Hydropower and Sustainable Development:
A view from the World Bank

Beijing

October 2004

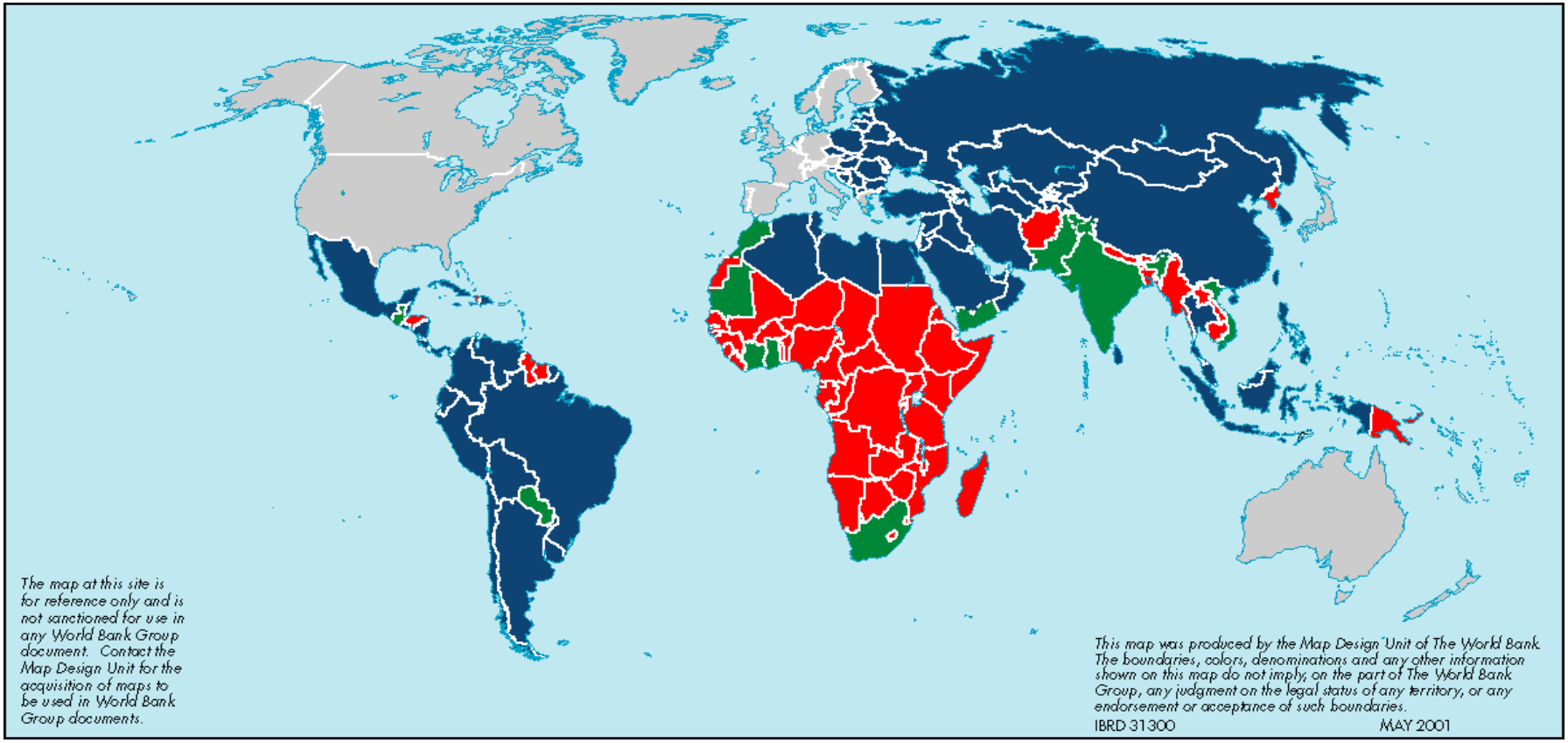
Story line

1. How hydro fits:
   - In sustainable energy supply
   - In water resource management
   - In reducing poverty
2. Special challenges of hydro
3. The evolving role of the World Bank

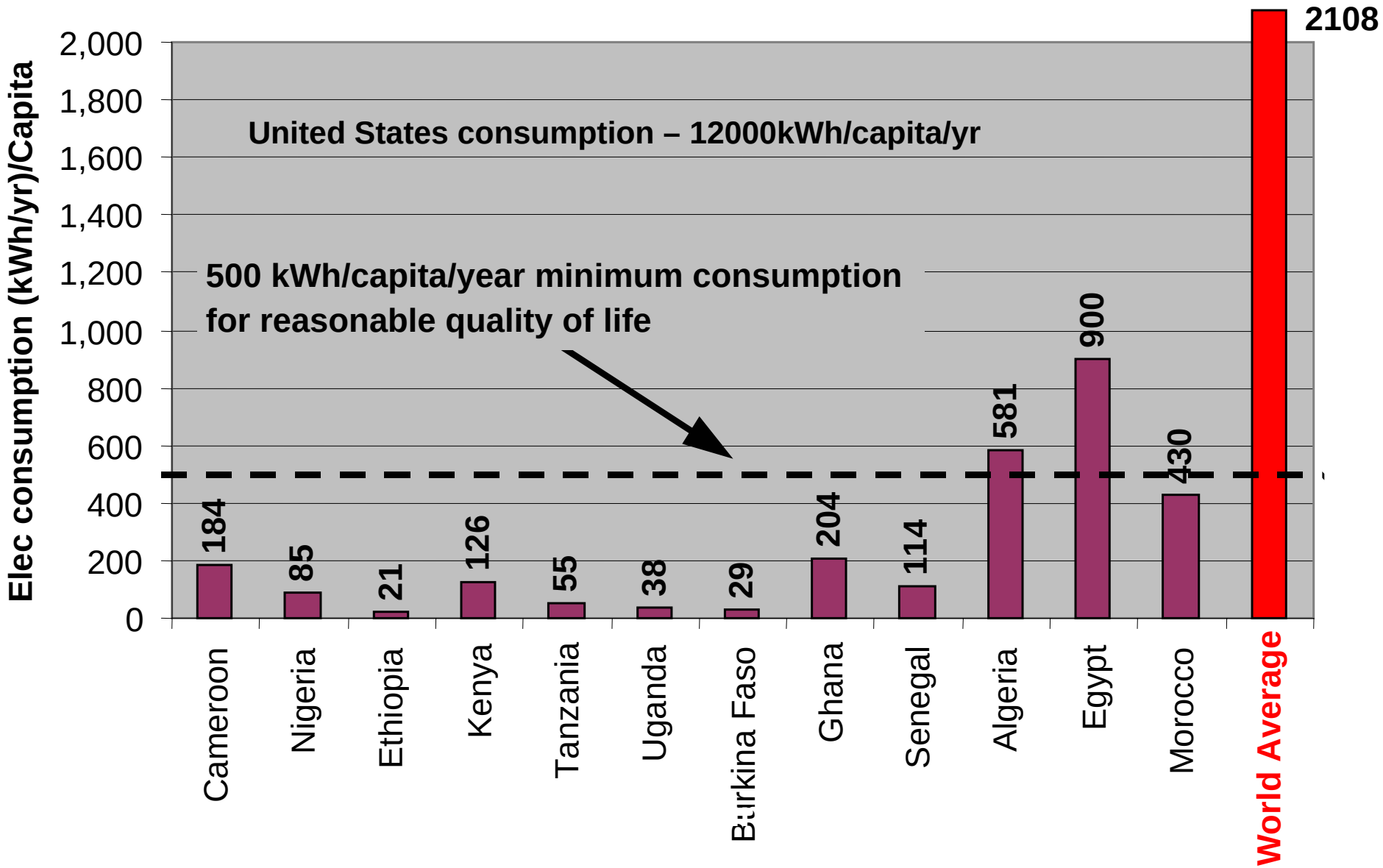
Electricity shortages (quantity, distribution and quality) are a major constraint in developing countries

Access to Electricity *(in % of Population)*

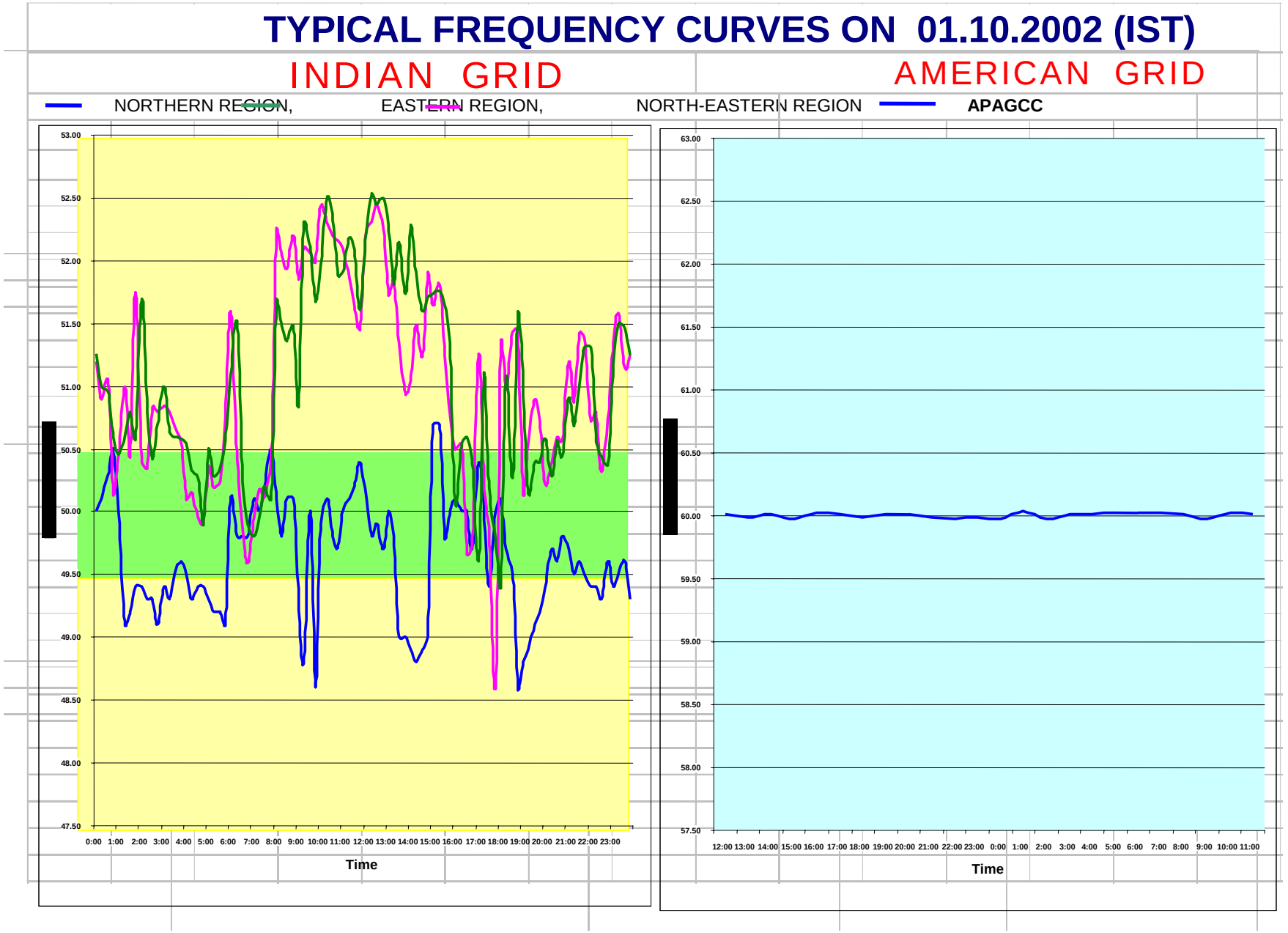
Red 3 - 33%
Green 33 - 66%
Blue >66%



Consumption per capita: Africa and the world



And poor quality of supply imposes huge costs…

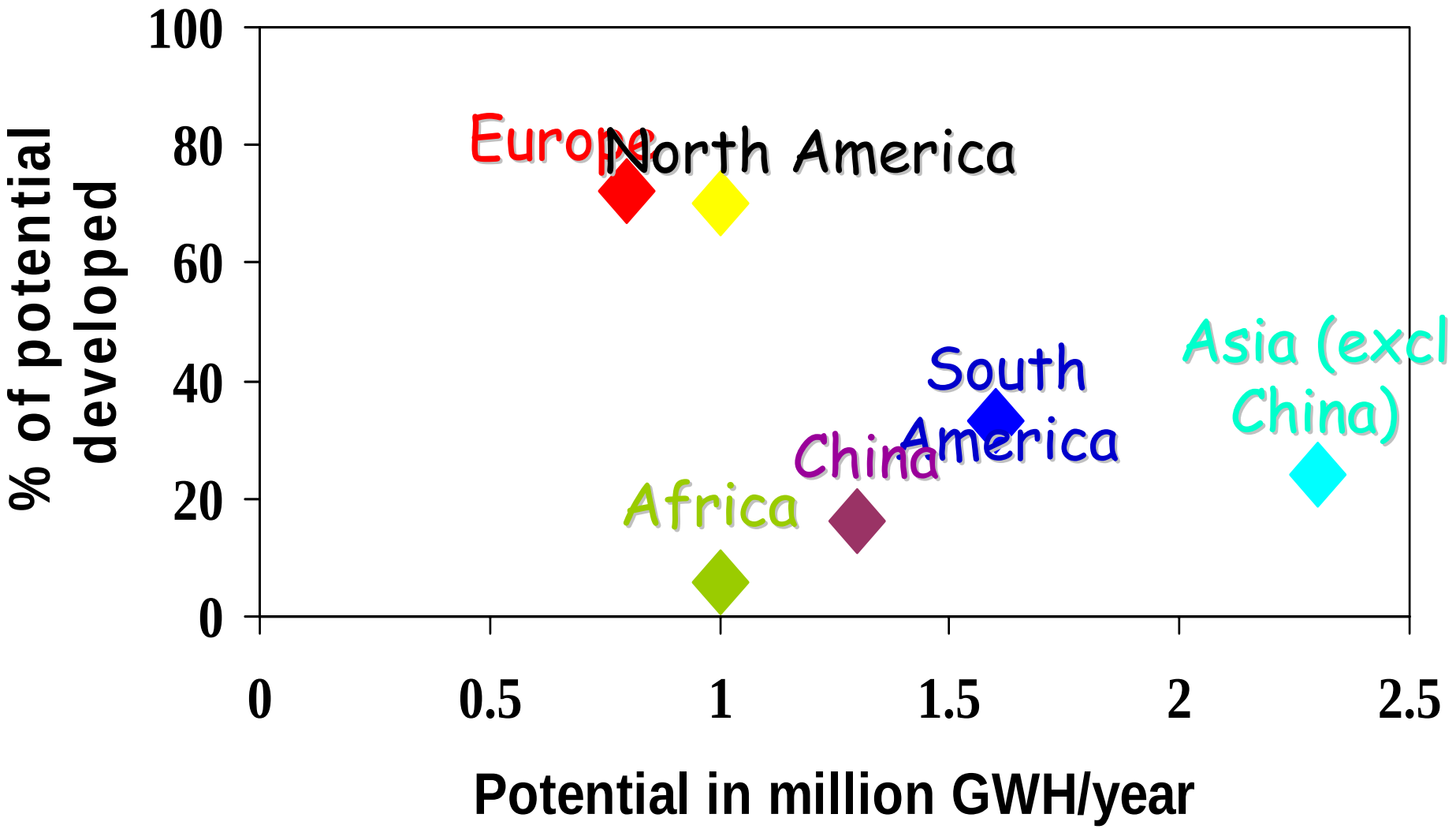


Hydropower can play a major role in developing countries

The potential role for hydro in the developing world…

- 70% of energy investments in next 30 years will be for electricity
- Hydro produces about 2,600 Twh/year of electricity; untapped economically viable potential is twice this (5,400 Twh/year)
- 90% of this potential is in the developing world

Development of economically-feasible hydropower potential in different regions



India as an example

India as an example

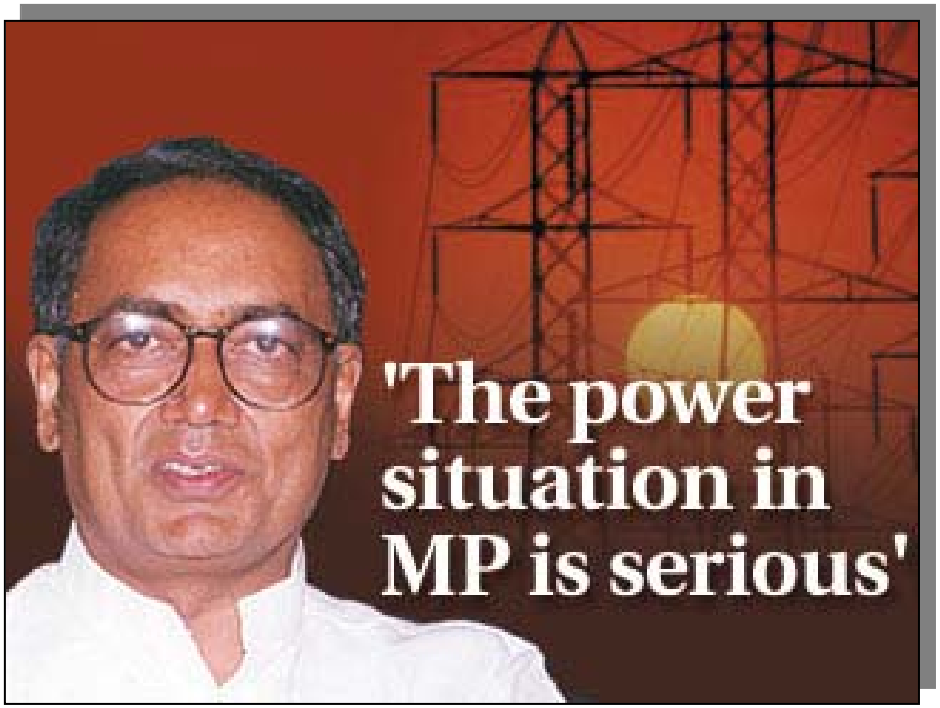
- Has lagged further and further behind China
- Similar generation capacity in 1950;
- Today:
  - India has installed capacity of 100,000 mw
  - China has 350,000 mw.
- There is a particularly acute shortage of peaking power…

INDIAN POWER SCENARIO

- INSTALLED CAPACITY 1,07,972.14 MW
  (AS ON 1.4.2003)
- GROSS GENERATION 532 BUs
  (2002-2003)
- PEAKING DEMAND * 81,492 MW
  (2002-2003)
- ENERGY SHORTAGE * 8.8%
  (2002-2003)
- PEAKING SHORTAGE * 12.2%
  (2002-2003)

SOURCE: CEA

Power shortage is widely acknowledged as critical for well-being and growth…

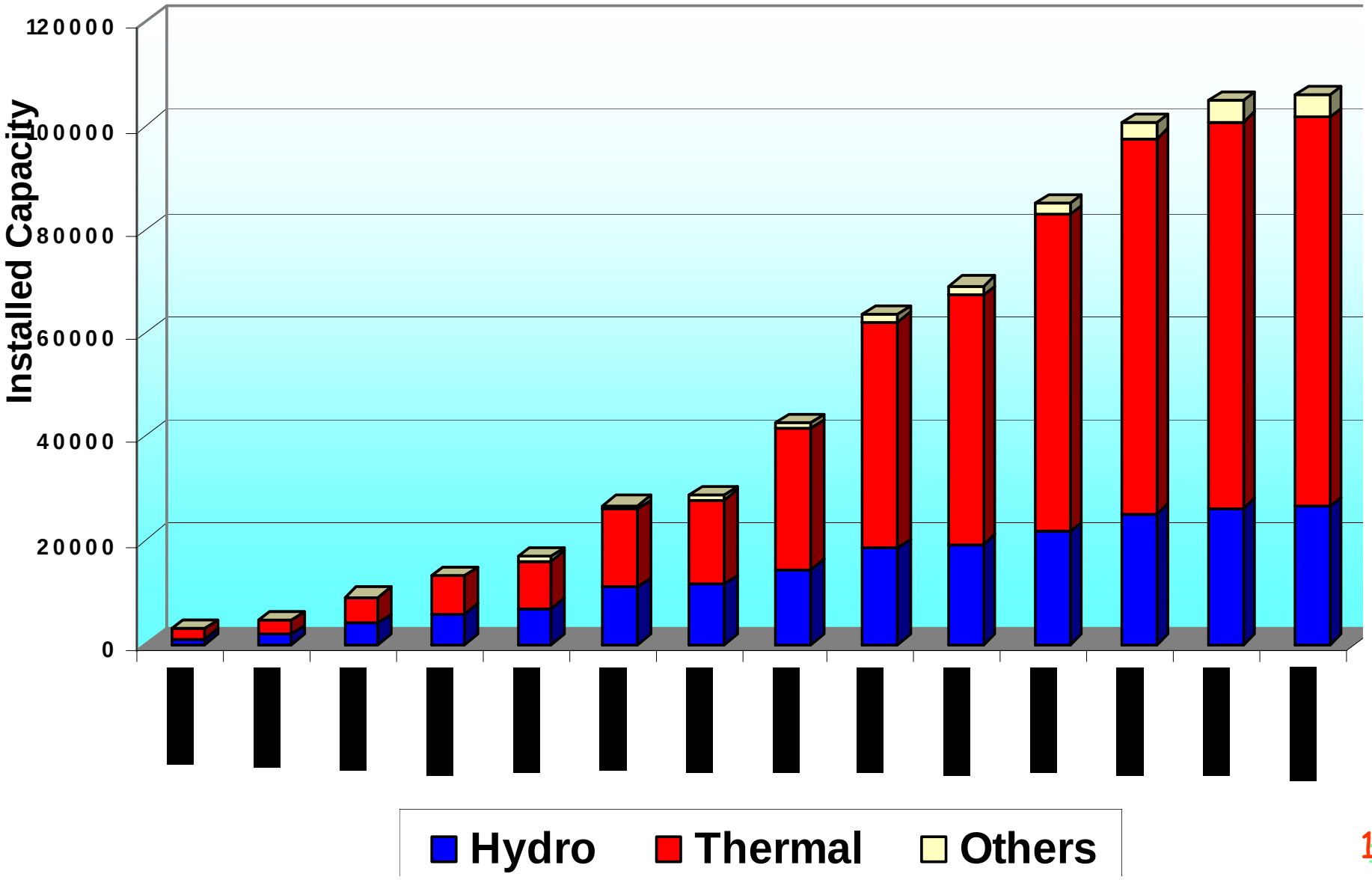


Headline in Times of India

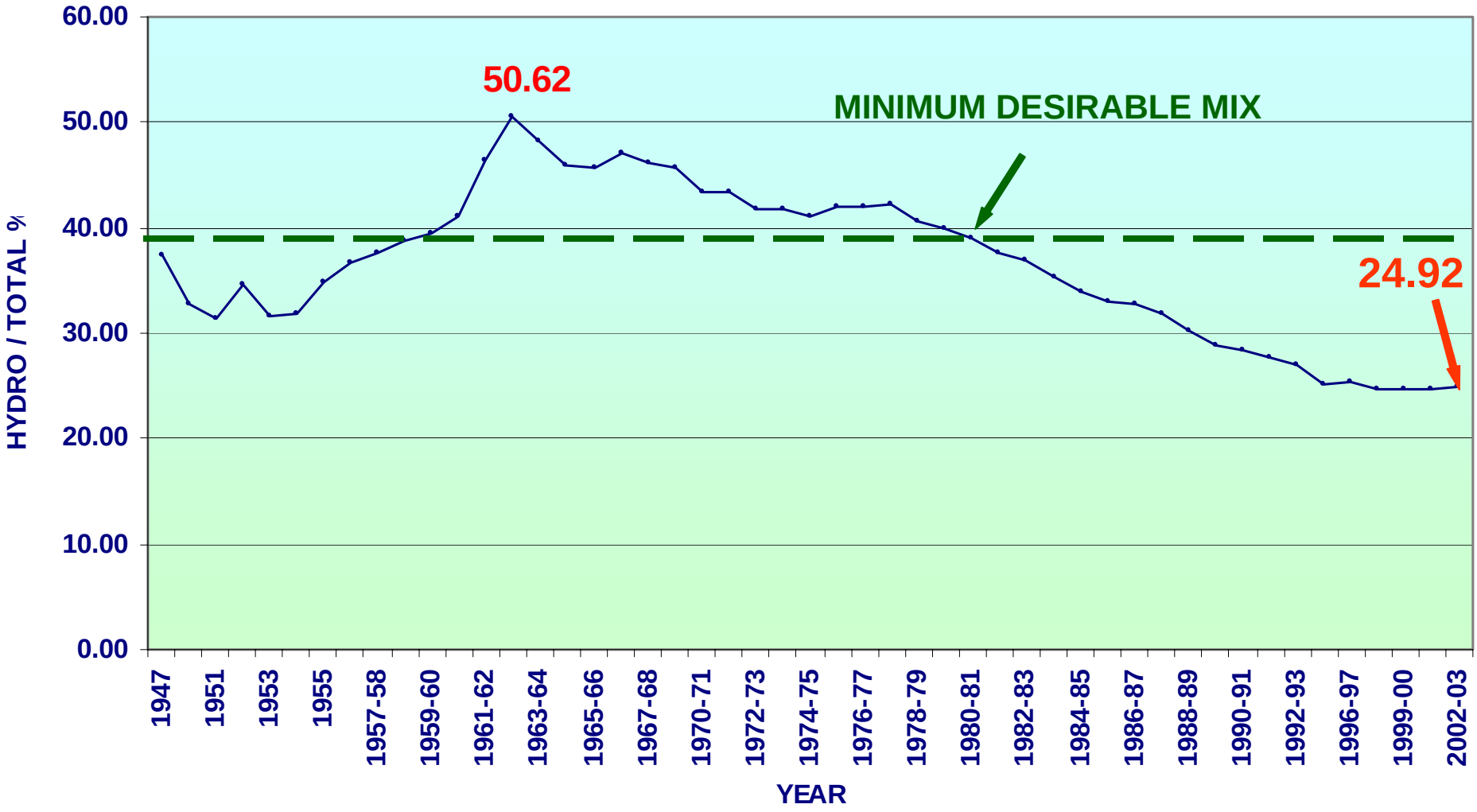
"Madhya Pradesh:

No power, no votes"

Growth profile of the power sector in India 1951-2003

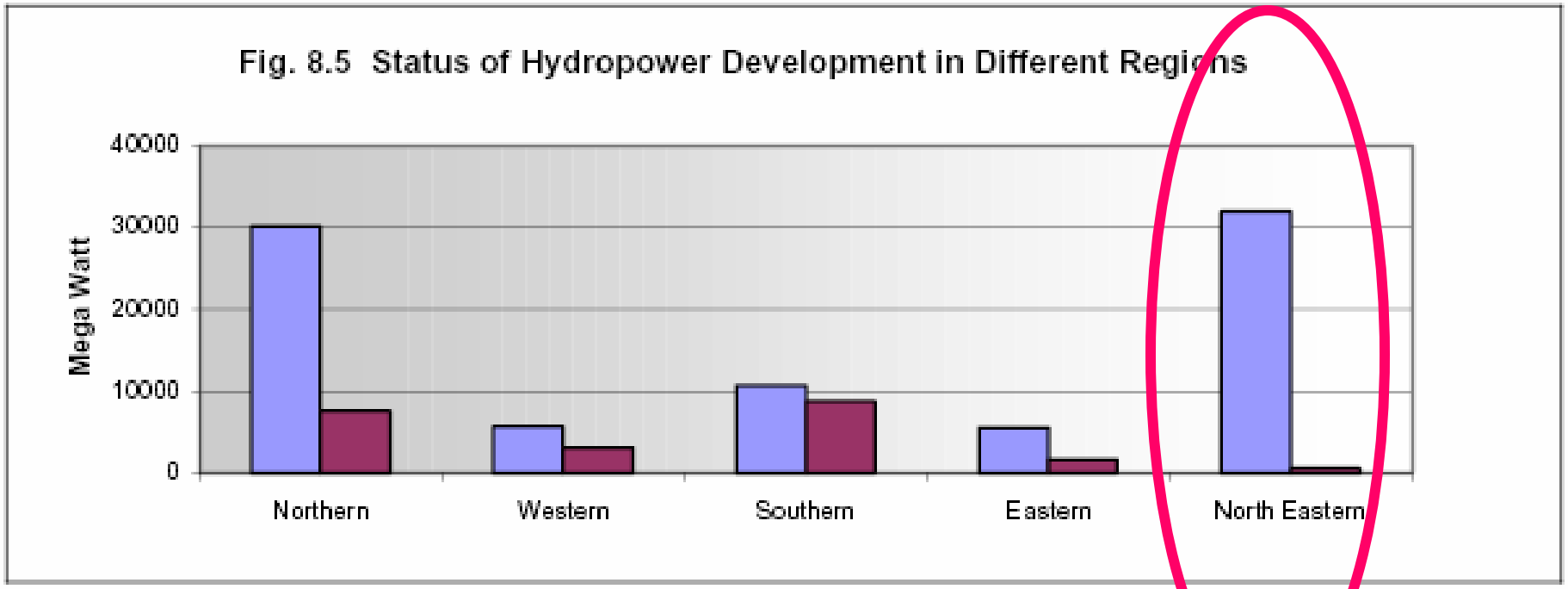


The changing energy mix…




Sindh
Lower Jhelum
Pong
Dehar
HIMACHAL PRADESH
PUNJAB
Giri Bata
Bhakra
Yammuna(Stage 2)
Nangal
Yammuna(Stage 1&4)
HARYANA
Tehri
PAKISTAN
CHINA (TIBET)
NEPAL
ARUNACHAL PRADESH
SIKKIM
BHUTAN
RAJASTHAN
UTTAR PRADESH
ASSAM
NAGALAND
Rana Pratap Sagar
Jawahar Sagar
Gandki
BIHAR
Obra
MANIPUR
Rihand
GUJARAT
MEGHALAYA
Loktak
Gandhi Sagar
JHARKHAND
MADHYA PRADESH
MIZORAM
Ukai
CHHATTISGARH
MYANMAR
Hirakud
MAHARASHTRA
ORISSA
BANGLADESH
Bhivpuri
Balimela
Khopoli
Koyna
Nagarjuna Sagar
Upper Sileru
Lower Sileru
BAY OF BENGAL
Tungabhadra
ARABIAN SEA
ANDHRA PRADESH
GOA
Malprabha
Kalindi
Sharawati
Bhadra
Jog
LAKSHADWEEP
Port Blair
TAMILNADU
Idukki
KERALA
Kadayar
N
Map not to Scale
Hydro Power Project

The special case of hydro as an engine for development in the poor Northeast….



Source: Policy on Hydropower Development, 1998, Ministry of Power.

1% of potential developed in GBM Basin

Himalayan Dams among the best sites in the world from environmental and social perspectives

Table 1. Land Area Flooded and People Displaced in Large Hydropower Projects

Project (country)	*Installed capacity (MW)*	*Reservoir area (hectares)*	*People displaced*	*Hectares flooded / MW*	*People displaced / MW*
Arun II (Nepal)	**402**	**43**	**775**	**<1**	**2**
Pehuenche (Chile)	500	400	0	<1	0
Pangue (Chile)	450	500	50	1	<1
Guavio (Colombia)	1,000	1,530	4,959	2	5
Tehri (India)	2,400	4,200	100,000	2	42
Ghazi Barotha (Pakistan)	1,450	2,640	899	2	1
Nam Theun-Hinboun (Laos)	210	630	0	3	0
Ertan (China)	3,300	10,100	30,000	3	9
Fortuna (Panama)	300	1,050	446	4	1
Chixoy (Guatemala)	300	1,400	3,445	5	11
Grand Coulee (United States)	6,494	33,306	10,000	5	2
Three Gorges (China)	18,200	110,000	>1,300,000	6	>71
Tarbela (Pakistan)	3,478	24,280	96,000	7	28
Salvajina (Colombia)	270	2,030	3,272	8	12
Zimapan (Mexico)	280	2,300	2,800	8	10
Itaipu (Brazil/Paraguay)	12,600	135,000	59,000	11	5
Victoria (Sri Lanka)	210	2,270	45,000	11	214
Kararao/Belo Monte (Brazil)	8,381	116,000	n.a.	14	n.a.
Aguamilpa (Mexico)	960	13,000	1,000	14	1
Betania (Colombia)	510	7,370	544	14	1
Urra I (Colombia)	340	7,400	6,200	22	18
Mangla (Pakistan)	1,000	25,300	90,000	25	90
Bakun (Malaysia)	2,400	70,000	9,000	29	4
Ataturk (Turkey)	2,400	81,700	55,000	34	23
El Cajon (Honduras)	300	11,200	4,000	37	13
Ilha Solteira (Brazil)	3,200	125,700	6,150	39	2
Guri Complex (Venezuela)	10,300	426,000	1,500	41	<1

Now India plans has started building 50,000 mw of hydro in the next twenty years…

THE SPECIAL CASE OF POOR, MOUNTAINOUS COUNTRIES

- Those with "water and gravity" next to large markets…
- Nepal, Bhutan, Lesotho, Laos, Uganda…
- Nepal and US have about the same hydro potential
  - US has developed 70,000 mw
  - Nepal has developed 300 mw
- Potential of huge economic benefits from royalties (~5% GNP)…
- Are wholly dependent on external financing….

Story line

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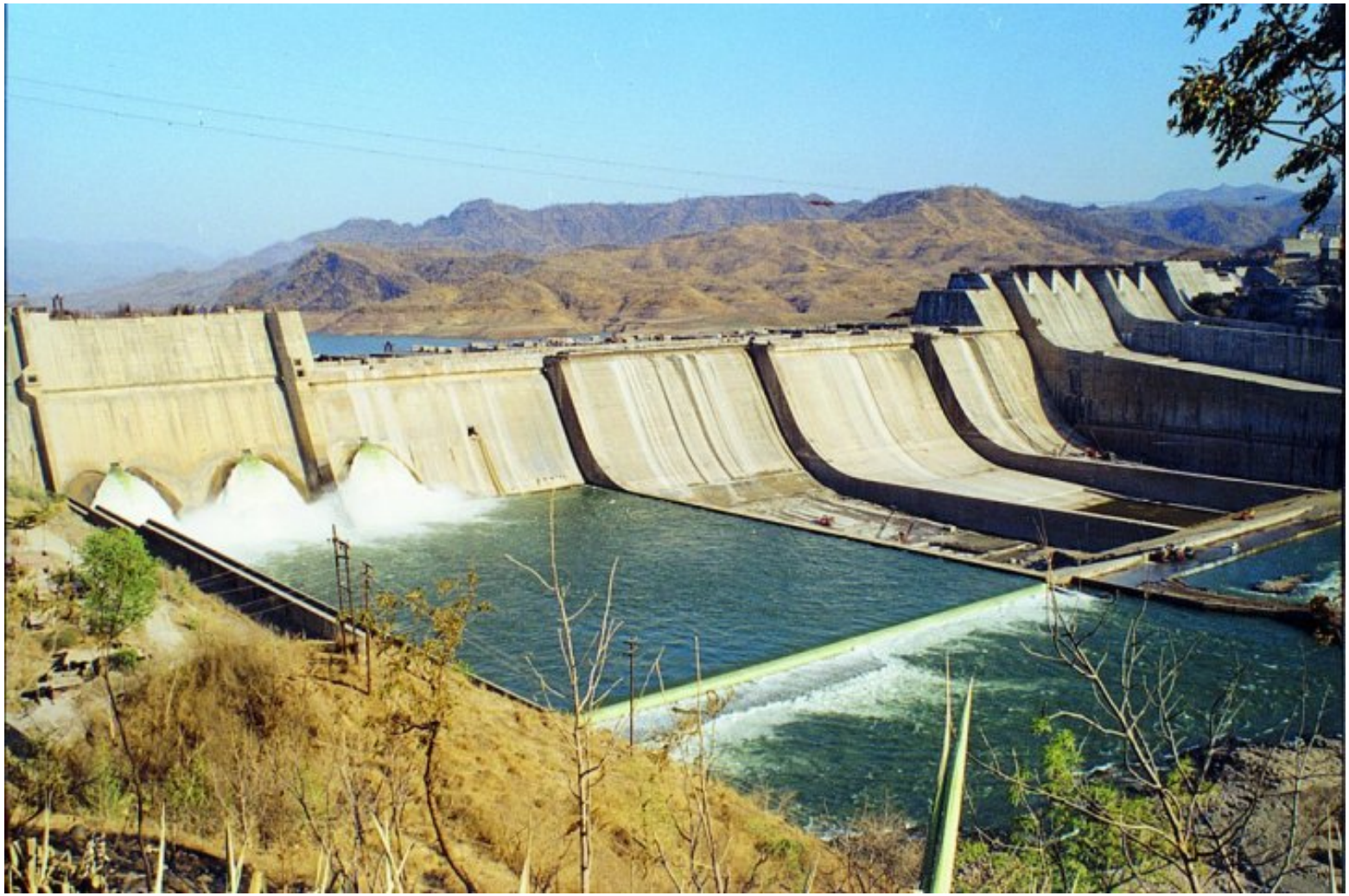
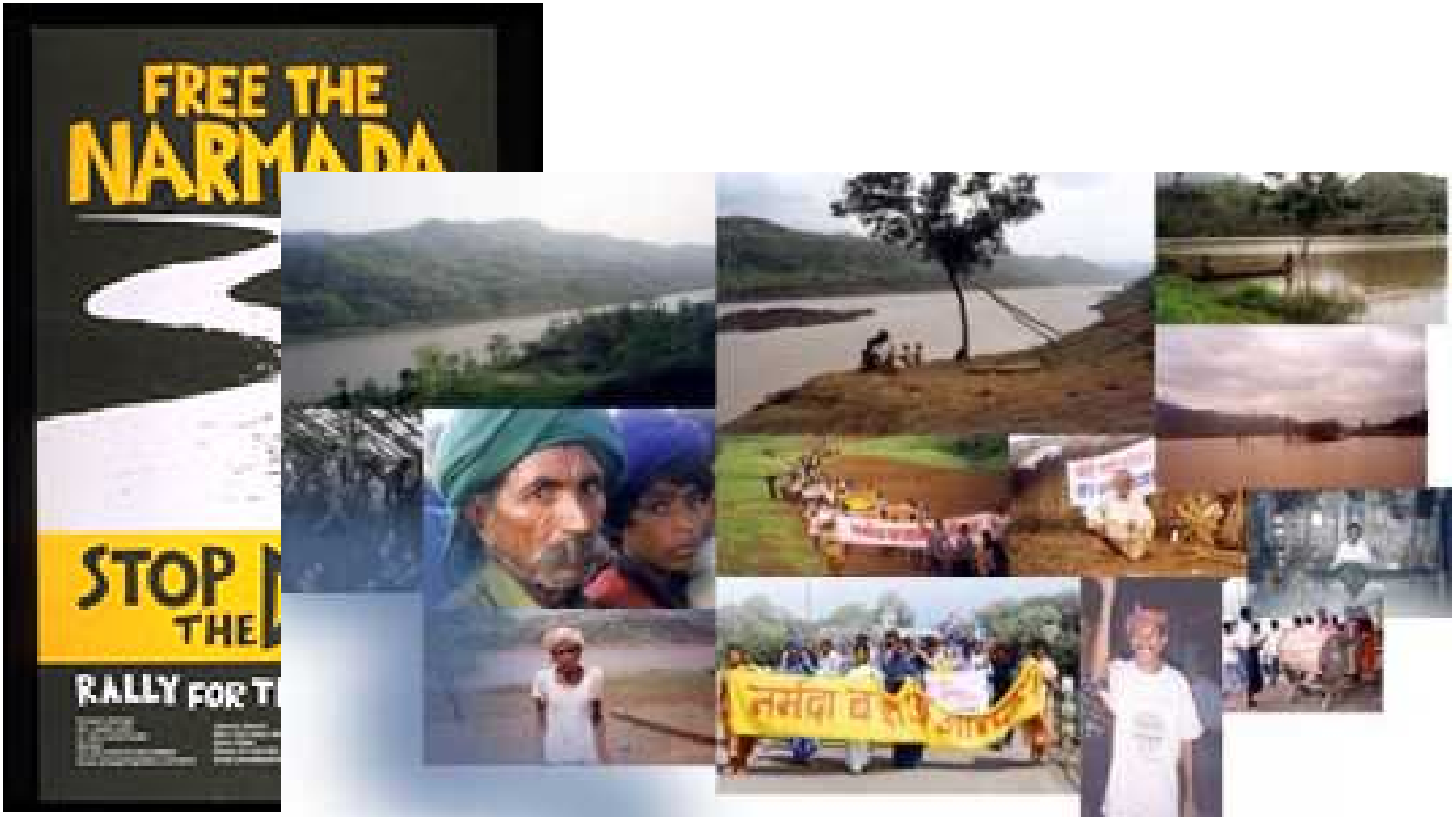
There have been major environmental and social concerns about large dams/hydro…
With the Narmada (Sardar Sarovar) Project in India the poster case….

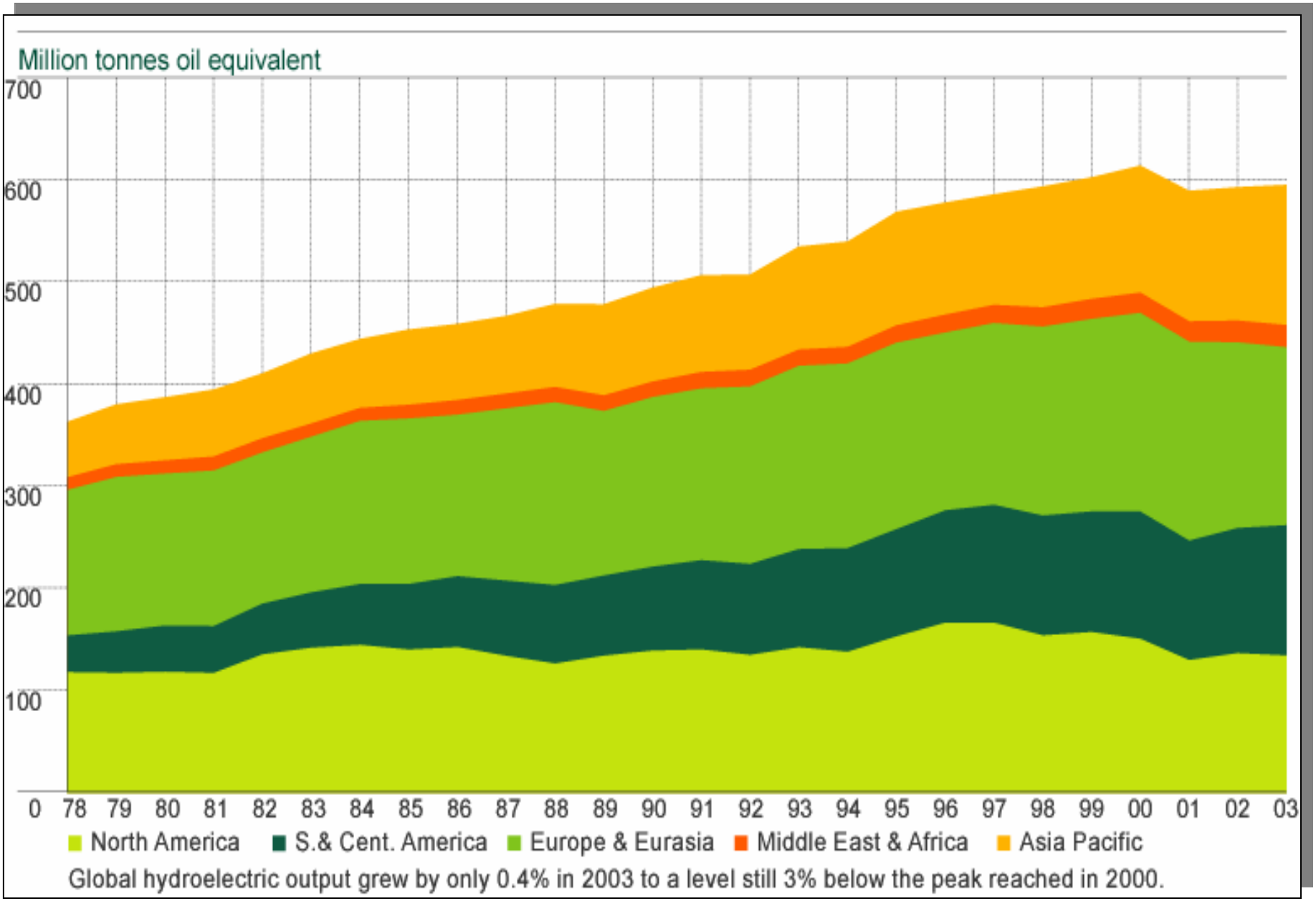




Friends of the River NARMADA

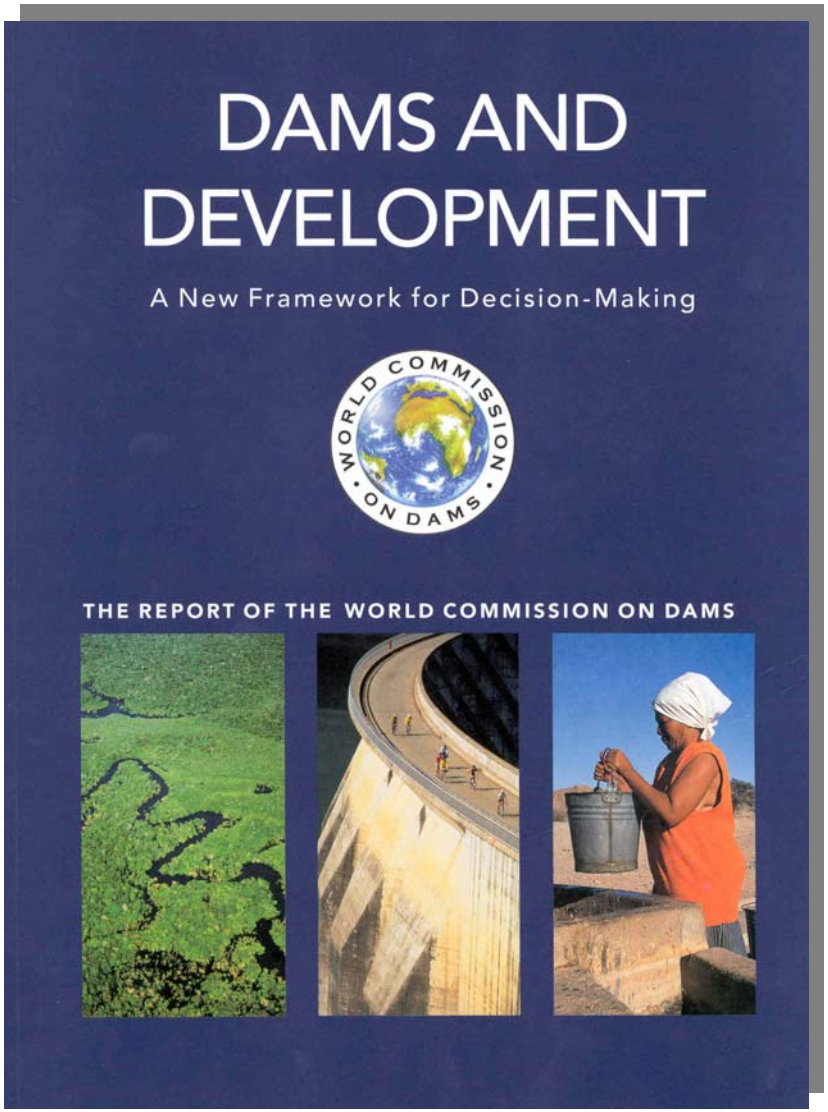
नर्मदा की घाटी में
अब लड़ाई जागी है
चलो उठो, चलो उठो,
रोकना विनाश है।

And partially as a result, hydropower has grown only slowly…



(Source: bp.com)

The World Commission on Dams was supposed to forge a new consensus …



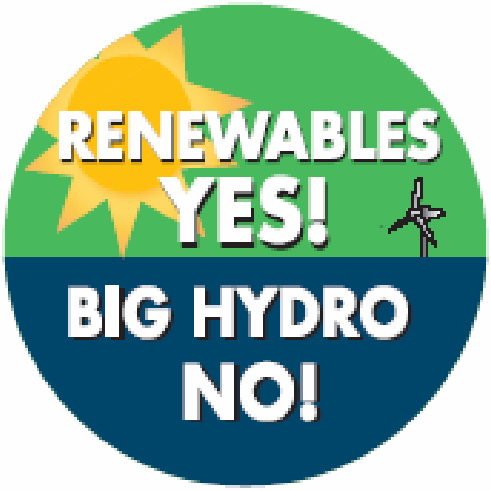
Broad acceptance of:

- 3 core values and
- 5 strategic priorities

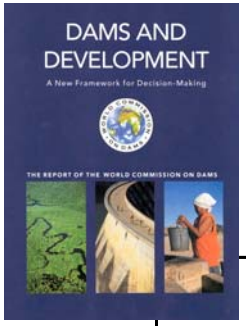
but

- the 26 normative"guidelines" not accepted by any countries building dams (nor by the Wolrd Bank)

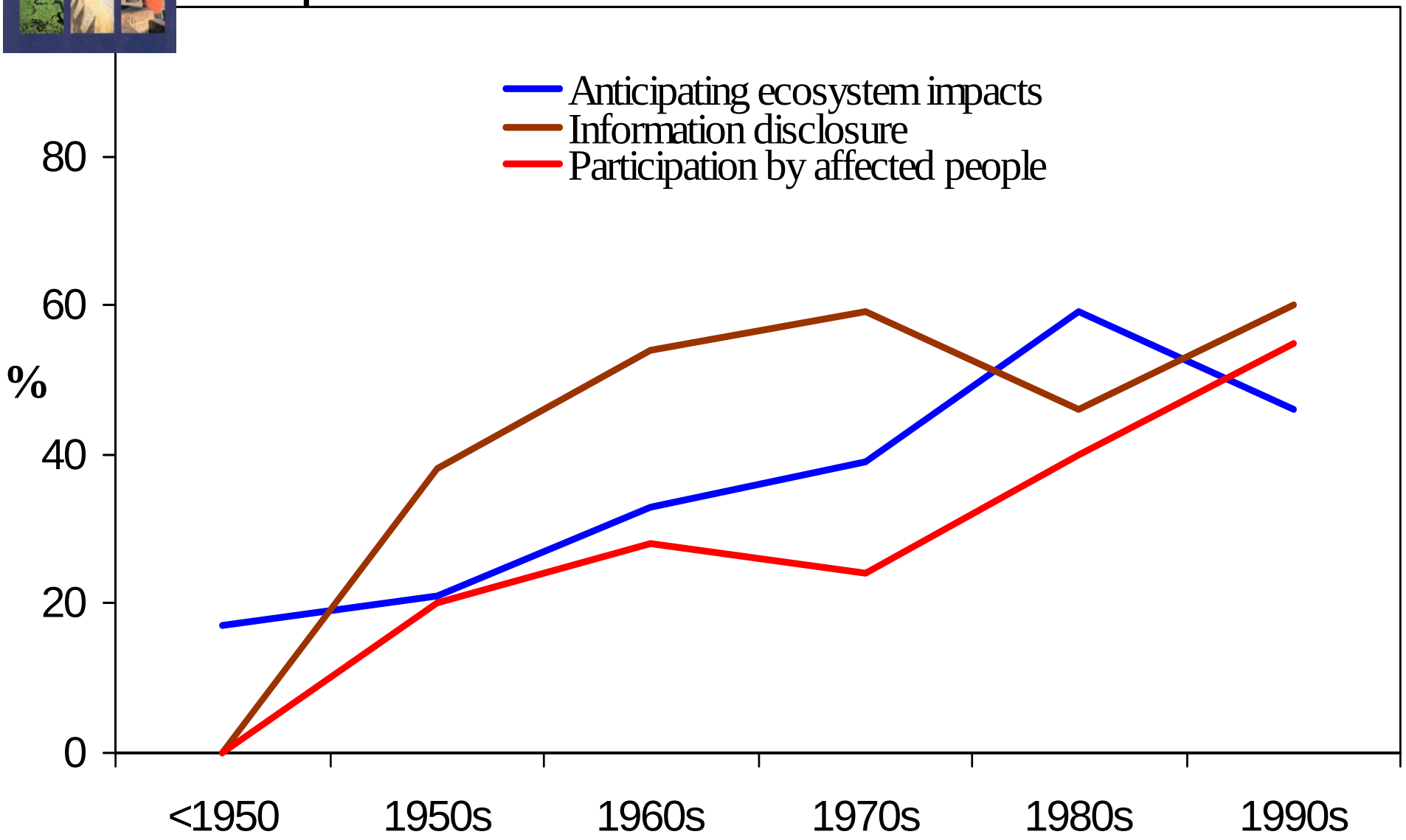
The anti-dam campaign has advocated "compliance with the WCD guidelines…"



But developing countries have taken an unprecedented, united position in restoring common sense…



WCD documented how performance has improved over time



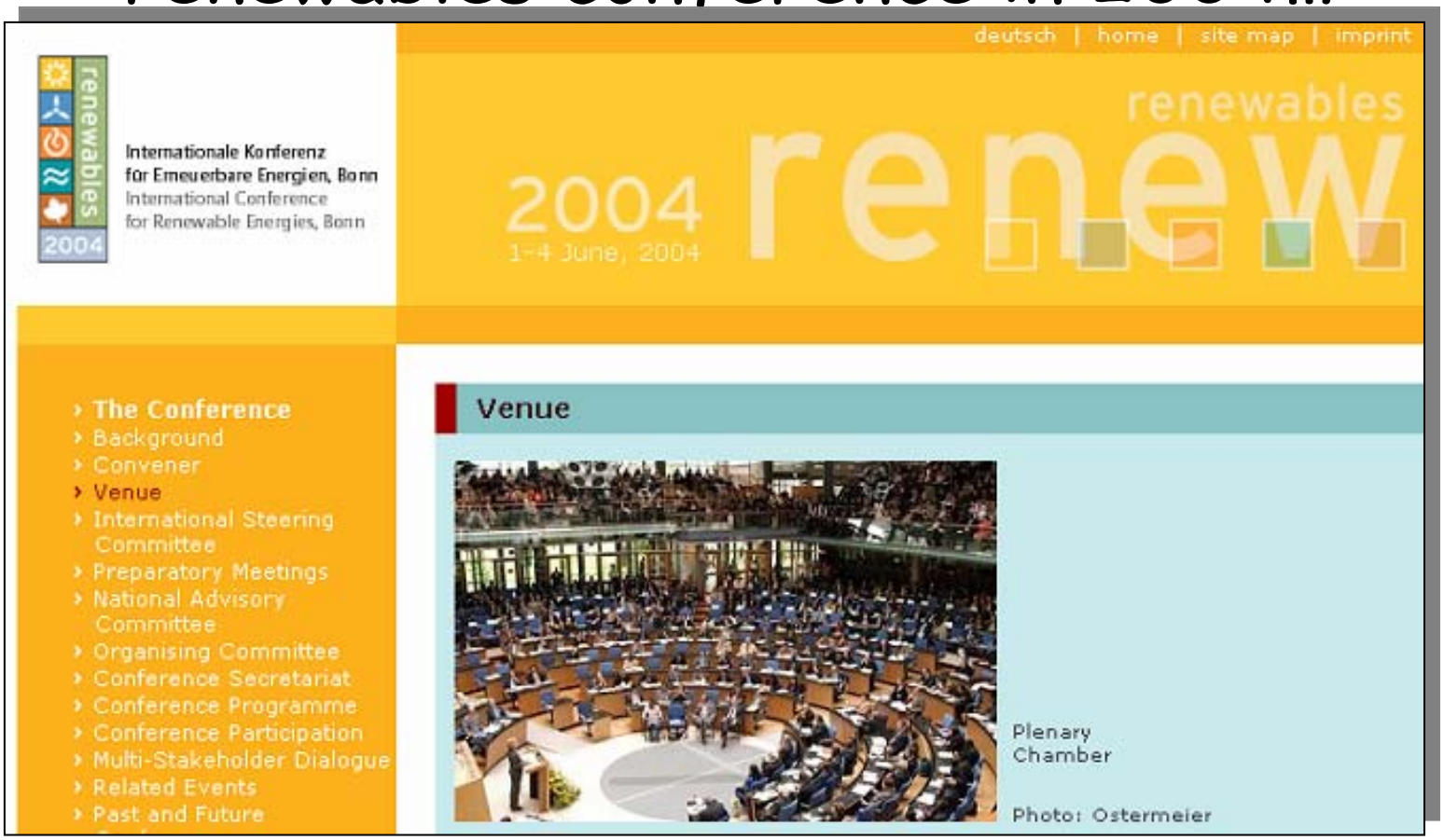
WSSD/Johannesburg Plan of Implementation…

- Identification of ALL hydro as a renewable source of energy, to be supported by international community….

The 3rd
World Water Forum
March 16-23,2003 in Kyoto,Shiga and Osaka,Japan

Another powerful statement from developing countries on the need for dams and other hydraulic infrastructure….

Latest, very important venue… Bonn renewables conference in 2004…



Where developing countries (Brazil and Uganda especially) took the lead against the anti hydro campaign and where all hydro was unequivocally recognised as "renewable"

And with the impending ratification of the Kyoto Protocol, hydro will get another major boost…

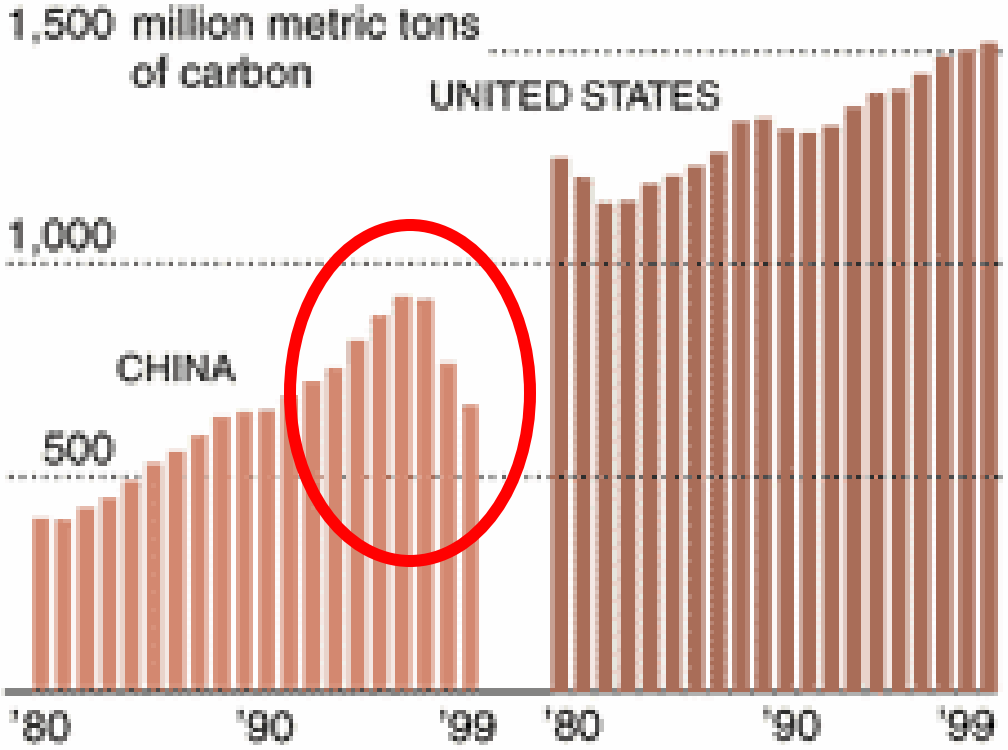
Climate change puts the spotlight on hydropower…. with China cited as a global leader…

85,000 mw of hydro have played a central role in reducting GHGs

The New York Times ON THE WEB

Tracking Carbon Dioxide Emissions

China's total carbon dioxide emissions have been declining in the past few years, while emissions from the United States are still rising.



EMISSIONS PER CAPITA, 1998
in metric tons

China	2.3
United States	20.1

Source: Natural Resources Defense Council, based on data from the U.S. Department of Energy and the United Nations

The New York Times

Global Warming: In Depth: Analysis

China is Aggressively Reducing Its Carbon Dioxide Emissions

Closing Dirty Power Plants

China has ordered all of its smallest, most inefficient and dirtiest coal-fired plants to shut down over the next five years.[15] According to reports, 2,840 MW of plants smaller than 100 MW were closed in 1997 and 1998, and a total of 1,820 MW small thermal power plants were closed in 1999.[16] The total capacity to be closed will reach 30,000 MW. To strengthen its closure orders, the central government has forbidden power grids to buy electricity from plants due to be closed and directed banks not to lend to them.[17]

In addition to shutting down existing plants, China also has limited construction of new small capacity units to ensure that only high-efficiency cogeneration plants and other clean, efficient and economic technologies are used.[18] The government intends to raise the efficiency of new large, domestically produced coal-fired power generation units to nearly 40 percent early in this century with intensified technology transfer and research and development programs.[19]

China's large hydroelectric capacity has grown rapidly over the last few years, reaching 65 gigawatts of capacity that produces 20 percent of the nation's electricity.[20] Several large projects, including the controversial Three Gorges Dam, are expected to come on line in the next 10 years. China's hydropower capacity will increase 35 percent to some 100,000 MW by 2005, representing 27 percent of the nation's power generation capacity.[21] Incidentally, China's nuclear facilities generate little more than 1 percent and are not expected to play a major role in the future of the country's power sector.[22]

Story line

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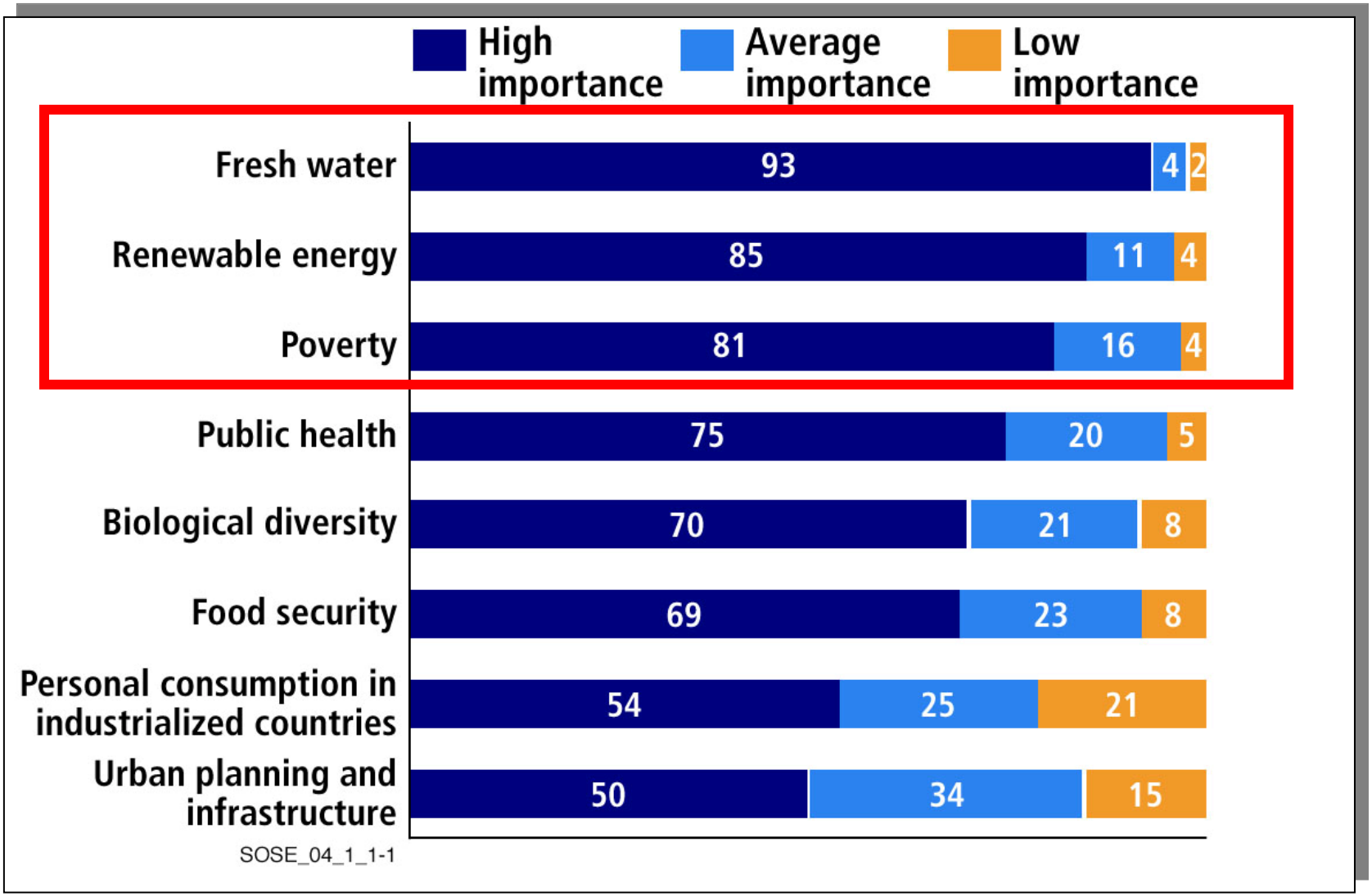
Items considered important by world leaders



China has long understood this…

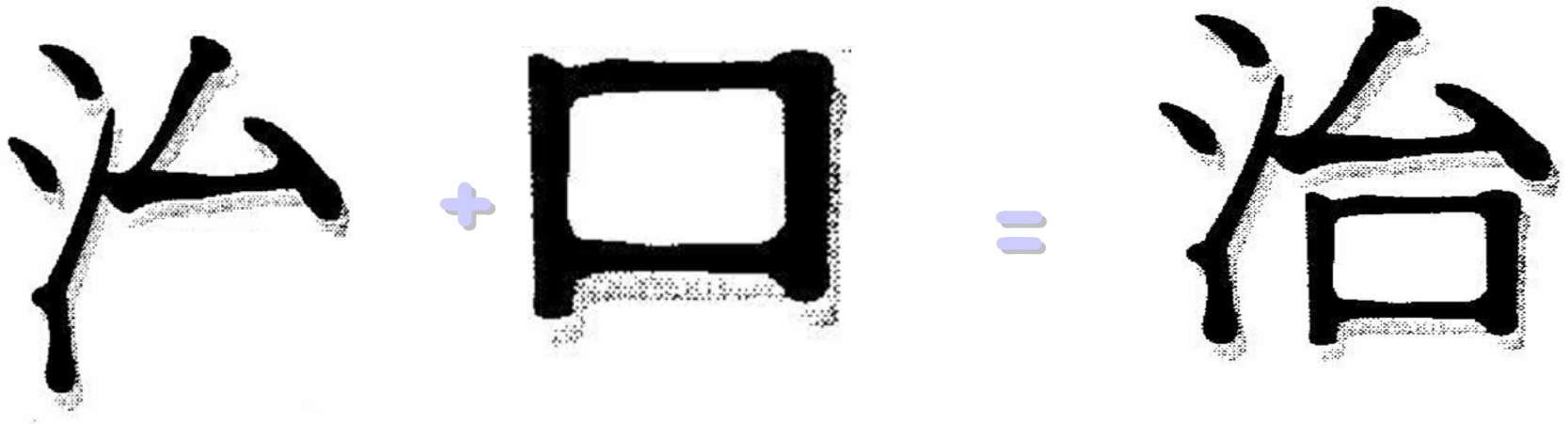
Problems of floods: … historic …

And contemporary (Yangtze 1998)….

Problems of drought…

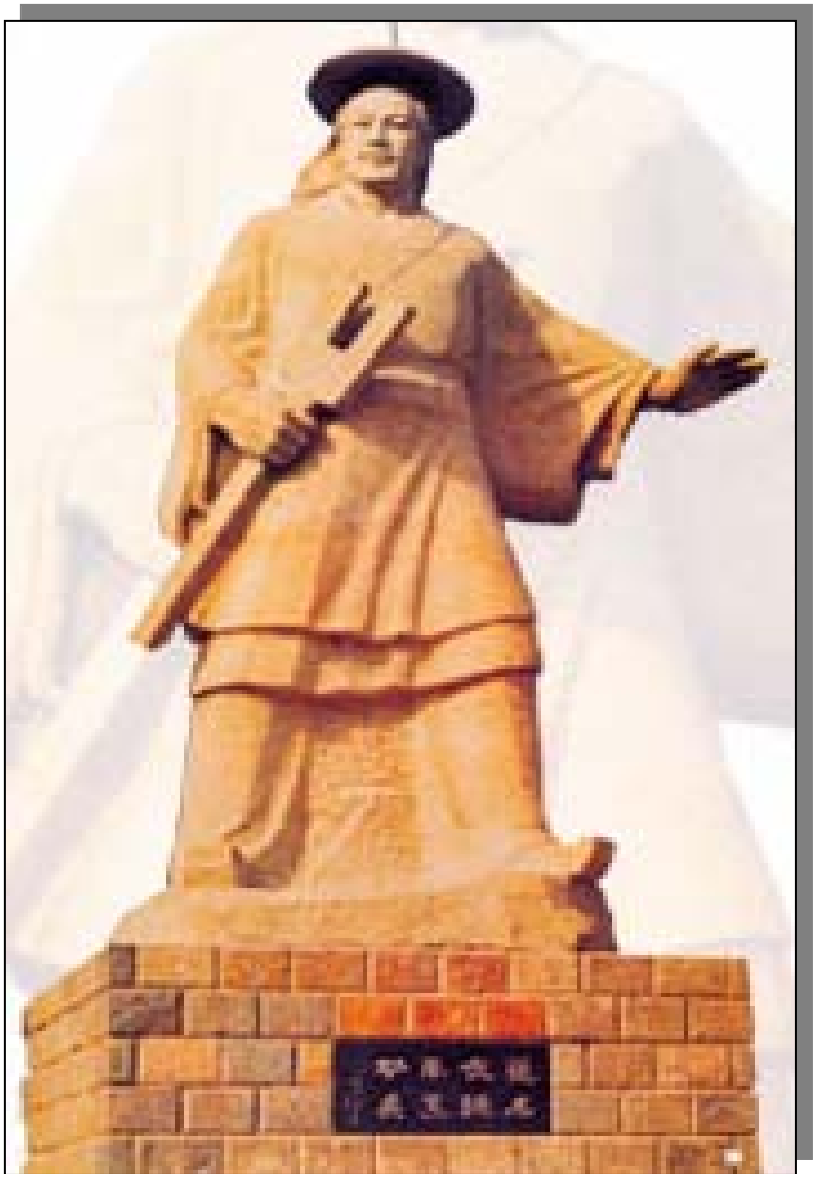
And drudgery, especially for women

Reflection of this in the language itself….

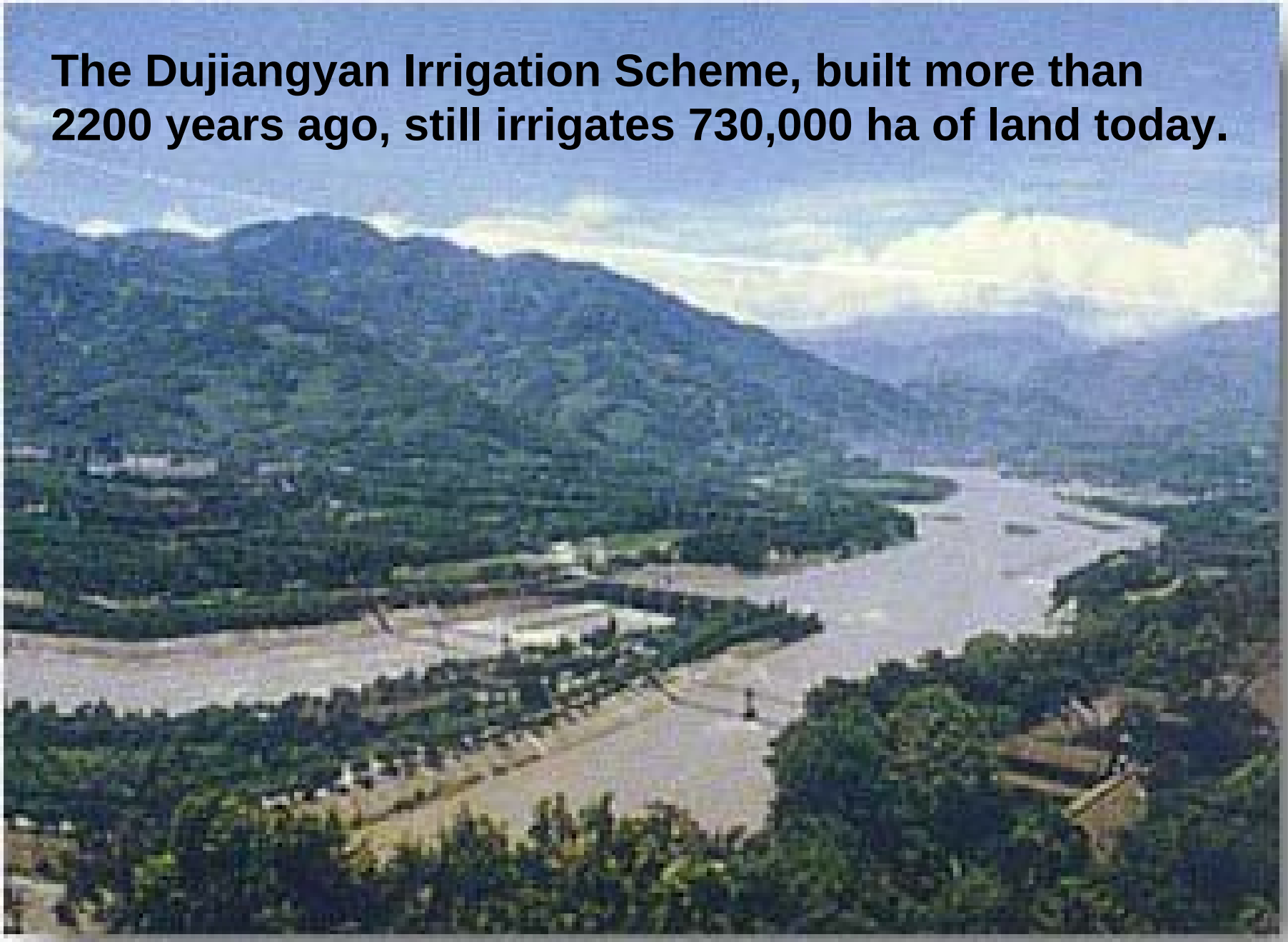


river + dyke = Political order

China has long been a leader in water management…



King Yu, China's forerunner of water engineering 4,000 years ago


The Dujiangyan Irrigation Scheme, built more than 2200 years ago, still irrigates 730,000 ha of land today.

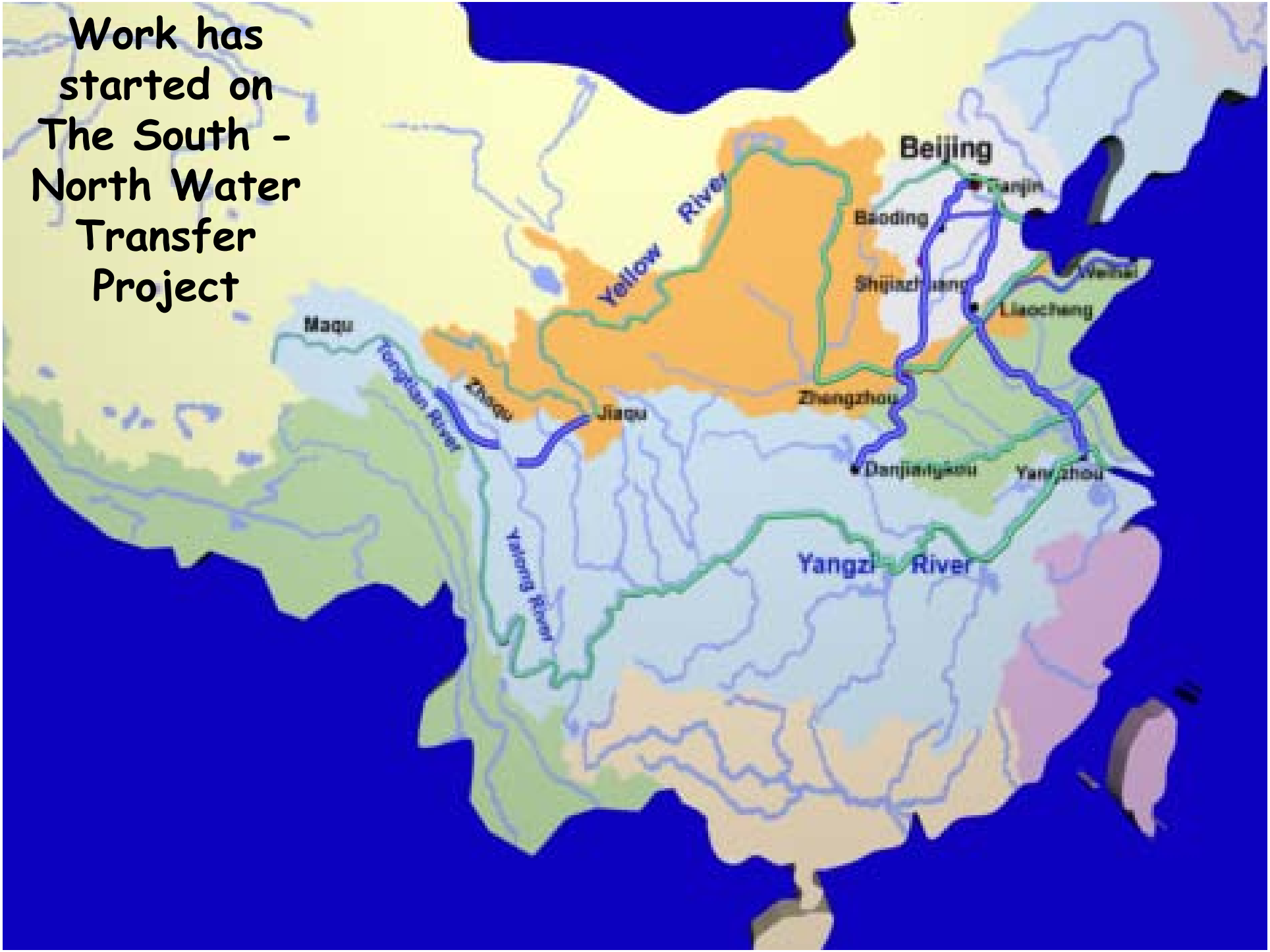
In recent decades China has invested massively in multi-purpose water infrastructure….

3,800 km of main dikes have been strengthened

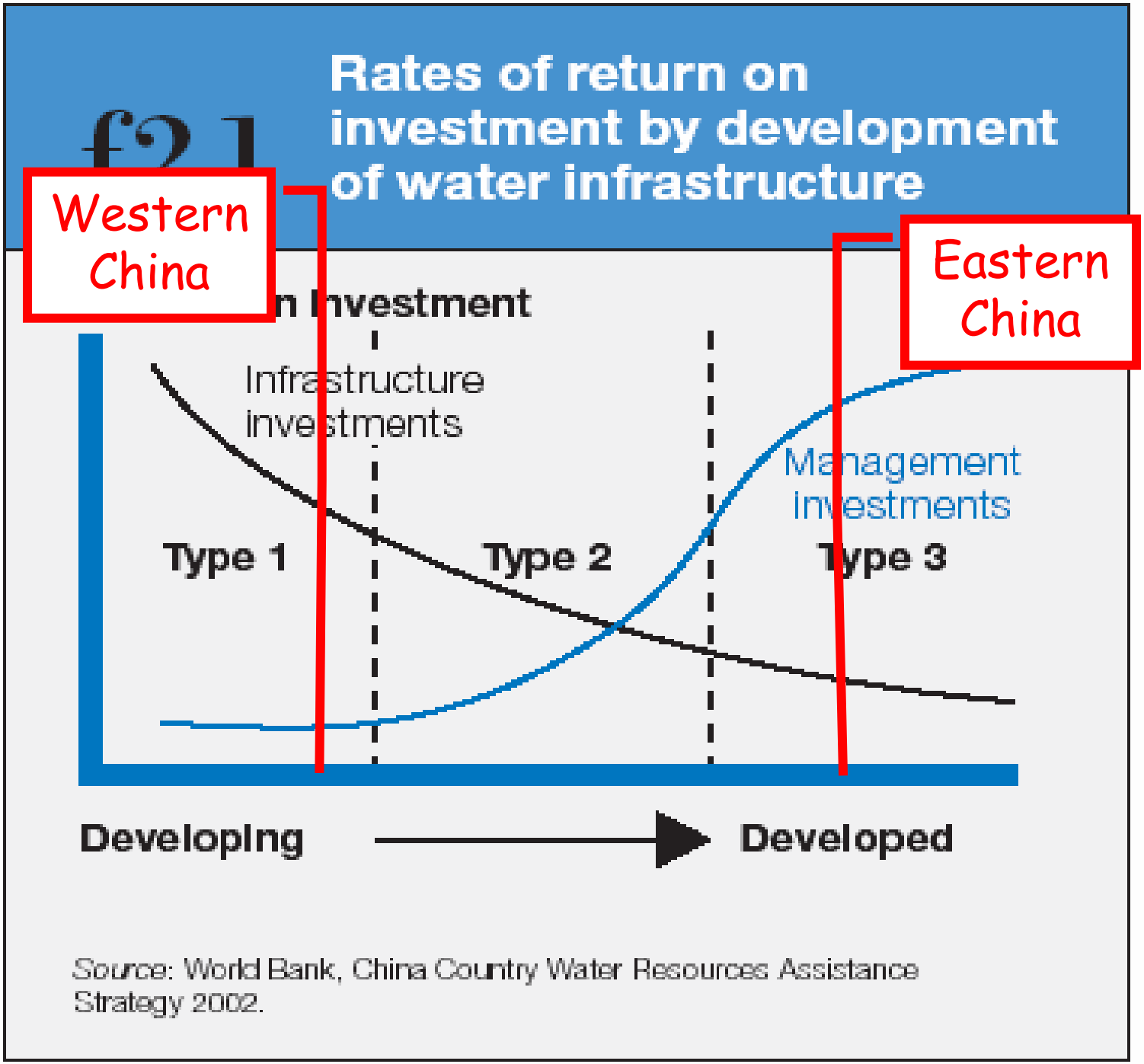
85,000 mw of hydropower capacity has been built…

There has been massive investment in multipurpose dams…

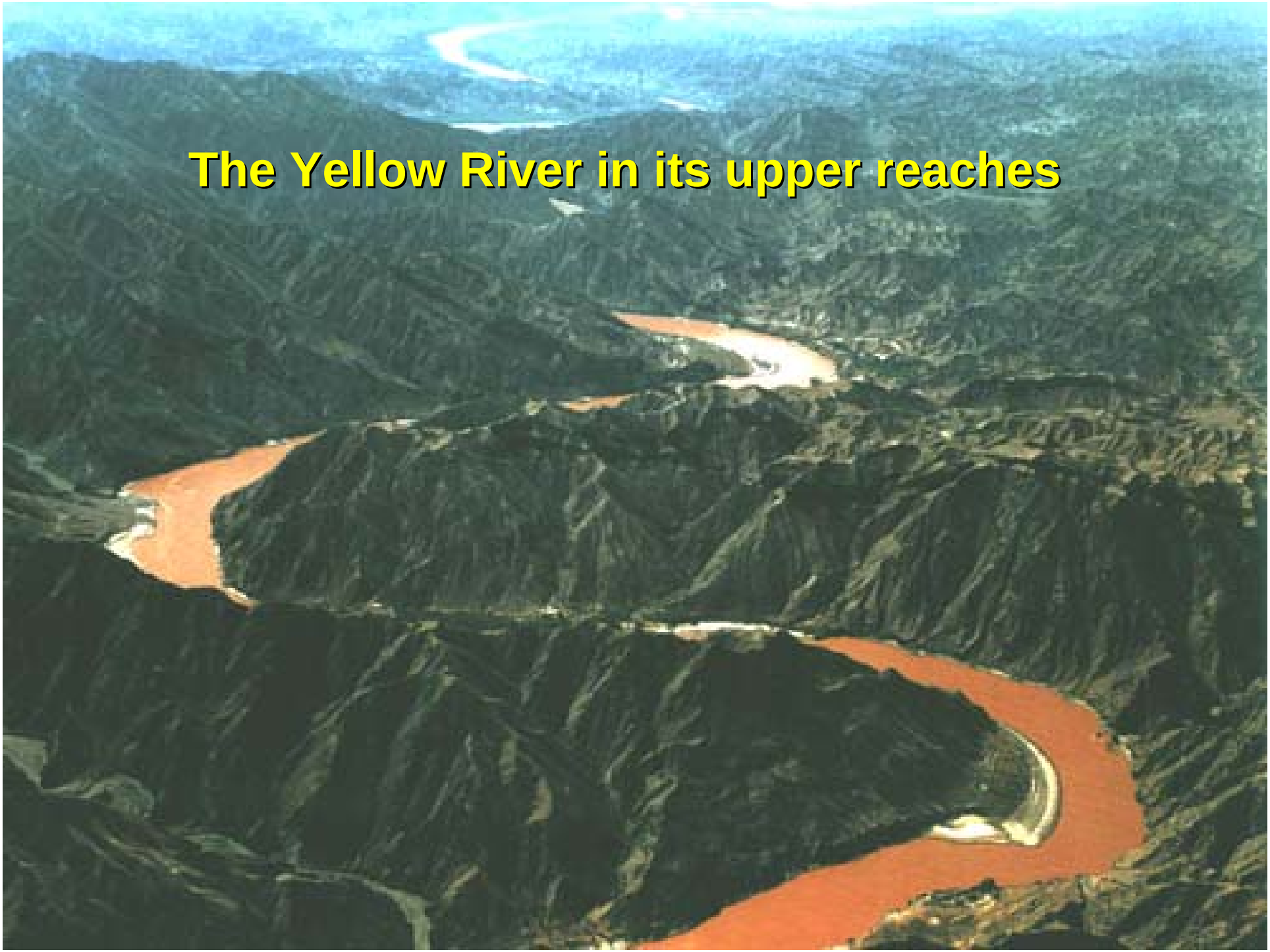
Work has started on The South - North Water Transfer Project



China is now at an inflection point….


Rates of return on investment by development of water infrastructure
Western China
Eastern China
Infrastructure investments
Management investments
Type 1
Type 2
Type 3
Developing
Developed
Source: World Bank, China Country Water Resources Assistance Strategy 2002.

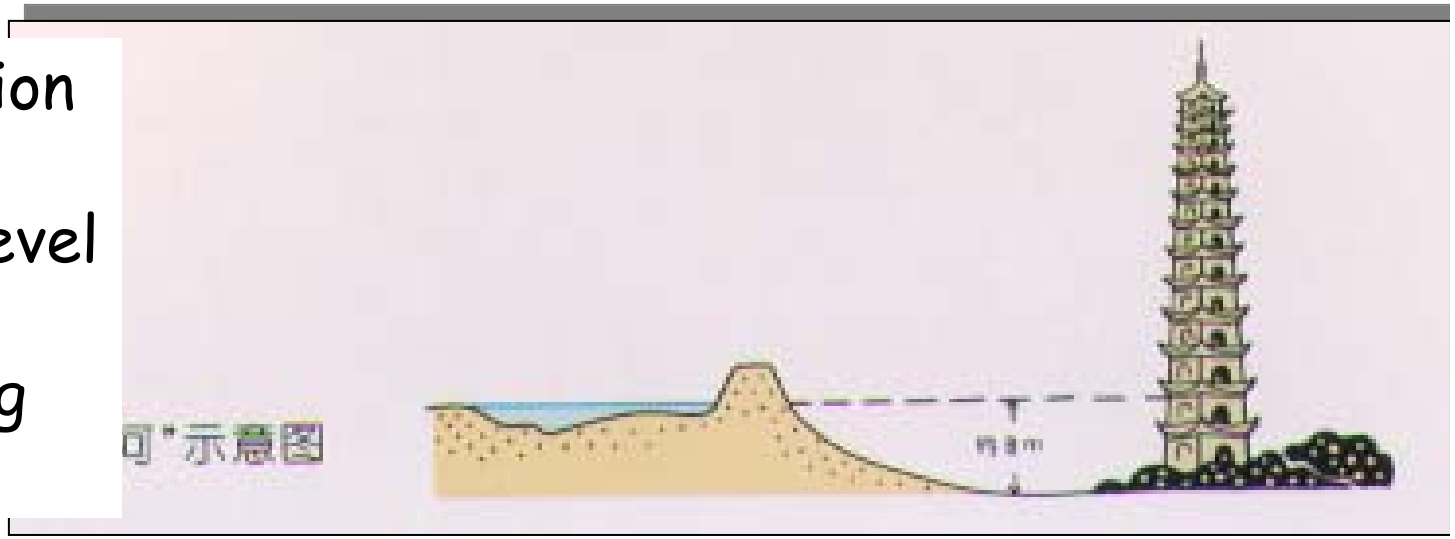
China now simultaneously investing massively in improved water infrastructure AND management…


The Yellow River in its upper reaches


The Yellow River further downstream

Major problems in lower reaches….

Sedimetation has raised the river level above the surrounding plain



With catastrophic floods when the dikes are breached….

What to do?

860,000 km^2 of eroded area in Loess Plateau has been brought under control.

Xiaolongdi Dam – an audacious attempt to scour the raised river bed in the lower Yellow River…

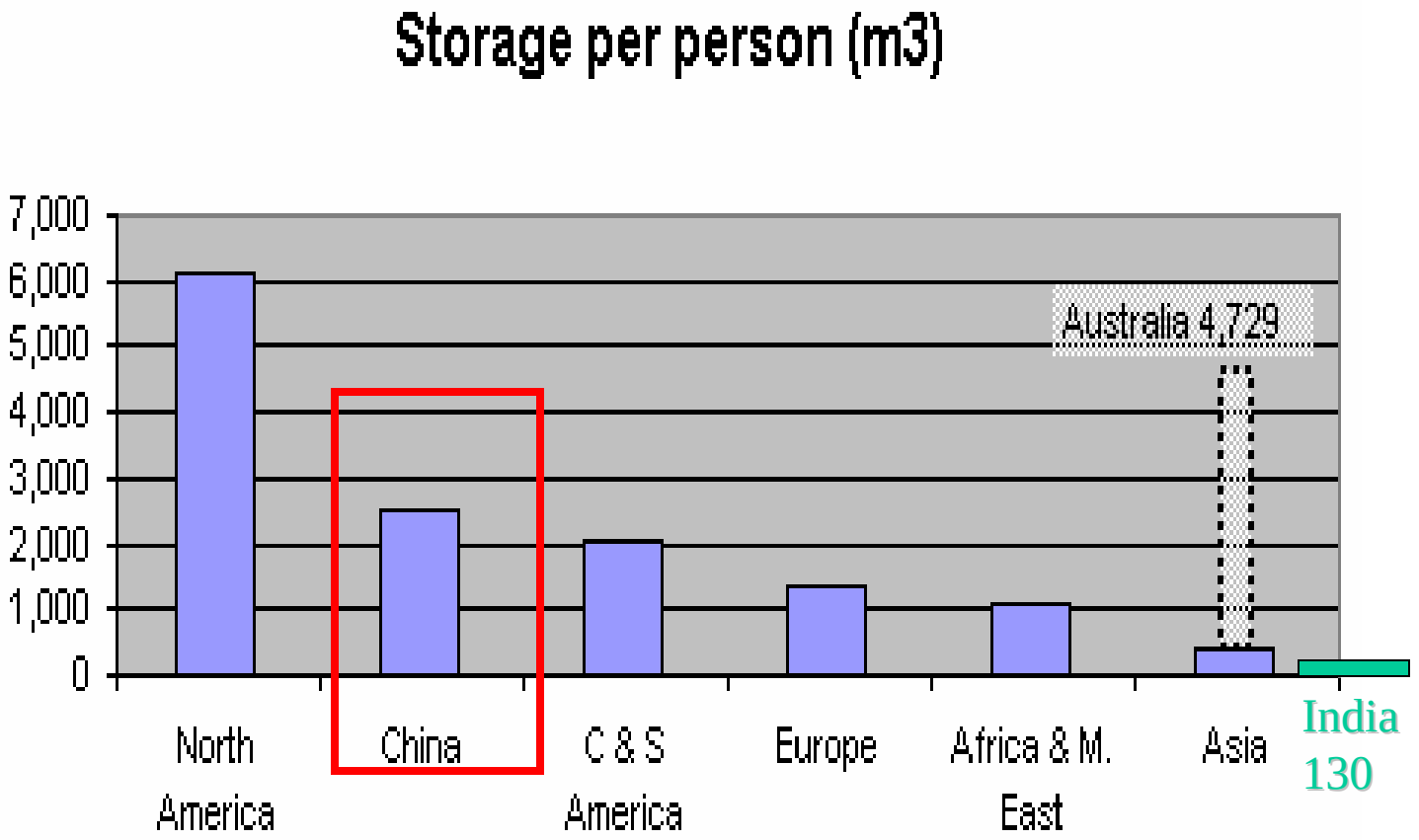
China also faces water quality challenges associated with rapid urbanization

Requiring large investments in Wastewater Treatment

All accompanied by an impressive National Water Saving Campaign

国家节水标志

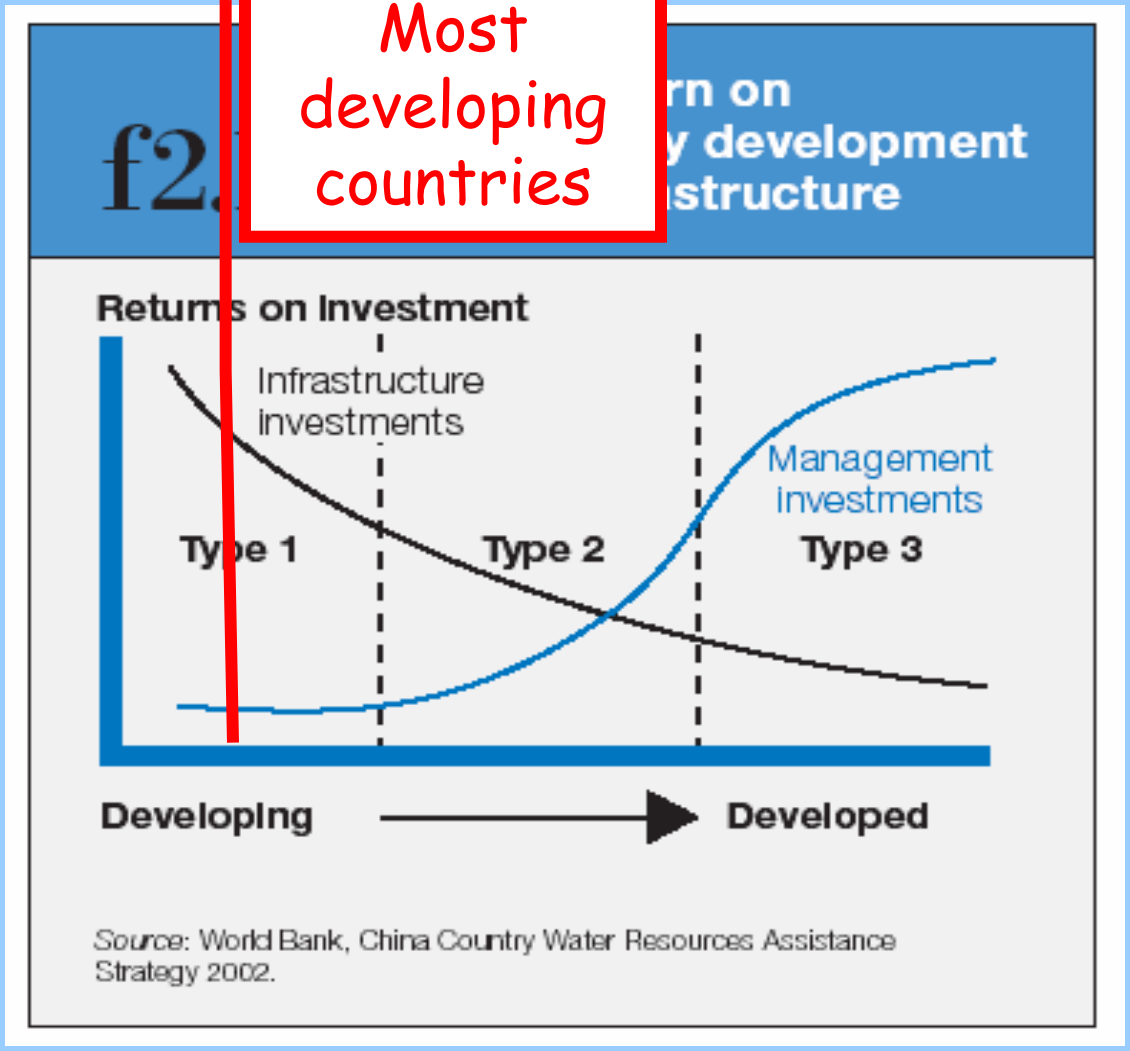
But China is far ahead of most other developing countries in terms of infrastructure…



China has 2,400 m^3/cap

US and Australia have ~5000 m^3/cap;

India has 130 m^3/cap, Ethiopia has 50 m^3/cap



QED: Most developing countries still have to make massive investments in multipurpose water infrastructure

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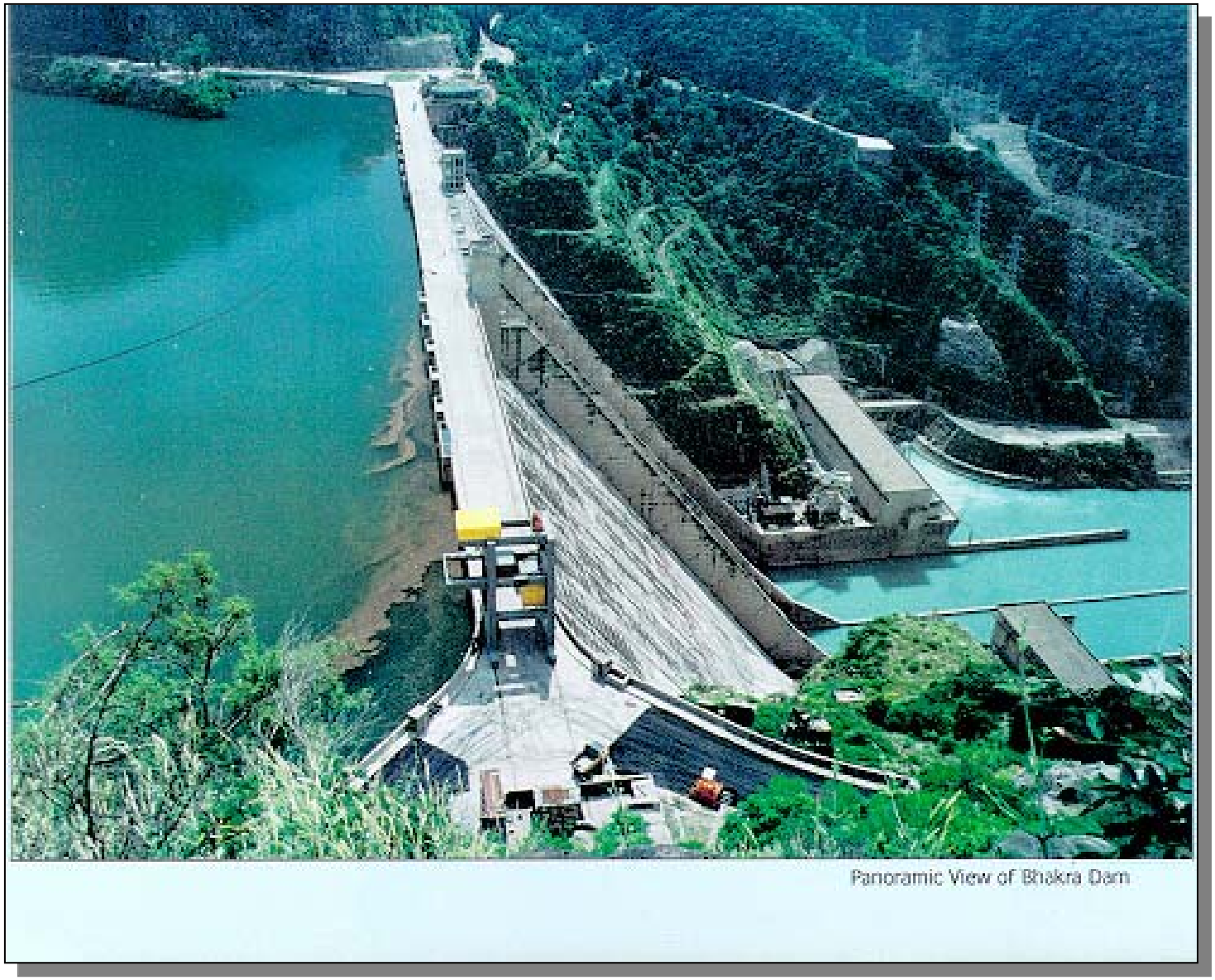
Investments in water resources development and management have broad, region-wide impacts:

Large economic and employment multipliers:

- 2 or more in wide variety of settings:
  - Tamil Nadu in India
  - Muda Basin in Malaysia
  - Sao Francisco Basin in Brazil
  - Columbia Basin in US
  - New South Wales in Australia…

For example: The Bhakra-Beas complex in India

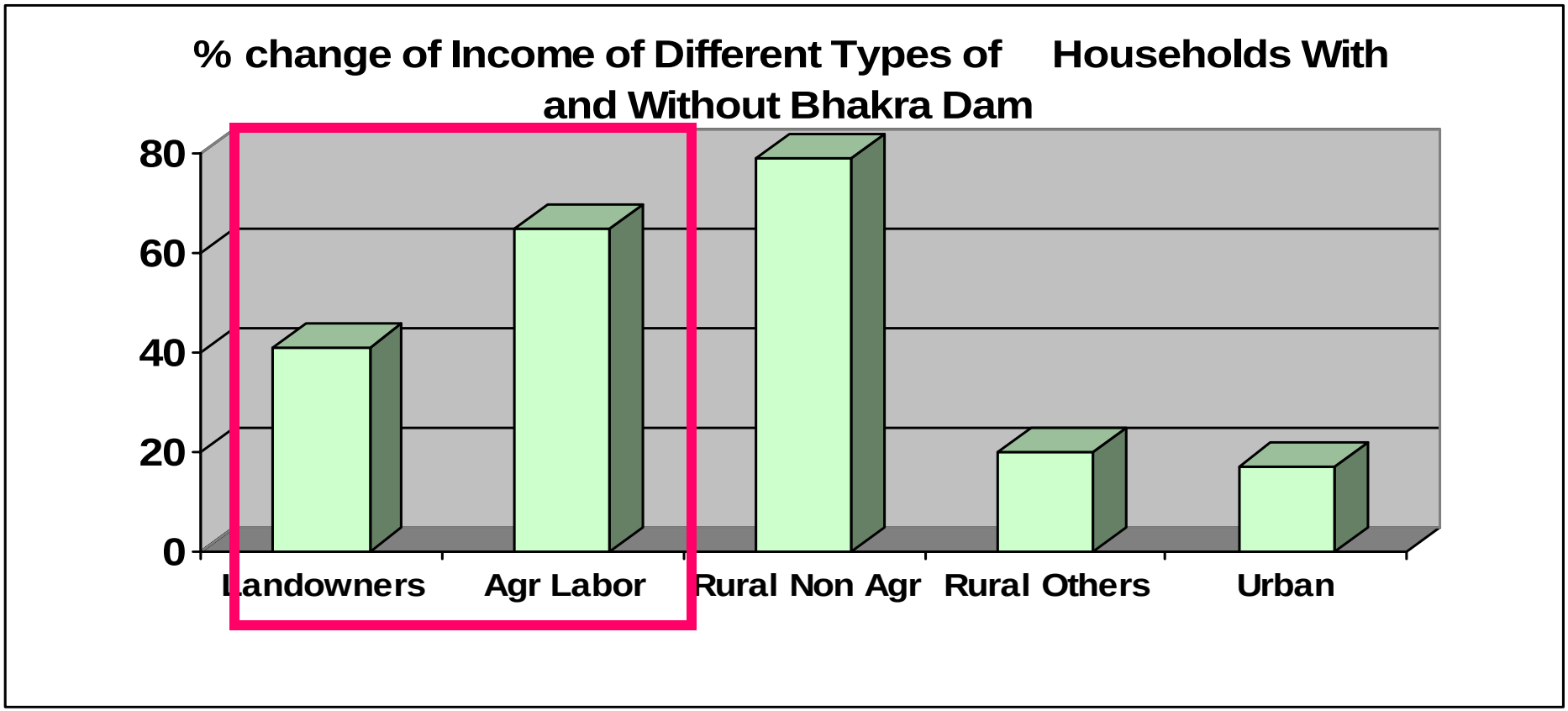


Panoramic View of Bhakra Dam

Irrigated 7 million hectares and provided 2800 mw of power

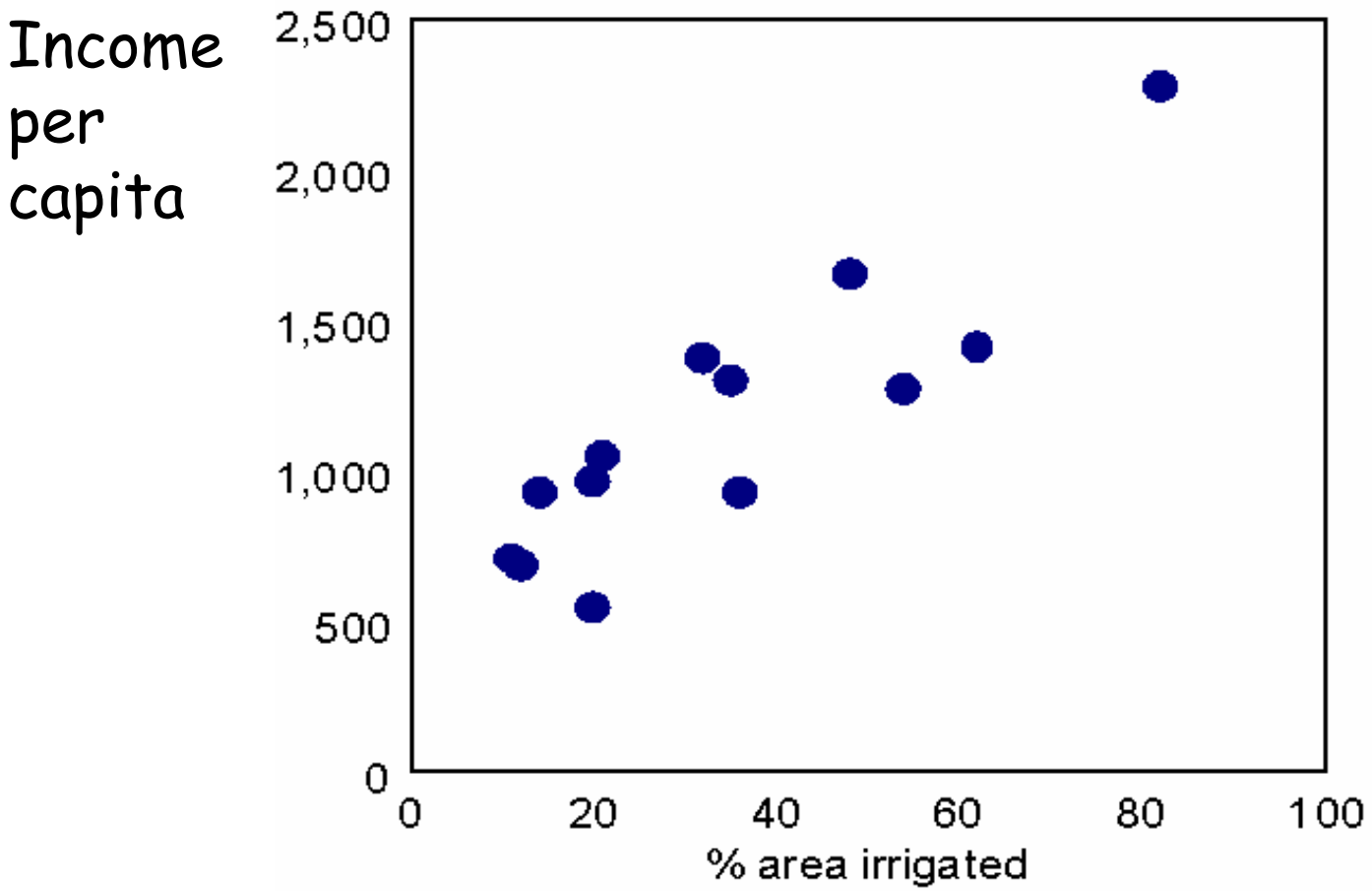
A major recent World Bank retrospective assessment of the economic impact

- The indirect benefits were as large as the direct power and irrigation benefits



- Landless laborers benefited (proportionately) more that landowners…
- and this does not include the million seasonal workers who migrate from Bihar to Punjab and Haryana each year….

… the overall effects on the poor?

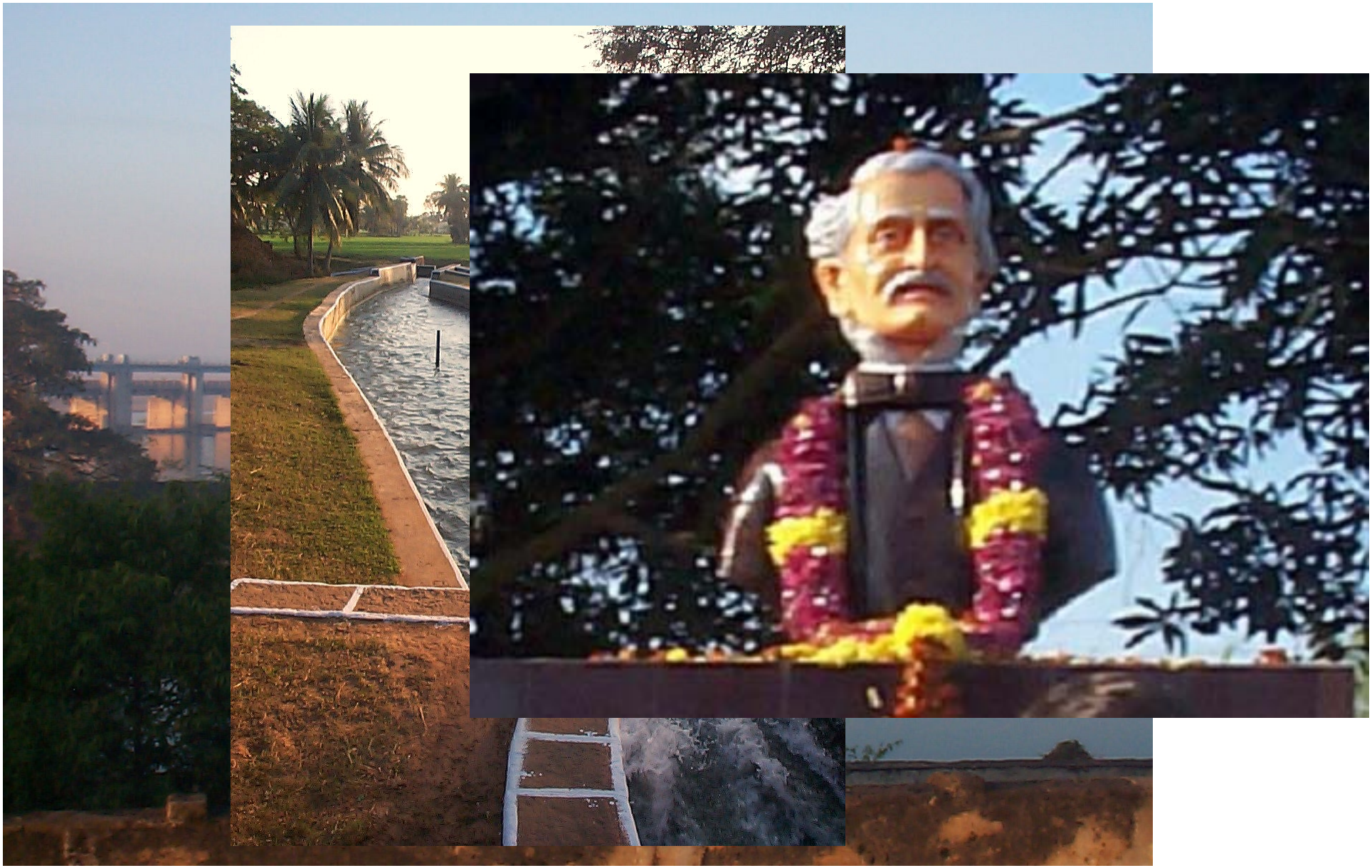


Net effect:

Unirrigated districts (< 10% of cropped area irrigated) --- **69% below poverty line**

Irrigated districts (> 50% of cropped area irrigated) --- **26% below poverty line**

In India…those who provide water are saints



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   - Benefit sharing
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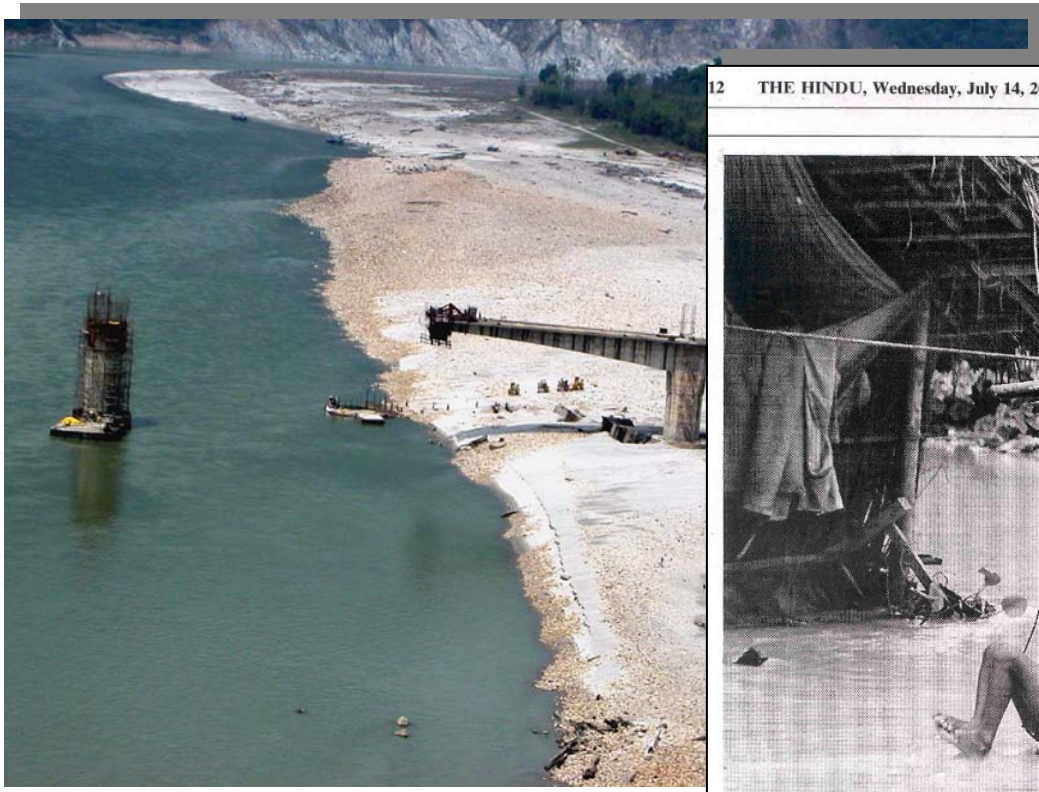
A particular public policy challenge …

- Hydro developers prefer run of the river sites (lower costs, smaller resettlement);

But

- This often means losing the other, "public" benefits of dams which come with storage (flood control, low flow augmentation…)

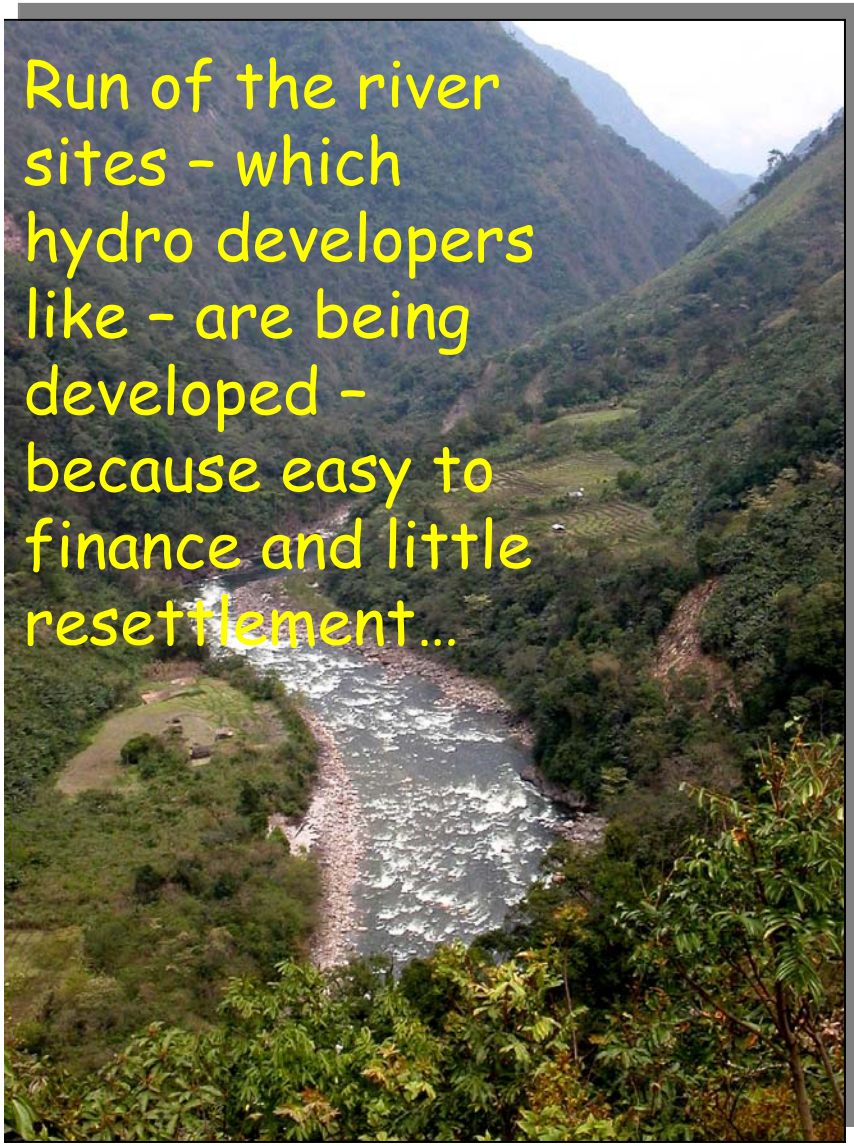
The example of India's Northeast: Enormous damages from floods

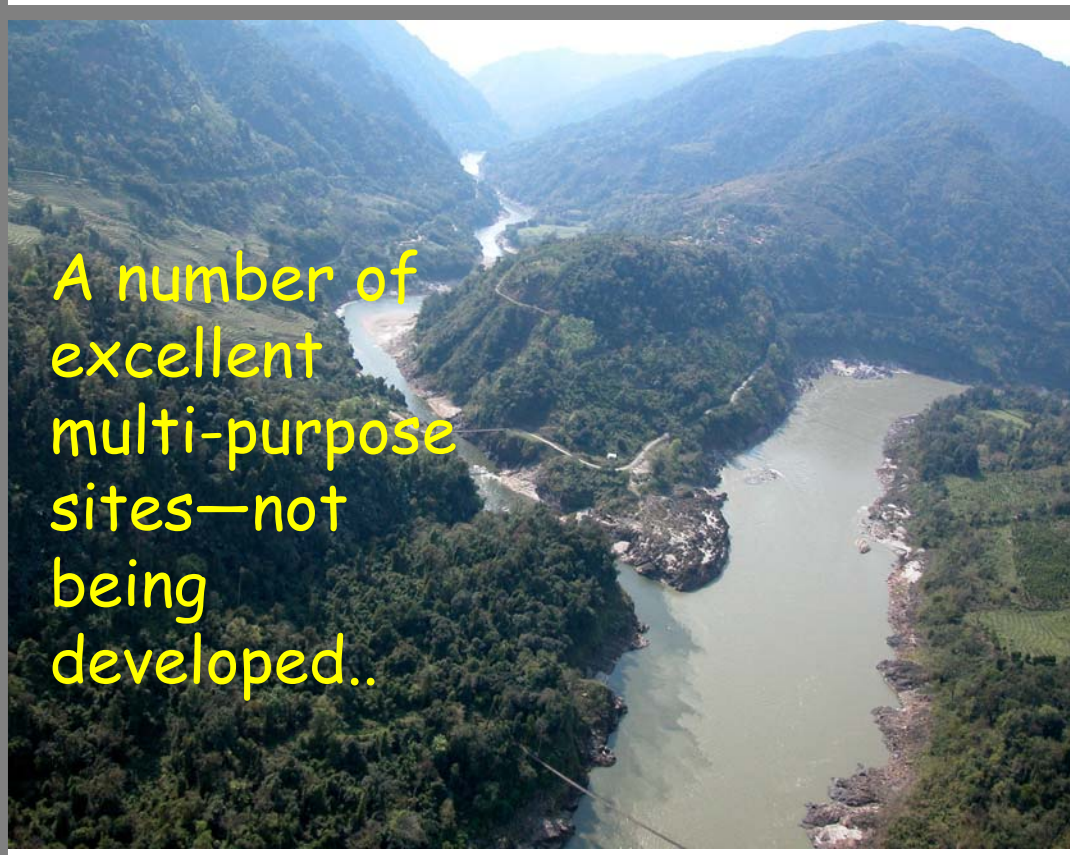


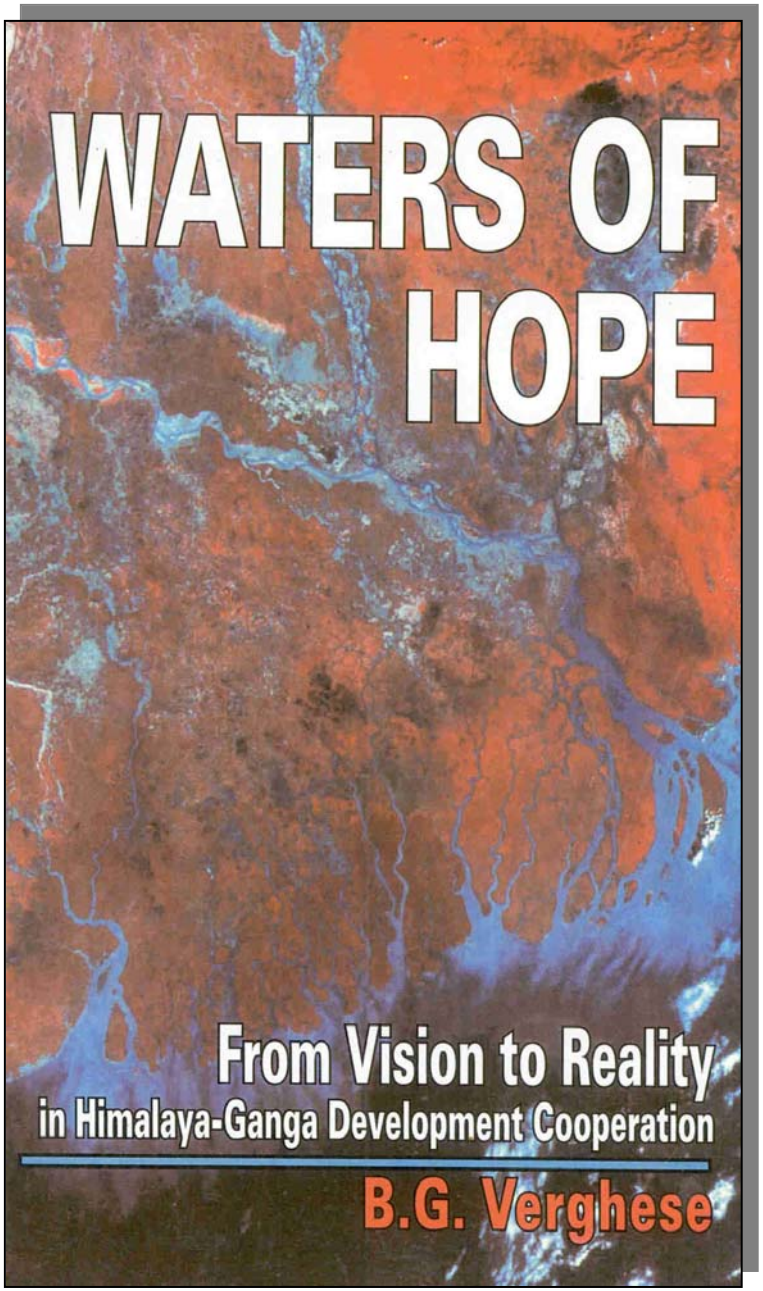
12 THE HINDU, Wednesday, July 14, 2004 NEWS

INNOVATION TO THE FORE: Amid the tragedy around, this man carries his two children to safety at Najirpur village of Muzaffarpur district in north Bihar. — Photo: Ranjeet Kumar

What is being done?





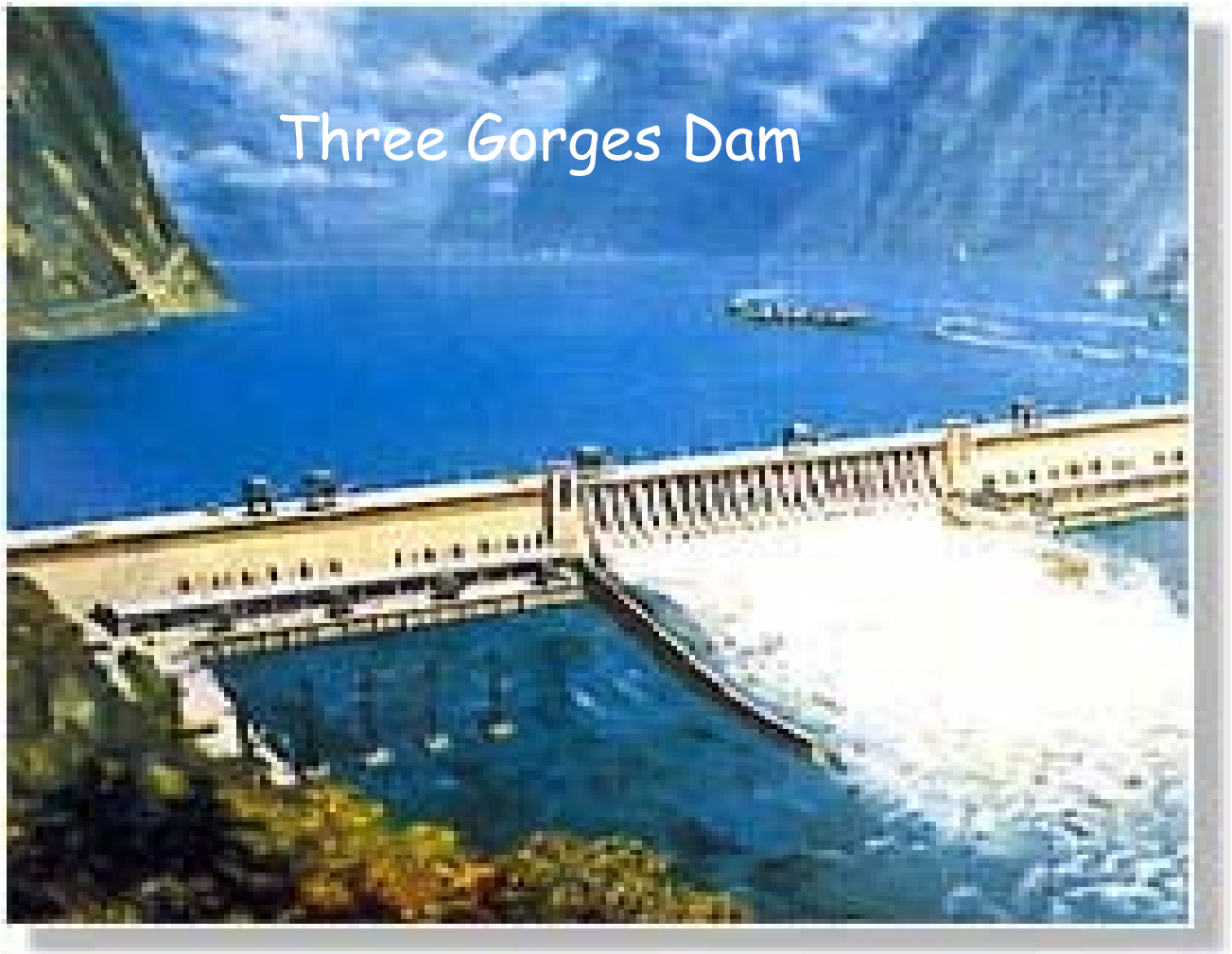


The Ganges/Brahmaputra/ Meghna Basin:

"the glaring contradiction of the largest concentration of the world's most poor unable to garner the bounty of one of the world's richest natural resource regions in which they live…….. is an indictment that can no longer be tolerated…."

Will mean more than just single-purpose hydro…

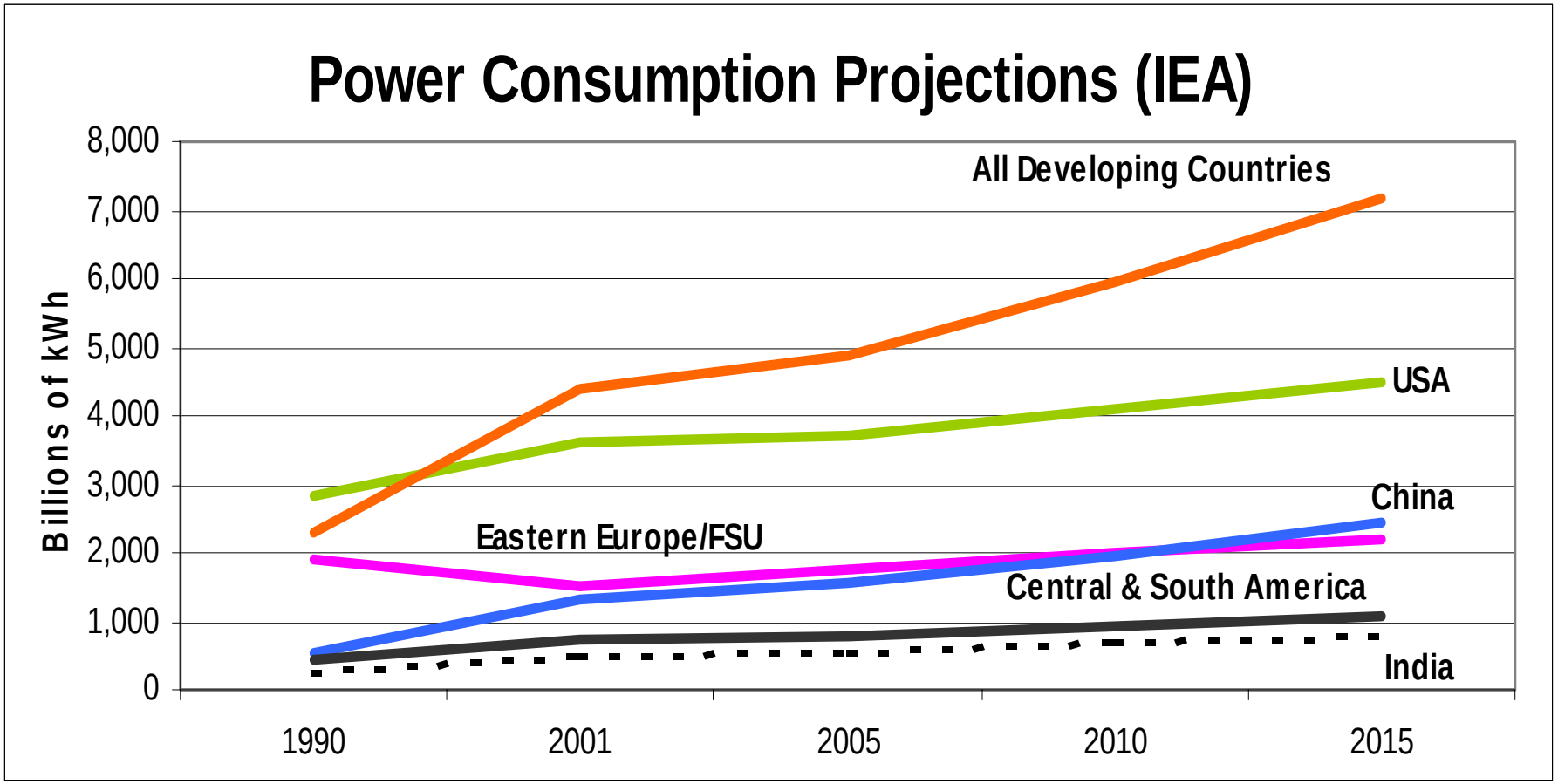
An example of good practice, where "public goods" (flood protection) is given primacy over "private goods" (electricity generation)…



Story line

1. How hydro fits:
   - In sustainable energy supply
   - In water resource management
   - In reducing poverty
2. The special challenges of hydro
   - As part of multi-purpose projects
   - Finding the right blend of public and private financing
   - Benefit sharing
3. The evolving role of the World Bank

Major growth in power demand will be in developing countries



The characteristics of thermal and hydro …
(after Chris Head…)

	Thermal	Hydro
Capital Cost ($/kilowatt)	400-1,400	800-3,000
Operating cost	high	low
Project life	~15 years	>50 years
Site influence	low	high
Construction risk	low	high
Construction time	~4 years	~6 years
Technology	changing	mature
Local:imported content	low	high
Electrical/mechanical plant	~80%	~30%
Multipurpose benefits	low	high
Regional ecoonomic multipliers	low	high

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Needs patient, long-term financing and insurance against political risk

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Risks best assumed by public sector

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Quality civil contractor, often local, is key

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Export credits play only supplementary role

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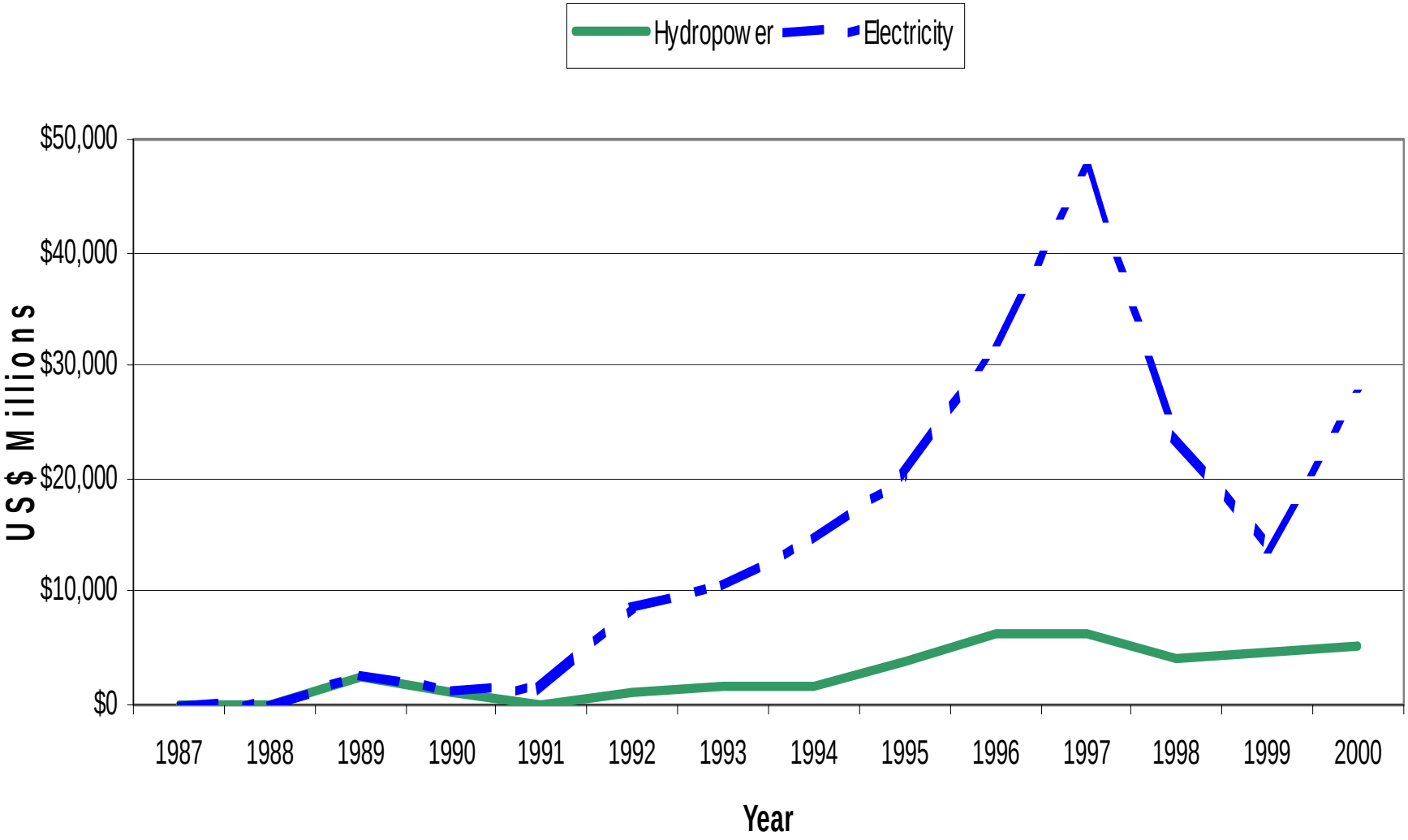
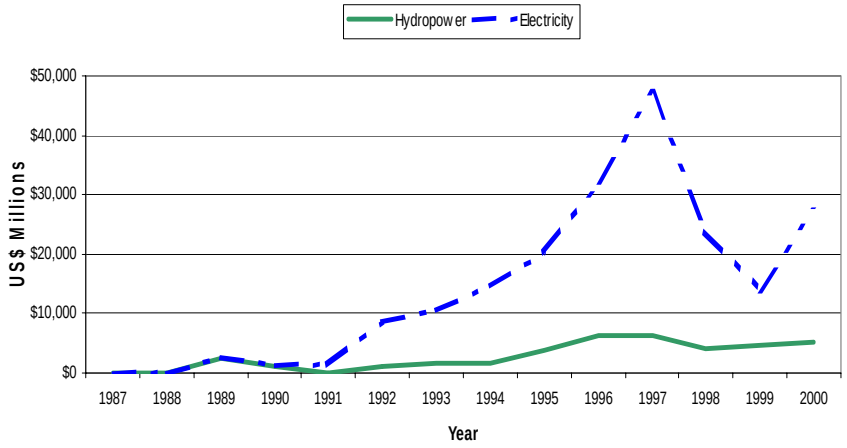
Public "beyond project" interest is central

How did this play out in "the roaring 1990s", when private sector investment in infrastructure was seen as a panacea?

Private investment in developing countries in all elecricity generation and hydro (1985-2000)





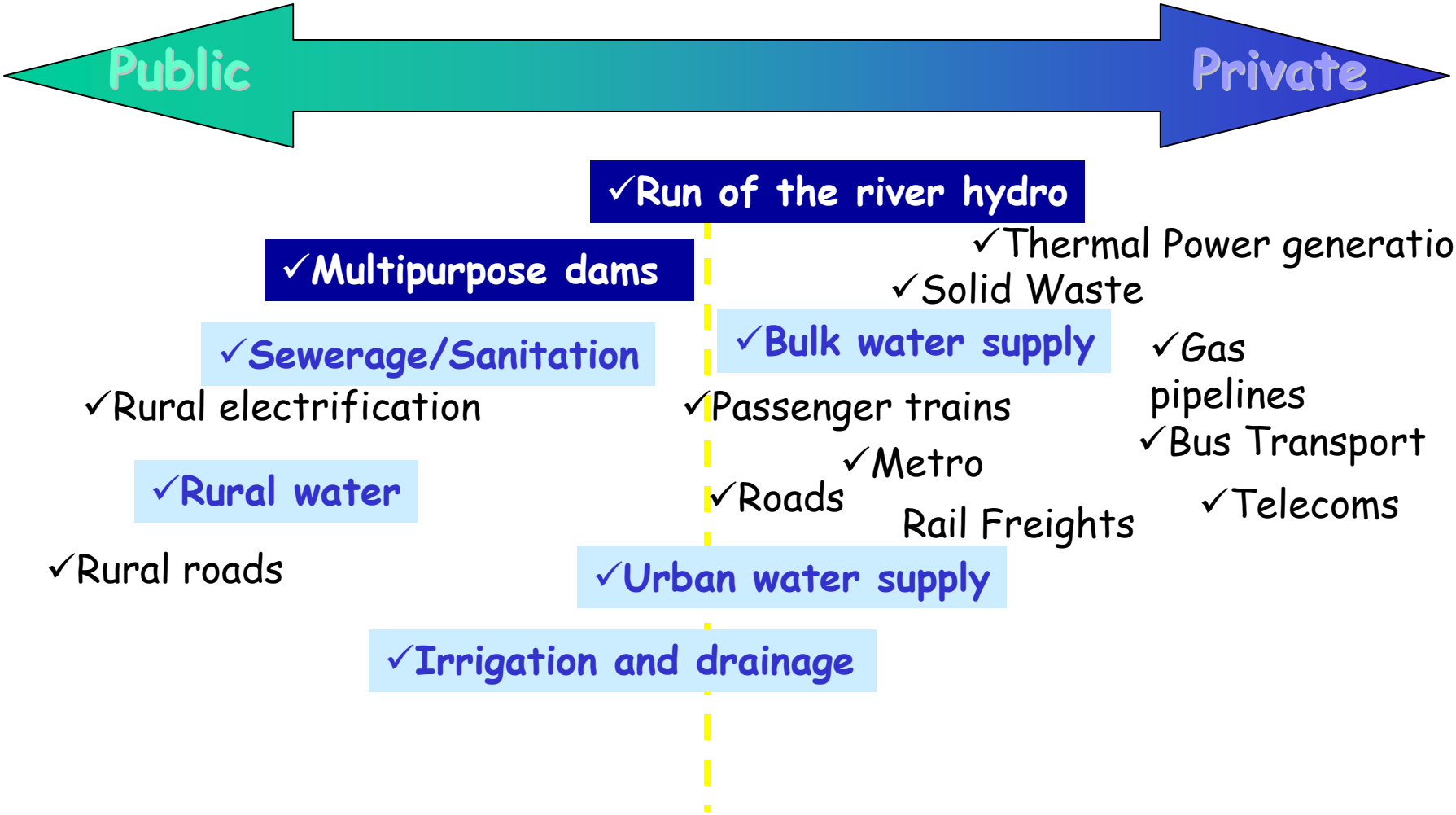
- Hydro accounts for **less than 5% of all private investment** in infrastructure in the developing world
- Private investment in hydro in developing countries is **very important**, but
- private investment accounts for only **about 20% of the the $15 billion annually** of public investment in hydro

Traditional International Private Investors Capability Has Declined

Developer	Sector	Stock Current	Stock Peak	Peak Date	S&P Rating
AES Corp	Energy	1.44	70.62	Oct-00	B+/ Credit Watch Negative
Enron	Energy	In Chapter 11			
Endesa	Energy	9.62	26.60	Jan-99	A/Negative
CMS Energy	Energy	6.56	40.45	Dec-98	BB/Negative

- The largest western infrastructure investors are struggling to restructure. Many are shedding their global portfolios.
- Project debt is downgraded daily, and debt investors are demanding higher and higher risk adjusted returns

The public sector will necessarily play the major role in much financing of water infrastructure…



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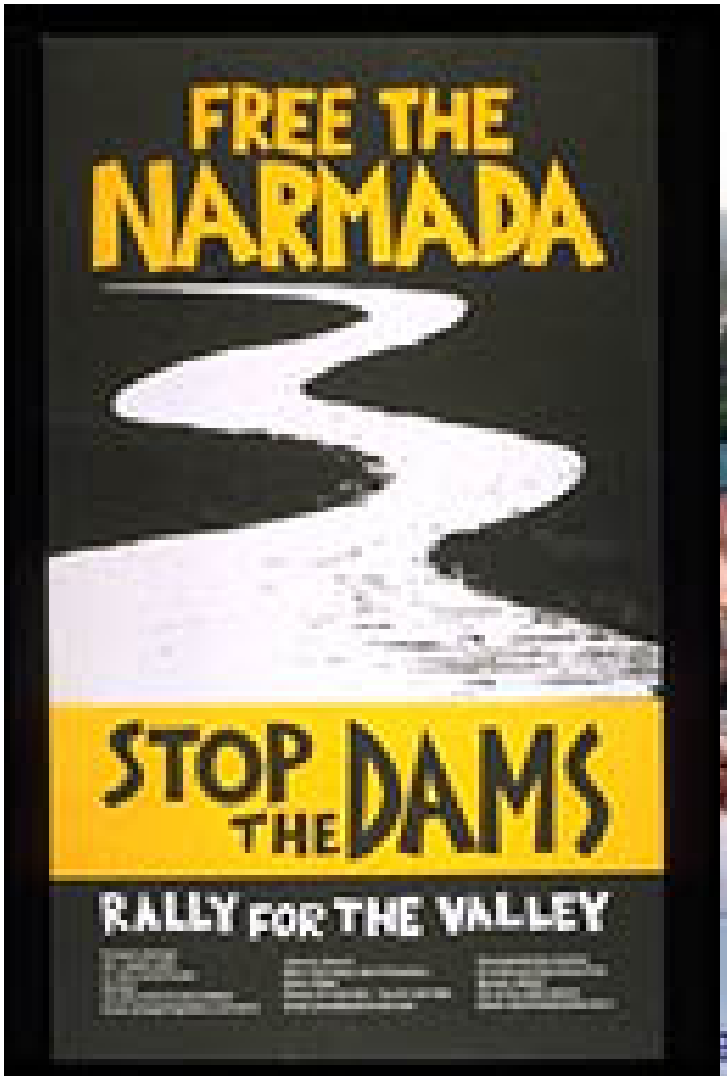
Most of the opposition to large dams has been because local people have borne a large proportion of the costs and received too little of the benefits..



Good resettlement and benefit sharing are essential..

Emerging good practice:

…China a world leader, treating resettlement less as a cost than an opportunity for development…

Emerging good practice:

…Benefit sharing in India

States get 12% of gross revenues as royalties

But where more needs to done to push these benefits down to local people…

Emerging good practice:

…Benefit sharing in Brazil…

Box 4.7 Royalties to communities: a Brazilian law for hydropower benefit-sharing

In Brazil, Law No. 7990, dated 28 December 1989, requires that royalties be paid to the federal government for using water for power generation purposes. The royalties paid by each power plant generating more than 10 MW represent 6% of the value of the power produced. The royalties are distributed as follows: 10% to the federal government, 45% to the state(s) where the venture is located and 45% to the municipal districts affected by the venture. The total amount paid out by the Tucurui dam in 1996 reached $19 million, with the total royalties for 1991 through 1996 topping $103 million. The Itaipu dam, in the south of Brazil, pays annually about $13 million in royalties. The royalties are among the leading sources of income for some of the municipal districts.

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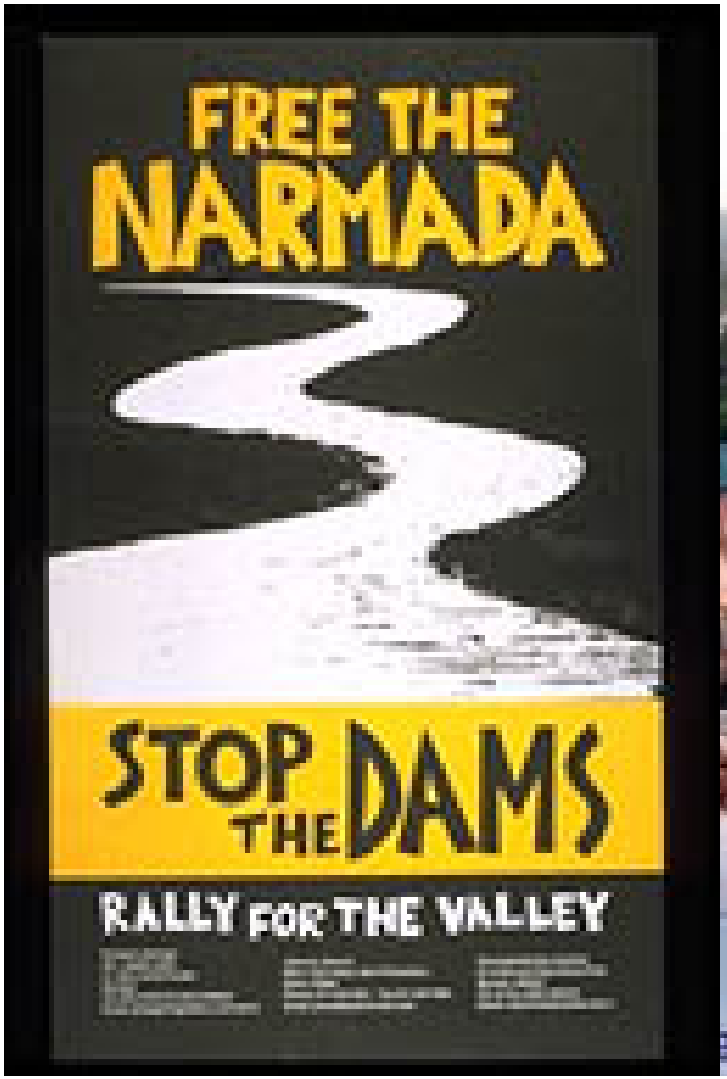
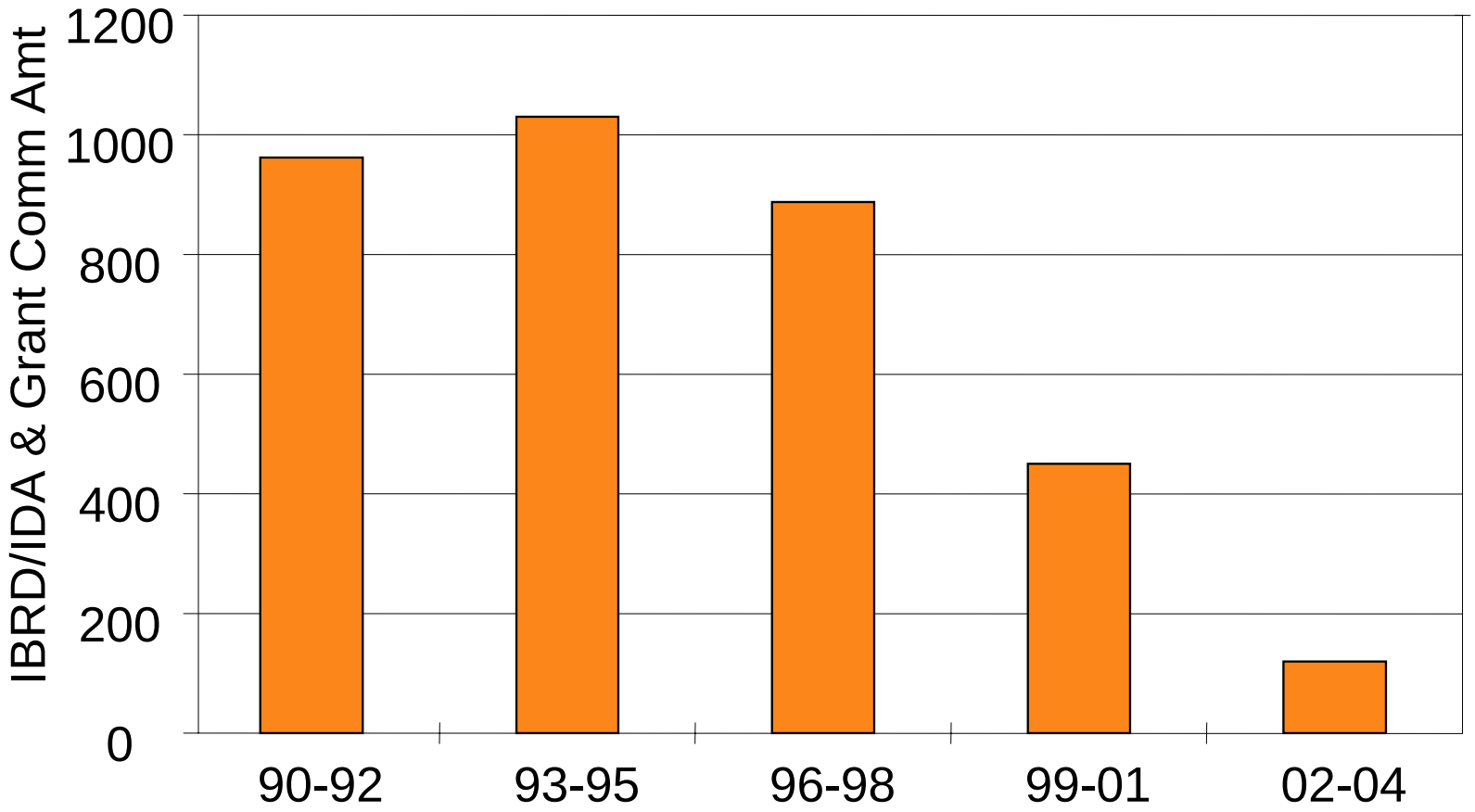
The mission of the World Bank

With Narmada as a flagship – large opposition from NGOs and developed countries to Bank involvement in major water infrastructure

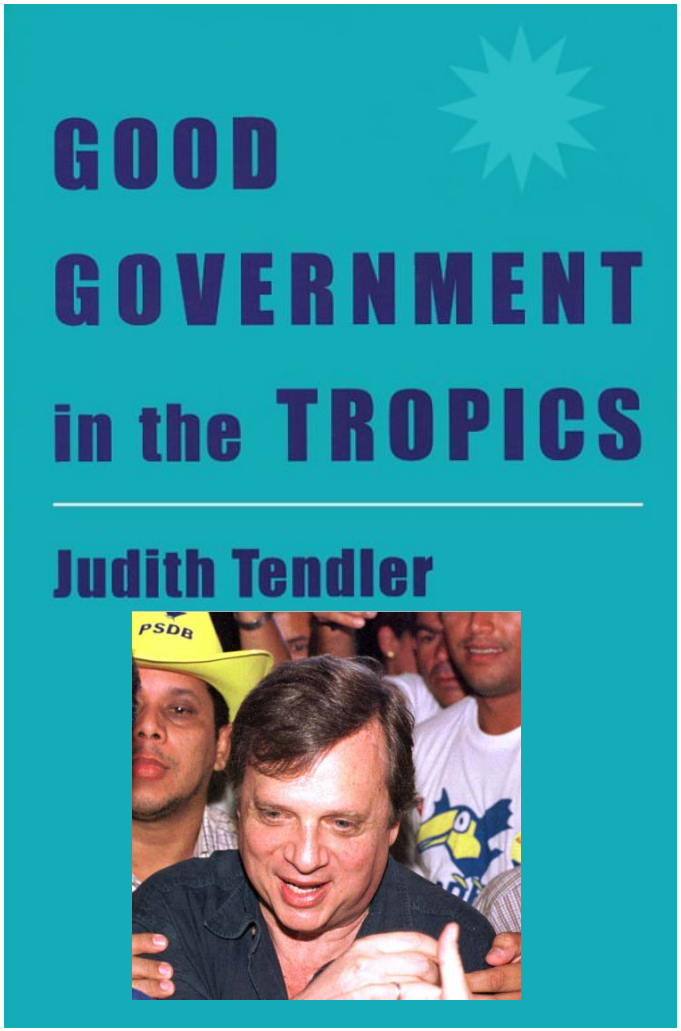


The Bank and Hydro: Recent History



But what did the "infrastructure-desperate" borrowers of the Bank think of this?

Middle-income countries "with choices" find the Bank's business processes rigid and unrealistic



Governor Tasso Jeressati of Ceara, Brazil:

"When I build a 10 meter high dam in the middle of the semi-arid, the Bank requires due diligence as though I were building Itaipu!"

Poor countries "without choices"

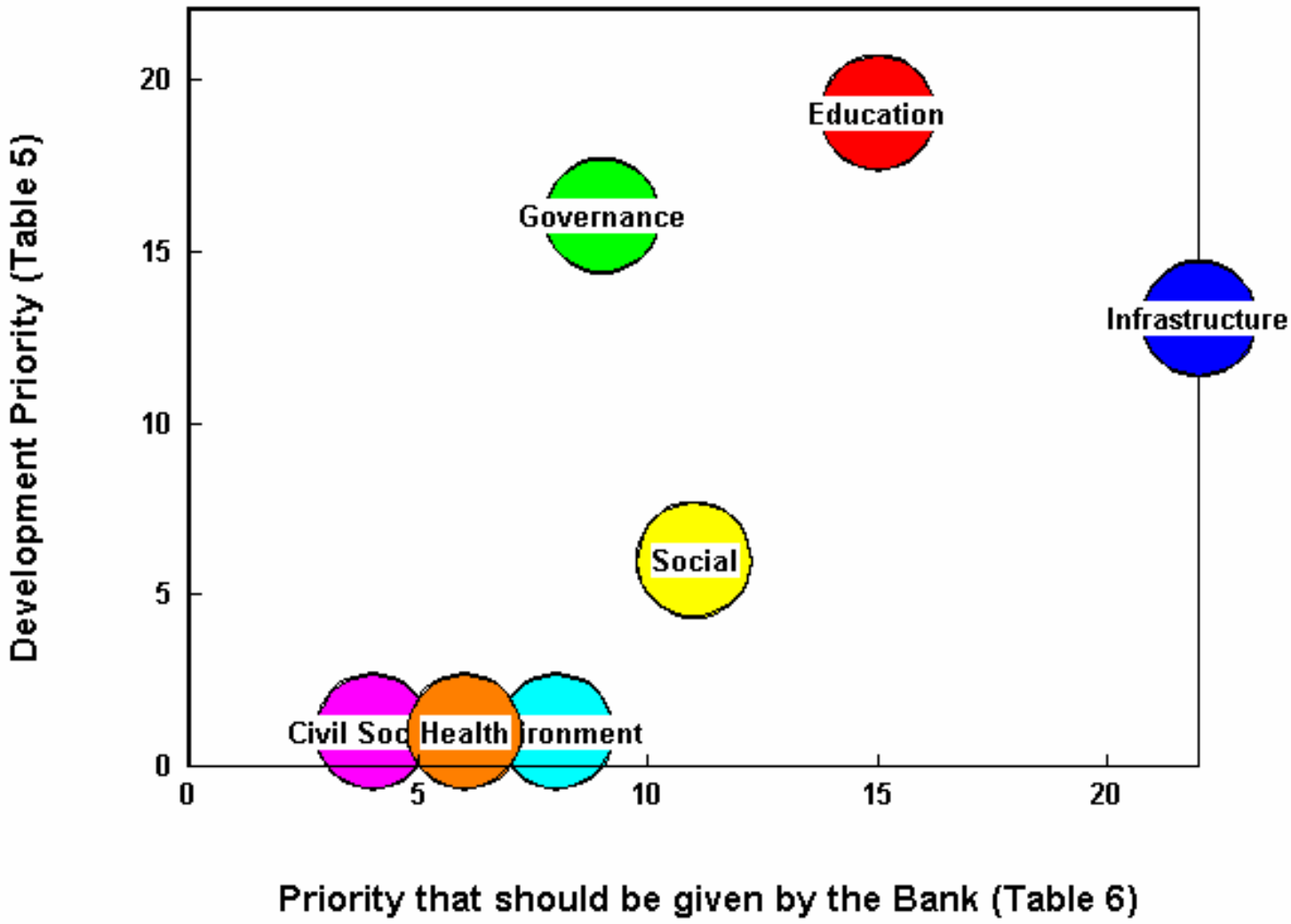
PEEVED MUSEVENI LAUNCHES US$550 MILLION UGANDA DAM.

Reuters, Jan 24, 2002

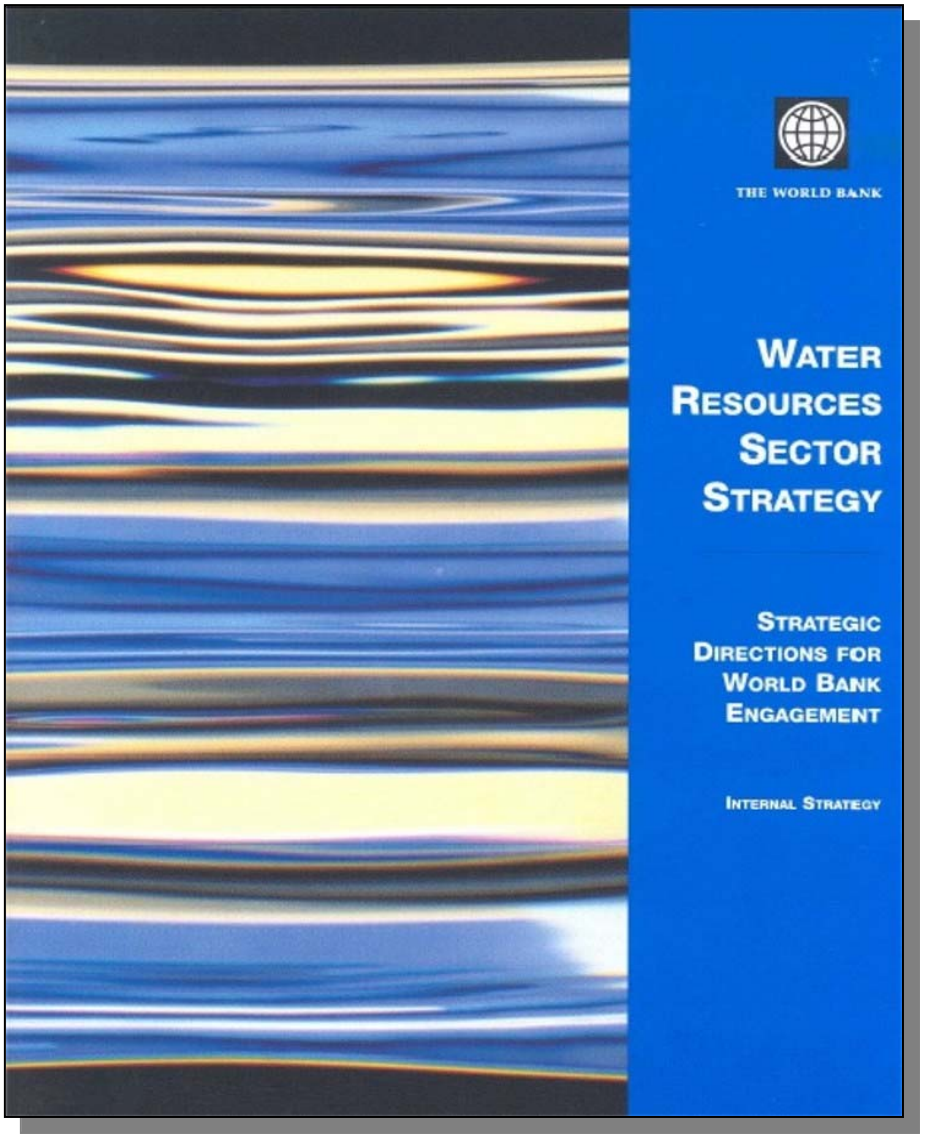
Ugandan President Yoweri Museveni yesterday launched the construction of a US$550 million dam on the river Nile but lashed out at his countrymen and donors for unduly delaying the project, reports Reuters. "I am ashamed to even come here," Museveni said at Bujagali, some 80 kilometers (50 miles) east of Kampala, where the dam is to be built to power electricity generation. "I am not happy because a project which should have taken two years has taken seven years to start. All this hullabaloo has been a waste of time and a lack of seriousness ... this was a circus," he said.

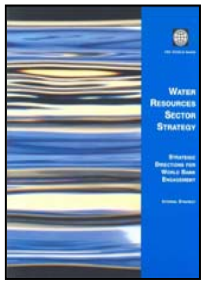
The Bank's just-released "Global Poll of 1000 opinion-makers"

5. South Asia



Feb 2003: New World Bank Water Strategy





Summary of main messages

1. …
2. …
3. …
4. On development – the Bank needs to assist countries develop and maintain appropriate stocks of well-functioning infrastructure
5. The Bank has a comparative advantage in dealing with these complex issues, and there is strong demand for Bank engagement
6. The Bank will follow become a predictable, transparent partner which will re-engage with "high-risk/high-reward" infrastructure.

Unprecedented leadership by developing countries on the Board in support of re-engagement with major infrastructure…..

CONFIDENTIAL
DRAFT

Statement by Chander Mohan Vasudev and Guangyao Zhu
Date of Meeting: February 13, 2003

Infrastructure Business : Key Trends and Issues

We welcome the Bank's renewed recognition of the importance of infrastructure investment, especially in the context of its commitment to poverty reduction , sustained international economic uncertainty and the prospects of a majority of poor countries not achieving the Millennium Development Goals.

Infrastructure and the Millennium Development Goals

2 The presentation makes a good case for the enormous pro-poor impact of investment in infrastructure. The linkage between infrastructure and poverty reduction is too well-documented to bear any repetition. The Bank's recent Water Sector Strategy also brought out the close linkages between pov arrow the

… We are firmly of the view that infrastructure investment is central to the Bank's mission of poverty reduction….

….We would like senior management commitment to at least two **high risk – high benefit** projects per region…

July 8, 2003

Infrastructure Business Trends & Action Plan

Presentation to Board

Official World Bank position on hydro…

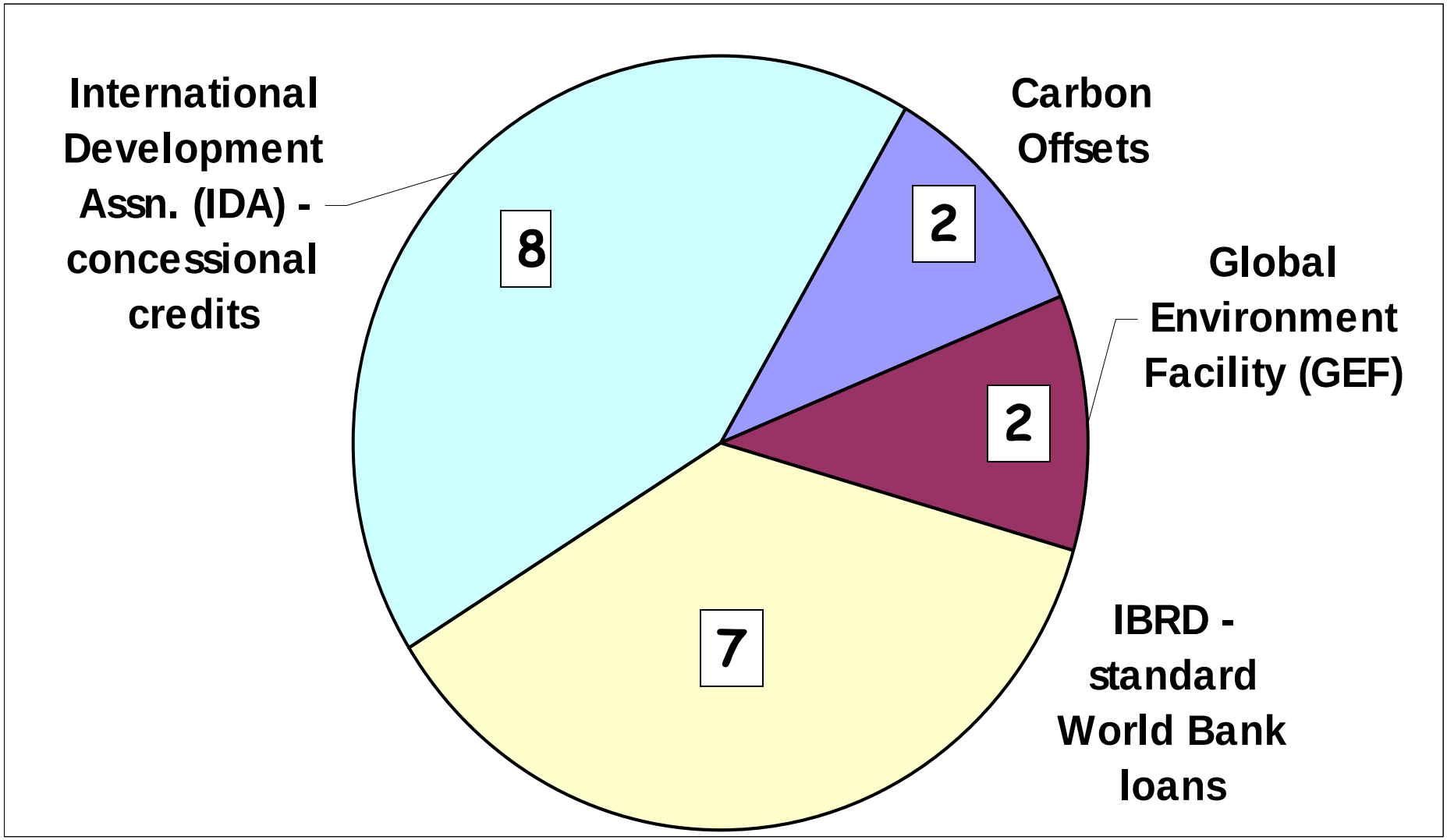
Expanding Support for Renewable Energy and Energy Efficiency

Consistent with understanding reached at the 2002 World Summit on Sustainable Development in Johannesburg and at the Bonn Conference, the World Bank Group regards all hydropower unambiguously as renewable energy. We shall support hydropower development of all scales …

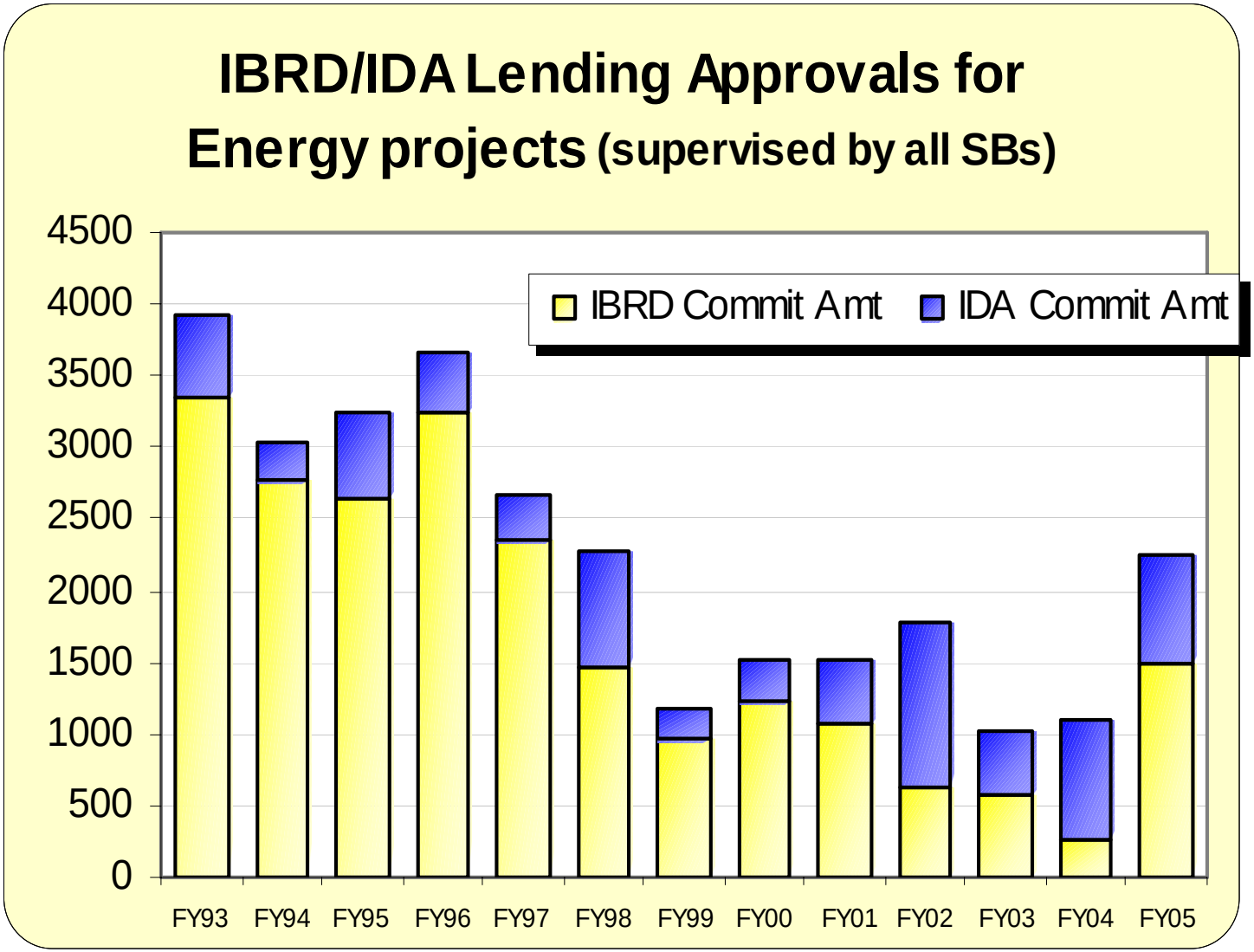
… and the proof of the pudding (as always) will be in the eating!

So what is happening?

The current Bank hydropower portfolio is still small….
Number of Active Hydropower Projects by Product Line



But energy is coming back on the Bank agenda



And hydro projects are now actually being approved by the Bank's Board over protests from NGOs…

IFC Projects

INTERNATIONAL FINANCE CORPORATION

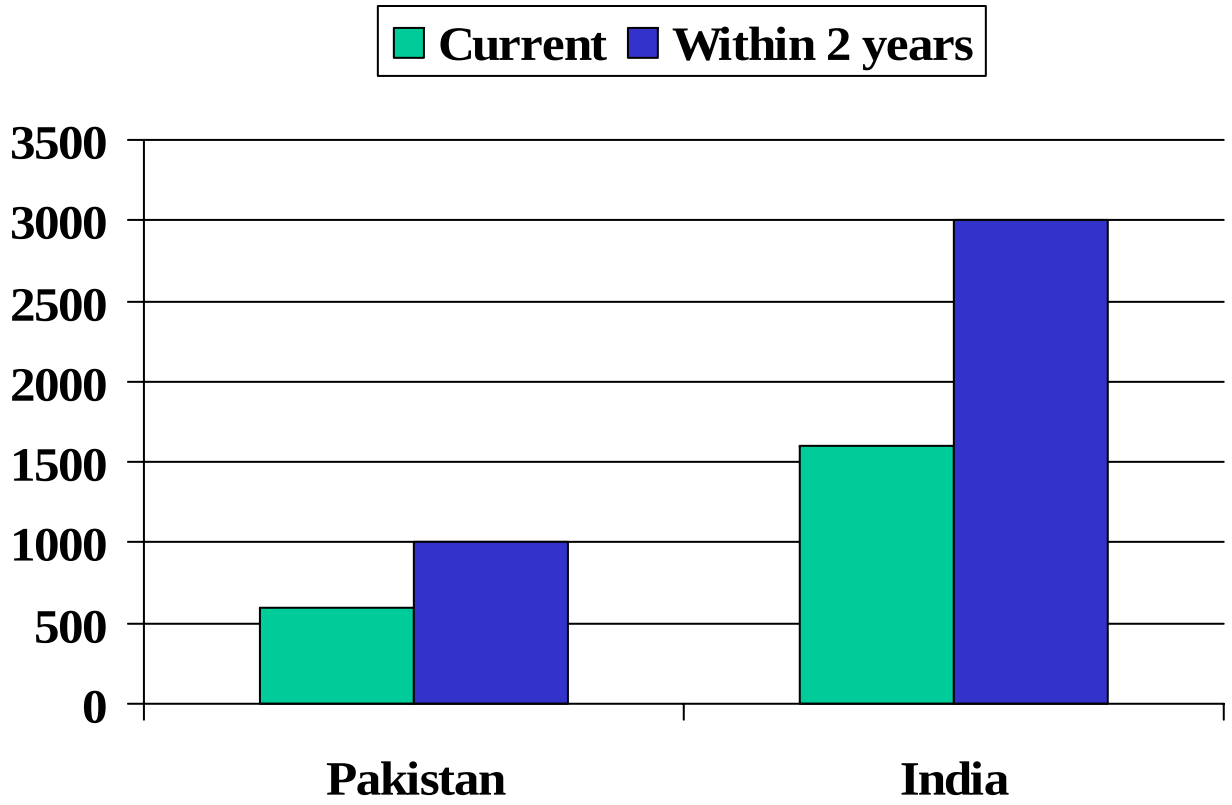
This Summary of Project Information is prepared and distributed to the public in advance of the IFC Board of Directors' consideration of the proposed transaction. Its purpose is to enhance the transparency of IFC's activities, and this document should not be construed as presuming the outcome of the Board decision. Board dates are estimates only.

Summary of Project Information (SPI)	
Project number	11632
Project name	Allain Duhangan Hydro Power Limited
Country	India
Sector	Utilities
Department	Infrastructure
Company name	ADPCL
Environmental category	A
Date SPI disclosed	August 11, 2003
Projected board date	October 31, 2003
Status	Pending Signing
Previous Events	Approved: October 12, 2004

Total project cost and proposed IFC investment

The total project cost is estimated to be $192 million, of which IFC is expected to contribute $45 million through a combination of an A Loan and a C Loan.

The example of South Asia: Anticipated World Bank lending in India and Pakistan…



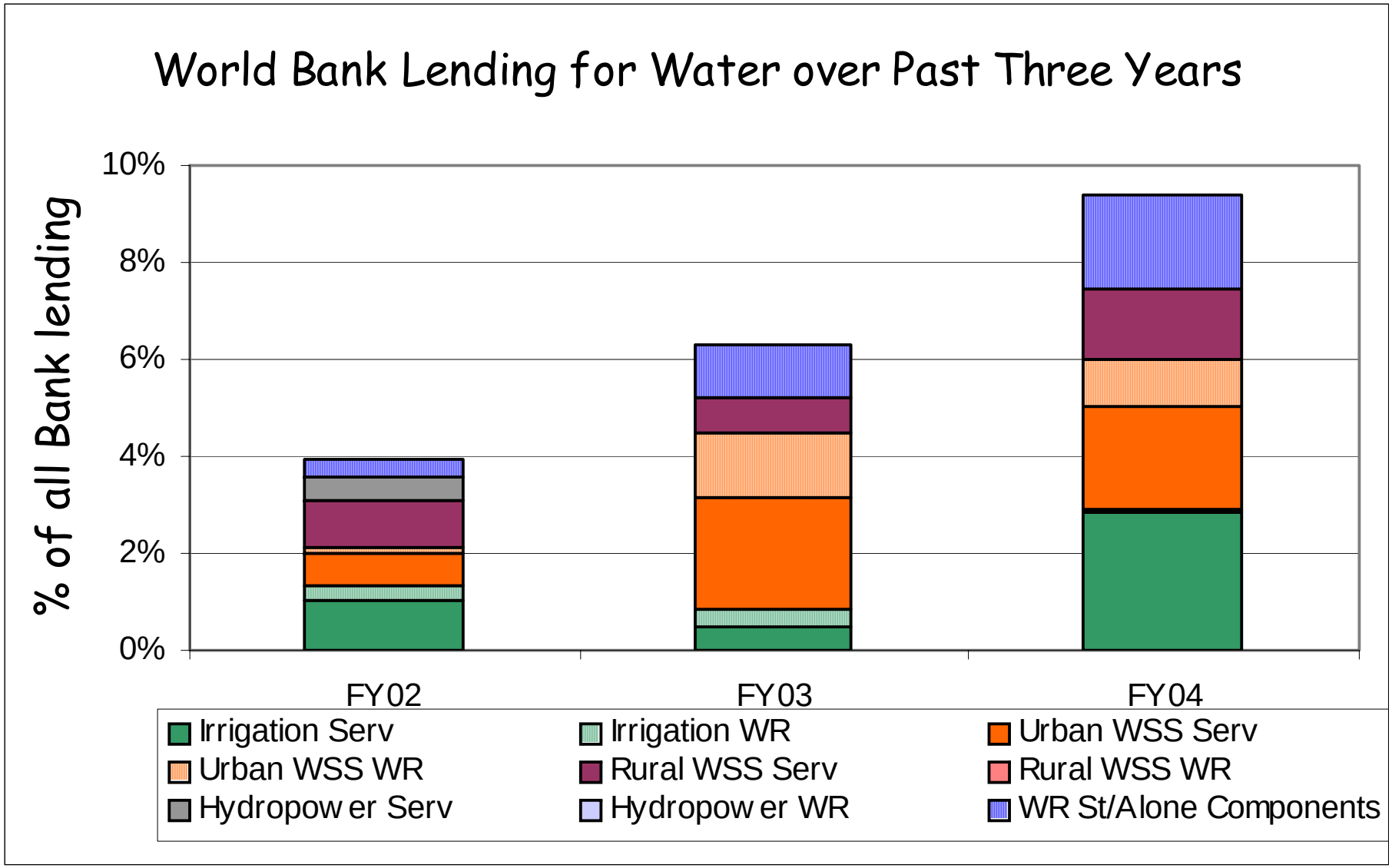
With ALL projected increase into infrastructure…

And substantial portion into hydro…..

New Country Assistance Strategies including major hydro

- India CAS approved last month
- $700 million for two major proposed hydro projects
- "why not more"? from the Board which used to wince at the word "hydro"!

Some promising signs….



Last month's Annual Meetings…

IMF/WORLD BANK Annual Meetings

Development Committee Press Briefing:

Remarks by the Chair (Trevor Manuel, Finance Minister from South Africa)

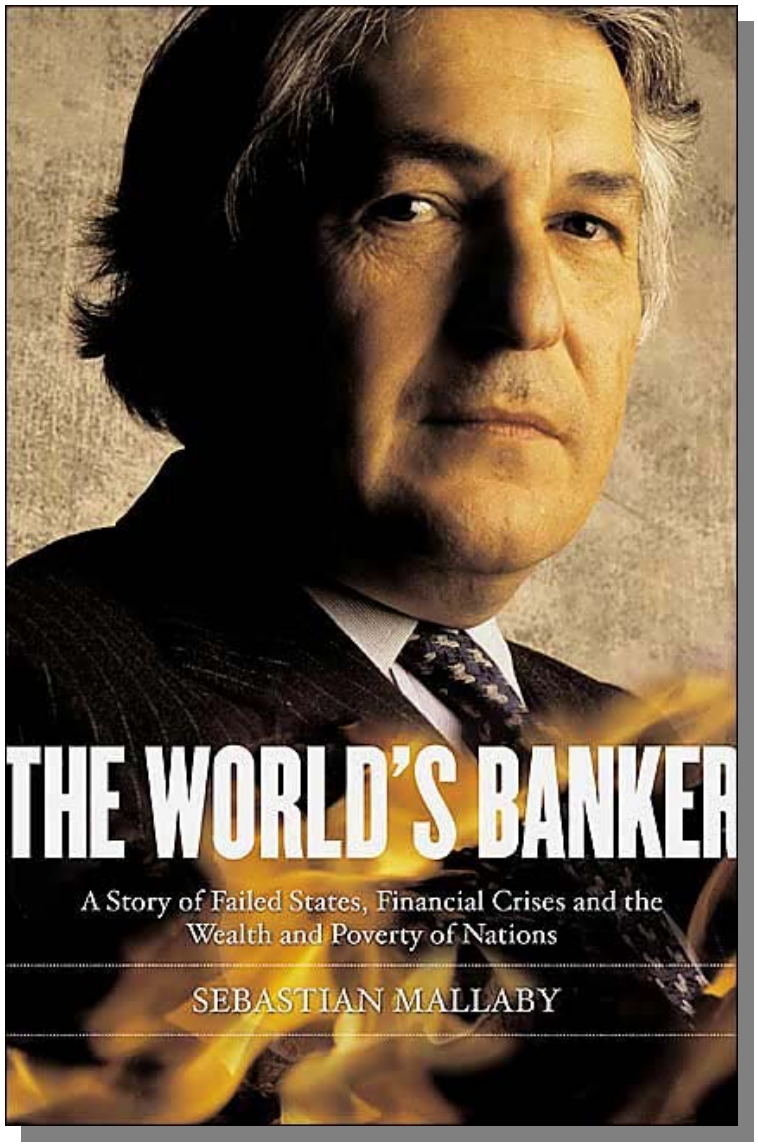
> …. a very warm round of applause for the World Bank's renewed commitment to investment in infrastructure, and I think that we recognize that in that discussion the value of infrastructure, certainly social infrastructure but also economic infrastructure and the extent to which the absence of good economic infrastructure prevents economic growth in the poorest of countries…

Remarks by the President of the World Bank:

> … infrastructure was a central theme…that came up intensively (at the Annual Meetings)…
>
> … (concerns) that the Bank had spent a lot more time in recent years looking at non-infrastructure projects…
>
> and leader after leader, or minister after minister from the developing countries were saying "poverty reduction is centrally lodged not just in education and health but in the infrastructure of the country.. we must have roads, we must have power and ports and water…"

We think that the Bank's Board and management has now "got water (and hydro) on the brain"…

The takeaway message on the World Bank and infrastructure



Thank you!