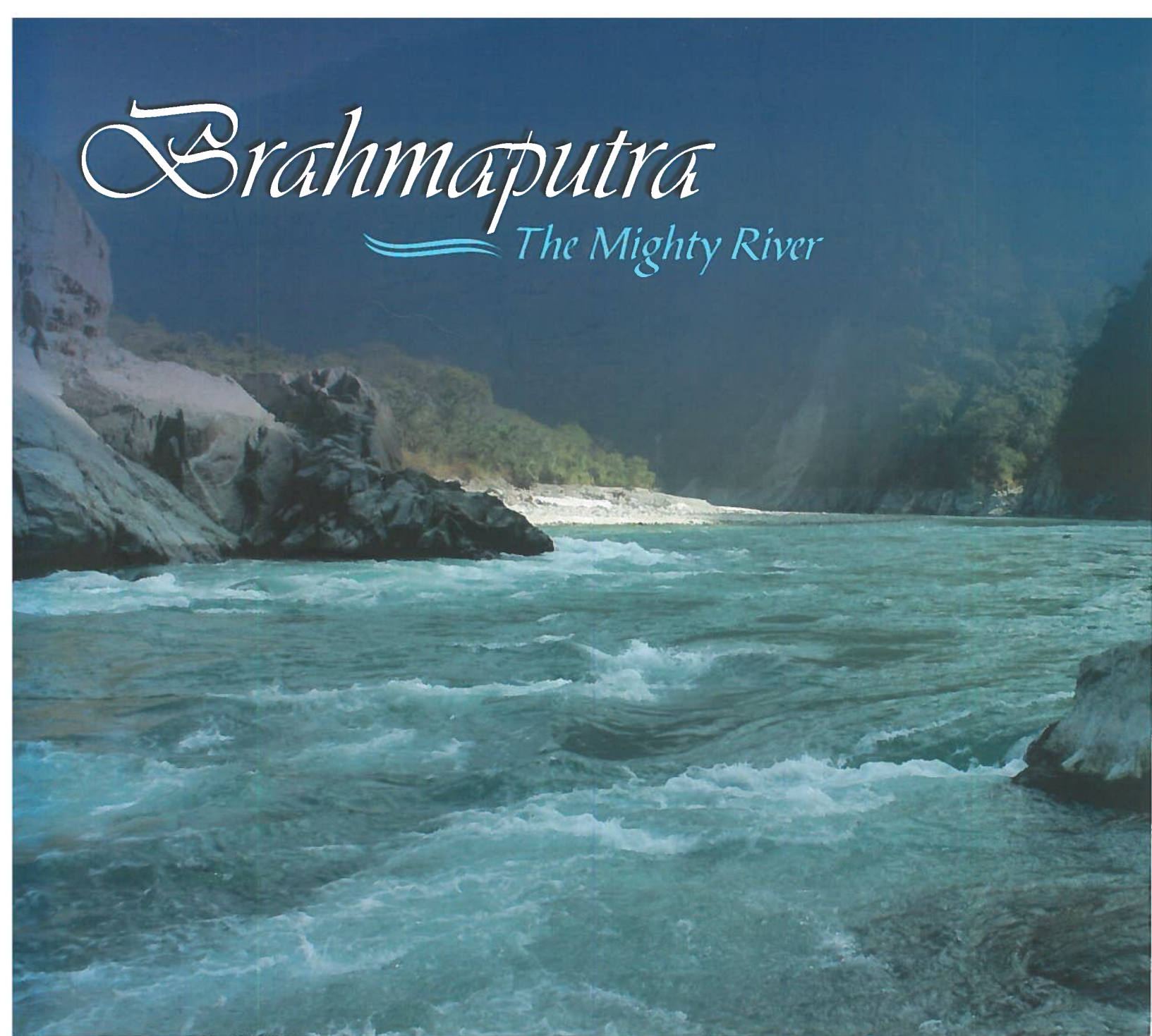


Brahmaputra

The Mighty River



Brahmaputra

The Mighty River

Conceptualised and Financed by



The National Academy of Sciences, India (NASI)
5, Lajpat Rai Road, Allahabad -211002, India

With the generous support from



Department of Science & Technology
Govt. of India

Research, designed and developed by



National Council of Science Museums
Ministry of Culture, Government of India
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Ministry of Culture, Govt. of India

33, Block-GN, Sector-V, Bidhan Nagar,

Kolkata-700091

Facilitated by

Assam Water Research & Management Institute (AWRMI)

Basistha, Guwahati

With the generous support from

Department of Science & Technology

Govt. of India

Message



During the Year of Science, amongst many activities, NASI council approved the project for establishment of Brahmaputra Gallery in Guwahati, Assam. Considering that NASI had already setup a Ganga Gallery in Allahabad which is today considered a most unique depiction of the holy river Ganges, Prof. (Mrs.) Manju Sharma was assigned the responsibility to provide guidance; and she prepared a concept note on the subject. Dr. Niraj Kumar was closely associated with her for the implementation of this project. An advisory committee was constituted with the following composition:-

Chairperson

Prof. Manju Sharma, Past President NASI & Distinguished Woman Scientist Chair-NASI;

Members

1. Prof. Pramod Tandon, Former Vice-Chancellor, N-E Hill University, Shillong, Meghalaya.
2. Prof. A. C. Bhagabati, Honorary Coordinator & Head of Division, North Eastern Regional Centre, Indira Gandhi National Centre for the Arts (IGNCA); (Former Vice Chancellor: Arunachal University, India), Dept. of Anthropology, Gauhati University, Guwahati-781014.
3. Dr. D C Goswami, Former Professor & Head, Department of Environmental Science, Gauhati University, Guwahati, Assam.
4. Prof. Chandan Mahanta, IIT Guwahati, Assam.
5. Shri Samarendra Kumar, Director (Hqrs), National Council of Science Museums, Kolkata.
6. Project Coordinator, Regional Science Centre at Guwahati, Assam
7. Dr. Niraj Kumar, Executive Secretary, NASI, Allahabad

The state government of Assam fully cooperated and provided the building and other facilities. Shri Samarendra Kumar of NCSM as a nodal point from NCSM has done the research on the presentations for the exhibits and other items in the gallery. The purpose of the gallery is to bring out the scientific, cultural, ecological and economic

significance of the great river Mighty Brahmaputra especially for the benefit of children, young students and scientists.

Brahmaputra is a trans-boundary river and one of the major rivers of Asia. About 2900 K.M. long, the river is important for irrigation and transportation. The river is prone to catastrophic flood in a Spring when the Himalayan snow melts. Floods on the Brahmaputra have been a recurring feature from early times. They may be attributed to the involvement of a host of related causes of a natural, hydrometeorological, and anthropogenic nature. But, in recent years floods of the river have become more severe, due to a variety of newly-emerged manmade causes, in addition to those generally recognized. It is also a classic example of a braided river and is highly susceptible to channel migration and avulsion. It is also one of the few rivers in the world that exhibit tidal bore. North and the South banks of the river Brahmaputra have the wetland, a characteristic feature of the hydrology of the system. These are locally known as the Beels. They are the abodes of rich flora and fauna unique to this region, unique for the breeding ground. All of the above the river, its tributaries, the wet lands and the chaporis along with the island of Majuli make it the largest mid river delta system in the world. The river system and basin (the confluence of the Indo-Aryan, Austro-Asiatic and Tibeto-Burman cultures), with its peculiar habitat give rise to specific ethnic culture evolved during the course of long evolutionary steps. The Sattras (a centre for cultural activities; even acts as a democratic institution to settle local disputes) villages and other vernacular settlements house people from various ethnic origins all of whom have settled in Majuli like Mishings, Deori, Sonowal Kachari, Koch, Kaivartta and Nath. The settlements have their own characteristics and building typologies. The Mishing and Deori population, which is the largest, has probably the most unique house form, which is on Bamboo stilts being located near the riverine tracts, wetlands and other hydrological features. All these settlements are interspersed in the unique natural landscape with wide variety of land types and water bodies that have resulted due to the unique interplay between geomorphology and hydrology of the island and the river. These diverse water bodies and groves house unique flora and fauna of the island. The understanding of the systems of this natural phenomenon by the local people is complete and exhibited in the local knowledge systems, the nomenclature of each natural component of the landscape has evolved over a period of time. All these naturally attract our attention to explore and know more and more about Brahmaputra, the majestic river.

The Academy gratefully acknowledges the valuable contributions of Prof. (Mrs.) Manju Sharma, Shri G.S. Rautela, Director General, NCSM, Kolkata, Shri Samarendra Kumar, Director, NCSM (HQ), Kolkata & his team, who are mainly instrumental in establishing the magnificent Brahmaputra-gallery. Thanks are also due to the Chief Secretary, Govt. of Assam, on whose advice Mr. Ratul Ch. Sarma, Secretary, Water Resources, Govt. of Assam, took keen interest and necessary steps to establish the Brahmaputra-gallery in the prime location of water resources office on the Guwahati-Shillong main road.

Dr K. Kasturirangan

President, NASI

Former Member, Planning Commission

Govt. of India, New Delhi

Foreword



Considering the need of inculcating scientific temper and popularization of science as part of its mandate of “Science and Society”, the National Academy of Sciences, India has taken up the programs for establishment of galleries of important river systems. A unique gallery on Ganges river at Allahabad has already drawn the attention of the people in that region. The academy therefore took up a similar project for Brahmaputra river in Assam.

The Brahmaputra river originates in eastern Tibet and the Ganges river’s source is in the west Indian border and flows south east across India to join the Brahmaputra river in Bangladesh. From here the Ganges-Brahmaputra River flows to the Bay of Bengal where it forms the Ganges Delta. This delta is one of the largest in the world and has the highest population density of any delta. **The world’s highest population density is supported by the Ganges and Brahmaputra rivers making them important for the survival of millions of people.** NASI has with the approval of its Council taken up the task of establishing a Brahmaputra Gallery at Guwahati, Assam similar to Ganga Gallery at Allahabad. The gallery would create awareness about the mighty river Brahmaputra by presenting its socio-scientific aspects in a magnificent gallery form, so that the people of the basin be enlightened with its enormous scientific, ecological, cultural and economic importance and thereby enthused for its conservation.

Brahmaputra is also a classic example of a braided river and is highly susceptible to channel migration and avulsion. It is also one of the few rivers in the world that exhibits tidal bore. North and the South banks of the river Brahmaputra have the wetland, a characteristic feature of the hydrology of the system. These are locally known as the Beels. They are the abodes of rich flora and fauna unique to this region. The river, its tributaries, the wet lands and the chaporis along with the island of Majuli make it the largest mid river delta system in the world. The river system and

basin (the confluence of the Indo-Aryan, Austro-Asiatic and Tibeto-Burman cultures), with its peculiar habitat give rise to specific ethnic culture evolved during the course of long evolutionary journey.

The efforts of the academy will go a long way in sensitizing the people of North-eastern region about the significance of the river Brahmaputra. I am confident that the beautiful gallery would attract millions of people and promote scientific tourism. The audio-visual effects of the exhibits, the message and information provided by the gallery would be truly beneficial for the students and other visitors. The academy is grateful to NCSM for all the help and the actual work done in establishing the gallery and to the advisory committee and other experts for providing inputs.

This unique venture of NASI and NCSM would promote the advancement of science and cultural values of the precious natural resources of our country.

We look forward for your kind response.

Manju Sharma
Chairperson, Advisory Committee
Former Secretary to the Govt. of India, DBT
New Delhi

Preface



The mighty River Brahmaputra is one of the most important rivers of Himalayas that drains the everlasting snows on the Indo-Tibetan water-shed and discharges on the Assam valley of NE India. The river becomes slower and deeper as it moves into the valley. Each summer, heavy monsoon rains add water to this part of the river. The heavy rains cause the river to overflow its banks. As it overflows, the river leaves the rich minerals it has carried down from the Himalayas on its banks in the valley.

The impacts of climate change on the Himalayan region, rising temperatures, recession of glaciers, extreme rain events, increased incidences of landslides and cloudbursts, and flash floods triggered by landslides affect the hydrological regimes of large rivers like the Brahmaputra that sustain millions of people, scores of ethnic cultures, and diverse ecosystems in the eastern Himalayan region. In recent years soil erosion caused by deforestation in the valleys of Tibet and north-east India has caused frequent massive scale flooding of the delta region in Bangladesh. Further oil exploration poses a threat to some endangered species that live in the Brahmaputra River. The stress on water resources (both surface and groundwater) is increasing rapidly due to rising demands of various users and the deteriorating quality of water. In many regions in India the extraction of groundwater is more than the recharge. The country's fragile resources are stressed and are depleting fast, both in quantity and quality.

All these are matter of serious concerns to us but there are tremendous opportunities for improving these conditions which require awareness in the society as well as management strategies that deal with these issues in a holistic manner. The exposition on '*Brahmaputra: The Mighty River*' is an attempt to showcase the pertinent issues and challenges posed by the river. It also introduces visitors to the importance of Brahmaputra for its vast resources. Effective use of dioramas, hands-on-interactive exhibits, colourful illustrations/visuals, animations, digital interfaces, multimedia programs and video based presentations make the gallery an enjoyable and learning experience.

I convey my sincere thanks to all who were involved in conceptualising the exposition and NCSM team who developed it.

G S Rautela
Director General
National Council of Science Museums
(Ministry of Culture, Govt. of India)

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Introduction

The river Brahmaputra has been a subject of great mystery and reverence since the early days of Assam's history and civilization. There had been sustained efforts over the centuries to unravel the hidden mysteries of Brahmaputra by countless monks, explorers and travelers from various parts of the world. The river is ranked amongst the largest rivers of the world in terms of discharge of water as well as sediment.

The gallery '**Brahmaputra: The Mighty River**' highlights the major issues and challenges of the river and also takes pleasure to introduce visitors to the importance of this river in terms of its vast resources.

1. **Religious Belief** – According to Kalika Purana, Parashurama hewed a channel from the lake Brahmakunda to bring the water to benefit people on earth. The river has received the name Lauhitya due to its red coloured water.

This event has been shown through a diorama with supporting panels. A separate multimedia kiosk provides detailed information on river civilization.

2. **Journey from Glacier to Ocean** - The Brahmaputra River originates from the Chemayungdung Glacier located on the northern side of the Himalayas in Tibet. It is one of the world's largest rivers covering a drainage area of 580,000 sq. km.

This section contains fibre glass model of Chemayungdung Glacier from where Brahmaputra originates and an interactive exhibit where visitors can feel the coldness of the glacier. A separate multimedia kiosk provides relevant information on Majuli island.

3. **Biodiversity** – The unique physiographic and climatic characteristics of Brahmaputra basin make it the richest reservoir of floristic and faunal diversity in India. The basin belongs to one of the twelve hotspots of mega biodiversity on earth recognised by the World Conservation Union.

This section contains walk through diorama on flora and fauna with a multimedia kiosk on biodiversity of the Basin.

4. **Climate and it's Impact** – The floodplains of Brahmaputra are dotted with a large number of wetlands or beels, which possess tremendous ecological significance as unique habitats for an exquisite variety of flora and fauna. However, the impact of global warming is severe on the Brahmaputra basin.

This section contains graphic panels and a diorama on waste water treatment plant.

5. **Economic Aspect** – The Brahmaputra has great irrigation potentiality and several mega dam projects are presently at various stages of planning and development. The valley represents the most urbanized and industrialized part of basin. It is richly endowed with vast reserves of petroleum and natural gas. The region is also known for its traditional silk products and has tremendous potential for development of handicrafts based on indigenous resources like cane, bamboo, bell metal etc.

This section contains graphic panels, interactive exhibits, display of various materials bearing economic importance, interactive video game and virtually created important tourist spots.

6. **Nurturing a Distinct Culture** - The Brahmaputra Basin is predominantly inhabited by tribal people with a fair degree of diversity even within the tribal groups. Each of these ethnic groups has their own cultural, social, structural and religious features. It is also a land of fairs and festivals and music and songs are essential part of its culture.

This section contains graphic panels, display of various artifacts bearing cultural diversity with a multimedia kiosk.

7. **Scientific and Educational Relevance** - Various studies on River Brahmaputra have been and are being conducted by many universities and institutes and more-recent scientific work has concentrated on understanding the hydrology of the Brahmaputra for watershed management and flood-hazard mitigation. A lot of literary work has been done on the ethnic identity, nature's beauty and regional diversity of the area.

This section contains graphic panels and a virtual book on various studies on Brahmaputra River. In addition to the above facilities the gallery also includes a quiz corner and 3D movie on the River Brahmaputra.

Religious Belief

The Brahmaputra River is one of the holiest rivers of the World! Possibly, this is the only river of the world which is considered holy by *Hindus, Buddhists, Jains and Bonpas*. *Amogha* wife of Sage *Shantanu* had a child by *Brahma* the creator of the universe. The child took the form of water. *Shantanu* placed the child right in the middle of the four great mountains – *Kailash, Gandhamadana, Jarudhi* and *Sambwartakka*. He grew into a great lake, the *Brahmakunda*.



Kamakhya Temple, Guwahati

According to *Kalika Purana*, *Parashurama* had come to this area to take a holy bath in *Brahmakunda* to wash off the sin of killing his mother. *Parashurama* then used his axe to let the water flow from the kunda outside for the benefit of people. The river has received the name *Lauhitya* due to its red colored water.

The name '*Lauhitya*' is mentioned in classical Indian literature like the *Mahabharata*, *Purana* and *Hasta-yurveda*. The name *Lauhitya* was also found in many other classical literatures like *Kalidasa's Raghuvamsa*, *Kalhan's Rajtarangini* and in stone pillar inscriptions as well as copper plates. However, *Kalika Purana* and *Jogini Tantra* mention the name *Brahmaputra* for the first time and the river was referred to as a masculine river, *nada*.

With the advent of new faith & religion many temples and monuments were built all along the Brahmaputra River. Most of these architectural grandeurs belong to the medieval period and bear silent witness to the glorious past.

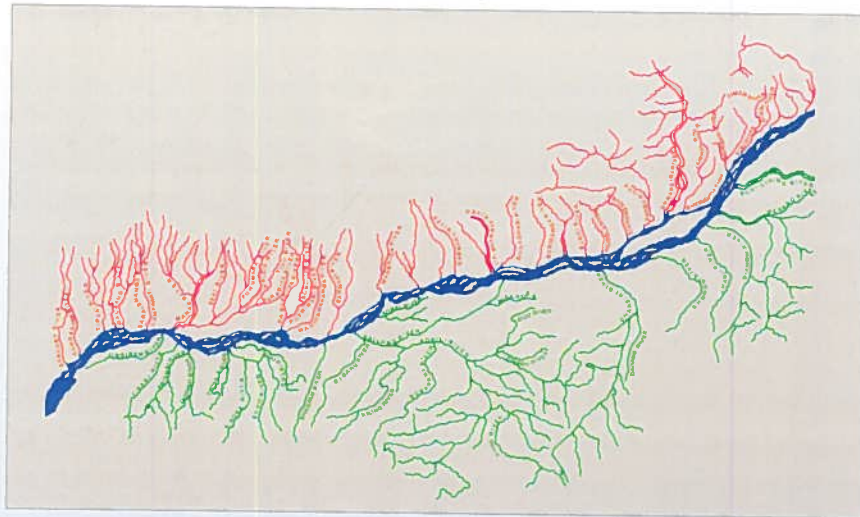


Hindu devotees completing Snan (bath) with deep respect and solemnity in Chilmari Ghat area of the river Brahmaputra

The lower reaches of the Brahmaputra are sacred to the Hindus. Every year many pilgrims come here to take view, pray and worship of this place.



Chema-Yung-Dung Glacier



An Intricate maze of Tributaries

Journey from Glacier to Ocean

The Brahmaputra in Assam presents a picture of awesome expanse, enchanting grandeur, overwhelming sobriety, and immense vigour. Originating from the great glacier mass of Chema-Yung-Dung, south east of the Mansarovar Lake in the Kailash range of southern Tibet at an elevation of 5300 m, the river covers the region of Tibet, China, India and Bangladesh.

In India, its basin is shared by Arunachal Pradesh (41.9%), Assam (36.3%), Meghalaya (6.1%), Nagaland (5.6%), Sikkim (3.8%) and West Bengal (6.3%). A unique river, it drains such diverse environments as the cold dry plateau of Tibet, the rain-drenched Himalayan slopes, and the landlocked alluvial plains of Assam and the vast deltaic lowlands of Bangladesh

An Intricate Maze of Tributaries

The mighty Brahmaputra with the well-knit network of its tributaries controls the geomorphic regime of the Brahmaputra

valley. The Brahmaputra is fed on its course through the valley by no less than 57 tributaries on its north bank and 33 on its south. The Brahmaputra and its tributaries constitute a vast fluvial system with unique flow, sediment-transportation and channel-configuration characteristics.

In the north the principal tributaries are

the Subansiri, the Jia Bharali, the Dhansiri, the Puthimari, the Pagladiya, the Manas and the Champamati. Amongst these the *Subansiri, the Jia Bharali* and the *Manas* are the trans – Himalayan rivers. The principal south bank tributaries are *Burhi-Dihing, the Disang, the Dikhow, the Dhansiri, the Kopili* and the *Krishnai*.



Subansiri River

Some of these are huge rivers by themselves and carry more water than, say, many of the famous European rivers such as the Thames, Siene or Danube. The tributaries have their own tributaries, some inordinately large, which in turn are fed by numerous rivulets and streams. Thus an intricate maze of water –bodies is formed, which is spread not merely across the valley, but also the hills enclosing it.

The 442 km long *Subansiri* River and the 360 km long *Burhi Dihing* River are considered longest, respectively among the north-bank and south bank tributaries. The *Subansiri* takes on at least 25 tributaries. Some of these, such as the *Chayal Chu*, *Kamala*, *Pabha*, *Dulung*, *Ghagar*, *Ranga* etc. have dozens of tributaries of their own.



Majuli Island-Assam's hidden jewel

Due to course changes by the river Brahmaputra and its tributaries, mainly the *Lohit*, *Majuli*, the largest river island in the world was formed and nestles in the lap of the mighty Brahmaputra.

The island is about 200 kilo-metres east from the state's largest city-Guwahati, of Assam and is accessible by ferries.



Majuli has exciting bio diversity. Many rare and endangered species are available here, such as the greater adjutant stork, pelican and the whistling teal.



Most of the people in Majuli practice agriculture, fishing and weaving. Boat making, dairy farming, pottery and handloom are other important activities.



*Majuli produces about a hundred different varieties of rice without a drop of pesticides or artificial fertilizers. **Komal Saul** is a unique kind of rice that becomes edible after just 15 minutes of soaking in warm water.*



Majuli Island has constantly been subjected to erosion by the mighty Brahmaputra. The land area of the island, as evidenced from the IRS satellite imagery of 1998, is 577.65 km² compared to 1245 km² according to available historical records. The available data indicate an erosion rate of 1.9 km²/year for the period of 1920–98. If the situation remains unattended, the island will soon be engulfed by the Brahmaputra and will become extinct from the world map.



Chains of festivals happen in Assam and Majuli every year. People from various parts of North-East India come to take part in these festivals.



Basin of the River-Physical Features

Brahmaputra drainage system is unique in the world as it provides the only example in the world where the drainage pattern runs in a diametrically opposite direction. For example in Tibet it flows from west to east but immediately south of Tibet it flows from east to west in Assam.

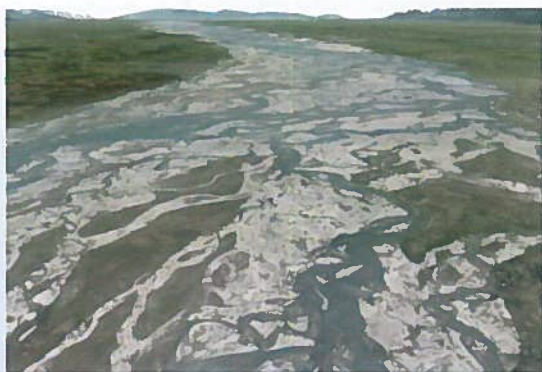


The gradient of Brahmaputra River varies from very steep near the source at the Tibetan plateau to very flat in the lower part of Bangladesh. From its source to Pe, a distance of around 1,600 km, the river had descended 22710 m, but in the next 250 Km it descends a stupendous 2300 m, the gradient in this stretch being 157-310 m per km. The latent force generated by the Dihang- Dihang- Lohit combine while descending from such great heights has to be dissipated in the plains, which explains the oscillating, braided nature of Brahmaputra's channels.

The river has a mean gradient of only about 1.5 m per km over a distance of around 650 km between Kobo, where the confluence is and Dhubri where it leaves Assam and enters Bangladesh, the difference in height of the two places being a mere 100 metre. Between Kobo and Dibrugarh the bed slope is 0.62 m per km, between Dibrugarh and Neamati near Jorhat 0.17 m per km, between Neamati and Guwahati 0.13 m per km, and between Guwahati and Dhubri 0.094 m per km.

Basin of the River- Fluvial Landforms

The Brahmaputra basin spreads over countries of Tibet, Bhutan, India and Bangladesh having a total area of 5,80,000 Sq. km. In India, it spreads over states of Arunachal Pradesh, Assam, West Bengal, Meghalaya, Nagaland and Sikkim. The basin is bounded by the Eastern Himalayas on the north & east, the Naga-Patkai ranges on the northeast and Meghalaya Plateau & Mikir hills on the south. Assam section of River Brahmaputra is in fact highly braided and characterised by the presence of numerous lateral as well as mid-channel bars and islands.



Braided view of River Brahmaputra



Deepor beel

Wetland constituting an important component of the fluvio-geomorphic regime of the Brahmaputra valley in Assam have their major impacts on flood dynamics. The freshwater lakes or beels are mostly located along the Brahmaputra as they generally originate owing to channel shifting of the river. Wetlands helps in reducing flood height as they act as buffer



zones for rivers and other water ways during the period of heavy rains.

Brahmaputra River meets river Ganga to form world's largest delta and finally meeting Bay of Bengal in south. The Ganga-Brahmaputra River system together forms one of the largest deltas in the world comprising some 59,570 sq. km.



Biodiversity

The Brahmaputra is a unique river which 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. The Brahmaputra basin in North-east India belongs to the Indo-Burma biodiversity hotspot, one of the 12 hotspots of mega bio-diversity on earth recognized by the World Conservation Union (IUCN). The outstanding feature of the region is the great diversity of flora and fauna and their enormous variation in both vertical and horizontal distributions. Its unique physiographic and climatic characteristics make it the richest reservoir of floristic and faunal diversity in India. The Brahmaputra basin in North-eastern India has 59 % forest cover, the highest in the country. It sustains a great diversity of flora and fauna. The region supports all types of vegetation right from the cultivated plains to grasslands, meadows, marshes, and swamps, scrub forests, mixed deciduous forests, humid evergreen forests, temperate





and even alpine vegetation. About 600 plant species from NE India are listed as rare, endangered or threatened. Further, over 800 species of orchids are reported from this region are considered endangered. The flood plains of the river have a large number of wetlands or beels, which provide unique habitats for a variety of flora and fauna and perform the function of water retention and support traditional fisheries.

The basin provides unique habitats for a variety of flora and fauna, including many endangered species. The NE region is reported to have about 7233 animal species that include 195 mammalian, 607 bird, 115 reptile, 54 amphibian, 267 fish and 4953 insect species. About 67 of these species (32 mammalian, 28 birds, 6 reptiles and 1 amphibian) are considered endangered. Among these are the one-horned rhinoceros, pygmy hog, hispid hare, Asiatic elephant, clouded leopard, marble cat, golden cat, binturong, hoolock gibbon, white-winged and the wood Duck. The plant resources of this region are enormous and they represent the rich floristic wealth of India.

Climate and it's Impact

The Brahmaputra basin represents an acutely flood-prone region characterized by awesome hazards of flood and erosion that creates an annual mayhem of devastations bringing untold miseries to the people causing colossal loss and

damage to public property and infrastructure. In recent years, floods of the river have become more severe, due to a variety of newly emerged manmade causes, in addition to those generally recognized.



People are forced to leave their homes by floods

Flood Management

Flooding and erosion along the banks of the Brahmaputra is now a serious threats to the basin. Over the years, various flood management measures for the river bank are being practiced. Some of them are construction of embankments, channel improvement, construction of reservoirs and sluices etc.

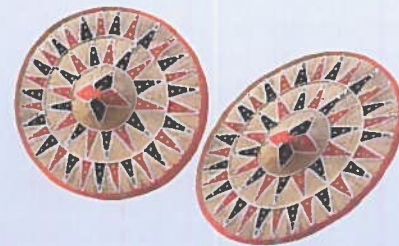
Embankments confine the flood flows and prevent spilling, thereby reducing the damage. These are generally cheap, quick and most popular method of flood protection. Materials like geo-textile bags, boulders, timbers are being used for construction of embankments due to their unique characteristics, like durability, availability, resistance to chemical waste, environment friendly nature and easiness in installation.



Embankments with slope protection using geo-bags



Embankments with boulder revetment



Global Warming- Threat for Basin

The Himalayan Region plays an important role in global atmospheric circulation, biological and cultural diversity, water resources, and the hydrological cycle, apart from the beauty of its landscape and provision of other ecosystem amenities. Environmental change in the greater Himalayans affects most of Central and South Asia, and the mainland of Southeast Asia.

According to Studies the impact of global warming on snow dominated region indicates that the Himalaya - Hindu Kush area is perhaps the most critical area, where vanishing glaciers will negatively affect water supply in the next few decades, because of the region's huge population. The ice mass over this mountainous region is the third-largest on earth, after the Arctic/Greenland and Antarctic regions.

The study concludes that in the flood plains the main threat of climate change therefore lies in the increase of extreme



Himalayan glaciers are at risk of disappearing by the year 2035 if the Earth continues to warm at its current rate



Mangrove forests threatened by climate change in the Ganges-Brahmaputra delta

precipitation in the monsoon and the associated flooding. In the short run the glacier melt may increase water availability, but also major waterborne disasters are likely to occur. Rapid accumulation of water in glacial lakes can lead to a sudden breaching of the unstable 'dam' behind which they have formed. The resultant discharges of huge amounts of water and debris often has catastrophic

effects to people, both upstream and downstream. In the long-term it will change the timing and availability of water.

Another serious concern of modern mankind and its environment is the rising sea level accentuated by global warming. India is amongst 27 countries that are most vulnerable to sea level rise caused by global warming. One meter rise of sea level is expected to inundate about 1000 sq km area of the Sundarban deltas. Nearly half of the 102 Sundarban islands in India spreading over 9.5 sq km area are uninhabited due to an abnormal rise in the sea level and massive erosion in the last four decades. Growing list of rare and highly endangered floral and faunal species of Sundarbans is attributable to these effects.



Sea-level rise could threaten the food security of the people in Ganges-Brahmaputra Delta by the middle of the century, by making the water and soil too salty to grow rice

Pollution- Threat for Basin

The Brahmaputra is the least polluted of all other major rivers of India. But we should not be happy for this as the pollution along the river is increasing day by day. Here most of the pollutions are created by Oil Industries of Assam and wastes of the cities like Guwahati.



Petroleum refining units contribute most of the industrial pollution load into the basin along with other medium and small industries.



Today river front is not visible due to floating vessels, restaurants at the bank.

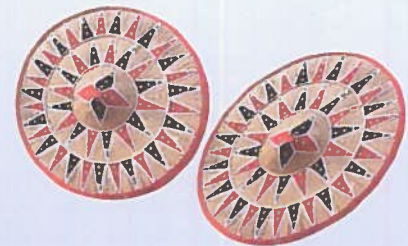
The effect of pollution is increasing, and it's high time to stop it now or we will have to pay the consequences soon!



Now it is common to see dense haze in northern India, Nepal, and Bangladesh. One source of the haze is the fires that burn throughout the region. These fires were probably deliberately set for agricultural purposes. Another source of the haze is crowded cities.



There are number of cities in this basin generating large amount of wastewater as well as solid waste everyday.



Economic Aspect

The soils of the Brahmaputra river basin are similar to the soils found in the Indo-Gangetic plains. However, crop productivity in the valley is low. The low productivity of the valley cannot be directly attributed to low fertility of soils. But rather the productivity is the result of socioeconomic constraints, including power and slow rate of adoption of improved techniques of crop production.



Agriculture plays an important role in the economic livelihood of the basin communities (approximately 80 per cent of its more than 100 million inhabitants are farmers).

Livelihood

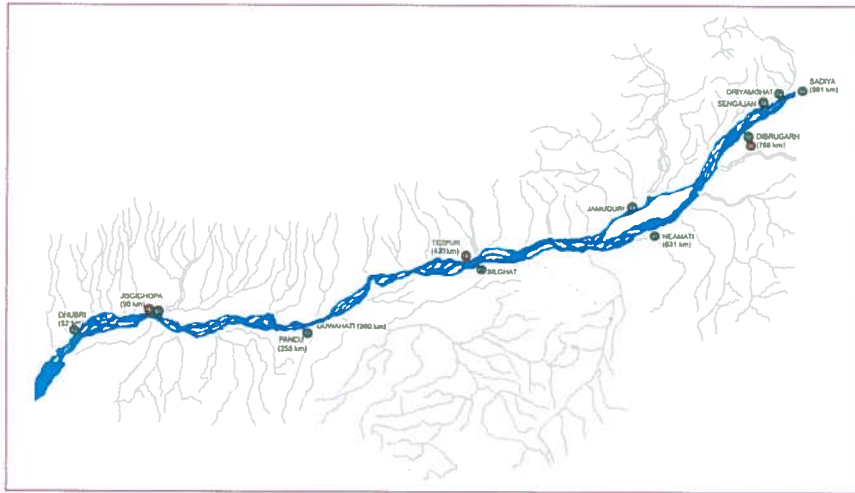
The Brahmaputra basin in India is home to over 200 indigenous multi-ethnic communities each with its distinct history, culture and their livelihood. Most of the people live in villages and some of their occupations are – agriculture, silk industry, fishery, handicraft, tea industry and horticulture. In addition to these bell metal, pottery, local wine making, boat making, musical instruments making, dry fish processing also provide livelihood to thousands of the people of the basin.



Fishing is practiced by mostly scheduled caste and tribes like Mishings and Deories.



Pots are made from beaten clay and burnt in driftwood-fired kilns while the women labourers shape the pots.



National Waterway- Lifeline of Assam

Inland Water Transport (IWT) is an economic, fuel-efficient, environment friendly and employment oriented mode of transport. For providing a better alternative mode of transport in North –East region the Government of India had declared the Brahmaputra from Dhubri to Sadiya as National Waterway no. 2. in context of the broadening trade pacts with Bangladesh and necessity of development of N. E. region. This National Waterway is of national importance.

Salient Features

Total length	891 Km
Stretch Details	<ul style="list-style-type: none"> • Bangladesh Border (Dhubri)-Guwahati-260 Km • Guwahati-Dibrugarh- 508 Km • Dibrugarh-Sadiya-123 Km
Owner	Inland Waterways Authority of India (IWAI)
Operator	Central Inland Water Transport Corporation (CIWTC)
Important Terminals	11 terminals-Dhubri, Jogighopa, Pandu (Fixed terminals), Tejpur, Silghat, Neamati, Dibrugarh, Sengajan, Panbari, Sadiya, Saikhowa
Transport	At present the waterway is being used by vessels of Govt of Assam, CIWTC, Border Security Force, tourism vessels, and other private operators. Long cruise tourist vessels are making voyages between Sivsagar near Dibrugarh and Manas wild life sanctuary near Jogighopa continuously. PoL was transported by IWT on trial from Silghat to Budg- Budg and Baghmari in Bangladesh.

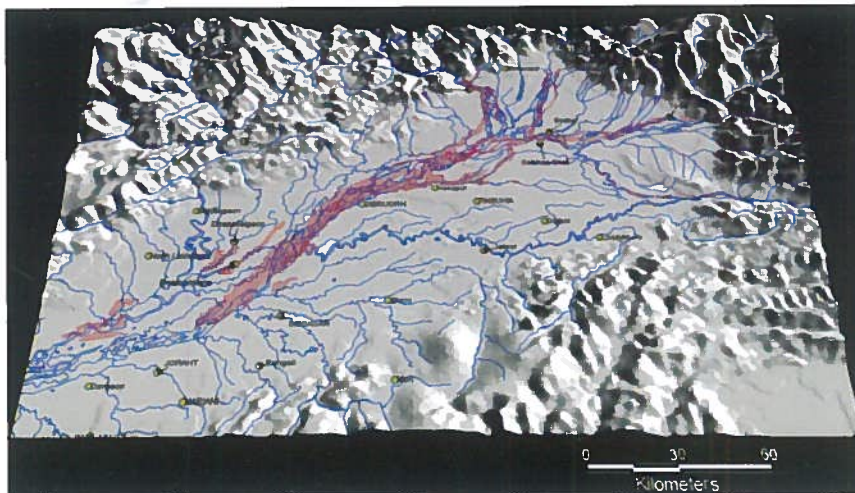


Irrigation- Basic Need for Development

The economy of the people of the Brahmaputra Basin is predominantly agricultural based, as most of the populations live on agriculture and allied activities for their livelihood. Till now, net sown area in the basin is low in comparison to the geographical area of the Basin. To meet the rising demand for food and to provide employment to the growing population, it is highly necessary to increase the pace of irrigation development.



The need to create adequate irrigation facilities to make water available during the dry months of the year for popularization of multiple cropping has gained an increasing urgency



The Brahmaputra river system has immense potential for development of surface water irrigation as many big and small tributaries meet the river at different places of its course.



In lift irrigation system water is lifted by pumps either from river/reservoir and then diverted to canal network. Such schemes may be electrically operated or diesel driven.



The Irrigation Department is the nodal authority of the Government of Assam responsible for harnessing water resources by constructing networks of water carrier system/canal.



The development programmes for improvement of irrigation facility in Assam has been taken up under three irrigation scheme, viz., Major Irrigation Scheme (above 10,000 Hectares), Medium Irrigation Scheme (2000 to 10,000 Hectares) and Minor Irrigation Scheme (up to 2000 Hectares).

Industry & Minerals-Glory of the Basin

Brahmaputra Basin is industrially backward by Indian standards as it has a few agro-based and mineral-based industries. However, the 150 years old Tea industry occupies an integral place in the economy. Assam is the second place in the world (after Titusville in the United States) where petroleum was discovered. The second oldest oil well in the world still produces crude oil.



Assam silk denotes the three major types of indigenous wild silks produced in Assam—golden Muga, white Pat and warm Eri silk. Assam produces about 10% of total natural silk of India.



Of the agriculture-based industries, tea occupies an important place in Brahmaputra basin. Tinsukia, Dibrugarh, Sibsagar, Jorhat, Golaghat, Nagaon and Sonitpur are the districts where tea gardens are mostly found.



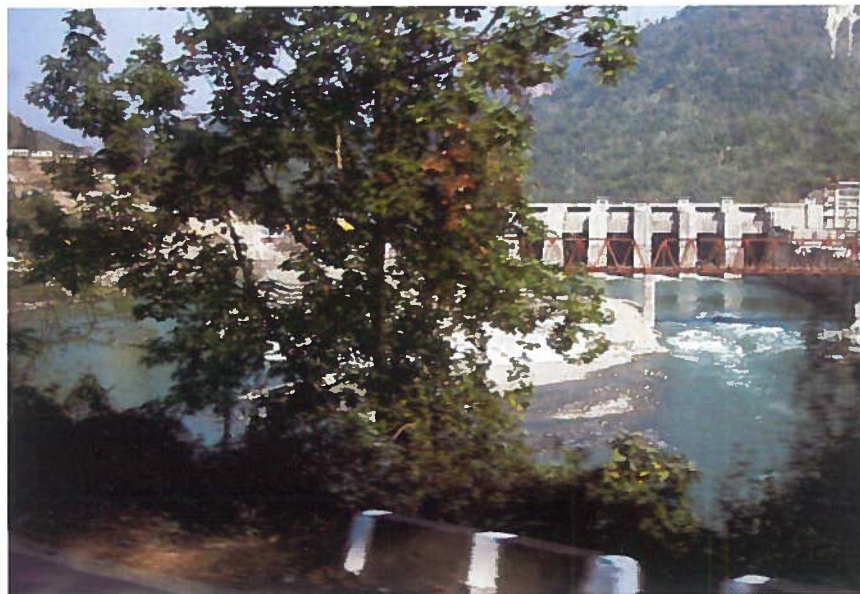
The State Assam contains about 1200 million tonnes of coal reserves. The entire coal in this region is unique in the sense that it is highly volatile (36% - 42%), has low ash content (3% - 15%) and possesses high crackling index (10% - 29%).



Digboi in Assam is an oil town that can be traced to the early 18th century, when oil was first discovered here. Digboi can proudly boast of two unique features: a 100-year-old extant oilfield and the world's oldest operating oil refinery.

Rivers and Dams-Storehouse of Power

Prior to independence, little thought was given towards water resources development in Brahmaputra valley. But, now the scenario has changed. 24 Major Medium Projects in Brahmaputra are under construction. Total identified capacity of the Brahmaputra basin as on 31.03.2012 (Courtesy: Water Resources Information System) is 66065 MW where capacity of 1847 MW has been developed and capacity for 5565 MW is under construction.



The Teesta Low Dam Hydroelectric Project Stage-IV (4 X 40 MW) involves construction of a 45 meter high concrete gravity/reinforced cement concrete (RCC) dam.



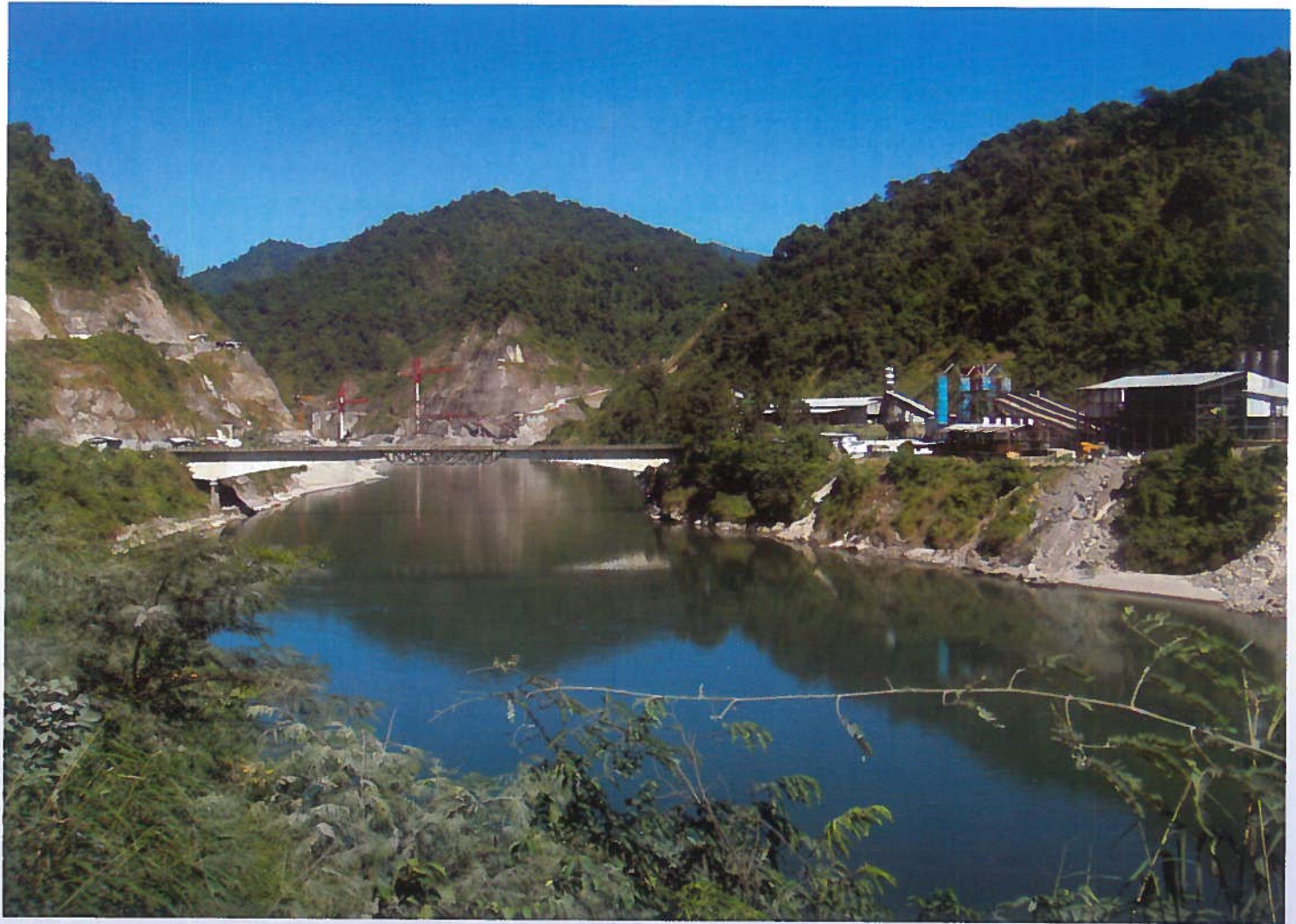
Doyang Hydroelectric Power Project is located at Wokha District, Nagaland, India



Ranganadi Dam in Arunachal Pradesh



Khandong Dam in Assam



Lower Subansiri Hydroelectric Power Project (LSHEP) in Lower Subansiri District on the border of Assam and Arunachal Pradesh states.

Tourism-Promising Sector of the Basin

Dominated by the mighty Brahmaputra River, India's North-East is a land of undulating hills and plains with luxuriant green cover and a wide variety of rare and exotic flora and fauna. The area has several attractive destinations: majority of these are National Parks, Wildlife and Bird Sanctuaries, areas with archaeological interests and areas with unique cultural heritage.



Kaziranga National Park – a world heritage site, is the hosts of two-thirds of the world's Great One-horned rhinoceros. Elephant Safari and Jeep Safari are the best ways to explore and unfold the vigour and splendour of this park.



Umananda Temple is located at the Peacock Island in middle of river Brahmaputra at Guwahati. It is devoted to Lord Shiva. The devotees as well as the tourists coming to Assam, takes a visit to this temple.



Brahmaputra River is among the best in the world for river rafting sports. The journey of river rafting begins at Dibrugarh, up the river to the plains of Pashighat.



The southern part of the Majuli island is a bird lovers paradise. Between November and March is the best time to visit this place.



Majuli, the largest riverine island in the world, nestles in the lap of the mighty Brahmaputra. Its wide blue sky, Holy River floating across the banks, and beautiful landscape makes it a perfect place of tourism.

Nurturing a Distinct Culture

The Brahmaputra Basin with a total population of about 80 million is extremely rich in cultural and ethnic diversity. The Brahmaputra facilitated wave of migration into this region from all directions, taking in people and cultural traits. The Brahmaputra basin in India is home to 200 indigenous multi-ethnic communities each with its distinct history, culture and geographic space. These are widely scattered from the Tibetan highlands through the Arunachal mountains to the Assam plains and its adjoining hills.

According to anthropologists population of Brahmaputra basin is divided into two segments- Mongoloid and Caucasians. The largest among the Mongoloid segment are the Bodos. They comprise a number of tribes such as the Bodo-Kacharis of the plains, Dimasas or Hill Kacharis, Rabhas, Lalungs, Garos, Chutiyas, Moran, Tippera, Hajongs etc. belonging to the Tibeto-Burman linguistic group. Though the Bodo-Kacharis, the Rabhas, the Garos, the Hajongs belong to the Mongoloid stock, their morphological features are different

from one another. The Kacharis are the tallest and have a medium face while the Rabhas have a broad face.



Garó girl

The Dimasa –Kachari lived along river banks and coasts. After the Raja Ashok period, a Dimasa leader named Bodo introduced the Buddhist religion. Bodo Kachari is the offspring of Bodo Raja. Numerically, the Bodos-Kacharies are the largest group among the plain tribes.

Mishing are the second largest Non Bodo tribal group in the plains and most closely affined to the Brahmaputra. Mishing villages are always built on the bank of the Brahmaputra and since the terrain is flood-prone, they build their houses on stilts raised around two metres from the



Bodo village

ground. Almost all these tribes have close affinity with the Brahmaputra and its tributaries. Even those who dwell in the hills are believed to have once lived in the plains and today, build their villages on the banks of the upper reaches of tributaries. Beside the above mentioned tribes, the Nepalis, the ex-tea garden labourers, the

Muslims-Assamese and Bengali, the Hindu Bengalis, the Hindu Assamese, the Buddhists have been living in this region since the coming of the British. Therefore, this region may be called the cauldron or the melting pot of different races having different languages and customs.



Mishing house

Dances

Brahmaputra Basin is the home of a number of indigenous tribes and races each of which has its own fairs and festivals. This has led to the propagation of innumerable dance forms throughout the region. Some of the dance forms are Bihu, Sattriya Nritya, Jhumur, Deodhani, Ali Ai Ligang dance etc.

Bihu

This is the most popular folk dance of Assam and as the very name suggests, is related to the Bihu festival, which is celebrated with much pomp and glory throughout the state. The festival is mainly a celebration of the different phases of cultivation and is observed by all the Assamese, irrespective of their caste and creed. Different types of Bihu are Bhogali Bihu, Kongali Bihu, Moran Bihu, Deori Bihu, Mishing Bihu, etc.

Sattriya Nritya

Sattriya dance is a renowned classical dance of Assam, which was introduced by Srimanta Shankardev to propagate the religion of Vaishnavism. This form of



dance is one of the eight principal classical dance forms of India and has a great cultural significance in the social scenario of the state. The basic aim of the Mahapurush, behind Sattriya dance, was to preach to the common people the religious teachings that were commonly inaccessible to them.

Bhaona

This dance form is basically performed in the village Namghars and Satras, in order to promote the Vaishnavite culture in Assam. It is actually a theatrical depiction of the one-act play Ankiya Nat, initiated by Sankardeva. An integral part of the dance is the Sutradhara, who recites the slokas, sings, dances and explains the various stages of Bhaona in detail. Another form of dance included in Bhaona is the Natuwa or Cali dance. One of the subdivisions of this dance form is the Hajowaliya, which is basically a woman's dance and is the combination of both Tandava and Lasya.

Jhumur Dance

Jhumur dance is a traditional dance of tea tribe communities of Assam. The dance is usually performed during autumn in

Assam. This dance incorporates songs and dialogues, which depict the joys and sorrows, yearning and aspirations of the everyday lives of the common people.





Musical Instruments

In Brahmaputra Basin no festival is complete without the rhyme and rhythms of musical instruments and melodic tunes. Some of the indigenous instrument used are dhol, pepa, tal, toka, gagana and sutuli.

Pepa

Pepa is made up of buffalo horn and is played during bihu performance. It has 3 different parts-the buffalo horn, a smaller pipe of bamboo and a part named as supohi to create pressure by mouth.

Dhol

It is a percussion musical instrument widely used during Bihu performance. It is a double sided barrel drum.

Gogona

It is made up of bamboo sticks. There are two types of gogona-ramdhon gogona and lahori gogona. Ramdhon gogonas are played by the male bihu dancers and lahori gogonas by female ones.

Toka

A musical instrument made up of bamboo sticks. One end of a bamboo is tied and other end is split into two. To create musical note both sides of the split end are pulled apart.



Sutuli

Sutuli is a clay baked wind instrument. It emulates the sound of a wild bird-kuli in Assamese or more popularly known as 'koel' in Hindi.

Taal

Taal is a pair of two copper plates which create a soothing sound while beating on each other. There are several type of taal- bor tal, xoru taal, maju taal, khuti taal etc.



Famous singer of Assam

Bhupen Hazarika

Bhupen Hazarika was a noted music director, playwright, actor, journalist, author, lyricist, politician and film-maker of the highest repute from Assam. His songs, written and sung mainly in the Assamese language by himself, are marked by humanity and universal brotherhood and have been translated and sung in many languages, most notably in Bengali and Hindi.



He is also acknowledged to have introduced the culture and folk music of Assam and Northeast India to Hindi cinema at the national level. He was one of the leading authors/poets of Assam and has to his credit more than one thousand lyrics and more than fifteen major books on short stories, essays, travelogues, poems and children's rhymes. He had produced and directed many documentaries in various languages. His biggest achievement in terms of awards would be 'The Dadasaheb Phalke Award', also considered as 'India's Oscar', which he was honoured in 1993 for his lifetime's contribution to development of Indian cinema. In 2001, he was honoured by the Government of India with the 'Padma Bhushan', one of the highest civilian awards.



Scientific and Educational Relevance

The Brahmaputra River is braided and unstable in its entire reach in the Assam Valley except for a few places. The instability of the river is attributed to high sediment charge, steep slope and transverse gradient. Apart from these, the entire area is in a seismic zone and receives earthquake shocks of moderate to severe intensity from time to time. The problem of siltation has been further aggravated due to landslides caused by high rainfall. Some manmade avoidable actions in the form of shifting cultivation and non-scientific commercial exploitation of forest, etc. have also accelerated the process of soil erosion in the catchments. The silt brought in the process gets deposited as the river descends into the plains with sudden reduction in slope, with the consequent reduction in the flow velocity and its sediment carrying capacity. Due to heavy deposition of silt, the river has frequently changed its course. Excessive silt deposition has also given rise to braiding and meandering pattern in the alignment of the river system. The left bank tributaries of the river Brahmaputra pass through stable reaches with flat slopes and carry lower sediment load of finer size. By hypsometric analysis of the tributaries, it is seen that the North bank tributaries indicates relatively young stage while the South bank tributaries indicate a mature stage. This has given rise to inherent tendency of river Brahmaputra to shift its course towards south and the river flows by the slide of hills at many places along its bank.

The flood and river management measures adopted so far in the valley are mostly of short term structural measures such as construction of embankments, permeable and impermeable spur, revetment etc. and are area specific

only. The poor maintenance of the flood management structures generally causes unexpected miseries to the people in case of their failure. The efficacy of these measures especially in the river system of Brahmaputra, which is highly aggrading/ degrading in different reaches, is also debatable. As such, there is a need for constructing storage reservoirs in combination with other structural/ non-structural measures.

Universities and institutes involved

There were various studies conducted by many universities and institutes. IIT Roorkee conducted a study on Brahmaputra river erosion and its control. One of the topic on seismicity was on "Earthquake Disaster Mitigation Scenario of North East India". More-recent scientific work has concentrated on understanding the hydrology of the Brahmaputra for watershed management and flood-hazard mitigation. IIT Roorkee and University of Southampton, UK conducted studies on "Hazard, Vulnerability and Risk on the Brahmaputra Basin: A case study on River Bank Erosion". Singhanian University conducted study on Biodiversity and soil erosion of Majuli Island. Assam Agricultural University, Gauhati University and Central Institute of Fisheries Technology, Kerala conducted studies on Traditional fish trapping devices and methods in the Brahmaputra valley of Assam. Studies were also conducted on Ornamental fish conservation in flood plain wetlands of lower Brahmaputra Basin. IIT, Guwahati conducted studies on Influence of Landform and geomorphic process on topographic evolution of a river island. Regional Research Laboratory, Jorhat and Dibrugarh University studied on

Erosion activity on Majuli and Nature of bank erosion along the Brahmaputra river channel, Assam, along with studies on Impact of climate change on flood characteristics in Brahmaputra Basin using macro-scale distributed hydrological model. IIT Kanpur and Dibrugarh University carried out studies on Tectonic controls on the morpho-dynamics of the Brahmaputra River system in the Upper Assam valley, India. North Eastern Regional Institute of Water and Land Management, Tezpur conducted studies on Chemistry of arsenic in groundwater of Ganges –Brahmaputra river basin. Christ University, Bangalore conducted studies on Brahmaputra River and its tributaries. Purbanchal Campus Tribhuvan University conducted studies on “An analysis of Trans-boundary water resources: A case study on river Brahmaputra”. Mizoram University, Aizawl conducted studies on Status of seismicity in the Northeast India and Earthquake Disaster Mitigation. IIT Kharagpur worked on topic “Earthquake hazard in Northeast India-A seismic microzonation approach with typical case studies from Sikkim Himalaya and Guwahati city”. Georgetown University School of Foreign Service, Qatar published article like “The Brahmaputra: Water hotspot in Himalayan Asia”. University of Dhaka conducted studies on erosion patterns in the Brahmaputra-Jamuna River, Jahangirnagar University, Dhaka conducted studies on Braiding and Channel Morphodynamics of The Brahmaputra-Jamuna River. International water management Institute, New Delhi along with University of Wyoming, USA conducted studies on Linking Rivers in the Ganges-Brahmaputra River Basin: Exploring the Trans-boundary Effect.

The Brahmaputra Board was set up by the Govt. of India under an Act of Parliament for the planning and integrated implementation of measures for the control of floods and bank erosion in the Brahmaputra Valley and for matters connected therewith. From 1989 onwards Aaranyak, which is a registered non-profit society for bio-diversity conservation in Northeast India and recognised as a Scientific and Industrial Research Organisation (SIRO) by Govt. of India, has been working relentlessly for conservation of rich biodiversity of the region. It is one of the most active NGO in the region and has influenced the policy making procedures.

The management of the Brahmaputra's vast waters needs adequate regional, national and international cooperation and pooling of resources and expertise. Strengthening of the information base, assessment of available technologies vis-à-vis the unique nature of the region and exploration for new appropriate strategies are other aspects that need to be emphasized. The Brahmaputra continues to throw a formidable challenge for use of its vast resources as a vehicle of economic change and social transformation to ensure peace and prosperity of the entire region.



About NASI



The National Academy of Sciences, India (NASI) strongly feels that science-society programmes are must to generate scientific temper as well as to solve several societal problems

education and research. Since its inception in 1930, the Academy is pursuing its objectives as evident from the fact that all its endeavor and achievements are well recognized by the scientific fraternity and the leadership of the country. Being the oldest Science Academy of this country, NASI has carved a niche in science promotional and popularization activities, following the mandate coined by its founder Prof Meghnad Saha. Presently, the President of the Academy is Hon'ble Dr. K. Kasturirangan, Member, Planning Commission, Govt. of India. The Past Presidents as Prof M G K Menon, Prof. M S Swaminathan, Prof (Mrs.) Manju Sharma, Prof A K Sharma, Prof V P Sharma, Prof S K Joshi, Prof Ashok Misra, Prof Asis Datta and others are also taking keen interest in the development of the Science in general and the Academy, in particular.

NASI - envisions the cultivation and promotion of Science & Technology in all its branches through-

- organising meetings and holding discussions on scientific and technological problems; and promoting scientific and technological research for societal welfare;
- undertaking such scientific works of technological or public importance as it may be called upon to perform;

- publication of proceedings, journals, memoirs, transactions and other works as may be considered desirable;
- creating an adequate impact of the Academy all over the country by opening Chapters of the Academy in other cities in the country, where reasonable number of scientists are interested;
- co-operating with other organizations in India and abroad, having similar objectives, and to appoint representatives of the Academy to act on national and international bodies;
- maintaining a Science Library;
- securing and utilizing funds and endowments for the promotion of science and technology;
- performing all other acts, matters and things that may assist in, conduce to, or be necessary for the fulfillment of the aims and objects of the Academy.

The Academy (NASI, Allahabad) is striving hard to promote Science & Technology by regularly organizing several activities, such as- (1) Publishing two quarterly journals (Proceedings of the National Academy of Sciences, India-Sec. A & B) and one bi-monthly journal (National Academy Science Letters); (2) holding an Annual Session in a scientific and academic institution, every year. The sessions were held (since 2000) at Allahabad, Pune, Shillong, Ahmedabad, Jaipur, Pondicherry, Mumbai, Mysore, Chandigarh, Kolkata, Jaipur, Trivandrum, Varanasi and Goa. These Annual

Sessions provide an opportunity for presentation of research papers by the young researchers. The sessions are popular and draw young and senior scientists alike from far and wide; (3) organizing symposia, seminars, and workshops on subjects of current national and scientific interest. More than 70 such programmes were held in last about ten to twelve years; (4) planning and executing programmes of science communication, like Science Extension Lectures, State Level Science Contests (Quiz, Debate, Oration, Exhibition, Essay, etc), Talent Search, Teachers' Workshop, Summer School, Vacation Training Programmes, Winter School, National Level Scientific Creative Writing Contest, Celebration of National Technology Day, National Science Day and World Environment Day, etc. About lacs of students/teachers have been benefitted by such programmes in last twelve years; (5) recognizing the significant contributions of the scientists at every level by honoring them with Fellowship/ Membership/ Lecture Awards/ NASI-Reliance Awards/ NASI-SCOPUS Awards/NASI-Young Scientist Awards and so. About 2000 scientists have been awarded in last 10-12 years; (6) instituting prestigious Research Fellowships/Chairs/Senior-Scientist Fellowship etc. to honor the distinguished scientists. More than 60 eminent scientists have been awarded with such prestigious Chairs/Fellowships; (7) holding a well organized library known as Dr. Sir Padampat Singhanian Library in which there are two sections, one for the research students and teachers and the other for school students. Library services

were enriched through digitization of the library, subscribing more books and by providing facilities of storage, reading room, microfilming, citation index etc.

Internet facility for educational purpose is also being provided to the students free-of-cost. In the year 2011 the library has been connected to National Knowledge Network (NKN). It is also having the direct access of several international journals of repute; and (8) maintaining 17 Chapters all across the country to organize scientific activities in and around their respective regions. Thus, during eight decades of its existence, the Academy has attained a niche in promoting science with the involvement of a large number of its fellowship and membership from all the areas of science and technology.

Apart from these activities, it is also organizing several other activities jointly with other two National Science Academies. NASI is jointly sponsoring the Summer Research Fellowship under the joint Science Education Panel to provide opportunities to bright under-and post-graduate students and teachers to usefully spend their summer/winter vacations, at a research laboratory for a period of two months. It is worth mentioning that a large number of Fellows of NASI have opted to mentor students and teachers under this programme.

About NCSM



National Council of Science Museums (NCSM), a premiere institution in the field of science communication, is an autonomous organization under the

Ministry of Culture, Govt. of India with its Headquarters in Kolkata. It administers and manages 25 science museums/centres spread across the country and Central Research & Training Laboratory, in Kolkata. In addition, it has developed 22 Science Centres which have been handed over to different States and Union Territories of India. NCSM is the largest network of science centres and museums in the world. These science centres provide an experiment based learning environment to inculcate a spirit of inquiry, foster creative talent and create scientific temper in the community. It is characterized by its two-pronged channel of communication - exhibits and activities. While the exhibits, both indoor and outdoor, are mostly interactive, the demonstrations and training programmes are also fully participatory and help children and the adults alike to learn the basics of science through fun and enjoyment. NCSM also conducts 23 mobile science exhibition units throughout the country to create awareness of science and technology in rural areas and provides hands-on learning opportunity to rural children.

Over 13.5 million visitors including 3.5 million students visit these science museums and centres every year and 2.5

million rural children are benefitted by its mobile science exhibition programme.

Major Objectives of NCSM

- To portray the growth of science and technology and their application in industry and human welfare, with a view to develop scientific attitude and temper.
- To popularise science and technology.
- To supplement science education given in schools and colleges to foster a spirit of scientific enquiry and creativity among the students.
- To conduct research in science and technology in the areas pertaining to the activities of the Council and to evaluate traditional science and technology in the light of modern scientific and technical concepts.
- To establish Centres for development of science exhibits and demonstration aids.
- To render assistance to universities, technical institutions, museums, schools and colleges or other bodies in planning and organising science museums and also in training of personnel for museum profession.
- To collect, restore and preserve important historical objects which represent landmarks in the development of science, technology and industry.
- To portray the Science & Technology heritage and the cultural interface of Science & Technology in India.

Brahmaputra Gallery

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