

Chapter 3

From Royal Canal to Neglected Canal? Changing Use and Management of a Traditional Canal Irrigation System in Peri-Urban Kathmandu Valley



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3.1 Introduction

While Nepal is the least urbanized country in South Asia, the current rate of urbanization in Kathmandu Valley, where the country's capital Kathmandu is located, is among the highest in this region (Muzzini & Aparicio, 2013). The valley population, growing at about 4.3% annually, increased by more than 499% between 1955 and 2008 (Bhattarai & Conway, 2010). It increased from 1.6 million in 2001 to more than 2.5 million in 2011 (Central Bureau of Statistics, 2001, 2012), and continues growing rapidly. This pace and intensity of urbanization and population growth cannot take place without seriously encroaching on the valley's land and water resources. Ongoing urbanization is causing land speculation, rising land prices, and radical land use changes, which also lead to a significant change in water uses and increase in water demand. Both quality and quantity of surface water and groundwater are under serious pressures, while the gap between water demand and supply continues growing (KUKL, 2017; Pandey et al., 2012; Shrestha et al., 2015).

A major aim of the research on which this chapter is based was to explore how these changes are experienced in specific water use settings in peri-urban Kathmandu Valley, and to assess their consequences for livelihoods, water rights, water access, water security, and the occurrence of water-related conflicts. Such insights can be gained from in-depth field research on major changes in use and management

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practices of key water sources and water infrastructure, in an overall governance context that is urban-biased. The stream-fed surface irrigation canals of Kathmandu Valley, with their long-established and—until recently—relatively stable water rights, provided a good setting for such research. Until urbanization of Kathmandu Valley took off in the 1980s, the management of stream-fed canal irrigation systems had been a priority of both state agencies and the population that depended on agriculture-based livelihoods. The name *rajculo* (royal canal) given to these systems expresses the historical interests of (royal) state actors in canal maintenance and management.

Mahadev Khola Rajculo is such a traditional canal irrigation system that has come under increasing pressure from urbanization. In this chapter we focus on developments around this canal, which is fed by a stream called Mahadev Khola in Dadhikot, a peri-urban village in Bhaktapur District in Kathmandu Valley.¹ This canal system is believed to have been developed around the 1670s (Adhikari, 2012). Initially run by villagers, it was managed by the Department of Irrigation from the 1950s until the early 1980s, and then handed over to a formally established water users' association (WUA) in the early 1990s. This WUA, however, did not remain active for long, with negative consequences for canal management. Meanwhile, changes like growing population, more intensive and increasingly commercial water uses, and decreasing reliability of the canal had driven those who could afford it into private investments for groundwater.

While struggles against water insecurity in agriculture and beyond are continuing, government policies have since long lost interest in action to keep peri-urban agriculture productive, and increasingly prioritize investments in urban expansion instead. We analyse interlinkages of the demographic, socio-environmental, economic and political-institutional dynamics with the changing uses and management of the canal. Further, we trace the actors' association with, or dissociation from canal uses and management through time, and what these processes mean for water access, water rights and water security. Our research shows that land use, social and institutional changes have led to a gradual weakening of canal-based water rights. Access to water from the canal is increasingly shaped by access to land in the upper reaches of the canal, to capital and technology, and to the right connections and social networks for funding and political support. These support new claims to water rights and new pragmatic practices of accessing water, rights-based or not.

This chapter is structured as follows: Sect. 3.2 provides an explanation of our research approach and methodology, and a short introduction of Kathmandu Valley and Dadhikot, the study area. In Sect. 3.3 we discuss the history of canal management and canal uses of the Mahadev Khola Rajculo, with a focus on the last decades. In Sect. 3.4 we reflect on the implications of these changes in terms of changing water access, water rights, water security and water-related conflict, in a context of national urban policies that formally aim to conserve agricultural land and

¹Administratively, Kathmandu Valley includes three districts: Kathmandu, Lalitpur and Bhaktapur. In the sixteenth century, Bhaktapur was the capital of the Kathmandu Valley Kingdom. The king constructed the irrigation canal to bring in water for drinking and irrigation (Pradhan, 2012).

livelihoods in this rapidly urbanizing valley but hardly contribute to their institutional support in practice. The chapter ends with a short conclusion highlighting the existing gaps in irrigation management in relation to the policy aim and practical need of conserving agricultural land.

3.2 Research Approach, Methodology and Study Area

3.2.1 Research Approach and Methodology

This study was inspired by the question how urbanization and associated changes in peri-urban spaces (see Simon, 2008; Leaf, 2011; see Chap. 1) influence the use, management and control of surface and groundwater in Kathmandu Valley. As shown by earlier studies, the rapid transformations caused by urbanization put enormous pressures on peri-urban spaces: growing settlements and population densities, migration and diversification of economic activities, emerging land markets, and changing land and water uses, to mention some. These often take place in increasingly complex socio-political and institutional environments (Butterworth et al., 2007; Simon, 2008; for South Asia, see Narain & Prakash, 2016). Recent changes in the use, management and governance of water in Kathmandu Valley provide a clear example of these processes. Urbanization and the expansion of water-based livelihoods bring in new water uses and users, and new ways of governing land and water, related to new development agendas and policy priorities. These are deeply influencing the, until some decades ago, relatively stable and ordered land and water access, rights, and use practices in the valley. They also lead to an ongoing erosion of local practices of negotiating water rights and solving water conflicts (see Upreti, 2000).

We approach these changes around the Mahadev Khola Rajkulo through a conceptual focus on water rights, approached from a legal anthropological property perspective (von Benda-Beckmann et al., 2006; see Roth et al., 2005, 2015) and access theory (Ribot & Peluso, 2003). In this approach, water rights are more than just the right to a share of water. A water right basically concerns “bundles” of rights and obligations pertaining to water and related resources (e.g. infrastructure) (von Benda-Beckmann et al., 2006; Roth et al., 2015). In canal irrigation, such bundles of rights and obligations have been conceptualized as “hydraulic property” (Coward, 1986; Coward & Levine, 1987). Following Ribot and Peluso’s (2003) theorization of access—in relation to property—access is defined as “the ability to benefit” from material or immaterial resources such as water or social networks and relationships. As we will show, changing land and water uses, water rights and access, and organizational practices of canal management and maintenance of the Mahadev Khola Rajkulo are closely related. It is especially the intricate interplay between rights and access—not only to land and water, but also to funding, markets, infrastructure, technology etc.—in wider processes of socio-technical, demographic, economic

and institutional change that deeply influences people's experiences of water (in-) security (Lankford et al., 2013; Zeitoun et al., 2013) and may also increase the probability of water-related conflicts (Shrestha et al., 2018).

As our aim was to understand how the use and management of an old irrigation canal system changed in the context of rapid urbanization and how this relates to the changing engagements of various actors and social relations between them, we designed our study as a qualitative case study of the Mahadev Khola Rajkulo. Case studies are well-suited for this type of research, in which in-depth information on the case forms the basis for a better understanding of the wider processes and relationships that the case represents, mainly related to transformations in water rights and access, and their implications for water security and conflict in a peri-urban context (see Flyvbjerg, 2006; Yin, 2009). The chapter is based on ethnographic research, with an interdisciplinary and socio-technical focus. The fieldwork for this chapter was conducted between 2015 and 2018 by the first and third authors of this chapter.

The findings discussed in this chapter are based on open-ended and conversational interviews, informal talks and group discussions with a wide range of informants. Interviewees included 26 farmers (18 male, 8 female), in-migrants (3), members of community-based organizations (7), executive committee members of the WUA (9), many of whom were either former or present local elected representatives. Interviews were also conducted with relevant government officials at the village level (1), municipal level (4) and district level (2), as well as from the department of irrigation (4). Changes in land and water use, rights and access to canal irrigation, and the roles and responsibilities in canal management were major topics during the interaction with farmers. These were also discussed with the executive members of the WUA and of community-based organizations, many of whom were also farmers. Interactions with these groups additionally helped to reflect on the formation, functions and dysfunctioning of the WUA and the alternative canal management groups and practices that have emerged over the years. Interviews with the government officials focused on the implications of peri-urbanization on food and water security, the state-led interventions for promoting agriculture and ensuring irrigation services in peri-urban settings, and challenges in these initiatives. In addition to these interviews, observation of the encroached canal sections, the intake, deserted field office and poorly maintained and leaking canal sections provided important insights in understanding the changing canal use and management practices.

3.2.2 Kathmandu Valley, Dadhikot and Mahadev Khola Rajkulo

Kathmandu Valley is one of the most productive agricultural areas in Nepal, with yields of major food grains (rice, wheat, maize) significantly higher than national averages (HMG & USAID, 1986). Historically, the valley exemplified the only

autonomous urban system based on productive agriculture and long-distance trade in Nepal (Ministry of Urban Development, 2017). The earlier settlements in this valley were located on drier, less fertile, elevated land. The low-lying farming areas of Kathmandu Valley had an elaborate network of irrigation systems and were known for being highly productive (HMG & USAID, 1986; Pradhan & Belbase, 2018). This land use practice was based on a conscious land use strategy, intended to maximize the area of land used for agricultural purposes and to preserve fertile and irrigable agricultural land (Shrestha & Shrestha, 2009; Tiwari, 1999).

The early urban growth of Kathmandu was based on its agricultural surplus (Ministry of Urban Development, 2017). Joshi (2018) notes that the rich cultural tradition of Kathmandu Valley can be attributed to the network of irrigation systems that supported advanced and intensive agricultural activities which, in turn, sustained a highly developed urban culture. Irrigation in Kathmandu Valley was possible through stream-fed canal irrigation systems. The operation and management of many irrigation canals received royal state sanction and support (Dixit, 1997). Hence these canals were called *rajkulos*, “royal canals”. Originating in the foothills, *rajkulos* are long-distance water canals, mostly built in the seventeenth century to fill up ponds, irrigate farmland along the canals, and serve settlements and their agricultural areas in the valley (GoN/NTNC, 2009; Shrestha & Shrestha, 2009). Irrigated agriculture was both a spiritual and material foundation of community life and was coupled with the *Guthi* system, a traditional socio-cultural and religious institution (Joshi, 2018).²

After the Department of Irrigation had been established in 1952, many farmer-managed irrigation systems in Kathmandu Valley were rehabilitated (Pradhan & Belbase, 2018). In the same period, urban growth outside the historic city core into the valley also started. This urban expansion gained momentum in the 1970s, as more areas were made accessible with the construction of a ring road, while establishment of industries increased employment opportunities. Urban expansion accelerated in the 1980s and 1990s, deeply transforming the rural agricultural landscape of the valley into peri-urban spaces characterized by a co-existence of agricultural and non-agricultural land and water uses, economic activities and livelihood practices.

The growth of settlements in the valley is generally spontaneous, as there is hardly any land use and other planning by government agencies (International Center for Integrated Mountain Development, 2007).³ This trend of unplanned urbanization has continued, engulfing peri-urban and rural agricultural land at an alarming rate (Ministry of Urban Development, 2017). However, although the percentage of land used for agriculture has drastically declined, thanks to its unique soil formation and topographical variation the agricultural potential of Kathmandu Valley remains considerable even today (NARC, 2006, cited in Rana et al., 2015). The Ministry of Urban Development acknowledges the need for promotion of urban

² *Guthi* is a traditional institution for collective, mainly religious and cultural, activities.

³ Implementation of various plans for urban development of Kathmandu Valley has been poor (Ministry of Urban Development/KVDA, 2015).

and peri-urban agriculture “in rooftops, vacant plots, peripheral areas of public buildings, parks, garbage landfills, etc.” to ensure food security now and in the future (Ministry of Urban Development, 2017: 34).⁴ Providing about 33% of the gross domestic product (GDP) and supporting the livelihoods of most of the population, agriculture is a mainstay of the Nepalese economy. Irrigation is crucial in maintaining and increasing agricultural production (Gautam, 2012; Pradhan & Belbase, 2018).

With an area of 6.27 km², Dadhikot⁵ is a rapidly growing peri-urban space, around 12 km east of Kathmandu. Dadhikot became part of Anantalingeswor Municipality,⁶ which merged with Suryabinayak Municipality in a restructuring of the local government in 2017 (Fig. 3.1). The annual population growth of Dadhikot

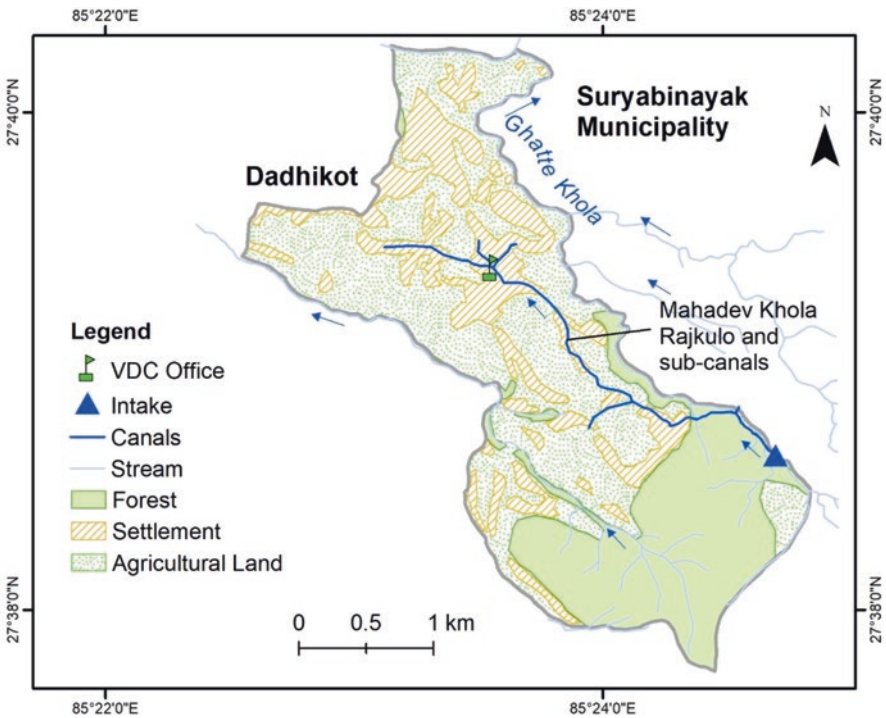


Fig. 3.1 A section of Mahadev Khola Rajkulo and sub-canals in Dadhikot

⁴Kathmandu Valley produces 4.6% of the vegetables and 3.5% of the potatoes produced in the country (Ministry of Agriculture, 2012 cited in Ministry of Urban Development, 2017).

⁵Until 2014 Dadhikot was a Village Development Committee (VDC). A VDC referred to a rural administrative unit and used to be the smallest local government unit in Nepal. Each VDC was administratively divided into 9 wards.

⁶The name “Anantalingeswor” comes from a temple believed to originate in the seventh century. With connections to the then ruling family, the area had administrative and political significance (see Shrestha, 2007).

increased from 1.17% (1981–1991) to over 6% by 2011. The built-up area has increased by over 250% between 1992 and 2010, and is expected to grow by about 110% between 2010 and 2030 (Sada et al., 2016). Nonetheless, agriculture still provides a major livelihood for many of its inhabitants. Paddy is the most common monsoon crop. In winter, many farmers have switched from wheat farming to commercial vegetable farming. Agriculture still depends on the traditional surface canal irrigation systems fed by the Mahadev Khola, a stream in Dadhikot. Mahadev Khola Rajkulo is the largest canal irrigation system in Dadhikot. Because of its reliable water flow in the past, many water mills for grinding wheat used to be operated along the canal; hence it was also called *Ghatte Kulo* (canal with water mills).

3.3 From Glorious Past to Neglected Present: The Trajectory of Mahadev Khola Rajkulo Management

3.3.1 *The Glorious Past of the Mahadev Khola Rajkulo*

The Mahadev Khola Rajkulo is believed to have been developed in the 1670s by the then king (Adhikari, 2012). Every year, farmers made a temporary intake of stones, brushwood and clay, through which water entered the earthen canal. The system was strongly associated with the socio-cultural and religious values of the kingdom. According to local farmers, a large area of land irrigated by this *rajkulo* was under *guthi* tenure.⁷ In a historical study on the Anantalingeswor area, Shrestha (2007) mentions that this ancient *guthi*, termed “*Ganesh Rajguthi*”, had royal significance and was managed by an ethnic group of Dadhikot, *Rajthala*. These *Rajthala* were relatives of the royal family of ancient Bhaktapur. With a significant political-administrative role and surrounded by highly productive land, this was a prosperous settlement.⁸ Through its control of *guthi* land, *Rajthala* was the primary group involved in the management of the canal. They cultivated the *guthi*-land, and part of the harvest was allocated for canal management. A farmer:

The harvest was annually collected in front of the temple in our village. My grandfather told me that the pile of harvest collected used to be higher than the temple, which had two storeys then.⁹

This harvest share was used, among others, to mobilize manpower for canal repair and maintenance. As the canal was of prime importance for agriculture-based livelihoods, the *guthi* institution organized rituals at a local temple, which is believed to

⁷ *Guthi* land refers to the land donated by the state or individuals for the purpose of religious or charitable institutions. *Guthi* land was exempted from tax and could not be taken back by the donors. Hence, people had a preference for *guthi* land. This community land tenure system continued even after the unification of Nepal in 1769 (Adhikari, 2008).

⁸ Earlier known as Chawadesh, this settlement is called Chitrapur (see Shrestha, 2007).

⁹ Before the earthquake in the early 1930s damaged it.

be the source of water for the Mahadev Khola, and thus the canal. In years with a delayed monsoon, special rituals for requesting rain were held.

As the earlier prosperity and political role of this settlement declined with changes in the political regime (Shrestha, 2007), the cultural practices associated with the *rajkulo* started decaying in the 1960s. A key informant: “during the inventory of landownership in the mid-1960s, many farmers claimed to be owners of the land [they worked] and thus converted *guthi* land into private land. After a few years, *guthi* and related practices were discontinued”. Yet, as canal irrigation continued to be crucial for agriculture, farmers remained widely involved in canal cleaning and maintenance. This practice of management by the farmers may also have been driven by the *Muluki Ain*¹⁰ of 1854, the first codified and written law applicable to the whole kingdom, and later amendments to it in 1952 and 1963 (Pradhan, 2000). These later versions allocated canal maintenance responsibility to tenant farmers, and even made their tenancy rights dependent on their labor and other contributions (ibid). If tenant farmers were unable to repair the canal system, the landowners often requested the government for a grant. Our informants stated that, until enactment of the Land Act of 1964, which entitled tenant farmers to half of the cultivated land, land in Dadhikot was largely owned by landowners from an adjoining settlement (Madhyapur Thimi Municipality). Farmers from Dadhikot were mostly tenants, and thus responsible for maintenance of the canal, the life-line of their agriculture-based livelihood.

3.3.2 *Government Intervention in Irrigation and Re-institutionalization of Community-Led Irrigation Management*

According to Pradhan (2000), state control of water resources has rapidly increased since the 1950s, especially since promulgation of the 1992 Water Resources Act.¹¹ Before the 1950s most regulation (in the *Muluki Ain*) focused on land tenure; while land was seen as a major revenue source, water and its regulation were seen as unimportant and left to local customary laws and uses. This changed after 1951, when public sector involvement in irrigation development started. In the 1950s, foreign aid also started entering the country, bringing about further socio-economic and legal changes. During these initial years of government intervention in irrigation, the Irrigation Department established individual offices for specific projects and took monitoring and maintenance responsibilities for completed projects (Pradhan & Belbase, 2018). The permanent dam of the Mahadev Khola Rajkulo

¹⁰The *Muluki Ain* has been adapted many times, and was recently replaced by the Civil and Criminal Codes of 2018.

¹¹A ‘revolution’ in the crucial 1950–1951 period ended the Rana autocratic regime and established parliamentary democracy under a constitutional monarchy (Pradhan, 2000).



Fig. 3.2 Dam of Mahadev Khola Rajkulo. (Photo Anushiya Shrestha)

(Fig. 3.2) was constructed in 1956 (District Irrigation Office Bhaktapur, 1996), as a result of which the command area of the canal increased.¹² Two caretakers¹³ and a supervisor, with a field office near the intake, were appointed under the responsible department for monitoring and operation of the dam and canal. They were involved in the operation of the barrage gates, canal maintenance and water tax collection.

In the late 1980s, the government introduced its Irrigation Working Policy, which emphasized participatory planning, development and management of irrigation schemes (Pradhan & Belbase, 2018).¹⁴ This new planning approach required a formally registered WUA for the construction, operation and maintenance of irrigation systems. In 1990, the multi-party system was declared. According to the farmers, the new government under the multi-party system eliminated the position of supervisor and reduced the number of appointed caretakers for Mahadev Khola Rajkulo to one. The latter provision was also slashed after 1992. In the same year, a landslide damaged the main canal at its head reach, which resulted in the complete dysfunctioning of the irrigation system for some years. As part of efforts to reconstruct it, a

¹²The new gross command area was 625 hectares and the net command area 450 hectare (District Irrigation Office, 1996), including Dadhikot and a downstream VDC.

¹³The caretakers were selected among the local farmers so that the operation, repair and maintenance of the main and the branch canals could be performed timely and through mobilization of the local farmers.

¹⁴The Irrigation Regulation and Irrigation Directives of 1988 were also brought out by the government in sequence. The Irrigation Directives provided detailed procedures for the formation of WUAs (Pradhan & Belbase, 2018).

WUA with members from Dadhikot and the downstream VDC irrigated by this Rajkulo was formed around 1994. A key-informant recalls:

after the massive landslide in 1992 we were not able to operate the canal for some years. We bitterly needed irrigation. Without irrigation, production would decrease, which could cause social problems like theft. So canal maintenance was essential. Finally, we agreed to use a temporary pipe to operate the canal. We formed a WUA and obtained NPR 800,000 from the government for the maintenance”.¹⁵ [...] Although the WUA had to actively engage in and contribute to the repair work, it was done through a contractor. A mistake was made in repairing the section, which further damaged the *rajkulo*.

This started disputes between the WUA members, with one member accusing another for intentionally causing this damage with the purpose of misusing the grant. Members of the WUA recall that, although the feasibility study of the irrigation project had been conducted, the work could not start due to the approaching local election in 1996. The newly elected local representatives claimed that they had the right to be WUA members and demanded reform of the recently established WUA. After much debate, the WUA was reformed, replacing some sitting members by elected local representatives. Debates about inclusion in and exclusion from the WUA created further internal divisions. The rehabilitation was completed amid increasing disagreements on political interests, financial mismanagement and lack of transparency related to the rehabilitation contract. Although the functioning of the canal had improved after rehabilitation, the continuing disagreements ruined the relations among WUA members; hence the WUA turned inactive soon after.

3.3.3 *Changing Water Allocation and Use in the Context of Increasing Urbanization*

Although the rehabilitation had improved irrigation services, covering the growing drinking water needs from a few traditional sources remained a daily hardship in Dadhikot. To solve this, the then elected local representatives of Dadhikot initiated a community-managed drinking water supply system in the mid-1990s. This system, based on a local spring source, started regular services via public taps, and shifted to household-connections with increasing urbanization and growing water demands. In both national and donor policies, improved drinking water (and sanitation) services were increasingly prioritized.¹⁶ Many other smaller community-level drinking water services based on local spring sources were initiated or rehabilitated soon, largely with government support. Many members of the Mahadev Khola Rajkulo WUA

¹⁵This financial assistance was under the government-supported Second Irrigation Sector Project (SISP) (District Irrigation Office, 1996), financed by the Asian Development Bank. Farmers had to contribute in cash and labor in accordance with the participatory management approach.

¹⁶The Water Resources Act (WRA) of 1992 prioritized access to drinking and domestic water over irrigation. Internationally, 1980-90 was the International Drinking Water Supply and Sanitation Decade (see Castro, 2007).

were involved as functionaries of such systems. As they started competing with each other to expand their services, an attempt to revive the WUA around 2005 failed. In the meantime, the available institutional and financial support and rapidly increasing water demands by a growing population provided further incentives for the local government and community-level water managers to expand drinking water supply services. As such initiatives competed with agricultural water use, they were seen as a potential threat by farmers of irrigated crops. According to one of them, “in the mid-2000s, efforts were made by a drinking water supply institution to tap water at the intake of the irrigation system. Farmers strongly protested this”.

Although farmers were able to resist this attempt to appropriate their water source, availability of canal water for Mahadev Khola was declining from the mid-1990s, when a permanent dam was built in the upstream village (where the Mahadev Khola originates). Traditionally, upstream villagers could only block water using brushwood (not stones), a method referred to as *syaule bandh* (brushwood dam). This practice guaranteed a sufficient water flow downstream. Irrigation management regulations restricted any construction that would reduce the share of water for downstream farmers. Earlier upstream attempts to make a permanent dam had been strongly resisted by Dadhikot farmers and the downstream village depending on Mahadev Khola Rajkulo.

However, while these downstream farmers were struggling with the consequences of the landslide that obstructed their irrigation, in the mid-1990s upstream villagers constructed their permanent dam. According to Dadhikot farmers, this was possible through the political affiliation between the chairpersons of Dadhikot and the upstream VDC. The share of water for this canal system, which was reduced by this construction, further decreased over the years with an increasing use of spring sources for drinking water supply, degradation and drying up of traditional ponds, and declining rainfall.¹⁷ With urban expansion, the commercial value of land and the number of land transactions have rapidly increased, changing land and water uses and livelihoods in this agriculture-based village. Poor canal maintenance, declining canal water availability and increasing upstream-downstream competition for scarce canal water further reduced farmer involvement in canal maintenance. Under the Local-Self Governance Act (LSGA) of 1999, the irrigation system became a responsibility of the local government as the custodian of natural resources and public infrastructure.¹⁸ At the request of the farmers, the village government provided a small annual budget for dam operation during the monsoon season and some assistance for canal cleaning and maintenance. Meanwhile, the district irrigation offices in Kathmandu Valley had been replaced by an irrigation division office. More importantly, with changes in irrigation policies, government assistance for irrigation had changed into a demand-driven approach, requiring an active WUA—which was absent in Mahadev Khola Rajkulo.

¹⁷Average annual temperature in Kathmandu Valley shows an increasing trend (0.033 °C/year), while total annual rainfall shows a decreasing trend (−5.9 mm/year) (UN-Habitat, 2015).

¹⁸The Local Government Operation Act of 2017 has been formulated under the federal system of governance.

3.3.4 *Urbanization, Declining Irrigation Service and Changing Priorities*

With an inactive WUA and decreasing water availability for irrigation, the water sharing arrangement between Dadhikot and the downstream VDC was discontinued.¹⁹ Furthermore, with a decreasing flow and increasing canal leakage, access to irrigation water for Dadhikot farmers has also declined. Year-round irrigation service nowadays has become restricted to farmers with fields near the canal intake; for the others it has become limited to the monsoon season. Even head reach farmers need to compete for a timely and equal volume of water, sometimes resulting in disputes. These escalated with the switch of winter crop from wheat for subsistence to commercial vegetable crops, an important new source of income here. This requires a regular irrigation of low intensity, increasing water competition between upstream and downstream farmers and sometimes causing conflicts. According to a farmer:

Upstream farmers grow pumpkin and cucumber for commercial supply. They only harvest these towards mid-July. If [too much] water flows into their fields, their crops will be damaged so they do not let the water go into the fields until harvesting is completed. As our fields depend on a branch canal fed with overland flow from these upstream fields, we do not get water even if it is in the canal. After harvesting, these upstream farmers are already in a rush for transplanting paddy and competing among themselves for canal water to prepare their fields. So there is little chance that we [lower-reach farmers] get canal water [even then].

Yet, farmers opine that canal water-related conflicts are fewer than in the past. A farmer from the middle-reach area:

Although not violent, minor quarrels were common in the past, particularly in the monsoon during the paddy transplanting period. In recent years, this has drastically decreased. Farmers in the middle and lower canal reaches know that upper-reach farmers will not leave water for the lower-reach farmers until they have completed their own irrigation.

This seeming contradiction—less water, but also less conflicts about water—may be explained by the fact that the decreasing reliability of the canal has set in motion a trend towards investments in technology for individualized water provision. Many farmers in the lower reaches have sunk dugwells or borewells and use groundwater for irrigation. However, lower-reach farmers stress that groundwater is not sufficient for irrigation, as they also use it as their alternative for declining drinking and domestic water services.

Yet, except for a few wealthy commercial farmers who have individually installed drip irrigation fed by their groundwater source, most farmers have to make do with limited groundwater or depend on rainfall. Thus, managerial concern for the canal continues decreasing. A former elected local representative and former WUA member:

¹⁹Farmers in Dadhikot irrigated during day-time (5 am to 5 pm), downstream village farmers during the night.

Policy is driven by the motive of urban expansion. With expanding built-up areas, people are increasingly discharging their household sewerage into the canal. We have grown up using drinking water from the canal, but now we hesitate even to put our foot in the canal. In a meeting at the municipality, I proposed to keep some hoarding boards to warn against this and stressed the need to improve canal management, but nothing has been done. It seems that they assume that [as in many other municipalities] this is a canal for now and will be a sewer in the future.

Meanwhile, some initiatives for canal maintenance have been taken with government funds. Female farmers, engaged in commercial farming through their women groups,²⁰ are maintaining small sections of a branch canal of Mahadev Khola Rajkulo through a small irrigation project under the District Agriculture Development Office (DADO). However, such activities are limited, while the thin and low-quality concrete canal lining gets quickly damaged, particularly as water flows increase during the monsoon season. While such groups are often blamed for bad repair works, women farmers' group members explain that they are required to maintain a given length of canal section and that beneficiary farmers should make a significant financial contribution to such works. However, as the farmers do not contribute, they are compelled to make do with the limited government funds, as a consequence of which the repair work cannot sustain. Other farmers argue that poor monitoring by DADO allows women farmers' group members to misuse funds. The DADO office, however, has limited human resources at the field level and lacks technical expertise regarding physical infrastructure.

Despite extensive monitoring, the maintenance supported by the district government did not sustain either. A farmer:

In 2016, when district government support was available for the canal, an ad-hoc committee was formed. Its chairperson has good political links. A check dam was constructed to protect the dam against [too strong] water flows in the monsoon. This was done under contract. In the same year, after a few days of monsoon showers, the check dam was washed away. The damage caused dissatisfaction among the farmers. Yet, in the next year the contract was again given to the same person.

Farmers tell that, with negligence in monitoring and evaluation, canal maintenance activities have actually not benefited the farmers, as the latter continue to suffer from canal leakage. In a group discussion on canal-related issues, women farmers stated:

We cleaned the canal and tried to bring water to our fields. But due to the leakage and seepage along the canal, water hardly reaches our fields. If this canal can be improved, we will have adequate water for irrigation.

Realizing the importance of repairing the dam, the canal and its operation, in 2016 the head reach farmers submitted a request at the Irrigation division office (IDO). The feasibility study conducted following this application showed that canal repair and maintenance was economically viable. However, the project was not selected

²⁰ Members of farmers' groups are entitled to various services, like training and input materials for agriculture.

for implementation. In response to queries about the reasons for this, a high-level official from the Department of Irrigation (DoI) argued:

Peri-urban areas are rapidly urbanizing, so investing in irrigation for staple food is useless. We can go for drip and sprinkler for cash crops, if there is demand and farmers are willing to contribute to the investment. Even for that, water availability is crucial. For peri-urban areas, the government will not invest if investments are high and return is low.

In addition, with the transfer towards the municipality status, expansion of roads and the Transportation Masterplan have become the focus, upgrading foot trails into motorable roads.²¹ Unlike for irrigation, as pointed out by the official, the economic return of investments in urban infrastructure (water supply and sanitation, solid waste management, and transportation) is expected to be substantial through direct income, capital gains and increases in taxes from urban residents (Ministry of Urban Development, 2017).

Investing for irrigation services in peri-urban areas is clearly low. As elaborated above, for many farmers lack of reliable irrigation services has been a major impediment to continuation and expansion of their agriculture-based livelihood. Further lack of irrigation may reduce the effectiveness of government activities to promote agriculture in urbanizing areas. An official from the District Agriculture Development Office explained:

Agricultural lands are being converted into residential plots and sold. Likewise, there are a large number of brick kilns under operation. Solving all these problems is beyond our capacity but we are promoting [peri-urban] agriculture and advocating for the same. Land in this district is highly productive and we envision developing 'model agro-farms'. While we [Agriculture Department] only have small support for irrigation, our programs such as subsidy on seeds, fertilizers, plastic sheets, tractors have direct benefits for the farmers. We also have programs to attract the youths in agriculture to generate self-employment opportunities and control their outmigration in lack of employment. These programs are under the support of the central government. This year we are promoting collection centers and have market extension programs. Until agriculture is commercialized, neither agriculture nor the country can be developed.

Urbanization has created new markets and thus stimulated commercialization of agriculture in peri-urban Kathmandu Valley. Examples are the switch towards commercial farming, particularly vegetables and floriculture that are commonly seen in areas with access to reliable irrigation. With urbanization, the commercial value of land has also skyrocketed, which has tempted many farmers to sell land (Shrestha, 2011). In Dadhikot, rising land prices and the widening of roads in an overall context of increasing land fragmentation,²² declining areas of holdings, worsening irrigation services and, consequently, decreasing crop yields, are creating an enormous incentive for farmers to sell their land. With the government-planned construction of an outer ring road passing through Dadhikot, urbanization and associated socio-environmental transformations will continue and probably intensify, while the canal and those depending on it for irrigation will lose in importance.

²¹ About 60% of the costs in existing urban areas is earmarked for upgrading and extension of roads (MoUD, 2017).

²² As a consequence of division of land between tiller and landowner, and inheritance practices.

3.4 Changing Canal Use, Rights and Access to Water, and Water Conflict

In this chapter we have shown how the Mahadev Khola Rajkulo in Dadhikot has undergone many changes in its long history, and how and why in these processes various actors associated with, and dissociated from, its use and management. Big changes in the more or less stable “traditional” socio-cultural practices of canal management started in the 1960s, and intensified under the influence of development programs from the 1980s. But the most radical changes happened since the 1990s, with the increasing pace of urbanization of Kathmandu Valley and changing developmental policies and priorities. Construction of a permanent dam in the upstream section was an outright, politically supported, denial of the existing customary water rights of farmers depending on this canal. As urbanization-driven changes in land and water uses continued, these farmers gradually lost their formerly strong and widely recognized rights and access to canal water in ever more complex ways (Fig. 3.3).

With changes towards participatory irrigation management policy, allocating management responsibilities to farmers and assuming their active participation by forming WUAs, the government has limited its own role as facilitator of irrigation systems management. In peri-urban contexts like Dadhikot, with rapidly changing land uses and increasing water competition, interests and participation in irrigation



Fig. 3.3 Diverse and changing uses of peri-urban land and water (These areas have largely turned rain-fed; see the dugwell in the middle of the field). (Photo Anushiya Shrestha)

management have been declining. Although a WUA was formed for the Mahadev Khola Rajkulo, its activities were limited to rehabilitating the irrigation system with external financial support. Similarly, activities of the local government, farmers' groups and ad-hoc committees for the canal seem to be a mere mobilization of development funds, with no significant long-term improvement of infrastructures and strengthening of institutional arrangements. Driven by the need to improve the canal system, upstream farmers attempted to form a new WUA. It could not materialize, however, because the proposed maintenance project was not selected for implementation. Over the years, irrigation services have become restricted to farmers close to the intake. Furthermore, with declining water availability and the switch to commercial farming, competition for canal water has spread to the riparian farmers in the upper reach as well.

Although open conflicts about canal water, which were common in the past, are not common anymore, divisions between upper-reach farmers with access to canal irrigation and an opportunity for irrigation-based economic activities, and lower-reach farmers without such access and opportunity, are prominent. Interestingly, during the fieldwork we noted that outsiders have also leased in land for commercial farming and even brick-making in the upper reach. They were able to use canal water by virtue of the water rights of the landowners (from whom they lease-in land) and by maintaining good social relations with neighboring farmers.²³ Those lower-reach farmers who could afford it created water access by investing in ground-water sources and other technologies (e.g. pumping stream water, drip irrigation system). Those unable to afford such alternatives depend on rainwater which, however, is increasingly unreliable. On the one hand, institutions, infrastructure and public interest in irrigation development are weakening, and thus adversely affecting agriculture-based livelihoods. On the other hand, the commercial value of land is increasing, which tempts farmers to sell their land. Urban expansion and immigration have made this peri-urban village grow rapidly. Demand for drinking (and domestic) water and reallocation of water sources that earlier helped in irrigation have increased.²⁴ An attempt to reallocate the Mahadev Khola Rajkulo was strongly opposed by many farmers, and a similar attempt made in 2014 was supported almost exclusively by farmers from the upper reach.

The decline in management involvement of farmers from the lower reaches can be related to their worsening access to canal water, which has severely reduced their concern for the irrigation system. As has been illustrated above, interest in irrigation is not only decreasing among an increasingly diverse peri-urban population and at the local government level, but also in the government agencies responsible for irrigation development. With ongoing urbanization in the context of a changing

²³We noted a brick-maker who had leased in land and hired a local inhabitant as a guard, whose responsibility included arranging water for brick-making by lifting water from the stream and even from the canal, when available.

²⁴The Government of Nepal has the national target of universal access to safe drinking water and sanitation for all. According to the census data of 2011, 85% of the households have access to water supply and 61% have sanitation (Central Bureau of Statistics, 2014).

climate,²⁵ irrigation is likely to be an increasingly competitive and costly service, beyond the reach of peri-urban farmers, particularly those depending on canal irrigation. With declining irrigated agriculture-based economic activities, conflicts about irrigation water may no longer be an issue, but these changes in land and water uses will definitely have adverse effects on the formal goals of conservation of agricultural land, sustainable agriculture and food security.

The literature on property and access discussed above (Ribot & Peluso, 2003; von Benda-Beckmann et al., 2006) is particularly relevant to make sense of the changes around the canal. As Ribot and Peluso (2003) have stressed, the concept of access—the ability to benefit—is much broader than property. While a property right may create access to a resource like water, this is not guaranteed, as is well illustrated by the fate of the water rights that used to be strongly attached to the Mahadev Khola Rajkulo. Nor is access necessarily rights-based. Developments around the canal in the last decades are causing a gradual weakening of the “bundles” of property rights and obligations historically associated with the irrigation canal. While in earlier times rights-holding farmers could be relatively sure about their access to canal water, nowadays the situation has completely changed. Access to water in this urbanizing village is increasingly shaped by access to land in the upper reach, to capital and technology, and to the right connections and social networks for funding, bribing and political support. The many demographic, land use, social and institutional changes around the canal have led to a weakening of canal maintenance and management practices, while growing demands for water outside irrigated agriculture support new claims to water rights and new practices of accessing water, rights-based or not. These changes are deeply influencing people’s experiences of water (in-)security (Lankford et al., 2013; Zeitoun et al., 2013) and may also increase the occurrence of water-related conflicts (Shrestha et al., 2018).

3.5 Conclusion

Dadhikot, like many other urbanizing villages in Kathmandu Valley, is undergoing rapid and radical changes, with great impact on its formerly agricultural land and water uses. A rapidly increasing population, unplanned urban development and loss of agricultural land in Kathmandu Valley have been identified as major peri-urban problems since long back, among others in the formulation of the first physical development plan of Kathmandu Valley developed in 1969 (His Majesty’s Government of Nepal, 1969; Kathmandu Valley Development Authority, 2015). Several of the current national policy documents, including the urban policy of 2007, the urban development strategy of 2017, and the national land use policy of 2015, have stressed the need to control the rapid conversion of agricultural land into non-agricultural uses. However, the importance of reliable irrigation services in

²⁵Climate change is noted to have adverse impacts on water resources in Nepal (WECS, 2011).

socio-economically sustainable agricultural livelihoods, and thus the need to restrict non-agricultural uses of land, has received little attention.

An example is the 20-years' Strategic Development Master Plan (2015–2035), drafted for the long-term development plan for Kathmandu Valley. While it recognizes the importance of food security and the need to protect “prime agriculture land” in the valley, it is silent about irrigation and lacks coordination with the organizations responsible for irrigation development (see Kathmandu Valley Development Authority, 2015). Moreover, as discussed above, irrigation management in peri-urban contexts is no longer a priority of the responsible authority, despite the fact that the irrigation policy recognizes prior rights over irrigation water and aims at conserving irrigated areas by restricting non-agricultural uses. As we saw in this study of changing use and management of a historic canal irrigation system in Dadhikot, the current practices with respect to water rights for irrigation contrast sharply with these policy intentions. In the meantime, the conversion of irrigated and other agricultural land into non-agricultural uses is continuing at high pace.

We share with Rana et al. (2015) the view that development plans and policies for Kathmandu Valley have remained biased towards the expansion of urban infrastructure. Despite its agricultural potential and importance, peri-urban agriculture lacks government support and recognition. Our study shows how the pressures on peri-urban agriculture and agriculture-based livelihoods are increasing, due to the low priority given to irrigation management. It is important to acknowledge that irrigation management is not a one-dimensional activity but rather a domain of complexly interconnected social, cultural, institutional, technical and agronomic activities (see Pradhan, 2000; Roth & Vincent, 2013). However, while irrigation management responsibilities have been allocated to communities, the local dynamics of changing land and water uses and how these shape community needs, interests and priorities, water rights and access to water, and conservation of agricultural land have received little attention.

Studies have stressed that water security is a relational, political and multiple-scale issue of both water access and control, and that any form of sustainable water security policy must consider such water-society interrelations and interdependencies with other resources (see Zeitoun et al., 2016). In the current national context of increasing priority for urbanization and ongoing efforts to strengthen national water policies, it is important to acknowledge that competition for water in peri-urban spaces is likely to increase with urbanization and the adverse impacts of climate change (WECS, 2011). Addressing climate change has been a major agenda in the formulation of new policies and strategies in Nepal, such as urban, irrigation, agriculture and water supply and sanitation policies. Through its National Adaptation Programme of Action (NAPA), The Climate Change Policy of 2011 has prioritized community-based adaptation through integrated management of agricultural, water and forest-based resources, to minimize the adverse impacts of climate change.

However, as discussed above, the rapidly changing land and water use practices and needs and interests of peri-urban communities largely contradict such formal community-based integrated management approaches. Studies on agriculture in

peri-urban Kathmandu Valley show that this is a profitable endeavor (Bhatta & Doppler, 2016; Rai et al., 2019). Thus, interventions for improving irrigation management, institutions and infrastructures could stimulate the peri-urban population to continue agriculture, and thus prevent ongoing conversion of agricultural land into non-agricultural uses while dealing with existing water-related issues.

This is not to conclude that the lack of irrigation services is the main driver making farmers move away from agriculture, nor is urbanization the sole cause of the drying up of water sources or degradation of the irrigation canal system. Clearly, the multiple causes of the changes in peri-urban land and water uses and their consequences for water rights, access to irrigation services and agriculture-based livelihoods are complexly interlinked. Nevertheless, ignoring these rapid and rampant changes and the differentiated impacts these changes have for a socially and economically diverse peri-urban population can further intensify the conversion from agricultural to non-agricultural land (and water) uses, against the governmental policy of conserving agricultural land. Alternatively, supporting farmers in their efforts to continue agriculture by, for instance, improving irrigation services can help attracting them to agriculture while at the same time generating self-employment opportunities and avoiding adverse repercussions on food security.

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