



ISSUE BRIEF

# WATER FOOD ENERGY CLIMATE NEXUS IN KOSI RIVER BASIN

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# Introduction

The Kosi River Basin is one of the major transboundary river basins of Hindu-Kush Himalayan region. The river originates in the Tibetan Plateau in China and flows through 27 eastern and central districts of Nepal, and 16 districts of Bihar, India, before joining the Ganga River (ICIMOD, 2017). A rough estimate shows that the river support lives and livelihoods of around “10 million people in the upstream of the river and more than 30 million people downstream” through irrigation, water supply, ecology, and hydropower generation. Over 80 per cent of the people in the Kosi Basin depend on agriculture for food, income, and employment (Ibid:2). Agriculture and allied services such as animal husbandry and fisheries are some of the major livelihood options people take in this river basin. A much smaller amount of water is used for industries. Off late, there has been a rise in cash crop cultivation which has increased water demands in the basin. The increased economic activities in the region have also led to competing demands on available water resources. Due to changing climatic conditions, there is additional stress on the system due to floods and droughts.

**This issue brief focusses on the major challenges faced by the people in the transboundary Kosi River Basin and outlines the nexus between water, food, energy, and climate as major drivers of the recent changes. This issue brief is based on numerous discussions and interactions with the local communities and stakeholders in India and Nepal covering the sample of Kosi river basin. We identify the problems, its impact on the people and investigate solutions as a way forward.**

# The Context

In our interventions and discussions in the Kosi region, we find that the disruptions in the river ecology, upstream-downstream relations, access to water for irrigation and domestic needs, water-induced disasters, outmigration of people, changes in water bodies leading to declining fish production and increased deprivation such as food and energy insecurities as some of the major problems in the region. Climate change comes in as a force multiplier which brings stress in terms of floods and droughts. The impacts and consequences are felt by the most marginalized women and men who are directly engaged in the agriculture and fisheries sector.

The historical changes in the river ecology are traced to the implementation of various projects on the river due to flood control and energy interests up-streams. The construction of the barrage, embankments, canals, and other structures was completed between 1959 and 1964 in phases. “In the first phase, construction of the eastern and western embankments was completed while in the second phase, the Kosi Barrage was built at Hanuman Nagar. The construction of the Eastern Kosi Canal and a hydropower project in the canal at Kataiya was completed in the third phase. The Chatara Canal was also built in this phase to provide irrigation to the land in Nepal’s Sunsari and Morang districts. The last stage involved the construction of the Western Koshi Canal” (Dixit et al, 2018:15). These interventions to tame the river has resulted in increased siltation in the downstream areas impacting the water-food relationship main on the Indian side. The excess of water/waterlogging, siltation and seepage have impacted traditional cropping system for which people are adapting through alternative crops and food production.

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**Map 1: KOSI RIVER BASIN**

Source: GEAG (2018)

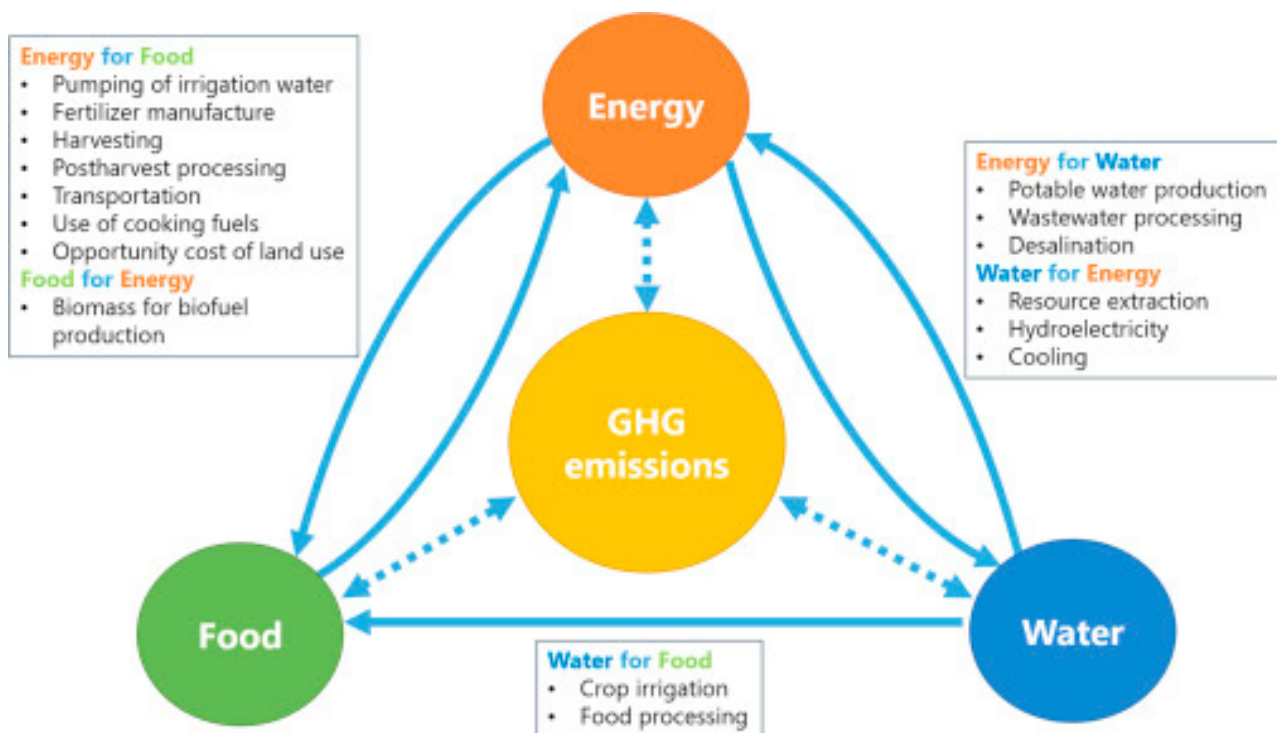
# Understanding Water-Food-Energy-Climate Nexus in Kosi River Basin

The water, energy, food, and climate nexus mean that the four sectors – water, energy, food and impacts of climate change are inherently connected (figure 1). Action taken in one sector may impact one or more of these sectors. These sectors are also important from the perspective of social and economic development. The nexus meaning a strong linkage in all these four sectors in meeting the increasing requirements for food, water, and energy – access to which is mediated by climate change (Rasul and Sharma, 2016, Amjath-Babu et al, 2019).

The big question is – how we understand this nexus in the Kosi river basin where livelihoods of people are profoundly supported by access to water. This relationship has been poorly understood over the years and its significance has been overlooked in many cases. For example, floods in the river have been exacerbated in recent years due to a changing climate which leads to having heavy precipitation upstream (Somanathan and Somanathan, 2009; Reddy et al, 2008). Climate change in the Himalayan river systems has been well established by recent assessments and Kosi river basin is not an exception (Wester et al, 2019). The floods in Kosi affects agricultural production system as fields get submerged underwater

for months affecting food production. The other side of the story relates to periods of drought or water shortage that leads to the pumping of groundwater for irrigation. The use of diesel pumps adds to the greenhouse gas emissions and hence these interlinkages creates a nexus. Enhancing relationships in the water-food-energy-climate nexus can contribute towards sustainable river basin management. It can also promote sustainable development and address the key issues of poverty and deprivation in the Kosi river basin. One of how this could be done is to improve dialogues between different stakeholders with the recognition that understanding the facets of this nexus is important.

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**Figure 1:** WATER, ENERGY, FOOD AND CLIMATE NEXUS

Source: Bieber et al, 2018



# The anatomy of the problems

Embankments have affected drainage system impacting agriculture: The Kosi embankments considerably changed the morphology of the river and the basin has lost its natural drainage system. This has resulted in the problems of drainage both for communities living inside and outside the embankments. Inside the embankments, huge sediment load is deposited and over a period, it has increased the height of the riverbed by up to several metres above the surrounding land. Thus, the drainage of monsoon flows gets blocked outside and between embankments in addition to seepage from the raised riverbed to the land outside when the river flow is high inside (see box1). It is a paradoxical situation. On the one hand, the communities inside embankments suffer from waterlogging because of no drainage facilities and bear the brunt of damaged crops and food insecurity. On the other hand, communities living outside the embankment area struggle to hold the water for irrigation purposes.

## Box 1: Embankments on River Kosi: A recipe for disaster

Embankments on Kosi river have led to a series of problems by not allowing water from outside to go inside, creating waterlogging in the outside area and seepage from underneath the embankments. The provision of sluices to overcome this problem is not helpful as the raised riverbed has made the sluices useless and in fact, opening them could lead to release of water outside. Stagnated waters and seepage outside the embankments for almost 8-9 months in a year has hard hit on the agriculture-based livelihoods of the people.

The crop fields which used to be lush green with paddy fields, once upon a time, is now covered with wild grasses all over. The land has lost its productivity and fertility due to acute waterlogging. In event of heavy rains, neither paddy nor wheat can be harvested in this area outside the embankments. In the Chauhatta Gram Panchayat of Supaul alone, 1200 acres of land is under waterlogged area, yielding into nothing.

The people living inside the embankments must face the fury of floods every recurring year. The huge amount of siltation inside the embankments have also not left them with much option to pursue agriculture. With lack of livelihood opportunities, distress migration to other cities such as Delhi and Punjab are high. The communities are also debarred of government services inside the embankments.

Pramod Mishra, a resident of village Chauhatta, in district Supaul, Bihar says that we suffer from "Kala Paani" (Black Waters), being in the outside areas of embankments, while inside, there is "Ujala Paani" (White Waters) for which government provides all the support. He referred to the stagnated waters which holds huge concentration of bacteria, causes diseases like malaria, kala azar, swelling, skin diseases and so on. Fishes in this water are diseased. The iron content is so high that a layer gets deposited on the stored water. The outside communities must deal with all these sufferings but there is no action or facilities provided by the government. For the insiders, at least when the flood waters come (ujala paani), the government provides relief and other forms of support.

*Source: Report of the Trans-boundary Dialogue, conducted by GEAG, January 2020*



## CHANGING AGRICULTURE BASED LIVELIHOOD PATTERNS

The land outside the embankments have not remained productive anymore owing to waterlogging for prolonged periods and seepage spread in acres of land. The waterlogging on the outside, extended for 3-4 km has made the land marshy and choked with grass and water hyacinth. Owing to recurring losses in cultivating the traditional crops such as paddy and wheat, the farmers had no option but to adapt to the cultivation of new crops and varieties. Garma Dhaan, a paddy variety which is flood-resilient, has been adopted by most of the farmers living outside the embankments. The farmers informed that Garma Dhaan is not fully resistant to waterlogged conditions. Hence, they harvest paddy much before it is fully ripened as they fear that rains and subsequent waterlogging conditions will destroy whatever little they can get. The other crop that has been adopted by the farmers in the waterlogged areas outside embankments is the Water lily (*Euryale ferox*), locally called makhana. Makhana cultivation is providing an alternative use of the waterlogged land next to the embankments.

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***"Garma Dhaan sehat ke liye bahut achcha nahi hota hai. Bas pet bharne ke liye kha lete hain. Usmein koi taakat nahi hoti hai"***, (We eat Garma rice just to fill our stomachs, it doesn't have any health benefits) said Satendra Ram of village Chauhatta, district Supaul, Bihar

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With the decline in fish stock, the Mallah fishing community depends on this crop for its livelihood. However, growing makhana in the waterlogged area is tough. After the monsoons when the river recedes, the depressions are filled with water where people grow makhana. The farmers have to dive deep (6-7 ft) into the ponds, making way through the thorns, to collect makhana seeds from the marshy lands. It involves hard labour. Farmers complain lack of training and help in processing and marketing of Makhana product due to which primary producers hardly get any profit.

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Anju Mishra (village Chauhatta, district Supaul) says, ***"investment in makhana farming is double than that in paddy cultivation. Intensive irrigation is needed. Only farmers who are slightly better off can afford to do makhana farming. But at least, there is some guarantee that makhana will give us good harvest and income as compared to paddy which we know that it will be submerged into waters and get destroyed"***.

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## IMPACT ON WOMEN

During and post-monsoon, when flood strikes, communities are severely affected. The degree of problems varies between geographies of people staying inside or outside the embankments. When floods come, the people living inside the embankments are hit first as their fields are submerged and they are cut off from accessing the market. For the people living outside the embankments, flood season is the lean period as waterlogging and inundation ruins the crops affecting household food security. Wheat crops have failed in the area due to waterlogging outside the embankments and hence communities rely on paddy. Rice-Rotis and moong dal have become staple food to consume. Floods which used to come once in 2-3 years are now an annual phenomenon. These changes in agriculture have impacted the livelihoods of the people as it is very difficult to rely completely on agriculture due to increased uncertainties. Male outmigration has increased manifold in the last decade or so. As men migrate, women members are left behind and must take care of both domestic and productive work. The burden of running the house disproportionately falls on women. The changing climatic factors together with nexus between water-energy and food gets superimposed on the structural issues such as lack of implementation of the minimum wage, access to land, health and education. These combinations are detrimental to women as she is caught at the receiving end of these developments.

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***"The government has kept us in false hopes since so many years. Till when should we remain hopeful that the situation will improve. There is no infrastructure, no schools and hospitals. Migration is high and we as women are left behind to take care of our families and suffer the sufferings"***  
– Mrs. Neelam Mukhiya, Social Worker, Supaul, Bihar, India

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# Way forwards: What can be done?

## 1 Transboundary Governance of Kosi Basin – the need for a nexus approach

There are issues related to livelihoods, agriculture, compensation, guide and ring embankments, siltation, seepage, waterlogging, gender and so on. The irony is that no one mechanism sees the issues of Kosi holistically for a sustainable solution that could maintain the river ecology and promote people's development. The issues, despite being so inter-connected are very disjointed when it comes to its governance towards a holistic, sustainable solution. Unfortunately, the policies and programme of the government have been quite fragmented, mainly with the idea of managing immediate crises, rather than being comprehensive enough to look at the issues of Kosi, holistically which would help lead to sustainable outcomes. A comprehensive look of these issues in an upstream-downstream context and a transboundary governance perspective would be helpful. People to people structured dialogues in partnership with the government may pave the way for shared solutions.

## 2 Open channels between embankments to feedwater systems

It is established that embankments have been contributing to recursive cycles of vulnerability in which women, children and the poor population are being significantly impacted. It is also a fact that getting away from embankments at this time may not be the most feasible options. In the past, when floodwater used to enter India from Nepal, it used to get diverted into numerous channels feeding lakes and ponds along the way. These channels have disappeared or encroached upon and water bodies are also shrinking. Along the embankments, there are some points where people themselves breach them so that water could flow out and not flood communities inside the embankments. A comprehensive on-ground research-based scientific data is needed which maps these areas and data points. This will help in understanding how some permanent channels can be opened to feed the water bodies outside embankments and divert water to avoid flooding inside the embankments. An area could be chosen as a pilot to study and implement this and if successful, can be taken up along the Kosi region for replications.

## 3 Conserve and manage water to avoid future water stress

Community-oriented integrated watershed management based on the principles of integrated river basin management could be a tactical option for preserving and protecting the freshwater ecosystems of the area. This approach suggests the integration of technologies within the natural boundaries of a drainage area and involves flood control, reducing soil erosion and sediment accumulation, land and water conservation practices such as water harvesting, recharging groundwater, crop diversification, and integrated nutrient and pest management. A good watershed management programme based on integrated river basin management will help in efficiently utilising the available resource as well as conserving it for the future.

## 4 Bring women at the centre of planning processes

One of the worst sufferers of the changes in the Kosi River is the womenfolk. As the environment is getting constrained with frequent floods and intermittent droughts, it has affected the agricultural production system. The agriculture is dependent on the environment and a changing climatic condition is making it vulnerable. An aftereffect of these change is increasing migration to cope with the loss and obtain an income as wage labourers in cities. Due to prevalent cultural norms, migration is much higher amongst men and women are left behind to look after families, farms and protection against floods. Women's life has changed considerably as she takes care of the entire households almost singlehandedly. However, women are not part of the planning process such as where the handpump should be installed or in the design of the toilet structures or any other developmental programmes related to agriculture. It is generally the older men who participate in these discussions which affect the lives of womenfolk. Increased participation of women into the process of development will help in seeking an alternative for better coping and adaptation.





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