

Effect of the Koshi River in the Koshi Tappu Region, Nepal

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River valleys and their associated floodplains have served as centres of human settlement since time immemorial. Koshi Tappu Wildlife Reserve and adjoining villages, are located on the floodplain of a snow-fed perennial river, called Sapta Koshi, a tributary of the Ganges. The Reserve covers an area of 150 km² and is an important habitat for Nepal's last surviving population of wild water buffalo (*Bubalus bubalis*), which was estimated as 100 in 1993. This area plays a special role in maintenance of the genetic and ecological diversity of the region; it is a Ramsar site supporting about 50,000 individuals of waterfowl and also serving as a staging and nesting site for about 325 bird species. The area is almost flat ranging only between 75 to 100m above mean sea level. The Sapta Koshi river, whose discharge varies from 362 cubic meter per second in March to a maximum of 4,729 in August, not only shapes the physical features of the region, but also modifies the ecosystem of the area and has profound impact on the socio-economic characteristics of the local communities in the vicinity of the reserve.

In the past, the area was covered with dense riverine forest and tall grasses where large carnivores such as tigers (*Panthera tigris*) and leopards (*Panthera pardus*) were abundant. Between 1958 to 1964, a barrage was constructed on the river under the Indian aided Koshi Project for the purposes of flood control, irrigation and electricity generation. Eastern and western embankments bounded the river floodplain, thereby restricting the water from flooding agricultural fields during the monsoons. Subsequently, the large carnivores disappeared as vegetation became thinner due to river bank erosion, and the continuous utilization of the area for fuel wood, fodder and livestock grazing by the growing human population in surrounding villages.

The importance of the area in terms

of ecology and socio-economic benefits merits a detailed study in order to understand the complex nature of the behaviour of the Koshi river and its impact on the physiography of the area, as well as the interactions of the people with the Wildlife Reserve. The reserve is presently under threat due to the frequent shifting of the Koshi river, and encroachment. In response to the serious threats faced by the Wildlife Reserve, IUCN has been supporting, directly and through the Asian Institute of Technology, different studies aimed at collecting and compiling information on the ecology of the area, socio-economic characteristics of the local communities and urgent conservation issues, in order to develop an effective management plan.

An overlay of three land use maps from 1959, 1978 and 1991 indicates that the river was more braided during the late 70s than prior to the construction of the barrage. Braided rivers consist of two or more broad, shallow channels divided by bars and islands, which are submerged only during floods. Although braiding may result from factors such as coarse bed material, highly fluctuating discharge and lack of vegetation, excessive silt load and consequent aggradation of the river bed are considered as the primary causes in the Koshi catchment.

The sediment concentration of the Koshi is about 0.2% at its gorge, Brahksetra, in comparison to 0.16% in Gandak, a similar river in Nepal. The concentration decreases to 24% of the initial concentration at Kursela in India, where the Koshi joins the Ganges, i.e., the remaining 76% of the initial sediment load is deposited along the way. Before the construction of the barrage, the sediment in Koshi was mostly deposited downstream of the present barrage, whereas the upstream area, including the Koshi Tappu Wildlife Reserve, was the site of river bed erosion. This was partially responsible for the gradual

movement of the river 112 km westward over 250 years.

Sediment concentration and frequency of floods in the river are related to the characteristics of the catchment area. Increased severity of floods and soil erosion in the major rivers of Nepal, particularly during the monsoons, has been influenced by the loss of forest cover in the mountainous regions of the country. Furthermore, steep slope cultivation, mass wasting and glacial movements have increased sediment concentration and frequency of floods in rivers like Koshi.

Aside from these causes, the construction of the barrage has also changed the pattern of deposition and braiding of the river. Immediately after the completion of the barrage, braiding activity decreased south of the barrage whereas, in the upper portions of the river, a higher degree of braiding was observed. Hence, it appears that due to the construction of the barrage, the locus of maximum sedimentation has shifted upstream.

The rate of the river bed accretion is highest near the barrage and decreases gradually northward, resulting thereby in a decrease in the average slope of the bed level over the stretch of the river. This has reduced the sediment transporting capacity of the river and, as a result, more silt is deposited in this region and the river bed rises further. This compounding effect has resulted in increased braiding in the river and ultimately caused a change in the course of the river. The Koshi river, which was earlier shifting gradually from east to west, changed its course dramatically during the monsoons of 1987, swinging from the western to the eastern part of the Reserve.

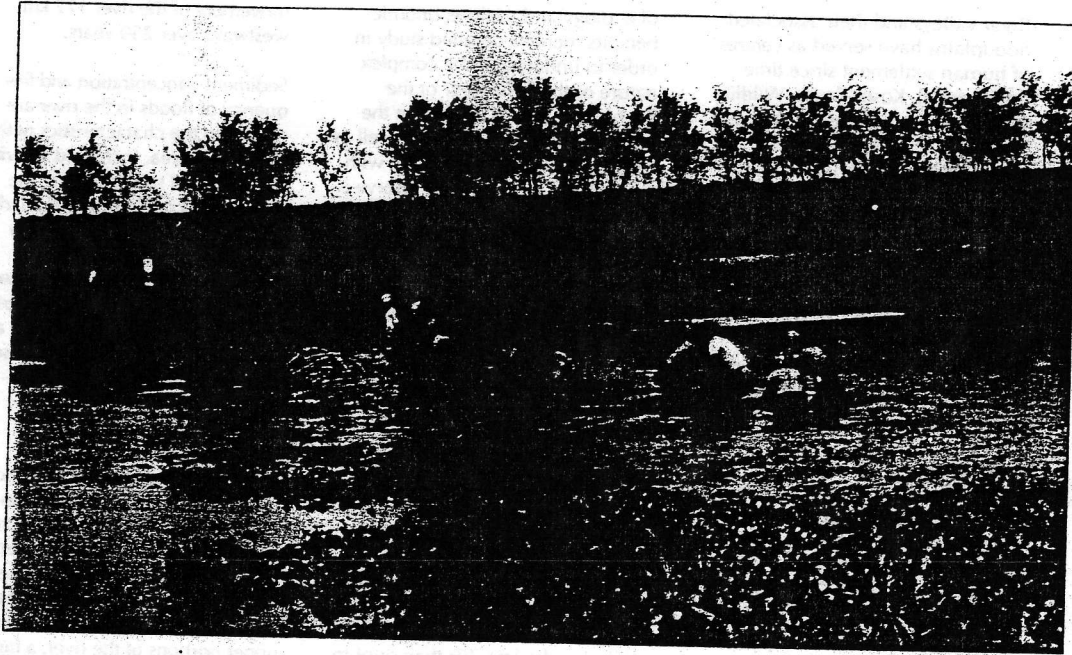
This sudden shift in the position of the Koshi river has resulted in a number of physical changes in the area and has important ramifications for park-people relations. A

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large track of the forest near Prakashpur village, and the grassland in the eastern part of the Reserve have been destroyed. After 1987, due to seepage from the river in the east, a seepage stream, with a 100 to 250m wide strip of marshes developed on the land east of

have to depend on the Trijuga river, a tributary of Koshi, as a source of water for their livestock. This river flows through the reserve, about one and half kilometers from the western boundary. Since people are allowed to use water from the river, they also take the oppor-

sive upstream erosion and slowing down of the river due to the barrage. Mitigation measures involve off-site activities like efficient watershed management, whereas on-site reduction of the sedimentation depends on the regulation of barrage, i.e. outflows of the water



eastern embankment. Although the newly formed stream and marshes have become sources of water for the people, the land has subsequently become more swampy and this has caused changes in the cropping pattern. The marshes have become a major grazing site for livestock and are subject to attack by *Fasciola hepatica*, found in snails which thrive in these marshlands. The present width and position of the river is posing restrictions on the movement of local people and the scouts as well as soldiers in the eastern side of the reserve. As a result, the people in the east are unable to cross over into the reserve and have more difficulty in utilizing its resources than the people in the west.

The people in the west have been affected differently. Water resources have become scarce. Driftwood in the river, which was once the major source of fuel wood and even a means of livelihood for some, is no longer available. They

Fishing in the marshes outside the reserve, developed after the shifting of the river from west to east

tunity of illegally grazing their livestock in this part of the reserve.

Furthermore, land which used to be flooded by the Koshi river before 1985 has become exposed after the change in the position of the river. People of this region are considering this land for cultivation to supplement their subsistence economy. Cultivation of similar land outside the reserve, has become an impetus for them in forming this attitude. Their claim is strengthened by the fact that compensation has not been given to the people for 465 ha land near Kamalpur village acquired by the Reserve. On paper this land still belongs to the people and they have to pay an annual tax. Thus, since they are legally the owners of the land, they have reclaimed the land.

In Koshi Tappu, the increased sedimentation has resulted from exces-

This involves inter-governmental cooperation between Nepal and India because the barrage is under the control of the Indian Government. Since the flow and the sediment load in the river increase significantly during the monsoons, one remedial action might be to augment outflows from the barrage if this can be done without increasing the flood risk in India thus reducing the sedimentation rate and floods in the Koshi Tappu region. The compensation to the people for the land between Trijuga river and the western boundary and the consideration of that area as a buffer-zone allowing the sustainable use of the resources, can be seen as positive steps to minimize the conflicts between Reserve and the local people.

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