Socio-Economics and Hydrological Impacts of Intersectoral and Interbasin Water Transfer Decisions: Melamchi Water Transfer Project in Nepal[1]

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Abstract

A common solution to the problem of rising urban scarcity is to transfer water to cities from rural, agricultural areas. This paper, using the case of the Melamchi water transfer project in Nepal, illustrates some of the complexities involved in the planning and implementation of a rural to urban intersectoral water reallocation. We present an analysis of the socioeconomic, rural livelihoods, and hydrological consequences with a focus on the basin of water origin giving consideration to the people most likely to be adversely affected.

To alleviate the existing water-scarcity situation in Kathmandu city, the Government of Nepal has recently initiated the Melamchi water reallocation project to divert a planned 170,200 cubic meters per day into the city drinking water system. This has a potential to generate large aggregate economic benefits due to difference in the relative economic value of water between the two river basins. The project benefits are realized by the urban sector, but all of the opportunity costs of the project are borne by the poverty-stricken residents of the basin of water origin. Within this context, the project effectiveness was assessed by considering the additional value generated, the process adopted, and the benefits sharing mechanism including the scale of compensations provided to the adversely affected households in the basin of water origin. The case study indicates Kathmandu residents including the urban poor will benefit from a well implemented project. The extent of impact in the Melamchi will be limited to the area close to the diversion point during the dry months of the year. The existing project compensation scheme has provided compensation for local public goods, such as, construction of school, hospital and road in the basin of water origin benefiting people there. But insufficient attention has been given to those directly affected. There was little discussion with donor basin residents during the initial stages of the project, and little negotiation on the compensation package. Vulnerable people such as *Ghatta* owners and tenant farmers, whose livelihoods entirely depends upon the water use activities in the water supplying basin could unduly bear the brunt of the project with little compensation. To achieve equitable gains from intersectoral transfers in situations where formal land and water rights are weak or absent will require an understanding of who will be impacted – especially marginal or vulnerable groups; and early discussion and negotiation with those affected for the development of due compensation.

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1. Introduction

The Government of Nepal has recently initiated an intersectoral and interbasin water transfer project to alleviate a drinking water supply crisis in Kathmandu city by transferring water from the nearby Melamchi river. The Melamchi Water Supply Project (MWSP) plans to divert 170,000 M^3/day of water (62 million M^3/year) out of the Melamchi river to Kathmandu city. It is planned that the volume of water diversion will triple using the same tunnel infrastructure, as the city water demand grows in the future. This paper illustrates some of the issues involved in the Melamchi intersectoral water transfer project. It discusses some of the likely socioeconomic changes and hydrological consequences of the water transfer project with focus on the basin of water origin. Then, we have summarized some of the public policy issues and selected concerns associated with the Melamchi water transfer project in Nepal. This presentation is based on the key findings from the recently carried out explorative case studies in the Melamchi river basin in relation to the water transfer project[3].

Urban water demand is escalating very fast in developing countries, particularly in South Asia, due to widespread urbanization in the recent past. In South Asia in 1999, the population residing in urban areas accounts for 28 % of total population, and the urbanization trend is rising sharply over the years giving a huge pressure on city infrastructures to deliver necessary water supplies. In Nepal, the urban population increased from 7 % of total population in 1980 to 12 % in 1999 (The World Bank, 2001). More than 250 million of populations in India now live in the urban areas (25% of the total national population), and it will be more than 50 % of the total national population by 2020 (Zerah, 2000). Drinking water scarcity is on a rising trend in several urban cities in South Asia. The situation of safe drinking water supply in Nepal is further worsened due to poor infrastructure and low level of public investment in the water sector, as only 44% of the total population has access to improved water sources (World Bank, 2001).

Existing drinking water supply situation in Kathmandu

The present population of Kathmandu city is more than 1.2 million, which was growing by more than 3 percent per annum during the last decades (MWSB, 2000a). The city water distribution system serves a population residing in an area of 50 km^2 within the perimeter of the city, some of these water-supplying pipes were buried underground more than 50 years ago (Dixit, 1997). The piped drinking water supply

[3] This paper has benefited from several case studies carried out in the Indrawati basin under the Ford Foundation supported IWMI and WECS/Nepal project in Nepal. These individual reports have been separately published by IWMI and WECS. The authors would like to acknowledge contributions of all of the researchers from IWMI and WECS involved in these case studies in

system covers less than 70% of the urban population: the city residents are now receiving 3 to 4 hours of water supply during the monsoonal season of July to October, and 1-2 hours in an alternate day during the rest of lean season. The Kathmandu city water supply agency, a government owned agency, has a capacity to supply only 120-140 MLD (100 to 115 liters per capita per day) in the rainy season of June to October (MSWB, 2000a). However, this further reduces to 80-90 MLD (i.e., 65 to 75 liters per capita per day) during the dry season from January to June (MWSB 2000a and 2000b).

The dry season piped-water supply in Kathmandu city is only sufficient to meet the basic water requirement of less than half of the city's population. Furthermore, the city's population is expected to be more than 3 million by 2015, and the city water demand[4] is projected to increase more than 500 MLD by 2015 (MWSB, 2000a). This will give additional stress on the city's already stretched water supply, a very alarming situation for the present and near future development prospectus of the capital city.

The remaining 30% of the city population (0.36 million populations), who are now outside of the public water supply network, are mostly urban poor and relatively poor section of the urban population; they are using private tube well, ancient stone spouts[5], and other temporary means of water sources. Therefore, the regular supply of lower cost hygienic water from the public distribution network is important from the perspective of maintaining equity across the different households within the Kathmandu city, and maintaining basic sanitation, and a livable urban environment.

In this context, Nepal government has designed the Melamchi Water Supply Project (MWSP) to transfer water of 170,200 m^3/day through a 26.5 km underground tunnel in the high Himalayan's terrain from Melamchi River to Kathmandu city located in the Bagmati basin. The total cost for Melamchi project (MWSP), including the rehabilitation and expansion of Kathmandu water distribution systems, is estimated to be US$464 million, spread over 7 years (2001 to 2008)[6]. The project represents both the case of intersectoral allocation from rural to urban use and interbasin water transfer, from the Melamchi river to the Bagmati basin. Such intersectoral allocation is now also on an increasing trend in other major cities (such as Madras, Pune, Delhi, Colombo) of South Asia due to rapid urbanization.

Nepal, particularly, Mishra (2000), Devkota and Bhattarai (2001) and Pun (2001). A summary and synthesis of the project findings is separately provided in Bhattarai, et al., 2002.

[4] This is based on 1.2 million of Kathmandu valley population, which is now growing at the rate of over 3% per year.

[5] Stone spout schemes (stone tap water) are centuries-old urban water supply schemes found in Kathmandu valley. Some of them are more than 300 years old and are still functioning, based on traditional water-harvesting techniques facilitated by mountain topography. This type of traditional method is rarely found in other parts of the world.

[6] The project is planned to complete in 7 years, but given the political instability at the central level institutions in Nepal and the deteriorating law and order situations, it is less likely that this project will be completed in the stipulated time of 7 years. There are already delays in the project works in several fronts than scheduled initially in 2001.

In the context of an acute scarcity of urban drinking water in Kathmandu, there will be aggregate level economic benefits generated by the project accrued to national economic account. This is because of transfer of the water resource from a relatively water abundant area to the water scarce area. However, a key question is whether the additional benefits generated by the project, mostly realized at the urban sector, will also equitably shared with the water-supplying basin, already a poverty-stricken region. This is one of the critical issues for the effective management of the water transfer decision, and equitable utilization of the national resources across the regions and across the basins. The equitable benefit sharing across the basins is a pertinent issue not only to the Melamchi project but also to all other planned intersectoral water transfer decisions in the region. Thus, public policy analysis and planning on intersectoral allocation of water decision should take into account all these benefits in recipient basin, as well should address all these adverse impacts imposed on the water supply basin after the water diversion.

An intersectoral water transfer imposes opportunity costs and third party effects (negative externalities) in the upper basin catchment. An effectively implemented intersectoral water reallocation scheme has the potential to increase allocative efficiency of water by transferring resources from lower-value use in the water-supplying basin to higher-value use[7] in the water scarce recipient basin. This gain can only be achieved when there is a provision in place to ensure that the net welfare and livelihoods of water supplying basin communities should be increased after the project water diversion, similar to that of the water recipient basin. Some of these issues and criteria on assessing the impacts of a water sector project are also recently discussed, debated and recommended by the World Commission on Dams Report (WCD, 2001) for compensating the loss caused by the project, which can also equally be applicable in the case of intersectoral reallocation of water [8].

Some of the major concerns and questions that are now associated with the Melamchi intersectoral (and interbasin) water transfer project, which are also addressed in this paper, are: 1) whether such scale of water diversion is needed now? 2). What are the possible livelihood consequences of the water diversion project in the basin of water origin. 3) What are the project benefits generated by the water transfer project and how they will be shared between the two basin communities? 4) What are the equity consequences of resources use across the two basin communities sharing the water? 5) Are the local communities in the water-supply basin going to be duly compensated in a fairly manner?

[7] In fact, due sharing of the benefits created from the transferred water between the water-sharing two basin communities is one of the critical aspects of effective implementation of intersectoral allocation of water resources.

[8] Some of these criteria identified and recommended by WCD report are, equity, efficiency, participatory decision-making, sustainability, and accountability, are also equally useful for evaluation of intersectoral water transfer project.

Objectives

The major objective of this paper is to assess some of the concerns and issues raised in Melamchi intersectoral and interbasin water transfer project in Nepal. The paper in particular looks at some of the hydrological, economic and institutional consequences of the water diversion project. The paper focuses on how the rural livelihoods in the basin of water origin are going to be affected after the diversion of water out of the basin. It also assesses the project compensation measures in relation to mitigate the project adverse impacts, which is important to improve the total welfare and livelihoods of the water-supplying basin after the water diversion.

To meet these objectives, the information was collected from multiple sources and previously conducted case studies in the Indrawati river basin. The Melamchi project is the first of such large-scale intersectoral water-transfer project in Nepal. Therefore, the procedures followed to implement this project, the mechanism in place to share costs and benefits across the regions (and basin communities), and the lessons learnt in this project will have large implications for any future water reallocation decisions in Nepal.

Outline of the study

The second section of this paper discusses the methodology adopted to carry out the case study. The third section of this paper provides an overview and basic features of the Indrawati basin, the basin of water origin. The fourth section illustrates an overview of the Melamchi Water Transfer Project, which includes the project's hydrological consequences, the project's impacts on socioeconomic front, and major institutional changes brought about by the project in Nepal. The fifth section illustrates some of the salient features about the economic benefits and costs of the project, and project financing aspects. The sixth section illustrates project's compensation schemes, and benefits sharing mechanism in place. The last section provides conclusions, their implications, and other unsettled issues in relation to the water transfer project.

2 Methodology of the study

There are several public policy issues and concerns raised in relation to Melamchi intersectoral water transfer decision, which is a distinct case in the history of water sector infrastructural development project in Nepal because of size of project, the level of costs involved, financing requirements (constraints), and so on. Therefore, an explorative case study approach was adopted to document important issues and concerns related to the water transfer project. This paper syntheses key findings of several case studies previously carried out in the Indrawati river basin in relation to the water transfer project. More specifically, this includes: the inventory of infrastructures and process documentation research of the Melamchi project (Devkota and Bhattarai, 2001); water accounting study in the basin (Mishra, 2000); formal and informal institutions in the Indrawati basin (Pant and Bhattarai, 2001). The methodologies adopted on each of the studies can be found in the respective studies, and a synthesis of methodologies and major findings of all of these case studies can be found in Bhattarai, et al., (2002).

Because of the unavailability of the basin level sectoral water use information in the public domain and the informal nature of functioning of the local level water institutions, field level information was collected using explorative and descriptive approaches including Participatory Rural Appraisal (PRA), key informant survey, and stakeholder consultation. In addition, review on past hydrological observations and a hydrological simulation exercise (water accounting model, detailed in Mishra, 2000), and related socioeconomic and institutional analyses were carried out. These individual case study findings were presented at the national level policy seminar in Kathmandu involving several water sectors policy makers and researchers [9]. These participants' comments at the seminar also help to validate these case study findings.

Later on, a desktop study was conducted for issue like broad level institutional changes, economics and financing aspects of the project, and recent issues and controversies in relation to the financing, project compensation, and implementation of the project activities. This was done by reviewing the project documents (feasibility study reports) and other related Nepali press news (news-clips) published over the last 3 to 4 years. Hence, the information and analyses presented in this paper are based on the primary information collected in the basin, which is then supplemented by a secondary research of a thorough desktop study.

3. Characteristic of the water supplying basin and water availability

The water-diversion intake of the Melamchi project is located about 42 km to the northeast of the Kathmandu city, in the interior mountain range. Melamchi river is a part of a larger Indrawati river basin,

[9] This paper has greatly been benefited from all of these seminar participants who provided comments and comments on the case study findings, for which, the authors are grateful to all of these seminar participants.

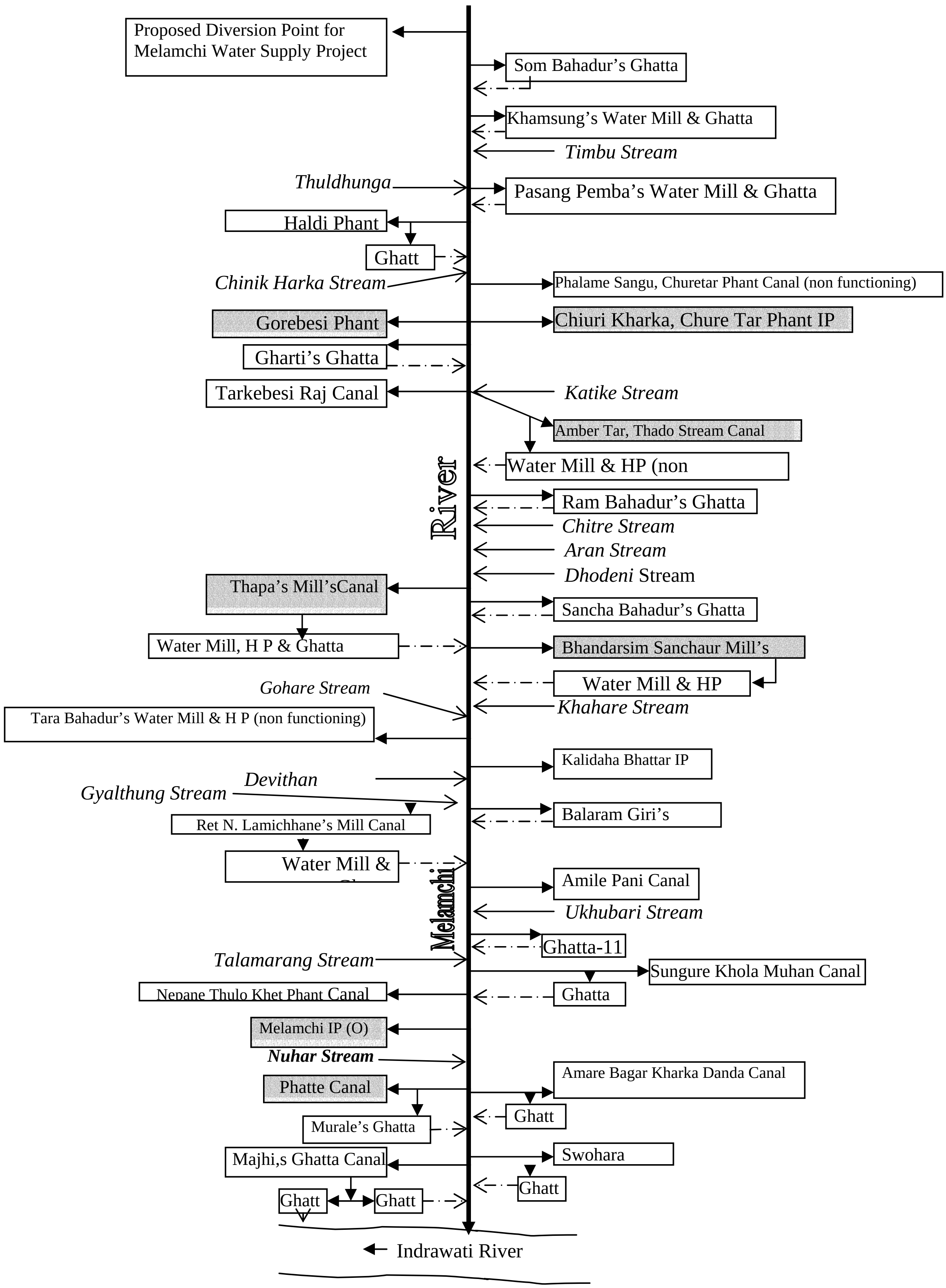
which originates from the high snowy range of the Himalayas, and it is a perennial river. Out of the 124,000 hectares of the catchment area of the Indrawati river basin, crop cultivation utilizes less than 2 percent, and the natural forest area covers nearly 40 percent of the basin. A summary on major characteristics of the Indrawati basin is provided in Bhattarai et al. (2002), and in Devkota and Bhattarai (2001).

Rainfall and snowfall in the upper catchment area are two major sources of inflow into the basin, with annual average rainfall of about 2,800 mm, which is concentrated mostly during 4 months of monsoon. The two months of July and August alone receives nearly half of the annual rainfall. There is very little storage and utilizing infrastructures in the Melamchi river basin, and thus a major portion of water flows out of the basin as river runoff without much beneficial use to the Melamchi basin communities. This high seasonal fluctuation of the river flow and low level of water infrastructures in the basin have created localized water stress and water scarcity in selected tributaries, particularly from February to May, when the river flows also reduce substantially (IUCN, 1999; and Mishra 2000).

At present, the major water uses in the donor basin include: irrigation for crop production, traditional water mills, and water turbines for electricity generation. Details on major water uses in the Melamchi river basin, down stream of the project intake site until it confluences with the Indrawati river downstream, are illustrated in figure 1. The figure 1 in a water flow diagram illustrates the flow paths of water in the Melamchi sub-basin until its confluence with the Indrawati downstream. Arrows in the figure 1 show points of diversion and direction of flows. There are considerable numbers of small-scale diversions in the area as shown in the figure by their local name, whether it is a canal diversion, or mill diversion, or *Ghatta* diversion, and so on.

(Figure 1 after this)

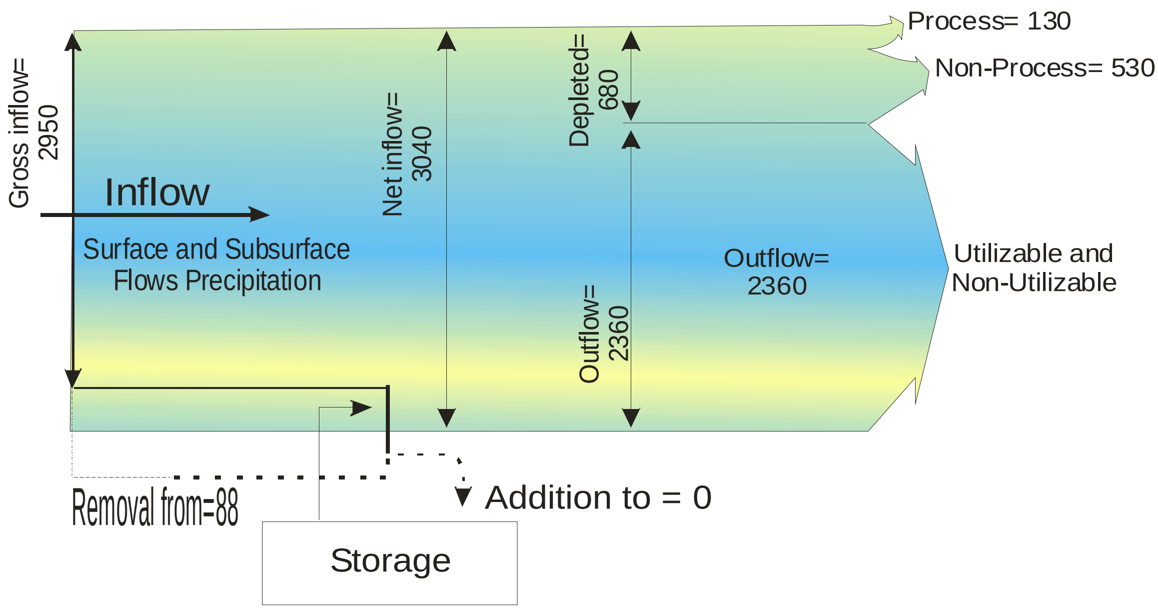
Figure 1 Flow Diagram of Melamchi river showing the water transfer project intake, Nepal.



Note: Ghatta – Traditional water mill used for milling grains,
Water Mill – Improved turbine type water mill used for several purposes including milling grains,
IP – Irrigation Project, (P) – Planned, (O) – Ongoing & HP – Hydro Power

The water-balance study conducted at the Indrawati river basin indicates that only a small portion of the available water is used within the basin, and a relatively large portion of water flows out of the Indrawati basin as river outflows (Mishra 2000). The detailed results of water accounting exercises are shown in the standard water accounting finger diagram in figure 2. Considering the level of annual water availability and the present water uses, the Indrawati basin is a huge water surplus basin. However, the higher seasonal fluctuation of river flow is one of the major problems for management and efficient allocation of water in the basin.

Figure 2. Finger diagram showing summary of water account result in the Indrawati river basin for dry year of 1979 (unit in million cubic meter).



Note: There is very little depletion of water by crop evapotranspiration (process depletion) relative to outflow (most of which is used downstream in the greater Ganges basin) and non-process uses such as forest evapotranspiration.

As shown in the figure 2, even in one of the driest year (1979) over the last 20 years, an average of 2,300 million cubic meters (MCM) of water flowed out of the Indrawati basin. The utilizable outflows (river runoff) take place in the river throughout the year, therefore, the Indrawati (also the Melamchi river) is an “open basin.” Based on the annual availability of water, the proposed level of water diversion (62 million M^3/year) by the Melamchi project would probably not even be detected downstream. In an average year, only about 23 percent of the available water in the basin depletes, whereas only 4% is process-consumed (for crops ET requirement), and the rest of the depletion is for forests and non-process depletion (for forests, shrub and barren land). The Indrawati river joins the Sunkoshi river downstream, which itself is already a huge water-surplus basin. This basin in fact stretches much longer, and eventually supplies water to the larger Ganga basin in the south. Even water transferred to Kathmandu's Bagmati basin, but not depleted there, will eventually reach the Larger Ganga basin, and ultimately drain to the Bay of Bengal.

Availability of suitable flat land for farming is a more crucial factor for crop production in the basin than the availability of irrigation water per se. This fact has large implications for assessing the present opportunity costs of the transferred water in the water-supplying basin, equitable sharing of water resources (benefits) across the basins, balanced regional development, benefits-sharing and interbasin solidarity, and so on. The level of present water uses determines nature and scale of project compensation, and the nature and structures of water rights[10] attached with each of these water uses.

Spring water and water from relatively inaccessible tributaries in the upper catchment is used for drinking purposes. Hence, the water project should not have any major adverse impact on the drinking water requirements of the Melamchi basin community[12]. This will, to some extent, minimize one of the potential social concerns and ethical issues (and human rights issues) involved in relation to the water diversion project, if the other welfare losses of the basin communities are adequately and fairly compensated by the project authority. However, there are other pertinent issues, like equity and social justice over resources use (and benefits sharing) across the basin communities, that also need to be properly taken into account while carrying out such a scale of water transfer across sectors and across basins.

4. The project impacts

The Melamchi water diversion project needs to be assessed based on the social obligation for the provision of drinking water to urban areas and the water security to the urban poor, as well as, the provision to share the benefits (costs) created by the project with the basin of water origin, and with rest of the society. This also includes equity across the water uses and other resources use in between the water sharing basins. The Indrawati river basin community is already a resource poor community

[10] The nature and structures of water rights issues in planning of an intersectoral water reallocation decision is very critical one, however, a limited scope of the paper at this stage precludes us to discuss all these equity related issues here. A more detailed on water rights issues on this topic can be found in this volume in Meinzen-Dick and Pradhan, 2002 (page…?????).

[12] That means the water diversion scheme at least will not impose any survival threat to water supplying basin communities.

compared to the Kathmandu city. In this context, the project impacts should be assessed from different perspectives, e.g., economics, social, social justice over resources in a society. Benefits sharing and social justice on use of water resources are central issues in relation to the Melamchi water transfer project, as well as to other intersectoral water transfer decisions in South Asia.

Some of the major hydrological and socioeconomic consequences of Melamchi project are summarized below.

Hydrological consequence of water diversion

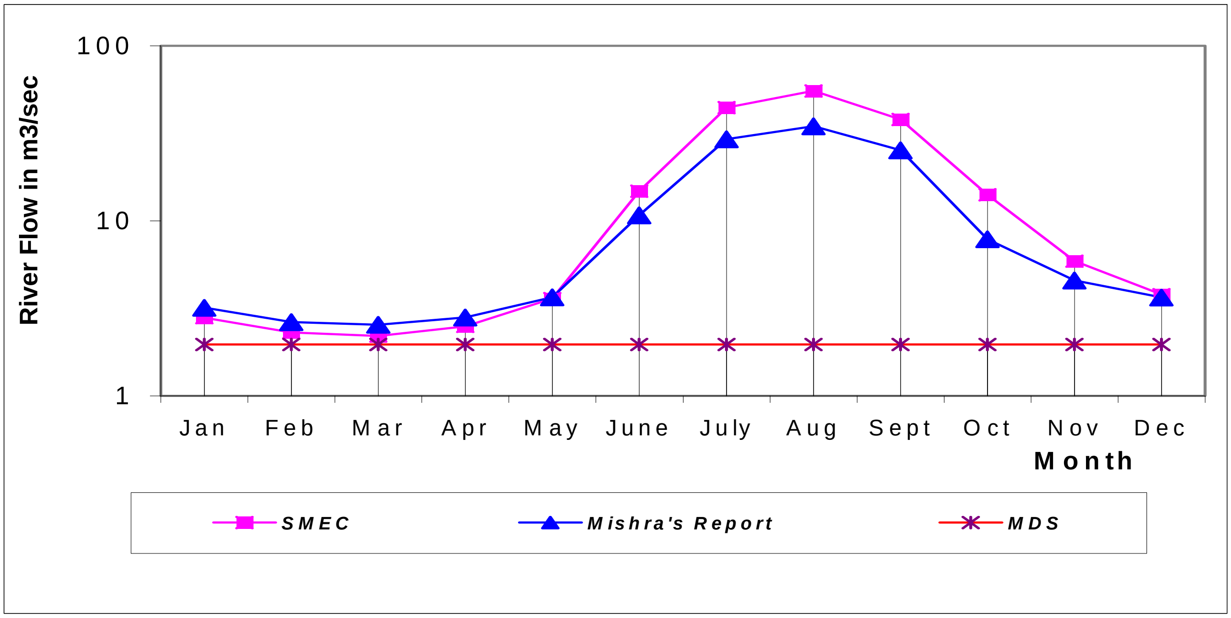
The first stage of the Melamchi project is designed to divert 170 million liters per day (170,000 m^3/day) of water out of the Melamchi river basin. In the second and third stages, there is a plan to supplement an additional 340 MLD (in total of 5.91M^3/sec) of water to the city by diverting it from Yangri and Larke tributaries of the Indrawati river to the same project intake and tunnel (MWSB 2000a).

The water accounting study in the Melamchi river shows that the proposed water diversion is less than 10% of annual average of the existing total river outflows (Mishra, 2000 and Bhattarai, et al, 2002). On average, there may not be any major hydrological adverse consequence in the Indrawati river basin at this level of water transfer out of the basin (details in Mishra 2000 and in Bhattarai, et al., 2002). However, there is a greater temporal variation of river flow within a year and between years, as well a large spatial variation at different confluences of the river basin. Comparison of average monthly flows at the Melamchi river downstream, collected from different previous studies, is presented in figure 3, and details of the river flow data are summarized in the appendix table 1.

(FIGURE 3 insert here)

On average, there is a plenty of water available in the river basin, however most of the river flows occur during a few monsoonal months. The average river flow is more than 25 m^3/second during the three months of July to September (Figure 3); whereas, the same river flow reduces to 3 M^3/sec in the month of March and April, when the impact of water scarcity is also mostly felt in the basin. The proposed water diversion (1.97 m^3/sec) by the project is slightly less than the average dry-season river flows (January-April), as shown in the figure 3. The reduced water flows after the project diversion would be, however, mostly confined to within a 1–2 km of the river stretch immediately downstream of the project intake site; two kilometers later on, other smaller tributaries join the Melamchi river (figure 1) providing more water and limiting the affect of the diversion.

Figure 3 Average monthly river flows and the proposed Melamchi water diversion[14] (in m^3/sec).



Note: From December to January, the proportion of water diversions to the Melamchi flow at the diversion point is large. In other months, the diverted proportion represents only a small fraction of Melamchi flows.

The households located immediately below the project diversion point will be the most adversely affected by the project water diversion. They may have to adjust some of their future water use activities during January to May. The equity over resources use almost entirely depends upon how effectively the project can compensate[15] these project adversely affected communities and households. According to the Melamchi project plan, the project is designed to release 0.4 m^3/s of water as a "minimum river flow," even during the dry season, to maintain the environmental and aquatic ecosystem[16] in the river (MWSB, 2000a; and IUCN, 1999). The project has, in fact, met the donor requirements for environmental and social impacts, and infrastructural project-financing guidelines, of several donors including the Asian Development Bank (ADB), the World Bank, and other bilateral donors (details in MWSB, 2000a).

[14] SMEC= SMEC, 1991; MDS= Melamchi Water Supply Diversion (MWSB, 2000); and Mishra's Report = Mishara, 2000. Details results on water accounting in the Melamchi river are in Mishra, 2000; and in Bhattarai, et al., 2002.

[15] The past record of infrastructure project related compensation distribution programs in Nepal is not good, more detailed discussions on this topic are found in Dixit (2000) and Gyawali (2001).

[16] Because of the limited scope of the study, we have only covered here the social and economic consequences of the water transfer. In the past, several EIA studies of the project were carried in the past by each of donor agencies involved in the project financing, and most recently another one EIA study by IUCN (1999).

Institutions and Institutional changes.

The supply of adequate drinking water to Kathmandu city, diverting it from the Melamchi river, has been one of the major public policy issues in Nepal for the past more than 15 years. However, the project funding was a major hurdle for Government of Nepal to initiate it alone, which needs almost half of the annual budget of the country. Due to the involvement of several external donors, coordination of the external funding itself is a major task. More important, this level of external financing requires a strong commitment by Nepal government and willingness to comply with the several requirements and conditions on institutional reforms attached with the external borrowing.

There is a prerequisite attached to the project funding by multilateral agencies[17] to change the country's water acts and to facilitate the involvement of private sectors in the management of the Kathmandu city water supply and distribution system. This is planned to be carried out through privatization of the government-owned city's water distribution agency. Other major institutional reforms or prerequisites for external donor financing of the project include: cost recovery, at least of the external debt recovery from the project beneficiaries; due compensation given to those adversely affected communities of the project, involvement of local stakeholders (NGOs) in project implementation; and formation of an independent water service fees assessment regulatory board.

The government has already enacted a legislation towards privatization[18] of Kathmandu water distribution system, but the privatization process is not moving ahead as planned. There is a lukewarm response even from the private sector to participate in this process due to unstable political governance, instability in the policies and programs of the government over the past few years, and due to recent deteriorating law and order situation. In fact, the city water supply system, after the implementation of the Melamchi water transfer project, is planned as a public-private-participation (PPP) type of a project with a provision to establishment of an independent regulatory body for setting water-services fees. This facilitates, and also provides incentives, for privatization[19]of service-delivery systems, independent of governmental interferences on setting the water fees. These are new initiatives and institutions innovations in city water

[17] One of the project funding criteria is that the project intake and tunnel construction works would not be started until the Govt. of Nepal will privatize the water distribution system in Nepal and the finalization of the project compensation scheme for the local community affected by the project work.

[18] At present, one act in relation to privatization of the Kathmandu water service system is in consideration with the national parliament since early 2001.

[19] Equity dimension on privatization of city drinking water system is an important issue here, as also pointed by the anonymous reviewer of this paper earlier. However, the limited scope of the paper precludes us to cover all these issues in single study. The equity aspect of this process also depends upon how the water-service will be improved, and water rates will be set up in the future; and access to water among the city's lower income households.

distribution system in Nepal that will most likely to be followed also in the other urban water distribution systems, and future water sector project-financing process in Nepal.

The project is planned to recover 50% of the project investment costs, and full recovery of the payment of the external debt service, through the increased water service revenues collected from the city residents (MWSB, 2000a), also the major project beneficiaries. The independent water fees assessment regulatory body is supposed to ensure the cost recovery objective of the project by raising the water service fee from US$ 0.11/M^3 at present to US$0.33/$M^3$ by 2007/8, when the Melamchi water arrives in the city distribution network. To avoid any abrupt rise in the drinking water tariff, and to minimize public criticism against the privatization of the distribution systems, there is a plan first to privatize the city water distribution system and to improve the reliability of city water distribution services with rehabilitation of some of the distribution network; and then to raise the water service fee gradually as the city water services improve over the coming years. However, there is a considerable level of skepticisms among the water professionals in Nepal whether the Kathmandu residents would be willing to pay this three-fold increase on water service fees[20], and the government has the willingness and capability of changing all these institutions, and enforcing new rules and regulations.

Moreover, one of the recent studies on willingness to pay of the Kathmandu city residents for the piped supply water has reported that the urban households in certain locations (about 20 to 40% of the sample surveyed households) of the city are willing to pay about US$ 0.25/M^3 for the piped-supply water, if it comes with reliable and improved services (Tiwari, 2000). Likewise, a recent study sponsored by the World Bank has shown that approximately 70% of the city population would be willingness to pay a fivefold increase in the current average water bills (that comes to close to US$8.50/househol/month) for improved water services provided by the private operator (Whittington, et al., 2002). However, there is a further need to assess in details the city residents' procurement costs for piped water in relation to the increased water fees under Melamchi water transfer project. This includes, the project implication to the water security to the urban poor households, the level of service delivery that the city residents want, and their willingness to pay for the Melamchi water and sharing the benefits (basin solidarity) with the water supplying basin communities.

5. Project financing and economics of the water transfer decision

[20] The water fee charged by the city water distribution system now is US$ 0.11/M^3. However, if we include all the opportunity costs incurred by a household due to unreliable supply, water pumping, collection and treatment costs at each household, then the real cost of water for a household now is already close to US$ 0.33/M^3. Details discussions on this issue can be found in Tiwari, 2000, and Whittington, et al., 2002.

Of the total project costs of US$464 million, about 62.5% (US$290 million) has been loaned by the Asian Development bank (ADB), the World Bank and other bilateral donors[21]. Then, bilateral donors like JICA, SIDA and NORAD have finance 12.5 % of the total project costs, and the Government of Nepal finances the remaining 25% of the project costs (MWSB 2000a and in Bhattarai et al, 2002). More than 75 % of the Melamchi project costs are planned to be spent for improving bulk water distribution, expansion, and rehabilitation of the city's already busted pipe network. In fact, less than the 25% of the total project cost is actually spent on the construction of both the project intake in the Melamchi river and the tunnel in the high mountain region (MWSB 2000a).

Project benefits

The project feasibility study shows that the Financial Internal Rate of Return (FIRR) of the Melamchi project is about 4.7%, however, the Economic Internal Rate of Return (EIRR) of the project is estimated to be about 13.5% during the first phase of the project. The EIRR will be increased to 15.3% when additional water will be diverted to the same project tunnel from nearby two tributaries, Yangri and Larke (MWSB 2000a).

A preliminary assessment of the total economic benefits of the Melamchi water diversion project shows that there will be a considerable level of aggregate level economic benefits generated by the project, but accrued to the national accounts and realized by the urban sector residents. For example, the annual transfer of 62 million cubic meters of water (@ 1.97M^3/sec) to the city during the first phase of the project is worth of about US $18 million[22] per annum, when the water rate in the city will be raised to Rs. per 24 per 1,000 liters (US$.33/$M^3$) by 2008. This is in assumption of 10 % of distribution losses of Melamchi water in the city water supply network. Moreover, when the project starts to operating on full capacity, and water transferred increases to 3 times than what is planned in the first phase (i.e., 0.5 million cubic meters per day), then the gross revenue from the project diverted water, additional water revenue generated because of the project water diversion, will be approximately US$54 million/year.[23]. This level

[21] Here, the Nepal government's experience in negotiating with several multilateral and bilateral donors together in this project, which lasted more than a decade, could be a very valuable information base, and a crucial experience for any future large-scale water-sector infrastructural projects planning, financing, and negotiations with other donors.
[22]This estimation is done @ of US$1=NRS. 75 equivalent. If we assume project benefits only for the six months of dry season, from January to June, then the project gross revenue will be US$9 million per year.
[23] These economics of the project value added are estimated by the authors based on the projected water diversion scheme and the service charge that is assumed to be set by the city water authority as agreed in the project financing condition set by the donors funding the project. The estimation is done assuming that the water services rate in Nepali Rs is maintained in the future at the same constant US$ value over the time

of project benefits are direct economic benefits, estimated without considering saving on opportunity costs of the city residents. The total economic benefits generated by the project including secondary benefits of improved water and sanitary supply, however, would be much higher than the financial rate of returns estimated in the project feasibility report[24]. Of course, achieving this benefit assumes adequate operation and maintenance dependent on the efficiency management of the city water distribution system.

The poor households in the Kathmandu city are now forced to bear more costs of the reduced supply of drinking water than the better-off households. Some of the recent surveys[25] on the city water supply have revealed that poor and marginal households are currently paying 2.5 times more for an incremental additional cubic meter of water from the public drinking water-distribution system than what the relatively well-off city residents are paying for (The Rising Nepal- a daily newspaper, July 26, 2000). Those with private drinking water connections have to pay only Nepali Rs. 4 per additional cubic meter after crossing the household's minimum limit of 10 M^3/per month, whereas, those with shared connections- mostly with the marginal income households- have to pay more than NRs. 10 per cubic meter of water for the additional quantity of water (MWSB, 2000a). Therefore, the present system of water service rate penalizes more to the poor and marginal households, who mostly depend upon the shared connection of tap water.

Furthermore, sale of water from tankers is already in place in the city, both by the public agency and by the private sector (private vendor). The price of water from the public-sector tanker during the dry season (December to June) is NRs. 150 to 180 per cubic meter of water depending on the size of the tanker (i.e., US$ 2 to 2.4 per cubic meter of water). The water rate from the private-sector tanker is, however, about 25 to 30% higher that that of the public sector water tanker (author's communication with the tankers supplying water in the city). In this context, US$1/ M^3 can be safely considered here as the real opportunity costs[26] of the bulk drinking water supply in the Kathmandu city during the non-monsoonal period, as that of half of the price of the tanker supply water. Then, the total economic benefits of the Melamchi project, for 8 months of the non-monsoonal season of November to June, will be about US$37 million per annum during the first phase of the project. This will, however, be increased to about US$ 111

[24] These opportunity costs involves, saving of time of the urban residents, reduction of costs on fetching water, saving on the cost of pumping groundwater, saving of energy in pumping and carrying water, saving in storing and saving in the costs on treatment of water to the city households (private costs).

[25] This survey on the city water uses and service fee structures was done by Lumanthas Support Groups for Shelter, Nepal water for Health, and Water Aid. Brief news item on findings of this survey was published in the Rising Nepal- a national daily newspaper in Nepal, July 26th, 20000).

[26] When more water is available from the Melamchi project, then the marginal price of water in the city, even for the tanker supply water, falls. Therefore, only US$1 per cubic meter of water is set here as the economic benefits of the water supplied by the Melamchi project, in terms of real opportunity costs of the bulk water supply in the city.

million/per year[27] after 2015 when the project (tunnel) is operating at its full capacity (i.e., 5.9 M^3/sec, or 510,600 M^3/day). This level of project benefit (direct tangible benefit) realized by the city residents in terms of opportunity cots is realistic one when we include all the present opportunity costs of procuring piped supplied water in the city (Tiwari, 2000; and Whittington, et al., 2002), and given the rising demands for water in the city because of the urbanization pressure.

Project adverse impacts

Despite the high level of project aggregate benefits, there are also significant level of opportunity costs imposed by the project in the Melamchi basin in terms of loss of opportunity of agricultural production, loss of employment and loss of future opportunity for development of other rural enterprises based on water-uses. There is also a serious inequity consequence of water transfer decisions; since the project benefits are mostly obtained by the Kathmandu city residents, while the opportunity costs of the water diversion would be mostly borne by the rural mountain community of the Melamchi basin, which is already a much marginalized and resource poor community compared to Kathmandu city residents. The effectiveness of the intersectoral water diversion decisions therefore needs to be assessed based on how effectively the marginal households and the project-displaced households (communities) in the basin of water origin (Melamchi basin) would be compensated for their livelihood (welfare) losses imposed upon them because of the water diversion by the project.

All of these opportunity costs of the project, both present and future losses of water-use options in the Melamchi basin, need to be assessed while evaluating the net project impacts in the basin of water origin. Estimation of all these costs and benefits (both temporary and long-term costs) is, however, beyond the scope[29] of this study. Some of the temporary economic and social costs that will be imposed in the Melamchi basin by the project are: influx of large number of people to the project area during construction phase, disturbances to the local people during the construction period, health hazard due to the blasting and dusts from the construction work, temporary displacement of people, and temporary

[27] The project benefits are estimated by multiplying 111 millions M^3 per year (assuming for 8 month of dry season and distribution loss of 10 %) of water diversion by US$1/$M^3$; which is equal to US$111 millions per annum (for 8 month in year). This level of project benefits is consistent with considering present level of acute water scarcity in the city and when we include all the private costs on procuring drinking water; as also supported by the recent household's level studies on willingness to pay for piped supply water in the Kathmandu city by Tiwari (2000) and Whittigton, et al., (2002).

[29] Given the data collected at this stage, we cannot provide detailed costs estimates for all the direct and indirect losses (and opportunity costs) imposed by the project in the basin of water origin.

acquisition of 60 hectare of agricultural land (IUCN, 1999). The large volume of soils and gravels disposal during the project construction may degrade the local watershed and negatively affect to the local community.

The major permanent socioeconomic costs (direct and tangible costs) that would be imposed by the project in the basin of water origin are the loss of productive assets due to permanent acquisition of 80 ha of agricultural land by the project, and displacement of about 25 households from their community (Pant and Bhattarai, 2001). Some of these costs would, however, be compensated under the existing project compensation plan. In addition, agricultural production of about 110 hectare of spring paddy and nearly 15 traditional water mills (Ghatta) along the Melamchi *Khola* are likely to be adversely affected during February to May due to the reduced flow in the Melamchi river after the project water diversion.

The opportunity costs imposed to the Melamchi basin because of loss of income from spring paddy production is estimated here, although with limited information. The gross returns from one Ropani (0.05ha) of spring paddy is about Rs. 1320 (details break down are given in appendix table 2), which is equivalent to US$350/ha.[30] In the Melamchi basin as a whole, total loss of spring paddy (110 ha) would be about US$39,000 per year[31]. This is the direct economic loss caused by the project, if the farmers there would not grow any other spring crops on110 ha of croplands due to acute water scarcity. In addition, there will also be losses of agricultural food production, deteriorated food security; and loss of employment and of rural livelihoods of the community, if other employment substitutions and rehabilitation programs are not timely provided to the affected communities.

In the case of project adverse impact on the traditional water mill owners (*Ghatta* owners), who are relatively the poorest members in the community, it is likely that their concerns will be heard at the last. The project most likely may lead their displacement from the present activities, and/or, their migration to other nearby villages, if the project rehabilitation program does not provide timely consideration to their needs and requirements.

6. Project compensations

Project compensation, in principle, is given to mitigate the loss caused by the external intervention (project) to the existing right holders of the resources. Or, it is given for the exchange of right to use the

[30] 1 hectare = 20 Ropani of croplands; and the US$ is estimated at exchange rate of US$1=Nepali Rs.75 (in 2000).

resource by the project agency providing the compensation with a system of formal rights (e.g., land or water rights). Providing a compensation package to the right holders for their loss is universally accepted, and most of the compensation schemes of infrastructural development projects are designed to address this concern. Nevertheless, distribution of compensation is always a tricky issue, it depends upon the quality of institutions involved, and governance of the agency involved in the task. In the case of intersectoral (interbasin) water transfer project, the compensation should consider existing right holder of water and land resources in the water-supplying basin who are adversely affected by the project. Therefore, water rights (property rights) issues are intrinsically embedded with issue on project compensation schemes.

Moreover, the project compensation based on holder of formal resource rights (water rights) also may not sufficiently address the externality and indirect effects such as third party loss due to water transfer out of the basin. It may not also address the losses suffered by those who make an earning from the property of other right holders, such as, tenant farmers. In case of the Melamchi project, the compensation package will not provide any benefit to those who are renting land for cultivation; this land will be acquired by the project but these tenant farmers will lose their source of livelihoods. Therefore, the land rights, and even water rights, based compensation mechanism needs to address these issues in a broader perspective of resource use issues in a society, and the rural livelihoods in the basin community supplying water.

The project compensation schemes followed in the Melamchi project, as well as in other infrastructure projects in Nepal in the past, are based on the land rights, and/or, compensation that is based on land based property losses caused by the external intervention. In the absence of clear water rights delineated to the small holders water users in the basin of water origin, such as, *Ghatta* owners (traditional water mill owners); it is less likely that these *Ghatta* owners will be fairly and duly compensated for the loss of their rural livelihoods caused by the water diversion. Despite of a huge scale of aggregate level benefits created by the project (to the national account), the rural livelihoods and occupations of few households (about 75 households)[32] already a poor and marginal section of the community are at stake. These 75 households and about 15 Ghatta owners in the Melamchi basin may end up bearing the entire social and opportunity costs of the water transfer decision, if well-constructed project rehabilitation programs are not timely implemented there to mitigate these project related adverse impacts. This is also important considering the poor track record of Nepal government agencies on distribution of project compensation to the

[31] Some of these crop fields may be, however, shifted from Paddy to less water requiring crops, such as, potato, wheat, or maize, during the spring season.

previous project displaced households (detailed discussions on this issue are given in Dixit, 1994 and Gyawali, 2001).

In principle, some of these costs imposed by the project could be potentially mitigated by providing due and fair manner of project compensation benefits to the project adversely affected households. Initiation of effective rehabilitation programs and other employment opportunities to the project affected households would potentially provide them a better rural livelihood opportunity. This may provide them the required incentives to remain in the same community, which would avoid the pain of forced displacement by the project, and disruption of their livelihoods. Therefore, the project compensation scheme and the way the project compensation and rehabilitation programs would be designed and implemented in the water supplying communities are very critical issues for mitigating the project adverse impacts, and/or to minimize the project adversaries, in the basin of water origin. The existing project compensation scheme of Melamchi project needs to modify to address all of these concerns.

The Melamchi project compensation scheme has a plan to spend about US$18.5 million for the general welfare improvement activities in the Melamchi basin, as a compensation package to mitigate some of the adverse economic, social and environmental effects imposed by the water-transfer project[33]. The two major components of the Melamchi project compensation package are: a. Resettlement Action Plans (RAP), with a budget of US$15 million; and b. Social Upliftment Programs (SUP), with a budget of US$3.5 million (MWSB, 2000a; and 2000b).

The Resettlement Action Plan (RAP) is designed for the land acquisition, resettlement of the households and communities displaced by the project, and for provision of local infrastructure. This includes a connection road, a school and a hospital for the local communities. Recently, the Melamchi Project Compensation Fixation Committee (CFC) at the Sindhupalchowk district has fixed the project compensation criteria, and it has decided to pay 10 times more for irrigated farmland, and 7 times more for the unirrigated upland, than the official land price normally set for the locality by the concerned District Land Revenue Office. This comes to around NRs. 250,000 to 450,000 for 500 square meters of cropland (per Ropanie[34] of land) in the Melamchi basin area (project related communication published in Kathmandu Post December 22, 2001). Moreover, there are some concerns among the local communities

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[32] About 25 households would be permanently displaced from their present location due to construction work and another about 50 household sin the Melamchi basin would be most adversely affected during the dry seasons due to less river flows after the project diversion of water out of the basin

[33] This comes to about 4 percent of the total project costs (MWSP). Considering the current development stage and socioeconomic activities in the Melamchi basin area, this level of compensation package represents a considerable sum.

about the process of determining land prices for acquisition, and the bureaucratic process[35] adopted here. The land prices set at the Land Revenue Office vary within the district, by market location and by several other characteristics, and not only by the access to irrigation factor alone.

Under the Social Upliftment Programs (SUPs), there is a plan to spend US$3.3 million in the Melamchi basin communities for poverty reduction and social and rural development sectoral programs. The SUP scheme is planned to operate at least for 10 years in the project-affected 14 villages communities (VDCs) of Melamchi basin implemented through the local District Development Committee; this program is also supported by the UNDP program in Nepal. The SUP program will also get part of funding from the additional water services fee collected by the Kathmandu city water distribution system in the post-construction stage (@ of NRs. 0.25/ M^3 of water, which comes to about Nepali Rs.15 million/year in equivalent of 2000 price level). This is equivalent to about one percent of the total incremental benefits created by the project (in terms of water revenue collection), which is much less than the demand of the Melamchi basin community for benefits sharing. During the project consultation meetings, the Melamchi basin communities have demanded that they should get about 5% of revenue collected from city water distribution system from use of water transferred out of their basin (Devkota and Bhattarai, 2001 and Bhattarai et al., 2002).

In spite of the apparently generous program, there was initial discontent amongst many of the basin residents. From interviews, our study showed that residents were ill-informed about the project, its likely hydrologic and socio-economic impacts, and the compensation package. There was little negotiation on issues of compensation, rather the package was developed by outsiders and offered to stakeholders. This is in contrast to situations where there are well-recognized water rights, and rights holders are involved in negotiations and in deriving what they consider a fair settlement.

6. Conclusions and implications

In the context of increasing urban water scarcity and the increased pressure for intersectoral reallocation of water, the Melamchi water transfer project presents a classic case of demand for an intersectoral reallocation of water with acute water scarcity in the urban city, Kathmandu, and abundance of water in the nearby basin just a few kilometers away from the city. Despite generating huge aggregate benefits to the urban society, the intersectoral water transfer projects, from rural to urban, are also not free from

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[34] 1 ha = 20 Ropanies. Thus, if the land price for land acquisition is set roughly @ NRs 250,00 per Ropanies, then, this comes to US$ 66,660 per hectare (@US$ 1 = NRs 75).

controversies because of the level of economic, social and environmental disruptions caused in the basin of water origin. Such intersectoral water transfer projects also produce differential impacts across the sectors and across the basins. In the case of Melamchi project, the benefits are mostly captured by the Kathmandu city residents in terms of better availability of drinking water and improved sanitation services, while the opportunity costs of the water transfer decision have to be borne by the upper catchment basin community. The Melamchi basin community is already a resource poor region deprived of other development opportunities as compared to Kathmandu city residents. In this context, the process, nature of negotiation strategies followed between the two basin communities, and scale of compensation benefits agreed upon are critical components for evaluation of the effectiveness of the water transfer project. Some of these issues discussed here are also equally relevant to other future intersectoral water transfer activities in the region.

Some of major shortcomings of the Melamchi water transfer project are:

- Inadequate involvement of local stakeholders (both formal and informal institutions) during the project planning; the adversaries and criticisms against the project could be avoided to great extent by timely involvement of the local stakeholders (stakeholder consultations) and taking them on board while project planning and implementation in the Melamchi basin.
- The existing project compensation package is not specific and targeted to the needs of households adversely affected by the project, such as, *Ghatta* owners, tenant farmers, and irrigation systems immediately downstream of the river diversion; they are the ones to suffer most during the lean season of water availability in the basin (IUCN, 1999; Devkota and Bhattarai 2001). Rather, the existing project compensation package gives more emphasis to the construction of local public infrastructures, such as, school, hospital, road, etc., which will not be utilized by the project-displaced households. They will be already displaced from the Melamchi basin by the time these infrastructures will be built there.
- Despite generating huge aggregate level benefits by the project at the national account, there is not a clear cut benefits sharing mechanism in place and a legal guaranty to transfer a portion of the water revenue collected in the city, due to the water transferred, back to the basin of water origin. A revenue sharing mechanism based on incremental value generated by the project, rather than the ad hock nature created project compensation scheme based on mercy of the central agency, is more equitable, participatory, rule based, and based on principle of social justice and

[35] Details on water sector project displacement compensation followed and their major shortcomings are given in Dixit, 1994.

equity over resources use in a society. This would also be conducive to the equitable regional development of a nation and a more transparent decision.

The nature and implementation of the project compensation program is one of the critical components for equitable distributions, and uses, of the available resources in the society, and this is important also for shaping the feelings of the communities for and against the external intervention (project). To enhance the welfare of the Melamchi project displaced households (communities), of course, lots also depend upon the overall governance of the project administration while implementing the project, and materializing what are stated in the project document. In addition, despite the appearance of an efficient and beneficial project at the project formulation stage, the real success of the Melamchi project is tasted only when it is implemented in practice. Therefore other equally important issues here are: project authority responsiveness to the concerns of local community, functioning of the project implementation authority, and over all effectiveness of water-sector governance in Nepal.

Water institutions for intersectoral water transfer decisions are at very infant stages in South Asia, but they are very rapidly evolving in the recent past due to increasing urban water demand from rapid pace of urbanization. Increasing drinking water scarcity in the urban areas (i.e., increased relative value of water) is one of the major stimulating forces for this recent surge in reallocation of water resources across the sectors. Therefore, some of the issues discussed and the case study findings illustrated in this study are not only confined to Melamchi project but also equally applicable to other ongoing intersectoral water transfer discussions and debates in South Asia and globally.

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Appendix Table 1: Comparison of Average Monthly Flow (in m^3/sec) at Melamchi project Intake collected from various previous studies on Melamchi Project.

Month	Sources				
	[1]BPC Hydro-Consult	[2]SMEC	[3]Mishra's Report	[4]Binnie & Partner	[5]Proposed MDS
January	3.2	2.8	3.19	2.8	1.97
February	2.7	2.3	2.64	2.5	1.97
March	2.5	2.2	2.55	2.3	1.97
April	2.8	2.5	2.81	2.6	1.97
May	3.7	3.6	3.67	3.5	1.97
June	10.2	14.8	10.77	11.0	1.97
July	27.4	44.4	29.29	30.5	1.97
August	34.4	55.3	34.79	36.7	1.97
September	24.4	38.0	25.3	26.6	1.97
October	8.2	14.1	7.85	11.3	1.97
November	4.9	5.9	4.56	5.4	1.97
December	3.7	3.8	3.65	3.7	1.97
Average	10.7	15.7	10.92	11.6	1.97

Note: (1) BPC – Butwal Power Company, Nepal (2) SMEC – Snowy Mountain Engineering Corporation, Australia. (Decide whether to include all or only Mishra and SMEC). (3) Mishra – Researcher, IWMI Nepal (4) Binnie & Partners – Int. Consultant, United Kingdom (5) Proposed MDS.

Appendix Table 2: Cost of cultivation of spring paddy (per Ropani) in the Melamchi River basin, Nepal, 2000.

S.N.	Particulars	Labor number	Value in Nepali Rs.
1	Ploughing	1 person with oxen	200.00
2	Land preparation	4 person	400.00
3	D.A.P	3 kg.	60.00
4	Urea	5 kg.	70.00
5	Seed cutting	1 person	100.00
6	Insecticides	Tentative	100.00
7	Weeding & field channel maintenance	3 person	300.00
8	Harvesting, threshing, storage	4 person	400.00
9	Seed	2.5 kg.	50.00
10	**Total production cost**		**1680.00**
11	Production & Income from 1 Ropani	200 kg of Paddy	Rs. 3000.00
12	Gross margin per Ropani of land		Rs. 1320

Source: Collected from the field observation by the researchers involved in case studies earlier (Pant and Bhattarai, 2001). Unit: 1 hectare of crop lands = 20 Ropani of lands; and US$1 = Nepali Rs. 75 in late 2000, when the survey was conducted in Nepal.