Chapter 23
A Tale of Three Himalayan Towns: Would Payment for Ecosystem Services Make Drinking Water Supply Sustainable?

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Key Messages

- Water scarcity has been increasing in Himalayan towns as natural springs are drying up.
- Investing in physical infrastructures alone does not help protect water sources that are mainly located upstream, or other watersheds.
- Incentive payment to the water source communities for protecting watersheds helps reducing conflict between water users and upstream communities. It requires an institution that plays a role of an intermediary.

23.1 Introduction

The Himalayas are known as the water towers of Asia and the source of freshwater to about a quarter (1.9 million) of the world's population (Bharti et al., 2020). Astonishingly, the Himalayan region in general, and its cities in particular, faces an acute drinking water shortage (Bhatta et al., 2018; Ojha et al., 2020; Rai et al., 2015; Tamang et al., 2020). Though the Himalayas are the source for most of the rivers in the region, in the hills and mountains the water from the rivers is largely used for generation of hydropower. As the fields and settlements at this altitude are higher than the rivers, usage for irrigation, household needs and other activities would

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require heavy investment in water infrastructure. These needs are met from drawing water from natural rainfed springs. Rapid urbanization along with climate change is causing springs to dry up resulting in water shortage in the Himalayan towns (Kattel & Nepal, 2021, Chap. 11 in this volume; Rai et al., 2019a, b; Rai and Rai, 2019; Singh & Pandey, 2020).

In Nepal, settlements in the hilly regions are searching for alternative water sources, while in the more urbanized areas of lower elevation, groundwater is being extracted for domestic and agricultural uses. Most municipalities are supplied water by the Nepal Water Supply Corporation (NWSC). However, in recent years, this system has been decentralized and since 2001 the Asian Development Bank (ADB) has supported small town drinking water supply projects in Nepal (ADB 2011). Altogether, 69 towns will have their own drinking water supply project in the three-phased ADB-supported plan.

However, all these projects, whether completed or ongoing, focus mainly on supplying water with scant attention paid to protection of the water source which is a key element of sustainability. The design of the projects indicates that the supply from existing water sources is taken as a permanent supply (Bhatta et al., 2018; Rai et al., 2017, 2018). This approach ignores future uncertainties, climate change and the role of upstream communities, all of which may affect water supply.

The communities living close to the water sources (upstream community) have a significant role in the maintenance of the water sources, and the watershed and dwindling supply may lead them to draw more heavily on the sources which downstream communities depend on currently (Rai et al., 2015, 2019a).

Existing drinking water supply projects have overlooked the role of local communities in the vicinity of the watersheds given the space for conflict between the upstream and downstream communities. Studies, however, suggest that with appropriate institutional mechanisms, upstream communities can be engaged in the drinking water supply projects through a subsidiary scheme for minimizing the conflict, while sharing water resources and also maintaining the quality and quantity of the drinking water supplied to the downstream communities (Bhatta et al., 2018).

For maintaining the quantity and quality of drinking water supply to the downstream, the upstream communities are required to change their behaviour or livelihood activities. Such changes include avoiding certain upstream activities (e.g., reducing the use of chemical fertilizer in agriculture, avoiding grazing animals near the water source) that have opportunity costs. For instance, they may have to switch from conventional farming methods to organic farming practices and regulate grazing. Therefore, the upstream community should be compensated for their efforts and the income-generating activities they would have to forgo. Without such compensation, water source communities are less likely to change their activities or behaviour resulting in the degradation of quality of water or reduction in the quantity (Kosoy et al., 2007).

In principle, as the beneficiaries of this behaviour change, water users should be required to pay compensation to the water source community (Alston et al., 2013). Such compensation, termed payment for ecosystem services (PES) is a mechanism, where beneficiaries pay for the positive externalities to the managers of the ecosystem or natural resources (Engel et al., 2008; Wunder, 2005). The payment is expected to incentivize ecosystem managers to change their behaviour and protect the water sources.

The PES scheme provides incentives to ecosystem managers most of whom are farmers to undertake conservation practices and adopt new technologies which could conserve water sources while also generating income for the farmers as co-benefits (Bulte et al., 2008). Usually, households living closer to water sources are resource-dependent with low-income, thus making their opportunity cost for participating in water source protection comparatively low. More often, these households do not even need full compensation for the costs they incur while modifying their activities and behaviour for protecting water sources. A small nudge or incentive would be enough to motivate them. Therefore, PES, which does not intend to pay the upstream communities the full costs of protecting the water sources, is a cheaper strategy for providing and improving the quality of drinking water in comparison with other available options such as purchasing water from a market or spending a considerable time to collect water from alternative sources (Rai et al., 2017).

PES can therefore improve social and environmental outcomes of the project by increasing both consumer and producer surplus and improving the management of natural resources (Choi et al., 2017; Engel et al., 2008). A meta-analysis of PES schemes indicates that watershed management was the dominant programme and was widely practiced in 62 countries in 2015 (Salzman et al., 2018).

This chapter draws lessons from three cases studies of drinking water supply projects in, Dharan sub-metropolitan City; and Dhankuta and Dasharath Chand Municipalities where the possibilities of introducing a payment for ecosystem services were examined for systemizing the water source protection (Bhatta et al., 2018; Rai et al., 2017, 2018). All three towns have an ADB-supported water supply project from new sources since the existing ones are insufficient to fulfil the increasing demand of these growing cities.

23.2 Study Sites

The study was carried out in three urban centres, where local water user committees were implementing drinking water projects since existing projects were unable to fulfil the demand of urban dwellers. Out of the three urban centres, Dharan and Dhankuta are located in eastern Nepal, while Dasharath Chand is in the far west. Ecologically, Dharan is in the foothills of the Chure hills, while Dhankuta and Dasharath Chand are in the mid-hills. In terms of population, Dharan is the largest of the three towns (27,750 households) followed by Dhankuta (3130 households) and Dasharath Chand (1,473 households). Dharan is in the downstream of the Sardukhola watershed, where water comes from the upstream; while in the case of two other municipalities, the water sources and the user communities are in different watersheds where the upstream–downstream relationship does not exist.

Due to lower elevation and larger size, Dharan has been extracting groundwater to supplement the stream water for household uses, while the other two towns are using stream water for the same purpose. Due to the activities of the upstream/water source communities, the stream water that these towns are getting is not of good quality and cannot be used for drinking without further treatment. The proposed PES schemes are to incentivise the water source communities for protecting the watersheds so that the water quality gets better and water supply does not get interrupted due to anthropogenic activities.

23.3 Water Users' Preferences

Neo-classical economic theory suggests that consumers are fully aware of their preferences and select the alternative which gives them maximum utility (Ben-Akiva & Lerman, 1985). In the context of the PES scheme, success hinges on the service users paying for the conservation activities to the extent that would incentivize the service provider communities to carry out those activities. Therefore, the design of PES scheme for water supply project should consider the provisioning of the most preferred services or services with the most preferred attributes to attract water users, while ensuring that water users contribute their maximum willingness to pay (WTP). Table 23.1 provides a summary of the most preferred attributes selected by the water users of the three schemes, during the focus groups discussion and verified by local water resource experts.

The selected attributes suggest that water users in these cities are concerned with the quality as well as the quantity of available water, the distribution system, protection of water sources, and how the payment for water sources protection will be utilized. The relative importance of these issues varies by location and the existing water storage capacity of the households. For instance, residents of Dhankuta and Dasharath Chand municipalities are concerned about the drinking water distribution system and the regularity of supply. These municipalities are semi-urban by nature, and most of the houses do not have water storage tanks. Households in these municipalities are more concerned about regular water supply each day as they do not want

Table 23.1 Attributes selected by water users

Attributes	Municipality		
	Dharan	Dhankuta	Dasharath Chand
Water quality	√		√
Water quantity	√		√
Distribution system		√	√
Protection of land from erosion	√	√	
Budget allocation for water source protection		√	

Source Bhatta et al. (2018) and Rai et al. (2017, 2018) to bear additional costs of purchasing or constructing water tanks for storing water. But in the case of Dharan, where most of the housing units have in-built water storage tanks, the main concern is the quantity/quality of water rather than the regularity.

The users also consider local conditions and the source of water supply while evaluating the water management programmes. Therefore, the selected attributes indicate that in Dharan where it is a part of the watershed, residents, have considered PES as a part of watershed management and the protection of land from erosion and water quality as two separate attributes. Dharan is one of the most affected towns by water-borne diseases due to open defecation in the upstream areas (Pant et al., 2016). The residents feel water quality can be improved through toilet construction to curb open defecation in upstream settlements, reduction in open grazing, and changes in the use of pesticides and fertilizers in the upstream farming. In addition, in Dhankuta, landslides during the rainy season affect the water quality, making protection of land from erosion and budgetary allocation for protection a key requirement. In Dasharath Chand, the water source is in the protected forest. Though the quality of water also gets affected due to sanitation and agriculture-related activities of water source households, the major concern here is that of quality, quantity and regularity of water supply with little concern about conservation of the watershed.

The selected attributes also show how consumers are concerned about the fund allocation for water source management activities. In Dhankuta, the water management committee charges each household NPR[1] 15 per month as watershed management fee, which amounts to around NPR 0.56 million per year. However, Dhankuta water users observed that the money paid to the water source community was being spent on infrastructure development, rather than water source protection. Noting that this may have negative impact on the upstream communities' willingness to undertake activities related to improving the quantity and quality of water the Dhankuta water users' main concern was the allocation of funds, particularly for water source protection. This is important since the conditionality of the PES scheme is to secure the flow of ecosystem services from the service providers (Wunder, 2005).

The preference for water source management also varies with the size of income and family. The importance given to water source management, and WTP increase with income and size of the family. However, the effect of gender on PES schemes is context specific. In Dhankuta, more Female respondents have prioritized improved watershed conditions compared to their male counterparts, while it is the opposite in Dharan and Dasharath Chand. Such context specific heterogeneity in gender response requires further examination.

[1] NPR is Nepali currency (the average exchange rate in 2018 was approximately USD 1 = NPR 108).

23.4 Water Source community's Preferences

Since PES is a voluntary agreement between water service users and providers, it is equally important to understand the preferences of the water source community (service providers) while designing a functional mechanism (Nyongesa et al. 2016). The activities identified by the water source community for watershed management should be the basis for determining the budget required to implement watershed management activities. In addition, it is also imperative to assess whether the upstream/water source community's preferences meet the expectations of water users for designing a workable PES mechanism (To et al., 2012). Therefore, the change in the behaviour or activities of the water source communities is related to the maintenance or improvement of the flow of ecosystem services (water supply) as expected by water user communities.

In all three case studies, the upstream/water source communities have identified activities that would support watershed management and also shown their willingness to participate in such activities though the type of activity has been determined by specific local contexts (Table 23.2). Most of the costs in managing the watersheds cost such as toilet construction, and providing piped water to the upstream households would be incurred as initial one-time.

Most of the identified activities are either related to addressing the land degradation due to agriculture or improving sanitation facilities in the upstream/ water source communities. In the study areas, the households in the vicinity of water sources rely heavily on conventional farming practices particularly farming on steep slopes. The farming practices are transitioning towards the use of modern inputs such as chemical fertilizers and improved seeds (Nautiyal et al., 2007). For instance, the use of chemical fertilizer has increased from 37 to 71% within five years in the upstream watershed from where Dhankuta municipality gets its drinking water. Such an increased use of chemical fertilizers around the water sources increases the chance of polluting the drinking water. Therefore, improvement in agricultural practices is one of the strategies that water source communities have proposed, which is acceptable to the water user community. Improvement of agricultural land can have a two-fold advantage—improved livelihood and better natural resource management. Climate resilient agriculture practices can contribute to livelihoods and improvement

Table 23.2 Activities proposed by water source communities

Dharan	Dhankuta	Dasharath Chand
• Grazing management • Toilet construction • Landslide protection • Agriculture improvement • Riparian buffers	• Seeds distribution • Irrigation facilities • Training programmes • Agriculture feeder roads • Land preparation	• Toilet construction • Grazing management • Off-season vegetation farming • Training on non-timber forest products collection/marketing • Provision of piped water in the village

Source Bhatta et al. (2018) and Rai et al. (2017, 2018) of water quality, while enhancing communities' resilience to climate change (Rai et al., 2019b).

Improved sanitation through toilet construction is another issue identified by the water source communities of Dharan and Dasharath Chand. In Dharan, open defecation is one of the key factors of water contamination since many upstream households do not have toilets. In Dasharath Chand municipality, local tradition prevents women from using family toilets during menstruation compelling them to go outside for defecation and urination and disposal of their used sanitary pads in streams. Similarly, grazing management is also a common issue in the watersheds of these two municipalities.

Upstream/water source households expressed concern about access to the existing community development fund as local elites often tend to control the community development funds. The situation is similar in the PES schemes too and could be counterproductive in the long -run as the marginalized communities who are excluded from access to the funds may not cooperate for maintaining and managing the watersheds (To et al., 2012). The majority of water source households in Dharan and Dhankuta prefer receiving in-kind support to cash to reduce the possibility of elite capture and potential corruption. A PES pilot project in Dasharath Chand shows that when the water source households received cash, and they established a revolving fund and made a provision to provide soft loan rather than using the fund as a grant.

23.5 PES Mechanism Design

In order to make PES financially feasible, the estimated WTP of water users should outweigh the cost of implementing water source management activities. However, the social opportunity costs of water source communities and the WTP amount are context specific. Since PES is considered as a voluntary mechanism, it is important to understand whether PES could be financially feasible at community level. If not, then it is imperative to find another way to motivate the water source community for conserving the watershed and help maintain the quality and quantity of drinking water supply.

There are three types of funding mechanisms in PES: users financed, government financed and compliance (Salzman et al., 2018). Our case studies are focussed on the users' financed PES scheme. However, the estimated WTP and water source management costs indicate that user' financed PES schemes are not financially feasible where the number of users is small (Table 23.3). In this context, small towns (water user communities) require external support from the government to make PES financially feasible. The government support could be in terms of projects rather than cash. For instance, the forest department can support reforestation activities, while the agriculture department can provide agricultural extension (training and technical) support for sustainable and environmentally friendly agricultural practices.

Table 23.3 shows annual WTP and water source management costs in three case study sites. In the case of Dhankuta, the lower limit of users' WTP is the existing

Table 23.3 Annual WTP and cost of water source management (USD)

	Dharan[a]	Dhankuta[b]	Dasharath Chand[b]
WTP of water users	80,000–100,000	5266–224,299	5119
Water source management cost	46,632–49,369	55,514	4505–10,988

Source Bhatta et al. (2018) and Rai et al. (2017, 2018)
Note 1USD = NPR 108[a] and NPR 107[b]

water source protection fee (NPR 15/household/month) and upper limit is their WTP for the improved services. However, the water users are not ready to pay additional fee unless there is an increase in the water supply. On the other hand, the water source community will not invest in watershed management because of their expectation that an increased demand for drinking water in the future would get them a better deal. There is also uncertainty regarding the expected improvement in ecosystem services from the change in land use (Mátyás & Sun, 2014). This is because climate change also affects the flow of ecosystem services (Fu et al., 2017).

This uncertainty about anticipated improvement of ecosystem services and the resulting hesitation of water users to make full payment could be a big obstacle in making an agreement between the two sides. Hence, designing a PES scheme based on the output of ecosystem services may not create a trustworthy environment between service providers and service users. Therefore, payment should be based on the input or activities carried out by water source households (Hejnowicz et al., 2014). We called these schemes as Incentive payment for ecosystem services (IPES).

In this context, a reliable institution is needed to facilitate the negotiation. In the IPES scheme, identifying the right intermediary institution at the initial stage is very crucial for building trust and confidence between service providers and service users (Corbera et al., 2009). In the study sites, the local stakeholders suggested that a tripartite institution led by the local authority of the user community is a requisite to implement the IPES scheme successfully (Bhatta et al., 2018; Rai et al., 2018). The tripartite committee—comprising of service providers, service users and the local authority could facilitate the payment from the users to the service providers and also monitor the activities of the water source community to ensure that the community carries out environment friendly activities as per the agreement (Bhatta et al., 2018). This mechanism increases the trust between ecosystem services users and service provides while improving both horizontal and vertical coordination among multiple stakeholders.

23.6 Conclusion

The three PES schemes for drinking water projects discussed in this chapter suggest that such schemes can be an effective tool in making drinking water projects sustainable where there is a clear distinction between water users and providers. For a sustainable system that avoids conflict, which may arise due to uncertainties resulting from climate change, it is suggested to provide incentive payment for the ecosystem managers based on their activities.

These cases studies clearly indicate that IPES schemes provide both immediate and long-run benefits to both sides. The immediate benefit for water users is the minimization of the potential risk of an obstruction of the water supply by the water source community. In the long-run, such a scheme contributes to uplift the livelihood of water source households through incentive payments which can be invested in income-generating activities and ensures the sustainable supply of the quality and quantity of water to water users. In addition, IPES considered in the three case studies also focuses on improving the sanitation infrastructure (toilets construction and piped water supply) in the water source community, which not only contributes to improve water quality for water users but also improves the health of water source households.

These schemes are clear examples of how IPES can be managed at the community level in a sustainable manner and also generate required resources for providing incentives to the water source community for protecting watersheds. Users' payment is sufficient to cover the IPES scheme in the area, where the size of service users is large. In the case of small communities where service users are fewer, government programmes should be designed to support watershed management activities. Similarly, the experience of these schemes suggests that designing an IPES scheme is a rigorous process as it requires information on biodiversity, land-use pattern, hydrology and economics with intensive dialogue between service providers and users. Therefore, the IPES design should be supported by technical experts (Asquith et al., 2007). The potentially high cost of this service can, however, be minimized if embedded with the initial environmental impact assessment process of the drinking water project. Based on the lessons from the three cases, we recommend designing the payment schemes based on the inputs of watershed management activities to create a trustworthy environment between service providers and consumers.

An additional aspect of IPES is the tripartite institution to implement the scheme at the community level. Since local authorities are responsible for managing drinking water projects and also for the conservation of the local environment, their leadership for coordinating local stakeholders would be readily acceptable. In addition, such a coordinating role of the local authority provides assurance of fund flow from users to service providers; and also, the implementation of environmental friendly activities in the water source area. Last but not least, IPES schemes are context specific since they rely on the preferences of service users and providers and also the hydrology of the watersheds. Therefore, carefully designing the scheme with the active involvement of three sides (local authority, service providers and service users) is a necessary condition to make an IPES scheme implementable and sustainable.

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