An aerial photograph of a river delta, likely the Brahmaputra, showing a complex network of channels and sandbars. The water is a deep green color, and the exposed sandbars are a light brown. A small boat is visible on the right side of the image, near the edge of the delta.

# The Mahabahu **BRAHMAPUTRA**

K K Dwivedi

















Dhritiman Mukherjee



The Mahabahu  
**BRAHMAPUTRA**



The Mahabahu  
**BRAHMAPUTRA**

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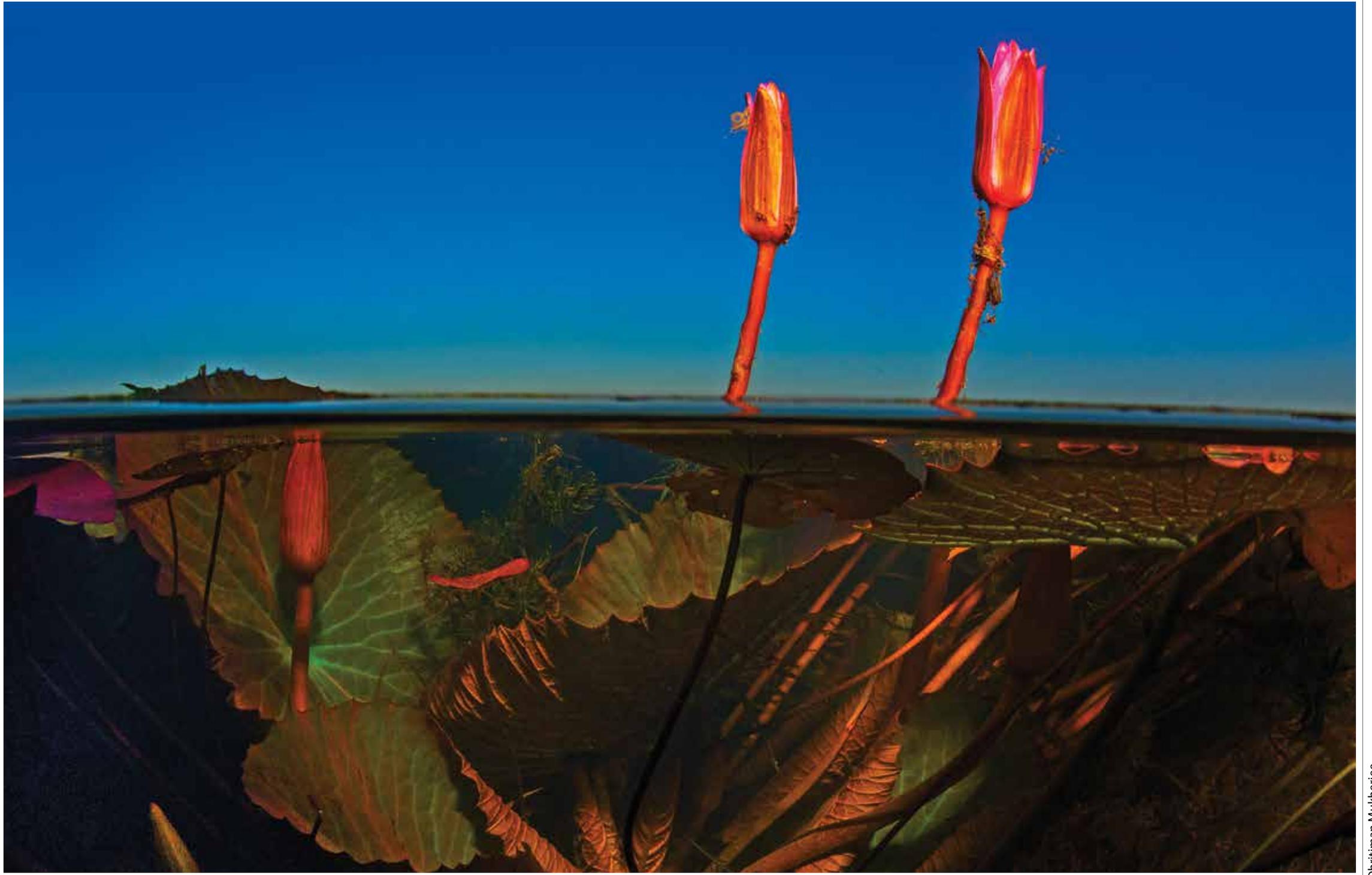
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Golden Emblem

# Tarun Gogoi



**Chief Minister, Assam**  
**Guwahati**  
**Dispur**

## MESSAGE



I am happy to note that FREMAA has undertaken the task of preparing a coffee table book on the Brahmaputra depicting it in all its facets.

The Brahmaputra is not just a geographical entity; it is a civilisational flow and the essence of Assam's cultural legacy which values nature as a bounteous source of nurture. Such are the diverse ways in which it has moulded the rhythms of work, culture, belief and oneness with nature that it is truly the lifeline of Assam. It is for this reason that the government has taken assiduous steps to address the challenges of floods and erosion as well as prepare an integrated and comprehensive plan for the sustainable development of the region.

I believe this book will be of immense help to planners and the leaders of today in conceptualising a new vision for river management in Assam. Let us not forget that the flow of the river is the flow of life itself.

I convey my best wishes to the editorial team and hope the endeavour sees its heydays.

(TARUN GOGOI)



Dhritiman Mukherjee

# Basanta Das



**Minister, WRD, Assam  
Government of Assam  
Assam Secretariat  
2<sup>nd</sup> Floor, Block B,  
Dispur, 781006**

## MESSAGE



*A* magnificent river of mystery is how the Brahmaputra finds mention in several mythological texts and epics of India. Down the ages, the river has shaped the demography, economy, culture and flora and fauna of Assam, nurturing an incredible diversity of flora and fauna as well as communities along its banks. This illustrated coffee table book, brought out by the Flood and River Erosion Management Agency of Assam (FREMAA) with financial support from the Asian Development Bank, is a model effort at seeking to capture in the flows of the Brahmaputra the many narratives of history, economy, culture and nature. The range of written content and excellent photographs depicting the river in its many moods promises to be a rare delight for readers.

I appreciate the effort of FREMAA in making a valuable contribution to the trove of existing accounts of the Brahmaputra.

(BASANTA DAS)



V.K. Pipersenia, IAS



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## MESSAGE



*The* mighty Brahmaputra, which originates from a glacier in the Kailash mountain range, thunders, gushes and flows for 2900 km through Tibet, India and Bangladesh, shaping the destinies of millions of people. The river has enriched their cultures, nurtured their economic activities, and ensconced them amidst nature of unmatched beauty. As a river emerging from a difficult terrain, the Brahmaputra has always posed a challenge for explorers and geographers. Even though the entire reach of the river has been explored in recent decades, its mystique remains unchallenged, as does the faith of the people in its flow.

It gives me immense pleasure to know that FREMAA has come out with a coffee table book that promises to draw readers into the vast universe of the Brahmaputra, giving them a glimpse of its many unknown facets. I am sure this book will make academics and policymakers look at the Brahmaputra with a new perspective.

(V.K. PIPERSENIA)



R.T.Jindal, IAS



**Additional Chief Secretary  
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## MESSAGE



*The* river Brahmaputra is central to the life of the people of Assam. It influences not only their livelihoods, but also their history and culture. The river has made the valley of Assam a globally important centre of biodiversity with a huge variety of flora and fauna.

I am glad to know about the publication of this book that covers various aspects of the river including its place in history, its impact on the region's economics, socio- culture and biodiversity.

I congratulate Dr K.K.Dwivedi and his team. I hope the readers will find this book very informative and well illustrated.

(R.T.JINDAL)



# Hemanta Narzary, IAS



**Principal Secretary, WRD  
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Assam Secretariat  
2<sup>nd</sup> Floor, Block-A  
Dispur-781006**

## MESSAGE



*I* gives me great happiness to know that FREMAA has taken the initiative to document the varied contributions of the wondrous Brahmaputra. The timing of the book is quite appropriate for it comes at a time when there is a great deal of debate around the issue of dams being constructed on the river in China and India. While there has been considerable research on the morphology and hydrology of the Brahmaputra, there have been fewer attempts to document the river's influence on the social, cultural and environmental aspects governing people's lives. In that sense this book marks a first in bridging this gap and providing a fresh starting point for future research.

I congratulate FREMAA and all the consultants involved in the process of bringing out this book.

(HEMANTA NARZARY)





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# Introduction

The Brahmaputra is my home. Its valley is where I work. For nearly 20 years now I have lived my life in tune with its majestic flow, mystic aura, regal grandeur and sublime grace. Awestruck by its mesmerising vistas, surely a masterpiece of nature, I have spent countless evenings made soothing by its soundscape – the rhythm of ripples and oar, and voices carrying across the huge watery expanse from the other shore. I still remember the wonder I felt when I saw for the first time this mighty river, nearly an ocean, that flows to the very end of the horizon. This sense of wonder gave rise to a passionate desire to know the river and to protect it.

Rivers have always been part of my life. I grew up on the banks of the Ganga in Allahabad. The Sangam, the confluence of Ganga and Yamuna, was my playground. The allure of boat rides or visits to the Kumbha Mela with my parents, including the ritual dip, form the vibrant tapestry of my childhood memories.

My tryst with the Brahmaputra began in 1997 when as part of the Assam cadre of the Indian Administrative Service I was first posted in Goalpara. The Goalpara Circuit House, surrounded by the Brahmaputra, was my first home. Every morning I would wake up to the sound of waves as they crashed against the rocks under an ethereal sky painted in the colours of the sunrise. Evenings were enlivened by the Goalporia folk songs sung by the fishermen while returning home with their catch.

Call it sheer coincidence or a deeper design at work, but every town I was posted in from Sadiya to Hatsingimari happened to be located on the bank of the Brahmaputra, covering the entire stretch of the river in Assam. In 2007, as Deputy Commissioner Tinsukia, I visited Kobo Chapori, the point where the rivers Siang, Lohit and Dibang merge to create the vast flow we know of as the Brahmaputra.

During my posting in Tinsukia one of the places I visited fairly often was the town of Sadiya, - it came under my administrative jurisdiction, for which I had to cross the river. Gradually, I immersed myself in accounts relating to the river. I was thrilled to discover that the British Political Officer J. F. Needham who went on an expedition to Tibet's Zoyul Valley in 1885 and discovered that the Yarlung Tsangpo-Siang - Brahmaputra waterway was actually the same, was posted in Sadiya at the time!

When I geographically sequence my postings in Jonai, Tinsukia, Dibrugarh, Sivasagar, Guwahati, Barpeta and Goalpara, among others, they follow the river's course from its beginning to its downward journey. All these stints provided me a golden opportunity to become intimately familiar with the Mahabahu Brahmaputra, as the river is known in Assam. I travelled to national parks and wildlife sanctuaries located on the banks of the river and photographed the amazing array of floral and faunal diversity that it nurtures. I also went further onto the river islands and forest villages and set up relief camps to help the people on the occasions when the river was in spate. In due course I



Aerial view of the Brahmaputra





Wetland in Majuli



experienced the serene as well as the fierce aspect of the Brahmaputra.

In fact, it is the circle of life created by the two faces of Brahmaputra that lies at the heart and soul of Assam. Its civilisational flows have shaped the way of life of the people here as reflected in the region's history, economy, literature, art, music, folkore, tradition, religion and philosophy. The river has also made possible and nurtured the coming together of people of different ethnicities and communities thus leading to the evolution of Assam's enviable composite culture.

Despite the undoubted influence of the Brahmaputra on each and every aspect of life in Assam, there is a dearth of literature on it. While studies and surveys have been conducted on its hydrology and morphology, not many efforts have been made to ascertain the extent to which the Brahmaputra has nurtured Assam's flora, fauna and the overall physical environment, and ways in which it has fundamentally shaped the socio-economic growth of the region.

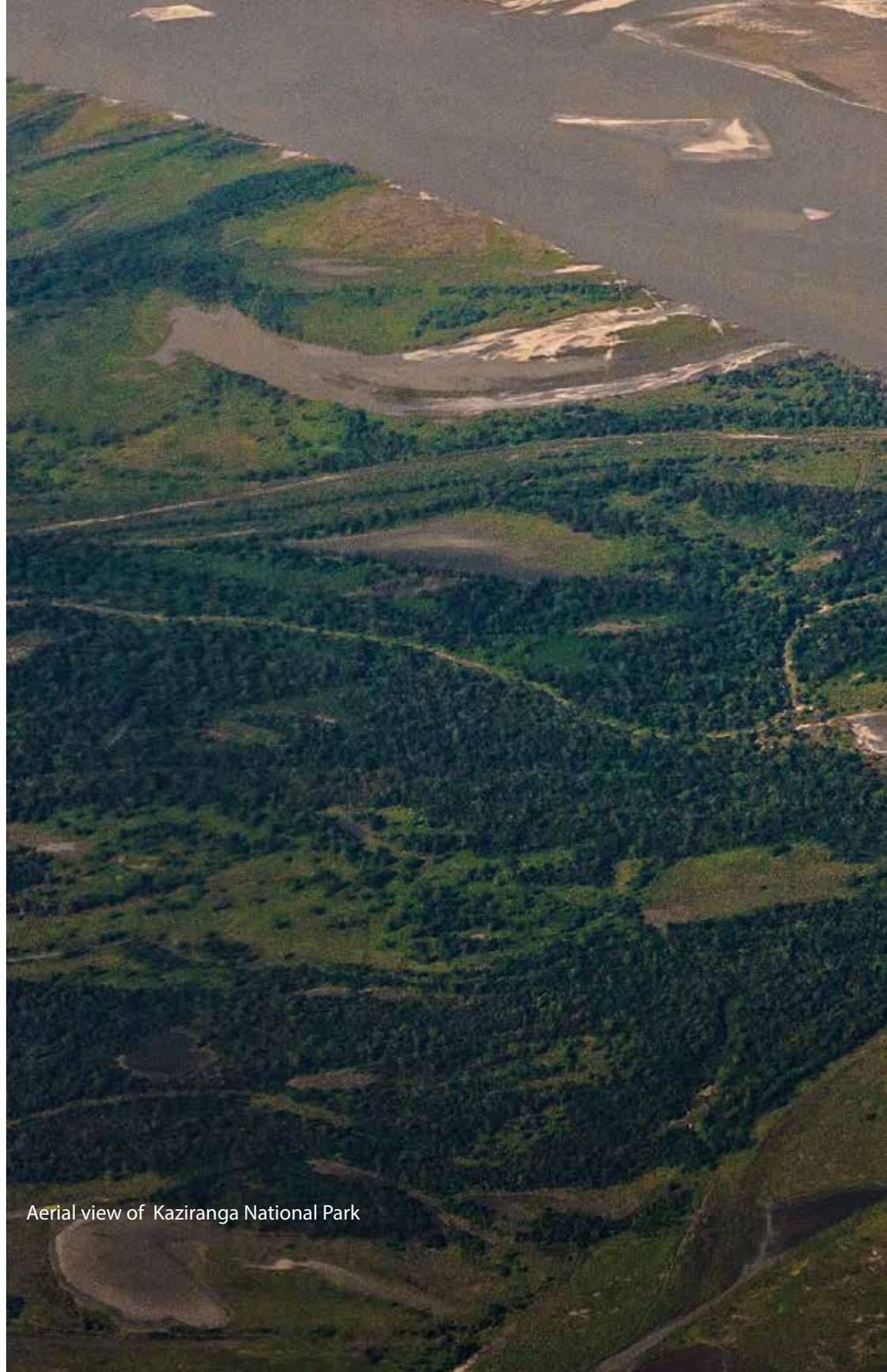
In February 2013 I was assigned a new role as CEO of the Flood and River Erosion management Agency of Assam (FREMAA). It was then that the idea of documenting the colours, hues, shades and moods of the Brahmaputra started to take definitive shape in my mind. When I discussed the concept with Ms Notsuka Totsuko, Mission Leader of the Asian Development Bank, she enthusiastically supported the proposal. TETRATECH India Ltd, the Project Management Consultant of FREMAA, brought experts and coordinated their extensive field visits, interaction with stakeholders, conduct of surveys, and also helped in putting the book together.

Our extensive travels bore fruitful results. We collected a treasure trove of information, shot photographs and video clips. A breathtaking array of photographs, including -aerial shots from drone, paramotor and airplane, underwater shots and images captured through camera trap -- show the Brahmaputra as never before. The visual contents as well as the original reports of experts can also be viewed online at [www.thebrahmaputra.in](http://www.thebrahmaputra.in) in an interactive format. The idea behind the endeavour is to provide a substantial reference base for researchers, planners, policy makers, academicians and interested lay readers.

This book is an effort to take the reader on a pictorial journey of the Brahmaputra which gently unravels its life cycle and bounties of nature, the mysteries and legends surrounding places on the river and, most of all, the myriad ways in which it has nurtured the body and spirit of the people whose lives are bound to it.

Welcome to an enthralling voyage on the Mahabahu Brahmaputra.

K.K.Dwivedi



Aerial view of Kaziranga National Park





Aerial view of Umananda Temple in Guwahati



# Journey

# A Moving Ocean

LIFE COURSE OF THE BRAHMAPUTRA

K K Dwivedi

नमस्ते ब्रह्मपुत्राय नमः शन्तनुसूनवे ।  
त्रिजन्मजञ्च यत्पापं हर मे लोहितात्मक ॥

O Son of Brahma! O Son of Shantanu! O Son of Lohit!  
I bow before you, wash away my sins of the last three births

-Yoginitantra.

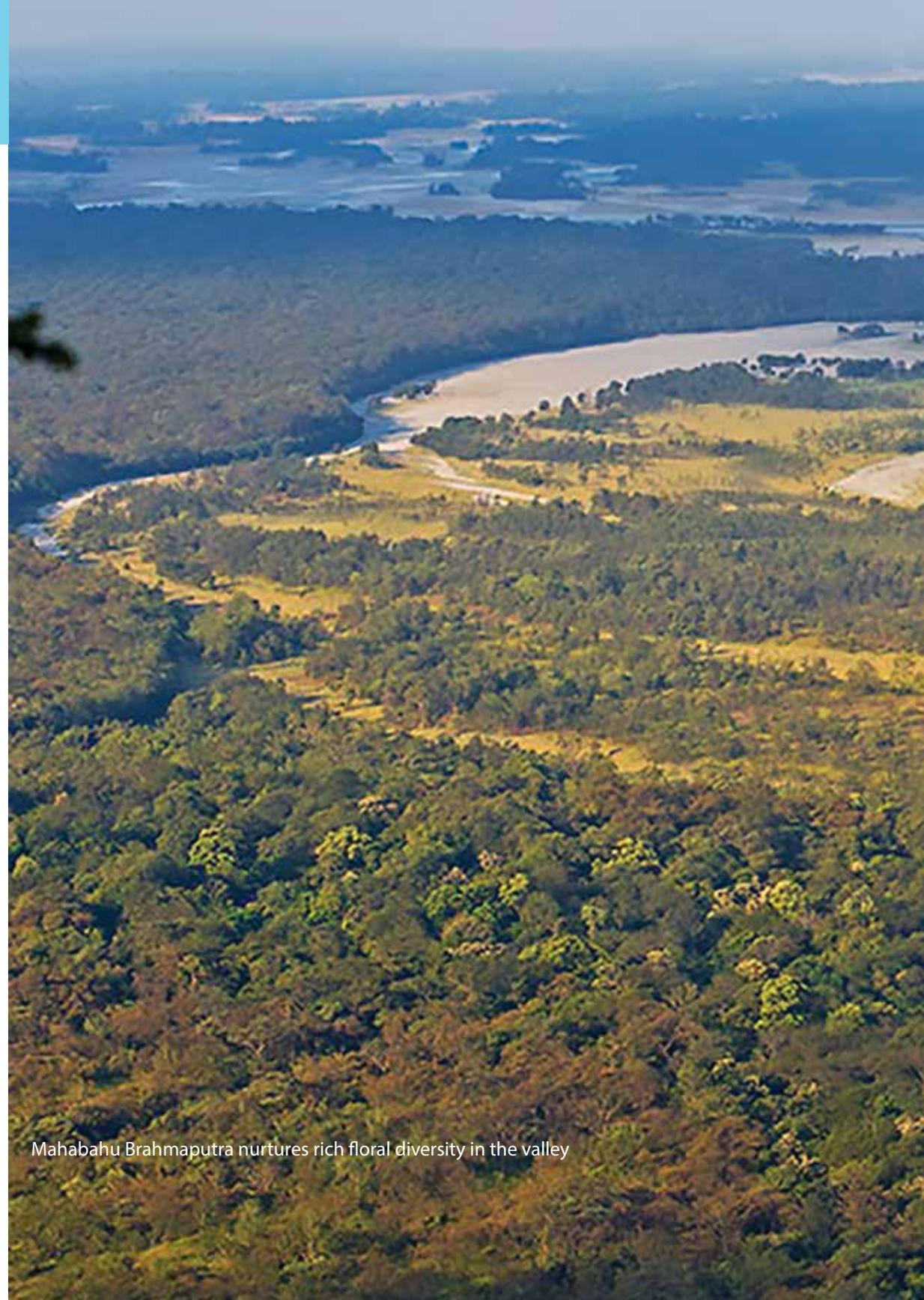
**A** moving ocean, no less, the Brahmaputra, which bestows the gift of life upon millions of people in Tibet, India and Bangladesh, is a river of myth, mystery and legend, revered by the Hindus, Jains and Buddhists alike. Gathering many rivers within its fold in its journey to the Bay of Bengal, it dominates the vast landscape of North-east India as it gushes down with tremendous force across time and space, enriching a vibrant array of traditions, culture and spirituality in the region.

## Mythology of a river

The *Mahabharata*, Kalidas' *Raghuvamsham*, the *Hastayurveda* and other ancient Sanskrit texts refer to the Brahmaputra as Lauhitya.

The first mention of Brahmaputra is found in the *Kalika Purana* (10th Century C.E.) followed by the *Yoginitantra* (16th Century C.E). The legend of Brahmaputra starts with sage Shantanu and his wife Amogha who lived on the bank of Lake Lohit on Mount Gandhamardan in the Kailash Range. One day when the sage was away, Brahma came there and was attracted to the beauty of Amogha. However, frightened at the sight of Brahma's four heads and four arms Amogha shut herself in the hut. Fearing her curse and racked with shame Brahma departed, leaving his *brahmabeej*(semen) there.

When Shantanu learnt about the incident, he asked Amogha to consume the *brahmabeej*. After a period, a stream of water issued forth from Amogha's nostril, signifying the



Mahabahu Brahmaputra nurtures rich floral diversity in the valley



birth of Brahma's son in the form of water. Shantanu placed the child amidst four mountains -- the Kailash, Gandhamardan, Sanvartak and Jarudhi in the north, south, east and west, respectively. Gradually, the child expanded into a great lake-- the Brahma Kunda.

One day Parashuram, on the advice of his father, came to the Brahma Kunda and bathed in it to wash away the sin of having beheaded his mother. Thereupon, cutting his way through the mountains he brought the water from Brahma kunda to Lake Lohit in the Kailash Valley. As he further cut through the Hemshringa mountain, the water flowed towards Kamakhya. Brahma named the stream Lauhityaganga. Later it came to be known as the Lauhitya because it started this journey from Lake Lohit, and also the Brahmaputra , the son of Brahma Incidentally, Brahmaputra is the only river in India with a male name.

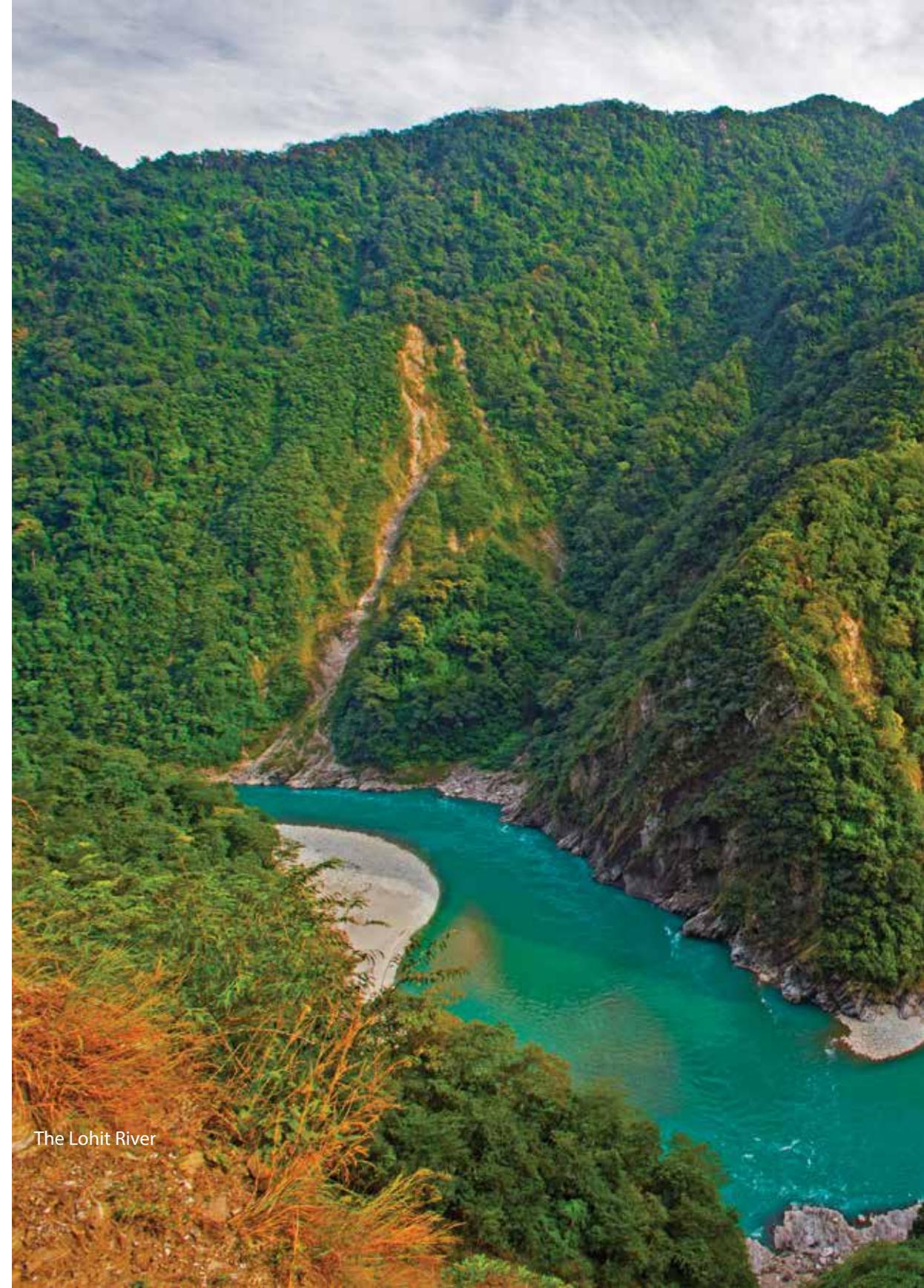
Many believe that Brahma Kunda and Parashuram Kunda are the same. But the latter is located on the Lohit River about 25 km north of Tezu in Lohit District of Arunachal Pradesh. It is a *tirtha* or pilgrimage and is visited by the devout in large numbers. Particularly so on Makar Sankranti (14 January), when the sun enters the zodiacal sign of Makar (Capricorn), in the belief that taking a bath in the 'kunda' on this auspicious day would wash away all their sins.

Tibetan mythology has its own origin myth where the Brahmaputra is concerned. Legend has it that a small stream starts from Mount Tise (the Kailash) to Mapham Tso or the Mansarovar Lake which is protected by four divine creatures --a lion, elephant, horse and peacock. From their mouths four rivers flow out --the Senge Khambab (the Indus), Lanchen Khambab (the Sutlej), Mapchu Khambab (the Karnali), and Tomchok Khambab (the Brahmaputra) towards the north, west, south and east, respectively.

Mount Kailash (6638 m) is a sacred place for Hindus, Buddhists, Jains and the Bonpo. For the Hindus, Mount Kailash is the abode of Lord Shiva and it signifies one of the most sacred and arduous pilgrimages. Buddhists believe that Kang Rimpoche ('snow jewel' - their name for Mount Kailash) is the home of God Demchog and his consort Dorje Phagmo. In Jain mythology, Kailash is worshipped as Mount Asthapada where the first Tirthankara of Jainism, Rishabhdev, attained freedom from the cycle of rebirth. Followers of the Bon, the religion of Tibet before advent of Buddhism in the seventh century C.E., believe that it was on Mount Kailash that their founder, Tonpa Shenrap, descended from heaven.

### Search for the river's origins

The Tibetan terrain is so inhospitable that the origin, source and course of the



The Lohit River



Dhritiman Mukherjee

Brahmaputra remained a mystery until the 19th century. How the Yarlung Tsangpo (the 'Purifier' as it is known in Tibet) reaches the sea beyond the Tibetan Plateau and whether it merges with the Yangtze, Mekong, Salween, Irrawady or Brahmaputra posed a big mystery to explorers. The suffix Tsangpo (river) is used for rivers originating or flowing through the Tsang province of Tibet. Other rivers like Sun Kosi and Trisuli flowing from this region are known as the Matsong Tsangpo and the Kyirong Tsangpo, respectively. A tributary of Yarlung Tsangpo (Brahmaputra) is known as Raga Tsangpo.

The discovery of Brahmaputra's origins is as fascinating as the river itself. One of the first clues was provided by Italian Jesuit Ipolito Desideri, the first European to reach Lhasa in 1715 C.E.. He heard that Tsangpo and Brahmaputra were part of the same waterway. In 1783, when Major James Rennell, the General Surveyor of the East India Company, also known as the Father of Indian Geography, compiled the first map of India in *Memoir of a Map of Hindoostan*, he showed the Yarlung Tsangpo and Brahmaputra as one and the same river.

In early 19th century, many expeditions were mounted to explore the upper reaches of the Brahmaputra in India. In 1825, in the course of an expedition, Captain Philip Burlton discovered that three rivers –Dihang (Siang),Dibang and Lohit merge at the foothills of the Himalaya to form the Brahmaputra.

To find out if the Brahmaputra, Siang and Yarlung Tsangpo are the same river, the British sent many expeditions from the upper reaches of Assam. Since the British were not allowed to enter Tibet, they sent many Indians in the guise of Buddhist monks, called 'pundits', to explore the Tibetan region. Captain Henry Harman sent Kinthup, a Lepcha from Sikkim, on one such expedition in 1880. Kinthup confirmed that the Yarlung Tsangpo and Brahmaputra was the same river. In 1885, again, J.F. Needham, the Political Officer at the British outpost of Sadiya, set out on an expedition to Zayul Valley in eastern Tibet in the company of Captain E.W. Molesworth and established that the Yarlung Tsangpo is the upper course of the Brahmaputra.

As the 20th century dawned, efforts to find the source of the river gathered pace, and several claims were put forth. In 1907, Swedish explorer Sven Hedin travelled to Mansarovar, earning the distinction of becoming the first westerner to circumambulate the Kailash. He claimed to have found the source of the Brahmaputra or Yarlung Tsangpo in the Kupa Glacier.

In 1913, while surveying the Yarlung Tsangpo Grand Canyon, British explorer and secret agent Frederick Marshman Bailey and mountaineer Henry Morshead conclusively proved that the Yarlung Tsangpo, Dihang or Siang and Brahmaputra were a single river. In 1924, English explorer Frank Kingdon-Ward set out to discover a colossal waterfall that he thought would explain how Yarlung Tsangpo descends



Kobo Chapori where Lohit, Dibang and Siang merge to make Brahmaputra

Kashmira Kakati

suddenly from an altitude of 3150 m north of Mount Namcha Barwa to 135 m at Sadiya within a distance of only 200 km. While, to his disappointment, he did not discover the massive waterfall he had expected to locate, he did come across a 108 feet high waterfall which he named Rainbow Falls.

In 1937, Swami Pranavanand, who travelled extensively in the Kailash Mansarovar area, claimed in his book *Kailash Mansarovar* that the origin of the Brahmaputra was to be found in the Chemayungdung Glacier (5150 m), which is 75 km to the east of Mansarovar and separated from it by Mount Maryum-La (5150 m), 150 km away from the source of the Indus, and 35 km from the source of the Setluj.

In 2011, Lui Shaochuang and his team at the Chinese Academy of Sciences used remote sensing images to map the Qinghai-Tibet Plateau following which they pointed towards Angsi Glacier, located on the northern side of the Himalaya in Tibet's Burang County, as the source of the Yarlung Tsangpo. They put the river's length at 3848 km and its drainage area at 7,12,035 sq. km. while the internationally accepted estimate of the distance travelled by the river is 2897 km, with its drainage area estimated at 5,80,160 sq km.



Braided river Brahmaputra

Dhritiman Mukherjee



Three glaciers claimed to be origin of the Yarlung Tsangpo - Brahmaputra

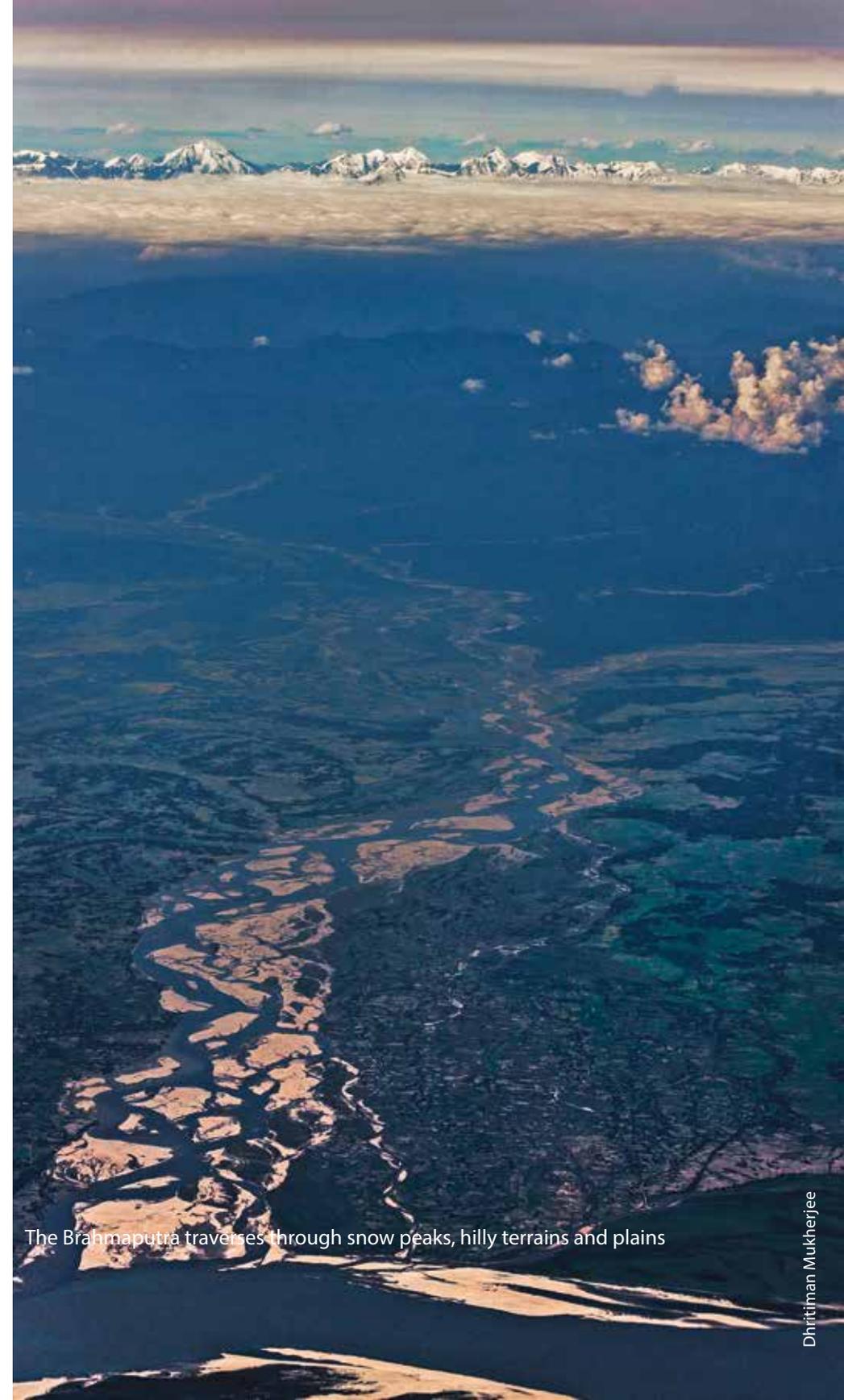
Yarlung Tsangpo-Brahmaputra River Basin



The Brahmaputra is so vast in stretches, it looks like a moving ocean



Dhritiman Mukherjee



The Brahmaputra traverses through snow peaks, hilly terrains and plains

Dhritiman Mukherjee



Parashuram Kunda on the Lohit River in Arunachal Pradesh

K K Dwivedi

## An epic course

The course of the Yarlung Tsangpo or Brahmaputra is truly a wonder of nature. From its source, the Yarlung Tsangpo flows in an eastward direction for 1625 km on a moderate slope in the Tibetan plateau between the Kailash Range in the north and the Greater Himalaya in the south..

After passing Pe Village in Tibet, the river makes a sharp turn in a north and northeast direction around the highest peak of east Tibet, Namcha Barwa (7756 m), justifying its title 'The Great Bend'. Then as the river flows in a south and southwest direction it hurtles into a spectacular canyon or gorge formed by Namcha Barwa (7756 m) and Gyala Peri (7151m). The Grand Canyon of the Tsangpo -- or Pema Ko as it is called in Tibet -- is the world's deepest (6009 m at its deepest point in Zongrong Village), longest (504.6 km) and narrowest (35 m) canyon in the world. Because the river is so difficult to access and kayak through, the canyon has been called the Everest of Rivers.

It is mindboggling to think of a river which measures about 660 m wide at the entrance of a canyon shrinking to 35 m at its narrowest point! The Zangqobalong (117.7 m) is the widest waterfall in the Grand Canyon of the Tsangpo, and the Bailang is the tallest at 35 m high. This area remained unexplored till 1998 when Buddhist scholar and explorer Ian Baker, Ken Storm and Brian Harvey succeeded in kayaking through the canyon.

The Buddhists consider the Pema Ko ( Grand Canyon of the Tsangpo ) to be one of their most sacred Beyul (hidden land) blessed by Guru Padmasambhava, the Indian

master (8th Century C.E) and founder of Vajrayana Buddhism in Tibet. So remote from the world is the Grand Canyon of Yarlung Tsangpo that it is one of the undisturbed ecological wonders of the world to this day. Its ecosystem is so diverse that it is described as one of the richest natural arboretum, natural zoo and plant gene bank on the planet, with over 3768 plant species, 2000 insect species, 680 fungi species, 232 bird species, and 31 amphibian species. This area is home to rare mammals like the black muntjac, and the wild goat-antelope called takin. Further, the river has an incredible hydropower potential of approximately 40000 MW.

Thereafter, the Yarlung Tsangpo enters northern Arunachal Pradesh at Gelling, a village in Upper Siang District from where it is known as the Siang or Dihang. Flowing further down for about 200 km, the Siang is joined by the rivers Lohit and Dibang at Kobo Chapori, approximately 25 km from Sadiya, at the head of the Assam Valley. The confluence of Siang, Dibang and Lohit creates a 'delta in reverse'. From here the river is known as the Brahmaputra.

Earlier it was believed that the Lohit was the main stream of the Brahmaputra, hence it is also known as *Luit*, *Borluit* and *Burhaluit* in Assam. In view of the high seismicity of the Himalayan region it is possible that at some point Lohit might have been the main stream of Brahmaputra. According to mythology, Parashuram washed his blood-stained axe in the river after his act of matricide that turned the river red, giving the river its name Lohit, meaning blood. Studies have shown that the reddish water of the river is attributed to the lateritic soil it carries from the hills. Lohit originates from the Zayul Chu range in eastern Tibet and traverses Arunachal Pradesh, through the



Saint on pilgrimage to Parashuram Kunda

K K Dwivedi

Mishmi Hills for 200 km before merging with the Siang.

It is in the plains of Assam that the Brahmaputra assumes its leisurely and regal flow in an east to west direction, bringing as many as 52 major and 121 minor tributaries into her voluminous folds. In the downstream flow to Dibrugarh the river is divided into two channels: the northern channel is called Kherkutia and the southern, main channel is known as the Brahmaputra. Both channels join about 100 km downward in Jorhat forming the 90 km long and 20 km wide Majuli island, one of the largest river islands in the world with a human population of over 150,000.

Traversing through Tezpur, Kamrup and Goalpara, the river flows into Bangladesh from Dhubri. Here the Teesta River enters its fold. Further downstream, the river again divides into two streams – the main stream, called Jamuna, flows 270 km to merge with the Padma (Podda) River, a stream of the Ganga, at Goalundo. The second channel, Brahmaputra (Brohmoputro), joins the Meghna River near Dhaka. From there on, the



Large numbers of people come for holy dip in Parashuram Kunda

Ranjita Bania



The braided nature of the Brahmaputra seen in Assam



Dhritiman Mukherjee

river in its downward course, is known as the Meghna. Near Chandanpur the Padma merges with the Meghna and then divides into multiple channels -- resembling the roots of the banyan tree -- before flowing into the Bay of Bengal. In the process it forms the world's largest delta.

The spellbinding nature of the Brahmaputra's physical feat is exemplified by just one detail: from its source ( alt. 5210 m) to Pe village in Tibet (alt. 3300 meter), the Yarlung Tsangpo descends only 1910 m over a distance of 1625 km, that is, on a low gradient or slope. But, in the next 200 odd km when the river reaches Sadiya, it descends by as much as 3150 m with a gradient of 157-310 m per km along this stretch. The sheer force generated by the river due to its sharp descent expresses itself by depositing a huge amount of sediment in the Assam plain and by branching off in multiple directions. With an average width of 10 km the river flows in three to six channels and forms thousands of islands and sandbars.

After entering Assam in a powerful burst, the Brahmaputra's demeanour changes. Between Kobo, where it enters Assam, to Dhubri, where it flows into Bangladesh, its gradient is only 1.5 m per km. As the slope reduces, the flow of the river too slows down, and at that lower velocity, its capacity to carry sediment out to the sea is reduced. Consequently, the sediment ends up getting deposited on the river bed and on the banks, widening the river.

## A colossal young river

The Brahmaputra is the biggest river in India as it carries the largest amount of water and silt among all the rivers in the country. It is the widest and second highest sediment-transporting river in the world after the Yellow River or Hwang He of China, and the fourth largest in the world in terms of the average discharge of water at the mouth of  $19,830 \text{ m}^3\text{s}^{-1}$ .

Geologically speaking, the river is the youngest among the major rivers in the world. Beginning its flow between the main Himalayan range of the Eurasian plate and the Kailash Range of the Indian plate, it flows along a seismically active fault in an unstable Himalayan terrain. Geomorphologically, the river has been severely disturbed at various points in time. For instance, following the high magnitude of earthquakes of 1897 (8.7 on Richter scale) and 1950 (8.6 on Richter scale) the river bed of the Brahmaputra and its tributaries lifted, which resulted in a change of the river's course. Thereafter a tendency to shift course southward has been observed in the Brahmaputra. Following the 1950 earthquake, a large part of Dibrugarh and Sadiya towns were washed away. Near Dibrugarh and the upper reaches the Brahmaputra was silted up 2.5 m to 3 m deep.

## A vast river basin

An idea of the vastness of the basin can be had by pointing to its spread - it extends as far north as the Kailash and Nyen-chen-Tanghala range while in the south it extends up to the Nepal Himalaya, the Noya and Barail ranges as well as the Meghalaya Plateau. Eastwards it extends as far as the Salween river basin and Patkai range along the Indo-Myanmar border; and westwards it extends up to the Ganga river basin.

The Brahmaputra's total basin area across China, India, Bhutan and Bangladesh is 1540 km long and 780 km wide. Although the river does not flow through Bhutan, it is an integral part of the Brahmaputra basin as many of its tributaries come through it. The drainage basin of the Brahmaputra is 5,80,160 sq km out of which about 2,93,000 sq km falls in China, 1,94,413 sq km in India, and about 45,000 sq km in Bangladesh. The drainage area in India is about 6 per cent of the total geographical area of the country. While alluvial and loamy soils predominate, lateritic, sandy, and clayey soils are also found in the basin area.

The Brahmaputra basin has the potential to meet 30 per cent of India's water requirements and 41 per cent of its hydropower needs. As for Bangladesh, it fulfils 94 per cent of its total water requirements.

## Climate

The Brahmaputra basin has varied climatic conditions, from snow covered peaks to the cold and dry Tibetan plateau; from hot and humid Assam to the floodplain delta of Bangladesh. The mean annual rainfall in the Brahmaputra basin excluding the Tibetan area is 2300 mm. The monsoon rain from June to September contributes between 60 to 70 percent of the annual rainfall in the basin. There are 610 glaciers in the Indian part of the Brahmaputra basin covering an area of 928.91 sq km with a volume of 49.57 cubic km. Out of these 161 glaciers are located in Arunachal Pradesh, and the remaining 449 are in the Teesta basin. Snowfall is experienced in Arunachal Pradesh from an altitude of 1500 m and above. The diverse climatic condition of the Brahmaputra basin makes it very susceptible to climatic change.

## Floods and erosion

A combination of morphological features and physiographical, geological and geomorphological conditions cause severe floods in the Brahmaputra basin of Assam. Excessive precipitation usually results in three or four waves of severe flooding from



Floods wash off a road in the monsoon.

Janasanyog Assam



A concrete bridge broken by the force of flood waters.

Janasanyog Assam



Aerial view of the devastating flood in Assam



Average 8000 Hect land is eroded by the Brahmaputra every year

KK Dwivedi

May to September almost every year. The flood prone area of the state is 31,500.00 Sq Km which is about 39.58 % of the total land area of Assam. This figure is almost four times the national average (10.2 per cent) of the total flood-prone area across the country! This and the fact that floods in the river basin account for 9.4 per cent of the total flood-prone area of India give an idea of the magnitude of this annual phenomenon.

Due its physical features, the Brahmaputra carries a huge amount of sediment or silt. As much as 97 per cent of the silt comprises sand which causes erosion. Consider these facts:

- From 1916 to 1926, the total area of the Brahmaputra in Assam was around 3870 sq km; by 2006 it had expanded to 6080 sq km.
- Due to continuous braiding and widening of the river, over 4.27 lakh hectares of land amounting to 7.40 per cent of the total area of Assam has been eroded. Since 1950, on an average, about 80 sq.km of land area is engulfed every year. Many villages have been completely eroded in the floods and thousands of families rendered homeless.

According to official estimates, the total loss caused by floods and erosion in the period 1953-2005 was nearly Rs. 26000 Million.

Floods and erosion not only cause loss of human life, cattle, dwellings and property; they also result in damage to economic infrastructure, loss of livelihoods and cause social disruption.

### Impact on the environment

National parks located on the Brahmaputra are very vulnerable to flooding and erosion. Among them are Dibru-Saikhowa, Kaziranga and Rajiv Gandhi Orang. The latter, located on the river's northern bank over an area of 78.80 sq km, is the oldest game reserve of Assam and an important breeding ground for many fish varieties. The iconic Kaziranga, a UNESCO World Heritage site famous for its rhinoceros, tigers and elephants, is also under grave threat. Between 1912 to 1998, a total area of 84.87 sq km of the park area suffered erosion along the 53 km length of the river. The average erosion in Kaziranga has ranged between 1 sq km to 1.6 sq km per year. The large woodland area of Dibru-Saikhowa, a biodiversity hotspot, has also suffered erosion and its huge grasslands have been silted over.

Another prominent example is that of Majuli, one of the biggest river islands of the



Erosion by the the Brahmaputra in Kaziranga National Park is a serious threat to wild life

world, which is shrinking due to severe erosion. In 1853, Majuli was spread over an area of 1246 sq km which shrank to 880 sq km by 1993 and to about 506.37 sq km in 2008. This means about 60 per cent of the original spread of the island has been eroded.

Floods do not always have a negative impact. In ecological terms, floodwater recharges the moisture in the soil and replenishes wetlands, resulting in enhanced agriculture and fish production. Floods also improve the water table in the plains. Fine silt brought by flooding is considered to be beneficial for fishes in the lower reaches of Bangladesh.

### **Institutional arrangements for flood management**

Institutional arrangements are in place for river management in Assam so as to prevent floods and erosion. Water Resource Departments of the Government of India and the State Government of Assam, the Brahmaputra Board and the Central Water Commission, in collaboration with the Indian Institute of Technology (IIT), Indian Space Research Organisation (ISRO) and other national and international agencies, plan and implement projects and programmes for managing the Brahmaputra and its

tributaries. Flood and River Erosion Management Agency of Assam (FREMAA) also implements flood and erosion management projects funded by the Asian Development Bank. In fact, FREMAA is working on developing a reliable flood forecasting system as well as a remote sensing-based mechanism to predict erosion.

About 1023 km of embankment and 20 sluice gates have been constructed over the Brahmaputra to prevent floods. Hydropower projects are also underway, and many more have been proposed in Arunachal Pradesh on the Siang, Dihang and Lohit. Huge dams are expected to control flooding in Assam's plains.

Some experts suggest that if the Brahmaputra channel is narrowed, deepened and aligned straight with the help of parallel guide dams the river would develop a high velocity, enabling it to carry the entire silt load. This would help prevent the floodwater from rising and also keep a check on erosion and widening of the river bed. Further, it would reduce the impact of floods in the basin area and make the river navigable for big ships. That, in turn, would provide carbon-free and cheap transportation of people and goods. Huge areas of arable land would also be reclaimed in the process.

Of late, there have been reports about a multipurpose dam proposed by China at Pema Ko at the Great Bend near India's northeast border, the aim being to generate 40,000 MW electricity and divert the water towards the parched provinces of Xinjiang and Gansu in the Gobi Desert. These reports have raised concerns in India about the ramifications of the proposed project. On the other hand, there is a view that the threat is overly exaggerated owing to the fact that only about one fifth of the Brahmaputra's total discharge in Assam comes from Tibet, the remaining accounted for by tributaries which do not originate from China.

## River of Navigation

For a distance of about 640 km downstream of Lhatse Dzong, at an average altitude of about 3500 m, the Yarlung Tsangpo is one of the highest altitude rivers in the world to be navigable. The Brahmaputra is navigable over 1385 km, from Dibrugarh to the mouth of the river in Bangladesh, and it has been made use of as a mode of transport from ancient times.

The East India Company took to navigating the river for transportation in a big way from 1844. The Joint Steamer Company introduced steamships in 1847. Tea and coal were transported from Upper Assam to Kolkata via Dhaka by steamer through the Brahmaputra for further export to other parts of the world. The navigation was tedious and difficult - it took about 65 days to reach Saikhowaghat in Tinsukia from Kolkata. After 1947, following the creation of East Pakistan, now Bangladesh, this river



The sun sets on Majuli



transportation route to Kolkata was stopped.

In 1988, a stretch of 891 km between Sadiya to Dhubri was notified as National Waterways 2. There are a total of 11 terminals on the waterway, owned by the Inland Waterways Authority of India (IWAI) and operated by the Central Inland Water Transport Corporation (CIWTC) of India. Following an agreement with Bangladesh, CIWTC and other Indian vessel operators are able to ply their cargo vessels between Assam and Kolkata through Dhaka. As per the estimates of the Inland Water Ways Department of the Government of Assam, over 4000 boats ply on the Brahmaputra in Assam; in 2013-2014, over seven million passengers and more than 35000 metric tonne goods were transported on this river route in Assam..

The need of the hour is to maximize the potential of the Brahmaputra and simultaneously minimise the impact of floods and erosion. To achieve this aim it is necessary to ensure the involvement of all the stakeholders, from government and non-government agencies to planners, engineers, private sector industries, environmentalists, knowledge institutions and last but not least, the local communities in planning and implementation of structural and non-structural measures in a holistic and comprehensive manner to address the issue of river management.



Brahmaputra supports large scale transportation of goods and people



The sky darkens as passengers cross the Brahmaputra on a ferry.

## Brahmaputra profile

Sl. No.	Particulars	Information		
1	Name			
	China	Yarlung Zangbo, Jiang , Pinyin		
	Tibet	Yarlung Tsangpo, Tomchok Khambab		
	India	Arunachal Pradesh	Dihang , Siang	
		Assam	Brahmaputra, Lohit, Luit, Bor Luit, Burhaluit, Burkung Buthur(Bodo), Nam- Dao-Phi(Ahom)	
	Bangladesh	Jamuna, Meghna		
Bhutan	Brahmaputra			
2	Source	Angsi Glacier (Lui Shouchuang), Chemayung Dung Glacier (Pranavananda), Kubi Glacier (Sven Hedin)		
3	Elevation	5,210 m, Chemayungdung Glacier		
4	Countries Covered	China, India, Bangladesh		
5	India	States in India	Arunachal Pradesh, Assam	
		Major cities on the bank of Brahmaputra in Assam	Sadiya, Dibrugrah, Tezpur, Guwahati, Goalpara, Dhubri	
6	Mouth	Bay of Bengal Bangladesh,Ganga Brahmaputra Delta-largest in the world	59510 SqKm	
	Length	Total	2897Km	
	China(Tibet)		1625Km	
7	India	Arunachal Pradesh	198Km	
		Assam	720Km	
		Total length in India	918Km	
	Bangladesh		354Km	
8	Wide in Assam	Average	5.46 Km	
		Min	1 Km at Hajo Guwahati	
		Max	16 Km in Dibrugarh	
9	Wide in Bangladesh	Jamuna-12 Km		
		Padma- 9.5 Km		



Fishermen row home as the sun sets on the Brahmaputra



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Sl. No.	Particulars	Information		
10	Depth	3 to 120 m		
11	Discharge	Annual	700 million metric ton	
		Average	19,300 m <sup>3</sup> /s (681,600 cu ft/s)	
		Max	100,000 m <sup>3</sup> /s (351,500 cu ft/s)	
	Brahmaputra basin	Total	580160Sq Km	
		China (50.51%)	293000 SqKm	
12	India (33.52%)	Total	194413 SqKm	
		States in India	Basin Area	% State area in Brahmaputra Basin
		Arunachal Pradesh	82424 SqKm	100%
		Assam	70634 SqKm	90.79%
		Meghalaya	11667 SqKm	52.52%
		Nagaland	10803 SqKm	65.70%
		Sikkim	7300 SqKm	100%
	Bhutan (7.75%)	45000 SqKm		
		47000 SqKm		
	Bangladesh (8.1%)	47000 SqKm		
		47000 SqKm		
	Rainfall	Tibet	400mm	
		India & Bangladesh	1700 to 4000mm	
14	Climate	Cold and dry in Tibet, humid and hot in India and Bangladesh		

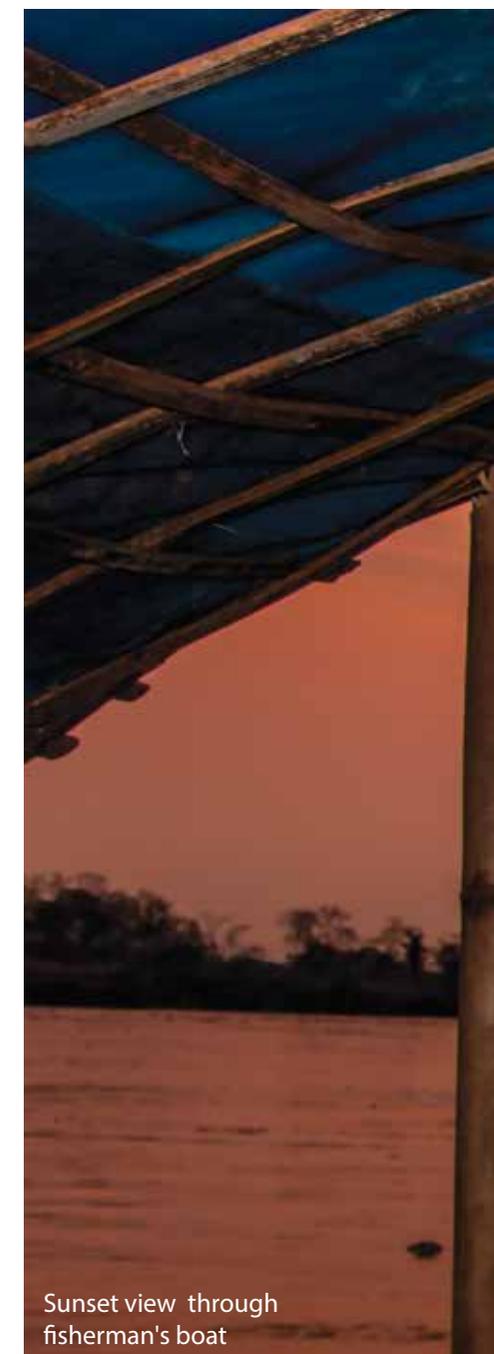


Lives of the people are intrinsically connected with the Brahmaputra.

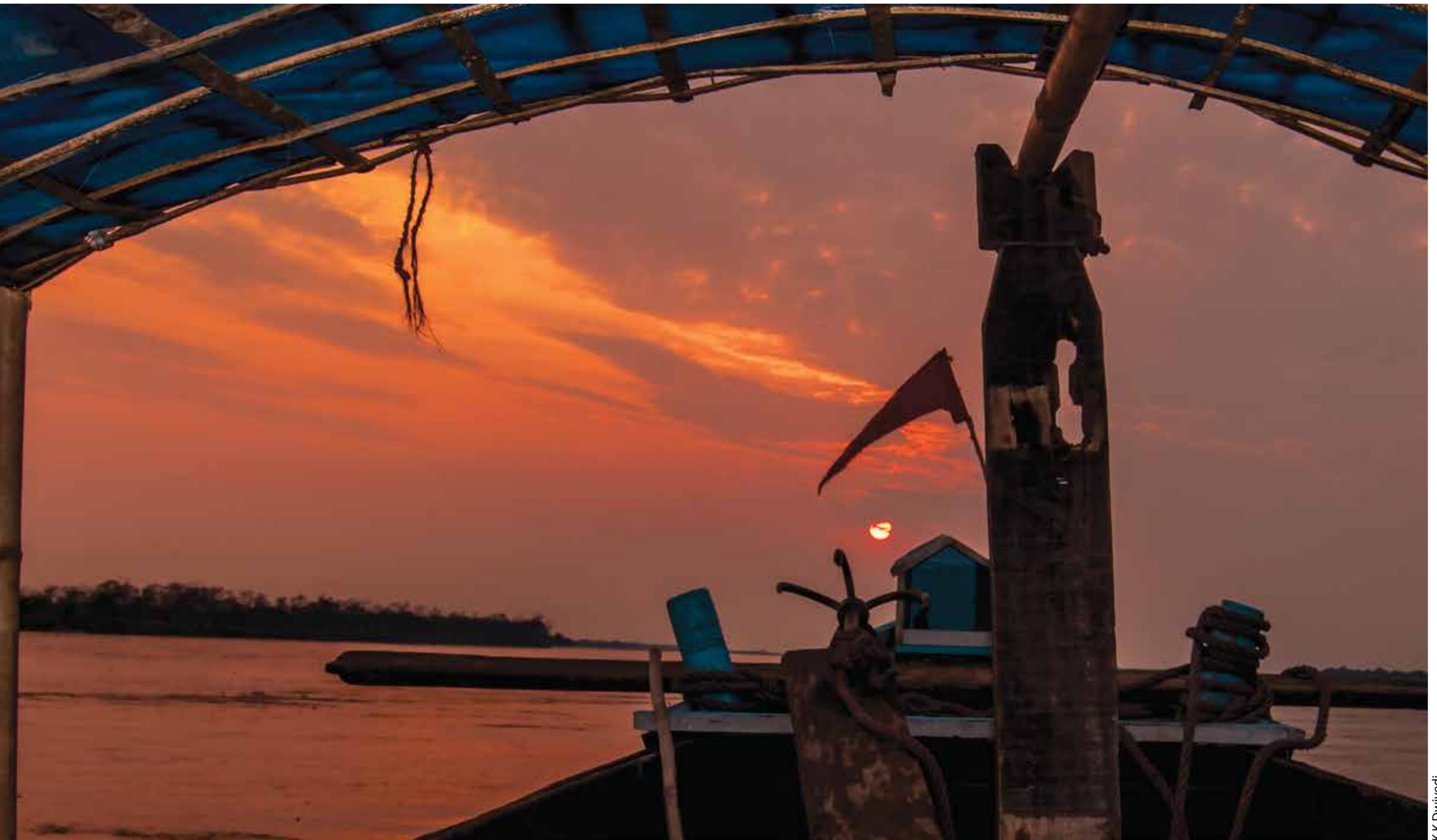
K K Dwivedi

Sl. No.	Particulars		Information	
15	Temperture	Tibet	Winter (Oct to May) Temp- 16° C (Min) and Summer (June to Sept) Temp - 29° C(Max)	
		India	Winter (Nov to Feb) Temperature in Arunachal Pradesh goes down to 0° C and in Assam & Bangladesh it goes down to 5° C , In Summer (March to Sept) Temperature in Arunachal Pradesh, Assam and Bangladesh goes upto 40° C	
		Tibet	Major Tributories in Tibet	22
			Noth Bank	Raga Tsangpo(Raka Zangbo), Ngangchu,Kyichu(Lhasa),Gyamda
			South Bank	Nyang Qu(Nyang Chu)
		Total Major Tributories in India	Total 57 from North and 33 from South	
16	Tributaries	India	Major Tributories in Assam	<b>North</b> Dibang , Lohit , Subansiri, Jiabharali, Barnadi,Puthimari, Pagladia, Beki, Manas, Ai, Gabharu, Chompawati, Sankosh, Raidhak, Torsa <b>South</b> Buridihing, Desang, Dikho, Bhogdoi, Dhansiri, Kopili, Konlong, Sonai, Digaru, Bharalu, Krihnai, Dudhnoi
			Major Tributories in AP	Ringong Asi, Yang Sang chhu, Sigong / Sirapeteng, Niyikgong, Angong, Simang, Yamne, Siyom, Yargyap, Hirit Korong
		Bangladesh	Teesta, Sankosh, Raidak I, Raidhak II, Jaldhako	
17	Erosion in Assam	River Widening	Year 1912-28	3870 SqKm
			Year 1963-75	4850 SqKm
			Year in 2006	6080 SqKm
		Erosion from 1954	Total area eroded	427000ha
			Rate of erosion	8000ha/year
No of Villages eroded	2534			

Sl. No.	Particulars	Information			
18	Flood in Assam	Annually flooded area in Assam by the Brahmaputra and tributaries		0.8 million hect	
		Total Flood Prone Area		31500 SqKm	
		Flood Damage in Assam in 2014 & 2015	Particulars	Year	
				2014	2015
			Village affected	4446	4763
			Population affected	4203609	3666908
			Relief Campes Opened	817	984
			Inmates in Relief Camps	803080	676205
			Human Lives Lost	69	64
			Animal Died	Big- 1093193 , Small - 313409 , Poultry - 354151	Big-622099, Small- 304991 Poultry- 404011
House Damaged	54088(Fully), 82095(Partially)	1537(Fully) 1955(Partially)			
19	Flood Protection in Assam	Total area protected		1650000 Ha (52% of Total Flood Prone Area)	
		Protective Measures Taken	Embankments- on Brahmaputra	Total 1023.88 Km North Bank 555.48 Km South Bank 468.40 Km	
			Major Sluiceson the Brahmaputra	20	
20	No of Hydrological observation station of Central Water Commission(CWC)	108			
21	No of Flood Forecasting station of CWC	27			
22	Bridges on Brahmaputra in Assam	Saraighat at Guwahati, Nar Narayan Setu at Goalpara, Koliya Bhomora at Kaliabor, New Bridges at Bogibeel (Dibrugrah), Dhaula(Tinsukia) and Saraighat(Guwahati) are under construction.			
23	National Park on the bank of Brahmaputra in Assam	Kaziranga,Orang, Dibru saikhowa			
24	Wild Life Sanctuaries on the bank of the Brahmaputra in Assam	Laokhowa Bura-Chapuri , Panidehing			



Sunset view through fisherman's boat



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Sl. No.	Particulars	Information		
25	Water potential			
	Surface Water potential (Km3)	537.2		
	Ground Water potential (Km3)	27.9		
	Total Water potential in the basin (Km3)	565.1		
	Hydropower potential of Brahmaputra Basin	66065 mw		
	Hydropower installed capacity	2120 mw		
	Hydropower under construction	5592 mw		
26	Navigation			
	China(Tibet)	640 Km		
	India	891 Km National waterway 2		
	Bangladesh	354 Km		
	Boats Registered in Assam	Steel vessels	45	
		Wooden Vessels	35	
		Pontoons	25	
		Shallow Draft Boat	53	
		Country Boat	7	
27	Water Transportation in Assam	Commercial Boat Services	River Cruise(VIP)	3
			River Cruise (Shallow Draft )	3
			Motor Tug(M.T)	2
			Pusher Tug	4
			Terminal facility & Barges	35
			Passenger Ferry Service	98
			Mechanically propelled boats	4000
28	Passengers in numbers(2013-14)	7039059		
29	Goods Transported in Metric Ton (2013-14)	356552 MT		



The Brahmaputra supports lives of millions of people in many ways



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Sl. No.	Particulars	Information				
30	Char (River Island ) in Assam	No fo Char Village	2251			
		Char Area	360.927 hect			
		Population in Char Villages	2490097			
		Major River Islands in India	Majuli, Umananda			
		Total Monitoring Station of Pollution Control Board			10	
		Parameters	Jan-2013		Dec-2013	
			Lowest	Highest	Lowest	Highest
		PH	6	7.2	7.5	8.5
		31	Water Quality/ Pollution in Assam	Conductance	20	148
DO	4.6			6.8	7.2	10.2
BOD	0.3			1.1	1.4	3.6
Nitrate	0.05			0.21	0.68	1.49
Total Coliform	0			730	2800	24000



The photographer pauses in his work to take in this mesmerising sunset on the Brahmaputra.





Joysagar and Kesavanarayan or Joydol Temple in Sivasagar was built during the reign of Ahom king Rudra Singha



© Prithiman Mukherjee

# Places



Kamakhya temple



Dhritiman Mukherjee

# Places Across the Tides of Time

Udayan Borthakur

The Brahmaputra, along with its tributaries, has created the fertile Assam Valley, also known as Kamarupa or Pragjyotisha, where settlement has been recorded for at least two thousand years. The broad river, 16 km wide in some stretches, divides Assam in two halves, with captivating towns and cities dotting its banks.

## Sadiya: Frontier town

Located at the confluence of the Dibang and Lohit rivers, which is joined further downstream by the Dihang (or Siang) to form the Brahmaputra, Sadiya is the easternmost township on the river. Built by Chutia dynasty ruler Gaurinarayan in the 13<sup>th</sup> century, it was the last station of the British government in the North East Frontier



A man carries home driftwood salvaged from the river to use as fuel wood for their evening meals.

Dhritiman Mukherjee

Agency (NEFA) as present-day Arunachal Pradesh until 1972. From a mythological point of view, Sadiya is thought to be the ancient kingdom of Vidarbha in the *Mahabharata*. One of the origins of the name Sadiya may be from the Assamese word for cremation: this being the place where a Gaur prince was cremated. The prince from Bengal had travelled to Sindhukshetra as Sadiya was then known, to build a temple there to cement diplomatic relations with the ruling Chutia kingdom. During Ahom rule, Sadiya became a major trading centre for the various hill tribes. In the late 19<sup>th</sup> century, the town gained the distinction of having the first printing press in Assam, founded by American Baptist missionary Miles Bronson. The Tamreswari Temple, known for its human sacrifices until the 18<sup>th</sup> century when the Ahom rulers put an end to the practice, is one of the important historical sites in Sadiya.



The Dhola-Sadiya bridge under construction will be the longest bridge in India at 9.17 km





Dhritiman Mukherjee

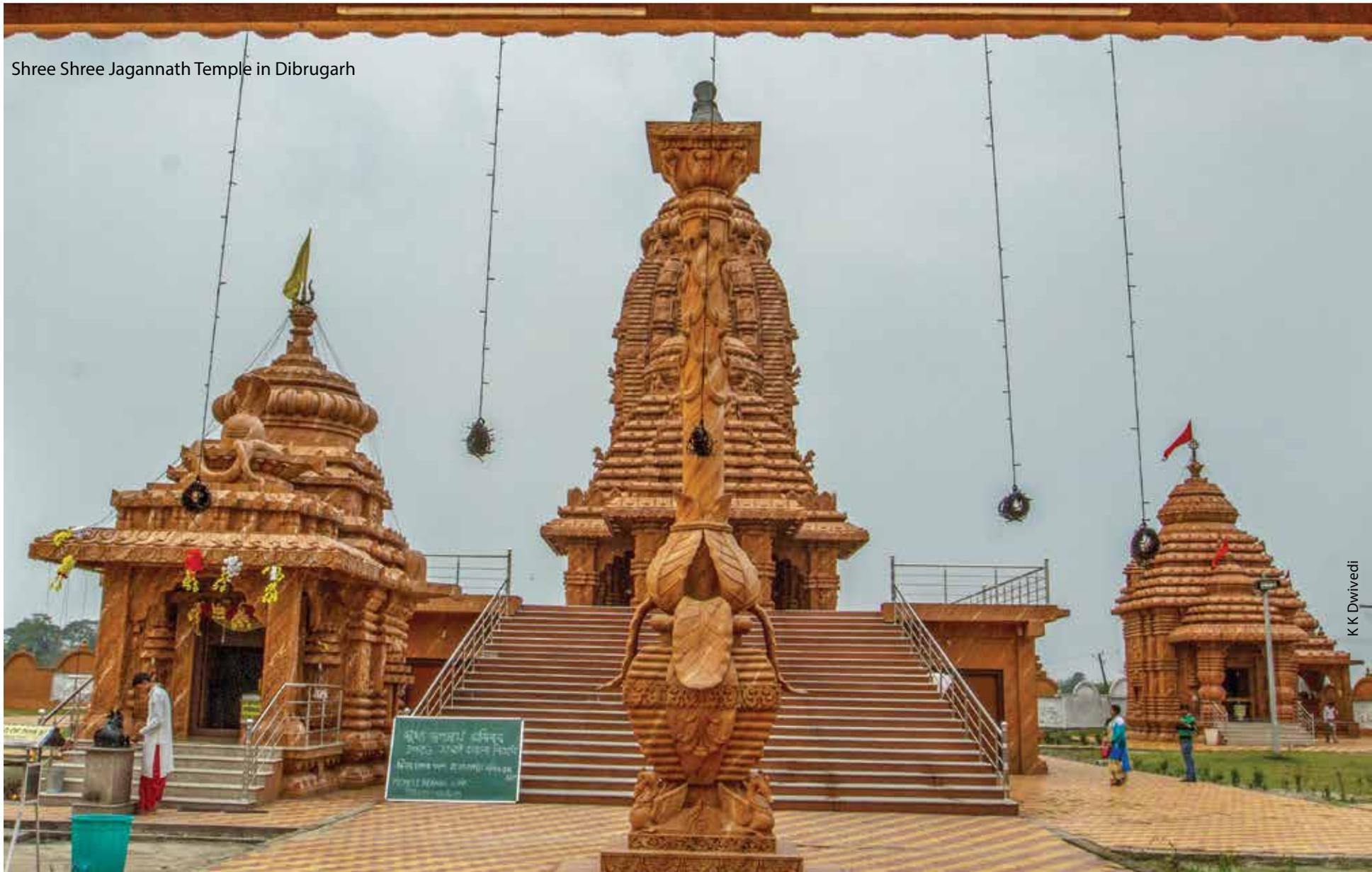


Oldest functional steam engine of the world used to transport coal from mines in Tinsukia district



## Dibrugarh: Tea City

The largest city in eastern Assam, Dibrugarh was founded by the British as a centre of importance from the administrative, military and trade points of view due to its strategic location at the confluence of the Brahmaputra and Buridihing rivers, the latter then being the main transport conduit for tea, oil and coal of the Digboi and Makum Coalfields, the first mining sites of the region. The name Dibrugarh is known to come from 'Dibaru' a stream that used to flow south of the present town and 'Garh' referring to a fort constructed by the British on the bank of Dibaru. It is popularly known as the Tea City of India. Dibrugarh, Jorhat and Sibsagar districts together produce half of the world-famous Assam tea grown in the region. The first medical school of North-east India, the Berry White School of Medicine, now known as the Assam Medical College, was established here in 1900. The 1950 earthquake caused the Brahmaputra to change course, devastating the town.



Shree Shree Jagannath Temple in Dibrugarh







Shiva Temple in Sivasagar

### Sivasagar: Ahom heritage

Sivasagar, formerly known as Rangpur, is a historic city, as the capital of the Ahom Kingdom between the years 1699 to 1788 C.E. It is situated near two tributaries of the Brahmaputra, namely, the Dikhow and Namdang. It is named after Ahom ruler Siba Singha and the magnificent Sivasagar Tank. Kuwari Ambika, wife of Siba Singha built three temples-Sivadol, Vishnu dol and Devidol on the bank of the Sivasagar tank. The tank and the Siva Dol temple on its bank are major historical monuments and the site is a tourist attraction. The tank itself is 1.04 sq km in area. Other historical Ahom monuments in Sivasagar are Joysagar, Gourisagar and Rudrasagar Tanks, Rang Ghar and Talatal Ghar. The Namdang Silasaku, a bridge hewn from a single rock in 1703 by King Rudra Singha still stands over the river Namdang on Assam's main National Highway 37.

Sivasagar holds the distinction of being the birthplace of the first Assamese language magazine *Orunodoi*. Published in 1846, the magazine ushered in a new era of Assamese literature, bringing forth many acclaimed writers in the language.

Sivasagar's economic sustenance is its paddy agriculture, tea, and several oil and gas fields. It is home to the One of the popular natural spots in Sivasagar is Disangmukh, the confluence of the river Disang or Dilli and the Brahmaputra. The Disang was an important channel of transportation for the Ahom rulers, and is said to have been marked the boundary of the Ahom capital, Rangpur. It remained so during the British period. The site is home to people of the Mising tribe with their rich culture.

Dhritiman Mukherjee



Oldest surviving amphitheater in Asia was built by Pramatta Singha in AD 1744-1750



Talatal Ghar, a grand Tai-Ahom architecture in Sivasagar



## Jorhat:Cultural center

Jorhat, the last capital of the Ahom Kingdom, is named after two *haats* (local markets) - *Macharhat* and *Chowkihat* which existed on the banks of the river Bhogdoi in the 18th century. A flourishing commercial metropolis, it underwent a decline following a series of Burmese invasions from 1817 and was almost completely ruined following the arrival of the East India Company's forces in 1824. But it soon regained its glory, however, with the accomplishments of the many scholars, writers, musicians, poets, painters and historians that it produced, becoming the cultural capital of Assam. In 1915, the Jorhat Sahitya Sabha was established here followed by the Assam Sahitya Sabha in 1917 in Sivasagar. It is also a place of immense archaeological importance, with edifices built by the Ahoms including several *Maidams*, which are the burial vaults of Ahom kings.

However, Jorhat lays claim to many firsts. In 1923, it became the first town of Upper and Central Assam to be electrified; the first airplane to ever fly in North-east India landed in Jorhat in 1928; the Jorhat Gymkhana Club is the oldest golf course in Asia and the third oldest in the world; the first stadium of Assam was built in Jorhat; the world's first Tea Experimental Station is located in Jorhat; and the first non-government college of Assam, J.B. College was established here. It also has another significant claim to fame – one of the biggest riverine islands in the world, Majuli, is located in Jorhat district. The port of Neematighat on the bank of the Brahmaputra is the gateway to Majuli, which can be reached only by ferry. Neematighat, a place of historic importance, is one of the most prominent river ports in the state.





Ferries park for the night as grey clouds roll in.

## Majuli Island

Majuli is one of the world's largest freshwater deltaic islands formed by the river and its anabranch, the Kherkutia Suti, in Jorhat District, Majuli lies at 85-95 m mean sea level, extending up to 80 km in the east-west direction and 10-15 km in the north-south direction. The first recorded land survey of Majuli (1662-1716) was in the time of Mughal emperor Aurangzeb, when it was mentioned as consisting of 13 small islands. As per the Survey of India map (2008), the island covers an area of 506.37 sq km. It is part of the alluvial floodplains of the Brahmaputra and its landform is purely depositional in origin and therefore highly susceptible to erosion by the river. Due to the great earthquake of 1950, the river configurations around the Majuli Island experienced drastic morphological changes which resulted in the onset of severe bank erosion. The frequency and magnitude of flood damage in Majuli have been increasing over the years.



Net fishermen return home before dark

K K Dwivedi





Defence personnel genuflect at the Majuli Satra



Museum in Majuli

Dhritiman Mukherjee

Apart from its unique geographic and physiographic features, Majuli is well known for its heritage as a Vaishnavite cultural site associated with the socio-religious reform movement of saint, scholar and poet Sankaradev and his disciple Madhavadeva in the 16th century C.E. The movement for a casteless social structure initiated by the saint and his disciple found expression through monasteries known as *sattras*, which became places of worship for Vaishnavites. The island still houses 30 such *sattras* which continue the tradition of passing on the essence of Sankaradev's principles through the *guru-shishya* or hermit-disciple tradition. The vibrant culture that was woven around the *sattras* has been preserved in Majuli in the form of the Sattriya dance, which was recognised by the government as a classical dance form in 2000.

Majuli is a vibrant melting pot of ethnic groups and cultures. With 20 different communities on the island it is a melange of cultural diversity. Agriculture is the

Majuli is famous for its mask (mukha) making tradition.



primary occupation, while fishing, dairy, handlooms, pottery and boat making are the economic activities on the island. The Mising people, descendants of people who came from Myanmar to settle along the Brahmaputra in the 17<sup>th</sup> century C.E., comprise the major community on the island. They celebrate an agrarian festival called the Ali-ai-ligang. The other communities here include the Chutias, Deoris, Sonowal Kacharis and Koch.

Majuli with its rich alluvial ecosystems, also has natural wetland and grassland habitats that support a diverse array of wildlife, especially a large number of resident and migratory bird species. A displaced population of Asian Elephant frequents Majuli. Threatened fishing cat is also reported from this river island .

## Tezpur: Historical landmarks

One of the first things that strikes the visitor in Tezpur is its indelible bond with the Brahmaputra, courtesy the iconic 3015 m bridge, the Koliya Bhomora Setu, built on the river in 1987. This architectural wonder gives a sense not only of the river but also of the city with its engrossing journey across time, historical and mythological. Tezpur is known as the 'land of love' because it celebrates the love between Lord Krishna's grandson Aniruddha



A fish is flung into the air as fishermen draw in their fine-meshed or mosquito nets, one indicted for the depletion of fish from the river.

and Usha, the daughter of *Asura* King Banasura, a devotee of Lord Shiva. The name Tezpur literally translates to 'City of Blood' for the war waged by Lord Krishna on King Banasura to rescue his grandson Aniruddha and unite him with Usha. Aniruddha is said to have been imprisoned at the Agnigarh fortress on a hillock overlooking the Brahmaputra, that stands to this day.

The presence of the past is evident in the ruined monuments that dot Tezpur, dating back to the 4<sup>th</sup> century C.E. Other places of historic interest include the Bamuni Hills archaeological ruins, the Maha Bhairab Temple, the Da-parbatia, an ancient temple and the Padum Pukhuri, a scenic tank. Chitrlekha Udyan, a garden park, dating from 1906, is also a popular attraction. Modern Tezpur was established by the British East India Company in 1835, when it became the district headquarters of Darrang district, and later of Sonitpur. During World War II, Tezpur sheltered refugees fleeing Myanmar.

Tezpur was also a hub of cultural renaissance in Assam boasting of legendary personalities such as Jyoti Prasad Agarwala, who founded *Chitrabon* the first film studio in Assam and produced the first Assamese film *Joymoti* in the 1930s. Today, Tezpur is a centre of educational excellence, with good schools, central university and a medical college. It has several tea estates in the vicinity.



Aerial view of Koliya Bhomora bridge in Tezpur. East of it is the Nameri river's confluence with the Brahmaputra.

Mahabhairav Temple is thought to have been built by King Banasura and its Shiva linga is said to be made of 'Living Stone' and growing with time.





## Other North bank towns

Bishwanath Chariali, Lakhimpur, Dhemaji are other key towns east of Tezpur on the northern bank of the Brahmaputra. The Bishwanath ghat at Bishwanath Chariali is a well known ferry point on the river, in addition to being a pilgrimage site due to its many temples. It is considered so holy that it is also known as the 'Gupta Kashi' or the 'hidden Kashi'. From Lakhimpur town, the Brahmaputra is navigable as far as Dibrugarh and Sadiya during the monsoon. Dhemaji, which gets its name from 'dhal' meaning flood and 'dhemali' meaning 'play', is the eastern-most district north of the Brahmaputra in Assam, and is severally affected by floods each year.



Moon rise landscape of the Brahmaputra



The Brahmaputra at Guwahati, with Umananda Island on right.

## Guwahati: Gateway to the northeast

As the largest city of Assam, Guwahati is located on the Brahmaputra and is the gateway to the North-east India. It is the busiest commercial hub and the biggest riverine port of the north-eastern region. Pragjyotishpura (Light of the East), as it was known earlier, finds mention in the *Ramayana*, *Mahabharata* and several Puranas and is associated with the names of Kings Narakasura and Bhagadutta. It is also mentioned in Kalidas' *Raghuvamsham*. Pragjyotishpura was the capital of the Varman and Pala kingdoms. In the account of Chinese traveller Xuanzang in the 7 century C.E. Pragjyotishpura was described as one of the most prosperous capitals. It also records how King Bhaskaravarman had built a strong navy and a flourishing trade centre along the channels of the Brahmaputra. In the 19<sup>th</sup> century, Guwahati came under British rule. In 1972 the capital of Assam shifted from Shillong to Guwahati, and the current capital of Assam, Dispur, lies within Greater Guwahati city.

There are several prominent ports on both banks with the Pandu Port, Kachari Ghat, Uzanbazar Ghat and Sukleshwar Ghat being among the prominent ones. Ferries and boats ply regularly from these ports to places in and around Guwahati. The Peacock or Umananda island, lies in the midst of the Brahmaputra and attracts pilgrims visiting the Umananda (Shiva) temple. Guwahati is famous for the Kamakhya Temple. Other historical temples are the Basistha Temple, Sukleshwar Temple, Shivadoul and Navagraha Temple.

The Assam Tourism Department, as well as private operators, offer popular cruises on the Brahmaputra with historical sight-seeing and wildlife safari activities.

Guwahati is the capital of Assam as well as a centre of significant economic and cultural activity. It has Assam's pioneering and prestigious educational institutes such as the Cotton College (established in 1901), now an university, and the Gauhati University founded in 1948. The city has a few technical institutes, the most prominent being the Indian Institute of Technology (IIT) Guwahati. Guwahati now boasts state-of-the-art sports infrastructure and multiple stadiums, recently hosting the South Asian Games 2016 which put international spotlight on the city; it also hosts the Indian Super League football club, namely the Northeast United FC.

## Kamakhya

The Kamakhya Temple is one of the most important historical and spiritual landmarks of Assam, especially for followers of Tantrik philosophy and Hinduism. Situated at the Neelachal Hill in the western part of Guwahati city, Kamakhya is one of the 51 *Shakti Peeths* in India. According to the Kalika Purana, Kamakhya Temple denotes the spot where Sati's *yoni*, or womb, fell after while Lord Shiva danced with her corpse. It is also believed that Sati, or Kamakhya, used to come here in secret to meet her love, Shiva.

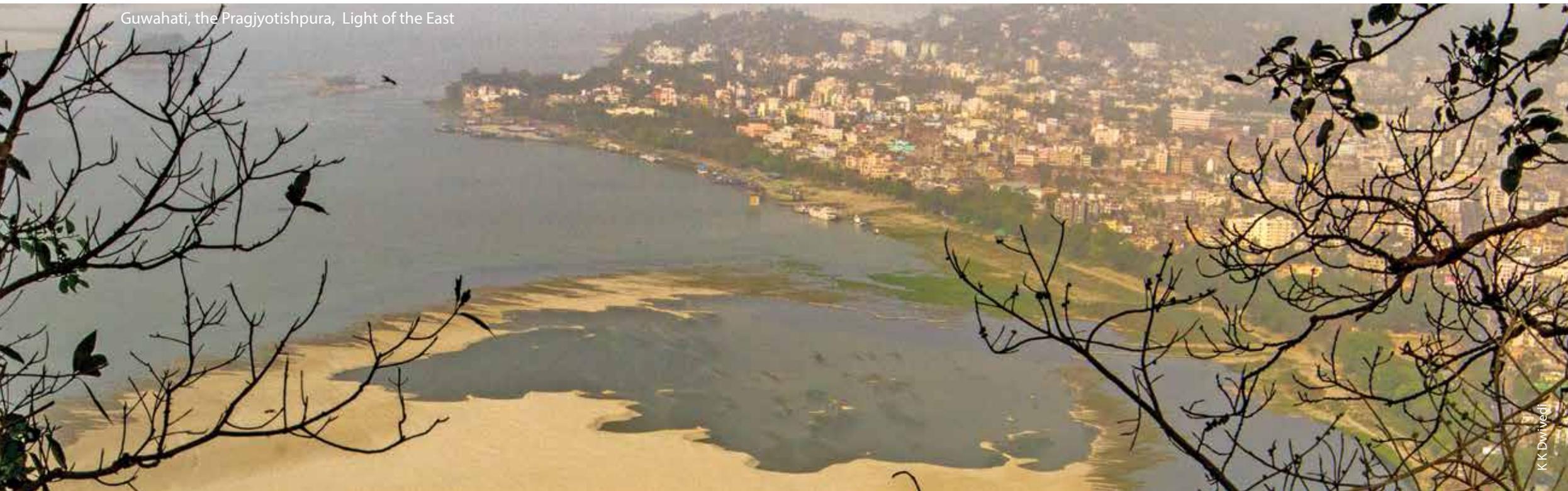
This temple, dedicated to Goddess Kamakhya, is surrounded by smaller temples dedicated to the avatars of the goddess viz. Dhumavati, Bogola, Tara, Matangi, Bhairavi, Kamala, Chinnamasta, Bhuvaneshwari and Tripura Sundari. In mythological belief, Narakasur, who was the king of Kamarupa, was known to have built the temple. Narakasur, in his early days was a worshipper of Vishnu and it was Vishnu who taught him to worship the Goddess Kamakhya. Later, under the influence of Banasura, the king of Sonitpur, Narakasur became arrogant and irreligious and asked Goddess Kamakhya to be his wife. The Goddess accepted his proposal on the condition that he construct a temple on the Nilachal Hill along with a tank and a road to the temple within a night. Narakasur was almost able to accomplish this task, but the Goddess caused a cock to crow, claiming that morning had arrived, and as such she refused to marry him. Narakasur was enraged and killed the cock. With this act,

Narakasur lost the goodwill of the Goddess.

The earliest known records of the Kamakhya date back to 8th-9th century AD, though it is possible that the original structure was built even earlier. By the 10th Century, this temple became a famous *tantrik* destination and a centre of mysticism and sacrificial ceremonies. It is believed that the Temple was destroyed during Hussein Shah's invasion of the Kamata kingdom in 1498. Vishwasingha, the founder of the Koch dynasty, found the ruins and revived worship at the site, but it was only during the reign of his son, Naranarayan, that the temple was fully rebuilt in 1565. The current final structure was rebuilt during the Ahom dynasty, with remnants of the earlier Koch temple carefully preserved. Built, destroyed and rebuilt over the centuries, the present structure of the temple consists of four chambers: the Garbhagriha or *sanctum sanctorum*, and three mandapas locally called Calanta, Pancharatna and Natamandira aligned from east to west.

The Kamakhya Temple attracts lakhs of devotees throughout the year. The most important and auspicious time for pilgrimage is during the five days long *Ambubachi Mela*, held annually in June. The Temple remains closed during 3 days of the Mela when the Goddess is said to be menstruating. It is essentially a fertility festival with devotees thronging to offer their prayers on the fourth day. Manasa Puja and Durga Puja are also observed with much fanfare at the temple, every year.

Guwahati, the Pragjyotishpura, Light of the East





Kamakhya Temple, a revered Shakti temple for Hindus.



The Hayagriva Madhava Temple

## Hajo: Site of communal harmony

An ancient pilgrimage site, Hajo is located on the bank of the Brahmaputra. It is uncommon in being a sacred destination for followers of three religions - Hinduism, Islam and Buddhism. The Hayagriva Madhava Temple was built by King Raghdeva in 1583 on Monikut hill and is built entirely of stone. Here, Hindus worship the Narasimha incarnation of Lord Vishnu. Buddhists consider it a sacred place. The Powa Mecca (*powa* - one-fourth) located on Garurachal hill in Hajo, believed to have been built on soil brought from Mecca, Islam's holy city, is a major pilgrimage spot for followers of Islam. It is also famous for bell metal works.

K K Dwivedi



The Powa Mecca

K K Dwivedi

## Goalpara: Folk music of the river

Goalpara, or 'the village of the milk men', is steeped in lilting music that matches the tides of the Brahmaputra flowing alongside it. Pratima Barua Pandey placing it firmly the Goalporia folk music on the cultural map of the country. Since Goalpara was once ruled by the Koch Rajbongshi kings, the dialect that has prevailed since those days is 'Goalpariya Bengali'. The Shyamrai *Sattra* was established in Goalpara three centuries ago, Since then the town has been an important centre of Vaishnavite culture. The *sattra* is most famous for the preserved ashes of Srimanta Sankardev. The ashes are put on public display for devotees once a year during September-October. Goalpara came under British rule in 1765. The city is also known for the Shree Chaitanya Gaudiya Math, established in 1969 and the Sufi saint Pir Mazhar's Tomb located in the centre of the town. Other places of archaeological and historical significance are the Sri Surya Pahar and the Hulukanda Pahar. It is



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believed that 99999 Shiva Lingas were established in Surya Pahar by Vyasa to build it as a second Kashi.

### Dhubri: Historical port town

One of the oldest towns of Assam, Dhubri is skirted by the Brahmaputra and its tributaries on three sides. It is one of the busiest ports of Assam. It was an international trading port during the British era, and is known especially for the transportation of

jute and subsidiary products. The name Dhuburi is believed to have been derived from the name of a woman called Netai-Dhubuni, although the Bodo-Kacharis believe that it is derived from 'Dubra' grass. The town fell under the monarchy of Bengal kings until 1874, but after that came under British Government's Assam Valley Province. It was first constituted as a Municipality in 1883.

Endowed with lush green landscapes Dhubri has many places of historical and ecological importance. Mahamaya Dham of Bogribari, is considered almost as important as Kamakhya Temple. The very prominent Rangamati Mosque was built during 17<sup>th</sup> century by Hussain Shah, the Governor of Bengal. This mosque is known



India Bangladesh Border at Dhubri

Dhritiman Mukherjee



Gurudwara, Dhubri

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for its distinctive pre-Mughal style architectural design. The Gurudwara Sri Guru Tegbahadur Sahibji is situated in the heart of the Dhubri Town, on the bank of the Brahmaputra. . It is said that Sikh Guru Nanaka visited here in 1505 A.D. and met Sri Sankardeva during his journey from Dhaka to Assam. Thereafter, the 9th Guru Tegbahadur established this Gurudwara during the 17th century. The Panchpeer Dargaha is the Mazar Sharif of five Sufi Saints who accompanied Raja Ram Singh during his time of invasion to Assam, and is an example of religious harmony where all sections of people visit to offer their respects. Other places of importance are the Matiabag Palace at Gauripur, Netai Dhubuni Ghat in Dhubri Town, Chandardinga Hillock and Dudhnath Mandir at Salkocha and Ramraikuti at Satrasal. The people of Dhubri depend heavily on the Brahmaputra for their livelihood. Its culture and heritage revolves around the river, but it is severely affected by floods.

**People**



The Singpho Raja or king at Tinsukia district

# People of the Brahmaputra

Farzana Begum

The Brahmaputra is a symbol of Assam. The life and culture of the people living on its banks is a reflection of the river's ebbs and swells. Flowing through the length and breadth of Assam from Sadiya to Dhubri, the river is celebrated in the history, mythology, poetry, folklore and songs of Assam.

To put it another way, the history and mythology of Assam is the history and mythology of the Brahmaputra. The river and the region have found mention in the *Ramayana* and *Mahabharata*. Assam's history is replete with stories of war, conquest and reconciliation on the banks of the Brahmaputra, its fertile valley having attracted several invaders to this region. Its lush banks provided the foundation for ancient urban centres and capital cities like Pragjyotishpura, Hatappesvara (or Hadappesvara), Durjjayanagara, Kamrup, Sadiya and Sonitpur. The powerful Varman, Pal, Kamata, Koch, Ahom, Chutiyas, and Kachari dynasties flourished here. The Brahmaputra and its tributaries acted as a natural demarcation of territories ruled by chieftains.

In the filigree-like mythic maps of the Brahmaputra basin, legends abound of kings like Narakasura, Banasura, and Bhismaka, princesses like Rukmini and Usha, sages like Shantanu, Parashuram and Basistha, and gods and goddesses like Shiva, Parvati, Kamakhya, Kama and Krishna.

Equally fascinating is the origin myth surrounding the Brahmaputra or son of Brahma, only 'male' rivers -- *nad* -- in India. In earlier times the river was called Lauhitya and found mention in early inscriptions and literary texts such as the *Brahmavaivarta*, *Kalika Purana*, *Matsya Purana*, *Varaha Purana*, *Vayu Purana* and the *Yoginitantra*. In addition to the legends of Lord Brahma and Amogha, and that of Parashuram, also connected to the river is the celebration of Ashokasthmi. The story is that the Brahmaputra was cursed by Sage Ashoka for washing away his hermitage. The river begged forgiveness, at which the sage relented and ordained a single day in the year, the eighth day of the month of Chaitra, when it would be sacred. The Brahmaputra has been called by other names too, but the people of Assam have their own local names for it -- *Burhaluit*, *Luit*, *Siriluit*, *Borluit*, *Bor nai*. Different tribal communities have their own names for the Brahmaputra as well.



Tangsa tribal family. The elaborate head gear has great hornbill tail feathers and boar tusks.



Bodo tribe

Bidyā Sagar Baruah



Deori Tribe

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Tea Tribe

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Singpho Girls



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A Tai Phake man and a young girl  
in their traditional attire

## Waves of migration and a composite culture

The Brahmaputra Valley has attracted waves of human migration from prehistoric times. The earliest people inhabiting this region were the Australoids and the Mongoloids; they find mention in the epics and the *Kalika Purana*, among others. They were followed by the Caucasoid who came in several waves of migration. The Indo – Aryans and Irano -Scythians were preceded by the Mediterranean and Alpino- Armenoids in this region. The migration of people to Assam, which started thousands of years ago, still continues.

Anthropologists, from detailed studies of the population of this region, have come to the conclusion that tribes of Assam are Mongoloid in origin. There are also some Australoid ethnic traits among them. The Mongoloids of northeast India are mostly speakers of the Tibeto-Burman languages. These people at different times came from different directions and migrated to the hills and valleys of north-east India. It seems quite probable that long before 1000 B.C., some of these early Tibeto –Burmans had penetrated within the frontiers of India, either along the southern slopes of the Himalayas, or by way of Tibet.

The Mongoloid tribes of North east India are categorized under the Khasis, Boro, Lushai- Kuki, Naga, Arunachal tribes and “Others” on the basis of one or the other factors like linguistic affinity, cultural similarity, common territory and biological closeness. The Boro form one of the most important tribal groups in Assam and belong from a very early period. Bodo is regarded as a generic term and different names are used to designate them. In Bengal and in Nepal, they are known as Meches. In Upper Assam they are identified as Sonowal Kachari, while in the western Assam, they are more popularly known as Boro or Boro- Kachari. In the Southern districts of North Cachar and Cachar they are designated as Dimasa and Barmans respectively.

The Ahoms belong to the Tai ethnic group of the Mongoloid race. They came to Assam in 1228. **The Ahoms came into contact with several communities when they started their reign in Assam. We get references from Ahom chronicles about different tribes like the Moran, Matak, Chutiyas, Misings, Kacharis, etc; who were occupying different territories in Assam.** The kingdom which Sukapha, the first Ahom king of Assam laid down in 1228 continued till 1826 . Within this six hundred years , they have left a rich legacy in the history of this land.

After the British annexed Assam in 1826, large number of people started migrating to Assam to meet the growing need of human resource for running the British administration. As tea cultivation started in 1836, a large group of people from different parts of India were brought to work as tea labourers. Started in 1853, migration of tea garden labourers on a large scale took place since 1860.

The next stream of migration started with Muslim peasants coming from the then East Bengal districts of Mymensingh, Pabna, Bogra, and Rangpur. It was in the beginning of the 1900s that people migrated from erstwhile East Bengal and they started inhabiting the *chars* (River Island)



One of reformer Sankardev's contribution to the Valley's culture - the Satriya dance  
Debasis Gogoi

of the Brahmaputra River. They came first to the district of Goalpara from the beginning of the 20<sup>th</sup> century. By 1931 most of the wastelands of the Brahmaputra valley was under their occupation. They at present form a significant proportion of the state's population. They occupy the *chars* of Dhubri, Barpeta, Nalbari, Kamrup, Morigaon, Nagaon, Darrang, Sonitpur, etc.

The third stream of migration consisted of Bengali Hindu refugees mostly from the then Sylhet district to the adjoining areas of present Assam during the partition of the country. After independence also, this flow of people continued. In Assam, another stream of migration took place with the advent of the Nepali graziers who from the beginning of the twentieth century started settling in the uncultivated hill slopes.

Over time, the intermixing between groups of different stock caused by centuries of living alongside has resulted in the fusion of both cultural and physical traits resulting in the growth and development of a composite culture that is unique to Assam. Contemporary Assam is a melting pot of many communities belonging to different

tribes, castes, linguistic affinities and religion. Followers of every major religion in India are found here. There are altogether 15 Scheduled Tribes (Hill) and 14 Scheduled Tribes (Plain) – all of them with their distinct culture, language, customs, religious belief and practices. Then there are the Tai Buddhist groups and the 'Tea Tribes', the latter forming a significant segment with distinct social and cultural features.

The innumerable river islands or *chars* formed by the Brahmaputra have also given rise to a unique way of life. It is interesting that, in spite of their vulnerability to flooding and erosion, the *chars* have been able to attract human settlements, where the settlers build their entire lives according to the river's life cycle. One such island is Majuli, one of the largest river islands in the world and the jewel of the Brahmaputra. The island is home to many communities; in fact Majuli can be called a mini Assam, with an exemplary history of the different communities living side by side in peace and harmony.

Sankaradeva initiated the Neo-Vaishnavite movement in Assam in the 16th Century, which left a lasting impression on the lives and culture of the Assamese people. Sri Sankaradev's teaching was simple – to surrender oneself to the one and only Supreme Power (*ekāsarana nāma-dharma*). The movement was carried forth by his disciples to almost all parts of Assam in the following two centuries; it continues to govern the socio-religious lives of the people of Assam to this day. The benign influence of Neo-Vaishnavism has built a society of tolerance and inclusiveness where the rigidities of caste and creed have been reduced to a great extent.

## People of the river

Since ancient times, the writings of foreign travellers, administrators and even invaders have unerringly described the grandeur of the Brahmaputra. Several historical accounts of the region were written in the medieval period. For instance, Ahom chronicles have references to different tribes, as do later European accounts. These written accounts give an idea of people's lives in this region in the last 800 years.

But the communities' origin and presence in this region precedes historical records. In fact, each group/tribe has stories about its origin and migration to this place, and these stories have been transmitted orally down the generations. Many tales speak of the tribes travelling on the river and their consequent settlements in Assam's valleys and hills. After Assam came under the British in the 19th Century, a wide spectrum of people, ranging from administrators, anthropologists, travellers, medical officers, explorers and missionaries, began to study the region in earnest. Their memoirs, journals, documents and reports provided valuable insights into the region's geography,

history, administration and ethnography.

There are around two thousand *chars* in Assam which are habitable. The people living in the *char* lead a river centric life. Their livelihood, society and culture are profoundly influenced by the river. The Misings, Deori and Kaibartas are found in the *Char- chaporis* of Lakhimpur, Dhemaji, Jorhat, Dibrugarh, Sibsagar, etc. Besides, the Mising, Deoris, Kaibartas, these islands are also inhabited by the Muslim cultivators who immigrated into Assam from East Bengal, the Nepalese immigrating from Nepal, the Hindu refugees and small numbers of people from Bihar and Bengal.

### The Deoris

The Deoris who live on the bank of the rivers perform 'Jima Puja' to propitiate the river and pray to the Gods for keeping their villages safe from floods and erosion. It is said, for example, that during the British regime the four clans of the Deoris took four boats on the river Brahmaputra and sailed without knowing their destination, sheltering in different *chaporis*. Later members of three of the clans assembled together at the southern bank of the Brahmaputra and made camps by using the boats for *Chois* (shade), under which they lived, cooked food and ate (*khowa*). Hence, the place came to be known as Saikhowa on the Brahmaputra. A similar story narrates the disappearance of the Patorgoyan group of the Deoris. Due to constant feuds with the neighbouring tribes in Sadiya, one night the Deoris came down the Brahmaputra in four small boats, and the boat carrying the Patorgoyan group is believed to have been lost on the river.



Mising women weave on their looms at home. Their colourful mekhela-sador designs are popular among women.

K K Dwivedi

### The Dimasa Kachari

The Dimasa Kachari, have a prayer that refers to a huge peepal tree growing near the confluence of the Dilao (Brahmaputra) and the Sagi, where they believe they were born and increased in great numbers. Then, travelling by land and water they reached Nilachal Hills on which the Kamakhya temple stands, then moved onward to Halali and finally settled in Dimapur.



The well-known Bihu dance of Assam. It is traditionally danced during the spring season in April.

Himangshu Lahkar

## The Misings

**Misings pride themselves to be the sons of the river.** The economic social and cultural life of the Misings is intimately related to a life cycle of the river. They settle **along the courses of the Brahmaputra, Subansiri, Ronganadi, Buroi and Bhoroli River in the northern side and the confluences of Dibru, Dihing, Disang, Dikhow and Dhansiri River in the south.** After settling on the river banks, they have adapted to a new environment and society. They construct their houses on piles. They are expert swimmers. Years of living on the river banks have enabled them to cope with flood and manage their lives during times of flood. The intimate relation of the Mising tribe with the river is aptly reflected in the saying – *Noi Suwani Miri* which means that the river is made beautiful because of the Miri (Mising).

## The river as inspiration for writers and poets

Travellers passing through the Valley have sung paeans to the river. When Mahatma Gandhi first visited Assam in 1921, the Brahmaputra's beauty moved him greatly, prompting him to write about Assam while sitting on the river bank in Tezpur town.

For writers, composers and singers in Assam, the river's moods have provided them just the kind of inspiration they need; in fact it figures in poems, songs, stories and novels with great regularity. In this context, the names of Laksminath Bezbaruah, Jyotiprasad Agarwala and Bhupen Hazarika are noteworthy. The name 'Mahabahu Brahmaputra' was first coined by Bhupen Hazarika in his song '*Mahabahu Brahmaputra maha milonor tirtha; Kata jug dhori aahise prakaxi, Xomonnyar artha.*' in which he calls the Brahmaputra a 'tirtha' (pilgrimage) located in the great confluence of different religions, namely the teachings of Guru Sankaradeva and Madhavadeva, Ajan Fakir and Guru Teg Bahadur who had preached monotheism and universal brotherhood.

In another iconic song inspired by Paul Robson's *Ol' Man River*, Bhupen Hazarika composed the song *Bistirno parore* where he expressed anger and sadness at the indifference of the Brahmaputra towards the moral decline and degradation of humanity – '*Noitikotar skhalan dekhiu, Manabotar patan dekhiu, Nirraj alash bhawe buwa kiyo?*' (Witnessing the moral decline and degradation of humanity, how do you still continue to flow so shamelessly and nonchalantly). In fact whenever he sang, it was as if the river was inside him and he had become the river, such was the undulating range, force and texture of his voice.

The floods of the Brahmaputra inspired his brother and singer Jayanta Hazarika to compose the popular song *Luitor boliya baan, toi kun phale dhapoli meliso, hir hir xobole kal rup dhori kaknu bare bare khediso* (O frantic floods of the Luit, where are you heading to this time, Whom are you chasing again with frightening sound of your waves).

During the freedom movement, the river became an inspiration for patriotic youth. For instance, Jyotiprasad Agarwala composed a poem/song, '*Luitor parore aami deka lora moriboloy bhoi nai*' (We youths from the bank of the Luit do not fear death). In a similar vein he says, '*Luitore pani jabi o boi, joyare kiriti deshe bideshe, sohore nagare, phuribi koi*' – O water of Luit, as you flow through different lands, cities and towns, tell the stories of our victories.

History, tradition, spiritualism, nature, or contemporary songs and stories of love, pain and separation, and folk literature, the river finds reflection in the narrative. Like the river's flow, the narratives too are abundant. And just as the Brahmaputra continues to flow with the tides of continuity and change, so do the communities living on its banks, for their destinies are intertwined.

Children make sand castles on the banks of the Brahmaputra





K K Dwivedi

# Brahmaputra: Economic Lifeline of Assam

Purusottam Nayak

**T**he foundation of Assam's riverine society and economy has been and continues to be the mighty river 'Brahmaputra'. Traditional economic activities like agriculture, fishing, transportation of goods and inland communications continue to rest on the river and the riverine climate that it has created. This monumental flow, however, can be a bane too, which raises several concerns for the communities whose lives depend on it.

In recent decades, however, a combination of factors, natural and man-made, has created an overall environment which has diluted the river's positive impacts on the livelihood, infrastructural and institutional arrangements in the Assamese society and economy. So much so that there is a worrying question mark over the 'lifeline' status of this great river.

## Flow of opportunities

- For communities in 22 out of 33 districts of Assam (6 new districts announced in 2016), the Brahmaputra is fundamental to the pursuit of their livelihoods, be it cattle wading, fishing, crop cultivation and irrigation, and riverine transport. During 2013-2014, the total number of passengers transported through the river's inland water transport system stood at 70,39,000, and the total amount of goods similarly transported stood at 3,56,552 metric tonnes, indicating comparatively higher magnitudes of transportation, human and material, in Assam's economy.
- Nineteen important tourist hot spots in the state are located on the banks of river Brahmaputra, therefore cruises on the river have emerged as an important component of adventure and luxury tourism on the river – in 2013, CNN International rated the Brahmaputra cruises among the top 10 adventure cruises in India. From 2006-07 to 2013-14, the total number of tourists to the state increased by one million, from 3.49 to 4.46 million showing an increase of 28 per cent. This has resulted in revenues of Rs 19.1 million in the form of rental charges for different types of tourist accommodation. A sizeable chunk of this tourist flow and revenue earned can be safely attributed to tourism activities on the Brahmaputra.
- Against the current economic demand of a little over 279,000 tonnes of fish, there is a shortfall of 12.83 thousand tonnes. The gap between present production and requirement is partially met by importing fish from other states. This means there is considerable scope for increasing fish production in Brahmaputra and its tributaries.
- In the last few years there has been a spurt of activity in identifying 46 dams in the Brahmaputra basin in Assam of which three are in various stages of operation and are expected to produce more than 2000 MW of power.



A fish-eye view of the Brahmaputra



Net fishing

Dhritiman Mukherjee



Jeng fishing

Dhritiman Mukherjee



Bamboo baskets used for fishing

Dhritiman Mukherjee



A fisherman brings out his catch

K K Dwivedi



Winnowing the rice, the staple food of the Brahmaputra dwellers



Bell metal work in Hajo

KK Dwivedi



Bamboo work

Dhritiman Mukherjee

## Areas of concern

River bank erosion, denudation, siltation and sandcasting have directly and indirectly affected people's lives, leading to displacement, loss of livelihood, land and jobs. Loss of land has internally displaced communities like the Mishing and others, forcing them to migrate to urban areas.

River bank erosion has wiped out more than 2500 villages and 18 towns including sites of cultural heritage and tea gardens, affecting the lives of nearly five lakh people. With the help of satellite images it has been estimated that the total land loss per year due to erosion caused by the Brahmaputra has ranged from 72.5 sq km to 80 sq km annually from 1997 to 2007-08.

The floods of 2004 caused unprecedented damage. They affected 28.5 million hectare of land including 12.57 million

hectare of cropland, impacted the lives of 12.3 million people across 10,560 villages besides claiming 251 human lives and innumerable cattle and wildlife. All the 27 districts were affected by the flood and the total damage was estimated at Rs 65000 million.

The erosion hazard posed by the Brahmaputra is extremely severe in vulnerable riverine sections like Majuli, Palasbari, Rohmorja, Bhuragaon and Bokuwal. Majuli, among the world's largest inhabited freshwater islands, and the legendary nerve centre of Assam's neo-Vaishnavite cultural heritage, has already lost as much as 371 sq. km of its landmass to the river in the last 50 years.

## The economic universe of the chars

Formed out of the Brahmaputra's typical flow, the large number of *chars* or river islands are spread across 14 districts along the river. There is an element of geographical instability about the *chars* primarily resulting from erosion, silting and inundation due to floods and the changing courses of the river.

Although the *chars* are home to 9.37 per cent of the state's total population, they constitute only 4



Life in Char -river island

Dhritiman Mukherjee



A potter takes his ware to the market

Himangshu Lahkar



Boat making is a small scale industry at places like Dhola.

Dhritiman Mukherjee

per cent of Assam's cultivable land. In a 10-year period from 1992-93 to 2002-03, the area of the *chars* has increased by 1.37 per cent, whereas the population in these areas has increased by 56 per cent. Hence, the population density of these areas is twice the population density of the state, which has resulted in greater pressure on limited resources.

Moreover, a high population growth rate, low literacy levels, poor health infrastructure, inadequate physical infrastructure and uncertain livelihood opportunities have trapped the people of the *char* in a circle of poverty and underdevelopment.

### What a simple river bank economy model shows

A simple quantitative local river bank economy model constructed for Dhubri's urban area showed that on a daily basis the Brahmaputra contributes to about 30 per cent of the total average person days created in this area. On an average, 2600 people get

direct daily employment in the ferries, in bamboo transportation trade, retail shops and other services along the river. The daily average indirect employment created is estimated to be around 5000 person days. The gross sales per day from all these activities amount to Rs 33.1 million.

Of the surveyed households, approximately 59 per cent depend on agriculture, 18 per cent on fishing, 13 per cent on river transportation activities, and 4 per cent on log collection. On an average, each family suffered asset losses worth Rs 60,533 in the year 2014-2015 due to the unprecedented floods which caused substantial damage to land, crops, animals, houses, buildings and roads.

The uncertainties governing the life course of the river forcing millions of people to think of alternative sources of employment and settlement and this could alter the central role of the Brahmaputra in their socioeconomic life. Although certain steps are being undertaken to minimise the loss of life and property by means of embankments, in the absence of a comprehensive approach to address the issue, such measures are inadequate and piecemeal.



Paramotoring is a new adventure sport introduced in Sivasagar to promote tourism.

## The way ahead

To ensure that the Brahmaputra remains an unmixed blessing for the people of Assam, immediate short term and long term measures are required. These measures should be based on a comprehensive approach taking into account environmental, economic, social and cultural dimensions.

Moreover, to arrest the impact of frequent floods and instances of the river changing course, an approach based on modern science and technology should be supplemented with the wisdom of local knowledge and practices that have been honed on long-standing experience.

- For instance, riverbank vegetation has a crucial role to play in stabilising bank sediments which reduce erosion and provides a shield between the river and the rest of the catchment area. Therefore, efforts should be made to protect the existing vegetation and create new stretches of plantation wherever necessary. The involvement of local communities in this exercise is a must.

- Infrastructure in the ghats needs to be developed for smooth movement of people and vehicles.
- More accommodation of all ranges is needed at tourist spots.
- Industrial units on the Brahmaputra's banks must be regularly inspected to ensure that hazardous effluents are not being discharged in the river.
- Since the settlers in *chars* are mostly dependent on cultivation for their livelihood, this creates excessive pressure on land. Thus immediate measures need to be taken at the level of government and NGOs to provide the settlers with alternative non-agricultural job opportunities.
- As char settlers suffer from a vicious circle of poverty and underdevelopment, interventions to build their capacities by creating better access to education and health facilities is a must.



Granary made of bamboo





Nature



Woodland in Pobitora Wildlife Sanctuary during the dry winter season and annually flooded Woodland on previous page





*Lagerstroemia speciosa*  
Ficus or fig trees are a major food resource for frugivores

K K Dwivedi

# Plant Life in the Brahmaputra Valley

Pranab Bujarbarua

**A**s the mighty Brahmaputra flows with stately grace through Assam from the east to the west, separating the state's sub-Himalayan region from its southern parts, it forms the breathtaking Brahmaputra Valley. At the Valley's easternmost point in Sadiya, the river flows at an elevation of about 135 m, which comes down to 30 m at the westernmost point in Dhubri. Being the largest plain in the North-east region, the Valley holds great significance not only for agriculture and industry but also for the rich vegetation and wildlife it boasts in various protected areas.

## Some facts:

- As much as 54 per cent of the Brahmaputra basin lies under forest cover, spreading across Assam, Nagaland, West Bengal, Arunachal Pradesh, Meghalaya and Sikkim.
- Of the 35.28 per cent forest cover of Assam, almost 20.6 per cent lies within the Brahmaputra basin and is known for its rich pool of biodiversity.
- As much as 90 per cent of the total flora of Assam is to be found in the Brahmaputra Valley, with more than 250 species of orchids, 33 species of bamboo, 12 species of cane, and a veritable medicine chest of plants with healing properties.



A typical grassland-wetland complex in Kaziranga

Dhritiman Mukherjee



An epiphyte laden tree in semi-evergreen forest



*Aerides multiflora*

The common Foxtail orchid *Rhyncostylis retusa*, worn by young girls in their hair during the spring festival of Bihu.

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*Anoectochilus sikkimensis* a diminutive ground orchid

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## A green spread

In general, Assam's vegetation is primarily tropical. It includes evergreen, semi-evergreen and deciduous forests, grasslands and stretches of riparian forest.

Variations in forest types and their vegetation are the outcome of physiographic (geographic) and edaphic (soil) conditions, and range of climate. The lack of altitudinal variation in the plains, particularly in the Brahmaputra Valley, has little role to play in determining its forest types. The vegetation and forest types along the Brahmaputra River in Assam can be categorized as tropical moist evergreen, tropical semi-evergreen and moist deciduous to riparian forest; grassland and savannah; wetlands and swamps; and degraded lands.

Of the 35.28 per cent of Assam's forest cover, 17.68 per cent falls under reserve forest and 5 per cent under the protected area network, with most of the protected areas located in the Brahmaputra Valley. There are various estimates of the number of plant species in Assam. The conventional estimates point to 3017 species

More recently, Barooah and Ahmed (2014) compiled a detailed checklist of the angiosperms and gymnosperms found in the state by listing 3854 species (including infra-specific species) under 1394 genera and 236 families. Of these, 2752 species are dicotyledons, 1080 are monocotyledons, and 22 are gymnosperms. The flora of Assam represents 18 per cent of the Indian flora. However, the figures are provisional as many areas are still either unexplored or underexplored.

The Brahmaputra Valley is far richer than the Barak Valley in its diversity of plants of different groups (multidimensional biotypes). It is also home to a number of endemic plants and some primitive angiosperms of significance. These aspects of the flora are important both from a taxonomic and ecological point of view.

Although a comprehensive account of the endemic species of the state is yet to be written, the Botanical Survey of India listed 102 species of angiosperms belonging to 75 genera as endemic within the political boundary of Assam – of this as many as 91 species belonging to 68 genera are found in the Brahmaputra Valley. Several groups of flowering plants such as orchids, legumes and cucurbits exhibit remarkable species diversity along with the genus *Dendrobium* (orchid), *Elaeocarpus* (Indian olive), *Piper* (pepper), *Garcinia* (the medicinal

mangosteen), *Calamus* (cane), *Dipterocarpus* (timber-yielding plant), etc.

Other families that contribute to the rich gene pool of the Valley include *Poaceae* (Grass family), *Orchidaceae* (Orchid family), *Fabaceae* (Legume family), *Asteraceae* (Sunflower family), *Araceae* (Aroids), *Cucurbitaceae*, (Cucurbit family) *Lauraceae* (spices such as cinnamon and bay leaves, etc.), *Arecaceae* (Palm family – coconut, betel nut and other palms), *Zingiberaceae* (Ginger family), among others, contribute to the rich gene pool of the valley.

### Botanical wonders

The area is also known for several botanical wonders. Some of the phylogenetically primitive families such as *Magnoliaceae*, *Anonaceae*, *Schizandraceae*, *Menispermaceae*, *Altingiaceae* and *Lardizabalaceae* grow in the Brahmaputra Valley and further eastwards but do not occur in other parts of India. No wonder many a naturalist has described Assam as the 'Biological Gateway' of North-east India. Moreover, the flora of the Valley has distinct similarities with the vegetation in nearby Nepal, Bhutan, the Indo-Burma and the Sino-Himalayan region as well as Malaysia, and to a lesser extent with peninsular India. What's more, some plants of African and North American origin are also found in a naturalized state in the Valley, providing



*Papilionanthe teres* a showy epiphytic orchid

tantalizing glimpses of travel across ages. As Armen L. Takhtajan (1969), the eminent plant taxonomist and geographer stated decades ago, 'The cradle of flowering plants lies in between Assam and Fiji'.

There are fewer gymnosperms in Assam. In the Brahmaputra Valley they are restricted to the districts of Darrang, Dibrugarh, Goalpara, Golaghat, Lakhimpur, Sibsagar and Sonitpur, which have five common species of gymnosperm, among them *Cycas pectinata* (Assamese: Nag Phona), *Podocarpus nerifolia* (Assamese: Katbhaluka), *Gnetum gnemon* and *G. montanum* (Assamese: Momai Lata) growing wild. Ferns and fern allies also comprise an important component of biodiversity.

The species representation of the cryptogamic group of plants such as moss (*Musci*), liverworts (*Hepaticae*) and lichens is remarkable in the Valley. Like the higher group of plants, that is, Phanerogams (angiosperms and gymnosperms), the cryptogams (pteridophyte, algae, fungi, lichens, etc.) are equally important as their uses range from food and medicine to dyes and ornamental purposes. Fronds of pteridophytic plants such as *Diplazium esculentum* (Assamese: Dhekia sak) are eaten as a vegetable. Different species of edible mushroom such as *Agaricus*, *Morchella* and *Pleurotus* are commonly available in the forests of the Valley and are often sold in local markets.

Assam serves as a centre of origin of economically important plants, such as *Musa* (banana), *Citrus* (lemon, orange), *Mangifera* (mango) *Zizyphus* (Indian jujube, bogori), *Camellia sinensis* var. *assamica* (tea). In fact, Singh and Varaprasad (2008) identified the Brahmaputra Valley as a 'probable agricultural heritage' site due to its unique and significant diversity in important cropping plants.

The plant resources available in the area lend themselves to a wide variety of uses starting from their timber yielding value to their utility as medicines, food, source of essential oils and gums, source of paper and pulp, dyes, resins, tannins, essential oils, and fibers, among others. These hint at avenues that await fruitful exploration, especially in the area of novel medicinal drugs. The Brahmaputra Valley is also known to produce some of the finest teas in the world that are the toast of connoisseurs.

Further, the sheer range of orchid varieties and ornamental plants present good prospects for floriculture. The many species of cane and bamboo play an important role in the development of forest-based cottage industries.

One of the main reasons for the richness of the Valley's flora stems from the fact

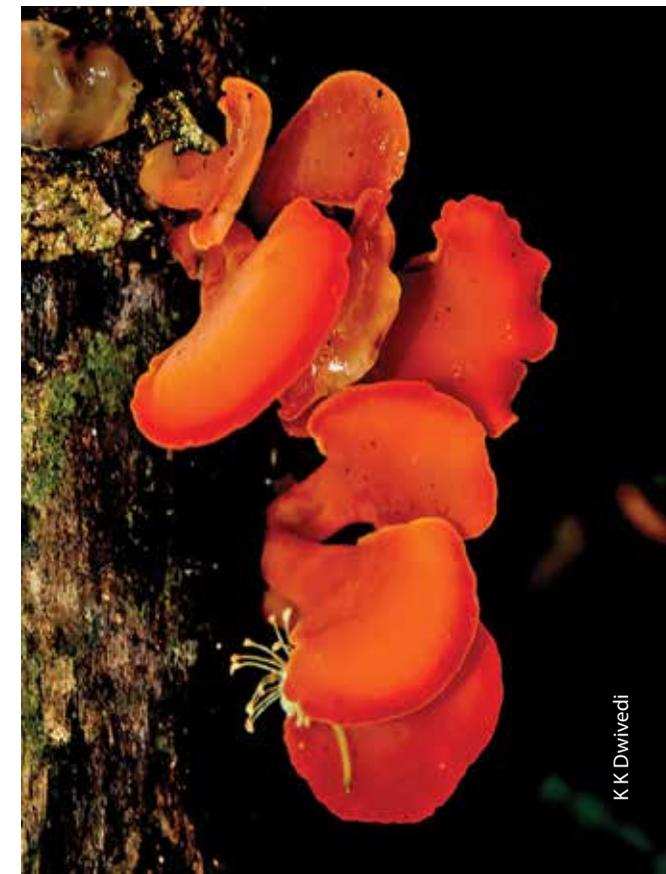


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Various species of fungi help to decompose dead vegetation and recycle nutrients.

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Fungi



Fungi



*Dioscorea pentaphylla*  
a species of yam with  
medicinal properties

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Flower of *Dillenia indica*  
whose sour fruits are  
eaten by people in curries  
and relished by elephants  
as well.

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Wild flower setting seed

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A wide variety of wild flowers dot  
the wilderness areas of the valley

K K Dwivedi



that the area is home to ethnically diverse communities with their particular use of different plant varieties. Over 332 plant species are used as sources of food, beverages and medicine and about 40 species of various wild plants are marketed as food and vegetables in local tribal and village markets of the Valley. The use of plants for a variety of purposes is an indicator of the intimate dependence and relationship of people of an area with the plant resources in their vicinity. Hence the Valley presents a unique opportunity for studies in ethnobotany or studies of the relationship between communities and the plant life in their areas.

The Valley has rich biological assets in the form of wild varieties of cultivated plants which is a gene bank of agronomic and economic importance, needed for genetic improvement of crop plants.

### Threatened Species

In reality, many rare varieties of plants are on the list of endangered species. The Botanical Survey of India estimates that about 700 plants in the North-east region are endangered to a lesser or greater extent. Of these 43 species belong to Assam.

There are 60 rare and threatened plant species and 871 species of angiosperms and gymnosperms at varying levels of risk in Assam. Of these 167 species are listed as endemic, 318 species are Critically Endangered, Endangered and Vulnerable, and 386 species are identified as being of rare value.

### Some of the plants in the Brahmaputra Valley that are Critically Endangered are

*Livistona jenkinsiana* (Assamese: Tokou, (English: Chinese Fan Palm), *Swertia chirayita* (Assamese: Chirota), *Smilax glabra*. Among the Endangered plants are *Aquilaria malaccensis* (Assamese: Sanchi goch, English: Agar), *Brucea mollis* (Fern), *Cibotium barometz* (Fern), *Citrus macroptera var. assamensis* (Lemon), *Dendrobium nobile* (Orchid), *Flickingeria fugax*, *Garcinia pedunculata* (Assamese: Bor thekera, English: Mongosteen), *Homalomena aromatica* (Assamese: Gandh Kochu).

Vulnerable species include *Elaeocarpus sphaericus* (Assamese: Rudraksha), *Gynocardia odorata* (Assamese: Chulmogra), *Hydnocarpus kurzii* (Assamese: Lemtem), *Mahonia napaulensis*, *Oroxylum indicum* (Assamese: Bhatghila), *Piper peepuloides* (Assamese: Pipal), *Rauvolfia serpentina* (Assamese: Sharpagandha)

Bamboo Flower

# Wildlife of the Brahmaputra

Kashmira Kakati

The Brahmaputra Valley is an alluvial plain created by the sediments of the great river over geological time. The narrow valley, about 700 km long and 80 km wide, is a melting pot for fauna from three different biogeographical realm origins -- Malayan, Chinese and Indian. The seasonally inundated floodplains of the river supported extensive grasslands, swamps and wetlands that have now been reduced to isolated stretches along the river. The tropical evergreen, semi-evergreen and deciduous forests typical of the Valley have also been cleared systematically for settlement and agriculture until only a few, disjointed patches remain.

The Hog Badger in Kaziranga. It feeds mainly on mammals, snails and slugs.



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Two rhinos skirmish on open grassland in Kaziranga.





Dhritiman Mukherjee



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Two subspecies of the Capped Langur, *Trachypithecus pileatus durga* (left) and *T.p.tenebricus* (right) occur on the south and north bank of the Brahmaputra respectively.



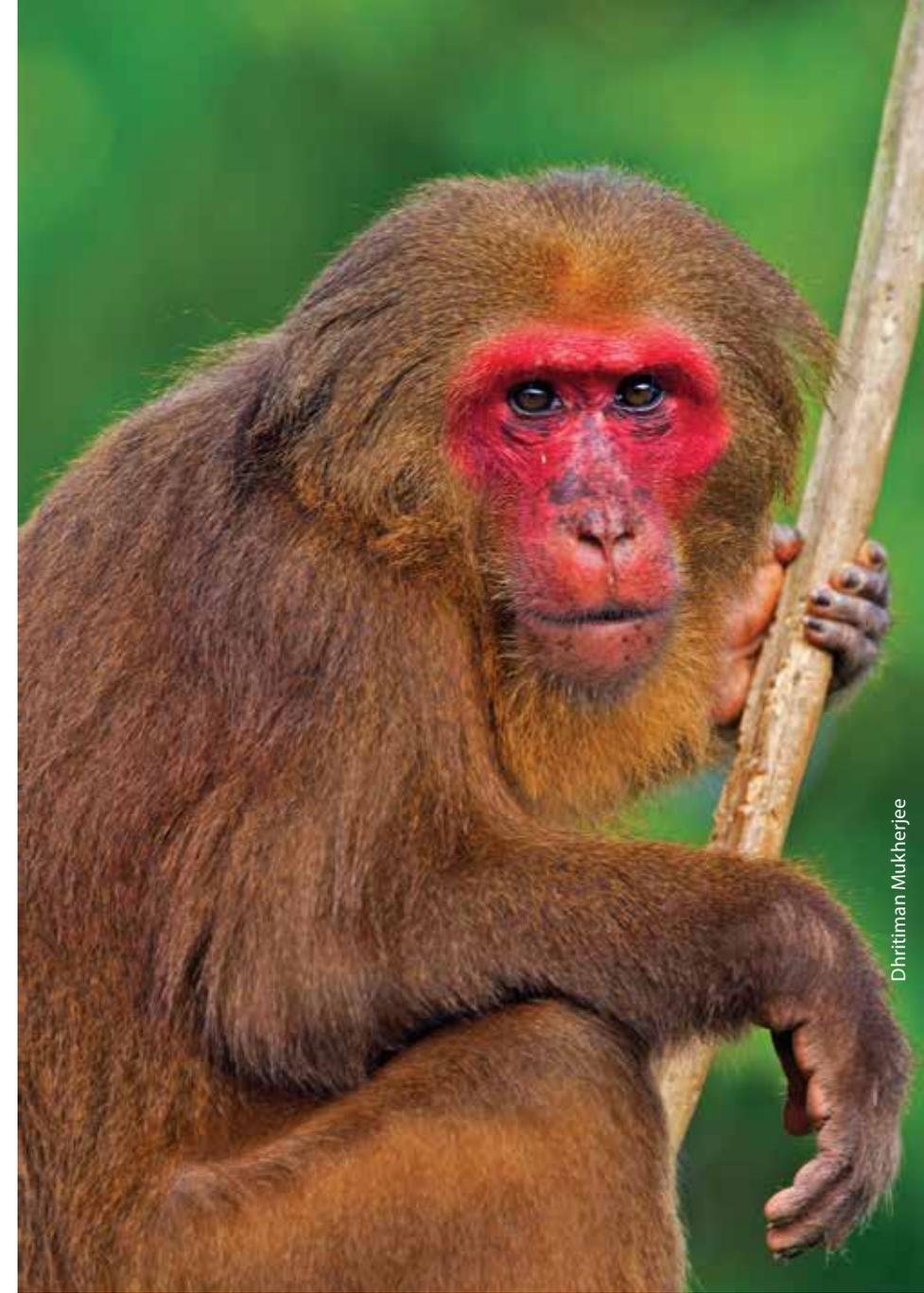
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The Assamese Macaque is a forest macaque widely distributed from Nepal to Vietnam.



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The Northern Pig-Tailed Macaque is restricted to the south of the Brahmaputra along its length in Assam.



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The rare Stump-tailed Macaque prefers dense forests and is not easily seen.



A capped langur's golden fur silhouetted in the light of the evening sun.

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The Common Palm Civet is widely distributed and will also enter homes in search of poultry or fruit.

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A leopard cat kitten



KKDwivedi

A jungle cat



Ujjit Dwivedi



The Brahmaputra grasslands, with its core in Kaziranga, is one of the bastions of the endangered Royal Bengal Tiger.

## Mammals

Nevertheless, these grasslands and forests are home to three of Asia's largest herbivore species – the greater one-horned rhinoceros, the wild water buffalo and the Asian elephant, and its largest carnivore, the tiger. The Valley's wildlife also includes the endangered and endemic golden langur, the Western hoolock gibbon and the Gangetic dolphin; and a single sub-population of the Critically Endangered pygmy hog. Of these, the rhino and the wild buffalo populations are the largest in the world. The jewel in



The Red Giant Flying Squirrel

Dhritiman Mukherjee



The critically endangered Pygmy Hog has only a single sub-population in the wild. Reintroduction efforts are on.

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The Bengal Slow Loris is the only nocturnal primate in India

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The Malayan Porcupine is the largest rodent species in the region

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The Western Hoolock Gibbon is endangered by loss of its closed-canopy habitats. Here in Barekuri, Tinsukia, several family groups are isolated in village areas which were formerly forest without hope of long-term survival.

the crown of the Brahmaputra Valley wildlife areas, Kaziranga National Park, famous for its rhino, also boasts the highest density of the Bengal tiger in the country, and the only known population of the Eastern swamp deer.

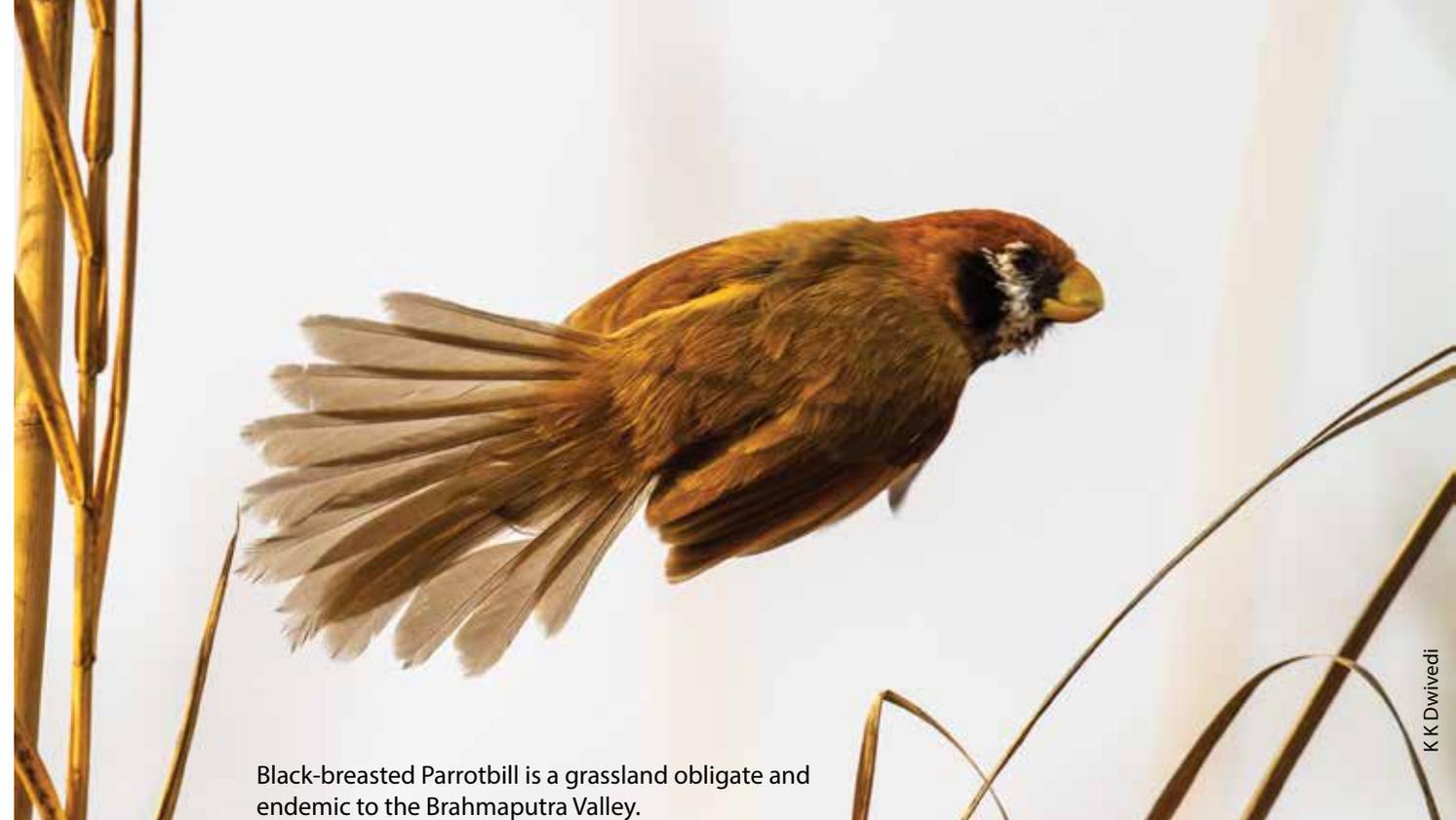
## Birds

The Brahmaputra Valley lies at the junction of the Australasian and Indo-Asian flyways. In addition, it has a wide variety of habitats from aquatic, swamps and marshes and floodplain grassland to deciduous woodland and evergreen forest, providing ideal breeding and feeding grounds for hundreds of species of birds. On average, around 40 per cent of these species are resident birds and over 30 per cent are migratory. About 10 per cent are local migrants.

Key sites in the Brahmaputra Valley, such as Kaziranga and Dibru-Saikhowa National Parks each, have close to 500 bird species. Other sites like the D'ering, Burhachapori, Laokhowa and Pobitora Wildlife Sanctuaries each have fewer total species, but nevertheless shelter some rare birds.

Two spectacular phenomena relating to birds are recorded from in and near the Brahmaputra Valley. One is the annual spring congregation of thousands of blue-tailed bee eaters on Koroitoli short grassland of Burhachapori Wildlife Sanctuary for nesting. Within a 1.5 sq km area of relative highland in the floodplain, the birds dig nest cavities on the ground. Feeding on their favourite food of dragonflies and other insects that abound in the nearby Kasodhora *beel* and *Dhania suti*, they lay eggs in early April. The eggs hatch in May, and by June before the flood waters come in, they leave.

The other phenomenon, recently documented and tracked, is the migration of thousands of Amur Falcons between eastern Asia and Southern Africa, through North-east India. Theirs is the longest overwater migration, of over 4000 km, of any bird of prey. Roost sites in Nagaland are known and they have flight paths over Assam, Meghalaya and Manipur. Radio transmitter studies of three birds have shown that in winter they fly to near



Black-breasted Parrotbill is a grassland obligate and endemic to the Brahmaputra Valley.

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Barn Owl

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A Changeable Hawk Eagle catches a hoary-bellied squirrel

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The Jerdon's Baza

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Grey headed fish eagle with a freshly caught eel

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A jungle crow picks off a Blue-tailed Bee-eater in Lawkhowa WLS

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Rufous-necked laughingthrush

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Silver-breasted Broadbill

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Oriental Pied Hornbill

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The Great Hornbill is a large impressive bird of North-east Indian forests. Their casques and feathers are important in tribal cultures as decoration. They are threatened by habitat loss and hunting.

the southern edge of the Brahmaputra Valley near Sivasagar and in spring at least one tagged bird journeyed up the Brahmaputra from Dhubri for almost 300 km till it veered away at the Karbi Anglong Hills, further on to Myanmar and Yunnan in China.

## Threatened birds of the Brahmaputra Valley

### Critically Endangered

#### Bengal Florican

The world's rarest bustard species is a resident here and numbering only 250-999 mature individuals throughout its fragmented range in India and Cambodia.

#### White-bellied Heron

A large riverine species with a global population size of only 50-249 mature individuals, occurring seasonally in Kaziranga, Dibru-Saikhowa, Manas and Pabitora.

#### White-Rumped Vulture

Once widespread in South and Southeast Asia and described as possibly the most abundant bird of prey in the world numbering millions, its population declined by 99 per cent in the 1990s due to the use of a veterinary anti-inflammatory drug diclofenac, combined with other causes. Only 2500-9999 mature individuals are thought to be surviving.

#### Slender-billed Vulture

Once common in Nepal, northern India and Southeast Asia, populations declined due to the decline of wild ungulate populations, and lack of livestock carcasses due to improved animal husbandry. The biggest blow was struck in the 1990s by the use of diclofenac, reducing the population to 1000-2499 mature individuals.

#### Red-headed Vulture

Ranging from Pakistan through other countries of South and Southeast Asia, the population is estimated at 2500-9999 mature individuals, with declines attributed to the reduced carcass availability and diclofenac use that causes renal failure.

### Endangered

#### 1. Greater Adjutant

Resident stork species which was widely distributed in South and Southeast Asia, but with 70-80 per cent of its population now only in Assam.

#### 2. White Winged Duck

A lowland riverine species with specific requirements of stagnant or slow-flowing water near forests where it uses trees to nest. The global population is 250-999 mature individuals of which the majority are in Assam in the evergreen forests of Tinsukia District and Dibru-Saikhowa National Park.

#### 3. Spotted or Nordmann's Greenshank

A migratory species that breeds in eastern Russia and is a passage or winter migrant in India.

### Threatened Grassland Specialists

Endemic to the Brahmaputra floodplains and adjacent hills is the Marsh Babbler, a grassland specialist. The Brahmaputra floodplains constitute some of the last remaining habitats for several other threatened grassland specialists such as the Swamp or Rufous-vented Prinia, Black-breasted Parrotbill, Jerdon's Babbler, Slender-billed Babbler, Rufous-rumped Grassbird, Bristled Grassbird, Swamp Francolin, Hodgson's Bushchat, Jerdon's Bushchat and Finn's Weaver. The endangered Manipur Bush Quail, also an endemic grassland species, was not seen after 1932 until an unconfirmed report from Dibru-Saikhowa in 1998, and one sighting in Manas National Park in 2006.

#### Rare Water Birds

Baer's Pochard, Falcated Duck, Ferruginous Pochard, Lesser White-fronted Goose, Black-bellied Tern, Spot-billed Pelican, Dalmatian Pelican and Little Gull.

#### Globally Threatened Raptors

Pallas' Fish Eagle, Greater Spotted Eagle, Imperial Eagle and Lesser Kestrel.



A Lesser Adjutant Stork, common in Brahmaputra wetlands, catches a chequered keelback snake. It will also eat frogs, fish and invertebrates.



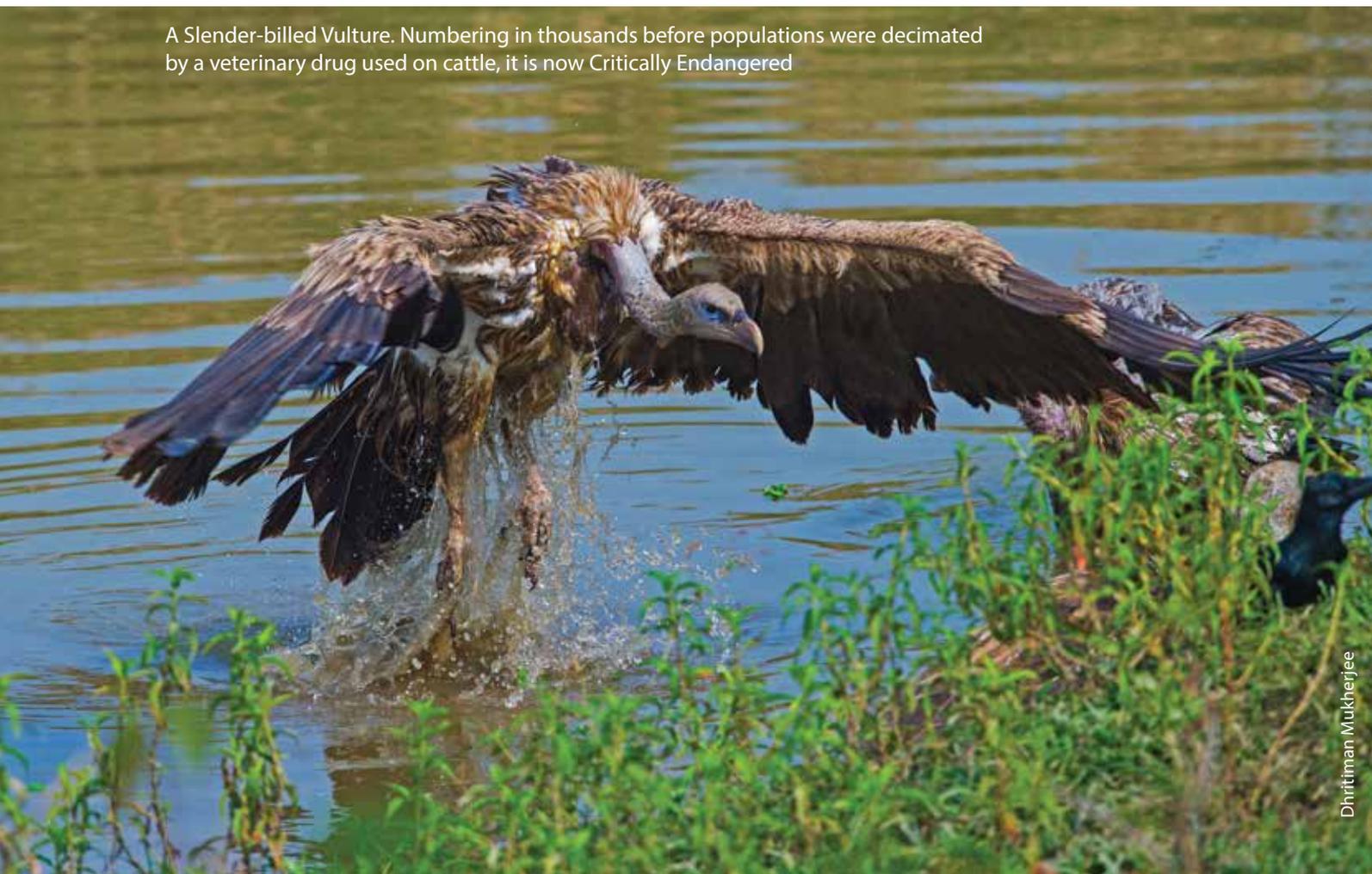
The Bengal Florican is Critically Endangered and an iconic species of the Brahmaputra grasslands.

Dhritiman Mukherjee



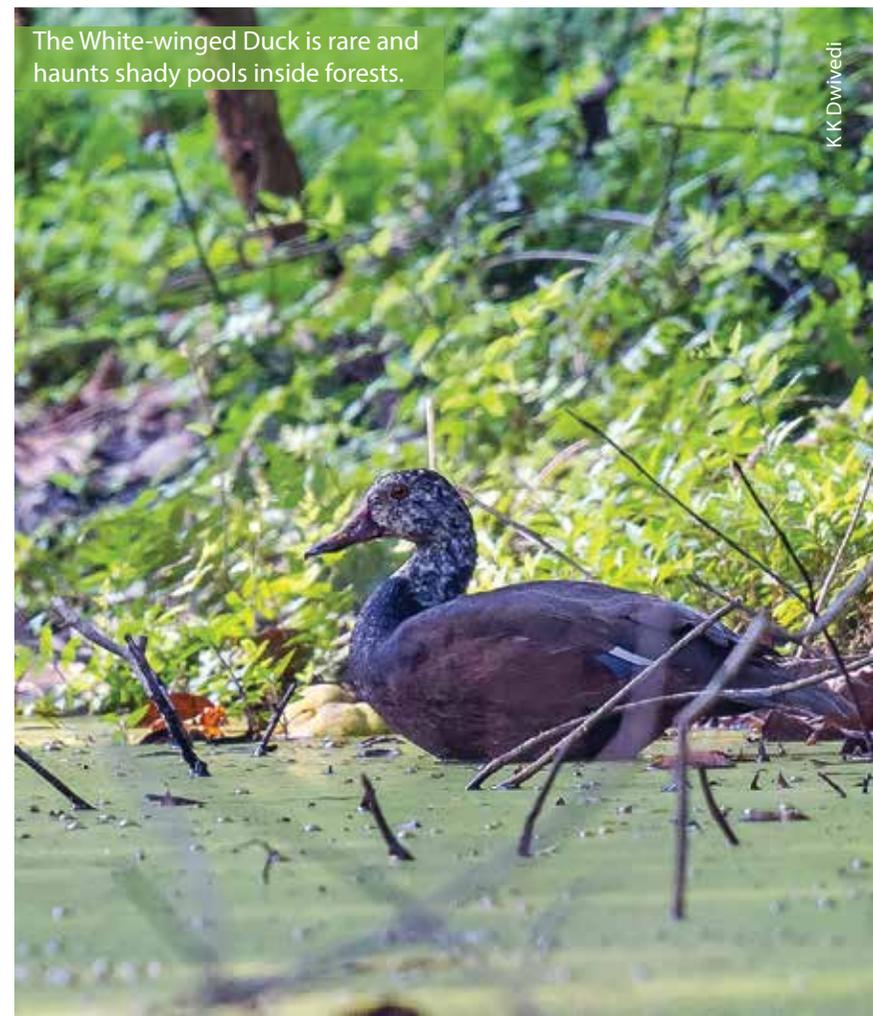
The Baikal Teal is a winter visitor to the Brahmaputra

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A Slender-billed Vulture. Numbering in thousands before populations were decimated by a veterinary drug used on cattle, it is now Critically Endangered

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The White-winged Duck is rare and haunts shady pools inside forests.

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## Herpetofauna

The herpetofauna of the Assam plains and hills have not been documented extensively and experts estimate that there could be as many as 500 species. In the Brahmaputra Valley, Kaziranga and Dibru Saikhowa National Parks are among the sites where reptiles and amphibians have been well documented. A study in Kaziranga recorded high mortality of reptiles during burning for grassland management and in road kills during the high flood season. Pollution of the river and *beels* is a threat to the herpetofauna.

## Crocodylians

Anecdotal records suggest that two species of crocodylians – the mugger and the gharial, were abundant on the Brahmaputra and its tributaries. Now the gharial is the rarest of Asian crocodiles and Critically Endangered with 200 individuals in India and Nepal. There are scattered recent records of gharial at different locations on the

Brahmaputra with sightings at Urapad Beel and Jinjiram River of Goalpara, and in the Manas and Beki rivers in western Assam and reported by locals from the Subansiri and Ghagar river, Dikhowmukh and Dihingmukh confluences. The last sighting was in 2005-2007 and as of now no breeding population is known from anywhere in North-east India. There are no reliable records of the mugger crocodile on the Brahmaputra and either it did not occur here, or was extirpated.

## Turtles and tortoises

The Brahmaputra Valley and adjoining hills are home to 21 species of turtles and reptiles, among them the only wild population of the Critically Endangered Black softshell Turtle and six other endangered species – the Yellow tortoise, Asian brown tortoise, Narrow-headed softshell turtle, Keeled box turtle, the Three-striped Roofed turtle and Assam Roofed turtle. In Kaziranga, 17 species of turtles are recorded while Dibru-Saikhowa National Park has 11 species of turtles. Among these, Oldham's Leaf Turtle, the Malayan Box Turtle and the Indian Tent Turtle are among the rarer species.



Lizard



Tokay Geckos are nocturnal and arboreal, living on trees and roofs of dwellings.

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## Lizards

Lizards are the least species diverse among the reptile group with 21 species recorded in Kaziranga and nine in Dibru-Saikhowa. These include the skinks, garden lizards, geckos and monitor lizards. Of these, the Bengal Monitor and Water Monitor are Vulnerable, Schedule I protected species. From Kaziranga have emerged new records of species such as the Golden Monitor *Varanus flavescens* recorded for the first time in the Brahmaputra floodplains, the Burmese leaf-toed gecko *Hemidactylus karenorum* recorded for the first time in Assam and the Reeve's Smooth Skink *Scincella cf. Reevesi*, recorded for the first time from India. The large Tokay gecko *Gekko gekko*, considered common in the region, is under threat due to poaching for its supposed medicinal value.

## Snakes

Thirty-five species are recorded in Kaziranga of which a few have been recorded for the first time in the Brahmaputra Valley. These are Jerdon's Blind Snake *Typhlops jerdonii*, Wall's Keelback *Amphiesma xenura*, Green Cat Snake *Boiga cyanea*, Arrowback Tree Snake *Boiga gokool* and Twin-spotted Wolf Snake *Lycodon jara*. The Green Vine Snake *Ahetulla nasutus* (var. *rhodogaster*) was recorded from the region after more than 60 years. Among the 22 species of snakes recorded in



Indian peacock soft shell turtle

Ujrit Dwivedi



The Red-necked keelback is commonly found near water and feed on aquatic vertebrates

Udayan Borthakur

Dibru-Saikhowa National Park, the short-nosed vine snake is Endangered, while the Assam Snail Eater and the Mock Viper are Vulnerable species.

## Amphibians

The abundance of water in the Brahmaputra Valley provides for much amphibian habitat. In Kaziranga, there are 24 species of amphibians from 14 genera. The Pied Warty Frog *Theلودerma asper* and Northern Trickle Frog *Phrynoglossus borealis* previously known only from hill areas of Arunachal Pradesh and Nagaland were recorded for the first time from the floodplains. Dibru- Saikhowa has 17 species of amphibians from 10 genera. Of these, the Annandale's Tree Frog *Chiromentis simus* is Endangered and the Common Cricket Frog *Fejervarya limnocharis* is listed in the Vulnerable category, while most of the others are common species such as the Assam Forest Frog, Bhamo Frog, Himalayan Tree Frog, Six-lined Thee frog, Striped Pygmy Tree frog and Ornamented Pygmy Frog.

### The Brahmaputra as barrier and corridor

The wide Brahmaputra serves as a natural or biogeographic barrier for certain species of wildlife. The golden langur, hispid hare and pygmy hog, for example, only occur on the north bank of the river, while the western hoolock gibbon, Malayan sun bear, pig-tailed macaque and stump-tailed macaque



Frog

K K Dwivedi

The streams and wetlands of the Brahmaputra Valley provide a variety of habitats for many species of amphibians.



Frog

K K Dwivedi

occur only on the south of the river. As human settlement and activities steadily disrupt the connectivity among forests in the Valley, the same river, however, also functions as a vital corridor for many species of wildlife that are able to ford water and use the islands for movement or as living spaces. As a corridor, the Brahmaputra connects patches of isolated forest thereby facilitating gene flow, helping increase populations and sometimes also allowing natural re-establishment of species at sites where they have become locally extinct. These connected populations are called meta-populations, and in Assam the Brahmaputra is instrumental in maintaining meta-populations of some of the most endangered animals in the world, such as the Bengal tiger, the Indian rhino, the Indian elephant and the wild water buffalo. Along the length of the Brahmaputra, there are only two significant river corridors that are used by a range of wildlife currently. These are - the string of islands between Orang NP and Kaziranga NP; and the

## Butterflies

The butterfly diversity in the floodplain area of the Brahmaputra is not very high owing to lack of vegetation complexity in what are predominantly grasslands. Butterflies need various host plants to complete their life cycle. For example, in Molai Sapor, a restored forest on a sand bar, only 43 species of butterflies have been recorded. Similarly, 56 species have been recorded in Orang National Park and 104 species in Dibru-Saikhowa National Park. While the Kaziranga National Park checklist had 493 species, most of these were seen in the forested Karbi-Anglong hills part of the park.

Rare butterflies in Brahmaputra floodplain protected areas

### 1. Kaziranga National Park

Purple Lancer (*Salanoemia fuscicornis*), Yellow band Palmer (*Lotongus sarala*), Swinhoe's Flat (*Celaenorrhinus zea*), Elwes' Silverline (*Spindasis elwesi*) and Peal's Palmfly (*Elymnias peali*).

### 1. Orang National Park

Blue Striped Mime (*Papilio slateri*), Yellow Jack Sailer (*Neptis viraja*) and Northern Jungle Queen (*Stichopthalma camadeva*).

### 1. Dibru-Saikhowa National Park

White Dragontail (*Lamproptera curius*), Archduke (*Lexias pardalis*), Blackvein Sergeant (*Athyma ranga*) and Common Gem (*Poritia hewitsoni*).

### 1. Molai Kathoni

In the restored forest site of Molai Kathoni, species are mostly not rare, but uncommon species include the Dark Archduke (*Lexias directa khasiana*), One spot Grass Yellow (*Eurema andersoni*) and the Circe (*Hestina nama*).



Common gem butterfly

K K Dwivedi



Common rose swallowtail butterfly

K K Dwivedi



Oak Leaf butterfly, an example of leaf mimicry and camouflage.



The Eri Silk Moth. Eri is a strong, durable silk produced from the cocoons of the silk worms.

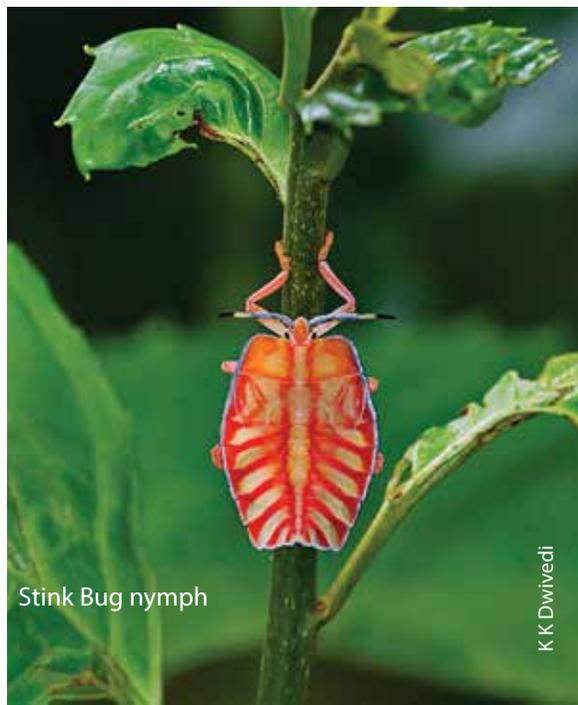
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An Orb Spider *Argiope pulchella*



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Stink Bug nymph

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Hopper

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Bug

K K Dwivedi



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*Sagra longicollis*, a frog-legged beetle named for its long, bent hind legs

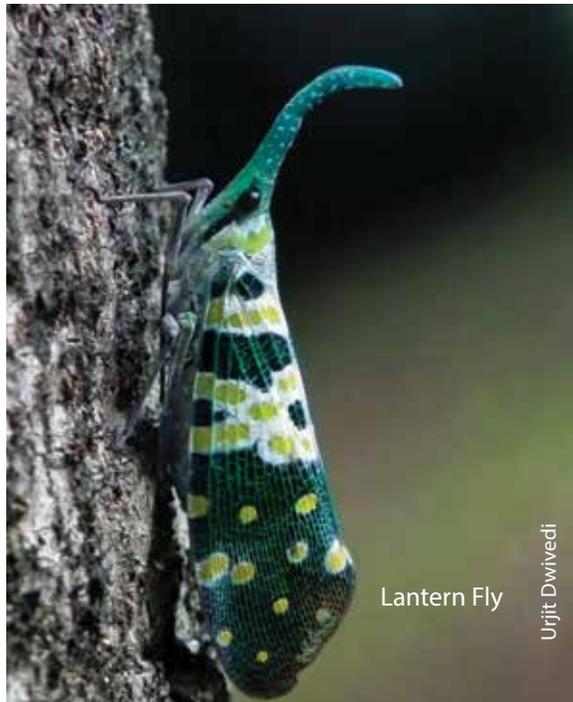
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Lantern Fly

Ujjit Dwivedi



K K Dwivedi

partially forested Kobo and Amarpur Chaporis that connect D'ering WLS and Poba RF to Dibru-Saikhowa NP at the eastern end of the river. Majuli, being inhabited, is used by the herd of River Elephants, and occasionally rhinos straying from Kaziranga.

## Protected areas of the Brahmaputra

Starting from the D'ering Wildlife Sanctuary of Arunachal Pradesh on the Siang, the Brahmaputra is the location for several protected areas. Within Assam, three of its five national parks are located on the Brahmaputra i.e Dibru-Saikhowa, Kaziranga and Orang, of which the latter two are also Tiger Reserves. These three Parks together cover 1278 km<sup>2</sup>. Six of its 18 Wildlife Sanctuaries are also on or close to the Brahmaputra, regulated by its floods. These are Panidehing, Laokhowa, Burhachapori, Pabitora, Amchang and Deepar Beel. Two other sites, Chakrashila Wildlife Sanctuary and Bordoibam Bilmuk Bird Wildlife Sanctuary (Proposed) are also located on the Brahmaputra plains, but further from the river's main channel.

**D'ering Wildlife Sanctuary:** The first protected area after the Siang/Brahmaputra enters the plains from the Eastern Himalaya, D'ering (190 km sq km) has a predominantly grassland habitat on sandy islands among the river channels. Its last rhino was recorded in 1965 and is an excellent potential site for the reintroduction of rhino. It is not known, however, if the record was of the one-horned rhino or the Sumatran rhino. It has large mammals like elephant and wild buffalo, carnivores including leopard and wild dog, and populations of Gangetic river dolphin, otters and migratory birds in the river. It is also an extremely scenic site.

## Dibru-Saikhowa National Park and Motapung-Maguri Beels

An example of a national park almost entirely within the river, Dibru Saikhowa is also a Biosphere Reserve. It is the largest salix swamp forest in North-east India. It is very rich in biodiversity, but human settlements within the boundaries present intractable obstacles to the effective management and conservation of a rich grassland habitat and a potential rhino reintroduction site. It boasts large mammals like the elephant and wild buffalo, a population of feral horses, river dolphins and over 493 species of birds including rare grassland specialists like the Marsh Babbler, Rufous-vented Prinia and Black-breasted Parrotbill. .

## Panidehing Bird Sanctuary

A small area of 33.93 sq km was declared a bird sanctuary in 1999. Large numbers of migratory bird species come here during winter while the river elephants make incursions into village to eat crops. There were rhinos here till 1987 when the last one was killed by poachers. In 1993 two rhinos came from Kaziranga, and another in 2007, that was subsequently killed in 2009. About 267 bird species have been recorded here, with 70 among them being migratory species. Most are common birds such as the bar-headed goose, mallards, gadwall and red crested pochard. The griffon and white-rumped vultures occur here but are rare. Poaching, grazing, and fishing within the sanctuary have taken a heavy toll on habitat within the sanctuary.

**Kaziranga, Orang and Pabitora National Parks:** The history of Kaziranga is inextricably linked with the saving of the Indian one-horned rhinoceros from certain extinction in 1905 to a population of about 2400 now which is 67% of the world population of this species. This conservation success has been marked by a recent downgrading of the status of this iconic, prehistoric species from Endangered to Vulnerable. The rhino has served as the umbrella species for Kaziranga, the conservation of which simultaneously saved several under threatened species. These include 57% of the world population of the Asiatic Wild Buffalo (1963 individuals), the largest single population in the world; and the only known population (1129±63 individuals) of the Eastern Swamp Deer or Barasingha of the Eastern Region, one of the three sub-species of Swamp Deer. A current translocation project from Kaziranga to Manas National Park, where it might have been extirpated, is in progress. Kaziranga-Karbi-Anglong is also habitat for a significant population of 1200+ elephants, over one-fifth of the 5500 elephants in Assam.

Orang National Park is the only site with rhinos on the north bank of the Brahmaputra, with a population of about 100. In Pabitora, suitable habitat and absence of predators has seen its rhino population of five to six in the 1960s burgeon to nearly 110 rhinos



Panidehing Bird Sanctuary

K K Dwivedi

now, within an effective 16 sq km area within the larger 38 sq km wildlife sanctuary. These national parks are also grazing grounds for mega-herbivores like the elephant and wild water buffalo. With about 125 tigers, the Kaziranga-Orang landscape, connected by the Brahmaputra river islands, is the stronghold of this endangered species in the region. The productive grassland of these three representative wildernesses and stringent protection has resulted in an exemplary conservation success. Forest personnel put their lives on the line to protect rhinos and the other wildlife.

**Laokhowa and Burhachapori Wildlife Sanctuaries:** These are examples of grassland sites that lost most of their flagship species such as rhino, wild water buffalo and tiger to human disturbance and poaching during the civil unrest of the 1980s. They are part of the Kaziranga-Orang riverine landscape, where the natural dispersal of these species is being facilitated through the protection of the river islands serving as animal corridors. The sites are also being prepared for reintroduction of rhinos under a plan called the Indian Rhino Vision 2020 whose goal is to have 3000 rhinos in seven populations in Assam by the year 2020. Among many species of visiting birds, Burhachapori is famous for its congregation of blue-tailed bee-eaters in Koroitoli *beel*. Here, every summer thousands of birds arrive for nesting in cavities on the ground, feeding on the abundant dragonflies and other insects. They arrive in April and leave in June, after the eggs have hatched and before the Brahmaputra inundates the *beel*.

**Deepor Beel Wildlife Sanctuary:** An Important Bird Area and Ramsar Site i.e. a wetland of international conservation importance, Deepor Beel (Dipa – elephant, Beel – wetland) is

Wild Buffalo and rhino during a stormy Kaziranga evening.



A wetland closed to Rajiv Gandhi Orang National Park being cleared of water hyacinth.



situated on the outskirts of Guwahati City. There are 150 species of birds recorded here. In the monsoon, the floods of the Brahmaputra brings in fish fingerlings in huge numbers. Elephants from the adjacent hill forests of Rani and Garbhanga come down to the beel at the beginning of summer when the water dries out in the hills. Here they drink water and feed on an aquatic plant locally called Mokhona *Euryale ferrox*, a favoured food that grows well in various patches in the beel. A railway line on their passage to the beel has proven to be a death trap for these elephants. In the last 8-9 years, about 14 elephants have died on the tracks. Other issues beset this diverse wetland, mainly the problem of sewage and garbage from Guwahati city.

### Narrative of a few Brahmaputra species

**River elephants:** In the early 2000s, a herd of 150 elephants (now 70-80) that came to be marooned on the river islands of the Brahmaputra between Majuli (Jorhat) and Dehingmukh (Dibrugarh) because of massive deforestation on the north bank of the Brahmaputra due to the Bodo political insurgency and the construction of the National Hydroelectric Power Corporation dam on the Subansiri, which cut off their access to their lowland ranging and feeding grounds in the foothills. The tragic story of a homeless herd of elephants, is equally the tragic price that is being paid by the people living on Majuli island and the south bank of the river across these three districts, where the elephants destroy crops, property and human life. A cautionary tale about the unforeseen impacts of deforestation and unplanned development projects on wildlife and humans.

**Island tigers:** An annual WWF exercise is carried out to document the use of the Brahmaputra river islands between Orang and Kaziranga National Parks by tigers for feeding, shelter and dispersal. These islands are crucial in maintaining the genetic linkages between sites that are otherwise isolated from one another, and are now being protected by the Sixth Addition to the Kaziranga National Park. They feed on livestock

from *khutis* (cattle camps) during their stay or movement on the river, and removal of cattle, while essential, has to be calibrated with the need to sustain these tigers until the natural vegetation regenerates and wild prey are established. Scientific research data like these can help secure critical areas for wildlife conservation.

**River dolphins:** There are an estimated 635 Gangetic dolphins in the Brahmaputra, including 35 in the Subansiri River and 17 in the Kulsi River according to a 2012 survey. Their preferred habitats on the river were the downstream sections of mid-channel islands of the Brahmaputra. They prefer water more than 6 m deep. The blind dolphins use echolocation to navigate in water and find prey. The survival of the endemic dolphin of the Ganga-Brahmaputra river system in an increasingly polluted and over-fished river depends on several factors – raising awareness against killing and other harmful fishing practices, and planning judiciously the dams on tributaries of the Brahmaputra that will affect the hydrology and ecology of the river in ways that are difficult to predict but might prove costly for this iconic species of the river. A plan for seismic surveys on the Brahmaputra river bed for hydrocarbons was thwarted by a concerted civil society movement supported by scientific data on the river dolphins.

**The Bengal Florican:** With fewer than a thousand birds in three populations worldwide (India, Cambodia and Nepal) and a population of 250-280 birds in India, most of it in the Brahmaputra Valley, this Critically Endangered bustard is of great conservation significance. An obligate grassland species, the Bengal Florican prefers very specific habitats. They avoid inundated areas, prefer higher grounds and a combination of grassland, both tall and short with the grass height being a crucial factor. Short grass areas are for the stunning territorial displays by male birds, and tall grasslands are for nesting and shade. They are direly threatened by conversion of their preferred grassland habitats to agriculture and settlements.

**The golden langur:** The endemic and endangered golden langur was discovered by forest officer E.P.Gee only in 1953 in Jamduar, on the Sankosh River near Bhutan. Previously believed to be restricted to Manas, in recent decades small populations have been identified in the forests of western Assam, mostly isolated by fragmentation. They also occur in the bordering areas of Bhutan. The Chakrashila Wildlife Sanctuary of Kokrajhar District was given protected status in 1994, especially for the langurs which have a global population of about 5000, and about 500 within the sanctuary. The species is shy and folivorous i.e. mainly leaf eating. A study of golden langurs in a rubber plantation near Chakrashila reveals that they have adapted to limited food availability and have also become habituated to humans. In such altered habitats the golden langurs are ecological refugees, and exemplify our failure to secure large extents of forest where natural processes can occur undisturbed and provide self-sustaining systems for wildlife.

The endangered Gangetic River Dolphin prefers confluences on the Brahmaputra and are fish-eaters.



Udayan Borthakur

## Jadav Payenge (Molai) and the restoration of Molai Kathoni

When he was four or five years old, Jadav Payenge or *Molai*, lived in the village of Borgum Kokilamukh where there was a forest with many birds and animals. In 1979, much of the village was lost to erosion, and people left the *sapori* (sand bar) but Molai continued to graze his buffaloes there. In 1979, when he was 14 or 15 years old, during an intense monsoon, many snakes died in the heat of the open sun. Asking elders in nearby Deori Village for a way to prevent the snakes from dying, he was advised to 'grow the tallest grass in the world'. With the 50 bamboos that they gave him, Molai who started out with the intention of creating some shade for snakes, ended up creating a 550 hectare forest, now famous worldwide as 'Molai Kathoni' with five tigers, deer, elephants and an occasional rhino. Saying that all of nature helped him to grow the forest – from the termites and ants that he carried from his village to populate the island, to the deer and elephants who helped him disperse seeds -- Molai's is a lesson in patience and a deep understanding of how to give back to Nature

## Wetlands of western Assam

The districts of Bongaigoan, Kokrajhar, Dhubri, Goalpara, Barpeta, Nalbari and Chirang in western Assam have large wetlands like Urpada, Tamronga, Doloni, Dheer and Diplai used by thousands of migratory birds. There are two important records of gharial from these areas within the last decade. In recent years, migratory birds at many other smaller wetlands have been recorded. Mostly, the wetlands are under threat of eutrophication and encroachment and need a well thought-out plan for revival and preservation.

## Protected Area Close to The Brahmaputra

Sl. No.	State	Name	Year notified	District	Area (km <sup>2</sup> )	Total Bird Species Recorded in IBA*
<b>NATIONAL PARKS</b>						
1	Assam	Dibru-Saikhowa NP & Biosphere Reserve; IBA Dibru-Saikhowa Complex (Dibru-Saikhowa NP, Poba RF, Kobo Chapori PRF, Amarpur Chapori, Maguri & Motapung Beel, Adjacent riverine tracts of Brahmaputra & Lohit rivers)	1999	Tinsukia, Dibrugarh	340 IBA 800	502
2	Assam	Kaziranga NP, Tiger Reserve, Elephant Reserve and World Heritage Site, IBA	1974	Golaghat, Nagaon, Sonitpur	860 IBA 849	490
3	Assam	Orang NP & Tiger Reserve, IBA	1999	Udalguri, Sonitpur	78.80	225
<b>WILDLIFE SANCTUARY</b>						
4	Arunachal Pradesh	D'Ering (Previously Lali WLS), IBA	1976	East Siang	190	150+
5	Assam	Panidihing Bird Sanctuary, IBA (Panidihing Bird Sanctuary, Phokolai and Dorou Beels)	1999	Sibsagar	33.93 IBA 40	160+
6	Assam	Laokhowa, IBA Laokhowa-Burhachapori	1998	Nagaon	70.13, IBA 114.17	200+
7	Assam	Burachapori, IBA Laokhowa-Burhachapori	1995	Sonitpur	44.06	"
8	Assam	Amchang	2004	Kamrup	78.64 IBA 74	200
9	Assam	Pabitora	1998	Morigaon	38.83	190
10	Assam	Deepar Beel, IBA & RAMSAR Site	2009	Kamrup	4.14 IBA 9	150
11	Assam	Chakrashila WLS, Chakrashila Complex IBA (Dhir, Diplai & Dakra wetlands)	1994	Dhubri, Kokrajhar	45.50 IBA 53	213

# Aqua Faunal Diversity of the Brahmaputra

Ranjita Bania

The mighty Brahmaputra with its large number of tributaries, innumerable flood plain lakes and the Barak River system in the south constitute the major water resources of Assam, supporting over 200 species of aquatic fauna, including the endangered river dolphin. Although many protected areas along the Brahmaputra have been traditionally regarded as a fish granary, it is widely believed that fish production has drastically declined in recent years. However, there is no data available on this aspect. Also, there is no comprehensive record of the fauna and their habitat ecology, especially the fish assemblage of different rivers, channels and other water bodies. As pointed out by J. H Harris in his study 'The use of fish in ecological assessments' (1995), fishes can be used as indicators of change of temperature and also for ecological assessment at all levels of biological organisation.

The Brahmaputra basin has a subtropical climate. It experiences three seasons -- winter (November –February), summer (March-May) and monsoon (June – October). There is no sharp demarcation between summer and the monsoon period during which rainfall ranges from 2000 mm to 3900 mm. The Brahmaputra's riparian zone is highly unstable and subjected to bank erosion on one or both sides at different places. The fast flowing section of the river is characterised by rocky substratum and a relatively stable bank.

## Tracking the fishes of Brahmaptura

The study on the Brahmaputra reveals the presence of 222 species of fishes belonging to 105 genera under 37 families and 12 orders, comprising as much as 75 per cent of the 296 species reported from India's northeastern region, and 25.31 per cent of approximately 877 freshwater fish species across India. The Brahmaputra drainage system boasts an impressive range of ichthyo-faunistic (fish fauna) resources or geographical terrains suited to a wide variety of fishes, with a combination of torrential (hill stream) and plain water species as well as cold and warm water species. The majority of the species belong to the order Cypriniformes (114 species), followed by Siluriformes (57 species) and Perciformis (29 species). Among the families, Cyprinids



The Assam Roofed Turtles inhabits both streams and large river. It is endangered and drops into the water at the slightest disturbance.



Dhritiman Mukherjee

were found to be the most dominant group with 80 species followed by Balionidae (17 species), Cobitidae and Bagridae with 13 species each and Channidae with nine species.

Of the 222 fish species found in the state, around 210 species are reported to have food value. During the study, only 50 species were found to have considerable commercial importance as food. In addition, 24 species have importance as game or sport fish, and around 150 species have potential ornamental value. Of the total fish species, 40 are found to be endemic to the state, that is, they are found only in Assam. Recent reports on catch statistics indicate that there has been a drastic reduction in the abundance of fishes accompanied by changes in the distribution range of several fishes due to habitat modification, overexploitation and other anthropogenic causes.

As far as the current conservation status of the recorded fish species is concerned, it has come to light that one third of the species, i.e., 41 species, are Vulnerable; 40 species are at Lower Risk-near threatened; 22 are Endangered, and one species is Critically Endangered. About nine species fall within the category of Lower Risk-least concern. The majority of the species (93), a large proportion, have not yet been evaluated. Alien fish species such as *Hypophthalmichthys molitrix*, *Ctenopharyngodon idella*, *Cyprinus carpio*, *Clarias gariepinus*, and *Oreochromis mossambicus* have been identified in the present study because of their occurrence in the natural water bodies of the Brahmaputra drainage system.



*Tor khudree* (pithia or Deccan mahseer)



*Sperata aor* (Ari or long whiskered catfish)

## A range of habitats

Depending upon their unique topography five types of fish habitats have been identified in the Brahmaputra: fast flowing rivers, sluggish pools, confluences, river meanders and flood plain wetlands or *beels*. The fact that pools and meanders are comparatively richer in fish biomass than rapids and open rivers indicates that faster currents have an adverse impact on fish biomass. There is greater fish biomass in clear rather than in turbid water. Again, depending on the availability of species around the year, the fishes of Brahmaputra can be divided into four different categories: those found throughout the year; pre-monsoon and monsoon; post-monsoon; and winter and dry season when the water level is at its minimum.

Apart from the fish species, the Brahmaputra is home to nine species of freshwater prawn. The river's flood plains also possess a total of 76 species of macrophytes or aquatic plants belonging to 36 families and 55 genera. *Poaceae* is the dominant family with seven species, followed by *Polygonaceae*, *Nymphaeaceae*, *Lemnaceae* and *Hydrocharitaceae*. The study showed that there are more monocot species than dicots and pteridophytes. Ecologically, five types of growth forms are found among the macrophytes: anchored floating leaf (5.26 per cent), obligatory submerged (15.79 per cent), free floating (11.84 per cent), anchored floating stem (25 per cent) and emergent plant (42.10 per cent).

## Bustling fish landing centres

The Brahmaputra has as many as 42 fish landing sites on both banks of the Brahmaputra, their names echoing the undulating cadence of the river. Among them Dholaghat, Guijan ghat, Dehing Mukh (Dibrugarh), Disangmukh, Kokilamukh, Nimati ghat, Biswanath ghat, Jogighopa, Dhekiajuli, Tezpur, Uzan bazaar (Guwahati), Chunari ghat, Cehunari kamakhyabari, Tulsibari, Joleswar ghat (Goalpara), Dhubri ghat and Bura buri are the major fish landing centres.

The monthly fish yield of the main fish landing centres showed a higher catch in the main river in post-monsoon months. The winter and pre-monsoon months were more favourable as fishing seasons in wetlands. There are 216 fishery cooperatives in the state with 43,394 members. It was observed that they are somewhat lax in following the rules and regulations governing fisheries even though their livelihoods depend on it. There are significant regulations pertaining to the use of the small-meshed mosquito net for fishing, the months of observing a closure of fishing activity, and catching broods and juveniles.



*Tetraodon cutcutia*- (Gangatooop or puffer fish)

K K Dwivedi



*Acanthocobitis botia* (Botia or sand loach)

Dhritiman Mukherjee



Dhritiman Mukherjee

### From brood banks to ethno-medicine based on fish varieties

The Brahmaputra’s considerable contribution towards hill fishery has been accelerated by the establishment of the first ever hatchery and brood bank of the Golden Mahseer courtesy an initiative of Assam (Bhoreli) Angling and Conservation Association (ABACA), an NGO established in the early 1950s for the conservation of the Golden Mahseer in particular. A total of 12 major angling spots have been identified, which is bound to increase the tourism potential of the state.

Depending upon the availability of water, depth, and type of water body, the size and type of the species to be caught as well as the number of individuals involved in fishing, four different types of fishing gears are used by the fisher folk operating in the Brahmaputra basin -- nets, traps, hooks and lines, and unconventional methods. The fishing nets are mostly of the fixed and moving type, and a total of 37 major fishing gears and 27 herbal drugs as piscicides were observed to be in use. The study has brought to light yet another fascinating fact, namely that indigenous healing systems have 16 different treatments based on the medicinal properties found in 12 fish varieties and the dolphin.



A shrimp crawls along the rocky bottom of a stream

Dhritiman Mukherjee



Vallisneria spiralis or Tape Grass bend with the water currents

Dhritiman Mukherjee

# Conservation Challenges

Kashmira Kakati, Pranab Bujarbarua and Ranjita Bania

## 1. Deforestation, encroachment and habitat fragmentation

Beginning in the latter half of the 19<sup>th</sup> century, there was rapid expansion of settlements, clearing of forest for forestry, agriculture, tea plantations and mining throughout the Brahmaputra Valley. Inevitably, the pressures of increasing population, survival needs of the poor and compulsions of growth impacted the environment, with the result that the abundant biodiversity of the region has been wiped out from a large area and now confined to only a few pockets.

In recent years too, a systematic encroachment of forest areas has resulted in Assam having one of the highest rates of forest loss in the country. The north bank of the Brahmaputra alone lost nearly 65 per cent of its forest cover since the 1990s, precipitating extreme human-wildlife conflict situations, especially with wide-ranging, long-lived species such as elephants.

Equally, the conversion of wetland habitats for human settlements, road construction, direct deforestation in wetlands, unsustainable levels of grazing and fishing activities such as dredge disposal have a considerable economic and ecological cost. A sharp decline in the catch of the Indian Major Carps points to the loss of spawning grounds in the Brahmaputra and most of its major tributaries. Poaching remains a threat for most species, especially high value ones such as rhino, tusked elephants and tigers for the wildlife trade, and prey species for the pot. Among the iconic species of the river, the Gangetic river dolphin has become highly endangered while the gharial is believed to be ecologically extinct.

## 2. Natural Processes: earthquakes, floods and erosion.

In a high rainfall and high seismic risk zone such as North-east India, natural disasters like floods and earthquakes are an omnipresent threat. In 1987 and 1950, the region experienced powerful 8.7 and 8.6 moment magnitude earthquakes and their aftershocks. The 1950 one drastically impacted the topography around the Siang, Buridehing and Brahmaputra with landslides, land subsidence, destruction of forests and major changes in river courses.

Over the decades, deforestation in the upper catchments of tributaries and the main river has increased sediment loads in run-off. Subsequently, with the combined effects of both natural and man-made disasters, the river bed has become shallower, the river itself is slower and the banks steadily eroded. Key Protected Areas are affected. There are frequent changes in the course of channels as well and changing dynamics disrupt succession stages of vegetation, adversely impacting forest cover. Siltation also blocks the mouths of channels that connect to *bevels*, thus preventing riverine fish from entering the wetland through the channels. Since there is no auto-stocking of fish



*Puntius geniuss* (puthi or golden dwarf barb) swim in an underwater landscape

and auto-removal of floating macrophytes during the monsoon months, wetland species are eventually exterminated.

### 3. Poaching, pollution and over-exploitation

Poaching remains a threat for most species, especially high value ones in wildlife trade such as rhino, tusked elephants and tigers. The wide-spread use of agricultural pesticides, fertilisers and pollution from machine boats of which thousands ply on the river regularly, impacts the water quality of the Brahmaputra and thus, the survival of species dependent on it. Poison fishing and over-exploitation are serious threat to the sustainability of aquatic faunal resources. Small-meshed mosquito nets used for fishing catch broods and juveniles indiscriminately, depleting stocks; and closure of fishing activities during the breeding season, as mandated by the Fishery Rules, are often observed only in the breach. Among the iconic species of the river, the Gangetic river dolphin has become highly endangered while the gharial is believed to be ecologically extinct.



Udayan Borthakur

A tiger that fell victim to poachers.



Feral horses run free in Dibru-Saikhowa National Park, their only home.



## 4. Wetland Degradation

The degradation and conversion of wetlands in the Brahmaputra Valley is a widespread problem. While eutrophication is a natural process, anthropogenic activities such as pollution and encroachment have accelerated processes to such an extent that many have been lost. Loss of wetlands also means a loss of livelihoods, mainly from fishing, and cultural elements of the communities that are dependent on them.

## 5. Weed Invasion

Water-hyacinth *Eichhornia crassipes* and *Ipomoea carnea* are two well known weeds in the Brahmaputra wetlands. They depress water flow, sunlight and oxygen in the system and harm native plants and animals, such as fish and turtles. In the terrestrial system too, invasion of native and exotic weeds present a major ecological problem, overrunning and degrading forests and agricultural landscapes. These species, such as *Ageratum conyzoides*, *Argemone maxicana*, *Chromolaena odorata*, *Lantana camara*, *Mimosa rubicaulis*, *Mikania micrantha*, *Parthenium hysterophorus* pose a serious threat to the healthy growth of plants, forest regeneration and agricultural productivity.

## Ways Forward

### 1. PROTECTION:

Wilderness areas function as watersheds and carbon sinks and provide tangible benefits in the form of innumerable natural resources such as fish, timber, other forest produce and recreation. It is worth considering the idea of bringing more areas within the ambit of protected area networks through ongoing programmes/projects of Joint Forest Management, Project Tiger, Project Elephant, Rhino Vision 2020, Eco-development Programme and the National Afforestation Programme. Eco-sensitive zones in the Valley should also be identified and any development project in those areas should be amenable to strict scrutiny and regulations. While Protected Areas have the benefit of strict protection, many connecting areas and wildlife habitats outside Protected Areas along the Brahmaputra are not monitored. Strict monitoring to check illegalities like pollution and poaching, unauthorized collection of fishes and violation of fisheries laws is especially required at this time. It is essential to have river patrolling on a regular basis to protect the river,

its wildlife and ultimately its people. Advanced technology like Unmanned Aerial Vehicles, Remote Sensing Technology etc should be used for effective management of bio diversity. It is also essential that the numerous dam projects across the region take into account all possible impacts on biodiversity and incorporate mechanisms for conservation of this biodiversity.

### Community Involvement:

Involvement of the local community is an essential factor for the success of conservation efforts, and towards this end, creating awareness about conservation issues, supported by facts, is an essential first step. In the last few years, for example, efforts by conservation organizations in sensitizing riverine dwellers to the status and requirements of the endangered Gangetic River dolphins in the Brahmaputra has helped mobilize local support for the species and save them from routine killing by fishermen, helping their populations revive. It is necessary to inform fisher-folk about the importance of aqua faunal diversity, the threats to them and their proper utilization. Similarly, issues of pollution, poisoning and over-fishing can be tackled by the government only with the buy-in of the local communities.

. Incentive mechanisms such as eco-tourism, may encourage the local communities to protect wilderness spots and species. Ecotourism projects, however, have to be planned in a scientific manner with the help of experts to be of minimal impact and maximum value. Similarly, a government-community partnership can be implemented to divert fishing communities towards culture fishery, especially cage culture in the river, so as to decrease the stress on the wild stock of fishes and allow their populations to recover.

For local communities to be equal to the task, however, it is necessary to build capacity by providing them technical, financial, managerial, marketing and training support.

### 2. WEED CONTROL, PLANTATION AND RESTORATION:

Plantations on degraded forest and riparian sites should be taken up on a priority basis. Special measures are required to control the factors contributing to the invasion of alien and invasive plant species, both aquatic and terrestrial. Habitat restoration, as wonderfully demonstrated by Jadav Payenge on the Molai Kathoni river island in Jorhat, can increase habitat available for wildlife as well protect sites from erosion and should be taken up at the village level in all the Brahmaputra districts.



The endangered Golden Langur. Endemic to the region.

K K Dwivedi



An Eastern Swamp Deer or Barasingha male in hard antler. Barasingha are animals of tall, flooded grassland.

K K Dwivedi

### i) Research:

Conservation efforts are most effective if they are informed by meticulous research inputs. Regular updates of the database on floristic and faunistic diversity in terms of species status, ecosystems and genetic traits; and an understanding of the pressures and climate change are crucial aspects of resource management. The formulation and proper implementation of a sustainable development program for fish is especially urgent on the Brahmaputra. It is also important to make thorough documentations of the ethno-cultural interlink in order to safeguard the Intellectual Property Rights of the communities. The agrarian community needs be made aware of pest-resistant or drought-tolerant varieties and genotypes of crop species that are amenable to new climate conditions, and the government has a critical role to play in facilitating this preparedness.

### ii) Landscape level planning

The forests of the entire Brahmaputra Valley, as recently as a century ago, was a connected whole. River islands formed and disintegrated, wetlands had their own cycles. Fish and wildlife were able to move seasonally between sites – from confluences to higher reaches of tributaries for spawning or foraging; or between the floodplains and hill forests, following the rhythm of the river and the seasons. Unfortunately, these connections have been lost or are tenuous at most. The current conservation strategy in the region is to preserve the already isolated patches of forest and maintain status quo. With all the attendant pressures on such isolated patches, it is not reasonable to envisage a long-term future for our forests, rivers and wildlife unless landscape level and multi-disciplinary perspectives are mapped out. This mapping must take into account social, ecological, economic and institutional aspects governing the use of biodiversity resources in the Brahmaputra Valley. The vision, strategy and action plan for the Brahmaputra Valley must involve the government, scientists, environmentalists, local communities including farmers and fishermen, financial institutions, NGOs and other stakeholders.

Long term visions and firm execution, such as is taking place in Kaziranga, where the Brahmaputra river islands are being protected as the Sixth Addition to the national park, are the need of the hour. Kaziranga' Sixth Addition will secure some part of the connection to the Burachapori-Laokhowa Wildlife Sanctuary complex and further to Orang National Park in the west; and to the riverine habitats north of Kaziranga. Further

upstream of the Brahmaputra, Kobo Chapori, a proposed reserve forest under Dhemaji division, represents another crucial riverine wildlife corridor connecting the forests of Arunachal Pradesh, Poba Reserve Forest of Assam, D'ering Wildlife Sanctuary and the Dibru-Saikhowa National Park. In the manner of Kaziranga's islands, it is important to secure Kobo Chapori and the river islands south of it bordering Dibru-Saikhowa NP as early as possible.

The Brahmaputra's bounty has been bequeathed to us in the form of incredible biodiversity unique to the area. How far we succeed in bequeathing this wealth of nature to future generations is the challenge before us. A judicious appreciation, utilisation and preservation of the resources of the Valley in a rational, scientific and creative manner can ensure economic upliftment for the region without compromising the conservation of the Brahmaputra Valley biodiversity.

The Brahmaputra Valley is the stronghold of the Wild Water buffalo.



KKDwivedi



Elephants are hard hit in conflict with humans. Vast tracts of their forests have been lost. Here people offer flowers to an elephant killed in conflict.



Udayan Borthakur



A Western Hoolock gibbon swings in bamboo.

K.K. Dwivedi



Aerial view of Palashbari project site of FREMAA



# FREMAA

# Flood and River Erosion Management Agency of Assam

K K Dwivedi

The Brahmaputra with many tributaries flows through the entire length and breadth of Assam causing severe flood and erosion and resulting in huge loss of human life, cattle, property, infrastructure, forest and wildlife and threatening economic growth and development of the state. Efforts made in the past have not yielded expected results. Then the need of introduction of innovative approaches, advanced technology and proven global practices were felt necessary. In 2010 the government signed a loan agreement with Asian Development Bank (ADB) and constituted a special purpose vehicle - FREMAA under the Societies Registration Act of 1860 to implement a comprehensive and integrated project for management of flood and erosion in Assam.

The project aims to substantially improve flood and erosion management in a comprehensive, cost-effective, holistic and sustainable manner and reduce the economic vulnerability and social disruption in flood prone areas in Assam. It also aims to strengthen the Water Resource Department through policy and organizational changes and increase its knowledge base as per international standard through the use of technology, training and exposure visits.

Structurally FREMAA consists of an apex advisory body headed by the Honourable

Totsuka Natsuko, the ADB Mission Leader interacting with the trainees under CBFMR program





FREMAA Photo

FREMAA provides vocational training to women to build capacity in its project area at Dibrugarh

Chief Minister of Assam, a Governing Body chaired by the Chief Secretary of Assam, an Executive Body (EB) chaired by the senior most Secretary of the Water Resources Department (WRD), a multidisciplinary Project Management Unit (FREMAA) headed by the CEO; and three sub project implementation offices (SIOs) led by the respective Executive Engineers of WRD. FREMAA is supported by the Project Management Consultant (PMC), Institutional Strengthening Consultant (ISC) and Benefit Monitoring and Evaluation (BME) Consultants.

The total cost of the Project is USD 150 M out of which USD 120 M is the ADB loan amount and USD 30 M is the share of the Government. The ADB loan amount has been divided in two phases. USD 49.9 M has been allocated for the Phase I which will be over by July 2016 and USD 70.1M will be utilized in Phase II. Loan negotiation with ADB for phase II is yet to start.

In Phase I, the project is implemented at Dibrugarh and Palashbari-Gumi. The project has structural and non structural components.



Bank protection work in progress in Dibrugarh ...

Udayan Borah

The structural intervention includes bank protection and revetment works using geosynthetic bags, boulders and cement concrete (CC) blocks, raising and strengthening of existing dykes and providing porcupine screens. Measures are also taken to ensure almost zero impact on the environment due to various interventions. The ADB mission periodically visits the sites and reviews the works in detail. The Quality Control Division of the Water Resources Department, Project Management Consultants, SIO and FREMAA engineers constantly monitor the progress of the project.

Non-structural measures comprises of institutional strengthening of Water Resource Department of the Government of Assam, and capacity building of vulnerable people to cope with flood and erosion. Institutional Strengthening Consultants (ISC) is developing a flood forecasting system and also designing an erosion prediction mechanism based on remote sensing technology. FREMAA also provided conceptual framework and actively supported the setting up of the Assam Water Research and Management Institute (AWRMI) to promote research and study in the field of river management including hydrology and morphology. The AWRMI will provide a framework to bring national and international organizations and academic institutions on one platform for better planning and project implementation. AWRMI will be stationed in the Green Building being constructed under FREMAA at Guwahati. Design of this building has recently received the prestigious award for “The Exemplary

Demonstration of Passive Architecture Design” from GRIHA and another award from HUDCO. Online Asset Management System and Online Training Management Application have also been rolled out. Several training program on River Survey, Construction Management, Project Management, FIDIC (*Fédération Internationale Des Ingénieurs-Conseils*) Contract Management etc. have been organized and exposure visits have been arranged for the officers of WRD to provide them the opportunity to understand global best practices in river management. FREMAA and WR Department, of Assam hold International Morphology Conference and International Assam Water Conference annually to discuss issues related to river management.

The project also focuses on people’s participation through Community Based Flood Risk Management and Livelihood Program. Under the program 32 villages have been selected in Palasbari and Dibrugarh project sites and Village Disaster Management Plans (VDMP) have been prepared for each and every village through a people’s Participatory Planning Process. Trainings have been imparted to large numbers of people through Civil Defence and Assam Disaster Management Authority on flood risk management. FREMAA is also implementing the Japan Fund for Poverty Reduction Program for improving the income of vulnerable families of flood prone areas in selected villages.



Geo bag works in Palashbari

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Greater Adjutant Stork



A hornbill delicately picks off a ripe fig

K K Dwivedi

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K K Dwivedi

# People behind the book



## K. K. Dwivedi

Dr. K. K. Dwivedi (D.Phil), IAS of Assam cadre, presently Commissioner, Panchayat and Rural Development and CEO of FREMAA is a nature and wildlife photographer. He has been working in North East India for nearly 20 years for conservation. He is founder president of Dibru Saikhowa Conservation Society and has been instrumental in setting up Arboretum and Orchid Parks in Assam. He has started annual Dibru Saikhowa Festival, Jeypore Rainforest Festival and Desang Festival to promote ecotourism and conservation. He has also authored a coffee table book-Incredible Dibru-saikhowa National Park. He manages websites on Jeypore Rainforest ([www.jeyporerainforest.com](http://www.jeyporerainforest.com)) and Birds of North East India ([www.birdsofnortheastindia.com](http://www.birdsofnortheastindia.com)). His photography works can be accessed on his web site-[www.kkdwivedi.com](http://www.kkdwivedi.com).



## Dhritiman Mukherjee

Dhritiman Mukherjee is one of the finest nature photographers in India. He has been into nature photography for last 15 years and he has got Royal Bank of Scotland Earth Hero Award for inspiring people towards nature conservation and Carl Zeiss Conservation award with many other national and international photographic awards. As a professional photographer his work has been being published in several national and international magazines, books and media houses.



## Farzana Begum

Dr. Farzana Begum, anthropologist, is a Research Officer in the Directorate of Assam Institute of Research for Tribal and Scheduled Castes, Guwahati. She is also a certified Trainer from the Department of Personnel and Training, Government of India and conducts Training Courses in institutions in different parts of India.



## Kashmira Kakati

Dr. Kashmira Kakati is an independent wildlife biologist working in the region since 1997. She has conducted research on mammals in places like the Balpakram National Park, Meghalaya and the Jeypore-Dehing Landscape of Assam. She is a member of the IUCN Primate and Cat Specialist Groups.



## Pranab Bujarbarua

Dr. Pranab Bujarbarua, a plant taxonomist, is a Sr. Assistant Professor, Post Graduate Department of Botany, Handique Girls' College, Guwahati. A worker in ecology and plant taxonomy in Northeast India for last two decades, Dr. Bujarbarua has over 40 publications to his credit.



## Purusottam Nayak

Dr. Purusottam Nayak, an economist, is a Professor in the Department of Economics, North-Eastern Hill University, Shillong. He has published more than fifty research papers in national and international journals and authored/edited four books, besides guiding a number of PhD students. He is involved in research in the areas of Human Resource Development and Women Empowerment.



## Ranjita Bania

Dr. Ranjita Bania, a fisheries biologist, is working as an Advisor (Fisheries) for Tata Trusts, Mumbai besides providing consultancy service to various fisheries projects & NGOs along with being the consultant for HICAP, ICIMOD, Nepal. She has authored three books along with number of research papers, book chapters, bulletins and good number of popular articles both in English and Assamese.



## Udayan Borthakur

Udayan Borthakur, a conservation geneticist, is the founder head of Wildlife Genetics Division in Aaranyak. He has over two dozen scientific publications to his credit and a member of the IUCN Asian Rhino Specialist Group. He is also a wildlife photographer and his photography work regularly published in magazines and books of national and international repute.





