OPPORTUNITIES AND CHALLENGES FOR KAZIRANGA NATIONAL PARK, ASSAM OVER THE NEXT FIFTY YEARS

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ABSTRACT

The last one hundred years have seen major conservation successes in Kaziranga National Park, with populations of many endangered species, notably rhino, elephant and tiger rising and the ecological integrity of the area being maintained, despite high biotic pressures and stochastic perturbations in the landscape. These successes, and the expectations that they will continue, also bring about several management challenges. Kaziranga is a relatively small national park in the flood plains of Brahmaputra River, which is one of the most sediment-charged rivers of the world and also has the highest flood potential in the Indian subcontinent.

The growth in Gross Domestic Product (GDP) in the State of Assam is one of the lowest in India and the economic problems in Assam have been exacerbated by long-term insurgency and civil unrest. The Government of India as well as the Government of Assam remain committed to 'accelerate the pace of socio-economic development' through development of infrastructure by construction of highways and expressways; harnessing of water resources and hydro-electric potential through construction of a series of dams on Brahmaputra River; improvements in the agricultural economy and enhancing oil and gas production. While these developments are needed, they nevertheless pose severe challenges for management of Kaziranga National Park, a natural World Heritage Site of global significance.

The paper discusses the opportunities and challenges for Kaziranga National Park over the next fifty years and highlights the risk of the area becoming an 'island' in a sea of development. It is obvious that major challenges for Kaziranga National Park will come from outside, including in particular regional pressures at a landscape scale as a result of both Assam government development priorities and more diffused pressures caused by rising populations and higher economic expectations. While annual flooding is necessary for maintenance of habitats within the park, modifications to river flow as a result of surrounding land use change and river management have the potential to impact on the way in which flooding affects the park. Maintaining internal integrity in the face of such changing hydrological patterns and ensuring external connectivity to adjacent natural areas are critical issues for park management.

The continued survival of Kaziranga National Park over the next century and consolidation of the conservation successes achieved in the last one hundred years will therefore depend to a large extent on what happens beyond the park's boundaries and also on ensuring that management options elsewhere – in the river and in the surrounding landscape, do not undermine the ecology and integrity of the park.

There is an urgent need to carry out a landscape level strategic environment assessment involving competent national and international agencies to review the development scenarios and to ensure that conservation concerns are fully integrated in the development trajectories.

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ASSAM: A RIVER STATE

The valley of the Brahmaputra River covers some 60 per cent of the state of Assam in north eastern India[1]. The Brahmaputra river (known as Yarlung Zangbo in Tibet and Jamuna in Bangladesh), flows 2,900 km from its source in the eastern Himalayas to the Bay of Bengal, its course taking it through China, India (58 per cent of the basin is in India), and Bangladesh whilst its catchment includes Nepal, Bhutan and Burma[2].

The immense river is fed by the southwest summer monsoon, when over 80 per cent of India's total precipitation occurs[3]. Extremely high, 24 hour rainfall events can occur in parts of the catchment, leading to the Brahmaputra River having one of the highest flood potentials in the subcontinent[3]. Floods are common during the monsoon; varying from five to 19 floods per season[4]. Although floods can develop into social and economic disasters causing loss of life, livelihoods and infrastructure, flooding is also part of the natural process which creates fertile lands. Indeed, the Brahmaputra valley is one of the most fertile stretches of land in India.

Assam has a primarily agricultural economy with 74 per cent of its population engaged in agricultural and allied activities. Monsoon-based rice production is the principal crop, covering 67 percent of the total cropped area[5]. Nearly 500,000ha of the agricultural land are irrigated, over 50 percent of this from surface flow[6]. Use of fertilisers and pesticides is increasing; fertiliser consumption rose from 14.2kg per ha in 1996-97 to 46.50kg during 2002-2003[7] and it has been found that pesticides are being used "randomly, without assessment of the pesticide formulation and quantity" mainly by farmers near urban areas who are converting to vegetable crops which are prone to pest attack[8]. Assam contributes up to 55 per cent of India's tea output, and 15.6 percent of world tea production[9].

Assam's GDP growth per head of population is the lowest in India, due in part to high population growth, but mostly as a result of immigration, the costs related to the perennial floods, slow agricultural development, high transportation costs, poor industrial growth and lack of infrastructure[10] Economic problems have been exacerbated by long-term insurgency and unrest. The Government of India is

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committed to "accelerating the pace of socio-economic development" in the north east region[11] and the potential for developing natural resources in Assam have been highlighted in a guide for investors produced by Coopers & Lybrand in 1996[5]. As well as highlighting mineral, forest resources and tourism potential, the report, not surprisingly, notes that the perennial water system of the Brahmaputra has potential for energy, irrigation and transportation development. Nationally, there are plans for a US$100 billion project that would integrate most of India's major waterways, and this could have major impacts on the state and its river. The project aims to transfer "surplus water" from the Himalayan and other rivers to regions where water is scarce, by delivering 173 billion cubic metres of water – equivalent to a quarter of the Brahmaputra's flow – each year, providing drinking water, irrigation of 35 million hectares and the generation up to 34 gigawatts of electricity. Nationally, the project would also involve the construction of 12 reservoirs, displacing an estimated 450,000 people and flooding 80,000ha of forest[12].

Development assistance is already flowing in to Assam, the most recent being approval, in December 2004, of a World Bank US$154 million credit to assist the Government of Assam to improve productivity in the agricultural sector. The scheme is designed to "stimulate the growth of Assam's agricultural economy, through predominantly pro-poor activities, directed primarily at small and marginal landholders, poor fishing communities, and the landless"[13]. Project activities include an investment grant scheme, development of the agricultural services and market chain development. The majority of the funding, about US$100 million or 77 per cent of project costs[13], will however go towards infrastructure development, including plans to upgrade and/or rehabilitate about 2,000km of the rural road[14].

KAZIRANGA NATIONAL PARK: ONE HUNDRED YEARS OF CONSERVATION SUCCESS

The grasslands, floodplains and flood plain lakes (known locally as beels) of Assam provide ideal habitat for a wide variety of species. Today, many of these are endangered and have had their habitat limited to small areas within the state – most notably Kaziranga National Park. Preliminary notification of the area as a forest reserve was given in 1905, making it one of the oldest protected areas in the world. The park was designated as a natural World Heritage site in 1985 on the basis of its *outstanding universal value representing significant ongoing geological processes, biological evolution and man's interaction with his natural environment* (criterion ii) and *for conserving important and significant habitats where threatened species of plants and animals of outstanding universal value from the point of view of science and conservation still survive* (criterion iv). The park currently covers 430km^2 although there are proposals to add an area of 454.50 km^2 by including the Brahmaputra River to the north and part of the Miker Hills to the south.

The park is home to about 60 per cent of the world population of the Indian one-horned rhinoceros (*Rhinoceros uncornis*), about 50 per cent of the endangered

Asiatic wild water buffalo (*Bubalus arnee*) and has the only viable eastern swamp deer (*Cervus duvaucelii*) population in the north-eastern region; about 400 animals. Its major conservation success has been the increase in numbers of rhino. A few were recorded when the park was first established, with the population counts recovering to 366 in the first survey in 1966, 1,552 in 1999 and numbers are still increasing[15].

The park has the largest grassland area left in the region. It stretches about 50 km along the south bank of the Brahmaputra. The annual river floods replenish the wetlands and allow the grassland areas to flourish[1]. The Brahmaputra is also the cause of severe erosion. Satellite data indicates a loss of more than 51 km^2 between 1967-68 and 1998-99[15] although silt deposition also leads to new land forming in other areas. Floods have also caused significant animal deaths. During major floods in 1998 many animals were drowned; for instance carcases were found of 39 rhinos, 23 wild water buffalo, 19 wild pig (*Sus scrofa*) and 15 sambar (*Cervus unicolor*). Hog deer (*Axis porcinus*) were most seriously affected, with 473 recorded deaths[15]. This species was also badly affected by the 1988 floods. Although precise statistics of flood related mortality are not available, there were only 2,900 deer counted in the census of 1991, compared to 10,000 in 1984. The wild pig has seen a similar decline with the census of 1991 counting only 555 individuals compared to a count of 1,645 in 1984[16].

Despite all odds in the last 100 years Kaziranga National Park has been able to secure the habitat of several endangered species including rhino, elephant, tiger, wild buffalo and swamp deer. The park managers, frontline staff, local communities and the civil society representatives have, under the guidance of the administrative as well as political leadership in the State of Assam, played a vital role in achieving this conservation success.

FUTURE CHALLENGES

Kaziranga National Park is now a protected area of global significance. While some issues remain to be addressed within the protected area, particularly with respect to a constant poaching pressure, the main challenges in the future will come from outside, particularly regional pressures at a landscape scale as a result of both Assam government development priorities and more diffuse pressures caused by rising population and higher economic expectations. Kaziranga is thus facing a situation similar to that experienced in many other parts of the world, where success in management within the boundaries of the protected area itself is threatened by changes in the wider landscape. Future success will depend on a the Government of Assam's commitment to adopting a landscape approach to conservation throughout the state, and ensuring that changes that take place outside the park do not create pressures so large that Kaziranga can no longer function effectively.

Some key landscape-scale issues will be addressed in this paper. They include changes to hydrology in the Brahmaputra system due to dam construction; road development especially widening the current highway and its impact on animal migration to avoid flooding; expected impacts of climate change; and more general land-use change due to population pressure and agricultural development.

Risks of the national park becoming an "island" in a sea of development

The last one hundred years have seen some major conservation successes in Kaziranga, with populations of many threatened species rising dramatically. These successes, and the expectation that they will continue, also bring management challenges. Kaziranga is a relatively small park, and the nature of the ecosystem means that land is being lost to the floods. Whilst there have been attempts to add more land to the park, only one addition of just over 40 km^2 has so far been gazetted as well as a new 96 km^2 sanctuary in Karbi Anglong[1]. Whilst efforts to expand the park will continue it is clear that the park management needs to adopt a landscape approach. This needs to look beyond the boundaries of the protected area and work with regional government, and where necessary also private interests, to agree a landscape mosaic that will provide a supportive environment in which Kaziranga can continue to flourish.

For Kaziranga to achieve another one hundred years of successful conservation there will need to be considerable effort to balance both the needs of increasing wildlife populations and, a range of development projects.

Floods: causes and implications

Flood control is a major issue for the Government of India, and across the country infrastructure has been developed to protect towns and villages from flooding[16].

A comparison of the three recent extreme floods (1987, 1988 and 1998) affecting Bangladesh (from waters of the Ganges, Brahmaputra and Meghna basins) found intense monsoon precipitation was the principal cause of flooding[17]. Other causes are still being explored, although research data are somewhat lacking[18]. In particular, there are differences of opinion concerning the significance of land use change and especially the role of deforestation in upstream areas, with some commentators believing this leads to accelerated soil erosion and landslides during monsoon precipitation thus contributing to the floods downstream, whilst others disagree with this interpretation[18,19]. Over 73 percent of the Brahmaputra watershed's original forest has been lost[2]. In north-eastern India at least 1,000km^2 of forests were being destroyed annually during the 1970s and 1980s[20], and during the same period, Assam's forest cover declined from 24 percent to less than 15 percent. This decline has continued as more than 3,000km^2 of land has been cleared for tea plantations in Assam and northern West Bengal[21]. Currently only four per cent of the land area is in protected areas.

The Brahmaputra is also one of the most sediment-charged rivers of the world[22]. The Brahmaputra region in India is highly prone to earthquakes and this causes landslides which disturb the drainage system[23]. Bank erosion has become a serious problem following the 1950 Assam earthquake, which changed the course of the river, and contributed to heavy flooding in the following years. The deforestation and flood control methods, such as the construction of embankments, have also altered the riverine ecosystem. This has resulted in the river becoming heavily silted. In Upper Assam the river bed has been raised to such an extent that only a few days of rain can result in major floods[24].

A likely increase in dams

India has over 4,000 big dams – only China and the US have more[25]. Dams have been instrumental in increasing irrigated land from 19.5 million ha in 1947 to 95 million ha by 1999-2000[24], a change in land management which is also partly responsible for the increase in food production from 51 million tonnes in 1950-51 to 208 million tonnes in 1999-2000. Dams also provide power, contributing a total of 22 007 MW of hydropower generating capacity by the end of the 1990s[24]. However, these 'temples of modern India', as dams were once described, also come with a long history of involuntary displacement and inadequate resettlement and rehabilitation of local populations. Eighty percent of the displacement in India today is caused by development-related projects. From this number, 58 percent aree linked to water-resource projects. It is estimated that large dams have submerged a land area of about 37,500 km^2 and have displaced at least 42 million people in India[24].

There are currently no large dams on the Brahmaputra. Given the river's international significance, any plans to harness its power generate great interest. In 2003, for instance, the Indian press was quick to follow up reports on possible dam developments in China with the Chinese Foreign Ministry. China replied that there were no plans to build a 'power plant' on the river[26]. In 1980, the Indian government established the Brahmaputra Board under the Ministry of Water Resources, to plan for and implement hydropower, flood control and economic development projects. The Board's 1997 government approved Master Plan for the Brahmaputra, proposes 34 "Drainage Development schemes" that include hydropower dams, embankment reinforcement and other multipurpose projects[27].

Dams are considered to bring several advantages including power, better irrigation and a reduction in the surges of water that cause flooding. However, from a conservation perspective, reduction in flooding would have enormous impacts on the ecology of Kaziranga. Many of these impacts would be detrimental to an ecology that has adapted over millennia to regular flooding.

Road development

The 54 km length of the National Highway (NH) 37 running parallel on the southern boundary of Kaziranga National Park, between Bokakhat to Ghorakati range divides the landscape between the low-lying grasslands in the north and the elevated Karbi Anglong hills in the south. During rainy season when flooding in Kaziranga National Park forces the wild animals to move southwards to elevated grounds, many wild animals are killed by vehicles while attempting to cross NH-37[28]. Hog deer, fishing cat, civet, swamp deer, hog badger suffer maximum mortality. The park managers have identified crucial animal crossing corridors on the NH-37 and have implemented several measures to reduce animal mortality including road signage, terrain easements, rumble strips, road awareness campaigns, intensive night patrolling and regulation of vehicular traffic[28]. The Government of Assam, in its vision for Assam in 2025, highlights the need to develop urban roads, State Highways and National Highways for the development of tourism, trade and commerce[27]. Plans are underway to convert the existing NH-37 to a six lane expressway[28]. If this happens, this linear development may cause a permanent barrier effect[29] and also increase wild animal mortality. There is an urgent need to conduct a comprehensive Environmental Impact Assessment study and develop appropriate mitigation options. Options may include, avoidance by re-aligning the expressway through Nagaon-Silghat-Tezpur-Lakhimpur-Jorhat to protect the ecological integrity of this World Heritage Site.

Mineral based Industries

The Government of India opened up the oil and gas sector to private investments, with the aim of enhancing crude oil production to meet the rising consumption of petroleum products[5].

The Coopers & Lybrand guide for investors notes that Assam has rich deposits of many minerals[5]. Assam already accounts for nearly 50 percent of India's on-shore crude oil production and has the highest success ratio (70 percent) in the world with respect to oil exploration[5]. The report notes that the state has over 1.3 billion tonnes of proven crude oil and 156 billion cubic metres of natural gas reserves. Approximately 58 percent of these reserves are yet to be explored, but offer "tremendous scope for exploration". Given these facts it is not surprising that the report concludes that "more areas in Assam are expected to be opened up" for hydrocarbon extraction. The areas recommended as having the best potential are the north bank of the Brahmaputra, the Brahmaputra river bed and marshy areas on the Brahmaputra banks[5].

One oil refinery in Numaligarh, has already been identified as a possible threat, being positioned upstream from the park on the Dhansiri river[1]. The oil exploration activity around Kaziranga National Park thus poses a tremendous challenge to conserving the values of this World Heritage Site.

Land-use change

There are 23 villages bordering Kaziranga and at least four tea gardens, with another 30 villages close by; the total population in the immediate area of the park is about 70,000[1].

The Karbi Plateau to the south of park is an important area of high ground. Large-scale habitat changes in the plateau include conversion to tea gardens, settlement, logging and *jhum* (shifting agriculture). These developments have mainly occurred in the last 50 years. One impact is that the gap between the park and the plateau is increasing, as suitable habitat is destroyed.

This has serious implications for the ability of Kaziranga Park, and for Assam as a whole, to maintain healthy populations of animal species. For example, the 2000 census recorded 86 tigers in the Kaziranga National Park[15], which is a growing and healthy population, but the long-term survival of the species in the region is also dependent on maintaining links to other healthy populations, through biological corridors and careful use of buffer zones. Currently these are not addressed in the management plan[15]. A recent global study identified the Kaziranga-Meghalaya region as one of the priority tiger conservation habitats in the Indian subcontinent, albeit one where more information is required on tiger populations and status in the landscape as a whole[30]. As land use changes increase around the park there are risks that the resident population of tigers and other animal species become genetically isolated and in time no longer viable.

The tea gardens that have developed close to the park boundaries also pose a threat through pesticide run-off. Tea gardens also increase the potential for invasive exotic species, such as mimosa, wild rose, water hyacinth and lantana, to colonise the park. The threat of invasive species has so far been controlled by the hard efforts of park staff and the regular flushing of the park from flood waters. Pesticide run-off is harder for park staff to control.

Climate change

Researchers have concluded that the strength of the Asian monsoon has often varied in response to changing global processes over the last few million years[31]. There is therefore every possibility that current and predicted changes in climate and precipitation will have impacts on the Brahmaputra River. Research suggests that the types of environmental changes predicted in climatic models are already taking place. Studies on many animals and plants that show significant alterations in range or behaviour that is not due to direct pressure from humans find that climate change is the most consistent explanation[32]. Studies in other parts of India such as Gujarat[33] and the Western Ghats[34] suggest that changes in species will soon or are already taking place as a result of climate change, even within protected areas. Given the extent to which the ecology of Kaziranga is dependent on the variations in

annual river flow, climate-induced changes could have a major effect on the park's ability to maintain biodiversity over time.

Firm evidence of a long-term regional trend in area-averaged precipitation for Asia has yet to be found[18]. However, various models have been developed to predict the possible effects of climate change on the climate of the region. Although the results differ in extent, all agree that an increase in water levels and thus possibly also of flooding is likely. One atmosphere-ocean-land model suggests that the Ganga-Brahmaputra discharge could increase by as much as 49 percent, due to an increase in the absolute humidity of air and the intensification of the South Asian monsoon circulation[35]. A climate change scenario using UKTR results (a high resolution transient climate change experiment carried out by the Hadley Centre in the UK) show the peak discharge of the Brahmaputra increasing by 13 percent following a 6^0C global mean temperature rise[19].

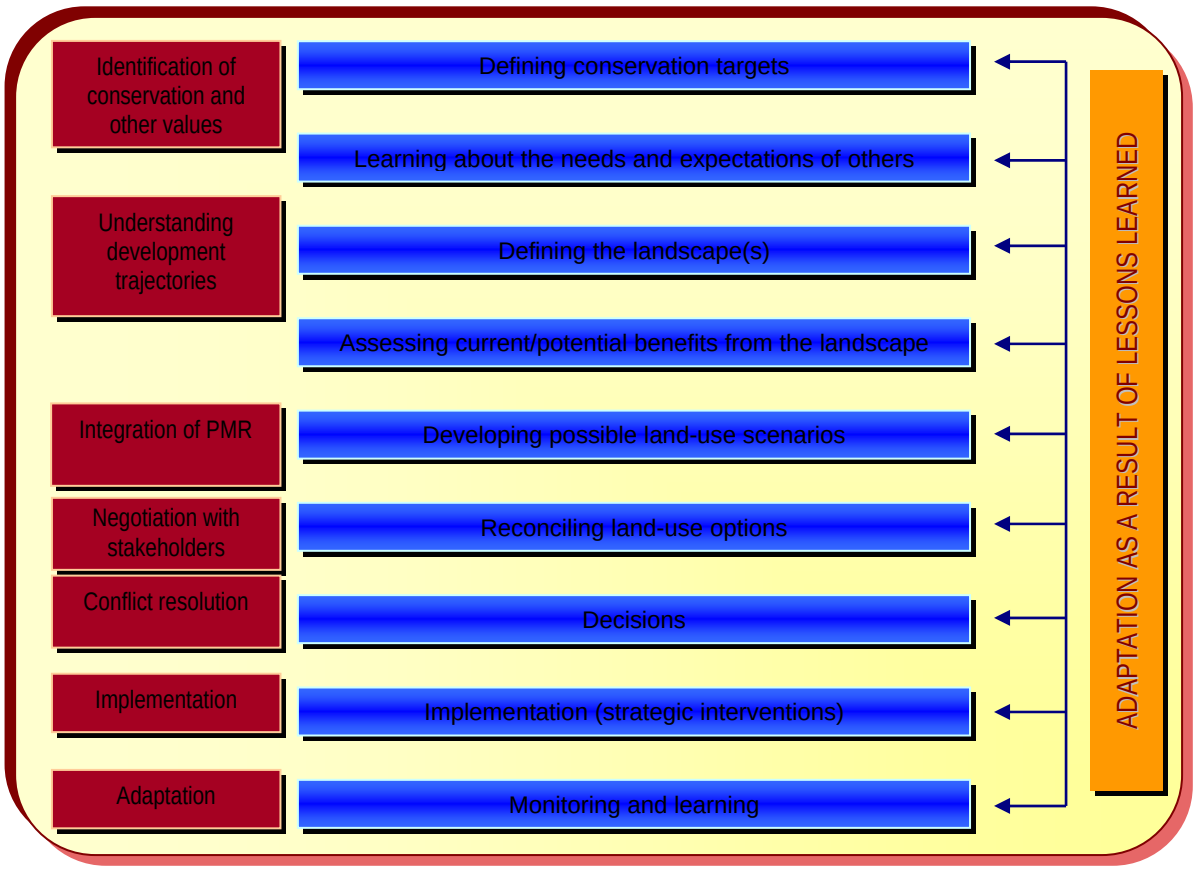
PLANNING FOR THE FUTURE – THE NEED FOR A LANDSCAPE APPROACH

Although Kazaringa has seen major conservation success, there are still many endangered species within or passing though the park. There are, for example, nearly 200 species of aquatic vertebrates in the Brahmaputra River System; including the endangered river dolphin, (*Platanista gangetica*), which is in steady decline. The conservation of this species is an urgent requirement, but will require strategies which go far beyond the boundaries of Kaziranga. In particular, this will require better implementation of the Indian Fisheries Act, including strict enforcement of a total ban on destructive nets and on killing of brooders and juveniles by explosives and poisoning[23].

It is therefore clear that the continued survival of species within Kaziranga National Park over the next century will depend to a large extent on what happens beyond the park's boundaries and will rely on ensuring that management options elsewhere – in the river and in the surrounding landscape, do not undermine the ecology of the protected area. Developing a mutually acceptable management mosaic will be difficult and implies hard negotiation and some trade-offs. The application of a landscape approach for Kaziranga will require evaluation of current and future pressures (including strategic impact assessment), development of different options (scenarios), agreement on the optimal way forward and a series of strategic interventions, carefully monitored so that adaptive management can be applied as necessary.

The major issue facing Kazaringa's is that the majority of the park is within the floodplain of the Brahmaputra[36]. The park is thus susceptible to upstream threats, such as pollution and any changes in the rivers flow due to changing land use practices, such as deforestation, and from possible hydropower and flood control projects. Longer term threats such as changes in monsoon patterns could also seriously affect the river's flow.

The Government of Assam has indicated a willingness to work with park authorities to explore future options. Pressure for new dams will be great, but the scale and location of these is still open for discussion. In the immediate future, work is needed to assess the values in the wider landscape, look at the likely impacts of development pressures and flesh out some alternative development scenarios for discussion and negotiation. Given the international importance of Kaziranga and the attention likely to be focused on the park in its centenary year, it should be possible to develop funding proposals for this work that would be attractive to donor agencies. A number of steps would be required as outlined in the box below[37]:



The immediate steps for Kaziranga's strategic environmental assessment would be:

- Identifying the scale of the study (the landscape).
- Identifying and contacting key stakeholder groups.
- Assessing current and potential benefits from the landscape (biological, energy etc) making use of existing studies and where necessary initiating new studies.
- Looking at likely pressures on Kaziranga National Park.
- Suggesting ways of avoiding or mitigating these pressures.
- Developing a series of scenarios for sustainable development in the catchment & beyond that would allow maintenance of Kaziranga's values and those of Assam's wider biodiversity.

Options for reducing damage

A number of options can be identified for reducing impacts of identified pressures:

- **Reducing erosion**: Strategies may be needed to stabilise river banks and thus decrease the likelihood of erosion. For example, a model experiment on the island of Majuli, on the Brahmaputra in Upper Assam, developed soil conservation techniques utilising native herbs known for their soil binding capacity. Soil erosion in the experimental site was reduced to only about 2 percent compared with about 15–20 percent in the previous years[38].
- **Underpasses/ Overpasses to address road casualties**: There is limited experience on the use of underpasses/ overpasses for wildlife that can funnel animals escaping floods away from traffic. Further research is required as it is not known if the range of wild animals including elephants and rhinoceros would use this infrastructure.
- **High ground refugees**: The forest department has already built a number of earthen platforms inside the park where animals can retreat from floods but their effectiveness needs to be evaluated.
- **Integrated catchment management strategies**: A number of methodologies exist for calculating impacts of dams and then planning to minimise side effects although a thorough study of likely effects of different hydropower schemes and locations is urgently required.
- **Extending the park's area**: The park has extended its boundaries and contiguous areas have been protected in recent years. Several other additions have been proposed[15] but they all need to be gazetted first and then placed under an effective management regime.
- **Pollution reduction strategies**: To reduce pesticide run-off into the river, several strategies would be needed including, conversion to organic production. In 2002, 71 tea gardens were producing organically in Assam and another three were in conversion[39].

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