Chapter 14
Interlacing of Regional Water Policies, Institutions and Agreements with Livelihoods and Disaster Vulnerabilities in the HKH Region: A Case Study of Kosi River Basin

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Abstract Koshi is a *trans*-boundary river that flows in China, Nepal and India. The river originates from Tibet in China and flows through Nepal and India covering 87,481 km^2 area and provides livelihoods for almost 40 million people, most of who depend on subsistence agriculture. The river is also a major source of sorrow for downstream population of Nepal and India due to occasional catastrophic flooding and intense flow of debris. The three countries through which the river passes have their own policies that may be adequate in compartment, but lack in integrated approach and therefore unable to optimize on this vast resource on a basin scale and unable to develop integrated plan to fight with water related hazards. These limitations are leading to high prevalence of poverty and food insecurity in the populated areas of the basin in these three countries. The on-going impact of climate change has further worsened the problem due to more extreme weather events like frequent flood and drought hazards in the basin which ultimately threatened the livelihood options of the Koshi dwellers. In the context of *trans*-boundary basin, a policy adopted by the upstream could generate either positive or negative externality to the downstream and there is a policy vacuum in the context of whole basin.

In this backdrop, this chapter discusses, national and regional policies, institutional frameworks, bi-lateral and multi-lateral arrangements as main drivers in addressing or failing to address the issues of disaster risk and livelihood vulnerabilities of communities living in the Kosi basin. This chapter calls for a better understanding and analysis of water, climate change, agricultural and disaster risk reduction policies related institutional frameworks is essential so that a comprehensive and coordinated institutional approach to optimize the basin's natural resources, reduction in hazard impacts and overall livelihood improvement can be achieved. This chapter also calls for effective management and regional cooperation in the Koshi river basin through continuous dialogue and for just water resource sharing among the riparian countries.

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14.1 Koshi River Basin: Untapped Potential and Unmitigated Hazards

The Koshi River Basin The Koshi river basin is a *trans*-boundary basin which originates in the southern area of the Tibetan Plateau in China, crosses Nepal from north to south, and then crosses the northern part of Bihar in India before joining the Ganges (Fig. 14.1). The total area of the basin is 87,481 km^2 out of which 32 % lies in China, 45 % in Nepal and 23 % in India. It is the home for 39.2 million people with higher population densities in the southern part of Nepal and Bihar part (CBS 2011; GoB 2012); and Koshi River basin is the main source of water for this huge population. It is extended from 33 m to altitude (Kathihar district of Bihar) to more than 5,000 m (*trans*-Himalayan part). A variation in bio-physical and socio-economic variation can be observed along with the variation in the altitude. The upstream has problems associated with snowmelt, water runoff, soil erosion, and land degradation, while downstream has problems associated with waterlogging, population growth, expansion of agricultural land, and urbanization.

Population Dynamics The decadal population growth at Koshi basin is observed 23.3 % over the last decade. The population was 31.9 million in 2001 and reached to 39.2 in 2011. A decadal growth up to 61 % has been observed in some districts of Koshi. It is higher for the downstream than the upstream (CBS 2001; CBS 2011; GoB 2012). The population growth within basin district is found higher than the corresponding national figure. As the water is central to basin people and therefore the further increase in population and urbanization in the basin is expected to pose threat to the livelihoods and water resource management at present regime of water resource management.

Livelihoods For communities living in the basin, agriculture and livestock are main livelihood options which have direct link with water and therefore water is the central to livelihoods (Table 14.1). Type of crops and livestock also varies along the slope. Koshi has a total of 3.4 million ha arable land with 0.08 ha per capita land holding. Rice, maize, wheat are the dominating crop in the basin covering an area of 2.1 million ha (61 % of arable land), 1.1 million ha (32 %), 0.8 million ha (23 %) respectively. Similarly, it consists a total of big and medium sized livestock of 23.7 million and the per capita livestock holding size is 0.60 livestock unit (MoAD 2012; GoB 2012).

More than 50 % of arable land of the basin only depends on rainfall. Rainfall is the main-source of water especially for agriculture and pasture at basin. A significant temporal and spatial variation in rainfall is observed at Koshi. The rain-fed agriculture is highly sensitive to variation in rainfall. The average annual rainfall at *trans*-Himalayan part is found 207 mm to more than 3,000 m at Eastern Himalaya.

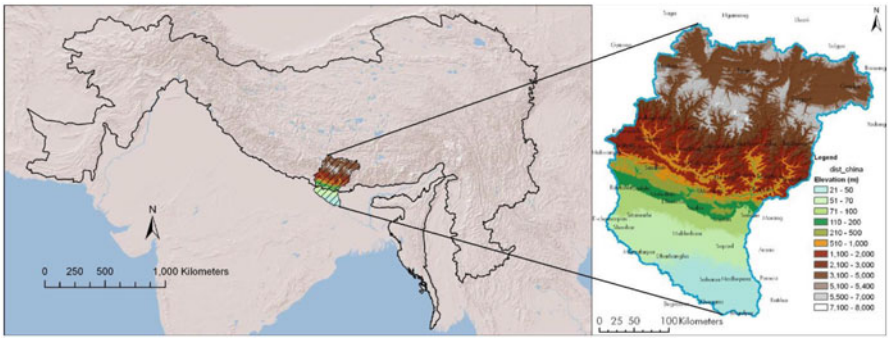

Fig. 14.1 Geological position of Koshi river basin. *Source*: ICIMOD, 2014

Table 14.1 Socio-economic indicators of the countries of the Koshi basin

Socio-economic Indicators	India	Nepal	China
Access to improved water resource, %	86	90	NA
Access to improved sanitation, %	33	35	NA
Per-capita electricity consumption, kWh	594	91	NA
Population below national poverty line, %	28.6	30.9	NA
Per capita GDP(USD)	640	252	NA
Per-capita water availability (cubic meter/capita/yr)	1,750	8,170	2,140

Adapted from Babel and Wahid (2008); FAO'S AQUASTAT (2013)

Within the same district also, it varies from 232 to 3,078 mm (for example Sankhuwasabha). Eighty percent of rainfall occurs in three rainy months (July to September). Too much and too little water is highly applicable to KB resulting into flood and drought which directly affect the water dependent livelihoods.

Irrigation is vital for increasing agriculture yields and commercialization. It ensures an adaptive capacity for the variability in rainfall due to climate change. But irrigation coverage at Koshi basin is lower than the national figure. Agriculture at upstream of Koshi is highly constrained by irrigation coverage for example Bhojpur has only 4.4 % irrigation coverage (Nepal Resource and Destination 2012). Less than 50 % of the arable land at downstream has irrigation facilities and rest depend on rain fed agriculture. The expansion of irrigated area is found higher at further downstream due to availability of groundwater and electricity subsidy (for example Begusarai district of Bihar receives irrigation only from underground sources). The irrigation efficiency for downstream of Koshi is only 42 % (GoB 2012). Further, a lower fertilizer use is found in the Koshi basin which is 112 kg/ha for Nepal part and 162 kg/ha for Bihar part (Nepal Resource and Destination 2012; GoB 2012). The commonly use fertilizer is mostly the nitrogen. Lack of irrigation is one of the constraints for the use of fertilizer along with other inputs in rain-fed agriculture. Similarly, lack of transportation facilities and poor

purchasing power of the farmers are considered other socio-economic factor affecting low fertilizer use at Koshi.

Due to low irrigation coverage, low fertilizer use and low input use, a very poor crop performance is found at Koshi basin. Even though, 85 % of total cultivated area used for cereal production where rice, wheat and maize are the major cereals. Rice being a more water consumptive crop; also the main staple food at Koshi (GoB 2012). The cereal production for Koshi is one-fourth of the south Asian yield standards. Rain-fed agriculture, variable rainfall, frequent occurrence of drought and low inputs used are considered as the poor cereal performance. Similarly, a poor livestock performance is observed at Koshi. The cattle and buffalo population at basin is the highest but its productivity is the lowest. Out of their total population, only one-third are milking. A milking cow and buffalo at basin produces 487 and 884 L milk/lactation respectively which is far below in comparison to global average. The farmers keep more livestock's holding for manure rather and social status. The unproductive animals are exerting pressure on forest, pasture and water.

A part from agriculture and livestock, fishery is also acting as a livelihood options especially for landless, marginal holders and ethnic groups. Fisheries provide animal protein, ensure food security and income for more than 5 million marginalized people through captured fisheries (GoB 2012; FAO 2002). Fishermen at Koshi are mainly from scheduled castes, tribal and dalits. Currently, the fish productivity recorded in some part of basin is very low which is only 27 kg/ha (FAO 2002). The use of chemicals and electricity for fishing is very common at Koshi

Energy and Tourism Energy insecurity is another challenge at Koshi basin because energy is considered vital to agriculture commercialization and off-farm employment generation. But only 20 % households have access to electricity (IWMI 2003) and rest depends on firewood and other conventional sources of energy. Bihar per-capita energy consumption is only 122 against 778 KWH of national average (GoB 2012). The basin people heavy depend on firewood for energy which severely impacts the forest degradation and finally the water resource conservation. Tourism business is another potential livelihoods options and means of off-farm employment generation. It is quite scattered currently and under exploited. The whole Koshi basin from Northern to South carries a significant potential from tourism perspective.

Hazards in the Koshi Basin As elsewhere in the HKH region, the inhabitants of the Koshi basin face multiple hazards. In general terms, the drainage basin of the Koshi River can be divided into three main zones: an upper erosional zone of sediment production, a middle zone of sediment transport with simultaneous erosion and deposition, and a lower zone of sediment deposition, each associated with somewhat different types of hazard. In the hills, landslides, gully erosion, and debris flows are common; while in the valleys, sediment deposition, and bank cutting are common.

There are four major types of recurrent disasters in the Koshi basin, they are; (1) glacial lake outbursts occur in the upstream of the river basin, in Tibet, China with impact on the upper and middle stream of the river basin, especially in the

boundary of China and Nepal. (2) flood hazards, mainly in the middle and downstream of the river basin, in Nepal and India. & (3) debris flows in the upper and middle stream of the river basin, especially in the boundary of China and Nepal. (4) droughts in the middle and downstream of the river basin, in Nepal and India (Chen et al. 2013). Notwithstanding the high level of occurrence of hazards of all types in the Koshi basin, there are few detailed investigations of hazard in the Koshi basin and a lack of data on the number and impacts of individual occurrences over the basin and over time

Despite being endowed with fertile land resources, water resources, potentiality of fisheries, hydro-power development and tourism, a higher incidence of poverty and vulnerability is observed in the basin than the non-basin part. Up to 60–65 % poverty incidence is observed in Sindhuli (Nepal) and Muzaffarpur (Bihar)districts (CBS, WFP, and World Bank 2006; Chaudhuri and Gupta 2009) which is significantly higher than the corresponding national figure of 25 and 26 % respectively (World Bank 2013). The per-capita GDP for the Koshi basin is 305 USD equivalents which is far below than the national figure of the riparian countries (estimated from NLSS (2011) and GoB (2012)). There is a data gap on exact figure of the Koshi population under malnutrition, but their proportion is expected higher because poverty has direct link with food insecurity. Insufficient livelihoods prompt large scale migration of men to big cities and also gulf countries for employment. The increasing number of female headed households & feminization in agriculture in the upstream areas of the basin are a testimony to this this trend (CBS 2011).

Management and use of water is shaped by the political, social and economic condition of the state (Yuling and Lein 2009). Due to the absence of appropriate policies and effective institutions to serve the basin with holistic perspective is hindering livelihoods progress, sustainability and creating vulnerability to water related hazards. Due to the absence of appropriate policies and effective institutions to serve the basin with holistic perspective is hindering livelihoods progress, sustainability and creating vulnerability to water related hazards. There is a distinct policy gap in each of the three countries to harness resources at basin or sub-basin scale, while generic and customary policies fail to address specific livelihoods context of communities living in the basin

14.2 Untapped Potential in the Koshi Basin

Koshi river basin presents a huge potential for economic growth which can only be harnessed with effective policies, institutions, infrastructure and disaster mitigation strategies. The following are the major potentiality of Koshi basin:

(i) There is a big room for increasing crop/water productivity through expansion in ground water irrigation, irrigation storage, increasing water use efficiency. The water use efficiency for Koshi basin is currently less than 40 % (GoB 2012; NWP 2005) and there is a big room for improvement. Irrigation

efficient can simply be increased by lining the canal and improving the other irrigation infrastructures. Similarly, investment for the water storage infrastructures can be options for the upstream where irrigation coverage is very low currently and limited scope for expansion in surface or ground water irrigation.

(ii) There is a possibility of increasing the crop yields by increasing the fertilizer inputs with other inputs especially in combination with irrigation inputs.

(iii) Crop reallocation, selection of water efficient and drought tolerance crop increases the production of crop per unit of water and reduces the pressure on water resources. Switching from water intensive crop (like rice) to less water requiring and more profitable crops like vegetables is a suitable option. Because the vegetables and fruits yields of the basin are found promising and are comparable with international standards for example the yield of potato at Bihar part of basin is found 18 MT/ha which is even higher than the global potato yields; but the vegetable area covers a very nominal portion of total cultivated area of the basin. The districts which are near to market and road network are switching to fruit and vegetable for example some mid-hills of Koshi basin near to Kathmandu is producing potato and tomato. The analysis shows the profit from those crops is 4–5 times higher than the cereals crop (Brown and Kennedy 2005). Enforcement of tradable water rights is essential moving to higher value agriculture and gain the efficiency of water use (Rosegrant et al. 2000).

(iv) Replacement of large number of unproductive livestock by more efficient one might be an opportunity for Koshi basin which reduces pressure on pasture, forest and water resources.

(v) Increasing per capita energy consumption which has direct and positive linkage with water availability and food security (Rasul 2012; Rasul 2014). The upstream has enormous potentiality of hydro-power (e.g Nepal part of KB has the economically feasible potentiality of 10,000 MW). Exploitation of hydro-power potential, essential for agriculture commercialization and off-farm employment generation. Electrification also reduces the forest degradation.

(vi) Sustainable promotion and harvest of fisheries In the Koshi basin water bodies. Koshi basin consists approximately an area of 0.3 million ha suitable for captured fisheries. The fish production and productivity is currently low. If managed properly, can address the food security problems of underprivileged community involved in fisheries traditionally.

(vii) There are urgent demands for mitigating strategies and measures to tackle the water hazards in the Himalayas. The existing strategies and measures are as follows (Mool et al. 2001; Dixit 2009): (1) monitoring—key indicators, including changes in the lakes and their impoundments, which should be observed using different data sets at varying time scales to evaluate glacier hazard and stability of moraine dams; (2) early warning—provision of timely and effective information, through identified institutions, that allows individuals exposed to imminent hazards to take action to avoid or reduce their risk

and prepare for effective response; (3) mitigation—measures to mitigate hazard risks by structural and non-structural means; (4) awareness raising—education to raise local awareness, and increase the relevant knowledge about how to respond; and (5) community participation and institutional arrangement.

14.3 Water Policy and Institutional Mechanism from Flood Risk Perspective in the Koshi River Basin

The three countries, China, Nepal and India that share the Koshi river don't seem to deal flood risk management from river basin perspective. The management of rivers is largely driven by water policies, while disasters of all types are governed under overarching disaster management policies. Therefore, it's important to understand water related hazards in the Koshi basin in integrated manner by analyzing reigning water policies and institutions of the three countries. This section therefore discusses pertinent water related policy aspect of the three riparian countries of Koshi basin. As discussed in previous chapters, despite endowed with fertile land resources, water resources, potentiality of fisheries, hydro-power development and tourism, a higher incidence of poverty and low per-capita income is observed in the Koshi basin districts than in the corresponding national figures. As a result, a higher incidence of undernourished populace is expected in the basin than the non-basin.

To support the livelihoods of the Koshi basin, water related interventions is an entry point. For this, firstly, the governments should have basin/sub-basin level policy focus which should go together with investment on water related infrastructure. Institutional capacity building from local to *trans*-national scale and establishment of good water governance (local to *trans*-national level) can address the major issues of the Koshi basin and improve the livelihoods. Further to this, many policy reviewers, planners, academicians and development practitioners in water sector argue that that lack of access to safe and secure water is not due to the quantity of water available in the basin area but rather because of the policy framework and underlying institutional set up to manage the water resources (Shrestha 2009).

14.3.1 China's Water Related Policy and Institutions

The history of water legislation in China is short and the laws governing river basin management are even more recent (Shen 2009). In 2002, the Chinese government amended the Water Law passed in 1988 to establish a legal foundation for integrated water resource management and demand management. For the implementation of the policy, several formal institutions have the responsibilities. At the

centre level, the State Council plays an overarching role through enactment of laws and regulations, and supervising their implementation and coordination. There are a dozen of ministries/authorities involved in various ways in water management such as the Ministry of Water Resources (MWR), State Environmental Protection Bureau (SEPA), Ministry of Housing and Urban and Rural Construction, Ministry of Agriculture, Ministry of Transportation, the State Forestry Bureau, State Oceanic Administration, National Development and Reform Commission (Zhang 2005).

It is argued that, too many agencies are involved in China in water management along sectoral lines, with only vague boundaries separating their responsibilities. This has not only led to overlapping responsibilities, but also inconsistent and sometimes conflicting policies made by different agencies with weak coordination among them. From a vertical perspective, water management is tied to administrative boundaries. Within the five-tiered administrative structure (national, provincial, municipal, county, and township), most water related institutions respond to only a single level, with no relationship to the levels above or below. Each administrative unit (provinces, municipalities, counties, etc.) is responsible for making and implementing policies within its jurisdiction, mostly based on its own interest and priorities without enough attention to their impacts on the integrity of water resources and the whole river basin (Xie 2009).

Due to such fragmented approach, the central government's policies are often resisted or ignored by local governments responsible for their implementation therefore, in most cases the effort for holistic planning and the principle to recognize the river basin as a logical unit for water resources management yet to be achieved. While, entire water resource planning and management, including flood modeling and early warning within a basin is under MWR and associated agencies, the role of disaster management agencies in China is limited only to emergency management in the after math of floods in the river basins.

14.3.2 Nepal's Water Related Policy and Institutions

Traditional water resources management practices of Nepal was focused on the supply side where only technical solutions were considered to meet the growing demand for water. Different sectoral agencies focusing on isolated projects on irrigation, drinking water supply and sanitation, hydropower, flood control, and other uses were developed. Independent sector authorities mostly controlled these projects on the basis of command and control (NWP 2005). The result was inter-sectoral and inter-regional conflicts over water use and highly constrained on the ground of efficiency, equity and environmental considerations. To overcome these problems, Nepal has realized that development and management of water resources have to move from sectoral approach to integrated and holistic approach with greater participation of community as well as other relevant stakeholders. Accordingly, the Water Resources Act 1992; the Water Resources Strategy (WRS) 2002, and the National Water Plan (NWP) 2005 have been developed by the government

of Nepal which are considered as long-term planning of water resources in Nepal. The WRS 2002 was formulated based on identified policy principles with IWRM approach. The following three key principles were followed while formulating WRS 2002, which are relevant to river basin management:

- Development and management of water resources shall be undertaken in a holistic and systematic manner, relying on the IWRM.
- Water utilization shall be sustainable to ensure conservation of resources and protection of the environment. Each river basin system shall be managed holistically.
- Elimination of (a) adverse impact caused by water scarcity, flood and bad infrastructure development (b) conflict and misunderstanding caused by water distribution and management (c) ineffective management and decisions resulting in irresponsible, unjust and irrational water distribution and management

The WRS 2002 and the NWP 2005 both have made policy commitment and support for transforming to integrated water resources management from traditional practice of fragmented and sectoral approach of water management. The NWP suggests for management of water resources on basin scale instead of managing water resources within administrative and political boundaries. Such transformation is required for rationale utilization, conservation and management of water resources within a river basin because of its complexity and accommodates the diversity of participation from various sectors and multitude of stakeholders. The NWP 2005 has been prepared mainly based on principles and lack mechanisms and procedures for enforcement, such as integrated planning, implementation, monitoring, reporting and evaluation.

According to NWP, the role of government for providing services is going to be replaced gradually by the involvement of the community organizations, NGOs and private sector (NWP 2005). The most visible is in the irrigation sector as evidenced by a large number of community managed irrigation systems. The Water Users Association (WUA) organizes and mobilizes the users and maintains linkages with other agencies. The WUA facilitates the interactions between the users and the agencies during the design and implementation of the project as the policy emphasizes "participatory approach". Not only this the WUAs are responsible to carry out operation and management related to acquisition, control, distribution and using water for irrigation systematically on equitable and sustainable manner. The WUAs are responsible for resources mobilization through fee collection and labour contribution among members. Nepal has made substantial progress in these directions, with widespread establishment of WUAs (ADB 7762-NEP 2013).

Water Institutions at Basin Level in Nepal A number of organizations at the central government level are involved in the water resources development and management in the country with varying responsibilities, functions and limited coordination. These are the National Planning Commission (NPS), Ministry of Irrigation, (MoI), Ministry of Energy (MoE), Ministry of Physical Planning and

Works (MPPW), Water and Energy Commission Secretariat (WECS), Ministry of Environment (MoE), Groundwater Resources Development Board (GWRDB), Department of Hydrology and Meteorology (DHM), Nepal Electricity Authority (NEA), Nepal Water Supply and Sanitation Corporation (NWSSC), Department of Water Supply and Sewerage (DWSS) and Department of Irrigation (DOI), Ministry of Agriculture and Cooperatives (MoAC), Ministry of Forests and Soil Conservation and various other government departments. Water resources development and management is still based on administrative boundaries rather than on hydrologic boundaries or river basin management. A coordinated strategic approach to use the water more effectively is yet to emerge. As long as sufficient water is available, the use of administrative units for water management at the sectoral level is not a big impediment; however, if there are upstream or downstream off-site impacts, then hydrologic boundaries and basin-level institutions become important (NWP 2005).

14.3.3 India's Water Related Policy and Institutions

The national water policy 2012 of India lays down the principle of equity and social justice which must consider use and allocation of water through informed decision making and established good governance system. This principle will ensure the participation of women and disadvantaged groups of people in planning, implementation and decision making processes of water resource management. Inter-basin water transfers are important not only for ensuring food security but also for meeting basic human need and achieving equity and social justice. It has recognized the importance of having a unified perspective in planning, management and use of water resources. It also highlighted that planning, development and management of water resources need to be governed by integrated perspective considering local, regional, State and national context, and keeping in view the human, environmental, social and economic needs (National Water Policy 2012). The draft national water policy 2012 has also recognized that river basins are to be considered as the basic unit of all hydrological planning.

There is a separate section on 'institutional arrangements' under the new water policy of India. The policy has strongly made two suggestions related to institutional aspects such as IWRM taking river basin/sub-basin as a unit for planning, development and management of water resources. For this the departments and organizations at the Centre/State Governments levels should be restructured and made multi-disciplinary accordingly. The policy also suggests for an appropriate institutional arrangements for each river basin to collect and collate all data on regular basis with regard to rainfall, river flows, area irrigated by crops and by source, utilization for various uses by both surface and ground water and publish water budgeting and accounting based on the hydrologic balances for each river basin. In addition, an appropriate institutional arrangement for each river basin should also be developed for monitoring water quality.

The policy has given emphasis on the role of local governing bodies such as *Panchayats*, *Municipalities*, *Corporation and WUAs* explicitly for water related project planning and implementation. It has also mentioned the role of communities who should participate in the management of water resources projects and services. In this process the State governments or local authorities can encourage the private sector to become a service provider through public–private partnership arrangement.

Based on official statistics, the number of WUAs formed so far in Bihar state is 67 and the area covered by them is 182,360 ha (MWR 2010). This data represents whole area of Bihar but excludes many unregistered WUAs, informal associations, partnerships, and groups which may be common in some villages. As per this data, India in total have so far formed 56,934 WUAs managing total area of 13,537,940 ha (MWR 2010). Constitutionally, water is a state subject in India and the states can adopt the Model Act by amending their existing irrigation acts, or enact new acts for Participatory Irrigation Management (PIM). In this regards Bihar has already framed legal framework for PIMs which enacted the irrigation act in 2003.

Additionally, the process of change in water management in India has been driven by many factors even if there are provisions for enforcing integrated planning and management approach in national water policies and strategies of India for example, the increasing unplanned, and largely unregulated industrialization in many locations has been causing environmental hazards and water pollution. In addition due to climate variability coupled with mismanagement of water resources are creating problems for the livelihoods of millions of people who are directly dependent on agriculture (UNICEF, FAO and SaciWATERs 2013), therefore the water resource policy in India in future should have to address above issues rather than only the demand and supply of water resources.

14.3.4 Water Related Policy and Institutional Gaps in Three Countries in Addressing Livelihoods Challenges and Disaster Vulnerabilities in the Koshi Basin

The review showed that all three countries of Koshi River Basin are in increasingly facing the pressures of too much and too little water as a result of climatic factors, poor water governance and institutional deficit. The situation calls for harmonizing the water related laws, regulations and acts with the policies and programs for flood and drought risk reduction in the Koshi basin. Further, water resources development is a multi-sector and multi-faceted concern and it calls for a coordinated planning and management of irrigation, hydropower generation, water supply, industrial use, disaster risk reduction and environmental protection.

The review carried out in the Koshi Basin Area of China, India and Nepal showed that the coordinating role of existing institutions is very limited as most

water management activities are being carried out by different water use sectors and sectoral agencies working at different administrative units (Table 14.2). The global experience on integrated river basin management suggests that it is important to first strengthen coordination among existing agencies by establishing a proper coordination mechanism with policy reforms and adjustments. Regular inter-agency consultation, compulsory information sharing, cross-review and endorsement of relevant policies and plans, and joint policy making are components of the coordinating mechanism.

At the conceptual and strategic level all three governments (China, India, and Nepal) of Koshi Basin are well aware of the severity of the water problems and committed in terms of enabling the environment through appropriate legal and institutional arrangements. The degree of importance given to integrated river basin management through developing national development action plans and activities are more reflected in China's current 5 year development plan whereas in Nepal, the policy implementation in practice needs to be supported with suitable action plans. India has been has been showing the signs of liberalizing its water policies. India's new water policy of 2012, express the intent of greater *trans*-boundary water cooperation. However, the intent is constrained by sub policies such as hydrological data sharing policy that still constrain access to hydrological data in key *trans*-boundary river basins for scientific institutions.

Central and Local Level Gaps in Institutional Arrangements In response to the complex water problems, more and more countries have adopted a systematic approach to integrate water supply, irrigation, pollution control, agriculture, hydropower, flood control and navigation for efficient, equitable and sustainable water management. It seems that most of the legal and institutional arrangements in China, India and Nepal are first targeted at the central level where several ministries, commissions, authorities and departments are being involved for its development and regulation of water resources although in most cases they are uncoordinated and fragmented. Too many agencies are being involved in water management along sectoral lines with overlapping roles and responsibilities. This has led to weak coordination and conflicting policies. Within the five-tiered administrative structure (national, provincial, municipal, county and township) in China and four tiered structure (national, state, district, village panchayat) in India and three tiered structure (national, district and village) in Nepal there is a large gap both in terms of understanding the concept of integrated water resources management and also the degree of policy implementation in practice at ground level. Broad objectives like environmental concerns, reducing pollution, balancing upstream and downstream needs, protecting and conserving ecosystems tend to have relatively low priority among the local agencies who are more concerned with local needs and more sectoral orientation.

Conflicting and contradictory provisions in various acts and rules signify the lack of coordination at the policy level with other vital and inter-connected subjects like flood risk management. For example, the Water Resources Strategy (WRS 2002) in Nepal has identified the need of a committee to integrate and coordinate all

Table 14.2 Indicative features of water policies & Institutions from DRR perspective

Country	Water Policy-key features	Main Water agency	Other agencies involved	Flood risk management perspective
China	Water Act 1988	Ministry of Water Resources	State Environmental Protection Bureau, Ministry of Housing and Urban and Rural Construction, Ministry of Agriculture, Ministry of Transportation, Forestry Bureau, State Oceanic Administration, National Development and Reform Commission provinces, municipalities, counties	Established procedures and protocols for managing flood risk in collaboration with disaster management agencies
	Integrated water resource management and demand management	Bureau of Hydrology		Bi-lateral agreements with India and Nepal on data sharing in *trans*-boundary rivers for flood risk reduction
	Unified management of water resources as national asset with equal access to all.			Stringent protection of hydrological data.
	Water as a national resource and management in administrative boundaries		Water users associations	Limited or no role for non governmental and international agencies in flood risk reduction activities in river basins
Nepal	NWP 2005	Ministry of Irrigation	National Planning Commission	Acknowledgement of Flood prevention perspective
	Holistic approach	Water and Energy Commission Secretariat	Ministry of Energy (MoE), Ministry of Physical Planning and Works, Groundwater Resources Development Board, Department of Hydrology and Meteorology, Department of Water Supply and Sewerage	Bi-lateral agreements with India and China on *trans*-boundary rivers
	Focus on IWRM			Liberal collaboration with non governmental agencies and international institutions for flood risk reduction
	Supply management and			
	Community participation			
	River basin perspective in spirit but management of water resources in administrative boundaries in practice		Ministry of Agriculture and Cooperatives	
			Ministry of Forests and Soil Conservation	
			Department of water induced disaster prevention	
			Water users associations	
			Non Government Organizations	

(continued)

Table 14.2 (continued)

Country	Water Policy-key features	Main Water agency	Other agencies involved	Flood risk management perspective
India	Water policy 2012	Ministry of water resources	Ministry of environment and forests	Flood control and regulation by water related ministry/departments
	Hydrological data sharing policy 2013	Central water commission	Ministry of agriculture	State and national disaster management authorities to respond in the event of floods
	Considers river basins as the basic unit of all hydrological planning. But in practice, planning and management takes place with in the administrative boundaries of each state with due role for water users associations and local panchayats		State water resources departments	Expressed openness to share flood flow data but in reality data is shared with only select national NGOs
			District administration	Limited role for NGOs and non government institutions in data collection, flood forecast and early warning
			Water users associations	
			NGOs	

the uses of natural resources within the catchment basin and has laid emphasis on the formation of River Basin Committee (RBC) at the River basin. The RBC is expected to formulate policies, coordinate, and supervise natural resources use and management within the river basin. At present, the District Water Resources Committee (DWRC) is supposed to perform this activity in coordination with other line agencies. This is again against the provision of Local Governance Act (1999), which recognizes District Development Committee as the planning agency at the district level. It has been observed that the DWRC is not functioning as designed at present (Pant and Bhattarai 2000). The district authorities who are also responsible for managing disasters with in a district, have different bodies and committees for water management and disaster risk management, often without mutual consultation (Table 14.2).

Conclusion

Missing Disaster Risk Perspective from Policies and Institutions

Integrated water resources management and mountain livelihoods—the existing water policies, laws and regulations of all three countries from Koshi Basin area are intended to implement the provisions of integrated water resources management with the overall objective of promoting comprehensive economic development, food security, and improvement in standard of living and conservation of environment. However, the most vital element of water induced disaster risk reduction is not adequately connected with water management policies and institutions in the basin countries. This disconnect impacts more profoundly in the Koshi basin, which among most disaster prone of the ten rivers that flow from the Hindu Kush Himalayan region.

Stand Alone Approaches of Flood Risk Management in the Koshi Basin The current disaster risk management approaches and practices by three countries in the Koshi basin adapt an independent path focused merely on mitigating floods in compartments, while ignoring the holistic IWRM approach of water storage, water management and water based livelihoods. In the downstream of Koshi basin, particularly, in Bihar, the flood risk is sought to be reduced primarily with the construction of embankments. While, embankments helped reduce flood risk for some locations in the Koshi basin in Bihar, they also proved to have have adverse effects such as interference with drainage, inability to stand erosion, etc.

In the changing mountain context, communities in the Koshi basin have been responding to environmental uncertainties and hazards through diversifying livelihood options, changing land use patterns, seasonal migration and changing food habits, frequency and sanitation practices (ICIMOD 2009). To strengthen this process, the national policies and institutions have an important role to play to make sure that local needs, priorities and concerns are

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reflected in the broader and integrated decision making on a river basin scale. A study conducted by ICIMOD in China (Yunnan), India (Bihar) and Nepal (Koshi Basin Area)showed that effective and integrated use of existing policies, institutional frameworks capabilities and enabling conditions coupled with access to livelihood options and opportunities can enhance the capacity to respond successfully to environmental uncertainties including water stress and hazards (ICIMOD 2009).

14.4 Way Forward

Recurring floods in the and other disasters erode development gains, displace millions and kill thousands every year. Over 95 % of people killed by natural disasters are from developing countries (World Bank 2009). River basin are major areas of livelihood activity of millions of people who are also exposed to the risk of flooding. Management of recurrent floods in the Koshi river remains a major planning and engineering challenge for China, India and Nepal for many decades. Minimizing exposure to flood risk and reducing underlying risk factors of the millions of inhabitants in the Koshi basin should be among top priority for all relevant policies of the three countries in the Koshi basin. Particular importance is the alignment of water, climate change policy, environment and disaster management policies of respective countries in the basin.

As detailed in the previous chapters, the crucial data sharing on water flows in the Koshi basin is shared in a bi-lateral arrangement between China–India, China–Nepal, Nepal–India and India–Bangladesh. Analysis of the river flow data is extremely important for understanding imminent flood risks and developing future flood scenarios. Apart from respective government agencies that are mandated to collect the analyze it and develop forecast products, there are quiet a few dedicated and expert institutions and organizations in the three countries who need this data on a regular and in near time basis to aid the efforts of these three countries. Although, there has been a human level appreciation from respective Government agencies of the non-governmental efforts of contributing to flood risk reduction, the fearful interpretation of water policies limit their appreciation from translating in to cooperation and collaboration. This paper makes following broad suggestions to water policies of the three main countries in Koshi basin, so that, committed experts and institutions will be able to contribute significantly to the flood risk reduction in the basin:

- Koshi basin floods annually from June–September ever year, some time with devastating results for the communities in the down stream-Terai in Nepal and Bihar in India. Declassification of real or real near time data during this period

by three counties will help experts and institutions to provide dynamic and useful assistance to concerned agencies in effective flood early warning.

- Since, there are a large number of private institutions vying for such data, the governments can consider creating accreditation system for data sharing. Accreditation may be given to selected national and regional scientific institutions under a strictly monitored data protection agreement that can limit the use of this data strictly for developing flood outlooks in coordination with respective government agencies. This will pave way for bringing best available flood modeling expertise out side the Government system to contribute to flood risk reduction in the basin.

When a river crosses a political boundary, a higher level coordination mechanism is an essential and the task of water resource management is not as smoother as like the basin which falls within an administrative boundary (Bandaragoda 2000). Koshi basin lacks bridging organization which links the riparian countries. Some kind of institutional framework exists in most of the *trans*-boundary river basin to regulate the water resource. But Koshi basin lacks bridging organization which links the riparian countries. Such bridging organization may play significant roles for the sustainable water resource management at basin scale and benefit sharing.

One of the example from southeast Asia is the Mekong River Commission which was grew from Mekong River Committee in 1995 (Lautze et al. 2013). It is an intergovernmental commission (among Cambodia, Lao PDR, Thailand, and Vietnam) established for the joint management of shared water resource for mutual benefits and sustainable management of the Mekong river. It is also a platform for data and information exchange. There are diverse views on the success of the Mekong river commission in fostering common agreement between countries in the realm of water utilization, water allocation and disputes resolution. However, according to the World Meteorological organization, the hydrological data sharing for flood forecasting and flood risk reduction has been one of the effective initiative among its World Hydrological Observation System (WHYCOS) projects world wide. The other such effective initiatives along the International river basins include, Hydrological observation system (HYCOS) in the Mediterranean basin with 20 countries, HYCOS in the Volta river basin with six countries, HYCOS in the Niger river basin with nine countries, HYCOS in the Hindu Kush Himalayan region with six countries, etc (WMO 2011).

The intention of this chapter is not to replicate the model of the Mekong river commission in the Koshi river basin. However, drawing successful elements from the Mekong river commission and the WHYCOS initiatives of WMO, the countries in the Koshi river basin can develop a workable joint mechanism to optimize Koshi river basin to sustain the livelihoods of over 30 million inhabitants and reduce their exposure to increasing flood risk. To address the current institutional gap at Koshi basin, the regional inter-governmental organization like ICIMOD, SAARC disaster management center, etc., can act as a bridging intuition to improve regional cooperation and formulating integrated policy for the *trans*-boundary river basin

like Koshi which will be a milestone to reduce poverty, ensure food security and mitigate hazard for the Koshi people. There is an urgent need for China, Nepal and India that share Koshi river basin to (1) development of common criteria and framework for holistic hazard, risk and vulnerability assessment and data sharing, (2) create a regional platform with three national governments for cooperation in hazard management activities in the Koshi basin, (3) foster regional/bilateral agreements to promote basin wide hazard mitigation and (4) learn from each other, jointly develop social and gender inclusive resilience and adaptation framework. To achieve these objectives, all three Koshi Basin countries have to give a significant consideration to the legal and regulatory mechanisms including institutional arrangements.

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