGA
BRAHAMPUTRA
BARAK
INLAND DRAINAGE IN RAJASTHAN DESERT
LUNI & WEST FLOWING RIVERS OF KUTCH & SAURASHTRA
MAHI
NARMADA
TAPI
SABARMATI
WEST FLOWING RIVERS BETWEEN TAPI TO TADRI
MAHANADI
SUBERNREKHA
BRAHAMNI-BAITARNI
RIVERS DRANING IN BANGLADESH & MYANMAR
GODAVARI
KRISHNA
ARABIAN SEA
BAY OF BENGAL
EAST FLOWING RIVERS BETWEEN MAHANADI & PENNER
PENNAR
WEST FLOWING RIVERS BEETWEEN TADRI AND KANYAKUMARI
CAUVERY
EAST FLOWING RIVERS BETWEEN PENNAR & KANYAKUMARI
INDIAN OCEAN
CWC/BPMO/501

**Fig:1**

# INDIA

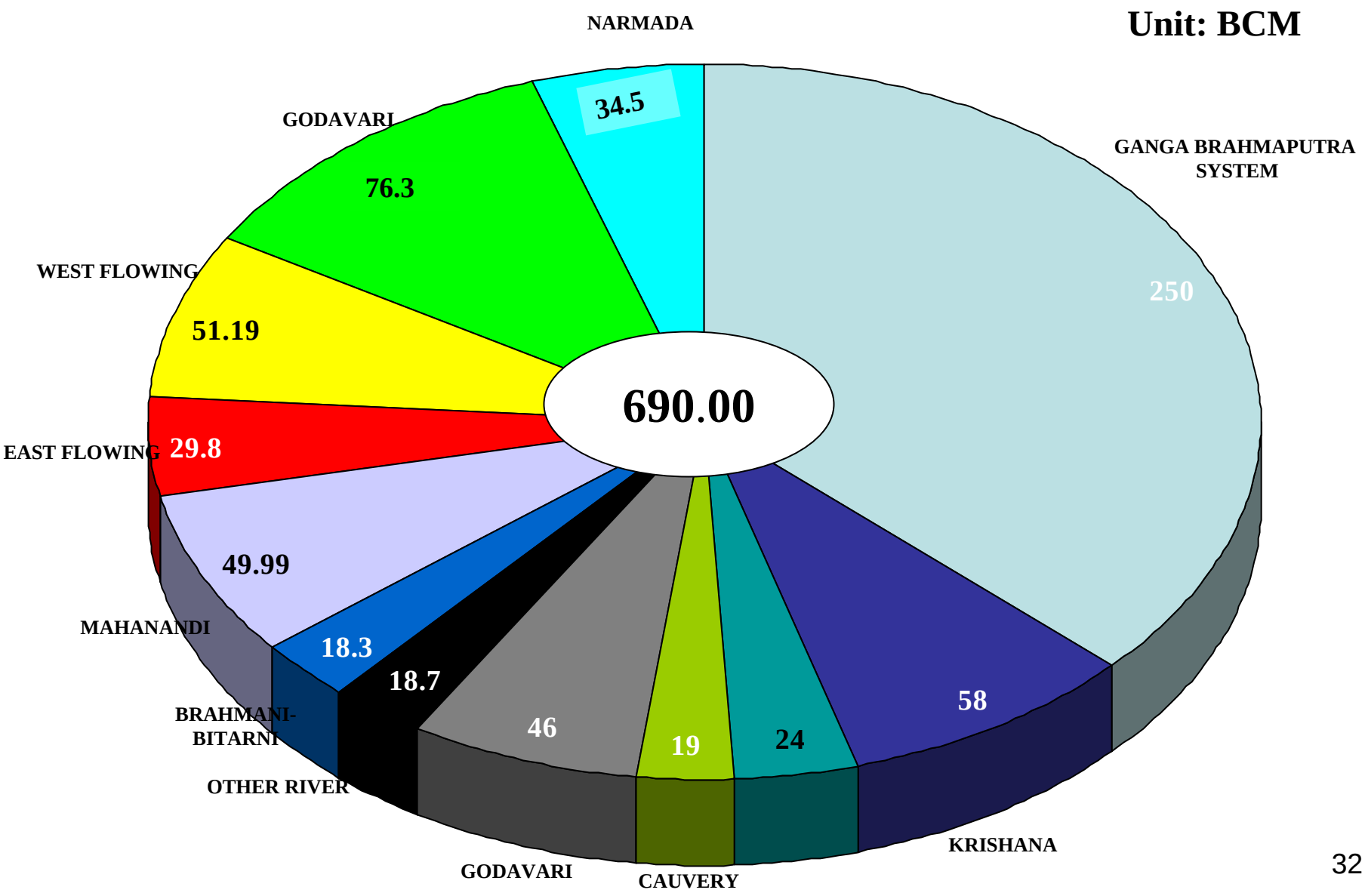
| S.No | BASIN | CATCHMENT AREA (SQ. KM.) |
|---|---|---|
| 1. | INDUS | 321289 |
| 2.(a) | GANGA | 861452 |
| (b) | BRAHMAPUTRA | 194413 |
| (c) | BARAK | 41273 |
| 3. | GODAVARI | 312812 |
| 4. | KRISHNA | 258948 |
| 5. | CAUVERY | 81155 |
| 6. | BRAHMANI | 39033 |
| 7. | MAHANADI | 141589 |
| 8. | PENNAR | 55213 |
| 9. | MAHI | 34842 |
| 10. | SABARMATI | 21674 |
| 11. | NARMADA | 98796 |
| 12. | TAPI | 65145 |

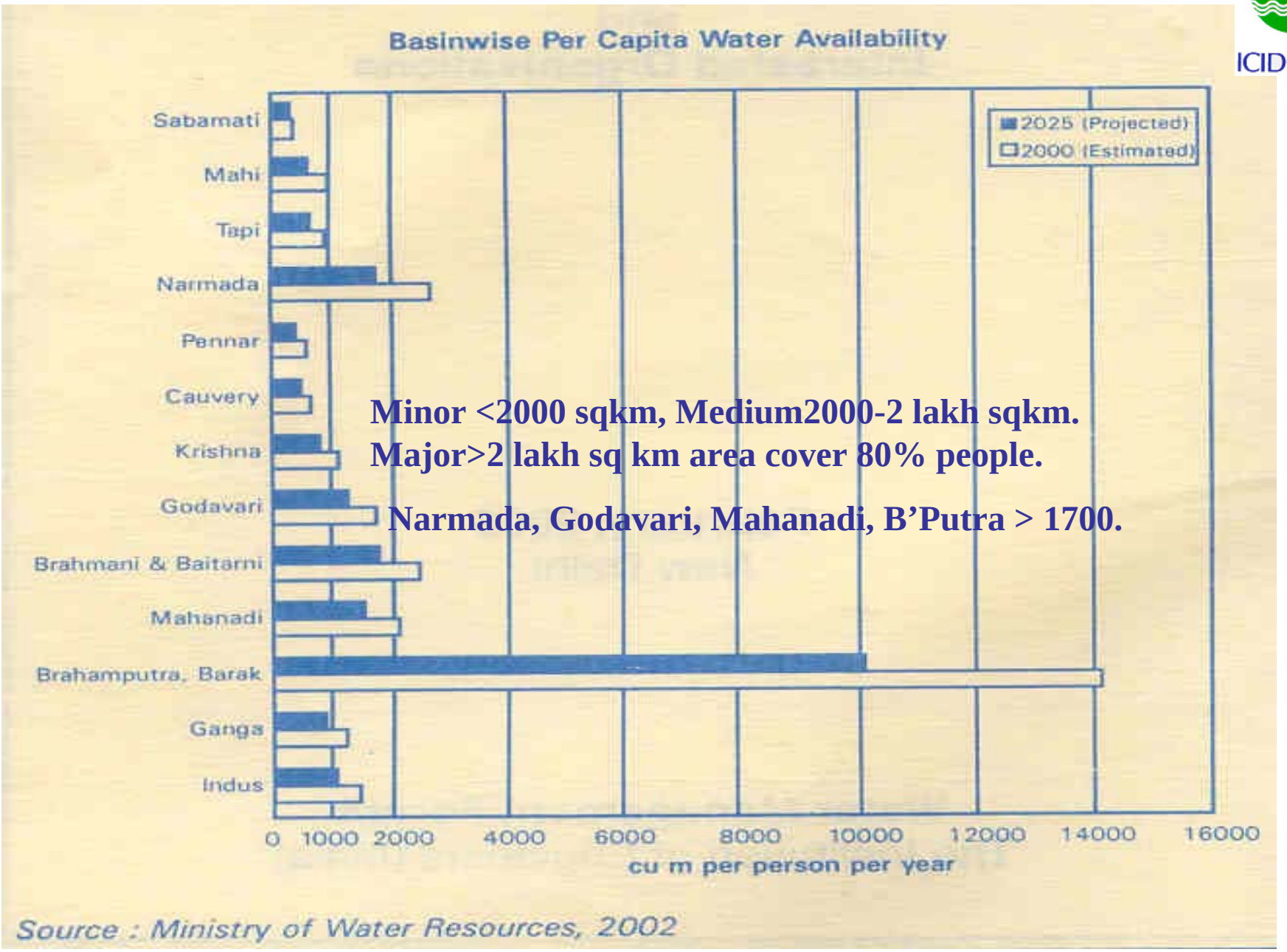
# BASINWISE WATER RESOURCES POTENTIAL



# BASINWISE UTILISABLE WATER RESOURCES

Unit: BCM






**Minor <2000 sqkm, Medium2000-2 lakh sqkm.**
**Major>2 lakh sq km area cover 80% people.**

**Narmada, Godavari, Mahanadi, B'Putra > 1700.**

## SUPREME COURT JUDGEMENT 2000(NBA vs. GoI) ON NARMADA PROJECTS & PERFORMANCE EVALUATION PROVE THAT LARGE STORAGE DAMS & INTER-BASIN RIVER VALLEY PROJECTS

### ENHANCE ECO-SYSTEMS AND *ESSENTIALLY NEEDED FOR*

- *food*
- *fodder*
- *fibre*
- *energy*
- *forests*
- *tourism*

- ***REVERSE DESERTIFICATION, GREEN THEM, REDUCE SAND STORMS. (IGNP, Bhakra-Beas in Punjab, Haryana, Rajasthan)***
- ***REDUCE IMPACTS OF FLOODS, CYCLONES, DROUGHTS (DVC)***
- ***REJUVENATE PENINSULAR RIVERS IN DRY SEASON. STABILISE ECO-SYSTEMS. (Return flow, seepages)***
- ***ENABLE GROWTH OF MORE BIOMASS PER UNIT COMMAND AREA.***

- ***DAMS REGULATE FLOW AND DEPOSITS OF SEDIMENT***
- ***STABILISE FISH CULTURE (in reservoirs, in d/s rivers).***
- ***ENHANCE FORESTRY (on reservoir's rim and command)***
- ***PROVIDE WATER FOR FLORA & FAUNA***
- ***STABILISE ECO-SYSTEMS SPECIALLY IN***
  ***Desserts, Deltas, Estuaries & Coastal Area***
  ***because of regulated releases, and rejuvenated rivers***
- ***IMPROVE WATER QUALITY***
- ***RECHARGE GROUNDWATER***
- ***REDUCE POVERTY, WHICH IS THE WORST POLLUTOR***

**NBA not given a single instance of 'on the whole' adverse impact on environment**

- **Complete SSD construction to final height as per NWDT Award.**
- **SC satisfied that more than adequate steps for R&R taken**
- **Only 4 villages fully & 241partially submerged. Largely houses affected.**
- **Objection to R&R is not from hill tribals, but from rich landed farmers who fear loss of tribal labour.**
- **'PIL' is BALOONING can't be allowed to BURST.**
- **PIL must not degenerate into "Publicity Interest Litigation" nor "Private Inquisitiveness Litigation".**
- **With channelisation of development, ecology & environment enhanced.**
- **Biggest dam to smallest structures are water harvesting structures**

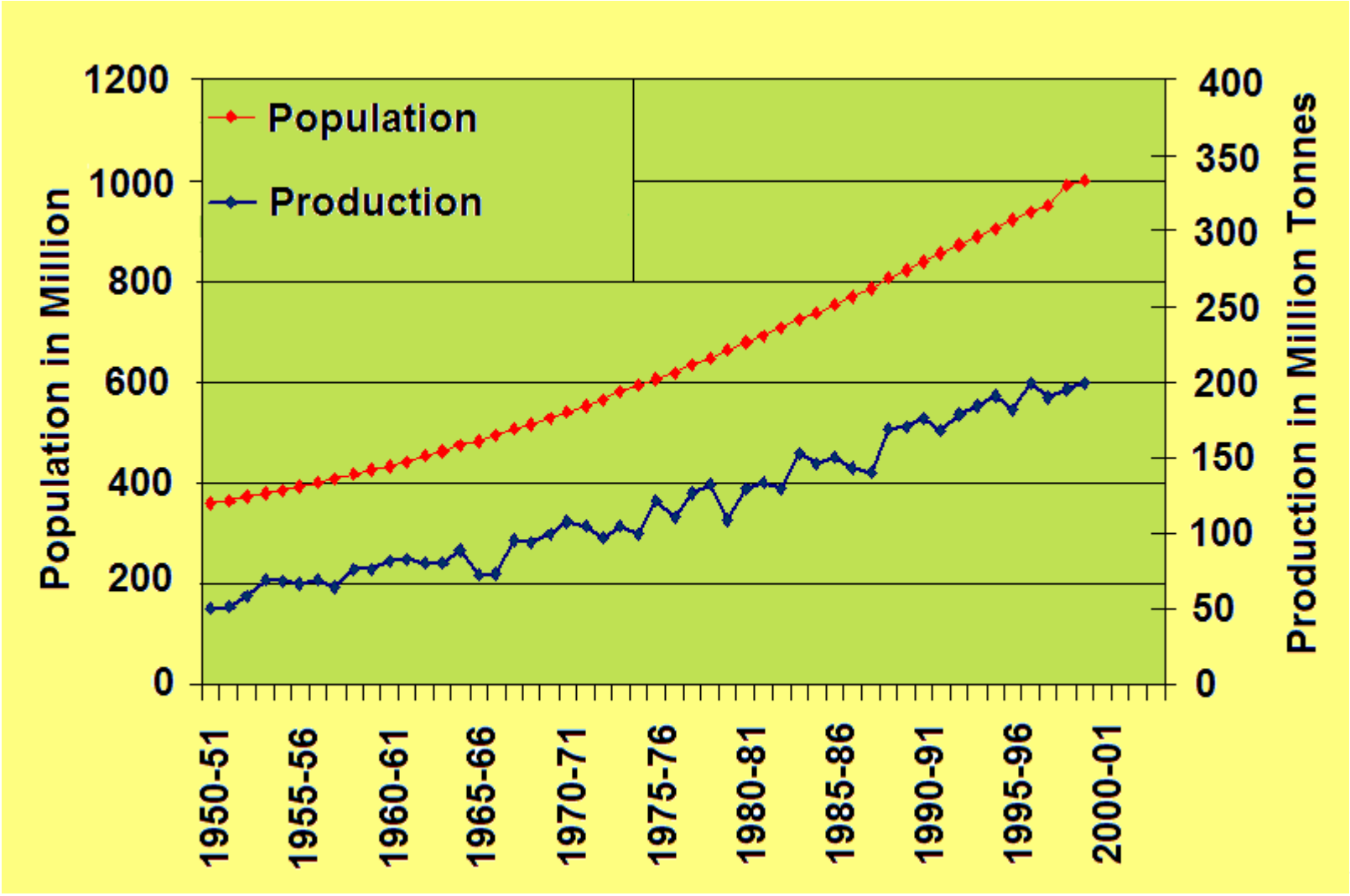
- **NBA not allowing surveys for demarcation.**
- **NBAs efforts to stall SSD through FMG failed.**
- **Environmental clearance not lapsed.**
- **Clearance given at PM level.**
- **Substantial compliance done.**
- **Dam is neither Nuclear Establishment nor industry.**
- **Since long, India has derived benefits of RVPs.**
- **High dam decision can't be faulted.**
- **Large dams upgrade ecology.**

**SSP benefited/affected peoples' proportion 100.**

**If multiplier effect considered, it is 200.**

- **Highly liberal packages for R&R adopted in Tehri, Almatti and Sardar Sarovar dams**
- **Compensatory afforestation and large catchment area treatment completed in Tehri, Almatti and Sardar Sarovar dams.**

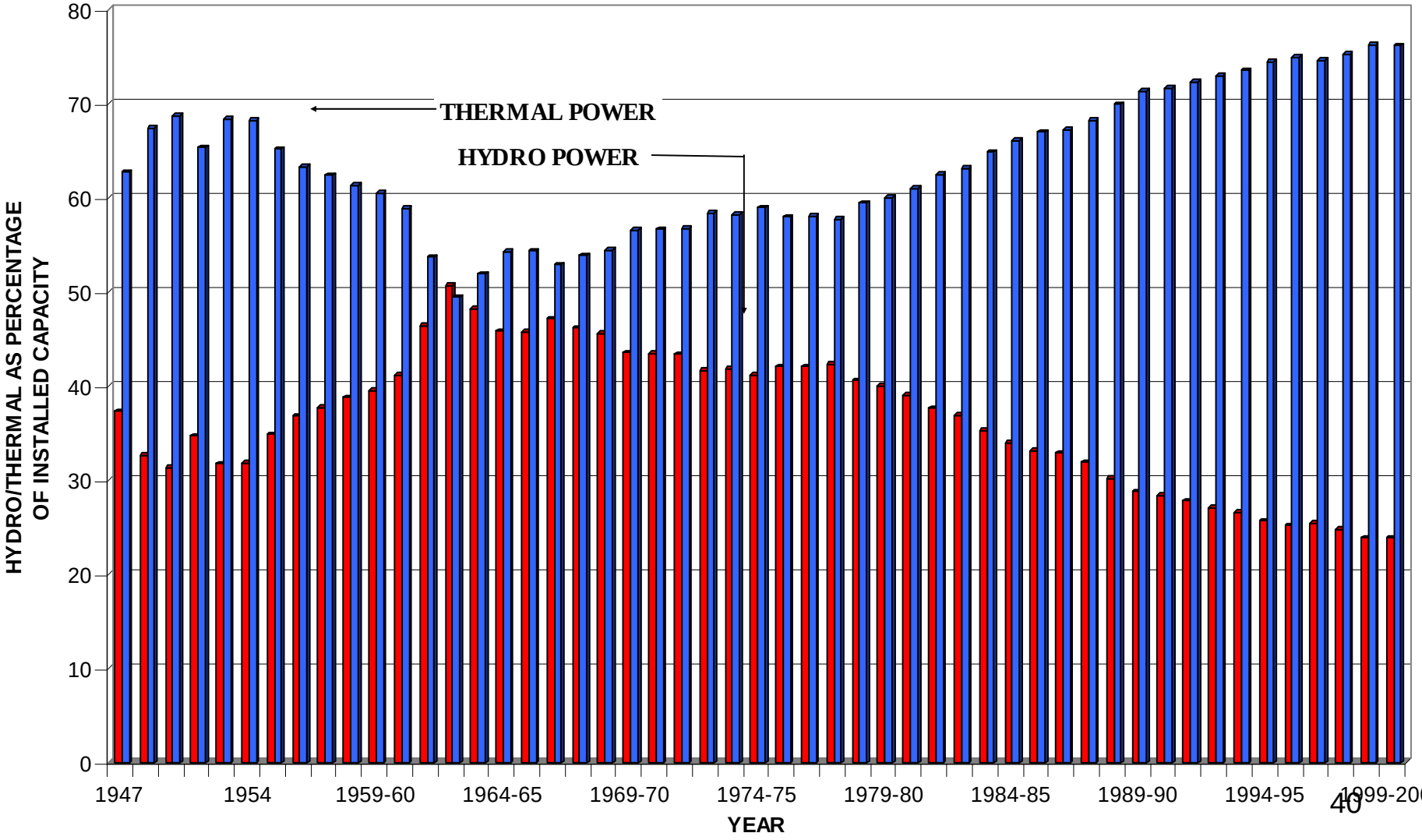
# INDIAN GROWTH IN FOOD-PRODUCTION & POPULATION



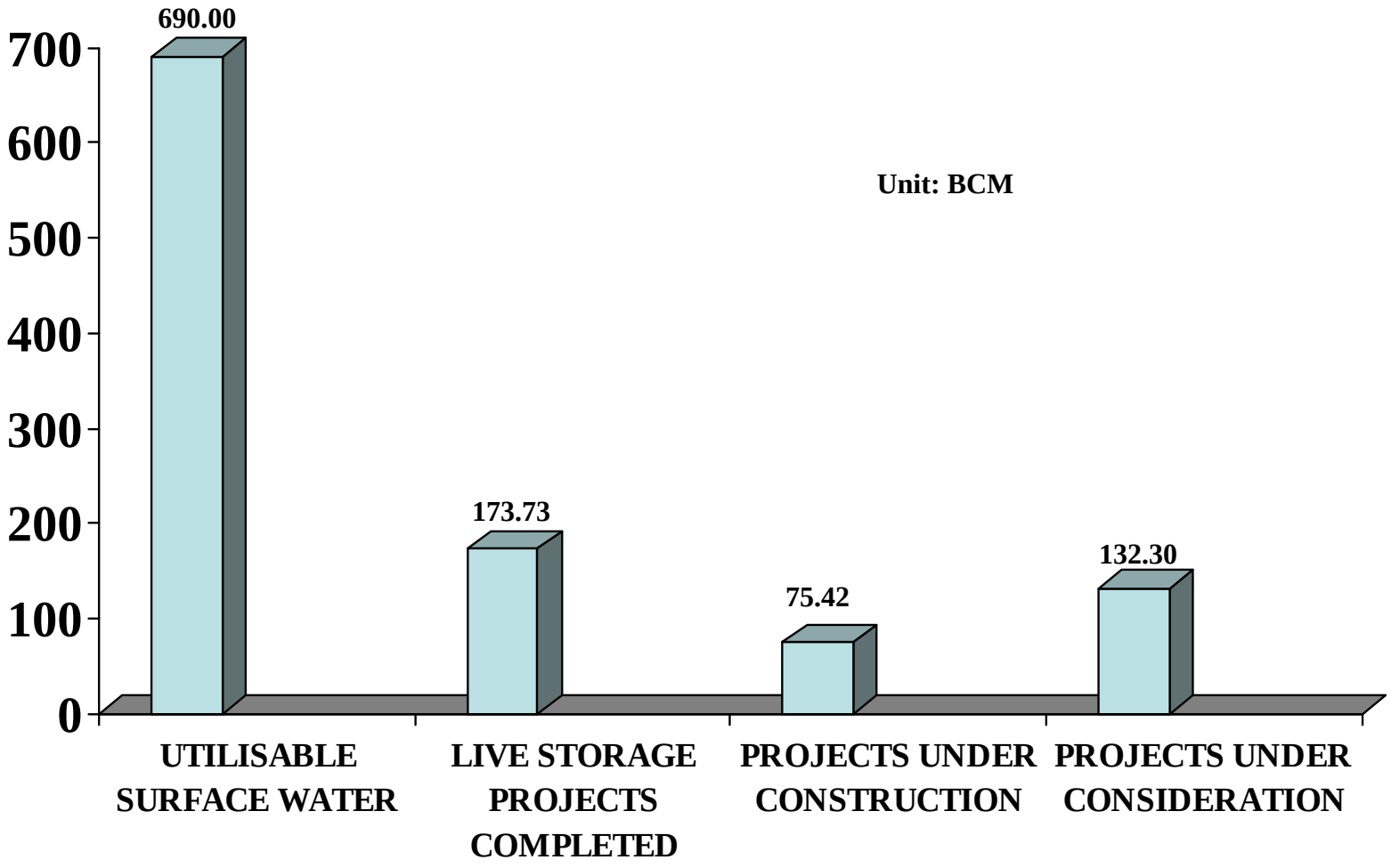
# Land Resources of India

| Year | Present | 2025 | 2050 |
|---|---|---|---|
| | (all data in million hectares) | | |
| • Geographical area | 329 | 329 | 329 |
| • Cultivable area | 184 | 184 | 184 |
| • Net sown area | 142 | 144 | 145 |
| • Gross sown area | 187 | 203 | 225 |

# SHARE OF HYDRO/THERMAL POWER



# STATUS OF WATER STORAGES THROUGH RESERVOIRS IN INDIA



# Water Potential of India

- On ground water front, against 396 BCM of total availability, nearly 175 BCM is in Ganga – Brahmputra & Meghna which is rich in surface potential also.
- The West and South India are victims of this gross imbalance.
- India has a cumulative live storage potential of 177 BCM.
- Additional 75 BCM of capacity will be achieved through on going projects.
- There is a potential to add 132 BCM through new projects under consideration.

# Domestic Supply

- By 2050, 90 BCM water will be required to meet domestic supply requirement for Urban areas.
- Estimate for rural areas about 29 BCM.
- Requirement for rural areas is met through ground water which poses serious quality and health problems.
- Quality water supply systems are required which is possible only through surface water storages.
- Mineral water costlier than milk

# Irrigation

- Requirement of food grains at 284 kg/head/year - estimated at 450 millions tonne by 2050.
- Yield of food crops may reach:
  - 1.5 tonne/ha in rainfed areas
  - 4.0 tonne/ha in irrigated areas
- Cropping intensity of 135 % at present may increase to 160 %.
- 64% of gross cropped area required to be brought under irrigation.

# Views expressed by Dr. C.P.Thakur,

# then Union Minister for Water Resources

- Mankind is at centre of environment. Basic needs of food, drinking water and energy are must to protect environment
- Multi purpose river valley projects, provide irrigation, water supply and hydro power to meet above needs and also help in upgrading environment
- ➢ Pressure groups, lobbies and activists guided by vested interests have created an environment of hatred opposing large hydropower and irrigation projects in particular.
- It is time once again to re-emphasise requirements of large river valley projects in order to ensure a better and prosperous future.
- River valley projects should be evaluated not on basis of their size, but on value that they would deliver to society.

# Views expressed by Shri B.L.Marandi,

# then Union Minister of Environment & Forests

- Indian economy being agricultural based, river valley projects will continue as lifeline for India
- Impossible to sustain electric supply without hydro development
- Basin- wise management and integration of environmental concerns be adopted in planning of river valley projects.

## Views expressed by Late Shri P.R.Kumarmanglam,

## then Union Minister of Power

Government should save funds that are spent on flood management and instead invest in hydel projects as they are multipurpose projects.

# THUS WE CAN CONCLUDE THAT-

✓ **Storage Projects (Large Dams &ILR)**

- **provide not only needed water but also help in**

➢ **Boosting Hydro power- must to stabilise grids**

➢ **Hydropower - a clean power unlike thermal & nuclear**

➢ **Minimize flood damages,**

➢ **Must for Agro- based Industries and Dairy**

➢ **Support Flora and Fauna, Tourism,Employment**

➢ **Enhance Economic development and poverty alleviation**

# Indian Priorities in Integrated Waste Water and Water Management

- Possible through accelerated construction of ongoing & new Storage Projects
- Need of water transfer links (ILR).
- Benefits of river valley projects are very large & substantially outweigh immediate environmental and social impacts
- Absence of water storage projects create very high adverse environmental & social impacts
- EIA not only for ‘before’ & ‘after’ but also ‘with’ & ‘without’ projects

- -----Contd

- Mankind is  at centre of ecological cycle
- Environment protection & mitigation need to be considered while planning development projects.
- Cost of mitigation of direct environmental damage should be charged to a developmental project
- Highly inappropriate to charge a water project for environmental damages due to other activities.
- Concerns for accelerated storage has been expressed by President, Prime Minister & Union Ministers for Water Resources, Power & Environment at open forums.

# Global Environmental Concerns

- Environment is a global phenomena and by one country not confined to that country alone
- Oil Spills, Nuclear explosions, Ozone layer depletion and Global Warming are hard examples
- Mitigation costs of Global Concerns must be shared not only by developing and developed countries jointly
- “Polluter pays policy” be followed vigorously

# Benefits from Interlinking of Rivers

- Regional imbalance in availability of water would greatly reduce and some of the surplus flood water flowing waste to sea would be fruitfully utilized.
- Will provide irrigation facilities to 35 Mha area (surface water - 25 Mha and ground water - 10 Mha) over and above 139 Mha of ultimate potential envisaged from conventional projects.
- Flood control benefits due to construction of storage dams. Could reducing flood peaks by about 20 to 30%

# Benefits From Interlinking Of Rivers

- Drought mitigation in 25 lakh ha area in the States of West Bengal, Bihar, Uttar Pradesh, Haryana, Rajasthan, Jharkhand, Madhya Pradesh, Gujarat, Andhra Pradesh, Karnataka and Tamil Nadu.

- Hydro-power generation of 34,000 MW. Against 84,000 MW of hydro-power potential only about 22,000 MW has been developed so far.
- Environment will be greatly enriched by maintaining better flows in the rivers throughout the year, providing vegetation and greenery to semi- arid and parched lands.

# ---Contd

- Most of the cities, urban centres and rural habitations are already water short. Future requirement of cities and villages will be supplemented by Interbasin water transfers
- Most of the link canals could greatly facilitate inland navigation.
- Development of fisheries. An important nutrition for the poor.
- Employment Generation
- Infrastructure Development
- Socio - Economic Development

# Major Issues in Inter-linking of Rivers

- **Cost**: At 2002 price level Rs. 5,600 billions
- Consensus among co-basin states has to be reached for transfer of surplus water.
- Construction of dams in India, Nepal and Bhutan requiring International agreements.
- Construction of dams involve environmental issues like submergence of forest land and habitations
- Manas-Sankosh-Tista-Ganga link passes through tiger reserves and reserve forest.
- Rehabilitation and Resettlement of Project affected People.
- Acquisition of land for long and wide canals

# Flood Moderation

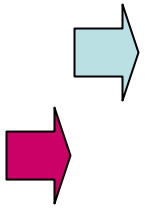
- Annual flood damage bill is as high as Rs. 58.46 billions. (1998)
- Those compelled to live close to the river, are affected most.
- There are cases of whole villages between the flood embankments.
- Even in a large city like Delhi, there are large slum clusters so close to the river that some of them are right in the path of water.
- **Displacement due to flood is an annual feature**.

# Flood Moderation

- Loss due to flood not merely a loss of habitat.
- Lot of infrastructure is washed away.
- Because of impending flood threat, investment level in agriculture & infrastructure remains low.
- Displacement due to flood adversely affects income.
- Floods damage drinking water sources for a long time afterwards.
- Outbreak of diseases.

# Relief from droughts

- Habitants of chronically drought affected areas – Usually marginal, subsistence farmers.
- Provide irrigated agriculture to these land owners - Improve their land productivity.
- Improve ground water situation.
- Lowering of GW levels is mostly because of **over-extraction**, in absence of a surface source.
- Improved GW situation - Easier availability of potable water
- Poverty alleviation.



# Employment opportunities

- A large amount of money to be spent on ILR
- In India, construction always was, and remains, labour intensive.
- Generation of jobs, in very large numbers, directly and indirectly.
- Almost all over India, no region left untouched in ILR Proposals.

# Increased food production

- Additional area under irrigation = 35 mHa. (An increase of 25 %)
- A higher agricultural produce ⇨ generally better economy. More funds for welfare activities.
- Better stabilization of prices overall and particularly food prices.
- **Any shortage, and particularly the food shortage, hits the poor the most.(*Which class suffered most in 1943-44 famine ?*)**

# Increased Hydro Power

- ILR will generate 34, 000 MW of Hydro Power
- A major boost to industry.
- Consequential benefits of increased employment, further boost to economy.
- Will improve share of hydro power to about 34 %. Essential for freedom from load shedding.
- A significant part of investment that goes into interlinking would anyway be required for increasing power generation. (Approx Rs. 1500 billions)

# Has Interlinking of Rivers done before ?

**In other countries** Many large scale water transfer schemes have been implemented and more are planned :

**Canada** - Many interbasin water transfer schemes have been implemented for hydro-power development.

**USA** has implemented California State Water Project envisaging transfer of water from Sacramento river in North California southwards through a 715 km long aqueduct and 1000 m lift.

**China** - is planning for transfer of 48 BCM of water from south to north.

# Has it ever been done before in India ?

- Beas Sutlej Link. About 25 years old. Transfers 8000 cusecs of water from Beas to Sutlej.
- IGNP Canal (Brings Sutlej water to Rajasthan)
- Sardar Sarovar Canal (Narmada water to Saurashtra)
- Periyar Vaigai West flowing to East flowing.
- Koyna. East flowing to West Flowing
- Sutlej Yamuna link. The waters of Sutlej are already reaching Yamuna through a complex route.
- A direct Sutlej-Yamuna link canal is under construction.
- Ganga water from Haridwar is reaching Yamuna at Delhi through Upper Ganga canal.

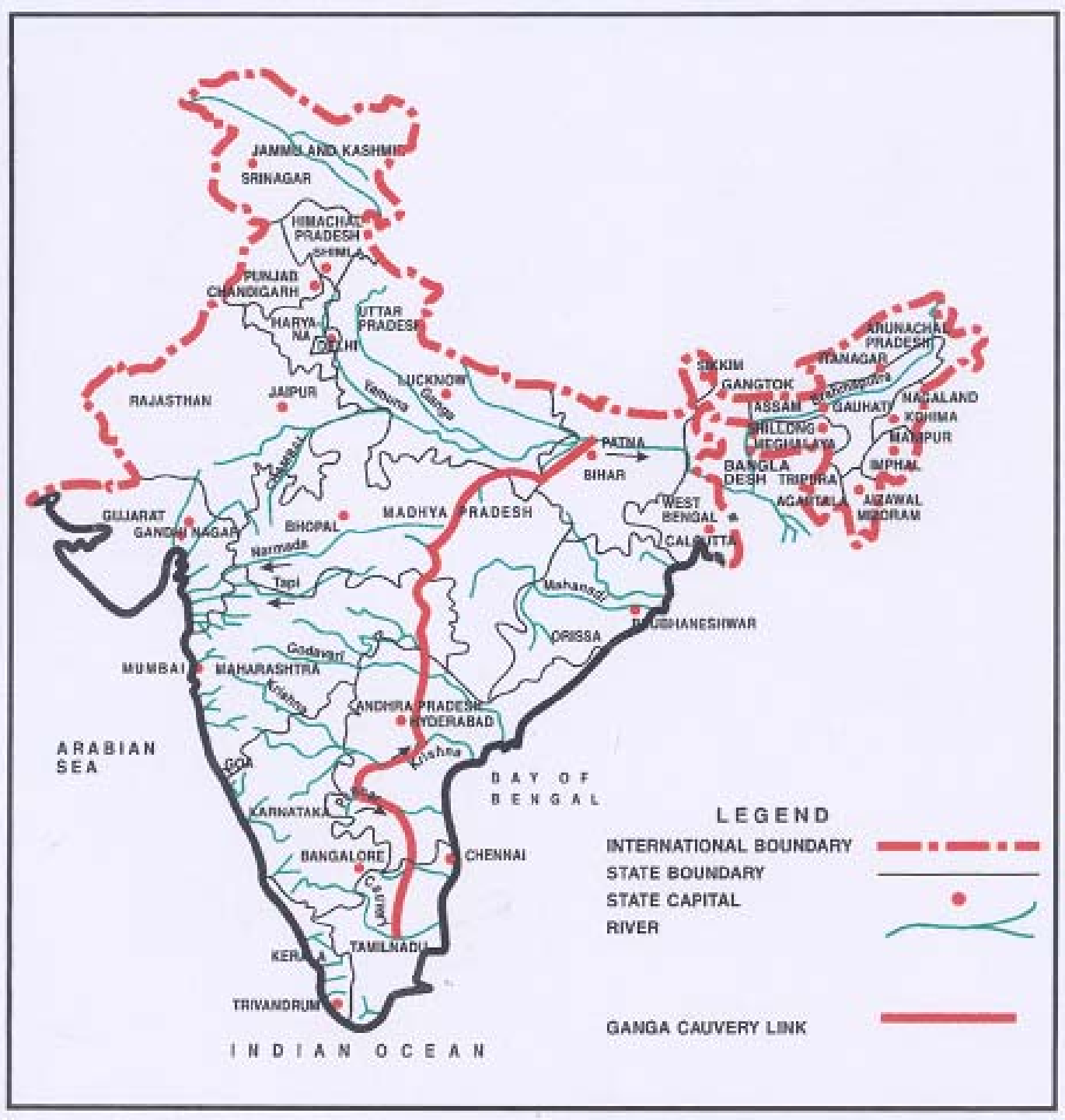
# Why do we need ILR in India?

- **Use of water within the basin would limit irrigated area to 139 mha.**
- **Inter-basin transfer would increase irrigation by about 35 mha.**
- **Use of water within the basin would limit total usage to about 1122 bcm.**
- **Inter-basin transfer would increase the utilization by about 200 bcm.**
- **Precipitation is erratic and uneven in space and time. Some areas are affected by floods, others by drought.**
- **Inter-basin water transfers would provide water from surplus to water short basins.**

# Problems/ Concerns/ Limitations of ILR

- **Cost**: At 2002 price level Rs. 5,600 billion
- Consensus among co-basin states for transfer of surplus water ?
- Construction of dams in India, Nepal and Bhutan require International agreements.
- Environmental activism, some submergence of forest land and habitations
- Manas-Sankosh-Tista-Ganga link passes through tiger reserves and reserve forest.
- Rehabilitation and Resettlement of Project affected People.
- Acquisition of land for long and wide canals

# Dr K L Rao's Ganga Kaveri Link.



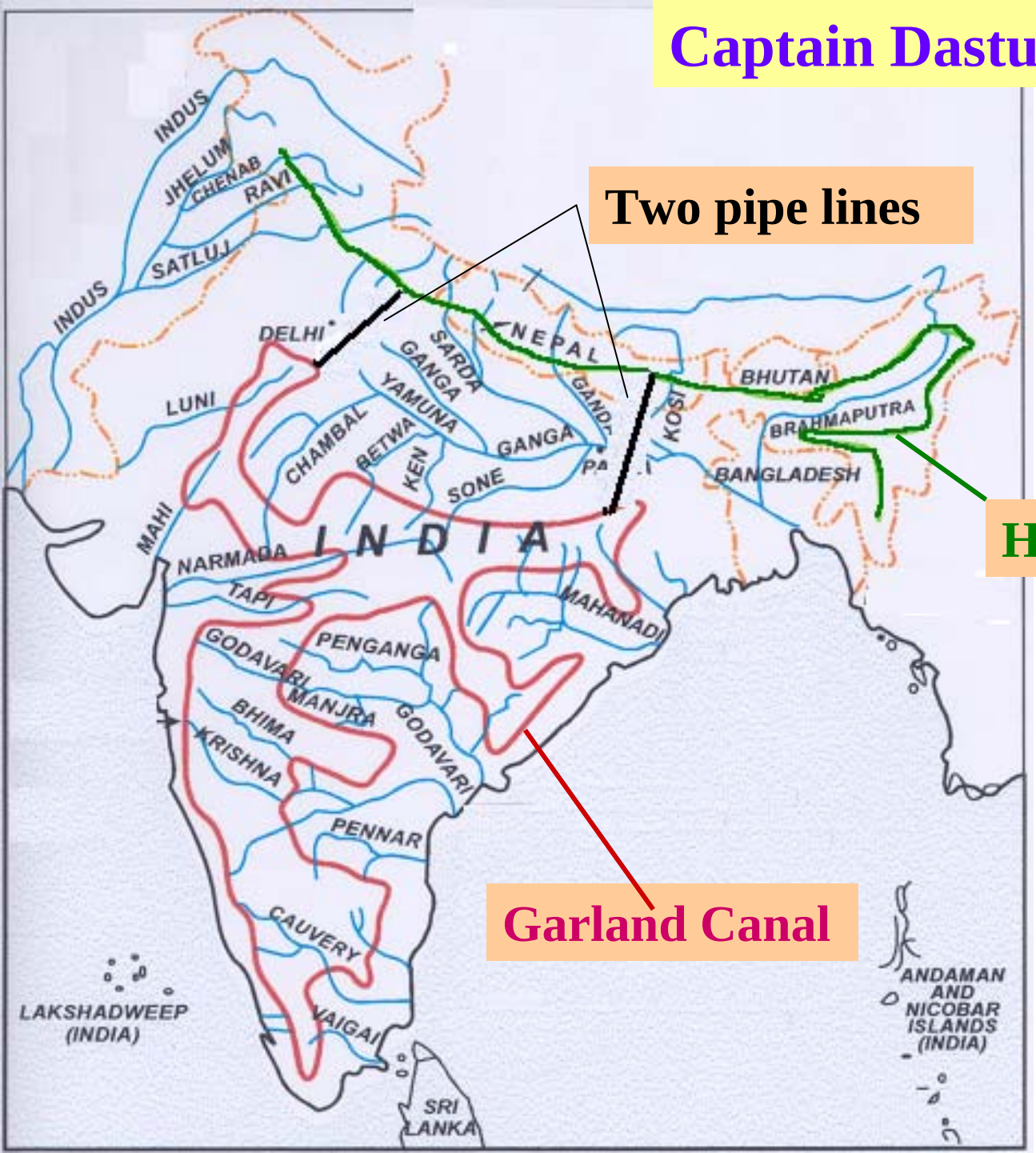
# Dr K L Rao's Ganga Kaveri Link

- Linking Ganga Ka[illegible] 2,640 Km canal.
- Pumping of 1,400 Cumec of Water over a Head of 550 Metres.
- Irrigation Development - 4 mHa
- No Flood Control benefits
- Estimated cost : Rs.125 billions (1972) *Cost At 2002 Prices Rs.1,500 billions)*
- Cost of Pumping - Rs. 5,500 crores/ year
- Large Power input, 5,000 to 7,000 MW

**Dr. KL Rao, a renowned water engineer.**

**Scheme was sound in hydraulics but was economically unviable.**

# Captain Dastur's Garland Canal



# Captain Dastur's Garland Canal

- **4,200 km long Himalayan canal with 90 lakes in between at about 400 M constant elevation**
- **9,300 km long garland canal with 200 lakes at about 300 M constant elevation**
- **Both canals inter-connected by pipelines near Delhi and Patna**
- **Cost- Rs. 241 billions (1977 Price Level)**

***[Rs. 7,00,000 billion at Present Price Level]***

➢**Scheme unsound in basic hydraulics.**

➢**Committees of experts found proposal technically infeasible**

# National Perspective Plan (NPP)

In 1980, Union Ministry of Water Resources formulated a National Perspective Plan (NPP) for interlinking of rivers envisaging transfer of water from surplus to deficit areas.

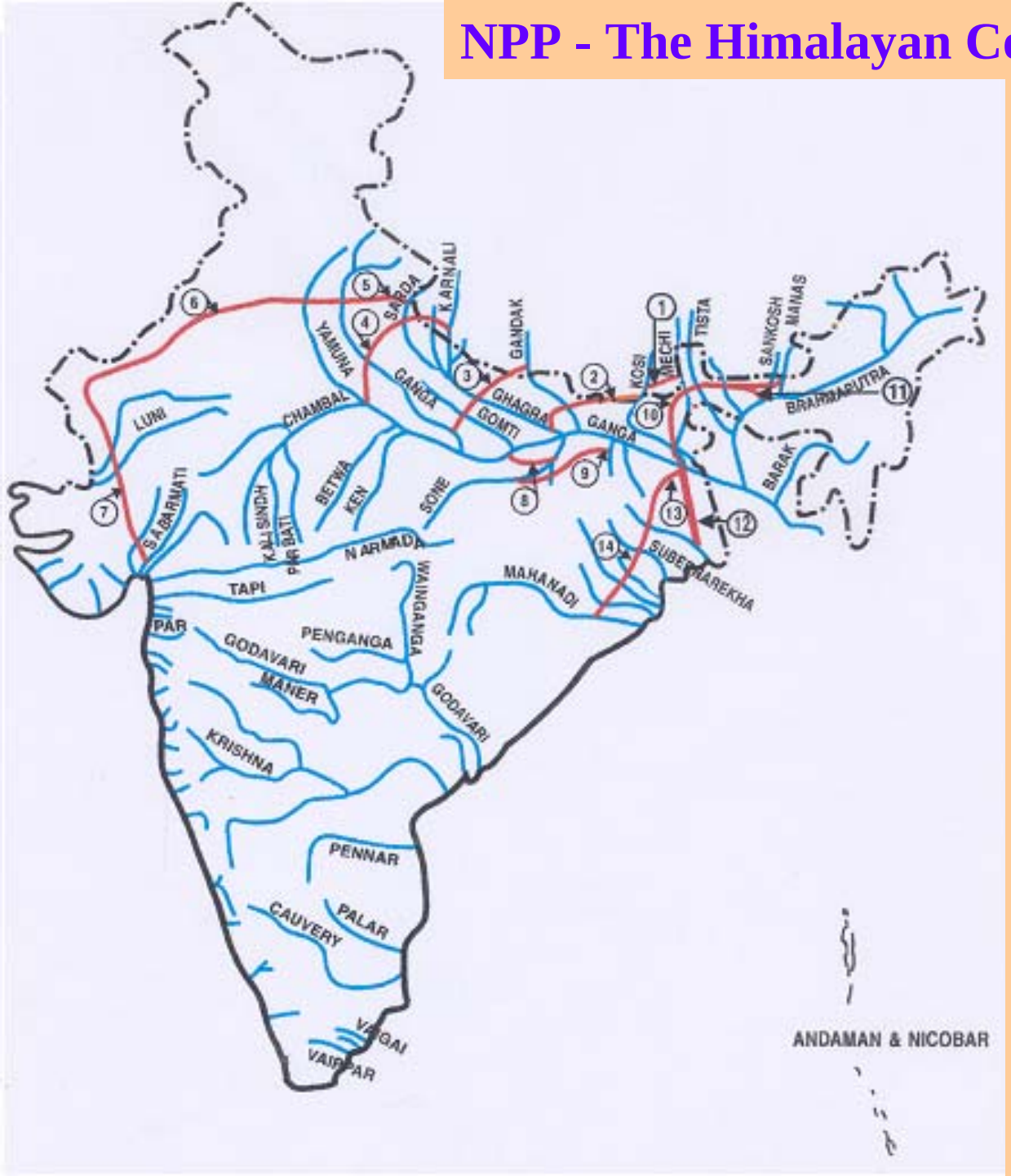
National Water Development Agency (NWDA) was setup as an independent society in 1982 to work on NPP

Two main components

- Himalayan
- Peninsular

Basic concept of Dr. K.L.Rao's Ganga-Kaveri link included.

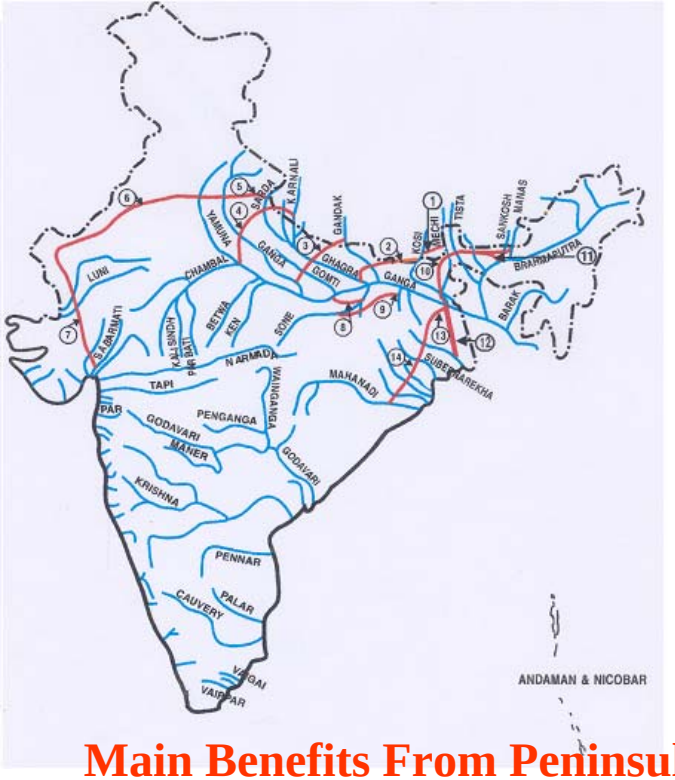
# NPP - The Himalayan Component 14 Links




Dams on Tributaries of Ganga and Brahmaputra in India, Nepal and Bhutan

Linking Brahmaputra ⇨ Ganga ⇨ Mahanadi Benefiting Assam, West Bengal, Bihar, Jharkhand and Orissa

Interlinking Canal Systems to transfer surplus flows of eastern tributaries of Ganga to the West, benefiting U.P., Uttaranchal, Haryana, Rajasthan and Gujarat

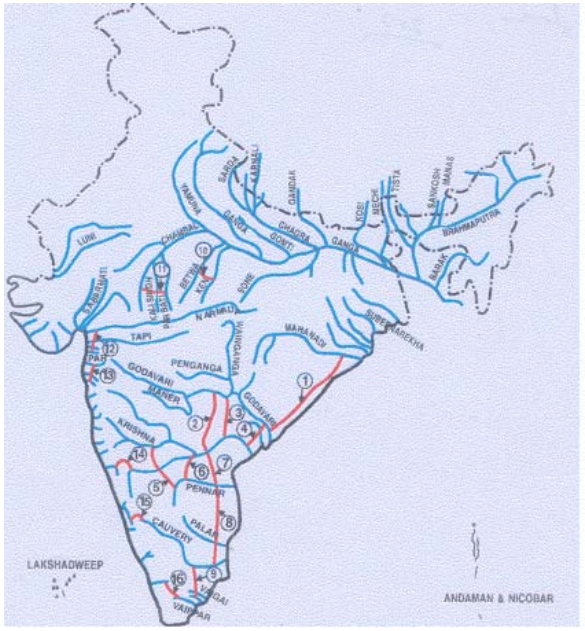



## Main Benefits From Himalayan Component

- 22 Million Ha of Additional Irrigation
- 30 Million KW of Power Generation (Including from Dams Proposed in Nepal and Bhutan)
- Augmentation of Flows at Farakka
- Drought Mitigation to Some Extent in the States of W.B., Bihar, U.P., Haryana, Rajasthan, Jharkhand and Gujarat
- Flood Control to Some Extent in Ganga and Brahmaputra Basins

## Main Benefits From Peninsular Component

- 13 Million Ha of Additional Irrigation
- 4 MW of Power Generation
- Drought mitigation to some extent in the States of Andhra Pradesh, Karnataka, Tamil Nadu and M.P.
- Flood Control to Some Extent in Mahanadi and Godavari basins



# Links Identified For Preparation Of Feasibility Reports

1. Kosi – Mechi
2. Kosi – Ghagra
3. Gandak – Ganga
4. Ghagra – Yamuna
5. Sarda – Yamuna
6. Yamuna – Rajasthan
7. Rajasthan – Sabarmati
8. Chunar- Sone Barrage
9. Sone Dam – Southern Tributaries of Ganga
10. Brahmaputra – Ganga (Manas – Sankosh - Tista - Ganga)
11. Brahmaputra – Ganga (Alt.) (Jogigopa – Tista – Farakka)
12. Farakka – Sunderbans
13. Ganga (Farakka) – Damodar – Subernarekha
14. Subernarekha – Mahanadi

# Main Benefits From Himalayan Component of ILR

- 22 Million ha of Additional Irrigation
- 30 Million KW of Power Generation (Including from Dams Proposed in Nepal and Bhutan)
- Augmentation of Flows at Farakka
- Drought Mitigation to Some Extent in the States of W.B., Bihar, U.P., Haryana, Rajasthan, Jharkhand and Gujarat
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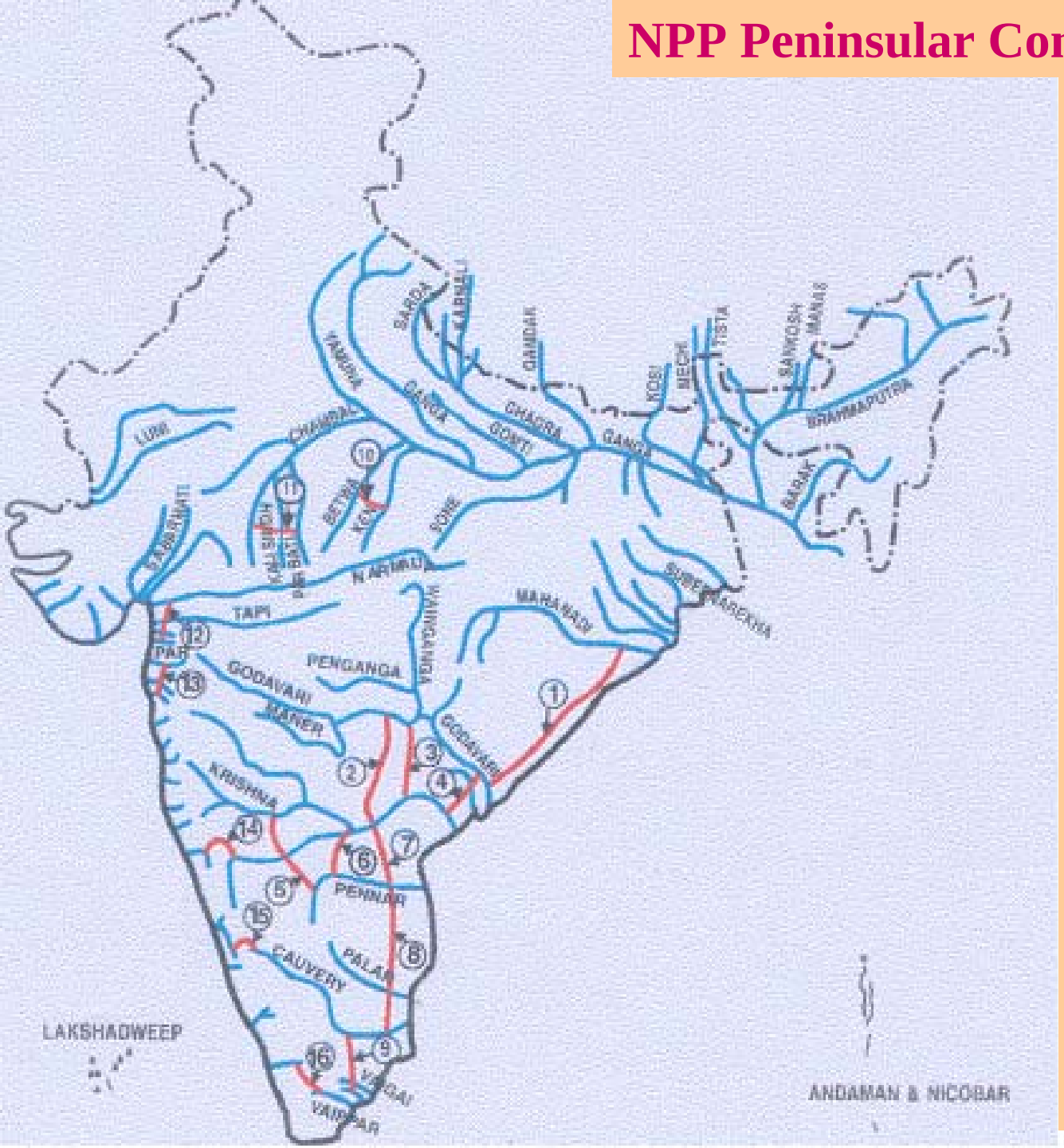
# NPP Peninsular Component 16 Links




**Transferring Mahanadi and Godavari Surpluses to Deficit Basins of Krishna, Pennar, Cauvery and Vaigai with 9 Link Canals**

**Lift Essential for Transfer of Water From Godavari to Krishna – Proposed in one of the above 9 Links (to lift 1,200 cumec over 116 m)**

# NPP Peninsular Component

- ✓Transferring Water From West Flowing Rivers of Western Ghats to the East to benefit Karnataka, Tamil Nadu and Kerala
- ✓Transferring Water From Ken River to Betwa River to Benefit M.P. and U.P.
- ✓Inter linking Parbati, Kalisindh and Chambal rivers to benefit M.P. and Rajasthan
- ✓Interlinking of West Flowing Rivers, North of Mumbai and South of Tapi, to benefit Maharashtra and Gujarat

# Peninsular Component - Links Identified For Preparation Of Feasibility Reports

1. Mahanadi (Manibhadra) – Godavari (Dowlaiswaram)
2. Godavari (Inchampalli) - Krishna (Nagarjunasagar)
3. Godavari (Inchampalli Low Dam) – Krishna (Nagarjunasagar Tail Pond)
4. Godavari (Polavaram) – Krishna (Vijayawada)
5. Krishna (Almatti) – Pennar
6. Krishna (Srisailam) – Pennar (Prodattur)
7. Krishna (Nagarjunasagar) - Pennar (Somasila)
8. Pennar (Somasila) – Cauvery (Grand Anicut)

# Peninsular Component- Links Identified For Preparation Of Feasibility Reports

9 . Cauvery (Kattalai) – Vaigai – Gundar

10. Ken – Betwa Link

11. Parbati – Kalisindh – Chambal

12. Par – Tapi – Narmada

13. Damanganga – Pinjal

14. Bedti – Varda

15. Netravati – Hemavati

16. Pamba – Achankovil – Vaippar

# Main Benefits From Peninsular Component

- 13 Million ha of Additional Irrigation
- 4 MW of Power Generation
- Drought mitigation to some extent in the States of Andhra Pradesh, Karnataka, Tamil Nadu and M.P.
- Flood Control to Some Extent in Mahanadi and Godavari basins

# Present Stage Of Studies By NWDA

- Pre-Feasibility Reports of all the 30 Links Completed
- Feasibility Reports of Following 6 Links Completed
  - Ken - Betwa
  - Par - Tapi - Narmada
  - Pamba - Achankovil - Vaippar
  - Godavari ( Polavaram) - Krishna (Vijayawada)
  - Krishna (Srisailam) - Pennar
  - Krishna (Nagarjunasagar) - Pennar (Somasila)

**Survey and Investigations for Preparation of Feasibility Reports of 18 Links Under Progress**

**Thus,**

**Interlinking of rivers is not merely a matter of water transfer from point A to point B. It is a question of a general boost to economy, increase GDP, ensure food & water security, improve environment and make a significant impact on unemployment situation.**

**In fact project benefits poor more than it does any one else.**

# Antagonism is not limited to Trans-Basin Water Transfer.

- Construction of dams
- National Water Policy - Ownership of Water
- Tradable Water Rights
- Priority of Water Uses – EFR
- Water Supply for Mega-Cities
- Public Private Partnerships
- Virtual Water Trade **!**
- Use of GM seeds

# Activists want Bhakra Project also to be de-commissioned

# IMPORTANT PUBLICATIONS FOR HYDROPOWER & RIVER VALLEY DEVELOPMENT AND ASSESSMENT & MANAGEMENT OF ENVIRONMENTAL IMPACTS

**Environmental Impacts Assessment of Water Resources Projects** – Concerns, Policy Issues, Perceptions and Scientific Analysis – Edited by Goel R.S., M/s Oxford & IBH Publishers, 2000

**Environmental Management in Hydropower and River Valley Projects-** Techniques of Management, Case Studies, Policy Issues & Application of Scientific Tools- Edited by Goel R.S., M/s Oxford & IBH Publishers, 2000

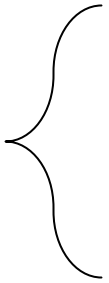
**Hydropower and River Valley Development** – Environmental Management, Case Studies and Policy Issues, Edited by Goel R.S. & Srivastava R.N., M/s Oxford & IBH Publishers, 1999

**Environmental Impacts of Water Resources Development** – Edited by Goel R.S., M/s Tata McGraw Hill Publishers, 1993

**Environment Management in Hydro Electric Projects** – Edited by Prof. Prasad Kamta & Goel R.S., M/s Concept Publishers, 2000

# PIN POINTED ACTION ITEMS FOR INTEGRATED WATER RSOURCES DEVELOPMENT & MANAGEMENT

- ✓Accelerated water storages development
- ✓Water quality improvement
- ✓Encourage
  - Rain-water Harvesting
  - Roof Top Harvesting
- ✓Reuse and recycling
- ✓Economy in water consumption



If Cost Effective & Quality Friendly

- ✓ **Maintain Self Assimilation Capacities At Critical River Stretches**
- ✓ **Ground Water Recharging With Strict Monitoring Of Water Quality**
- ✓ **Inter-basin & intra-basin transfer of water projects**
- ✓ **Social awareness & Scientific perceptions**
- ✓ **Role of educational institutions, women & children**
- ✓ **Role of professional societies**
- ✓ **Urgency in adopting strategies**


THANK YOU

**Professional Water Managers**

Formally trained, qualified, experienced.

Accountable

**Non-Professionals**

Qualifications (in irrigation, hydrology, water management) ?

Accountability - **ZERO, NIL**

# Basic Water Planning

| | Professionals |
|---|---|
| Expected population 2050 | 160 crores |
| Food requirement | 500 MT |
| **Total Water Requirement** | 1450 bcm |
| Total Precipitation | 4000 bcm |
| Total Fresh Water | 1869 bcm |
| Utilizable quantity | |
| Surface Sources | 690 bcm |
| Sustainable GW | 432 bcm |
| **Total Utilizable Quantity** | 1122 bcm |
| **Deficit 328 bcm** | **328 bcm** |
| Interlinking will give us | 200 bcm |

possible only if the storage capacity is taken from present 177 to contemplated 384 bcm.

The alternative for this quantitative planning is

Use traditional methods

“Wisdom of the centuries”

Rain water harvesting

More Rainwater Harvesting

Some more Rainwater Harvesting

Catchy slogans

# Basic Water Planning

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| Rainwater Harvesting | | |

Use traditional methods –

"Wisdom of the centuries"

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Catchy slogans

**Problems/ Concerns/ Limitations**

# Food Security in India – 1700s and 1800s

| Year | Famine Deaths (lakhs) |
|---|---|
| 1769-70 | 30 to 100 |
| 1837-38 | 8 |
| 1866-67 | 15 |
| 1876-77 | 50 |
| 1896-97 | 50 |
| 1899-1900 | 30 |

***Ref: Britannica Micropaedia***

One third to one tenth of the population died !

Cannibalism was common in famine affected areas !

# Food Security in India – 1700s and 1800s

| Year | Famine Deaths |
|---|---|
| 1769-70 | |
| 1837-38 | |
| 1866-67 | |
| 1876-77 | |
| 1896-97 | |
| 1899-1900 | |

This *despite the fact* that in these times the population was a fraction of what it is today; the land and water systems were in their pristine glory; the forest cover was beyond our wildest dreams; the ground water table was at its best ever. . . .

**And "wisdom of the centuries" was being practiced.**

# Food Security in India – 1900s till 1975

Era of eternal shortages

Dependence on Food Imports

PL 480

Rationing

Guest Contro

High food cos

This despite the fact the in these years the population was much less than what it is today, the land and water systems were in a much better state, the forest cover was very good, the ground water table was also good. . . . .

# Food Security in India – 1960 onwards

1969 Second Irrigation Commission

Three point strategy to combat food shortages

- Reservoir backed assured irrigation
- High yielding verities of seeds
- Chemical fertilizers

(*and also insecticides and pesticides*)

→ The Green Revolution

# Food Security in India – The Green Revolution

- Food production up from 50 MT to 200 MT
- Food security – no more imports. India is now a food grains exporting nation
- Enough buffer stock to tide over consecutive drought years
- Food prices more affordable
- Last but not least – Prosperity in rural India. Agriculture is no longer a “bare subsistence” activity.

# Food Security in India – The Green Revolution

- Food production up from 50 MT to 200 MT
- Food sec
  food grai
- Enough b
  drought y
- Food pric
- Last but n
  Agriculture is no longer a “bare subsistence” activity.

This despite the fact that the population has increased from

33 millions in 1769

to 330 millions in 1947

to over 1000 millions in 2000.

# Points to note:

1. Our ancestors lived without modern irrigation, because they were constrained by the technology available to them. And **NOT** because they were in some way wiser.

2. The so called “Traditional methods” could not feed a population of 3 crores in 1700s, or 35 crores in 1950s and 60s. And ***there is no question*** of these feeding a population of 160 crores in 2050.

3. The “***Wisdom of centuries***”, which we are being told is now “dying”, ***was in fact never alive*** to start with.

# Issues to be resolved for project implementation

- Cooperation amongst Co-basin states
- Constitutional provisions to facilitate inter state transfer of water.
- Legal & Regulatory framework.
- Political issues
- Environmental issues
- Project Affected Persons and their rehabilitation
- Water Pricing
- Funding mechanisms