The Abdus Salam International Centre for Theoretical Physics

2372-28

Joint ICTP-IAEA Workshop on Sustainable Energy Development: Pathways and Strategies after Rio+20

1 - 5 October 2012

Scenario of Renewable Energy for Sustainable Development in Indian Subcontinent with Special Reference to North East India

Kaveri Bhuyan

National Institute of Technology, Arunachal Pradesh
India

Strada Costiera, 11 - 34151 - Trieste - Italy • Tel. +39 0402240111 • Fax. +39 040224163 • sci_info@ictp.it • www.ictp.it
ICTP is governed by UNESCO, IAEA, and Italy, and it is a UNESCO Category 1 Institute

“Scenario of Renewable Energy for Sustainable Development in Indian Subcontinent with Special Reference to North East India”

Presented by

Kaveri Bhuyan

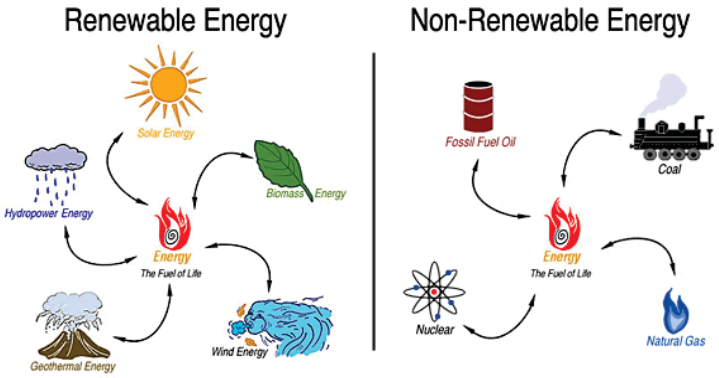
Department of Electrical and Electronics Engineering,
National Institute of Technology,
Arunachal Pradesh, India
E-Mail: kaveribhuyan@gmail.com

CONTENTS

- Introduction
- Overview on Resources and Technologies
- Hydro Power Potential and Status of Development in North East India
- Key Issues for Sustainable Developments in North East India
- Tackling Challenges for Renewable Energy deployments
- Concluding Remarks

Introduction

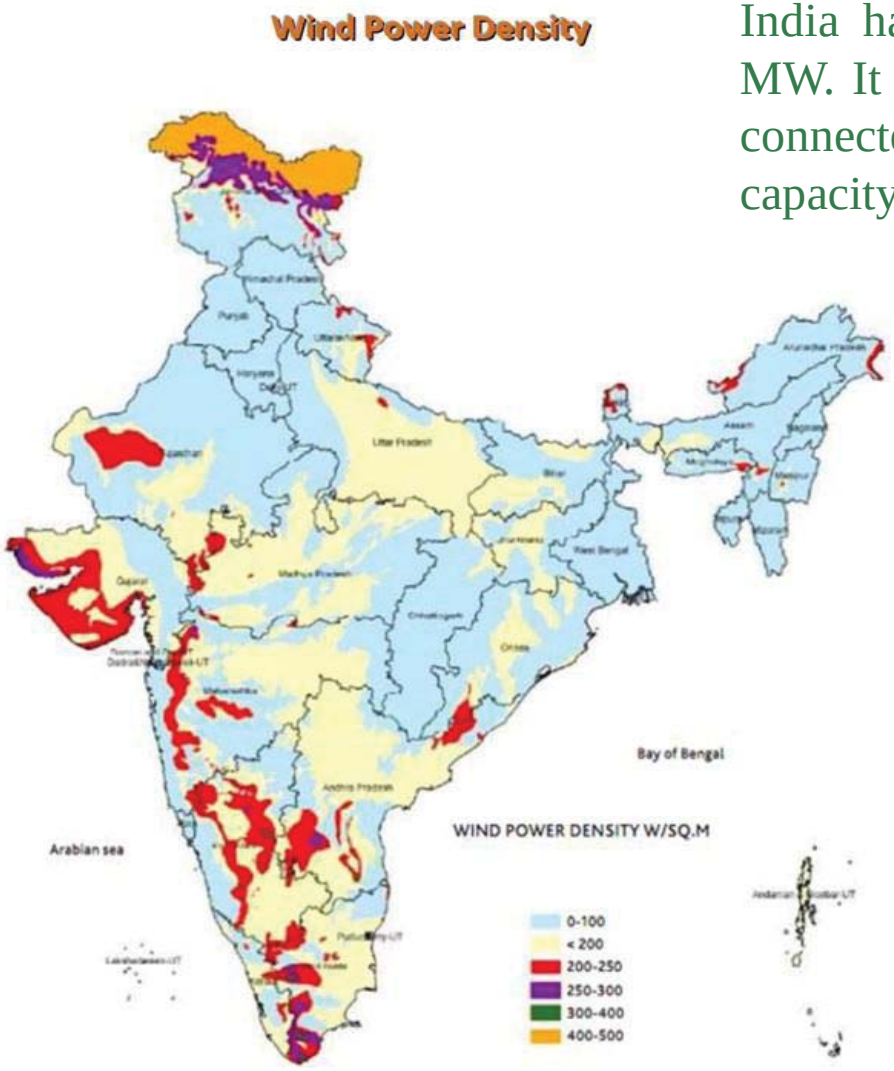
- India is a country with more than 1.2 billion people accounting for more than 17% of world's population.
- It is the seventh largest country in the world with total land area of 3,287,263 sq kilometres. India measures 3214 km from north to south and 2993 km from east to west.
- It has a land frontier of 15,200 km and coastline of 7,517 km and has 28 states and 7 union territories.
- India's energy-
  - ✓ Non-renewable (coal, lignite, petroleum, thorium and natural gas)
  - ✓ Renewable energy sources (wind, solar, small hydro, biomass, cogeneration bagasse etc.).
- India ranks in 5th position in generation of electricity in the world
- Consumes 3.7% of the world's commercial energy - 5th largest consumer of energy globally.
- Set to become 3rd largest emitter of CO_2 by 2015 (IEA 2007)



Current Energy Scenario

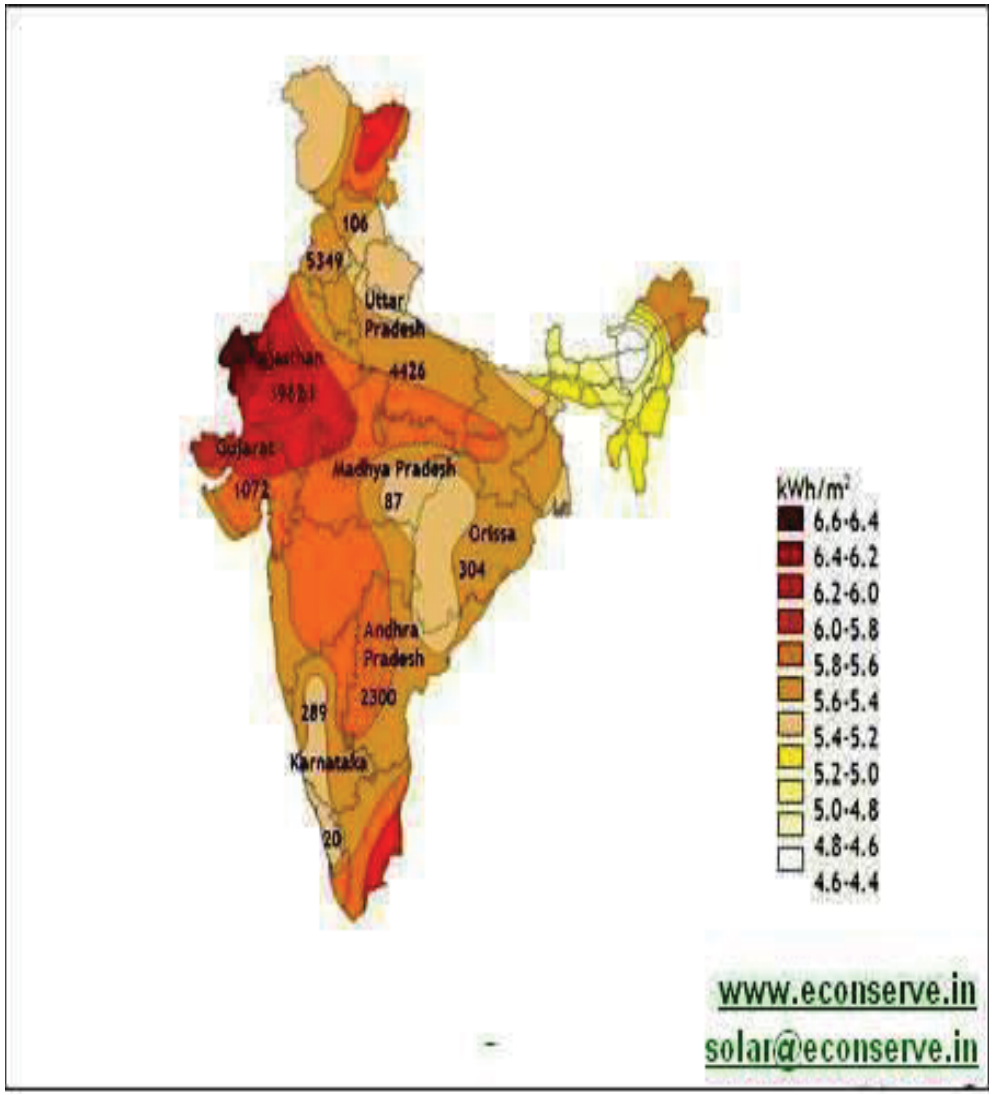
The Wind Power Spread

India has a wind potential of around 48,500 MW. It contributes to around 75% of the grid-connected renewable energy power installed capacity.



Source : Centre for Wind Energy Technology 2010.

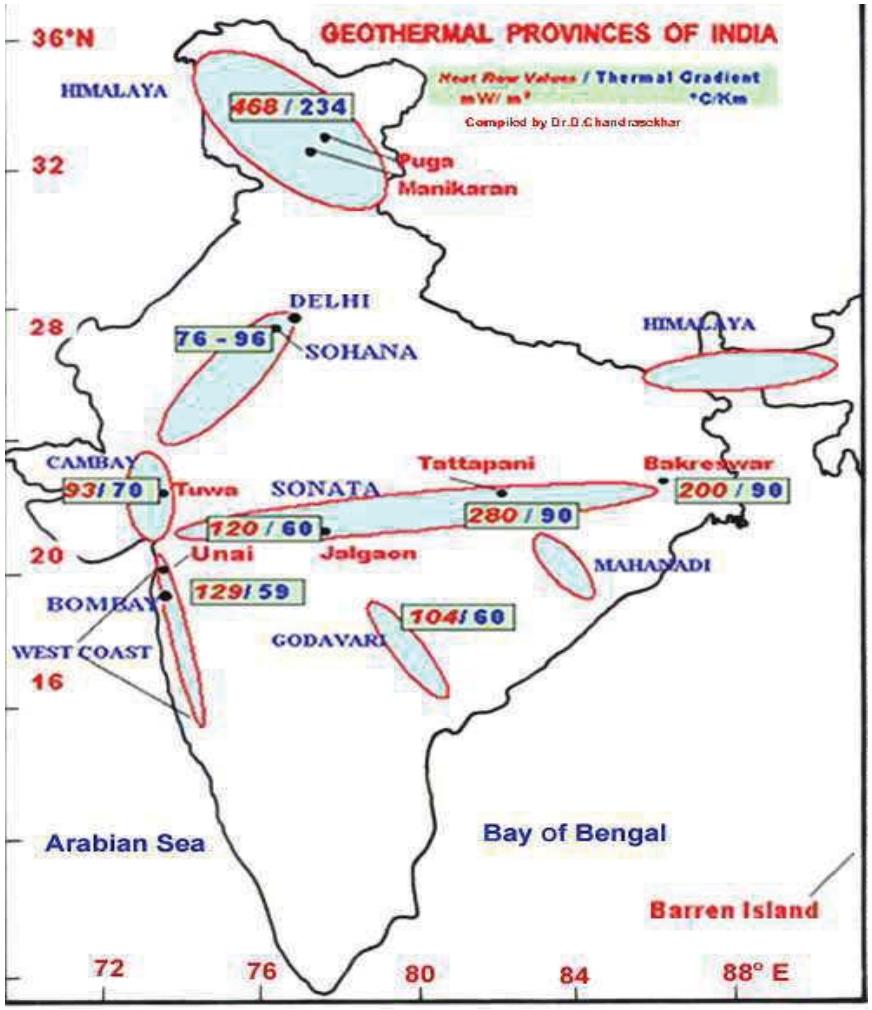
Current Energy Scenario



The Solar Power Spread

The average solar radiation incident over India varies from 4 kWh/day – 7 kWh/day. The solar radiation received over the Indian land area is estimated to be about 5,000 trillion kWh/year.

Current Energy Scenario



The Geothermal spread

Indian geothermal provinces have the capacity to produce five times greater than the combined power being produced from non-conventional energy sources such as wind, solar and biomass.

Current Energy Scenario

The Thermal Power spread

Coal accounts for 55% of the country's energy need. Out of a total of 1,71,926 MW of electricity generated, coal powered thermal power plants accounted for 92,418 MW as of February, 2011 indicating that most of India’s electricity needs are dependent on coal.

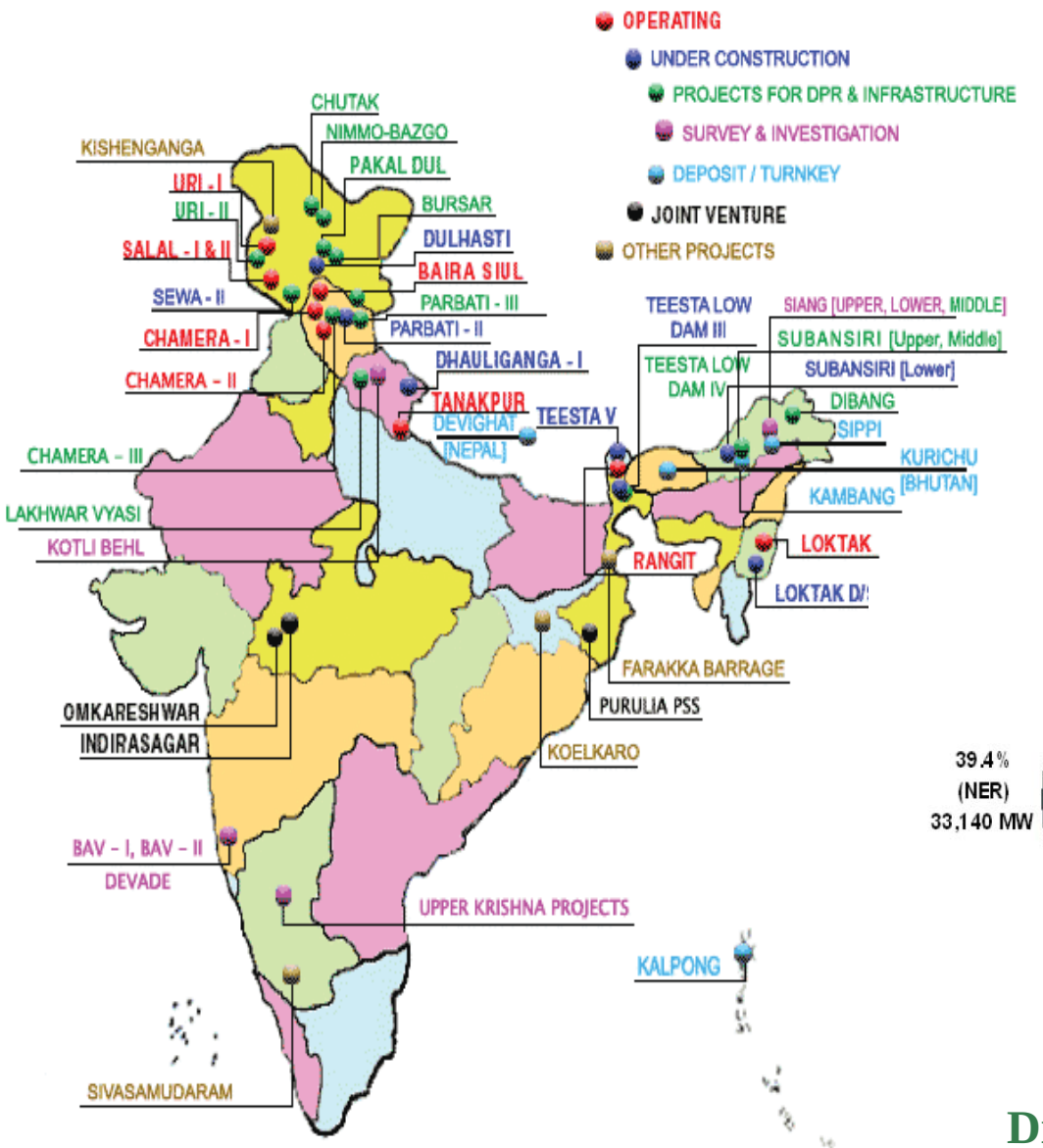
Current Energy Scenario

The Nuclear Energy Spread

✓Nuclear power is the 4th largest source of electricity in India after thermal, hydroelectric and renewable sources of electricity.

✓ As of 2010, existing nuclear power plants generates 4,780 MW and are expected to generate an additional 2,720 MW.

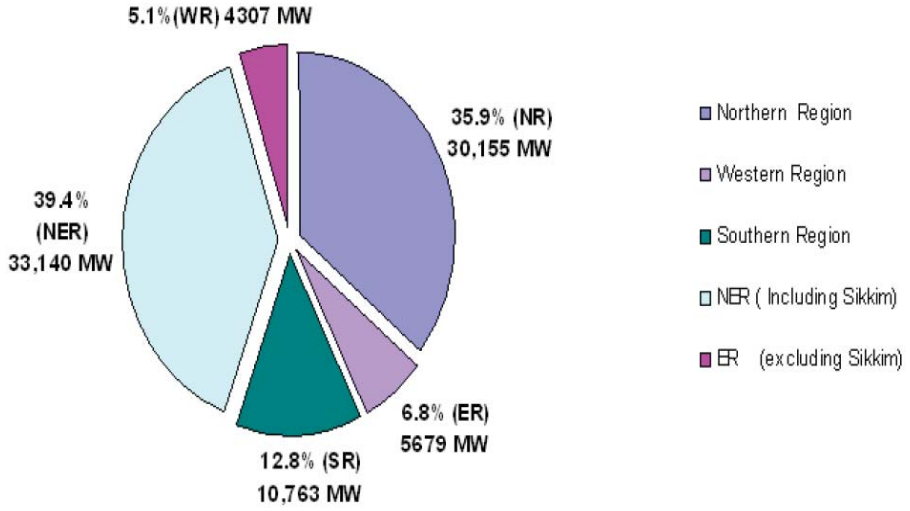
Current Energy Scenario



Map of Hydro Power Distribution

✓Out of the total power generation installed capacity in India of 1,76,990 MW (June, 2011), hydro power contributes about 21.5% i.e. 38,106 MW.

✓In totality India is endowed with hydro-potential of about 2,50,000 MW.



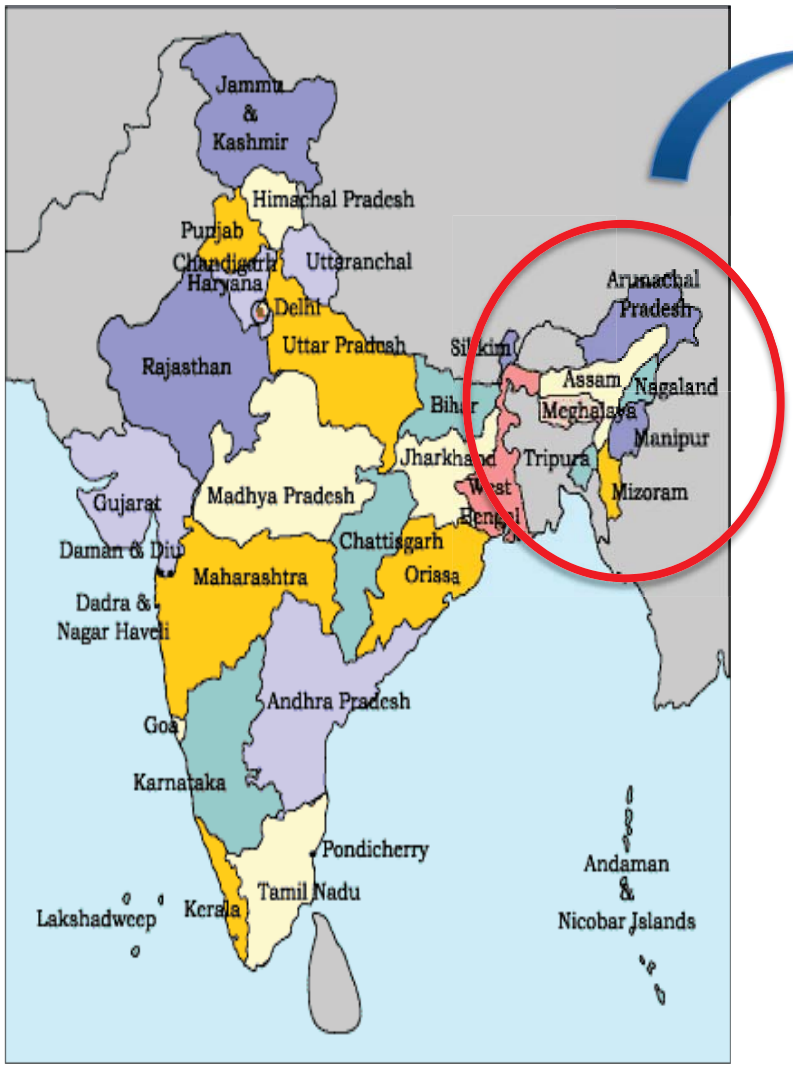
Distribution of Hydro Power Potential by Power region

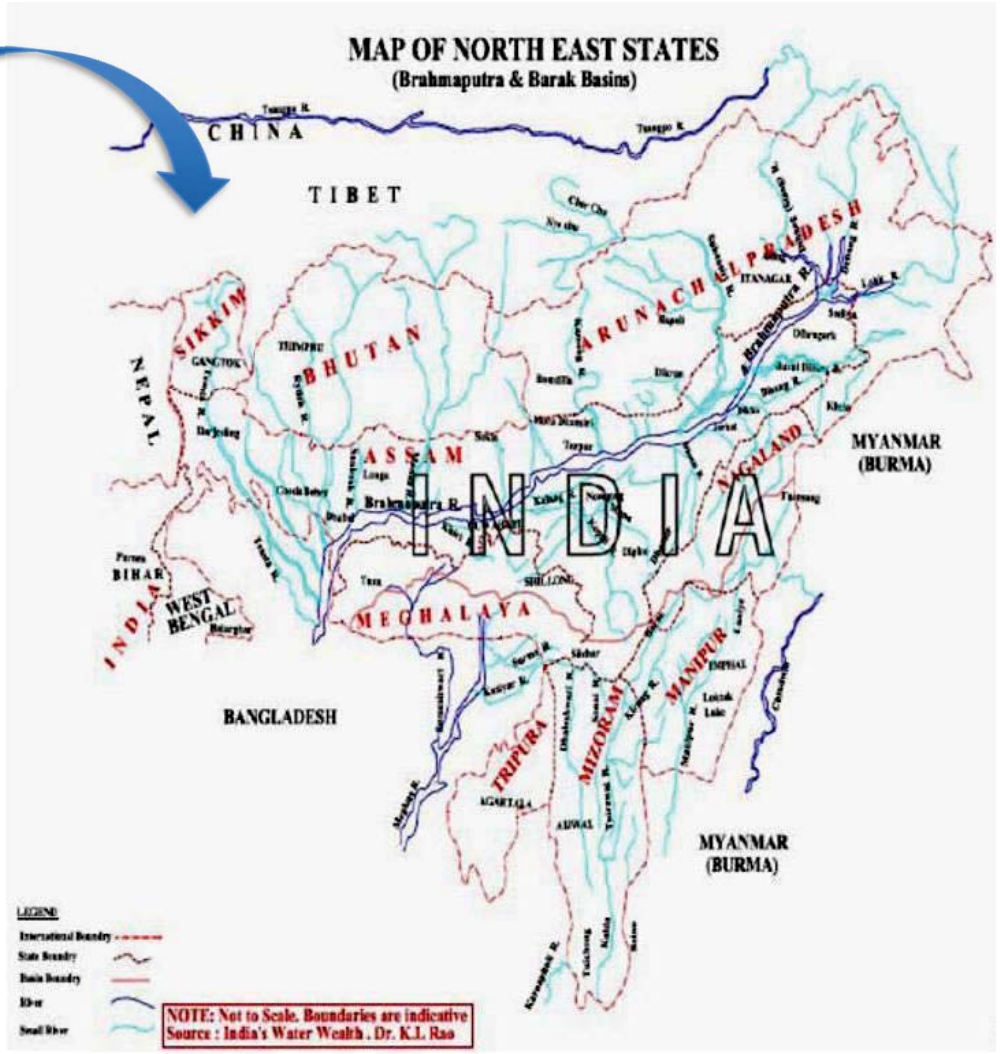
Table 1 Efficiency of Electricity Generation

(Ref: "Annette Evans, Vladimir Strezov, Tim J. Evans, "Assessment of sustainability indicators for renewable energy technologies," Renewable and Sustainable Energy Reviews 13 (2009)**).**

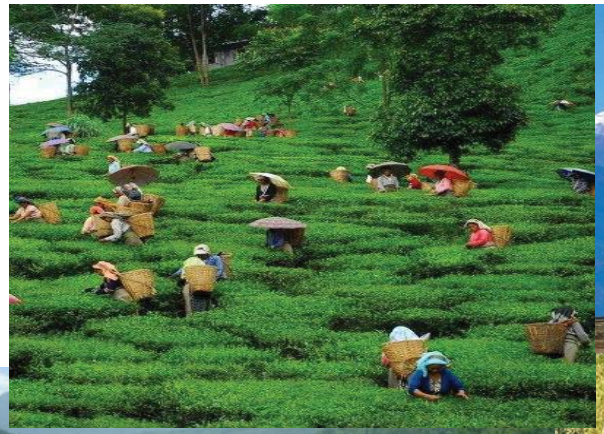
Photovoltaic	4–22%
Wind	24–54%
Hydro	>90%
Geothermal	10–20%
Coal	32–45%
Gas	45–53%

Moving towards The North East

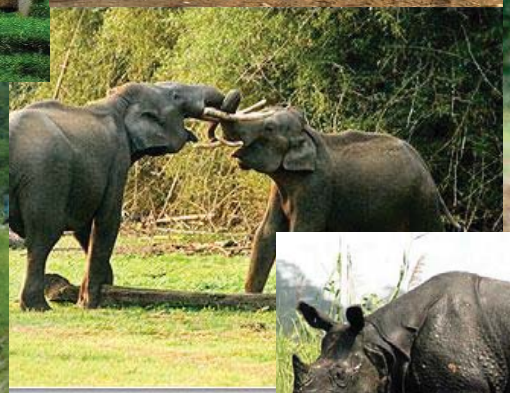




The North East Region













Hydro power potential in North east India

- Tagged as "Future Power House" (60,000 MW)

- This river system drains a catchment area of 238,473 square kilometres, which is 7.25 % of the geographic area of India.

- The hydropower potential of the North-eastern power region, including Sikkim, is 33,100 megawatts at 60 % load factor, almost all of which excluding Sikkim is from the Brahmaputra basin.

Potential and Projects

State-wise details of the potential and installed/under installation projects

S.No	State	Potential		Projects Installed		Projects Under implementation	
		Nos	Capacity	Nos	Capacity	Nos	Capacity
1	Andhra Pradesh	497	560.18	62	189.83	18	61.75
2	Arunachal Pradesh	550	1328.68	101	78.835	28	38.71
3	Assam	119	238.69	4	27.11	4	15
4	Bihar	95	213.25	18	58.3	11	36.31
5	Chhattisgarh	184	993.11	6	19.05	1	1.2
6	Goa	6	6.5	1	0.05	-	-
-7	Gujarat	292	196.97	4	12.6	-	-
8	Haryana	33	110.05	7	70.1	2	3.4
9	Himachal Pradesh	536	2267.81	112	375.385	40	132.2
10	Jammu & kashmir	246	1417.80	34	129.33	5	5.91
11	Jharkhand	103	208.95	6	4.05	8	34.85
12	Karnataka	138	747.95	111	725.05	18	107.5
13	Kerela	245	704.1	20	136.87	7	23.8
14	Madhya Pradesh	299	803.64	11	86.16	4	19.9
15	Maharashtra	255	732.63	39	263.825	15	51.7
16	Manipur	114	109.13	8	5.45	3	2.75
17	Meghalaya	101	229.8	4	31.03	3	1.7
18	Mizoram	75	166.93	18	36.47	1	0.5
19	Nagaland	99	188.98	10	28.67	4	4.2
20	Orissa	222	295.47	10	79.625	5	3.93
21	Punjab	237	393.23	43	153.2	15	21.4
22	Rajasthan	66	57.17	10	23.85	-	-
23	Sikkim	91	265.55	16	47.11	2	5.2
24	Tamil Nadu	197	659.51	16	94.05	6	33
25	Tripura	13	46.86	3	16.01	-	-
26	Uttar Pradesh	251	460.75	7	23.3	-	-
27	Uttarakhand	444	1577.44	95	134.12	55	230.65
28	West bengal	203	396.11	24	98.9	16	79.25
29	Andaman & Nicobar Islands	7	7.27	1	5.25	-	-
Total		5718	15384.15	801	2953.58	271	914.81

Non-conventional energy projects Vs Sustainability

Socio- Economic Indicators

➢The consumption of electricity in the North-eastern power region:

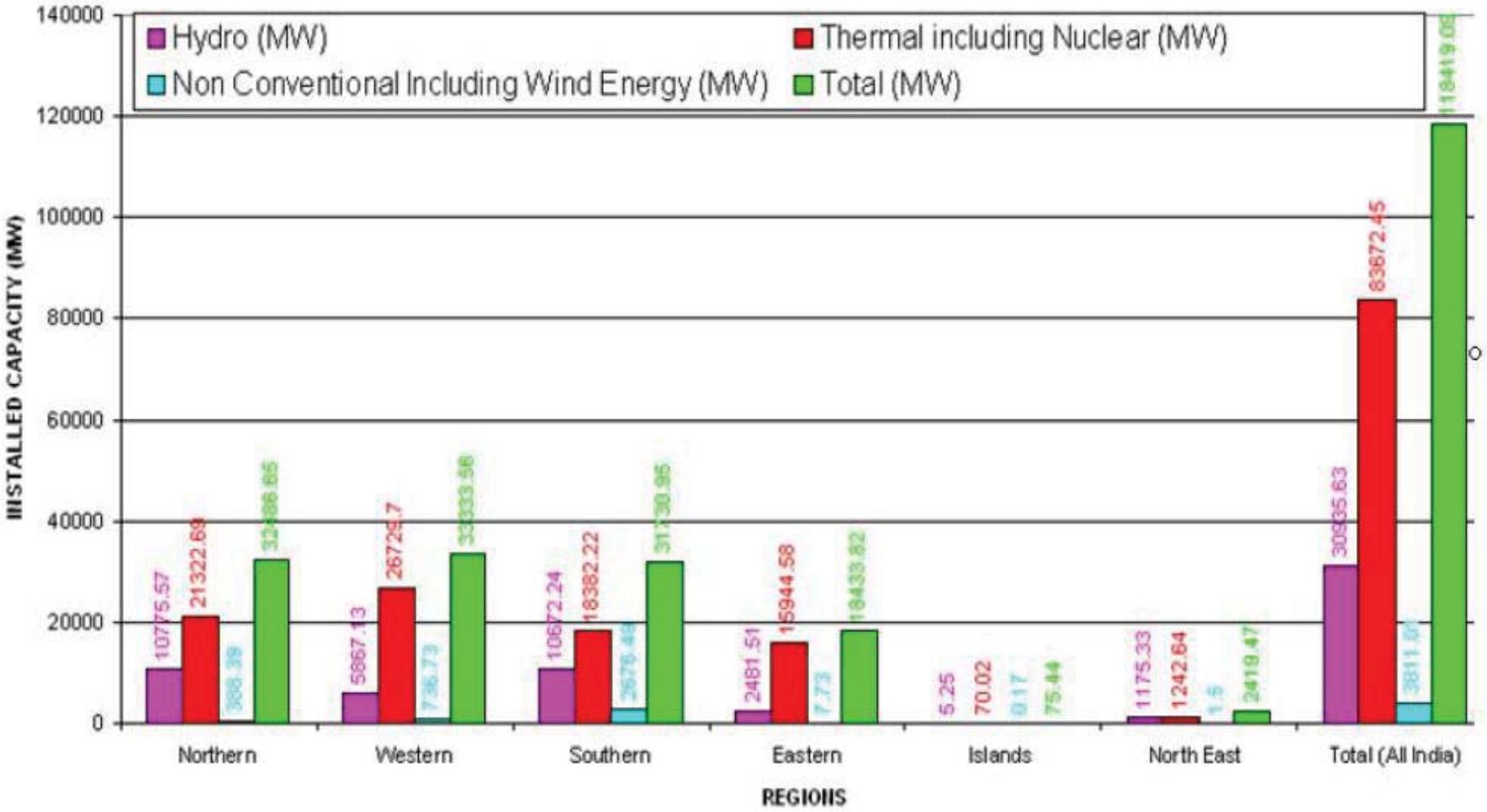
- ✓ The domestic and commercial sectors (**45 %**).
- ✓ The industrial consumption is less than **1 %**

➢ The annual per capita consumption in the region is 119 kilowatt-hours compared to 390 kilowatt-hours for the country.

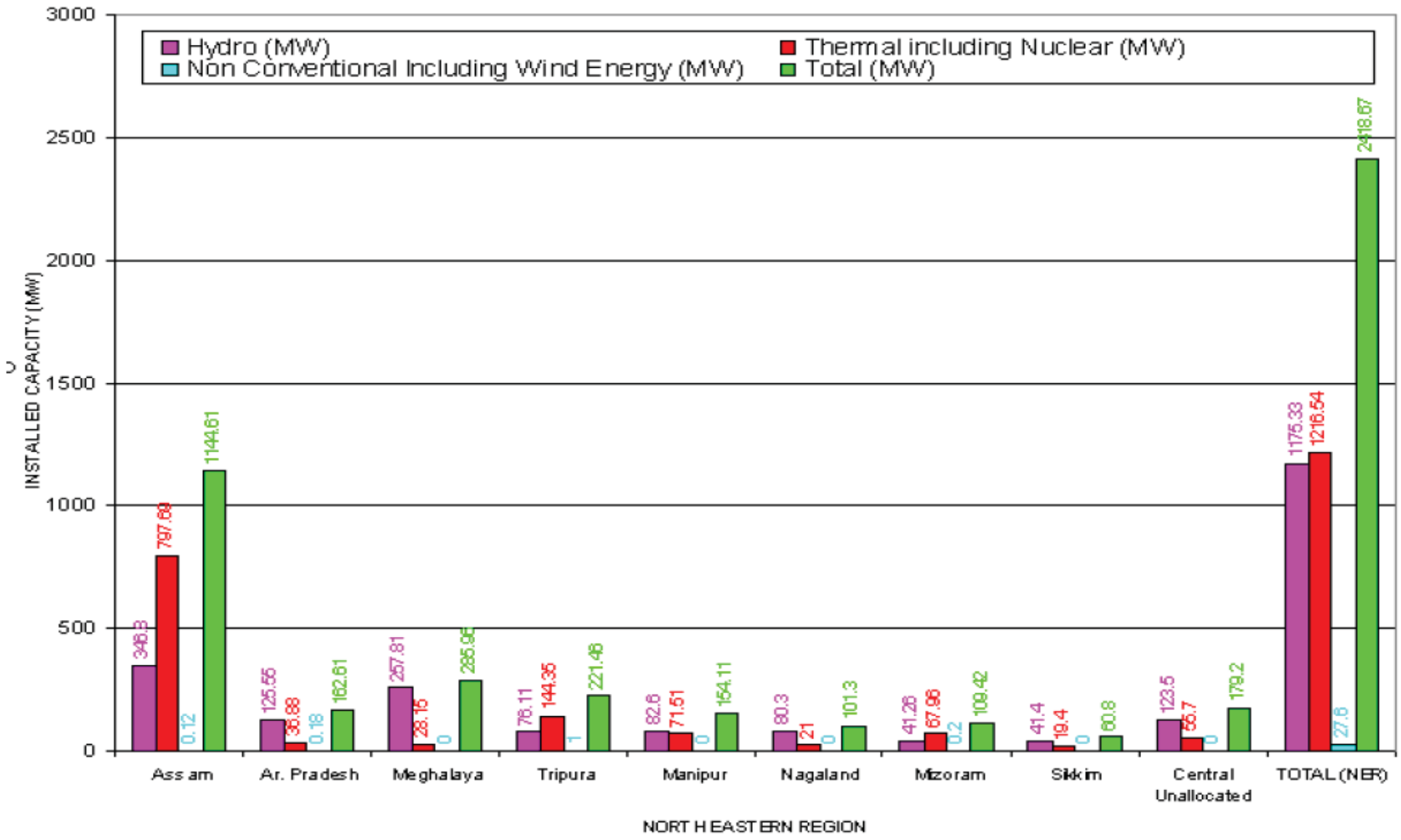
➢Village electrification is **76.6 %**

➢34.28 % live below the poverty line

➢ Only 0.95 million hectares is irrigated out of a total irrigable area of 3.2 million hectares



Installed Capacity of different types of power in India



Installed Capacity of different types of power in NE region

Concerns in the Development of Hydropower in North East India

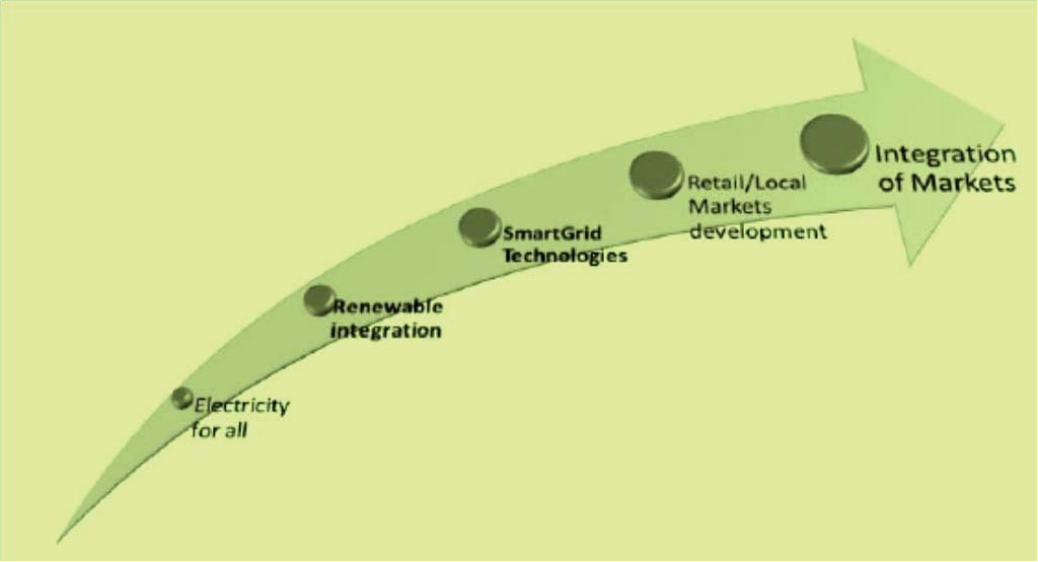
✓Technical and Organizational Issues in NE regions

✓International boundary issues

✓Ecosystems and biodiversity

✓Human health

✓Seismicity



Road Map to smart and sustainable energy developments

Subansiri Project - an ecological challenge?

Researchers find behavioural changes in some species of fish in Subansiri river over last 2 monsoon

By Our Correspondent

DHEMAJI, Sept 30: The Subansiri is one of the principal north bank tributaries of the Brahmaputra abound with various fish species. So far researchers recorded more than 160 species of fish in the river system and found behavioural changes in some of the species, especially in barilius, locally known as boriwala in recent years.

Lakhi Prasad Hazarika, a fish researcher and an assistant professor of Zoology at North Lakhimpur College, who has been acutely studying the various aspects of the fish species found in Subansiri experienced drastic decline in the upstream migration of barilius in last two monsoons.

'Like other rivers of this region, barilius or boriwala are a dominant fish species in the Subansiri and during my study I found some behavioural changes in this species. When this fish becomes fingerling from the spawn it generally migrates to the upstream in big herds. But this migration has been noticeably and rapidly decreasing in Subansiri in the recent years,' said Hazarika.

He also told wetlands, particularly in Kaziranga, was the most ideal breeding places for the boriwalas in Subansiri and after breeding there the fingerlings usually went upstream in search of food and for some other reasons. He told this change may occur due to changes in water quality, sediment load or water temperature in the river.

'The natural flow of the river has been fragmented at Gerukamukh by constructing the dam of the Lower Subansiri Hydroelectric Project (LSHEP) and the water is not flowing through its original channel at the dam site as it diverted through diversion tunnels, which may be the root cause of all changes in the river,' added Hazarika.

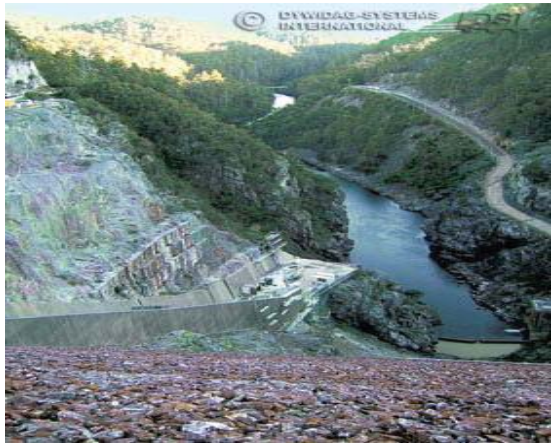
Keshoba Krishna Chatradhara, Secretary of the Peoples' Movement for Subansiri Brahmaputra Valley told the National Hydroelectric Power Corporation (NHPC) Ltd's LSHEP posed serious threat to the entire ecosystem of the river.

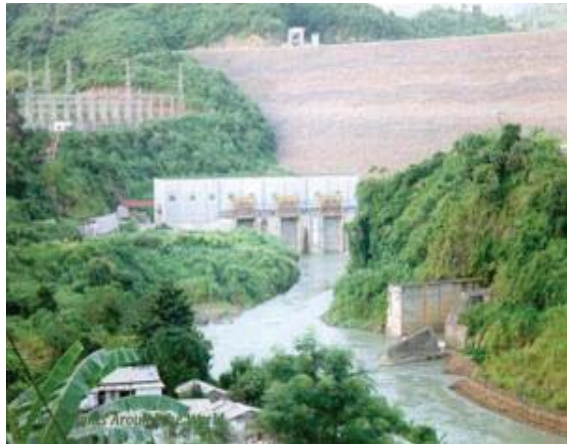
He told riverine people already started to experienced negative impacts of the project though it was still in the constructional phase.

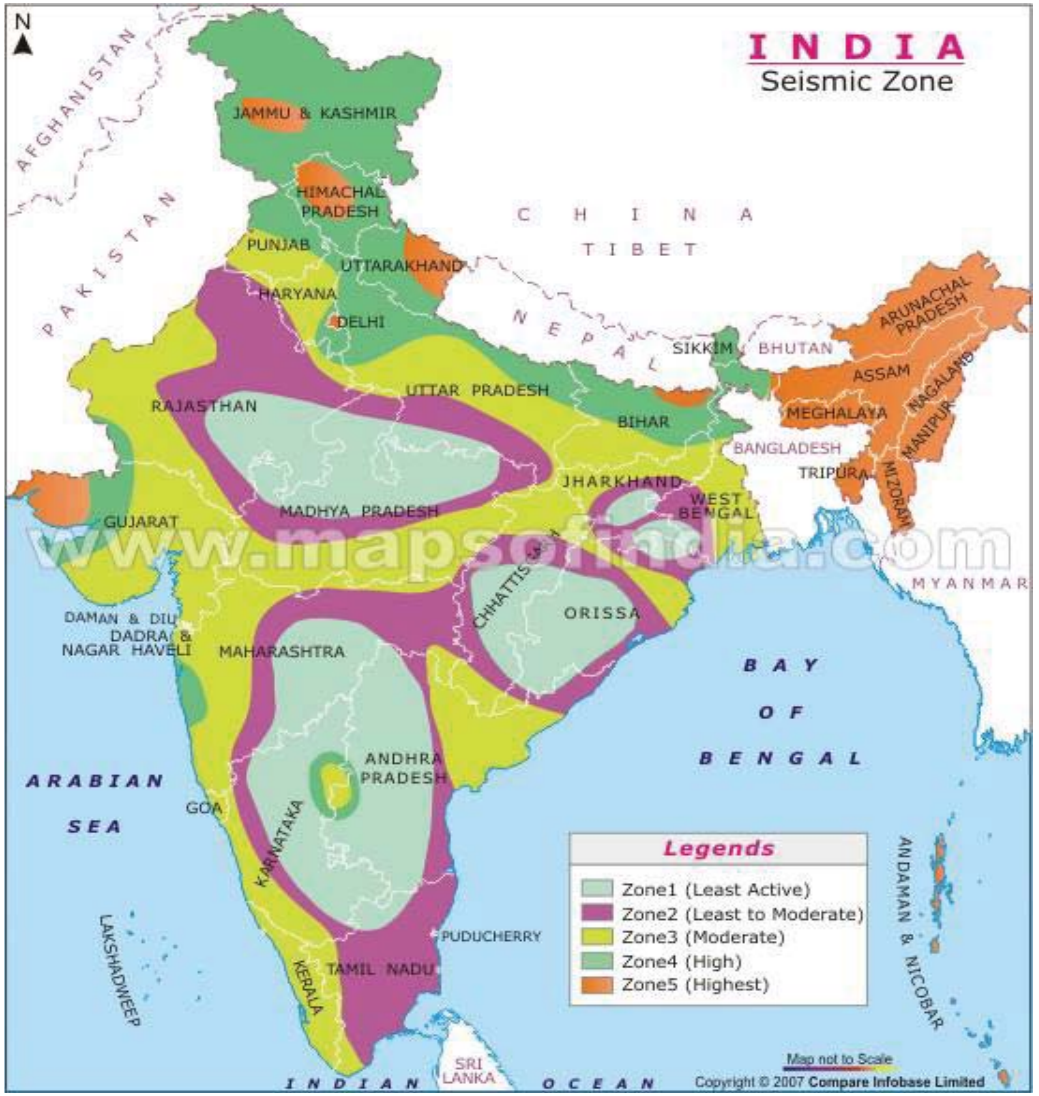
Chatradhara told this correspondent, 'The NHPC Ltd has illegally dumped huge amount of muck for years round the clock on the river which noticeably changed the ecology of the river and the fish quantity is rapidly decreasing in the river. If the dam is once completed the livelihoods of thousands of poor fishing families will be affected- directly or indirectly depending on the fishes of the Subansiri finish.'

He also told that the fish amount may not be huge in economic terms or to properly reflect in national economic statistics, but it was crucial component in livelihood and nutritional security of the riverine families. To ensure ecological security of a river no large dam should constructed over it, Chatradhara urged.

He told the United States has decommissioned more than 1000 dams in the past decade and many of these were decommissioned to reinstate migratory run of fishes like Salmons and Steelheads. He reiterated the LSHEP would be cause for extinction of many rare aquatic species including fish in the Subansiri.







The seismic zone map of India

Rationale for development of hydropower in North-eastern Region

- ✓ Satisfy power requirements outside the region and could be the mainstay for meeting future peaking needs in the country.
- ✓ Identify energy-intensive industries that provide the local population with access to electricity by utilizing the cheap hydropower available.
- ✓ Benefit the region itself through the development of infrastructure such as roads, communications, and electricity supply to remote hilly areas, improving the quality of life.
- ✓ Income generation
- ✓ The maintenance of forests as carbon sinks is receiving increasing attention through the expansion of carbon trading opportunities.
- ✓ Benefits of revenue from 12% free power to the home states
- ✓ The potential for socio-economic growth of the region is widely recognized by the government and International Organizations, mainly because of the abundance in natural resources and rich biodiversity

Concluding Remarks

- The potential of North-East India is extreme and it depends on the alertness of people as well as the government to take right steps

- It is necessary to carry out a detailed study of the long-term and short-term impacts of large-scale hydropower development

- The development of the North-eastern Region's hydro potential could pave the way for formation of a South Asia regional power grid and foster cooperation among the countries in the region.

- While large-scale development of the Northeast's hydropower potential finds justification in the context of the overall power demand in the country, it is also essential to consider and identify avenues for utilization of electricity in the region.

- For generating greater acceptability of storage projects among affected populations, a policy on resettlement and rehabilitation specifically tailored to the socioeconomic and cultural milieu of the North-eastern Region has to be evolved. Given the sensitivity of the issues, development of policies on storage projects, sharing of costs and benefits, and resettlement and rehabilitation would ultimately require national-level political input.

National Institute of Technology, Arunachal Pradesh

THANK YOU