Damming Northeast India

Juggernaut of hydropower projects threatens social and environmental security of region

By Neeraj Vagholikar & Partha J. Das[1]

With the Northeast identified as India's 'future powerhouse' and at least 168 large hydroelectric projects[2] set to majorly alter the riverscape, large dams are emerging as a major issue of conflict in the region. Although the current scale of dam-related developments far outstrips anything which took place in the past, the region has been no stranger to dam-related conflicts. For example, the Kaptai dam, built in the Chittagong Hill Tracts of East Pakistan (now Bangladesh) in the 1960s, submerged the traditional homelands of the Hajong and Chakma indigenous communities, and forced them to migrate into parts of Northeast India. Over the years, this has led to serious conflicts between the refugees and local communities in Arunachal Pradesh. In the 1970s, the Gumti dam in Tripura submerged large tracts of arable land in the Raima Valley and displaced the local tribal population, leading to unrest. Projects such as the Loktak hydroelectric project commissioned in the 1980s have impacted the wetland ecology of the Loktak lake in Manipur, seriously affecting the habitat of the endangered Sangai (the brow-antlered deer) and the livelihoods of local people. The impending loss of home, land and livelihood has led to many years of opposition to the Pagladiya project in Assam and the Tipaimukh project in Manipur on the Barak river. More recent times have seen major conflicts emerge in Assam and Arunachal Pradesh over the individual and cumulative impacts of over 100 dams planned in upstream Arunachal. Dam-induced floods from projects such as the 405 MW Ranganadi hydroelectric project in Arunachal and the intense people's opposition to the under-construction 2,000 MW Lower Subansiri hydroelectric project on the Assam – Arunachal Pradesh border have been major triggers for what has now emerged as a major political debate on the downstream impacts of dams in the region. Meanwhile, in the uplands of Sikkim and Arunachal, minority indigenous communites such as the Lepchas and Idu Mishmis have expressed concern about the impacts of multiple mega projects in their homelands. The large dams' juggernaut promises to be the biggest 'development' intervention in this ecologically and geologically fragile, seismically active and culturally sensitive region in the coming days.

THE REGION

Northeast India, consisting of the eight states of Assam, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Tripura and Sikkim, is known for its biological and cultural diversity and the unique Brahmaputra and Barak river systems. While the eight states are indeed collectively referred together as the 'Northeast', there is substantial diversity within the region even as far as political and socio-economic issues are concerned, both historically and in contemporary times.

The region is rich in biodiversity and is home to important populations of wildlife species such as the rhino, elephant, tiger, wild water buffalo, pygmy hog and gangetic river dolphin. Three out of 34 biodiversity hotspots identified globally[3] – Himalaya, Indo-Burma, and Western Ghats and Sri Lanka – cover parts of India. The Northeast is traversed by the first two and in 8% of the country's geographical area it also houses 21% of Important Bird Areas within India, identified as per international criteria. It is an area which is still poorly documented and in recent years biologists have discovered new species and extended known ranges of existing ones in the region. This is not just restricted to smaller life forms, but also large mammals such as primates, discovery of which is rare these days, an indication of how unexplored the region is. The Northeast also has a high level of endemism (plant and animal species found nowhere else).

The Brahmaputra[4] is one of the world's largest rivers, with a drainage basin of 580,000 sq km, 33% of which is in India. Originating

BITTU SAHGAL

Biodiversity-rich ecosystems on the Assam-Arunachal Pradesh border will be negatively impacted by the under-construction 2000 MW Lower Subansiri hydroelectric project.

NEERAJ VAGHOLIKAR

The altered flow patterns in the Brahmaputra and its tributaries due to multiple large dams will have a substantial impact on fisheries and livelihoods in the Brahmaputra valley.

in the great glacier mass of Chema-Yung-Dung in the Kailas range of southern Tibet at an elevation of 5,300 m, it traverses 1,625 km through Chinese territory and 918 km in India, before a final stretch of 337 km through Bangladesh, emptying into the Bay of Bengal through a joint channel with the Ganga. A unique river, it drains such diverse environments as the cold dry plateau of Tibet, the rain-drenched Himalayan slopes, the landlocked alluvial plains of Assam and the vast deltaic lowlands of Bangladesh. An extremely dominant monsoon interacting with a unique physiographic setting, fragile geological base and active seismo-tectonic instability, together with anthropogenic factors, have moulded the Brahmaputra into one of the world's most intriguing and gigantic river systems. The dramatic reduction in the slope of the Brahmaputra as it cascades through one of the world's deepest gorges in the Himalayas before flowing into the Assam plains explains the sudden dissipation of the enormous energy locked in it and the resultant unloading of large amounts of sediments in the valley downstream. The river carries the second largest sediment yield in the world, while it ranks fourth in terms of water discharge.

SAMSUL HUDA PATGIRI/SANCTUARY PHOTO LIBRARY

The fragile ecology of the Loktak lake and livelihoods of those dependent on it have been seriously impacted by the Loktak hydroelectric project in Manipur. Lessons must be learnt from such cases before embarking on massive dam expansion plans in the Northeast.

In the course of its 2,880 km journey to the Bay of Bengal, the Brahmaputra receives as many as 22 major tributaries in Tibet, 33 in India and three in Bangladesh. Many of the north bank tributaries are of Himalayan origin, fed by glaciers in their upper reaches, e.g. the Subansiri, the Jia Bharali (Kameng), and the Manas. The Dibang and the Lohit are two large tributaries emerging from the extreme eastern flank of the Himalayas, while the Jiadhal, the Ranganadi, the Puthimari, and the Pagladiya are some of the major tributaries with sources in the sub-Himalayas, the latter two in Bhutan. The river system is intricately linked with the floodplain ecology of wetlands (*beels*) and grasslands in the Brahmaputra valley. For example, these linkages are evident in the world-renowned ecosystems such as the Kaziranga National Park in Assam. Due to the colliding Eurasian (Chinese) and Indian tectonic plates, the Brahmaputra valley and its adjoining hill ranges are seismically very unstable and the region has seen some major earthquakes (see box on Dams & Environmental Risks).

ABDUL WAKID

Northeastern wildlife biologists have raised concern about the impact of multiple hydropower projects in the Brahmaputra basin on the national aquatic animal, the gangetic river dolphin.

The other major river basin in Northeast India is the Barak. This river has its source in Manipur and the upper Barak catchment area extends over almost the entire north, northwestern, western and southwestern portion of the state. The middle course of the river lies in the plains of Cachar in southern Assam, while the lower, deltaic course is in Bangladesh. Both the Brahmaputra and the Barak river systems are also the lifeline for livelihoods such as fishing and agriculture of local communities in their respective floodplains.

The region is home to a diversity of indigenous communities, with a substantial portion of the population dependent on natural resource-based livelihoods. This diversity of communities comes with unique socio-cultural, agro-ecological and land-holding systems (such as different forms of community control over forests in various parts of the region). By the late 19th century, tea and other business had brought massive demographic and economic change to undivided Assam. But the experience was varied across the region. For example, the area that would later become Arunachal Pradesh was relatively isolated from such changes. In 1875, the British established the 'inner line' - a demarcation between the Assamese plains and the mountains through which nobody could pass without a permit.[5] This restriction and the geography of the region kept Arunachal Pradesh isolated from upheavals, such as conversion of massive stretches of land into privately owned tea gardens, seen in Assam.

The region, today, is marked by socio-political complexities, which include struggles for political autonomy and associated armed conflicts. The Indian constitution has attempted to deal with the northeast's unique nature by establishing a system of administration that differs from the rest of the country. The Sixth Schedule and other constitutional provisions relevant to the Northeast offer different degrees of autonomy and self-management (including natural resource management) to indigenous communities. Despite this, there seems to be little opportunity for them for participation in decisions related to large developmental projects. Faced with a multitude of challenges, the region is currently charting a course for 'development', and multiple large hydel projects for power export are a part of the government's official development plan.

NORTHEAST POWER SURGE

In 2001, the Central Electricity Authority (CEA) did a preliminary ranking study of the hydroelectric potential of various river basins in the country. The Brahmaputra basin was given the highest 'marks' and 168 projects with a total installed capacity of 63,328 MW were identified. The tag of being the country's 'future powerhouse' has been proactively used for the region since the Northeast Business Summit in Mumbai in July 2002. The 50,000 MW Hydro Initiative launched by the Ministry of Power in 2003 also has a major focus on the Northeast. The 'Pasighat Proclamation on Power' adopted in January 2007 at the North East Council's Sectoral Summit on the Power Sector identifies the region's hydropower potential as one of the priority areas to contribute to the country's energy security.

The push for large hydropower projects in the Northeast was primarily a process driven by the Central Government till the gradual liberalisation of hydropower policies allowed states to invite private players. While Sikkim kick-started this process in the Northeast in 2001-2, the process gathered momentum across the region in 2005. Although states such as Arunachal Pradesh and Sikkim are at the forefront in the initiative to sign multiple Memoranda of Understanding/Agreement (MoU/MoA) with power developers, other states such as Meghalaya, Manipur, Mizoram and Nagaland have seen some action too. Assam and Tripura are smaller players in hydropower because of their topography. In May 2008, the then Union Minister of State for Power, Jairam Ramesh, raised concern about the 'MoU virus' which was affecting states like Arunachal Pradesh and Sikkim. He was referring to the very rapid pace at which agreements (MoUs/MoAs) were being signed by these State Governments with hydropower companies, particularly in the private sector. Till October 2010, the government of Arunachal Pradesh has already allotted 132 projects to companies in the private and public sector for a total installed capacity of 40,140.5 MW, with around 120 of these projects having an involvement of private players. Each of these agreements have been accompanied by huge monetary advances taken from project developers at the time of inking the deal, before any public consultations, preparation of Detailed Project Reports and receipt of mandatory clearances!

This kind of process of signing MoUs, where monetary advances are paid upfront, greatly compromises the manner in which subsequent clearances take place as such projects are considered as a *fait accompli* by both the developer and the state government. Moreover, it leaves no room for an assessment of options for development planning in areas where these projects are coming up. The Comptroller and Auditor General (CAG) of India, the supreme audit institution in the country, has, in a performance audit[6] for 2008 – 9 for the state of Sikkim, highlighted serious concerns about the manner in which projects have been handed out to some private hydropower players. While the Meghalaya Legislative Assembly has seen a debate and enquiry on the manner in which projects had been allotted to hydropower projects in the state, the Assam Legislative Assembly has debated the implications of the dams' juggernaut in upstream Arunachal Pradesh. In Arunachal Pradesh too, local affected communities, civil society groups, the media and opposition political parties have repeatedly raised serious concerns about the process of rapidly allotting projects to power developers without any public consultation.

Despite the concern raised by a central minister about the 'MoU virus', the Central Government has proactively granted various clearances to these projects ignoring important concerns. At least two dozen large hydroelectric projects have got final environmental clearance in the Northeast. Other than seven large hydroelectric projects in Arunachal Pradesh which have already received final environmental

FACTS ON NORTHEAST HYDRO

- Assessed hydroelectric power potential of the Northeast: 63, 257 MW[1]

This is 43% of the total assessed hydropower potential of the country

Assam: 680 MW, Arunachal Pradesh: 50,328 MW, Manipur: 1784 MW, Meghalaya: 2394 MW, Mizoram: 2196 MW, Nagaland: 1574 MW, Sikkim: 4286 MW, Tripura: 15 MW

State-level figures may vary depending on updation by State Governments. E.g. Arunachal Pradesh now estimates a potential of 57,000 MW. Revised figures for the full Northeast region would be closer to 170 hydropower projects for a total capacity of 70,000 MW

- Large hydropower projects (above 25 MW) already in operation in Northeast

Sikkim: Rangit III, Teesta V
Assam: Kopili, Khangdong, Lower Borpani (Karbi Langpi)
Manipur: Loktak
Meghalaya: Umiam Umtru IV, Kyrdamkulai, Umiam Stage I
Arunachal Pradesh: Ranganadi Stage I
Nagaland: Doyang

11 projects with total installed capacity of 1686 MW

- Large hydropower under construction in Northeast

Sikkim: Chujachen, Teesta III, Teesta VI, Rangit IV, Jorethang Loop
Arunachal Pradesh: Kameng, Lower Subansiri, Pare
Meghalaya: Myndtu, New Umtru

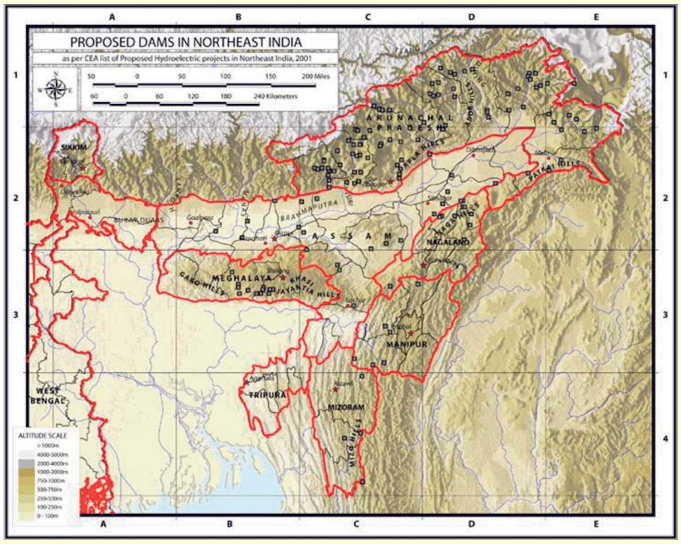
10 projects with total installed capacity of 4891 MW. Many projects across the region are at various stages of clearance and be shortly under construction.

- Arunachal Pradesh – Biggest hydropower player in region[2]

❖ 132 hydropower projects with total installed capacity of 40, 140.5 MW already allotted by State Government to private and public sector players as of October 2010
❖ 92 of these are large hydropower projects (above 25 MW)
❖ 38 of these are above 100 MW
❖ 50 projects granted Scoping or pre-construction environmental clearances (first stage) by Environment Ministry from September 2006 – October 2010
❖ 7 hydro projects have received final environmental clearance till October 2010

[1] *Central Electricity Authority data from report of Inter-Ministerial Group on NE Hydro, February 2010. Slight variation with CEA 2001 data.*

[2] *Arunachal Pradesh state government and Ministry of Environment & Forests data.*



ECOLLAGE. THIS PLATE FIRST APPEARED IN WHITAKER, R.W. AND CAPTAIN, A.S.(2005) *SNAKES OF INDIA, THE FIELD GUIDE*, DRACO BOOKS, CHENNAI, 2005.

Central Electricity Authority projections (2001) identify 168 hydropower projects for a total capacity of 63,328 MW in the Northeast

clearance, at least 50 have received first stage environmental clearance for carrying out pre-construction activities. While pre-construction clearances do not necessarily translate into final clearances, existing experience shows that the Ministry of Environment and Forests (MoEF) grants final environmental clearance to over 95% of all projects which it appraises for their environmental and social impacts.

The government and the proponents of large dams in the region paint a win-win picture: exploiting the country's largest perennial water system to produce plentiful power for the nation; economic benefits for Northeastern state governments through export of power to other parts of the country; employment generation; comparatively little direct displacement of local communities as compared to elsewhere in the country; the promise of the dams and private capital changing the perceived 'lack of development' scenario of the region forever.

THE ENVIRONMENTAL IMPACT ASSESSMENT (EIA) FARCE

Considering the unique features of the region and the scale of intervention planned, it is critical that the social and environmental impacts are carefully assessed before deciding whether these projects are truly feasible. Large hydroelectric projects need to pass through mandatory 'environmental clearance' procedures, administered by the MoEF, to evaluate their viability on environmental and social grounds. Based on their specific location, they could also require other clearances such as 'forest clearance' from MoEF and approval from the Standing Committee of the National Board for Wildlife (NBWL) for locations inside or within 10 km radius of wildlife protected areas (PAs). A key feature of the environmental clearance process is the Environmental Impact Assessment (EIA) report, which is a critical document aiding the decision-making. It is important to note that this is the only study under current clearance mechanisms to include a mandatory component on social impact assessment.

RAVI SANKARAN

The EIA report of the 1750 MW Demwe Lower project was completely silent on the downstream impacts of the project on critically endangered grassland birds such as the Bengal Florican in the Lohit river basin.

RUN-OF-THE-RIVER (ROR) HYDRO[1]

The Bureau of Indian Standards Code IS: 4410 defines a Run-of-the-River Power Station *as:*

A power station utilizing the run of the river flows for generation of power with sufficient pondage for supplying water for meeting diurnal[2] or weekly fluctuations of demand. In such stations, the normal course of the river is not materially altered.

IS: 4410 defines a Storage Dam *as:*

This dam impounds water in periods of surplus supply for use in periods of deficient supply. These periods may be seasonal, annual or longer.

The term 'run-of-the-river' hydro is a cause of major confusion in the public at large and definitions of the term around the world may vary from the above definition. According to some, a project is RoR only if inflow equals outflow on a real-time basis, i.e. if there is no storage or flow modification at all. Others (like the BIS definition above), use the term to refer to projects with relatively smaller storages and lesser flow modification. But contrary to the popular image created by dam proponents that the river is flowing unhindered and unaltered, the ground reality may be quite different.

Most of the so called 'run-of-the-river' hydroelectric projects being developed in the Himalayan region involve large dams which divert the river waters through long tunnels, before the water is dropped back into the river at a downstream location after passing through a powerhouse. These projects are promoted as being 'environmentally benign' as they involve smaller submergences and lesser regulation of water as compared to conventional storage dams. This perception conveniently ignores the impact of several features intrinsic to this design. For example, long stretches of the river will be bypassed between the dam and powerhouse, with up to 85 - 90 % of the river flow in the winter (lean season) diverted through the tunnels. In the 510 MW Teesta V project in Sikkim the 'head race tunnel' taking the water from the dam to the powerhouse is 18.5 km long and bypasses a 23 km length of the river. Not only will this destroy riverine ecology, but a cascade of projects will mean most of the river would essentially end up flowing through tunnels. The Affected Citizens of Teesta have aptly described this as: "Our sacred Teesta is being converted into an underground river."

These projects also involve extensive tunneling in a geologically fragile landscape, the environmental and social impacts of which are grossly underestimated. Impacts observed include cracks in houses above long tunnel alignments, drying up of water resources and major landslides. The list of project-affected-persons is clearly much longer than what is calculated at the planning stage which only looks at those whose lands are to be directly acquired for various project components. The tunneling also generates a huge quantity of muck and rock debris, the disposal of which is huge challenge. Power companies in Sikkim have earned themselves the name *uttani musa* (mountain mouse in the Nepali language) for digging the insides of the Sikkim mountains. The indiscriminate dumping of such massive quantities of excavated muck in steep Himalayan valleys with little available flat land has been another cause of serious impacts and environmental violations in projects. This is a fact corroborated by the Comptroller and Auditor General (CAG) of India in a 2009 report on Sikkim.[3]

Another type of RoR project being built is that which has a 'dam-toe' powerhouse located immediately downstream of the dam. Examples of such projects are the 2,700 MW Lower Siang, the 1,750 MW Demwe Lower (Lohit) and the 2,000 MW Lower Subansiri located in the Arunachal foothills just before these rivers enter the plains. However, the impact of these mega RoR projects is certainly not small. The reservoir of the 2,000 MW Lower Subansiri project will submerge a 47 km length of the Subansiri river while the 2,700 MW Lower Siang project will submerge a 77.5 km length of the Siang river (total 100 km length of various rivers to be submerged in this project). The above-mentioned projects will also cause drastic daily fluctuation in river flows downstream (*see section 'We all live downstream'*) due to power generation patterns, particularly in winter. Dam proponents argue that these projects are benign since the total flow in the river downstream over any 10 – day period in the year will be the same as in the pre-dam condition. But they fail to acknowledge that the massively altered daily flow patterns will have serious social and environmental impacts in the Brahmaputra floodplains.

There are other issues related to siting of such projects and their impacts in the ecologically and geologically fragile, seismically active and culturally sensitive Northeast. For example the Expert Committee of IIT Guwahati, Dibrugarh University and Gauhati University which studied the downstream impacts of the 2,000 MW Lower Subansiri project has stated in its final recommendations of June 2009 that such a mega dam is inappropriate in such a geologically and seismologically sensitive location.

Hydropower proponents are currently running a misleading campaign which claims that the RoR projects being built in states such as Arunachal Pradesh do not even include construction of dams! It needs to be clarified here that the bulk of the projects involve not just dams, but large dams[4], as defined by India's Central Water Commission, the International Commission on Large Dams (ICOLD) and the World Commission on Dams. Irrespective of the nature of project, dams fragment rivers, breaking the organic linkages between the upstream and downstream, between the river and its floodplain.

It is clearly misleading to universally label RoR projects as 'socially and environmentally benign' projects. Whether of RoR or storage type, both the individual and cumulative impacts of hydropower projects in any river basin need to be comprehensively scrutinised and understood. This, together with free, prior and informed public consent, should be the basis of decision-making on these projects.

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[1] Some of the key documents referred to for this box include: Draft fact-sheet on RoR projects, Kalpavriksh (upcoming); Hoover, R. Dams Lite? Run-of-River Projects No Panacea. *World Rivers Review.* August 2001; Restructured Rivers: Hydropower in the Era of Competitive Markets, International Rivers Network, 2001.

[2] Daily

[3] http://www.cag.gov.in/html/cag_reports/sikkim/rep_2009/civil_chap1.pdf

[4] ICOLD defines large dams as: *'those having a height of 15 meters from the foundation or, if the height is between 5 to 15 meters, having a reservoir capacity of more than 3 million cubic meters'.*

MAP NOT TO SCALE / SANCTUARY ASIA. ADAPTED FROM MAP OF DEPARTMENT OF HYDROPOWER, SIKKIM.

Plans for multiple large run-of-the-river hydropower projects in Sikkim will leave virtually no stretch of the Teesta river flowing free

What about the quality of these EIA reports for dams in Northeast India? Let us, for example, look at certain biodiversity aspects of the EIA reports. Dr. Anwaruddin Choudhury, renowned naturalist from Northeast India, has examined EIA reports of at least five large hydroelectric projects – Kameng, Lower Subansiri, Middle Siang, Tipaimukh, and Dibang – and finds them all poor on wildlife aspects. A common feature of his introductory comments on these reports has been: "contains innumerable (instances of) incorrect data, unverified and superfluous statements, and above all reveals the casual approach," referring to the power companies and EIA consultants. Dr. Choudhury says: "It is shocking that mega hydel projects in the northeast are being granted clearances based on such reports. How can we decide the fate of some of the country's most important wildlife habitats based on sub-standard impact assessment studies?"

Here are a few examples from these reports: the EIA for the 1,000 MW Siyom project lists 5 bird species in an area which has over 300 and even in this short list has one which is non-existent; the EIA for the 600 MW Kameng project reclassifies carnivores such as the red panda, pangolins and porcupines as herbivores; the EIA for the 2,000 MW Lower Subansiri lists 55 species of fish in a river which has at least 156 and reports an area called the 'Arctic' in the Eastern Himalayas.

But these days citizens' groups are getting cynical and increasingly reluctant to send their comments on poor EIA reports to the government. That is because necessary additional and credible studies are rarely asked for by authorities. On the contrary, the reports are sanitised by developers based on the comments received, to weed out problematic portions, and the projects conveniently granted clearance.

In some cases additional rapid EIAs have been asked for, which prove to be entirely inadequate. In the Lower Subansiri project on the Assam-Arunachal Pradesh border, the Zoological Survey of India (ZSI) spent six days doing an additional study and then made surprising statements such as: "...The long and vast water body thus created by the reservoir will be happy haunt for aquatic creatures." It is well known that native aquatic species, whose habitats are fast-flowing rivers, do not find the still waters of a reservoir a 'happy haunt'! While reservoirs may benefit exotic species that are introduced for fisheries, such introduction has very often proved to be detrimental to the native species. It is a matter of serious concern that reputed government institutions such as ZSI have given such poor reports. While biodiversity was used as an indicator in the above examples, the reports have been found to be poor in many social and environmental aspects in general. In some cases the MoEF has indeed asked for additional detailed studies when EIAs were found to be poor, but often they have been post-clearance studies! There is little logic in first clearing the way for destruction of wildlife habitats and then doing a detailed assessment as a formality after project work and environmental destruction is well under way.

Another trend has been to grant clearances to projects that destroy sensitive wildlife habitat based on poor assessments, and then claim to compensate the losses by asking for other areas to be protected. While appropriate compensatory mechanisms may be relevant in some cases, they cannot substitute a sound decision-making process based on comprehensive environmental and social impact assessment. The main problem in current environmental decision-making processes is that virtually every project is treated as a *fait accompli* both by the Expert Committees appraising these projects and the regulatory authorities concerned. This subverts the possibility of a proper environmental decision-making process.

DAMS AND ENVIRONMENTAL RISKS

A recurring theme through this briefing paper is the environmental risks aggravated due to the presence of large dams, as well as those faced by the dams themselves, in the Northeastern region (see section on 'Hydropower and climate change' and box on 'Dams and Floods' for example). Despite this, environmental risk assessment is perhaps one of the weakest links in the Environment Impact Assessment framework. Currently, the only mandatory risk assessment requirement is to conduct a 'dam-break analysis' which predicts the effects of flooding downstream, in case the dam actually breaks.

The Expert Committee studying the downstream impacts of the Lower Subansiri hydroelectric projects has highlighted risks of constructing large dams in a geologically and seismologically sensitive area. The Comptroller and Auditor General (CAG) of India has, in a 2009 report reviewing the implementation of the 10th Five Year Plan projects by NHPC and NEEPCO[1] in the Northeastern and Eastern region, expressed concern about the time and money being spent on geological survey and investigations being lower than global standards. This is closely linked with a relatively poor understanding of 'geological surprises', a major environmental risk during construction of hydroelectric projects, particularly in the Himalayan region. It must be noted that the CAG observation is related to a public sector company like NHPC which has the maximum experience vis-à-vis building hydroelectric projects in the country. The situation is likely be grimmer with the private players, with little or no prior experience of building large hydropower projects.

Let us take the example of earthquakes. Currently the focus is only on whether the dam will withstand the earthquake. Occasionally, the issue of whether the water reservoir itself can induce seismic activity is discussed. While these are both very important aspects, they are not the only earthquake associated risks as far as dams are concerned. Researchers in the Northeast have been highlighting overall impacts of earthquakes on river systems[2], which can increase risks to and from existing large dams. Dam engineers are quick to point out that a particular dam may survive a major earthquake, but even assuming that the actual structure is able to withstand a powerful tremor, quake-induced changes in the river system may have a serious impact on the viability of the project itself, as several basic parameters vis-à-vis the regime of rivers, and the morphology and behaviour of channels, may change. The last two major earthquakes in the region (1897 and 1950) caused landslides on the hill slopes and led to the blockage of river courses, flash floods due to sudden bursting of these temporary dams, raising of riverbeds due to heavy siltation, fissuring and sand venting, subsidence or elevation of existing river and lake bottoms and margins, and the creation of new water bodies and waterfalls due to faulting.

Analysis of the available scientific data clearly indicates that the neo-tectonism of the Brahmaputra valley and its surrounding highlands in the eastern Himalayas has pronounced effects on the flooding, sediment transport and depositional characteristics of the river and its tributaries, which in turn has a bearing on the long-term viability of dams. The earthquake of 1950, for example, raised the bed level of the Brahmaputra at Dibrugarh by at least three metres (10 feet) leading to increased flood and erosion hazard potential in the river. Brahmaputra expert, Dr. Dulal Goswami, says: "A single earthquake event could cause sedimentation equivalent to several decades of normal sedimentation during the high flow period." This could certainly render many of the proposed dams economically unviable as dam life is intricately connected with rates of sedimentation. However, this is yet to be studied as part of risk assessment.

Another important environmental risk was discussed for the first time by the EAC on River Valley and Hydroelectric projects in July 2009 with respect to the 3,000 MW Dibang Multipurpose project. In its meeting the committee noted: *"After critically examining all the issues the committee noted that the Dibang high dam is located in high seismic zone V and the area receives very high rainfall during monsoon. The dam impounds huge reservoir stretch (43.0 km). A situation may arise when high rainfall together with a major earthquake may occur. The steep slopes charged with rain water and triggered with earthquake are very vulnerable and may lead to large scale landslide. A major landslide may occur into the reservoir which may lead to creation of water waves in the reservoir....overtopping causing serious safety problems may happen."*

This is a very crucial risk to the downstream areas even if the dam stands intact. In October 1963, the Vaiont dam in Italy, one of the world's tallest, set off earthquakes as soon as its reservoir began to fill. One tremor set off landslides that plunged into the reservoir, creating a huge wave that overtopped the dam by 110 metres. About two minutes later, the town of Longarone was leveled and almost all of its 2,000 inhabitants killed.[3] However, except for the one discussion in July 2009, the EAC has been silent on the need for such risk assessment studies while evaluating umpteen projects in the Northeastern region for environment-related clearances.

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[1] The full-form of NHPC used to earlier be National Hydroelectric Power Corporation. Now the name has been changed to 'NHPC Ltd.' without a full-form. NEEPCO is the North Eastern Electric Power Corporation.

[2] Goswami, D.C. and Das, P.J., 2002. Hydrological Impact of earthquakes on the Brahmaputra river regime, Assam: A study in exploring some evidences. *Proceedings of the 18th National Convention of Civil Engineers*, November 9-10, 2002, Institution of Engineers (India), Assam State Centre, Guwahati, pp. 40-48.

[3] McCully, Patrick, 2007. Before the Deluge: Coping with Floods in a Changing Climate. A report by International Rivers.

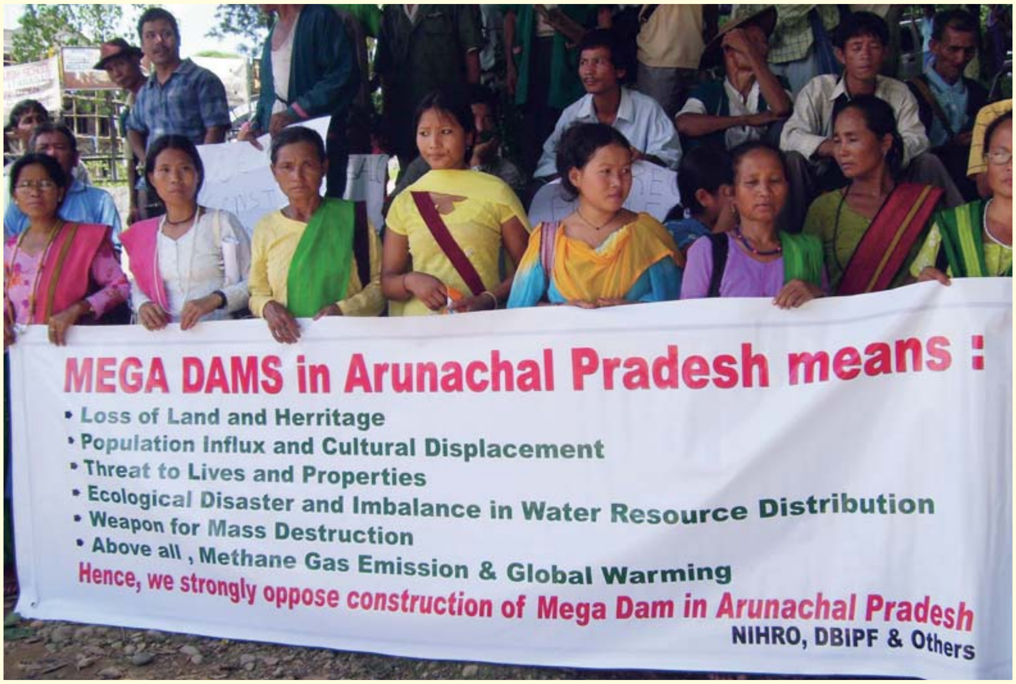
Dr. Dulal Goswami, environment scientist and renowned expert on the Brahmaputra river basin says: "The geophysical nature of the Brahmaputra river basin is fragile and dynamic. The scientific knowledge base on the river system is currently very poor, for example on aspects such as sedimentation and hydrology which are linked to the economic life of the project. This needs to be strengthened urgently, more so in light of emerging threats from climate change (see separate section). Without the availability of comprehensive information, how can we determine the long-term viability of projects in this region? The wisdom of such public policy has to be questioned. Economic viability apart, the mega-projects planned come with tremendous ecological and social costs which are unacceptable."

UNDERESTIMATING SOCIAL IMPACTS

One of the major arguments put forward in New Delhi to 'sell' large hydroelectric projects in the Northeast, is that there is relatively 'small displacement' by submergence as compared to that in other parts of the country and therefore these projects are benign. But a careful perusal of the ground situation indicates that displacement, particularly of livelihoods and rights is grossly underestimated. Azing Pertin of the Siang Peoples Forum in Arunachal Pradesh says "Since our state is hilly, there is very little land where permanent cultivation is possible. Virtually all our available arable lands will be submerged by the 2700 MW Lower Siang project in the affected area in the Siang Valley. The magnitude of impact has to be understood keeping this context in mind. It is misleading to argue that the land being lost is a small percentage of the total area of the district or state and wrongly assume that the project is benign."

The impacts of dams on resources under common use (e.g. pasture lands), vital to livelihoods of local communities, is also a major missing link in impact assessment of projects.[7] Shifting agriculture (*jhum*) is a dominant traditional land use in the hills of Northeast India and plays a critical role in the livelihoods of people, maintaining agricultural biodiversity and providing food security. Increasing pressures on land have resulted in the shortening of *jhum* cycles (the length of the fallow period between two cropping phases), thus impacting the ecological viability of this farming system. The submergence of land by hydel projects will further shorten the *jhum* cycle and enhance the pressure on the surrounding areas, thus affecting the environment and the livelihoods of *jhum*-dependent communities over a much larger landscape. In addition to the submergence, land use restrictions will apply in the catchment area of the reservoir as per mandatory norms to reduce siltation and to increase the life of the reservoir. Further, compensatory mechanisms required as per forest laws to offset the loss of forests due to the project, also lead to protection of other areas, affecting community access to land and resources. Take, for example, the conversion of Unclassified State Forests in Arunachal Pradesh, which allow more access and control by local communities, into Protected Forests, with greater state control.[8] The impacts on rights of local communities in such cases also need to be examined in terms of the Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006.

Clearly the impact on local communities is well beyond just the submergence area. However, in the existing planning and decision-making process, the social and environmental impacts over the larger landscape due to various aspects described above are not assessed. This is therefore not reflected in the decision-making on the overall viability of the project.



TADO KARLO

Women activists at a protest rally against large dams held in Itanagar, the capital of Arunachal Pradesh, in July 2007.

States such as Arunachal Pradesh are home to small populations of culturally sensitive indigenous communities. Therefore, direct and indirect displacement is high if looked at in the perspective of local population (as opposed to the population of the country). Dr. Mite Lingi, Chairman of the Idu Indigenous Peoples Forum, says “The ‘small displacement’ argument to sell these projects as being benign needs to be confronted. The entire population of the Idu Mishmi tribe is around 9500 and at least 17 large hydel projects have been planned in our home, the Dibang Valley in Arunachal. As per this faulty argument, little social impact will be indicated even if our entire population were supposedly displaced!” The land in the state has also been customarily delineated between different indigenous communities and clans. Therefore, contrary to popular belief, there isn’t plenty of land for resettling people in the state, just because the population density is less.

Further, the concerns being expressed in states like Arunachal Pradesh and Sikkim are not restricted to the issue of displacement. The over-900-day *satyagraha* in Sikkim by affected indigenous communities from 2007-9 focused on the impacts of hydel projects on Dzongu, the holy land and reserve of the Lepcha tribe. The protests have also received the support of the Buddhist monk community in Sikkim, as a sacred landscape stands to be desecrated. Sociologist Vibha Arora says: “Such protests are not merely on grounds of displacement but that the region’s cultural and ethnic traditions are rooted in the river Teesta and its environs.” A major concern in the Northeast is the influx of large labour populations from outside the region. Dr. Lingi adds, “We have been given constitutional and legal protection, particularly with respect to our land rights and restricted entry of outsiders. These projects are going to require both skilled and unskilled labour which Arunachal Pradesh cannot provide. 17 large projects in the Dibang Valley will bring in outside labour, upwards of 150,000 people, for long periods, as these are long gestation projects. We are concerned about the demographic changes and other socio-cultural impacts associated with this, as the Idu Mishmis are only 9500 in number. The development policies are in glaring contradiction to the constitutional and legal protection we have been given.”

CLOS

Police stop a peace march by Buddhist monks and other groups against large hydel projects in Sikkim in 2007. The march was held on Gandhi Jayanti, October 2nd.

RAJU MIMI

The Idu Mishmi community, opposed to the 3,000 MW Dibang Multipurpose project, block the conduct of what they believe was a farcical public hearing in March 2008.

NEERAJ VAGHOLIKAR

The 2,700 MW Lower Siang project in Arunachal Pradesh will submerge most of the arable lands in the affected area.

Despite major movements emerging in the region raising serious concerns about the impacts of dams, it will be misleading to argue that there is universal opposition to hydropower projects across the Northeast. In states such as Sikkim, Arunachal Pradesh and Manipur, there are also those amongst local communities who are defending the projects. Monetary gains from sale of land, small contracts during construction and a promise of quicker development of basic infrastructure like roads and bridges is cited as a major motivation. Responding to these arguments, journalist-activist Raju Mimi, from Dibang Valley, Arunachal Pradesh says: "We certainly want a bridge across the Lohit river at Dholla ghat. But the government cannot thrust on us some of the world's largest hydropower projects, such as 3,000 MW Dibang and 4,000 MW Etalin, by promising that we will get a bridge in return! What kind of governance is this? We should get the bridge irrespective of whether these hydropower projects come up or not."

While dam related opposition has primarily been seen in states such as Assam, Arunachal Pradesh, Sikkim and Manipur in recent times, the state of Mizoram saw a major rally against dams in the Sinlung hills in September 2010. Perhaps the first of its kind in the state, the rally was organised by the Sinlung Indigenous Peoples Human Rights Organisation (SIPHRO) and Sinlung Peoples Collective in Aizawl, the capital of Mizoram. Their memorandum to the Chief Minister, also signed by a wide array of civil society groups in the state who participated in the rally, argues that dams are being pushed for the benefit of a minority of influential individuals in the state who seek to corner the financial gains from compensation and contracts. They cite the examples of the Serlui B and Tuirial hydropower projects wherein they claim that has already happened. Opposing the plans to extensively dam all big and small rivers in the Singlung hills, they state that the land, rivers and forests are the backbone of the existence and survival of the Hmar and other indigenous people of the region. A crucial argument they make is that their very citizenship and democratic rights are integrally embedded with the land, forests and rivers and these must be safeguarded and protected for all time to come.

WE ALL LIVE DOWNSTREAM

An issue of heated current debate in the Northeast is the downstream impacts of dams, often a lacuna in the broader popular discourse on the impacts of dams in the country, which is primarily influenced by upstream submergence and displacement. When large dams block the flow of a river, they also trap sediments and nutrients vital for fertilising downstream plains. They alter the natural flow regimes which drive the ecological processes in the downstream areas. Quite literally they disrupt the connections between the upstream and the downstream, between a river and its floodplain.

A major catalyst to trigger the larger debate on downstream impacts of dams in Assam, has been the repeated incidents of dam-induced floods across the state from upstream projects (e.g. 405 MW Ranganadi in Arunachal Pradesh) in recent years. Downstream impact concerns raised in the Northeast include: loss of fisheries; changes in *beel* (wetland) ecology in the flood plains; impacts on agriculture on the *chapories* (riverine islands and tracts); impacts on various other livelihoods due to blockage of rivers by dams (e.g. driftwood collection, sand and gravel mining); increased flood vulnerability due to massive boulder extraction from river beds for dam construction and sudden water releases from reservoirs in the monsoons; dam safety and associated risks in this geologically fragile and seismically active region. The Brahmaputra valley, a thickly populated narrow strip of land with hills surrounding it, has awoken to the fact that it is going to be increasingly vulnerable to risks from existing and proposed large dams upstream. This realization has been significant for a civilisation whose cultural identity – customs, food habits, music, religious beliefs – is inextricably linked to its river systems.[9]

One of the key issues which have come up is the drastic daily variation in river flows which will take place after these dams are commissioned, particularly in winter. For example, the average winter (lean season) flow in the Subansiri river in its natural state is approximately 400 cubic metres per second[10] (cumecs). Both the ecology of the downstream areas and people's use of the riverine tracts in winter is adapted to this 'lean' but relatively uniform flow of water on any particular day (even though there is a gradual variation through the season). *Chapories*, for example, which are exposed and drier in winter are used for both agriculture and cattle grazing purposes, by local communities, and simultaneously by wildlife. After the commissioning of the 2,000 MW Lower Subansiri project, flows in the Subansiri river in winter will fluctuate drastically on a daily basis from 6 cumecs for around 20 hours (when water is being stored behind the dam) to 2560 cumecs for around 4 hours when the water is released for power generation at the time of peak power demand in the evening hours. Thus the river will be starved for 20 hours and then flooded for 4 hours with flows fluctuating between 2 percent and 600 percent of normal flows on a daily basis.

The flow during peak load water releases in the Subansiri river in winter will be equivalent to average monsoon flows and will cause a

NEERAJ VAGHOLIKAR

The ecology of wetlands (beels) in the Brahmaputra valley is intricately connected with the rivers. Dam-induced changes will also impact the downstream wetlands and those whose livelihoods are dependent on these.

‘winter flood’ drowning on a daily basis drier riverine tracts used both by people and wildlife throughout winter. The downstream livelihoods and activities likely to be impacted by this unnatural flow fluctuation in the Eastern Himalayan rivers include: fishing, flood-recession agriculture (e.g. mustard), river transportation and livestock rearing in grasslands for dairy-based livelihoods. But downstream communities are yet to be officially acknowledged as project-affected persons due to upstream dams. Flow fluctuations in rivers such as Lohit, Dibang, Siang and Subansiri will seriously impact breeding grounds of critically endangered grassland birds such as the Bengal Florican, foraging areas of the endangered wild water buffalo, habitat of the endangered ganges river dolphin and important National Parks such as Dibru-Saikhowa and Kaziranga. The natural flow pattern of a river is like its ‘heart beat’ and alternate starving and flooding of these major rivers on a daily basis is a threat to the ecological and social security of the Brahmaputra floodplains.

Assam has seen serious concern raised by a wide sector of civil society groups (e.g. mass movements and major students unions) on the downstream concerns vis-à-vis the spate of mega dams planned in Arunachal Pradesh. A major focus of conflict has been the 2,000 MW Lower Subansiri project, under construction on the Assam-Arunachal Pradesh border. Downstream agitations by local movements and the All Assam Students Union (AASU) led to the setting up of an interdisciplinary expert committee[11] to study the downstream impacts of the project. Interim recommendations were made by this committee in February 2009 to stop work pending completion of the report. But they were ignored by the power company and both the State and Central governments. In their final report submitted in June 2010 this committee has recommended that: *“…The selected site for the mega dam of the present dimension was not appropriate in such a geologically and seismologically sensitive location…Therefore, it is recommended not to construct the mega dam in the present site…”*

Following a major debate in the Assam Legislative Assembly in July 2009, a House Committee was set-up to look at the impacts of dams on downstream Assam. The committee, in its July 2010 report, has categorically endorsed the Expert Committee recommendations raising concerns about the Lower Subansiri project. On August 12th, the Rajya Sabha (Upper House of Parliament) saw a lively discussion on the issue in response to a calling attention motion by a Member of Parliament from Assam, Birendra Prasad Baishya. On September 10th, the Union Environment Minister, Jairam Ramesh, held a public consultation on the issue in Guwahati as a follow-up to a meeting, with a delegation led by the Krishak Mukti Sangram Samiti, a major peasants’ movement in Assam in August 2010. Along with the Brahmaputra valley in Assam, downstream impact debates have also raged in Manipur and in southern Assam, in the Barak Valley, downstream of the proposed 1500 MW Tipaimukh dam. A long battle fought by those affected by the Mapithel dam in Manipur in the Thoubal river basin has forced the state government to conduct a review of the impacts of the project, including in the downstream areas.

While media reports seem to indicate that the Union Environment Minister has communicated to the Prime Minister the concerns raised in the September 10th public consultation in Guwahati, we need to wait and watch whether the Centre responds adequately to the serious concerns raised in the downstream areas of proposed projects. However, the experience of decision-making until now makes one thing amply clear: the Central Government has been in denial of a basic fact of nature - that a river flows downstream. This is evident from the Terms of Reference (ToR) for Environment Impact Assessment (EIA) studies granted by the MoEF for at least 50 large hydroelectric projects in Arunachal Pradesh from September 2006 to August 2010. In most cases the ‘baseline data’ is restricted to only 10 km. downstream of the project and the actual ‘impact prediction’ has been asked to be restricted to an even shorter distance downstream-only between the dam and powerhouse! There is only one aspect which is mandatory to be studied beyond 10 km downstream in all cases; this is the ‘dam-break analysis’ which predicts the effects of flooding downstream, in case the dam actually breaks. But dam-break is not the only downstream risk a dam poses, as indicated earlier. Unfortunately, most detailed downstream studies are only prescribed as post-clearance studies as has been done in the environmental clearance granted to the 1,500 MW Tipaimukh Multipurpose project in October 2008 and to the 1,750 MW Demwe Lower project on the Lohit river in February 2010. This clearly indicates that the projects are being treated as a *fait accompli* and the clearance processes as a formality. It was only recently that the MoEF for the first time prescribed partial downstream impact studies for a few projects before grant of clearance (e.g. 3,000 MW Dibang Multipurpose project and 2,700 Lower Siang). But the ToRs in these cases, too, do not ask for comprehensive downstream studies, which should have been the case.

PMSBV

Local movements make their presence felt at a rally downstream of the under-construction 2,000 MW Lower Subansiri hydroelectric project organised by the Mising Students Union and the Krishak Mukti Sangram Samiti.

DAMS AND FLOODS

By Himanshu Thakkar

A perception carefully built and nurtured by the proponents of big dams is that dams control or help moderate floods. In theory, it sounds possible. However, in practice, that perception won't stand up to scrutiny if actual experience with dams is objectively assessed.

People of Assam have been raising concerns about dam-induced floods in downstream areas due to hydropower projects like Ranganadi, Umtru, Karbi-Langpi, Kopili, and Kurichu. While the technocracy keeps disputing the on-ground experience of people, it might help here to recount some of the instances of dam-induced floods across the country.

In August 2006, Surat city on Tapi River in South Gujarat experienced the worst floods in its history due to a sudden release of 7 to 10 lakh cusecs (cubic feet per second) of water from the upstream Ukai dam. At least 150 people were killed, 80% of the city was under water, and over 20 lakh people were trapped inside the flooded city without drinking water, milk, electricity or communication for four days and nights. This disaster could have been avoided if the Ukai dam had adhered to the dam operating rules properly, keeping in mind upstream and downstream rains and short-term forecasts, as well as the capacity of the downstream river channel and the timing of the high tides.

The Ukai Dam story was repeated in many river basins across India in 2006, including the Mahi, Sabarmati, Chambal, Narmada, Krishna, Godavari and Mahanadi basins. A sudden high release of water from dams (many of them having high pre-monsoon storages) was the prime reason for flood damages in these basins. Each dam has specific operation rules. For example, lowering pre-monsoon water storages to reduce downstream flood risk in monsoons, is often a mandatory requirement. Many instances of dam-induced floods are due to mismanagement of dams by faulty operations, while lack of proper operation rules is also a reason in other cases. An overall lack of transparency and accountability in dam operation in the country is an important contributing factor to such disasters.

The floods of 2006 were in no way unique. Similar instances include: Mahanadi floods in Orissa in September 2008 due to faulty operation of the Hirakud dam, floods in the Damodar basin in 2009, floods in Punjab in 1988 (and also in 2010) due to sudden releases from the Bhakra and Pong dams, floods in the Krishna basin in late September-early October in 2009 due to faulty operation of the Upper Krishna, Tungabhadra, Srisailam and Nagarjunsagar dams, floods in the Bhagirathi and Ganga river basin due to faulty operation of the Tehri Dam in Sept 2010. Over the years, India has experienced escalating flood damages despite the fact that the total area supposedly protected by flood-control engineering projects has grown.

It is often claimed by the government that India's 5,000 plus large dams bring flood control benefits, yet all too often the results have been increased flood damages, usually because of mismanagement. The National Commission on Floods, set up by the Central Government, noted in 1980: "Most of the reservoirs completed in the country do not have any specific operation schedules for moderation of floods." In the Ganga basin, the Kangsabati dam is supposed to reserve more than a quarter of its reservoir for flood storage, yet the report says, "The Kangsabati reservoir has no operation rules drawn up so far, nor have the moderation benefits been evaluated." A working group report of the Planning Commission for the 11th Five year Plan and the Maharashtra government report after the 2006 floods corroborate such observations. Some changes brought about in the functioning of the Ukai dam after the 2006 disaster also indirectly admits that the dam was mismanaged in 2006. However, no accountability has been fixed on dam operators in any of these instances.

The Way Forward: A comprehensive flood-management program should revolve around improving and disseminating flood-forecasting, flood-coping mechanisms and flood-preparedness. Some key areas that must be addressed include sustaining and improving the natural systems' ability to absorb floodwaters; improving dam management (in existing projects), and instituting clearly defined and transparent operating rules that are stringently enforced; improving the maintenance of existing flood-control infrastructure rather than spending money on new dams and embankments; undertaking a credible performance appraisal of existing infrastructure in a participatory way, removing dams and embankments that are found to be ineffective; and producing transparent disaster management plans to be implemented in a participatory way. Most importantly, India needs to assess the potential impacts of climate change on rainfall and on the performance of flood-control infrastructure, to begin planning for the crucial adaptation to changing climate.

In the Northeast, even as per official plans, most projects do not have an explicit flood moderation component, thus there being no question of these being able to effectively moderate floods. Out of the 130 plus hydropower agreements signed in

The Hydropower-Climate Change Nexus: Myth, Science and Risk for Northeast India

By Partha J. Das

INTRODUCTION

The scientific evidence that the Himalayan region is being impacted by climate change is growing, with serious ramifications for Himalayan river basins and the Indian subcontinent. Studies show that hydrological characteristics such as discharge pattern, sediment load, snowmelt run off and intensity and frequency of flooding in Himalayan Rivers are changing due to climate change. The Brahmaputra river basin is particularly sensitive to climate change impacts, implying changes in volume of water, sediment and biogeochemical processes.

One reason cited by promoters of hydropower development in developing countries is that energy from hydropower is "clean" because, unlike thermal energy, its production does not generate green house gases (GHG). Therefore it is suggested that by investing in hydro, developing countries like China and India that emit large amounts of GHGs can reduce or slow the growth of their carbon emissions and contribute to mitigating climate change. However, recent research has generated enough information to question this assumption.

Since dams are designed around known characteristics of rivers and local geology, it is natural that changes in the hydrological regime triggered by climate change will affect the existence, operation and management of these projects considerably. However this aspect is usually ignored by agencies executing projects, making it difficult for disaster management agencies as well as communities to anticipate and prepare for possible hazards like flash floods. Experts acknowledge that the present knowledge base about hydrology, climate, ecology and geology of the Himalayan region is inadequate to support large-scale interventions on the Himalayan rivers. Climate change introduces an additional layer of uncertainty to this evolving knowledge base.

As a result, the present development paradigm that envisages a massive expansion in large dams in the northeast, is full of risk[1]. In the sections ahead we discuss how the myth of green hydropower is being

DEBOJIT BORUAH/GREEN HERITAGE

The June 14, 2008 floods in the Lakhimpur district of Assam were aggravated by sudden releases from the 405 MW Ranganadi hydroelectric project.

Arunachal Pradesh, only one project on the Dibang river is officially a 'multipurpose' project. Major hydropower projects in the lower reaches of several rivers such as the Siang, Lohit and Subansiri are not multipurpose projects and have negligible flood moderation components, even as per the admission of project authorities. More importantly, many of the dam-induced floods occurrences across the country, highlighted earlier, have been from dams with explicit flood moderation components such Ukai, Damodar, Bhakra and Hirakud.

In conclusion, there is mounting evidence that structural measures have been largely ineffective in controlling floods and have worsened flooding in many parts of the country. Yet the State and Central Governments' in India – with support by international agencies like the World Bank, the Asian Development Bank and the Japanese Bank for International Cooperation – are pushing for more, not fewer, of the same structural solutions. The opportunity provided by the report of the World Commission on Dams on reviewing, planning and decision-making frameworks for large dams appears to have been completely lost on India's water managers. Affected local communities, however, are fighting against such faulty measures at a number of places.

Himanshu Thakkar is the Coordinator of South Asia Network on Dams, Rivers & People. For more information on Dams & Floods across the country visit www.sandrp.in

CUMULATIVE IMPACTS OF DAMS, CARRYING CAPACITY OF RIVER BASINS

With multiple dams in each river basin, the issue of cumulative impacts of dams has become a crucial issue. The late Nari Rustomji, who served as Assam's Chief Secretary and Dewan of Sikkim had, through his writings, warned that development inputs into Sikkim needed to be within the absorptive capacity of the region. In 1998, the Expert Appraisal Committee (EAC) on River Valley and Hydroelectric projects, appointed by the MoEF, noted Rustomji's observations while examining a proposal for environmental clearance for the 510 MW Teesta V hydroelectric project in Sikkim. Since this was one of the multiple large hydroelectric works in the ecologically and culturally sensitive Teesta river basin, the committee recommended a detailed study on the 'carrying capacity' of the river basin before taking a decision. But the MoEF granted clearance to the project without such a study being completed in advance. However, one of the conditions for clearance to the project was that "no other project in Sikkim will be considered for environmental clearance till the carrying capacity study is completed."

In spite of this self-imposed condition the MoEF subsequently granted environmental clearance to at least seven new hydroelectric projects before the carrying capacity study was finally completed in early 2008. The ministry has thus violated its own mandatory condition. Sikkimese civil society groups such as the Affected Citizens of Teesta (ACT) are disappointed that a golden opportunity has been lost. There was hope that the carrying capacity study process would enable a comprehensive assessment of cumulative impacts of the many proposed hydroelectric projects and a serious options-assessment for ecologically and culturally sensitive development in the Teesta river

disproved and a body of evidence is being built up to counter the prevailing view. We also try to explain the implications of climate change for hydropower projects and consequences for people with respect to the Northeastern region, the Brahmaputra river basin in particular.

HYDROPOWER GENERATION AGGRAVATES GLOBAL WARMING AND CLIMATE CHANGE

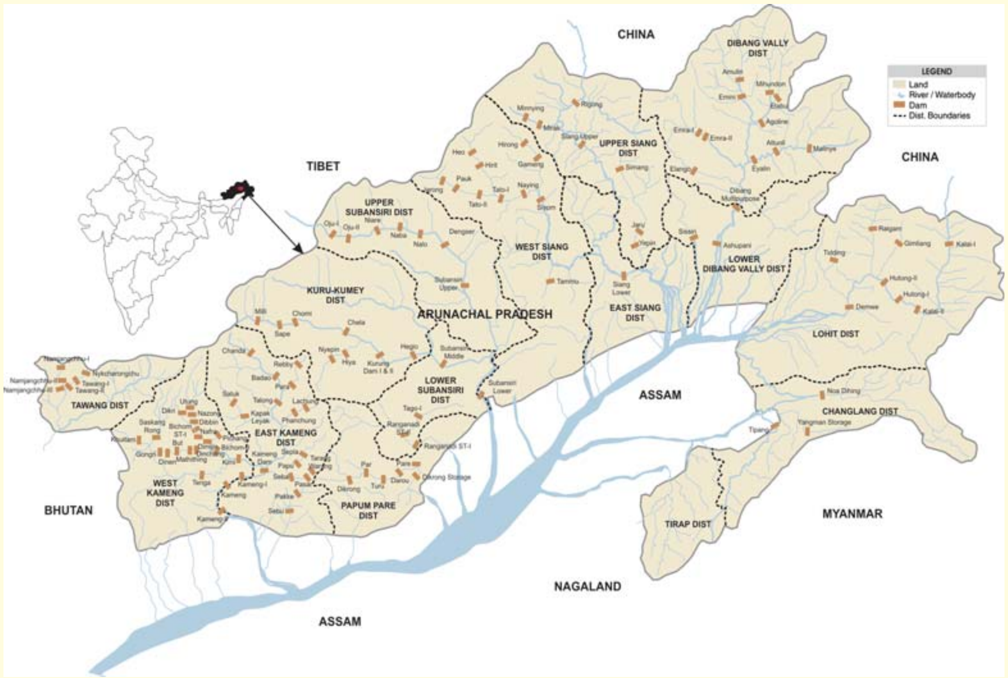
Scientific evidence of greenhouse gas emissions (like methane, carbon dioxide and nitrous oxide) from the reservoirs of hydroelectric projects has been emerging since the 1990s[2]. However, the climate-benign nature of hydropower was strongly questioned for the first time by the World Commission on Dams (WCD)[3]. It was known by the year 2000 that globally 70 million tonnes of methane and a billion tonnes of carbon dioxide were emitted annually from reservoir surfaces. A recent study carried out by Brazil's National Institute for Space Research estimates that the large dams of the world emit 104 million tonnes of methane annually from reservoir surfaces, turbines, spillways and downstream river courses[4]. Greenhouse gases like methane and carbon dioxide are produced in reservoirs due to rotting organic matter (vegetation) and carbon inflows from the catchment[5]. Large dams of the world contribute about four percent of the total warming impact of human activities and they could actually be the single largest source of anthropogenic methane emissions, accounting for about a quarter of the total methane emissions from the earth's surface[6]. Tropical shallow reservoirs where the natural carbon cycle is most productive are the highest emitters of methane, while deep water reservoirs exhibit lower emissions. Dams in Brazil and India are responsible for a fifth of these countries' total global warming impact, although these sources of emissions are not considered in the national greenhouse inventories.

According to the Inter Governmental Panel on Climate Change (IPCC) these revelations have challenged the conventional wisdom that hydropower produces only positive atmospheric effects (e.g., reductions in emissions of carbon dioxide and nitrous oxides), when compared with conventional power generation sources[7]. Taking cognizance of the GHG emissions from hydropower projects, the executive board of the United Nations Framework Convention for Climate Change (UNFCCC) has excluded large hydro projects with significant water storage from its Clean Development Mechanism (CDM)[8] programme. That means hydroelectric projects with big storage dams are not considered as climate-friendly and therefore are not accepted as desired alternatives for climate change mitigation or adaptation. The IPCC has recommended estimation of methane emissions from large dams and evaluation of the net effect on the carbon budget in the regions affected by large dams. A recent study by Swiss scientists, released in October 2010, reveals that substantial amounts of the greenhouse gas methane are released not only from large tropical reservoirs but also from run-of-the-river (RoR) reservoirs, especially in the summer, when water temperatures are higher. This finding disputes the existing belief that RoR projects with smaller reservoirs, particularly in temperate regions, are a climate-neutral way of generating electricity[9].

basin. But the MoEF has continued granting clearance to one project after another without seriously examining the issue in a holistic manner as per its own mandated condition. After completion of the study in 2008, however, the MoEF had declared certain areas in North Sikkim in the Teesta river basin as 'no-go' areas for dams. But this condition too has been recommended for dilution by the EAC in early 2010, threatening to open up the last free-flowing stretches of the Teesta in Sikkim for more dams.

In fact, the National Environmental Appellate Authority (NEAA)[12], a special environmental court, in an April 2007 order has also observed that it feels the need for "advance cumulative study of series of different dams coming on any river so as to assess the optimum capacity of the water resource giving due consideration to the requirement of the Human beings, Cattle, Ecology/ Environment etc." However, this order has been repeatedly violated by the MoEF. Even though river basin-level studies have been prescribed for some river basins such as the Bichom and Lohit in Arunachal Pradesh, these have been de-linked from clearances to be granted to individual projects. Therefore, project clearance can continue business as usual, without completion of cumulative studies, making it a cosmetic exercise.

In December 2008, the Standing Committee of the National Board for Wildlife (NBWL) has relaxed a condition restricting the construction of dams in the upstream areas of the Subansiri river, imposed earlier while granting clearance in May 2003 to the 2,000 MW Lower Subansiri hydroelectric project coming up on the Arunachal Pradesh-Assam border. This relaxation has happened without consultations in Assam, located downstream,



MAP NOT TO SCALE / SANCTUARY ASIA. ADAPTED FROM MAP OF THE DEPARTMENT OF HYDROPOWER, ARUNACHAL PRADESH.

The cumulative social and environmental impacts of over 130 hydropower projects proposed in Arunachal Pradesh has been a matter of intense debate in the state and in downstream Assam.

Contrary to the scientific evidence, project proponents have been rhetorically promoting hydropower as clean and green to outweigh its other known detrimental impacts. It is important to analyse the facts emerging from recent scientific research to counter this misinformation.

ARE HYDRO-PROJECTS SUSTAINABLE UNDER CLIMATE CHANGE?

Climate change is likely to cause such changes in local and regional weather and climate patterns that would jeopardise dam operations and trigger more complex and intensive impacts downstream. It has been projected that Himalayan river basins like that of the Brahmaputra river may experience increased summer flows and more flooding for a few decades initially, due to rapid melting of Himalayan and Trans-Himalayan snow and glaciers. In the long run however, they will face scarcity of water as a result of progressive reduction of flow as the river-feeding glaciers recede and disappear from the headstreams[10]. In fact, the Upper Brahmaputra river basin has already lost roughly 20% of its water reserves bound in glaciers during the thirty years between 1970 and 2000, which is equivalent to the loss of 175 cubic km of glacier mass in that period and about 7 cubic km of glacial mass loss per year[11]. While such melting of glaciers leads to increased dry season run-off in the short term, in the long-term there could be a decline of dry season river run-off from glaciers, turning perennial rivers like the Brahmaputra into seasonal river systems[12]. Although there will be an initial increase in flow in the Brahmaputra basin due to accelerated glacial melt till about the fourth decade of this century and increase in mean rainfall over the upstream of Brahmaputra basin by about 25 per cent, the overall summer and late spring discharges are eventually expected to be reduced consistently and considerably, at least by 19.6% on an average during the years 2046 to 2065[13].

The planning of hydropower projects that are now operational or in different stages of implementation in the Northeast, have not incorporated any considerations for possible impacts of climate change on the rivers and the dams, either when the projects were being designed or when the EIA reports were being prepared. In the case of many of these dams, the meteorological and hydrological time series data of rainfall, extreme rainfall, water level and discharge used to design dams, is not adequate to be able to provide a reliable description of trends and periodicity of rainfall and river run-off. These trends become more uncertain in a changing climate scenario, resulting in large fluctuations in the normal inflows to the dams. Such a situation usually disrupts normal operations of the dams affecting power generation. IPCC predicts that extreme rainfall i.e. episodes of very high and/or very low rainfall are likely to increase in the Asian region in the coming decades[14]. In such a situation the dams will either underperform due to lack of adequate flow or will exacerbate flooding hazards triggered by excess flow. Therefore, to adapt climatically, such dams would need to be redesigned with inputs from high resolution regional climate models to generate reliable future climate scenarios for specific geographical areas of concern. This is not easy as of now, given the difficulty in developing reliable climate simulations at small spatial scales.

SINLUNG INDIGENOUS PEOPLES HUMAN RIGHTS ORGANISATION

A protest rally against multiple dams planned in the Sinlung hills of Mizoram was held in the state capital, Aizawl, on Sep 28, 2010.

RAJU MIMI

Downstream groups in Assam team up with their counterparts in Arunachal Pradesh to oppose a public hearing being held for the 3,000 MW Dibang Multipurpose project.

and ignoring a demand by some members of the committee to first get an understanding of the cumulative impacts of 22 large hydel projects which can potentially come up in the Subansiri river basin, once the restriction has been lifted. The Inter-Ministerial Group set-up to give recommendations for accelerating hydropower development in the Northeast has, in its 2010 report, specifically recommended that MoEF not hold up environmental clearances pending completion of cumulative impact assessment studies, thus rendering the entire exercise futile.

While the EAC in its September 2010 meeting has finally expressed an opinion that a cumulative downstream impact assessment does indeed require to be carried out in Assam to study the impacts of multiple projects in the Brahmaputra river basin, it is silent on the need to halt environmental clearances of individual projects until such a study is completed.

PEOPLE, DEVELOPMENT AND POWER

In the current situation it seems difficult to bring accountability back to the governance process on these mega-hydel projects in the Northeast, without addressing the arguments on development and power being used to ride roughshod over some of the country's most important ecological landscapes, and the livelihood rights of the people of the region.

The belief that each of these mega-power projects is crucial for India's energy security is a major reason for subversion of environmental and social issues. This myth needs to be busted. Girish Sant of Prayas Energy Group, a leading organisation working on public interest power sector issues, says: "Development needs increased energy services. But demand forecasts that planners make are usually an overestimate and there is a bias towards centralised large projects to meet this highly inflated demand. This is not the 'least-cost' way of getting the required

Due to impact of climate change, water stress will be felt more in winter, in general, which will be aggravated in weak monsoon years, thus significantly affecting agriculture, the principal livelihood of the people, and the overall economy of states like Assam, West Bengal, Sikkim and Arunachal Pradesh, the main Brahmaputra basin states in India. Further, changing temperatures and evaporation rates would alter soil moisture conditions and the amount of run-off from the catchments into reservoirs[15]. Given this scenario, it will become increasingly uncertain whether the required inflow of some rivers could be sustained to produce power efficiently, especially in the lean season in the future. This also brings into question the wisdom of investing thousands of crores of public money in such ventures, when there is so much uncertainty over the hydrological changes in the rivers in the region under a changing climate. A recent study of hydro-electric power generation conducted in the Zambezi Basin in Africa, taken in conjunction with projections of future run-off, indicates that hydropower generation would be negatively affected by climate change[16].

ARE DAMS' SAFEGUARDS AGAINST CLIMATIC UNCERTAINTY?

An argument made by promoters of large dams is that if precipitation and river flows are likely to become uncertain and vary widely due to climate change, then it is important to create large storage dams in upstream areas to make water supplies more certain. The faulty logic behind this argument is that more storage is necessary to hold additional water volume if river flow increases and also to hold the occasional peak flows, which can then be used to augment winter flow from the reservoirs. That this is an unsound argument is seen clearly when one considers the technical limitations and the very high financial stakes involved with building large storage dams in the Greater Himalayan region. Erratic increase in river flows will make it difficult to operate the dams under specific designed conditions and put the dams at high risk of flash floods due to Glacial Lake Outburst Flooding (GLOFs)[17] and cloud bursts[18]. On the other hand, big storage dams also become economically unviable if constructed only to store occasional high flows when average river run-off reduces because of retreat of glaciers and uncertain precipitation[19].

Adopting standards for evaluating the sustainability of hydropower projects under different climate change scenarios is prescribed as an important criterion for decision making in hydropower governance[20], which should be applied strictly to hydropower projects in the Himalayan region.

HYDRO-PROJECTS MORE HAZARDOUS DUE TO CLIMATE CHANGE

The frequency of heavy precipitation events has increased over most land areas, consistent with warming and observed increases of atmospheric water vapour. Intense rainfall events will become even more frequent in the future.[21] Dams are often seen to trigger flash floods in downstream areas. The potential of such dam-induced flash floods will increase due to climate change in the Northeastern region because of the projected intense as well as erratic rainfall and run-off in rivers. Since most of the hydropower plants in the region are run-

PRIVATE HYDROPOWER: PUBLIC RESOURCES, PRIVATE PROFITS

By Shripad Dharmadhikary, Manthan Adhyayan Kendra

A large number of the hydropower projects in the Northeast are now being handed over to the private sector. Privatised hydropower plants not only have all the problems associated with such projects, like displacement of people and environmental destruction, but also some other issues of great concern.

The most serious issue is that private hydropower projects are in effect handing over our common property and public resources of rivers and water to private companies for private profits. This is further facilitated by India's new Hydropower Policy (2008), the first stated aim of which is to induce private investment in hydropower. Together with the Central Electricity Regulatory Commission's tariff orders, it heaps a bonanza of concessions on the private companies. These include:

1. The determination of tariff by the 'cost-plus' approach instead of competitive bidding. This means that the tariff is set so that all the costs of the company are met and an assured profit is added to this. This pushes up the risk of cost padding (exaggeration of actual costs).
2. A 15.5% assured rate of return on equity (investment by owners), and provision for other bonuses.
3. Private companies are protected against major risks, the burden of which is passed on to the public at large. In particular, the projects are fully insulated from hydrological risks for the first 10 years – that is, they get paid for the full 'design energy' generation even when they can't generate this energy due to less water in the river. But when more energy is generated than the 'design energy' due to high water flows, the company gets to keep all the extra money.

Thus, private players can make assured and large profits with few risks. Meanwhile, this is likely to push up the cost of the power generated from the projects.

However, the real windfall begins for the companies once they recover all the costs. India's new hydropower policy allows developers to sell 40% of their saleable electricity on a merchant basis. Merchant sales, as opposed to a long-term Power Purchase Agreement (PPA), allow developers to sell power at higher prices in the open market.

In the case of hydropower projects, the main component of production costs is the cost of finance - repayment of borrowed capital - principal and interest (the full social and environmental costs are often externalised, and thus not paid for by the projects themselves). After 7-10 years, when full repayment of capital costs is complete, the cost of generating power can fall

services. With increasing conflicts over the siting of new power projects, we urgently need an alternative approach towards power sector planning – such as Integrated Resource Planning (IRP).[13] Such an approach can have substantial environmental and social benefits as energy services can be delivered with a sizeable reduction in the number of new power plants required by the country. IRP considers a mix of supply side and demand side solutions while giving equal importance to both. It includes a combination of cleaner centralised energies, decentralised renewable energies and efficiency improvements, which will together provide energy services at least cost. Several such alternative studies done across the country indicate that requirement of additional capacity for power generation can be reduced by as much as 50% of that reported in the official conventional plan." Such information could prove critical in the discourse on dams in the Northeast, where state governments like Sikkim, Arunachal Pradesh and Manipur keep expressing helplessness in response to community opposition to projects, citing the country's power needs as one of the major reasons to build these projects at any cost.

But a more fundamental concern within the region is the internal debate on whether this dams' juggernaut really means development for the region and whether free, prior and informed consent of the local indigenous people has been obtained before crafting these development policies. Over the past few years, as the region has witnessed major protests over the mushrooming of so many large dams, it has also had its share of supporters, not only within state governments, but also some land owners affected by projects who

of-the-river projects', having little or no capacity to hold excess flows (insignificant flood cushion), heavy rainfall in the upstream areas creates a situation where it is a normal practice to release the excess water to ensure the safety of the dam, thus resulting in flash floods downstream. While dam authorities argue that they are only releasing water coming from the upstream and not adding to the flood, the reality is that the manner in which the dam is operated and the pattern of water release can accentuate the impacts of flood in the downstream even if total volumes of flood waters may not vary significantly from a no-dam situation in a particular case.

Increase in intense rainfall events has accelerated the high rate of soil erosion and landslides in the Himalayas. Sliding land, rock, mud and snow masses often result in blocking river channels in steep Himalayan valleys. When these naturally dammed rivers are eventually breached under the growing pressure of water accumulating behind the newly-formed dam, it leads to an avalanche of water gushing down the hills and creating havoc as flash floods in downstream areas. Landslide dam outburst floods (LDOF), as this type of flooding is called, have been responsible for several large floods affecting northeast India. The 'Yigong flash floods' triggered by the collapse of a landslide-induced dam on the Yigongzangbu river - a large tributary of the Yarlung Zangbo (Tsangpo) - on June 10, 2000, caused havoc in the river Siang in the bordering areas of Arunachal and China with estimated property losses of not less than a billion rupees, 30 deaths, more than 100 people missing, and more than 50,000 rendered homeless in five districts of Arunachal Pradesh.[22] If there happens to

CLIMATE CHANGE IN THE HIMALAYAS AND ADJOINING REGIONS

Scientists have ascertained that average temperatures are rising across the Himalayan region and the Indian subcontinent. The mean air temperature of the Himalayan region rose on the average by about 1°C from the 1970s to the 1990s with sites at higher elevations warming the most[1]. This is about double the average warming of 0.6°C for the mid-latitudinal northern hemisphere over the same time period[2].

The Tibetan Region, through which the Brahmaputra flows on its way to India, has undergone considerable warming. In the period 1960-2000, the rate of warming in Tibet was 0.26°C per decade, which was higher than the global trend (0.03-0.06°C per decade), and the trend in other parts of China (0.04°C per decade)[3].

The mainstream of the Brahmaputra that is called Siang in Arunachal Pradesh is known as Yarlung Zangbo (Tsangpo) in Tibet. Chinese scientists have found that temperature is increasing even more alarmingly in the Yarlung Zangbo (upper Brahmaputra) river basin. In the period 1971-2003 warming over the Yarlung Zangbo basin was 0.30°C per decade[4], which is significantly higher than the rate of increase of the average annual temperature over India (0.22° C per decade)[5] in the same period. Considering the entire Brahmaputra basin there is a clear increasing trend in temperature at an average rate of 0.06°C per decade[6].

Mean annual precipitation decreased between the 1960s and the 1980s in the Yarlung Zangbo basin, but the same has been increasing since the 1980s. On an average, annual and seasonal precipitation has gone up in the upper Brahmaputra basin in the period 1960-2005, at the rate of 6.75 mm per decade[7].

As a result of increasing mean temperatures in the Himalayas, Tibet and the upper Brahmaputra basin, snow cover and glaciers are melting rapidly, bringing irreversible changes to the Himalayan Cryosphere[8] and rivers that are enriched by snowmelt. Himalayan glaciers have been sharply. However, in the open market, electricity can fetch a very high price. Thus, allowing a private company to sell power in the open market can lead to huge profits.

In the case of a public company, when the cost of generation goes down in later years, the result is a decrease in the pooled cost of electricity generation; it can then sell the power at lower tariffs. The benefit thus goes to the public at large. But in the case of a private developer, this benefit goes directly to shareholders.

The private companies are also none better at responding to the social and environmental issues than the public companies. This is clearly shown in the case of the 400 MW Maheshwar Hydropower project on the Narmada, promoted by the S.Kumar's group, where the environmental and rehabilitation conditions have been blatantly and repeatedly violated, and the MoEF has had to call for suspension of work.

Private companies are also non-transparent, hiding behind the excuse of commercial confidentiality. However, in recent times, State Governments have preferred signing agreements with the private sector for large hydropower projects as they provide greater flexibility in negotiating financially lucrative deals as compared to Central PSUs.

look forward to financial compensation. As big business houses get ready to invest thousands of crores in these hydropower projects, sharp internal conflicts are increasing. Historian, Dr. Arupjyoti Saikia, says: "The State Governments' and a few others are indeed supporting these proposed investments. But the region's historical experience of exploitation of natural resources like land and oil, has led to apprehensions amongst a large section of people about the possible detrimental role of this capital - in the form of 'hydro dollars' as it has often been described by its votaries - towards the larger well being of the region. Civil society has pointed out that the colonial capital inflow into the region in the form of tea-plantations could hardly generate enough economic space where the local people could have participated, besides locking off huge land resources out of their reach. The same

AFFECTED CITIZENS OF TEESTA

The Affected Citizens of Teesta stage a protest in New Delhi in December 2007 during their marathon satyagraha against the dams juggernaut in Sikkim.

found to be in a state of general retreat since the year 1850[9], consistent with the general warming trend of the earth since the industrial-era began.

Several rivers in Northeast India, including the Brahmaputra (Yarlung Zangbo), and its tributaries like the Subansiri (Loro Chu), the Manas, and the Jia Bharali (Kameng), are fed by meltwater from snow and glaciers in the Tibetan and Himalayan region. 12.3 percent of the Brahmaputra is glacial meltwater[10]. Glaciers in the Bhutan Himalayas are now retreating at an average rate of 30-40 m per year[11]. In the past 40 years or more, glacial area in the entire Tibetan Plateau has shrunk by more than 6,606 sq km, with the retreat being higher since the mid-1980s[12].

The temperature of the Qinghai-Tibet Plateau is expected to rise by 2.5°C by the year 2050, resulting in thinning of glaciers and increased meltwater initially, but culminating in large-scale shrinkage of glaciers, reduction in meltwater, and eventual disappearance of glaciers[13]. Similarly, over Northeast India, annual mean maximum temperatures are rising at a rate of 0.11°C per decade, while the annual mean temperatures are also increasing at a rate of 0.04°C per decade[14].

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ENVIRONMENTAL VIOLATIONS

Hydropower projects are granted environmental, forest and wildlife clearances with several conditions imposed on them to supposedly reduce the environmental and social impacts of these projects. However, a look at some of the mega-hydropower projects either under construction or recently completed in the Northeast, shows a rather poor scenario vis-à-vis compliance.

The 510 MW Teesta V hydroelectric project in Sikkim, commissioned in 2008, has often been touted as being an environmentally benign RoR project (see box on RoR projects). However, the project was embroiled in an enviro-legal battle due to indiscriminate dumping of muck and debris in the Teesta river in violation of environmental laws. In an affidavit submitted to the Supreme Court appointed Central Empowered Committee in 2007, the Sikkim Chief Secretary admitted that the power company has *"grossly violated the terms, conditions and guidelines"* imposed by the MoEF and has deliberately dumped excavated material generated from extensive tunneling work *"into the river Teesta obstructing its free flow causing thereby huge damage to the forest and environment."* The Comptroller and Auditor General (CAG) of India in a 2008-9 report on Sikkim note about the same project: *"Spoils were thrown along the river banks raising the river bed of the Teesta leading to change in the flood behaviour of the river, acceleration of toe erosion and degradation of the overall geo-environmental setting of the area."*

The under-construction 600 MW Kameng hydroelectric project has made changes in the locations of the Bichom and Tenga dams and the Kimi powerhouse after getting initial clearances[1]. No fresh environmental and forest clearances have been sought by the project, although it is mandatory as per law to do so.

Several violations of environment and forest laws, as well as Supreme Court orders, have repeatedly been reported in the past few years in the 2,000 MW Lower Subansiri hydroelectric project. For example, conditions imposed by the Supreme Court in April 2004 include:

"(ix) The NHPC will also ensure that there is no siltation down the Subansiri river during the construction phase..."

"(x) Under no circumstances, the excavated material will be dumped either in the river or any other part of the National Park/Sanctuary or the surrounding forests...."

In spite of these conditions, there has been indiscriminate dumping of muck and debris in the river, repeatedly recorded since 2004. This is a clear violation of Supreme Court orders, but work has been allowed to continue business-as-usual. More recently, in September 2010, Assam-based groups have written to the Environment Minister about other serious violations in the project. There have been major changes in the design of the project (e.g. change of underground powerhouse to surface powerhouse, reduction in depth of foundation from 17 metres to 9 metres), yet the project authority has not sought fresh environmental clearances as required by law. No action has been taken by MoEF as of the first week of November 2010 on this issue.

In the 1750 MW Demwe Lower project in Arunachal Pradesh, forest land has been illegally used for road construction and labour colonies before forest clearance has been obtained.

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[1] Kalpavriksh case study on 'Compliance and monitoring of environmental clearance conditions of the Kameng hydroelectric project', Arunachal Pradesh (2008). This has also been reported in the CAG report of 2009 on implementation of 10th Five Year Plan power projects in the Northeast and East by NEEPCO and NHPC.

MANJU MENON

Illegal dumping of muck and debris in the Teesta river during the construction of the now commissioned 510 MW Teesta V project in Sikkim.

be a man-made dam on the river further downstream of such a bursting natural dam, the severity of damage could be many times higher because of a dam break or the release of excess water from the dam (a standard practice when the storage capacity is exceeded due to excessive inflows). This would be true for both storage and run-of-the-river projects.

The massive floods in western Assam in 2004, that were caused by water released from the Kurichhu Hydropower Plant (60 MW) in Bhutan on the Kurichhu river, were in fact triggered by the bursting of a landslide dam formed on September 10, 2003, on the Tsatischhu river, a north–easterly flowing tributary of the Kurichhu River (itself a tributary of the Manas river that flows through western Assam). Failure of the landslide dam on July 10, 2004, released a flood wave that had a peak discharge of 5900 cubic meter per second at the Kurichhu Hydropower Plant 35 km downstream[23]. Allowed to pass through the spillways of the dam, the flood waters reached the rivers Manas, Beki and Hakuwa and caused devastation in Barpeta district of Assam. Part of the flooding in the years 2007 and 2008 in western Assam were also attributed to releases from the Kurichhu dam.

Many of the rapidly retreating glaciers in the Himalayas have shrinking snouts, that leave glacial lakes behind, allowing water to accumulate rapidly as snow and ice melts faster. Sudden discharge of large volumes of water and debris from these lakes causes glacial lake outburst floods (GLOFs) in valleys downstream.

There are many glacial lakes in the Brahmaputra basin in Tibet and some of these have the potential to cause GLOFs and create flood havoc in downstream areas in Arunachal Pradesh and Assam. Some of the Himalayan tributaries of the Brahmaputra such as the Manas, the Sankosh originating in Bhutan and the Teesta passing through Sikkim also have potentially dangerous lakes in their catchments that could cause flood disaster in Assam, in the northern part of West Bengal, and in Sikkim respectively. Large dams are being implemented or planned on all these GLOF prone rivers by Governments of India and Bhutan. The Mangdechhu hydroelectric Project (720 MW) proposed to be constructed with help from India on the Mangdechhu, a tributary of the Manas river[24], is prone to be affected by GLOFs since the headstream region of the river adjoins expanding glacial lakes. The three hydro projects planned on the Sankosh river (Punatsangchhu in Bhutan), viz. the Punatsangchhu hydroelectric Project Stage-I (1200 MW) and Stage-II (990 MW), and the Sankosh Multipurpose Storage Project (4060 MW), may be a cause of aggravated flood hazards in future (both in Bhutan and Assam), as the upper reaches of one of its tributaries, the Pho Chhu in Northeast Bhutan, is severely GLOF- affected.

ALTERNATIVES TO LARGE HYDROPOWER DAMS IN A CHANGING CLIMATE[25]

There are two options to reduce the risk caused by large hydropower dams in an era of climate change impacts. The first is not to go for any large dams in the Himalayan landscape and alternatively promote micro, mini and small hydropower on a case-to-case basis. Such projects would have minimum structural interventions on the river systems, be congenial for the environment, appears to be now being done with the region's water. The compelling argument being made is that the sudden rush of capital for multiple mega hydropower projects is another attempt to siphon off resources from the region which itself has a small power demand. There appears to be some truth in this."

An important element of protests in the region has been the strong involvement of youth from the Northeast. These young people certainly want development and economic progress, but they oppose the kind of development they feel will destroy their cultural and natural heritage. Tone Mickrow, a young leader from Arunachal Pradesh, is the General Secretary of the Idu Mishmi Cultural and Literary Society, the apex body of the Idu Mishmi community. He says, "Can the Dibang Valley absorb this kind of mega development? We need power, but these mega dams are not the development we want locally. We cannot allow such massive destruction of our rivers and submergence of our lands, which are intricately connected with our identity. Development activities need to keep in mind the absorption capacity of the region. We would rather go in for a few micro, mini and small hydropower projects after careful scrutiny and full public consent on a case-to-case basis. Such projects would be relatively benign – they will involve small dams on some of the tributaries, minor influx of outside labour and will be finished in short periods. This can help us set-up small-scale enterprises, for example horticulture-processing based, giving an impetus to the local economy and providing local employment."

A banner of the Affected Citizens of Teesta (ACT) during its 900 day *satyagraha* in 2007-9 against the rush of dams in Sikkim read: "Meaningful development, not destructive development." But will the political economy of large-dam building allow for processes to take the genuine consent of local communities and debate various options for local development? The current experience is discouraging. The Idu Mishmi community has blocked the public hearing for the 3,000 MW Dibang Multipurpose project no less than 10 times because they have no faith in this process, as a democratic space. Their concerns appear valid as the government has already accepted 150 crores rupees as an upfront premium from the project developers and the foundation stone for the project has been laid – before public consultation processes being complete and before mandatory clearances being granted. Despite widespread protests in downstream Assam, no downstream public consultation has been held to date while taking decisions on upstream projects.

Where do we go from here? There are several areas of action which need immediate attention, but the seriousness of the situation demands that there is a moratorium on dams in the region till fundamental issues are sorted out. These include:

Ensuring transparency and accountability in decision-making and governance processes related to these dams at all levels – whether related to signing MoUs, conducting impact assessment studies or addressing trans-national issues in these river basins; building in mechanisms to get the free, prior and informed consent of local indigenous communities; learning lessons from old projects in the region such as Ranganadi, Gumti and Loktak; alternative power planning approaches at the national level; planning for genuine options-assessment and appropriate development in the ecologically and geologically fragile, seismically active, politically and culturally sensitive river basins of the Northeast.

But progress on these fronts will not be possible without a widespread political debate on these issues within the region. As Akhil

and enable communities to fulfil genuine power requirements. This could be accompanied by an earnest exploration of alternative sources of new and renewable energy such as solar, wind, geothermal and biomass. These aspects have never been seriously assessed in the Northeastern region.

The second option is to develop hydropower technologies that will not need construction of large dams and will absorb the climatic uncertainty and associated downstream impacts as well. However, given that no such technologies appear to be on the horizon, this option appears very remote in the immediate future.

KHARCHOONG DIYALI

The Khangchendzonga landscape in the Eastern Himalayas in Sikkim is likely to face the brunt of climate change. Major hydropower development is planned in the region.

No policy instrument in India addresses (even partially) the uncertainties of impacts of large dams under climate change. Conventional disaster risk reduction programmes in downstream areas are pitifully inadequate to offset the negative impacts of large dams. The true cost of mitigating the climate-change-induced risks of large dams will be several times higher compared to the investment in the hydro projects themselves. On the other hand, the success of making the projects 'climate proof' will be inversely proportional to the scale and intensity of dam building, given the emissions from large dam environs and the compounding uncertainty of risk due to dams.

Perhaps there is no middle path to walk here. It will not be possible to create a win-win situation in a business-as-usual scenario involving construction of more and more large hydropower projects in the Northeast. Large

CONTESTED WATERS

On August 12, 2010, an hour long debate took place in the Rajya Sabha on the downstream impacts of dams in the Northeast. The Environment Minister, Jairam Ramesh, admitted that environmental decision-making on dams in the region has indeed been insensitive until now and promised reform. But he also made a pitch for dams on the Siang[1] in Arunachal Pradesh for strategic reasons, to supposedly strengthen India's position in future negotiations with China on the Brahmaputra waters. While India and China have an Expert Level Mechanism (ELM) on transboundary rivers since 2007 to share river flow data and discuss issues, there is no specific treaty on the Brahmaputra waters. The argument being made by some is that if we build dams on the Siang we can establish our 'user rights' over the river. The water resources technocracy in the country has also argued that to safeguard against the impact of possible reduced flows, due to any proposed diversion of the Brahmaputra waters by the Chinese, we build large storage reservoirs in upper reaches of major rivers in the Brahmaputra river basin such as the Subansiri, the Siang and the Lohit to store monsoon waters.

Responding to the Environment Minister's arguments, Itanagar-based civil society organisation, Arunachal Citizens Right (ACR), issued a public statement in August 2010. Citing ongoing protests against large dams by communities in the state, ACR argued that making these large dams a fait accompli is "an affront to the people of Arunachal Pradesh who remain pawns in the larger energy security policy of the Government and now in the geo-political relations between India and China, all without their consent." Protesting being made "sacrificial lambs and guinea-pigs", they argued that: "…India should immediately explore the possibility of a joint discussion with China on the issue of riparian rights and water sharing of rivers which flow through both the countries. On the issue of riparian rights the people of Arunachal Pradesh will definitely stand by Government of India's position on downstream impacts of diversion of river water flow in the upstream of a river basin. But, that would mean that Government of India should also recognize the legitimate concerns over downstream impacts of dams in Arunachal Pradesh voiced by the people of Assam and within Arunachal itself."

While it is true that getting China to listen to our perspective on the Brahmaputra may not necessarily be easy, New Delhi needs to exhaust all dialogue options, rather than getting into a race with our neighbour and build unjustifiable mega dams which will undermine the social and environmental security of the current and future generations of the Northeast. It clearly seems to be an outdated notion to view 'user rights' only in terms of uses created through dams and hydropower. Especially these days, when traditional uses of water and ecosystem services (benefits provided by nature to society, including in economic terms) are increasingly being recognised around the world. It cannot be forgotten that the Brahmaputra has nourished an entire civilisation. A memorandum against Brahmaputra dams, sent by 50 Northeastern civil society groups to the Chinese and Indian governments' in September 2010, has argued that those living along the rivers are the first users, defenders and protectors of this riverine ecosystem.

It also needs to be understood that, in practice, the term 'user rights' can at best mean establishing a certain kind of use of the river which may help in future negotiations with China on a Brahmaputra-specific agreement or treaty. It is not a legally enforceable right as per international law as is being claimed in certain arguments, but a possible bargaining tool. It could have been legally enforceable only if there was a specific bilateral or multilateral treaty on the Brahmaputra waters to which both India and China are signatories. This is not the case until now. It may also be noted that the United Nations 'Convention on the Law of the Non-Navigational Uses of International Watercourses' was adopted in 1997, but is yet to be ratified. During voting, China opposed the convention and India abstained from voting, which is an indicator of the level of legitimacy the two countries give to this international convention. It also needs to be understood that the UN Convention, when ratified, will at best be a form of 'soft law'. Soft law is not enforceable in courts or tribunals but may help in the interpretation of existing principles of international law.

The way forward should be to proactively engage China on a one-on-one dialogue on the Brahmaputra within a framework which seeks to

dams invariably enhance people's vulnerability and risk in a changing climate. Given the scientific evidences of large dams contributing to global warming as well as becoming potential sources of risk due to climate change, it has become imperative to do proper risk assessment in a holistic sense for each of the proposed or ongoing projects and for every river basin in which multiple projects are being planned. The prevailing development paradigm pegged on large interventions on natural systems generates considerable risk along with the resources such as hydropower it creates. The blue print for developing hydropower by building multiple large dams on the region's rivers will increase the risks manifold and is certainly not the answer to provide climate security to the people of Northeast India.

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[1] Risk: A risk is the association of the probability of occurrence of a hazard or disaster with the (economic and financial) losses it would imply. Risk can be defined as RISK = HAZARD x VULNERABILITY/CAPACITY, where a 'Hazard' can be defined as a potentially damaging physical event, phenomenon or human activity that may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation; a 'Disaster' is a serious disruption of the functioning of a community or a society causing widespread human, material, economic or environmental losses which exceed the ability of the affected community or society to cope with the consequences using its own resources; 'Vulnerability' refers to a set of conditions and processes resulting from physical, social, economical and environmental factors, which increase the susceptibility of a community to the impact of hazards; 'Capacity' is a combination of all the strengths and resources available within a community, society or organization that can reduce the level of risk, or the effects of a disaster.

[2] Rudd, J. W. M.; Harris, R.; Kelly, C. A. and Hecky, R. E. (1993). 'Are hydroelectric reservoirs significant sources of greenhouse gases?' *Ambio* 22:246-248.

[3] WCD (2000). *Dams and Development: A New Framework for Decision Making*. Report of the World Commission on Dams. Earthscan, London.

[4] Lima, I. B. T.; Ramos, F. M.; Bambace, L. A. W. and Rosa, R. R. (2007). Methane Emissions from Large Dams as Renewable Energy Resources: A Developing Nation Perspective. *Mitigation and Adaptation Strategies for Global Change*. 13:2, 193-206, DOI: 10.1007/s11027-007-9086-5

[5] Bates, B.C.; Kundzewicz, Z.W.; Wu S. and Palutikof, J.P. (Eds.). (2008). *Climate Change and Water*. Technical Paper VI of the Intergovernmental Panel on Climate Change, IPCC Secretariat, Geneva, 210 pp.

[6] International Rivers (2008). *Dirty Hydro: Dams and Green House Gas Emissions*. Fact Sheet of International Rivers. http://www.internationalrivers.org/files/dirtyhydro_factsheet_lorez.pdf as on 18.05.2010.

[7] Bates et al.(2008) in end note 5

[8] CDM: The Clean Development Mechanism (CDM) is a process that allows emission-reduction (or emission removal) projects in developing countries to earn certified emission reduction (CER) credits, each equivalent to one tonne of CO_2. These CERs can be traded and sold, and used by industrialised countries to meet a part of their emission reduction targets under the Kyoto Protocol. The mechanism supposedly stimulates sustainable development and emission reductions, while giving industrialized countries some flexibility in how they meet their emission reduction limitation targets.

[9] DelSontro, T.; McGinnis, D. F.; Sobek, S.; Ostrovsky, I. and Wehrli, B. (2010). 'Extreme Methane emissions from a Swiss Hydropower Reservoir: Contribution from Bubbling Sediments'. *Environmental Science & Technology*, 44 (7): 2419 – 2425. DOI: 10.1021/es9031369

[10] Kundzewicz, Z.W.; Mata, L.J. ; Arnell, N.W.; Döll, P.; Kabat, P. ; Jiménez, B.; Miller, K.A.; Oki, T.; Sen Z. and Shiklomanov, I.A. (2007). *Freshwater resources and their management*. In 'Climate Change 2007: Impacts,

safeguard the long-term social and environmental security of the river basin. We certainly need to raise serious concerns about the ongoing dam plans on the Brahmaputra by China and put forward a strong case based on the ecological, cultural and livelihood sustenance the river provides currently to lakhs of people downstream. Media reports in mid-November 2010 indicate that the Chinese government has started work on the 510 MW Zangmu project, supposedly a RoR project, on the river upstream. On November 18, 2010, the Chinese government has defended its decision to build a dam on the Brahmaputra and said that they have taken "full consideration of the impact on the downstream area."

A mere statement of this nature is unacceptable and India needs to strongly demand an explanation from China on how downstream issues have been considered as claimed by them. As explained in other portions of this paper, so-called RoR projects could also have serious downstream impacts. For example, due to drastic alteration in natural flow patterns, even if total quantities of flow remain the same in the downstream over a period of time. We need to understand case-specific impacts of such projects (individually and cumulatively) on India and any complacency on part of our government by blindly accepting arguments that 'RoR is environmentally benign' would be dangerous. The Indian government could make a bold start by protecting the Indian portion of the Brahmaputra as a "cultural and ecological endowment of the people of the region and the country as a whole", as demanded by one lakh signatories from the Northeast in a memorandum sent to the PM on November 2, 2010. This would also give us the moral right to stridently oppose Chinese dams on the Brahmaputra.

[1] The Brahmaputra is called Siang in Arunachal Pradesh and Yarlung Tsangpo in Tibet. The first project being taken up in the lower reaches of the Siang is the 2,700 MW Lower Siang project, a RoR cum storage project.

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Major quarrying operations in the riverine tracts of the Subansiri, downstream of the dam site of the 2,000 MW Lower Subansiri hydroelectric project. This has disrupted an important corridor for movement of elephants close to the Assam-Arunachal Pradesh border and led to increased human-elephant conflict in nearby areas.

Gogoi, of the Krishak Mukti Sangram Samiti, says: "Technical issues are important. But the dams' debate in the region cannot be restricted to these issues alone. It is a matter of our rights over our natural resources. These resources are being handed over to power companies and our rivers transformed dramatically by political decisions taken in New Delhi and within the State Governments of the region. This requires a political response from people of the region and that will be our focus in the coming days."

Adaptation and Vulnerability, Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change', M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 173-210, 184pp. http://www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4-wg2-chapter3.pdf as on 07.08.2010

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[13] Immerzeel, W.W.; van Beek; Ludovicus P. H. and Bierkens, Marc F. P. (2010). 'Climate Change Will Affect the Asian Water Towers'. *Science*, 328: 1382-1385.

[14] Bates et al.(2008) in end note 5, 86 pp.

[15] Kumar, R.; Singh, R. D. and Sharma, K. D. (2005). 'Water resources of India'. *Current Science*, 89(5): 794-811.

[16] Bates et al. (2008) in end note 5, 74 pp.

[17] GLOF: Glacial Lake Outburst Flooding, described later in section 'Hydro-projects more hazardous due to climate change', para 4.

[18] Cloud Burst: A cloudburst is an extreme form of rainfall, sometimes mixed with hail and thunder, which descends from high clouds and fall at the rate of normally more than 100 mm per hour, causing accumulation of more than 2 cm of rainfall in few minutes often leading to disastrous flash floods.

[19] Dharmadhikary, S. (2008). *Mountains of concrete: Dam building in the Himalayas*. International Rivers, California, US. 35 pp. http://www.internationalrivers.org/files/IR_Himalayas_rev.pdf as on 08.09.2010

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[24] Cooperation with Bhutan Status report of Central Electricity Authority, Ministry of Power, Government of India. http://www.cea.nic.in/hydro/bhutan.pdf. (As on 28.02.2010).

[25] For a more comprehensive look at alternative approaches to power planning see booklet on 'Alternative Power Planning' produced by Prayas Energy Group and Kalpavriksh at prayaspune.org/peg

[1] The section on Hydropower and Climate Change has been authored by Partha Jyoti Das (Aaranyak), while the rest of the briefing paper has been authored by Neeraj Vagholikar (Kalpavriksh). The section on climate change has liberally used information from credible contemporary scientific research. It is an attempt to familiarise the common reader with what science says about the linkage between climate change and dams, in contradiction to the prevalent perception. It also indicates possible implications of unabated dam building when climate change is triggering significant changes in the environment, both predictable and uncertain, in the geo-ecologically fragile and climatically sensitive Northeast Indian region, by interpreting scientific results in the given geographical context. The briefing paper has extensively referred to existing writing/publications by Kalpavriksh members on the issue in the last ten years which may not necessarily be specifically referenced. These include: the special issue of the Ecologist Asia magazine on Northeast dams brought out in January 2003 (guest edited by Kalpavriksh members Manju Menon, Kanchi Kohli & Neeraj Vagholikar); the Dossier on Large Dams for Hydropower in Northeast India by Manju Menon and Kanchi Kohli, and published by South Asia Network on Dams, Rivers & People (SANDRP) and Kalpavriksh in 2005; extensive writing in the popular media by Neeraj Vagholikar. Himanshu Thakkar of SANDRP has authored the box on 'Dams & Floods' and Shripad Dharmadhikary of Manthan Adhyayan Kendra the box on 'Private sector hydro'. The paper has a significant focus on the Brahmaputra river basin and the states of Assam and Arunachal Pradesh, as this is a major ongoing debate and conflict.

[2] Central Electricity Authority, 2001

[3] www.biodiversityhotspots.org

[4] Goswami, D.C. & Das, P.J., 2003. The Brahmaputra river, India, *The Ecologist Asia,* Vol. 11 No. 1 January – March 2003

[5] To the present time, all non-Arunachalese, Indian or foreign, require a permit to enter Arunachal Pradesh. This, along with other legal measures preventing land transfer to outsiders, has prevented both land alienation and large scale influx of outside populations in the state. These measures are generally appreciated by locals as they have allowed them to keep intact both their political and natural resource-related rights till date.

[6] http://www.cag.gov.in/html/cag_reports/sikkim/rep_2009/civil_chap1.pdf

[7] Personal communication with Dr. Gita Bharali, North Eastern Social Science Research Centre (NESRC). She has studied in detail the impacts of the Pagladiya and Karbi-Langpi dams in Assam. For detailed information and statistics on displacement due to development projects and activities in Northeast India, please contact Dr. Bharali at: gitabharali09@gmail.com

[8] Draft fact-sheet on 'Dams and shifting cultivation', Kalpavriksh (upcoming)

[9] Note on 'Socio-economic impacts of big dams in downstream areas of Assam' presented by Dr. Chandan Kumar Sharma during the public consultation on dams in Northeast India on September 10, 2010

[10] One cubic metre = 1,000 litres. Therefore, a flow of one cumec (cubic metre per second) is equal to 1,000 litres/second.

[11] The Expert Committee had members from IIT Guwahati, Dibrugarh University and Gauhati University.

[12] With the setting of the National Green Tribunal in October 2010, the NEAA has now been dissolved.

[13] See booklet on 'Alternative Power Planning' by Prayas Energy Group and Kalpavriksh at prayaspune.org/peg

Neeraj Vagholikar has been involved in research, writing and advocacy on environmental and social aspects of large dams in Northeast India since 2001. He is a member of Kalpavriksh, a leading environmental non-profit organisation in the country, and focuses on environmental governance issues related to large infrastructure projects.

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UBPHOTOS

A protest rally against large dams in the Brahmaputra river basin held in Guwahati in November 2010.

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