Institutional Arrangements for Water Management in the East Rapti Basin, Nepal

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Physical Characteristics

The East Rapti river basin (ERRB) has a catchment area of about 3,200 square kilometers. The East Rapti river course starts with a very steep slope in mountainous areas and flattens on the way out to meet the Narayani river. The lower reach of the river has mild slopes and larger discharges as many tributaries join its course. Consequently, the river has relatively higher velocities of water in the upper reaches than in the downstream reaches.

The water accounting computations indicate that the basin is an "open basin" (Adhikari 2002). In a typical dry year, only 53 percent of the available flow in the basin is depleted, allowing the rest (47%) of the utilizable flow to move out of the basin. This indicates a potential to harness this utilizable outflow. Also, as only 6 percent of the depleted water is process-consumed, there is a potential to further increase the process-consumption. The study also pointed out that there are substantial spatial variations in water availability compared to temporal variations within the basin.

There is an inflow into the basin upstream through the tailrace of the Kulekahni hydropower plant built into the adjacent Bagmati river basin. Kulekhani-I and II hydroelectric power plants are located in the upstream catchment area of the basin near Bhainse in the Makawanpur district with an installed electrical capacity of 60 MW and 32 MW, respectively. This is a large water storage hydroelectric power station with catchment and reservoir areas of 126 and 2.2 square kilometers, respectively. One 114-m high rock-fill dam has been constructed in the Kulekhani river to store a gross volume of 85 million cubic meters, which ultimately drains to this basin via the two hydroelectric plants.[3] The water of the Mandu river of this basin is also added to the drain from the first hydroelectric plant while being diverted to the second power plant. Consequently, water in the Mandu river downstream from the diversion point has become insufficient for running about 10 privately run water mills, for which compensation was paid by the power plant.

The population density is 145 persons per square kilometer and has been increasing at the rate of more than 2.8 percent every year due to people's influx into this area (Ghimire et al. 2000). The basin has been experiencing a population influx from different parts of the country from the 1950s with a state-supported resettlement program and the trend is continuing. Promising farming land is still available in the basin area and people like to settle down in this

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[3]Recently, it launched the "Kulekhani Disaster Prevention Project" to protect the catchment area.

land. The rate of urbanization is also relatively high, and about 23 percent of the population lives in urban areas, compared to the national average of 15 percent. The literacy rate is about 40 percent. Forty two percent of the population is below the poverty line (earning less than NRs 2,500/capita/year; US$1.00 = NRs 78). Only about 36 percent of the population has piped water supplies.

The land use pattern in the basin indicates an extensive presence of forest (39%) followed by agricultural land (27%) and National Park land (27%). The basin has a diverse biophysical environment by gradients, altitudes, landforms and soil types.

The average farm holding size is 0.9 hectare per household and over 75 percent of the population is engaged in agriculture. More females (87%) are found engaged in agriculture than their male counterparts (67%). The land distribution pattern in the basin is highly skewed (Ghimire et al. 2000). About 46 percent of the farmers own less than 0.5 hectare each, amounting to only 16 percent of the total cultivable land whereas 6 percent of households own more than 2 hectares each. It was found that a significant propotion of (over 75% of the population is engaged in agricultural activities) the population has either no access to land or own only a small amount of land. Therefore, land-tenancy arrangements are commonly practiced in the basin area.

As mentioned earlier, about 27 percent of the basin area is under agricultural cultivation (Adhikari et al. 2000; RTDB et al. 2000; Ghimire et al. 2000). It is estimated that only 45 percent of the total cultivated area (about 86,000 ha) in the basin is irrigated, and only about half of it receives year-round irrigation services.

The irrigation systems that divert water directly from the East Rapti river have adequate water supplies (as per the farmers' need) whereas almost all the irrigation systems diverting water from its tributaries have less-assured and limited water supplies, below the farmers' needs (Adhikari et al. 2000). Consequently, river-fed irrigation systems have better productivity in all cereal crops: rice, maize and wheat.

Emerging Trends

Growing Seasonal Water Scarcity

The basin experiences seasonal water scarcity for agriculture. Surface irrigation systems are stressed for required water supplies during the dry season. Consequently, many irrigation water users' groups are making extra efforts to augment water supplies from alternative surface sources and groundwater. The stress has also increased because of growing water demands from other sectors.

In addition, high spatial and temporal variations in water availability are forcing farmers of some areas to look for alternative cropping patterns. Although rice has a low water use efficiency, for a variety of reasons, it is cultivated as the main crop in dry areas by poor people. Despite many irrigation infrastructures, lack of dependable sources and unreliable supplies have, in many cases, resulted in failure of maize crops, particularly in dry areas during the spring season. Due to low evaportranspiration requirements of winter crops and substantial efforts to manage water for rice during the monsoonal season, farmers of relatively dry areas experience more water scarcity during spring than during other seasons.

Marginalization of Fishermen

Bote and *Danuwar* groups depend heavily on fishing. However, the number of fish has been decreasing over time (Ghimire et al. 2000). The main reasons for this are pointed as floods, dam construction in Narayani at Triveni, use of gelatins and poisons for fishing by other communities, and lack of moss, plankton and the essential flora deposition in the riverbeds for fish food. The fishermen opine that the industrial effluent has a major role in reducing the moss. The decreasing number of fish in the river streams can largely marginalize these underprivileged and predominantly illiterate tribes who hardly have any access to agricultural land and other alternative jobs. The availability of fish is declining, while the means of catching them, for example the supply of wood required for making fishing boats, has been restricted after the establishment of the National Park.

Water Conflicts

Conflicts are emerging between upstream and downstream water users, mainly between irrigation systems that draw water from the same stream. Some inter-sectoral conflicts are also observed although they are very few. For example, the Bhandara water supply system has started facing the problem of water shortage because of recent water diversions upstream of its intake. Victims of a 1993 flood are settled by its intake, about 2 kilometers downstream of Kusum Khola. They are accused of stealing water for irrigating their kitchen gardens and polluting water at the source. Conflicts have been so fierce that people have started thinking about removing the new settlers or shifting the intake further upstream.

Similarly, incidents of conflict have been reported, between the Machaan Hotel located near the Lothar river and irrigators of the Pratappur Mau Irrigation System, over the use of water during winter months in the East Rapti river. The hotel wants water to flow downstream for the use of boat services for tourists, whereas farmers want water for irrigating their crops.

Sand Mining

The riverbeds of the East Rapti river and its major tributaries have been good sources for sand, gravel and aggregates for construction in this rapidly urbanizing basin. As the quality of these materials in this basin is perceived to be superior, the rate of sand mining has been increasing over time. Furthermore, it has become a source of income for the District Development Committees as they levy a tax for sand mining. The collection of these materials, however, is not done in a regulated manner. Neither the individual collectors nor the licensed agencies are aware of, or serious about, the interests of other stakeholders. The haphazard digging of the riverbanks for collecting these materials has not only caused riverbank cuttings and landslides but also disturbed the river's flows causing, at some places, overflow of river water into agricultural fields, as floods during rainy seasons have raised riverbeds at some locations. The raised riverbed near Hetauda is perceived to be dangerous to the city itself. By the intake point of the Padampokhari Irrigation System, just about 2 kilometers downstream of Hetaunda, the riverbed is reportedly lowered. This has made it difficult and expensive to divert water to the permanent intake.

Increase in Cultivated Area

Over the last 20 years, the cultivated area in the basin has increased from 83,448 hectares to 85,578 hectares whereas the forest cover has decreased by 73,255 hectares indicating that part of the forest has been converted into agricultural lands.

Water Pollution

The pollution of water in the river basin due to disposal of industrial wastes, has been reported by the users and confirmed by the district officials. The brewery, soft-drink bottler, and paper mill are reported to have disposed of industrial waste into the river in the Chitwan district. The irrigation users of ward nos. 8 and 9 of the Birendranagar municipality in Chitwan have complained of the pollution in the irrigation water due to the waste disposal by the brewery and soft-drink industries. The people have lodged official complaints to the Ministry of Population and Environment (MOPE) and to the Ministry of Water Resources. The district officials said that this matter will be investigated. Likewise, people complained about waste disposal by the industries in the Hetauda industrial district in Makwapur. During the discussion, the Chief District Officer said that the industries have been asked to dispose of industrial waste after it is treated and they have agreed to do so. However, it remains to be seen whether they will comply with the decision reached between the local people, administration and the industries. The cases of water pollution are reported to the local authorities; however they lack the technical capability to investigate the matter and the MOPE does not have an office at district level. Therefore, the problems are not addressed immediately. The users in the river basin reported no other form of pollution. This is because most of the water in the river basin is used for irrigation.

Adverse activities, such as using poison and explosives for catching fish, harming the well-being of aquatic flora and fauna should be stopped. Safe disposal of industrial effluent should be sought. While this kills fish in the Rapti river it is also hazardous to wildlife in the Royal Chitwan National Park (RCNP).

In relation to water pollution, downstream stakeholders, particularly the livestock farmers, complain about the polluted water drained out of the industrial area of Hetauda where the number of industries (71 at present) is on the rise. Severe complaints and conflicts are not occurring, not because of unpolluted outflow, but because of the ignorance of downstream stakeholders about the degree of pollution and its adverse effects. Nevertheless, there is a growing concern about pollution and effects of polluted water on the life and property of the concerned people downstream. Because of this concern, perhaps, the government is planning to establish a Common Water Treatment Plant.

In the case of rural water-supply systems, the intake areas at the water source are protected through fencing against external pollution only in the immediate vicinity. The Hetauda industrial area and the Hetauda cement factory have polluted the Karra Khola that joins the East Rapti in Hetauda, and the East Rapti river itself, both in the Sandstone quarry site nearby Bhainse and from the effluent from the cement factory in Hetauda. The Hetauda industrial district is planning to minimize the pollutants from the industrial area.

Institutional Characteristics

District boundaries, traditionally and legally encompassing several village-development committees, form the main basis for state administration and governance. The hydrological boundary of the basin passes over two administrative districts. This indicates a need for a cross-district arrangement for managing river-basin water.

People in the basin have had a long tradition of making collective efforts to manage natural resources, including agricultural water. Traditionally, there have been several beneficiaries' organizations at the individual system level. They have been taking care of local operation and maintenance (O&M) activities through collective efforts. Going beyond that tradition, recently 134 irrigation systems in the Chitwan area were registered with the District Water Resources Development Committee. The registration provides them a legitimate status. In the past, farmer-managed irrigation systems of eastern Chitwan formed a separate federation for consolidating regional efforts to adopt a relevant irrigated agricultural development strategy, and accordingly approached the related agencies for assistance.

Historically, surface-irrigation systems were initially developed and managed by indigenous and tribal community organizations and the systems concentrated more in the central plains of the basin than in the hills. Later, with the state-supported resettlement programs in the basin area following disastrous floods and landslides in the surrounding hills, numerous immigrants received land entitlements on cleared forestlands in the basin. Irrigation development and management practices started becoming a concern of mixed communities. Presently, there are more than 200 farmer-managed irrigation systems in the basin and they account for about 90 percent of the irrigated area (RTDB/IAAS/IWMI 2000). The state initiated supporting irrigation developments in this area only from the 1960s.

Evolution and Use of Water Laws, Rules and Norms in ERRB

The District Water Resource Committees (DWRCs) in Chitwan and Makawanpur districts have been registering WUAs in their respective districts but the issuance of licenses to use water resources has not been put into operation. The DWRCs are not properly organized due to lack of budget and manpower. A workable mechanism for allocating, reallocating and monitoring uses of water resources is yet to be developed. The DWRC Chairman and the member secretary are not so aware of the existing and emerging issues in the basin and its subbasins. Scarcity of water and competition between water uses are increasing. District Irrigation Offices and District Water Supply and Sanitation Offices are facing increasing cases of the conflicts concerning different uses of water resources. Most of the conflicts are resolved at the local level by the users association or the concerned village development committee (VDC). District Irrigation and Water Supply Offices have resolved some of the disputes but there are a few conflicts that have reached the appellate court. The Jiudi-Chipleti Irrigation System in Chitwan is one example where conflicts were registered over sharing of water from the same river subbasin of Pampa Khola.

The Tharus and Darais were the original settlers in the Rapti basin area until 1953. They developed the irrigation systems before 1953. The need for irrigation water was less, as settlement in the area was very small and scattered. The villages contributed their resources for the development of irrigation according to their needs. With the implementation of the

state-sponsored resettlement program since 1953, many people, mostly from western Nepal, have settled in the area after clearing the forest. Initially, they took management contracts from the irrigation systems developed by Tharus and Darais (Shukla et al. 1997). In course of time, they started the development of new irrigation systems.

An informal user group was formed to initiate the irrigation development. The users reported that in the beginning the distance between the headworks used to be 1.6 kilometers. The users developed the necessary rules with respect to the system development, resource mobilization, water allocation and distribution, and O&M. These informal rules constituted the working rules for the operation of the system.

With the development of new irrigation systems there was a rise in conflict among the users, which required appropriate mechanisms for resolving the disputes. Another reason for the conflicts was due to the change in the watercourse by the river during high flood, which washed away the intake and required construction of a new intake at a different location. However, earlier appropriation rights were recognized. The mechanism adopted by the users to solve the disputes and in defining the water rights was through negotiation among the users. Therefore, the downstream users have to negotiate with the upstream users if there is objection from them. However, there is an understanding between the users that the need of every user should be addressed as far as practicable.

In some cases, government functionaries at the local, district and zonal level arbitrate conflicts, and a written agreement is signed between the disputing parties (Shukla et al. 1997). Such agreements served as a basis for rules and norms for the development and management of irrigation systems. The development of rules and norms was further reinforced when the government started various intervention programs to support the development and rehabilitation of irrigation systems. One of the conditions for government interventions was the requirement for official registration with a water user association (WUA). Consequently, the informal water user groups became WUAs and their informal rules were formalized through the WUA constitutions. The users reported that almost all the WUAs in the river basin are legally registered, as they received government support. The water laws and rules, as practiced in the river basin at present, evolved through various negotiation processes between the users as the history of irrigation development took place since 1953. The formalization of these rules however took place when external support was provided to these irrigation systems.

The Water Resources Act (WRA) of 1992, replacing canal, electricity and related water resources acts of 1967, dealt mainly with the concept of public domain in water, a system of licensing and the authority to charge fees for services rendered. This Act was the first comprehensive treatment on the management of water resources in the country. The new Act has provided the ownership of water to the state irrespective of its origin or existence. This is a major departure from the earlier concept of private ownership of water as provided for in the Aquatic Animals Protection Act, 1960. The WRA is an important legal instrument to give absolute recognition to the state's ownership and control of water resources. The government is empowered to allocate water rights and resolve related issues, and to license and control usage. Licenses are mandatory for commercial and industrial users, and these licenses are transferable.

The prior use or the established water use of riparian owners under the provisions of the National Code have also been continued and protected by the WRA. These prior rights did not limit the quantity of water they were entitled to use. The traditional use of water did

not anticipate shortages in water supply and hence, did not foresee the need to set priorities among water users. Readjustment in traditional water uses and inclusion of new members have been possible in practice through government intervention by expanding the command area with additional investment for permanent structures.

Land Rights and Water Rights

The WUAs represent the collective interest of the respective users in the basin. In the absence of male members, women can also represent the male members in WUAs or assembly and related decision-making processes as de facto members (Ghimire et al. 2000).

In general, access to irrigation water rights is tied up with access to land rights. In irrigated lands, this means that the rights to use water are automatically transferred to the offspring as landownership is inherited. A similar case prevails when land buyers acquire landownership after purchase. Water rights are also related to the tenure system. Different kinds of tenure arrangements operate in the basin, e. g., owner-operator, share-cropping, mortgage, lease, and contract farming. Share-cropping is a quite common practice, after owner-operators. All operators hold possessions of water rights as they are required to contribute resources in terms of kind, cash or labor for the system development, acquisition, distribution and the use of water resources for irrigation.

To sum up, the prevailing practices of customary rights in the river basin are: water share based on investment, water right purchase from others (Pradhan 1989) and water rights proportionate to the land in irrigated area (Pradhan 1989). The availability of irrigation water for area expansion, the users' willingness to invest in its development, and external resources obtained for the development of the irrigation have influence in defining the water right of the users in the river basin.

Dispute Management

The intersystem conflict is mainly between agricultural use versus the National Park, hotels and tourist resorts due to the many diversion structures in the river, which obstruct boating by tourists who are the guests of several hotels and resorts. The consumption of water by several irrigation systems, especially towards the upper section of the National Park, has seriously decreased the amount of water in the river during the summer season.

External factors have been a potential cause of conflicts between systems, particularly high floods (associated with catchment degradation due to encroachment upstream) that damage diversions structures and change stream-courses. In some cases, intervention by external agencies has displaced the old structures and obstructed water-distribution patterns among users. Thus, construction of new intakes invites conflict when existing intake points and canal lining are lost, as none of the users want to lose their claim to water. Conflicts also occur due to those who have sometimes not participated in, or not paid cash or required labor for, repair-works. Although settled by the users themselves, more conflicts do occur due to water competition in water-deficit areas.

Depending upon the nature and severity of conflict, a range of mechanisms is used to resolve conflicts. These include both formal and informal mechanisms. Although not frequent, there are cases resolved by simple informal negotiations and arbitration, for example where an agreement has been signed between the disputing parties through the mediation of the village development committee (VDC) and local *Panchabhaladmi* (group of local people accepted by

the disputing parties). In some other cases, the VDCs have forwarded the cases to the Chief District Officer (CDO). Although informal mechanisms are most common, users approach legal and quasi-legal institutions when informal mechanisms fail to resolve conflicts adequately (Shukla et al. 1997). Some of the cases have passed from the District Court even up to the Supreme Court for final resolution of the problems (Shukla et al. 1997). Different water rotation schedules are used to minimize conflicts within the system. Therefore, the conflict between and within irrigation systems is less pronounced in the river-basin area.

There was conflict between supply of drinking water of Pithuwa VDC and irrigation water of neighboring Chainpur VDC, as both have the same water source on the Kair stream. It is natural that both desire water supply according to their own convenience. Since drinking water is a more critical issue than irrigation and due to high water demand during daytime, the conflict was resolved by a mutual written agreement whereby Chainpur would divert water only at night for irrigation so that the high demand for drinking water of Pithuwa residents is met during daytime.

Inter-Sectoral Water Transfer and Organizational Linkages

Important actors for managing the catchment area at the national level have been identified as the Ministry of Water Resources (MOWR) and the National Planning Commission (NPC), whereas at the district level, actors include Forestry, Water Supply and Sewerage, District Development Committee, Electricity, Irrigation Offices and concerned municipalities. Resource users, both as individuals and organizations, VDCs and industries are responsible for managing the catchment area at the local level. The Makawanpur industrial district is the authority to manage water in the Makwanpur district. A brief review of the water uses in the ERRB and its legal status is presented in table 1.

Precise policies are lacking with respect to inter-sectoral water transfers or interbasin transfers of water. The natural resources in the country are owned by the state and only use rights are given out. According to those principles, the central government level agencies have had the sole decision-making authority. Recently, initiatives have been made for delegating some authority to district-level water-resources committees. Subsequently, these district- level committees are expected to be primarily involved in river-water management tasks at the district level.

There are no institutional arrangements at the Rapti basin level to cope with multiple use of water. For inter-sectoral water allocation, only informal arrangements exist, for example, between water mills and irrigation. The same is the case for intra-sectoral water allocation and distribution, e.g., between irrigation and irrigation. However, a district-level federation of WUAs in both districts (Chitwan and Makawanpur) covering the East Rapti basin, and a separate federation of WUAs in East Chitwan, have recently been formed.

Table 1. Water utilities in the East Rapti river basin.

Type of utility	Number	Who owns utility	Who operates utility	Legal status of operator
Surface irrigation systems	214	Government and farmers both collectively and individually	WUAs = 208; jointly by the government and farmers - 6	Govt. Department, local WUAs; some recognized by law and some informal
Groundwater schemes	STW = 589 Dug-wells = 1,809 Treadle pumps = 47	Mostly by individual farmers and some in groups	Mostly by individual farmers and some in groups	Some recognized by law and some informal
Domestic water supply schemes	45	Municipality-level schemes (3 schemes) by the government and village-level schemes by users' groups	Municipality-level schemes by Water Supply Corporation and village-level schemes by users' groups	Majority of user groups legally recognized
Hydropower plants	One	The government	Nepal Electricity Authority	Government body
Wastewater treatment plants	None	Not applicable	Not applicable	Not applicable
Wetlands and other water bodies	Numerous; exact number yet to be ascertained	Royal Chitwan National Park	Park officials and local people in buffer zone	Buffer zone peoples' committees legally recognized
Hand pumps	Numerous; exact number not available	Individual farmers	Individual farmers	Informal and private
Industries	126	Public and private	Government and private sectors	Legally recognized

Customary Practices for Inter-Sectoral Water Allocation and Distribution

Except Narayani Lift and Khageri irrigation systems, which are jointly managed by the government and users associations, farmers themselves manage all other systems. Typically, irrigation systems acquire water from a series of headworks along a stream. An arrangement for water allocation between these systems is based primarily on mutual consensus among upstream and downstream users, especially during the dry season. The tradition is that the downstream systems approach the upstream system through functionaries to make an informal request for sharing water. Also, there are systems among which a formal legal right of access to water is also found. In some others, water is allocated proportionately into a number of shares depending upon the labor contribution to O&M to maintain the common intake.

In the case of an intra-system water allocation, boundary rules are used to define who are users and who are not. Each farmer within the rule is allocated water based on his labor contribution to O&M of the system. Stringent rules are implemented during water-deficit periods to ensure equity in allocation. Systems switch from a continuous mode of supply to a rotational pattern of water distribution method as canal supply decreases towards the lean season. In most of the systems, opportunistic users' behaviors like shirking work and water pilferage are controlled by payoff rules for graduated sanctions.

One embankment (18 km long) and a number of spurs are built along the river course for flood protection in the downstream area. But no storage facility that can control or distribute the flow of units from the river to other places or sectors is developed. No explicit allocation of uncontrolled river water is found among various sectors. As mentioned earlier, conflicts between tourism and irrigation sectors indicated that although the national government assigns a high priority to tourism and national parks, exclusion of water use from the river for irrigation appears impossible unless options are developed acceptable to both sectors. This brings an issue of little or no water allocation across sectors and protection of riparian property rights.

All but one of the industries is supplied with water from the Hetauda industrial district. Using an intake channel, they extract water from both the Karra stream and a well. Hetauda Textiles has its own well and only a minor part of the consumption is supplied by the Hetauda industrial district. Water allocation and supply within industries are demand-based and do not seem to be a problem since revenue is collected from the use of power.

Integration of Overall Legal Framework with Water Law

There are some incongruities of laws related to water resources. Laws relating to a specific subject matter and to a particular area supercede the laws relating to water resources. For example, the 1998 Drinking Water Regulation, prescribed in pursuance of Section 24 of the 1992 WRA, provides a set of separate and contradictory procedures from that prescribed in the 1993 Water Resources Regulation with regard to licensing, and fees to be charged for a license, and for constitutions of user's associations, dispute settlement mechanisms and a tariff-fixing committee.

The 1999 Irrigation Regulations, which were also prepared based on the 1992 WRA, prescribe a separate set of rules and procedures with regard to forming WUAs. This regulation prescribes authority to the District Irrigation Officers (DIO) to constitute WUAs for those

systems that are to be handed over to FMIS. The 1998 Local Self-Governance Act (LSGA) has given similar authority to the VDCs and municipalities for development and management of drinking-water facilities, irrigation canals and hydropower projects. The VDCs, DDC, and municipalities have the authority to levy taxes for using natural resources within their jurisdiction.

The 1998 LSGA requires the local entities to form users' associations or consumer's groups for implementation of village-, municipal-, and district-level development projects. But it does not have an independent authority to register water user's associations. The 1999 Local Agencies Regulation, under the 1998 LSGA, has prescribed rights and responsibilities of users' groups, and procedures for engaging the services of users' groups for the construction of development projects.

Specific enactments, such as the 1967 Forest Conservation Act, 1972 National Park and Wildlife Conservation Act, and 1972 Soil and Watershed Conservation Act, restrict certain activities on rivers, streams or other similar sources of water within their respective jurisdictions. In these cases, the rights of the people are subject to the provisions of such enactments.

Review of legislation related to water-resources development reveals overlaps and conflicts between different acts, and between the act and regulations under the acts. There is no legislation regarding inter-sectoral water allocation and distribution, and interbasin transfers. There should be harmony among related legislations.

Water Administration

As a major natural resources, water should be developed and managed so that it will play a catalytic role for the social and economic development of the country. Because of the temporal and spatial variations and the resultant scarcity value of the resource, there exists one school of thought of recognizing and treating it as an economic good, while on the other hand, it is also required to manage a certain amount of balance between the social and the economic good. Consequently, appropriate institutions are required to be developed at national, regional, basin, district and local levels for managing the water resources of the country.

Water availability in Nepal is characterized by a highly unbalanced situation between availability and the need. There is asymmetry between the supply and demand and this has put a tremendous amount of pressure on the government capacity for the management of the resource. Water-management elements such as demand management and water-use efficiency along with crop diversification have been lacking in the planning of water resources.

The development and management of water resources are patterned along the lines of sub-sectoral uses. Irrigation, domestic water supply, and generation of power have been entrusted to separate departments, and sometimes put under different ministries resulting in a piecemeal approach. There has been an absence of effort to create, or a failure to see the need for, an appropriate institutional framework or mechanism to give effect to the policy on the utilization of water resources on a river-basin basis. Water administration continues to move along traditional and sectoral lines. The Ninth Plan has put an emphasis on the integrated development of water resources on the basis of river basins.

A review of the policy framework for the management of irrigation, domestic water supply, and hydropower sub-sectors, together with a recent initiative to empower local bodies with

responsibility and resources, reveal a definite shift towards community participation in service delivery and a great reliance on the private sector for the production of goods and services.

Over the years, water-resources management has gone through a series of changes. Before the Sixth Plan period, the responsibility for development and management for meeting water demand was vested with a number of central government departments and their supervisory ministries. This approach manifested a lack of participation by beneficiaries and the system performed dismally. The government could not sustain the level of financial resources needed to operate, maintain and manage the structures in addition to finding funding sources for new projects. In the circumstances, new development efforts came to be based more and more on community and private-sector participation.

A number of central-level institutions are involved in formulating policy, plans and programs for the development and management of water resources. The ministries and their departments related to water-resources development are responsible for formulation of policies, implementation of plans and programs, and monitoring and evaluation in their respective sub-sectors. There is an absence of a long-term and comprehensive vision for development of water resources. There are good sub-sectoral plans but they lack cohesion and coordination. Sub-sectoral agencies for irrigation, domestic water supply, and hydropower formulate policies and regulations based only on their limited sub-sectoral needs. Uncoordinated development of water resources, coupled with pressure from increasing population and decreasing sources of water have resulted in adverse impacts on the ecological systems. Conflicts among users are emerging. Lowering of groundwater levels, drying up of wells in certain locations, destruction of forests, and pollution of rivers from towns and industrial effluents are some of the examples.

Separation of functions between the ministry, department and district offices or operational-level agencies tends to get blurred in practice. Interference in implementation from politicians and higher-level officers is common. The tendency of referring to a higher-level office for decision or for instruction on matters within one's own jurisdiction and authority is also widely practiced. Involvement of a policy-level body in regulation makes policy implementation weak, and regulation ineffective. Under the current framework, overlapping in the functions is evident from information in table 1. There is an absence of clear separation of policy from implementation or operational functions.

Spatial water administration is based on administrative boundaries of districts that do not follow the basin's hydrological boundaries. There are various bodies for coordinating various agencies involved in programs associated with water resources. The Water Resources Development Council, National Planning Commission and District Water Resources Committees are the main agencies associated with the inter-agency coordination. There are no established procedures for the involvement of the private sector in the irrigation activities and licensing, and pricing arrangements are still under discussion.

Conclusions

The ERRB is an open basin and has both traditional and modern methods for water use for various purposes. However, there are seasonal and temporal variations in water availability across the basin. The users have been following both customary practices and legal provisions

as specified in the WRA to regulate the use of water in the basin. However, present legislation is not sufficient. The creation of new basin-level institutions and regulatory frameworks is required for water allocation and sharing; private sector and community participation; strengthening of the regulatory system for water rights, pollution control and environmental management; water pricing and cost recovery; and groundwater management.

Lack of specific water rights and ownership issues need to be resolved. Historically, water has been allocated mostly for irrigation benefits. With the enactment of the 1992 Water Resources Act, the government is now empowered to allocate water rights, resolve water-related issues and license and control usage. The 1993 water-resources regulation provided for the formation of users' organizations, establishment of district water-resources committees, licensing, and the formation of committees for resolving disputes, but all of these have yet to be enforced or implemented properly.

Another issue of major concern is the lack of harmony among the related laws. The 1992 Water Resources Act is a comprehensive piece of legislation on water resources dealing with their development, utilization and conservation. A review of other laws related to water resources shows a certain amount of incongruity. The Drinking Water Regulation (No. 2055) for instance, has prescribed a set of separate and contradictory procedures with regard to licensing, constitution of users' groups, dispute settlement and committee for fixing tariff. Likewise, the Irrigation Regulation (No. 2056 of 2000) has prescribed a separate set of rules and procedures regarding the formation of users' associations. The authority for the same is entrusted to the District Irrigation Officer, whereas the Local Self-Government Act (No. 2055 of 1999) has given similar authority to the VDCs, municipalities and DDCs.

The preferable option would be the consolidation of the 1993 Water Resources Regulation with all conflicting procedural laws found in various regulations relating to licensing fees, registration of WUAs and WUGs, irrigation and drinking water service fees, and dispute settlement mechanisms. While doing so, it is necessary to amend the Irrigation Regulation (No. 2056) so as to make District Water Resources Committees responsible for registration of WUAs. Likewise, LSGA and Regulations also need additional provisions under which DDCs, VDCs, and municipalities are also required to obtain licenses for proposed and planned drinking water and irrigation projects, leaving service delivery and implementation functions to them.

Although statutory laws have been promulgated and amended over the last 30 years, many of the water-rights-related activities in the water sector are still based on customary rights. As Nepal's population grows, water stresses will be felt frequently and conflict on water use will also be more frequent. Also, since water-resources development is an integral part of national economic growth, there will be new investments in infrastructure that will require trade-offs and/or compensation to existing users. This means the legal framework for water use in Nepal must address these emerging issues. It must be able to facilitate a transition from customary rights to statutory rights. In addition to the legal framework, there must be an improvement in the enforcement of statutory laws and regulations.

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