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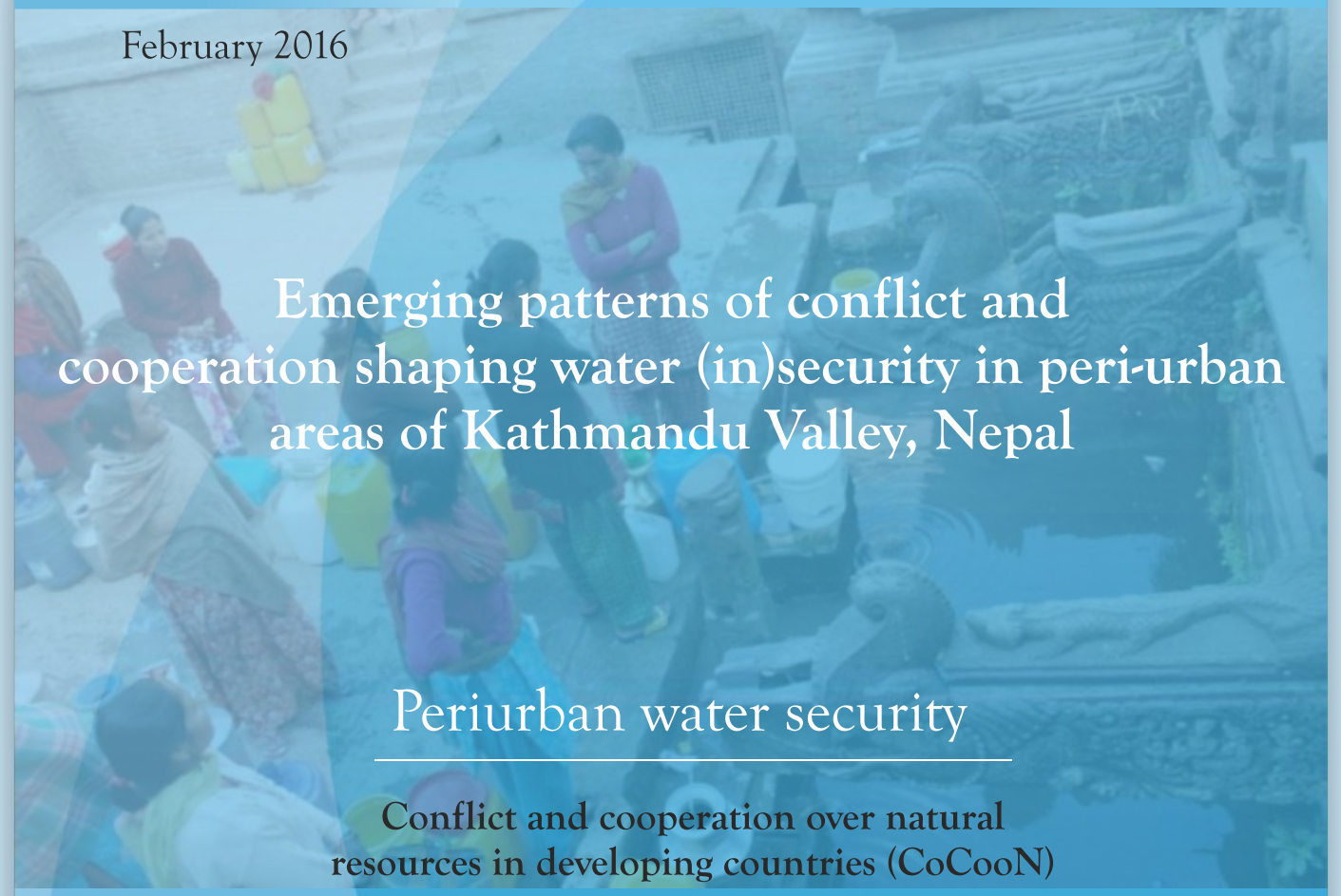

Emerging patterns of conflict and cooperation shaping water (in)security in peri-urban areas of Kathmandu Valley, Nepal

Periurban water security

Conflict and cooperation over natural resources in developing countries (CoCooN)

Conflict and cooperation in the management of climate change (CCMCC)

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Source of front cover picture: Dik Roth, 2015

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Abbreviations

BRBIP	Bagmati River Basin Improvement Project
CBS	Central Bureau of Statistics
CC	Climate Change
CCC	Climate Change Council
CCN	Climate Change Network
DDC	District Development Committee
DoI	Department of Irrigation
DoLRM	Department of Land Reform and Management
DUDBC	Department of Urban Development & Building Construction
DWSS	Department of Water supply and sewerage
DWSS	Drinking water supply system
FEDWASUN	Federation of Drinking Water and Sanitation Users Nepal
GCMs	Global Climate Models
GWRDB	Groundwater Resources Development Board
ICIMOD	International Centre for Integrated Mountain Development
IDRC	International Development Research Centre
IPCC	Intergovernmental Panel on Climate Change
KUKL	Kathmandu Upatyaka Khanepani Limited
KVDA	Kathmandu valley Development Authority
KVWSMB	Kathmandu valley Water supply Management Board
LAPA	Local Adaptation Plans of Action
LSGA	Local Self Governance Act
MLD	Million Litres per Day
MCCICC	Multi-sectoral Climate Change Initiatives Coordination Committee
MoFALD	Ministry of Federal Affair and Local Development
MoIr	Ministry of Irrigation
MoLRM	Ministry of Land Reform and Management
MoUD	Ministry of Urban Development
NAPA	National Adaptation Plan of Action

NEC	Nepal Engineering College
NGO	Non-governmental Organisation
NLUP	National Land Use Policy
NUDS	National Urban Development Strategy
NUP	National Urban Policy
NWP	National Water Plan
VDC	Village Development Committee
WASH	Water, Sanitation and Hygiene
WECS	Water and Energy Commission Secretariat
WRA	Water Resources Act
WRS	Water Resources Strategy
WSMBA	Water Supply Management Board Act
WTFCA	Water Tariff Fixation Commission Act
WUA	Water Users' Association
WUC	Water Users' Committee

Emerging patterns of conflict and cooperation shaping water (in)security in peri-urban areas of Kathmandu Valley, Nepal

Abstract

Kathmandu Valley, consisting of three historic city namely Kathmandu, Lalitpur and Bhaktapur, have been suffering from acute water shortage as urbanisation is taking place in rapid pace. The bearing of water shortage is directly fulfilled from the peripheries of the city in the valley named peri-urban. Peri-urban areas are increasingly witnessing insecurity of water resources due to rapid urbanisation and climate uncertainty. The effect is widespread, but poorly documented and considered in practice. This paper presents two focus areas, namely: A) the geographic case (Hanumante river basin); and B) thematic cases of: (i) forces affecting peri-urban fringes: peri-urban agriculture and real estate development; (ii) traditional water systems-irrigation canals and Stone spouts or Hitis; and (iii) peri-urban to urban water transfer through private and government bodies in the Kathmandu valley. The study was conducted in five Village Development Committees in Hanumante river basin known as, Jhaukhel, Dadhikot, Sudal, Siddhipur, Lubhu and Godawari. Since 2014, these Village Development Committees are a part of newly formed municipalities. An overview of the issues around and emerging pattern of conflict and cooperation shaping Water (in)security in peri-urban areas, rapidly growing urban areas, which depend on peri-urban resources, development of different industries linked to urbanisation in peri-urban areas, and the outcomes of urbanisation, such as Hanumante river functioning as an "open drain", water priorities to urban dwellers and its implication on water (in)security in peri-urban areas which is further aggravated by climate uncertainty.

Key words: *Climate change, urbanisation, water (in) security, Kathmandu Valley, peri-urban*

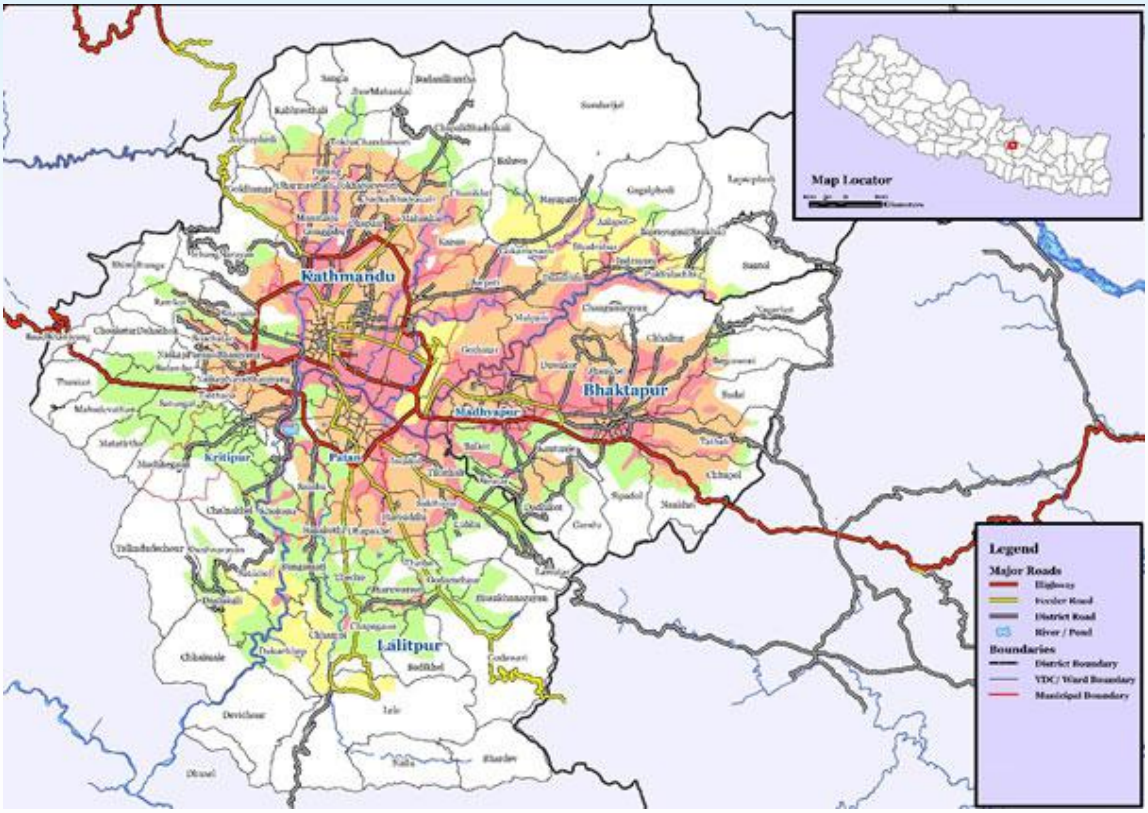
1. Introduction

1.1. Objective and rational

Kathmandu valley, consisting of three historic cities – Kathmandu, Lalitpur and Bhaktapur – is a roughly circular intermontane basin that in prehistoric times formed a lake (the location of valley, its major cities are indicated in figure 1). The settlement history of Kathmandu valley is thousands of years old, and historically it has always been an important cultural and trade hub between India and Tibet. Population growth in the valley started to accelerate in the 1970s, and the valley is now among the fastest-growing urban agglomerations in South Asia (Muzzini & Gabriela 2013). Population in Kathmandu valley increased from 1.6 million in 2001 to over 2.5 million in 2011, a decadal increase of over 56 percent (CBS, 2001; 2011), and is projected to reach five million by 2025.

Urbanisation in the Kathmandu valley is characterised by urban sprawl expanding towards formerly predominantly rural areas (Thapa & Murayama 2009). Rapid urban expansion (Thapa & Murayama 2009; JICA 2012) and increasing water stress (water demand in the valley is 360 Million Litres per Day (MLD), while piped water supply is 123 MLD in the wet season and 76 MLD in the dry season (KUKL, 2014)) have increased peri-urban to urban water transfers by both, state and private actors to fill the water demand gap (Shrestha *et al.*, 2013; 2014). Over 90 percent of private water tankers supplies in Kathmandu valley are extracted from peri-urban groundwater resources (Shrestha 2011). Studies have shown the drying of stone

Figure 1: Kathmandu valley and main cities



Source:
http://reliefweb.int/map/nepal/nepal-liquefaction-hazard-map-kathmandu-valley-floor-area-1993-survey-10-oct-2008 (Adapted Version)

spouts and drawdown of the water table (Shrestha et al., 2013). This is likely to be exacerbated by extensive sand mining in peri-urban areas (Sada and Shrestha, 2014). Additionally, peri-urban areas are rapidly urbanising, with increasing conversion from agricultural to non-agricultural land and water uses.

In Kathmandu valley, the balance between water supplies and human need has come under increasing threat from the growing population, urbanisation, and the uncertainty in water availability, which is likely to increase under climate change. Unregulated urbanisation has also changed the use and control of water resources in the dynamic, fluid peri-urban areas in Kathmandu valley. In these processes of change, new forms of conflict and cooperation around water security are occurring. There is thus a growing urgency for dealing with these changing conditions by conducting integrative research that takes into account the complex processes in peri-urban areas and has an explicit research into our focus. Through informing evidence-based policies and improved water governance and management approaches, this would reduce the pressure on already stressed systems and aim to increase the water security of poor and marginalised groups in society.

This scoping report undertakes an exploration of the emerging patterns of conflict and cooperation shaping water (in)security in peri-urban areas of the Kathmandu valley as a result of increasing stress (through the combined effects of climate change and urbanisation) and competing claims for water resources.

1.2. Research questions guiding the scoping study

Two major knowledge gaps have been identified. First, how urbanisation and climate change interact in

inducing water insecurity in peri-urban areas in Kathmandu valley, creating potential for conflict and/or cooperation. Second, how current water, climate change and other relevant policies influence the potential for water-related cooperation and conflict. The purpose is to improve mutual learning concerning the strengthening of institutional and community capacities to manage and reduce water insecurity and increase resilience. The research aims to address the following questions:

- How and to what extent is urbanisation and climate change, mediated by existing policies and social processes, locally experienced at creating water (in)securities and vulnerabilities?
- How does peri-urban water insecurity create opportunities for conflict and cooperation? At what levels and under what conditions do conflict and cooperation arise?
- How do current water policies and climate programmes influence water security and insecurity, and the potential for conflict and cooperation?
- What technical, organisational and institutional innovations are needed to avoid conflicts and promote cooperation?
- How can resilience and adaptive capacities of affected communities be enhanced?
- What promotes cooperation in the management of peri-urban water resources, and how can this understanding be made policy-relevant?

1.3. Conceptual-theoretical points of departure for the study

The analytical framework described in this section will be used to explore the dynamics around peri-urban water security and stressors emerging specifically from urbanisation and climate change, which are influencing the development of conflict and cooperation around peri-urban water resources. A deeper understanding of these dynamics and stressors will enable a more thorough analysis of the vulnerability of peri-urban communities and their subsequent coping strategies will aid in the formulation of interventions regarding both, concrete actions and policy development. An initial exploration of developing a theoretical framework for analysis can be found in Annex I.

As water security is a complex socio-environmental problem at the intersection of social and natural systems, defining appropriate strategies requires conducting integrative research that combines insights from social and natural sciences (inter-disciplinary) and promotes shared understandings between scientists, policy-makers, water users and the public (trans-disciplinary). This points to the socio-technical approach, that sees water systems as comprising both technologies and institutions that shape access to water, and technologies as socially constructed (see e.g. Roth &Vincent 2013). The underlying premise is that, in adapting to peri-urban water insecurity, both technologies and institutions through which water is accessed get transformed, favouring certain groups over others in these "hydro-social configurations" (Swyngedouw 2009). This framework allows us to integrate the social with the technical in analysing water allocation and management, as well as how changing configurations differently impact on (groups of) people positioned differently in terms of use, control, access and rights.

Conflict and cooperation

The framework builds on the approach of Ratner, Meinzen-Dick *et al.* (2013) for analysing diverse configurations of conflict and cooperation as well as the differing pathways to a situation of cooperation.

Water insecurity can lead to cooperation when communities instigate the formations of mechanisms for joint action at the local level to improve the situation. In other instances, resource competition leads to various forms of conflict. Whether or not this in turn leads to cooperation depends to a great extent on the possibilities for conflict resolution and mediation, whether from inside the community or by external parties (as sometimes problems may be big for communities to handle). Though, in many instances, conflict could be seen as a necessary station en route to reaching a (desired) situation of cooperation. Also, one needs to keep in mind that cooperation is not always positive per se for all those involved. For example, as Gillinson (2004) discusses "cooperation is almost always good for those within groups, but not always good for those outside them". Cooperation is not always voluntary and can also be of a forced nature; the question is then whether this is a desirable state? On the other hand, conflicts can be seen as a positive, functional part of growth and development and in that sense can be viewed as a potential for spurring improvement and thus cooperation. For example, Laws *et al.* (2014) indicate there is "a growing body of research and practical experience suggesting that 'hot' forms of interaction, in which the participants have detailed historical knowledge of the issues and a direct stake in the outcome, can enhance the quality of practical deliberation and decision making".

The manifestation and developments of conflicts can differ greatly, depending on the cultural, social, political and institutional context. Therefore, this research initiative will specifically look at how conflict and cooperation (along a continuum, not as two extremes) manifest themselves in the specific study areas along these various dimensions. A final note on the concepts of conflict and cooperation. Because most (mainstream) conflict/cooperation literature is focused on the international context, this research will need a specific conceptualisation and theorisation that differs from more traditional scarcity conflict approaches. Both, conflicts and the search for solutions can be scaled in various ways; this strategic scaling may have profound consequences for how the conflict is framed, what kind of parties become involved and what kind of solutions can be sought.

This research endeavour also aims to contribute to a better understanding of internal divisions, for example, at the community level within the Nepalese context and how they work out in terms of access and control of water, water security, decision making power, conflict and cooperation etc., and along which lines of differentiation (Roth 2015).

Resilience

The concept of resilience will be dealt with from a social-political perspective, as a transformative capacity either facilitated, neglected or blocked in the political institutional world (Roth 2015).

Water security

Regarding water security, this is not seen purely from a physical access point of view, but this concept will be used as a general frame for exploring certain questions about water control and water transformations.

Peri-urban vs. urban

The urbanisation process in the Kathmandu valley, as in many developing countries, can be characterised as extremely dynamic. Areas that are rural today might be peri-urban tomorrow. In turn, current peri-urban areas could be part of a municipality very soon. This has strong implications for governance mechanisms, such as policies, regulations and institutions. Government institutions tend to have a preference for clear demarcations and categorizations, whereas, in the case of peri-urban areas this is not always possible or straightforward. Therefore, this is an important element that will be taken into account throughout this research endeavour.

1.4. Methods of the scoping study

1.4.1. Literature review

A scan of secondary sources of information, past studies of the peri-urban sites within Kathmandu valley encompassing different dimensions of water security due to urbanisation and climate change uncertainties have been undertaken. An overview of the reviewed literature can be found in Annex II.

1.4.2. Informal meetings with key informants

Informal meetings and discussions with resource persons from the Nepal Engineering College (NEC) have been held. This institute has been involved in International Water Resources Management (IWRM) related research in Kathmandu valley for the past ten years. A major point stressed during these meetings was the fact that it would be beneficial to take a wider area such as, a river (sub) basin or watershed as a unit of investigation in order to really analyse the different flows of water resources from the peri-urban fringes to the urban centres, and the dynamics around these flows, at various levels.

Figure 2 and 3 : Consultative meeting in Kathamandu

Source: Jasmina van Driel, 2015

1.4.3. Consultative meeting

In March 2015, a consultative meeting with a range of resource persons working in the field of water management in Kathmandu valley was held to obtain input into the final selection of study areas for in-depth research (figure 2 and 3). The major outcome of the meeting was an overview of potential thematic and geographic research areas based on participants' experience, knowledge and discussions that were held during the meeting.

1.4.4. Field Study

Reconnaissance visits: Preliminary reconnaissance visits to potential in-depth study areas were undertaken during the months of June, July and August, namely the following wards (formerly VDCs): Jhaukhel, Dadhikot, Sudal, Siddhipur, Lubhu, Godavari and Bhaktapur municipality (all part of the Hanumante river basin).

Checklists: During the field study work, checklists that were prepared in advance were used as a guidance tool for interaction with various community members and other stakeholders encountered. The checklists (which are adapted to specific situations as they are encountered in the field) are attached in

Annex III.

Informal meetings: Informal meetings will form part of the more in-depth case studies, once the exact research sites have been determined. These will be held with people from different layers of the communities in the research sites as well as with government representatives, private sector players and non-governmental organisations.

Photo-voice: Because the fieldwork period for this research is relatively limited, a strong visual tool that will be deployed to capture perceptions and ideas of representatives from various stakeholder groups is photo-voice. This enables people to capture the challenges of water security from their personal perspective, providing room for differing viewpoints.

1.4.5. Policy Analysis

A preliminary review was undertaken to obtain insight into the policy framework for water resources management, climate change and urban planning in order to gain a first understanding of the various ways in which these shape the dynamics around water security and conflict and cooperation in the management of peri-urban water resources. A preliminary overview of findings is provided in chapter three of this note. A list of relevant policies and their focus is provided in Annex IV.

2. Water security, urbanisation and climate change in Kathmandu valley

2.1. The peri-urban valley: issues and trends

Kathmandu valley is situated at an average altitude of 1350 MASL and is a relatively circular basin with a diameter of approximately 25 Km surrounded by hills on all sides with an average altitude of 2800 MASL (Pradhanang et al., 2012). Covering an area of around 665 Km2, it is home to five municipal towns, including the capital city Kathmandu. The water in the valley is supplied mainly by the Bagmati River and its various tributaries. The Bagmati basin has a total catchment area of approximately 3750 Km2 and originates in the Shivapuri hills, just North East of the urban centre Kathmandu.

Traditionally, the valley was home to an intricate water supply system that dates back as far as 500 AD[1]. Water from the surrounding hills of the valley was transported through open canals, irrigating the agricultural fields and recharging ponds at the edges of the cities. These recharging ponds in turn ensured water could be supplied to various parts of the cities by an intricate underground canal system that would simultaneously filter the water. People within the cities could access this clean water through so-called "Hitis", traditional water taps and spouts. However, with increasing urbanisation this system has largely disappeared and many of the Hitis have either dried up or become literally buried under the pillars of "modern" development.

The process of urbanisation in the valley started in the early 1960s and accelerated after the 1970s (ICIMOD 2007). The construction of the ring road in the mid-1970s created a strong incentive for rapid urban growth beyond the traditional city cores, extending to the rural areas in the periphery. The process of urbanisation and the subsequent expansion of built up areas in the peripheral rural landscape has

[1] http://spacesnepal.com/archives/nov_dec08/nagbahal_hiti.html (accessed 24th of November 2014)

resulted in the emergence of rural-urban intermediary areas, differentiated by a mixed rural-urban economy and livelihood, differently called rural-urban fringe, urban interface, or peri-urban area by different researchers (Allen 2003; Brook *et al.* 2003; Narain and Nischal 2007).

Kathmandu valley is increasingly faced with severe water security challenges regarding both, quantity and quality of water. The main sources of water are currently the Bagmati River and its tributaries as well as groundwater. However, it is estimated that the Kathmandu valley Water Supply Company can at present only meet 23 percent of the total water demand during the dry season and about 38 percent during the monsoon season (KUKL, as cited in Shrestha 2012). This has forced people throughout the urban areas to seek out alternative water sources. Many of these sources are located in the urban-rural interface areas, or peri-urban areas, and are thus being diverted for the advancement of the rapidly growing urban centres in the valley.

Kathmandu is currently one of the fastest growing metropolitan[2] cities in South Asia, with an average growth rate of 4.75 percent per year (Pant 2012). Water is increasingly diverted from agricultural activities, rural and peri-urban domestic needs in order to meet urban residential, industrial and recreational needs (Sada & Shrestha 2013; Narain *et al.* 2013). Other consequences of urbanisation are the deterioration of surface and groundwater (Shrestha 2007; Chapagain *et al.* 2012), unprecedented pressure on groundwater sources in the peri-urban areas (Sada *et al.* 2013) due to insufficient water supply by the municipal water supply company KUKL[3] in the Kathmandu valley (Yoden 2012). Various studies show that attempts to meet the demand of urban inhabitants, the overexploitation of groundwater[4] resources has resulted in groundwater depletion (Pradhanang 2012) on average by one to four meters per year in deep-wells (Shrestha 2012) and approximately 2.5 meters per year in shallow wells (Shrestha 2007).

These developments have amongst others impelled the emergence of groundwater markets, at their most prominent during the dry season when the municipal (KUKL) water supply becomes almost negligible (Dongol *et al.* 2012), creating increased water security problems in the peri-urban areas. These water markets manifest themselves at different levels; the individual level (profit based), the community level (service based) and the commercial level (profit based) (Dongol *et al.* 2012). The latter concerns the largest volume of water transfer and is mostly operated by water tankers, thus creating major challenges. Water extraction by water tankers has already been prohibited in certain parts of the valley due to opposition from peri-urban communities (Dongol *et al.* 2012). Due to the fact that current groundwater extraction rates exceed recharge by a factor of six, groundwater levels are declining by an average of 2.5 meters per year (Pant 2012). Apart from this, groundwater irrigation is increasing in Kathmandu valley due to declining traditional surface water irrigation system and competition over existing surface water.

Urban wastewater is also an important aspect of urban–rural water flow, which opens up new opportunities for peri-urban agriculture, but often with adverse health impacts for both the producers and consumers of the produce (International Water Management Institute 2006). But, also reduced agricultural productivity, incomes and limited livelihood opportunities (Narain *et al.* 2013). According to Shrestha (2007), Kathmandu's "major rivers are turning into open drains". These rivers play a major role for the irrigation for large groups of peri-urban farmers. Wastewater irrigation has been more common with changing climate, particularly with the changes in rainfall patterns.

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[2] Leaching of the pollutants from unplanned disposal of municipal wastes, contamination from sewage line, domestic, industrial waste water into the river.

[3] 60 percent in wet and 30 percent in dry season by KUKL (2008); KUKL (Kathmandu Upatyaka Khaanepaani Limited).

[4] Groundwater: Shallow and deep boring, and dug wells.

Although, very limited studies have focused on the climatic trends in Kathmandu valley, studies have projected that the pressure from the increasing demand on Kathmandu valley's water is exacerbated by climate change and variability factors. Generally, for Nepal as a whole, Global Climate Models (GCMs) predict a rise in temperature between 0.5 ^{0}C and 2.0 ^{0}C (NCVST 2009 as referenced by Bartlett *et al.* 2010) over the next 15 years, and an even larger increase over the next 45 to 75 years. This would increase the evapotranspiration rate and could thus change the water balance in certain parts of the valley. The projections for mean annual precipitation are less conclusive, partly due to the fact that "the exact effects of climate change on precipitation levels in the region are based on complex factors governing the Asian monsoon and their interaction with increased carbon dioxide levels, which is not well understood" (Bartlett *et al.* 2010). Despite this, various recent models and studies, of which the most prominent is that of the Intergovernmental Panel on Climate Change (IPCC), do predict that the summer monsoon will become more intense, as well as more changeable with more frequent extreme precipitation events (IPCC 2007 as referenced by Bartlett *et al.* 2010).

2.2. Research gaps identified

In the first part of this report, two overall research gaps were outlined, namely:

- How do urbanisation and climate change interact in inducing water insecurity in specific settings, creating potential for conflict and/or cooperation?
- How do current water, climate change and other relevant policies influence the potential for water-related cooperation/conflict?

Despite being key elements determining peri-urban water security, the complex interdependencies among water users, urbanisation and climate change in Kathmandu valley have not prominently been analysed in earlier research (Shrestha 2015). Additional research gaps identified based on earlier research include the following:

- The identification of the most vulnerable groups or individuals and in what ways their vulnerabilities can be reduced.
- What are the different ways in which the ecological footprint of modern cities is borne by peri-urban locations? And what are the specific implications of this for land and water resources?
- How do these processes along with climate change shape the water security of peri-urban residents and how do users adapt to them?
- In what ways can the legal and institutional frameworks of the urban and peri-urban areas be redefined in order to improve management of resources?
- Attempts of local government to regulate water exploitation have not been successful thus far. This has created the need for improved mechanisms to promote sustainable water resources management, as one of the means to ensure peri-urban water security (Sada & Shrestha 2013).

In order to gain deeper understanding of these issues and uncertainties, this research aims to develop a concrete theoretical and conceptual framework for analysing the dynamics around cooperation and conflict in the context of peri-urban water insecurity and climate change in the Kathmandu valley.

3. Water, urbanisation and climate change policies in Kathmandu valley

3.1. Short description of the administrative, policy and institutional landscape

The administrative, policy and institutional landscape is structured according to the three thematic areas shaping the nexus, namely: water, urbanisation and climate change. An overview of the outcomes of a quick institutional analysis concerning all three domains can be found in Annex V.

3.1.1. Water resources

One of the main water resources regulations, the Water Resources Act (WRA) dates back to 1992 and aims to regulate the use of all forms of water resources in the country to ensure rational utilisation, conservation and management. A license is mandatory for utilising any water resource, except when it concerns an individual or collective use for the purposes of drinking, general domestic supply and irrigation or in the case of surface water, for running water-mill or water grinder as a cottage industry, and for the use of boat on a personal basis for local transportation. For collective use of water resource, there is a provision for the establishment of Water Users' Associations (WUAs), which are treated as corporate bodies. There seems to be a contradiction between the above described WRA and the Local Self Governance Act of 1999 (LSGA). The latter gives authority directly to local bodies to plan, design, implement and operate water related endeavours. The tasks of conservation and regulation of water resources were also entrusted with the VDC, municipalities and DDCs. However, the introduction of the Local Self-Governance Act in 1999 limited the roles of local development bodies (maintenance and protection of water related infrastructure, prevention of pollution of water resources and protection of the environment) and authority was provided to the District Water Resources Committees, such as licensing.

There are also several other, more recent regulations that provide systematic frameworks for water resources development and shape the regulatory landscape, such as: the Irrigation Policy of 2003; the Water Resources Regulation of 1993; the Water Resources Strategy (WRS) of 2002; the National Water Plan of 2005; the Water Tariff Fixation Commission Act of 2006; and the Water Supply Management Board Act (2006).

A special mention here is made of the Bagmati River Basin Improvement Project and the Bagmati Action Plan of 2009-2014. The former is aimed at improving water security and resilience to potential climate change impacts in the Bagmati Basin, through the formation of a River Basin Organisation for the implementation of IWRM principles. The road map for this project is based on the Bagmati Action Plan, which revolved around the promotion of rain water harvesting at the household level, the rehabilitation of existing ponds to recharge groundwater through rainwater harvesting, increasing the quantity and quality of water in the river, enhancing the river ecosystem (peri-urban) through effective management of urban growth, and waste water treatment at household and community level before flowing back into the river.

Institutional landscape

The main government agencies and other key agencies with a mandate in water resources in Kathmandu valley are the following:

- Ministry of Irrigation (MoLR): utilisation and management of water resources in irrigation sector. Preparation of plans, development of policies and its implementation to achieve agricultural development targets. The Department of Irrigation (DoL), falling under the Ministry of Irrigation, is mandated to plan, develop, maintain, operate, and manage and monitor different modes of irrigation and drainage systems.

- Water and Energy Commission Secretariat (WECS): formulate on necessary policies and strategies by conducting studies, research, analysis and surveys of water resources and energy development, and to establish the coordination among national and sectoral policies related to water resources and energy.

- Kathmandu Valley Water supply Management Board (KVWSMB): develop and oversee services, policies, and provide a license to service providers for the operation and management of water supply and sanitation services in Kathmandu valley.

- Kathmandu Upatyaka Khanepani Limited (KUKL): operate and manage water and wastewater services in Kathmandu valley.

- Department of Water Supply and Sewerage (DWSS): provide and ensure safe, convenient and adequate water supply.

- Groundwater Resources Development Board (GWRDB): responsible for groundwater investigation, exploration, operation, and utilisation and regulation of groundwater resources.

- Federation of Drinking Water and Sanitation Users Nepal (FEDWASUN): facilitates the provision of drinking Water, Sanitation and Hygiene (WASH) services to communities, and advocates for water and sanitation rights (drinking water and sanitation for all and forever), bringing people's issues to the attention of policy makers and service providers, and promotes good governance in relation to both, user's committee/groups and service providers.

- **Kulo organisation:** they are responsible for supervision of water management, maintenance of the system and its component, water distribution, and human mobilization for irrigation in a Kulo system. All the farmers whose land are irrigated from Kulo are the members of the Kulo organisation.

3.1.2. Urbanisation

With regard to urbanisation, Nepal has several policies and regulatory acts as well as a very recent strategy document from the year 2015: the National Urban Development Strategy (NUDS). The objectives of this strategy include elaborating medium/long term strategic visions for national and regional urban systems, establishing benchmarks and standards, prioritising initiatives and investments, suggesting legal and institutional frameworks and suggesting new approaches to urbanisation in light of existing and emerging challenges of sustainability, increased resilience and climate change mitigation and adaptation.

The National Urban Policy (NUP) from 2007 is the principal policy for guiding urban development throughout the country. One of its aims is “the development of safe and prosperous urban centres by increasing resiliency against environmental shocks and stresses as well as by harnessing local economic development potentials including mobilization of local resources”.

There is also a National Land Use Policy from 2012, which seeks optimum utilisation of land while preserving natural resources and cultural heritage, through classification of land and enforcement of land use control accordingly. The policy encourages land consolidation as opposed to land fragmentation. Finally, there is also a Water Supply and Sanitation Sector Policy, aimed at the attainment of socio-economic development and improvement of health of the urban population through the provision on sustainable water supply and sanitation services.

Institutional landscape

An inventory of institutions and actors linked with urbanisation is given below.

- Ministry of Urban Development (MoUD): its function is to provide basic services for urban development (i.e. proper residential areas, buildings, provision of drinking water and sanitation etc.).
- Ministry of Federal Affairs and Local Development (MoFALD): provide coordination, cooperation, facilitation, and monitoring and Evaluation of activities undertaken by local bodies.
- Kathmandu Valley Development Authority (KVDA): is responsible for the preparation and implementation of physical development plans (e.g. land use planning); Land development/land pooling; and monitoring and regulating mechanisms for integrated development of the Kathmandu valley.
- Ministry of Land Reform and Management (MoLRM): look after the land administration and management activities, and is responsible for ensuring the efficient and effective administration and sustainable management of available land resources.
- Department of Urban Development & Building Construction (DUDBC): is responsible for urban development, settlement management, and safe and environmentally friendly building construction.
- Department of Land Reform and Management (DoLRM): undertakes land reform, land administration and management functions through its nationwide distributed district land revenue offices.
- Land Fragmentation: comprises of two focus areas. First, land inheritance/transfer from one generation to another; and second, as a part of urbanisation, land are fragmented into a number of plots for housing purpose.

3.1.3. Climate change

A specific Climate Change Policy was endorsed in 2011 and some of its policies are relevant to this research project. The relevant objectives include:

- To implement climate adaptation-related programmes and maximise the benefits by enhancing positive impacts and mitigating the adverse impacts as well as initiating community based local adaptation actions;
- To enhance the climate adaptation and resilience capacity of local communities for optimum

utilisation of natural resources and their efficient management; and

- To develop the capacity for identifying and quantifying present and future impacts of climate change, adapting to climate risks and adverse impacts of climate change, the development of a reliable impact forecasting system to reduce the impacts of climate change in vulnerable areas, and in natural resources and people's livelihood.

However, according to Jha and Shrestha (2013) "none of the objectives address the deeper social issues such as justice related to climate change".

Nepal has also developed a National Adaptation Plan of Action (NAPA). Some of the elements relate to water supply, water security and climate change, which include:

- Promoting community-based adaptation through integrated management of agriculture, water, forest and biodiversity;
- Community-based disaster management for facilitating climate adaptation;
- Empowering vulnerable communities through sustainable management of water resource and clean energy supply; and
- Promoting climate-smart urban settlements.

However, according to Jha and Shrestha (2013), the Nepal NAPA emphasises the "document largely remains a very technical one with very little recognition of social aspects of climate change adaptation. This is especially reflected in the complete exclusion of social scientists in the preparation phase of the plan".

The initial idea behind the development of the NAPA was to translate this further into Local Adaptation Plans of Action (LAPAs) by identifying local adaptation needs, reducing local climate risks and vulnerabilities, and increasing resilience. However, within the Hanumante basin, to date only a LAPA for Lamatar VDC has been prepared but not yet officially endorsed.

Institutional landscape

The institutional landscape related to climate change is embryonic and under development. The mainstreaming of climate change policies in development initiatives is frequently advocated, but remains elusive.

Climate Change Network – formed by the government in 2007, which is under the chairpersonship of the secretary of the Ministry of Environment is responsible for stakeholders' coordination (Jha and Shrestha, 2013).

The Climate Change Council – established in 2009 under the chairmanship of the Prime Minister. This body is responsible for policy coordination in climate change (Jha & Shrestha 2013).

The Multi-sectoral Climate Change Initiatives Coordination Committee (MCCICC) was established with the aim to function as the key national platform for ensuring regular dialogue and consultations on climate change related policies, plans, finance, programmes/projects and activities (Jha & Shrestha 2013).

Moreover, specifically for the implementation of LAPAs, the formation of District Coordination Committees is proposed. Within the Kathmandu valley there are three districts and 21 municipalities. Each municipality consists of a number of wards, known as the smallest administrative unit in Nepal. Most former VDCs are now wards with the same name under a municipality.

3.2. Research gaps

With regard to the policy and institutional landscape, this research endeavour aims to explore the following research gaps:

- What are the implications of the transformation of VDCs into wards under a number of municipalities in the research area – especially what this means for water security and conflict/cooperation? In other words the institutional transformation of rural and peri-urban areas into urban areas.

The scoping study has brought out that the poor coordination between water resource policies and urban planning policies are making it difficult to realise programmes of action for climate change adaptation. Despite being key elements determining peri-urban water security, these complex interdependencies among water users and water uses, urbanisation and climate change adaptation have not been analysed sufficiently in earlier research. A further, more extensive and critical analysis of water and urban management policies could support the improvement of resource management decisions.

[5] http://kvda.gov.np/Kathmandu-Valley.aspx: Kathmandu Metropolitan City, Lalitpur Sub-metropolitan City, Bhaktapur Municipality, Madhyapur Thimi Municipality, Kirtipur Municipality, Tokha Municipality, Budhanilkantha Municipality, Gokarneshwor Municipality, Kageshwori-Manohara Municipality, Shankharapur Municipality, Changunarayan Municipality, Mahamanjushree - Nagarkot Municipality, Suryabinayak Municipality, Mahalaxmi Municipality, Anantalingeshwor Municipality, Godawari Municipality, Karyabinayak Municipality, Dakshinkali Municipality, Chandragiri Municipality, Nagarjun Municipality, Tarakeshwor Municipality

4. Conflict and cooperation around peri-urban water resources and climate change in the study sites

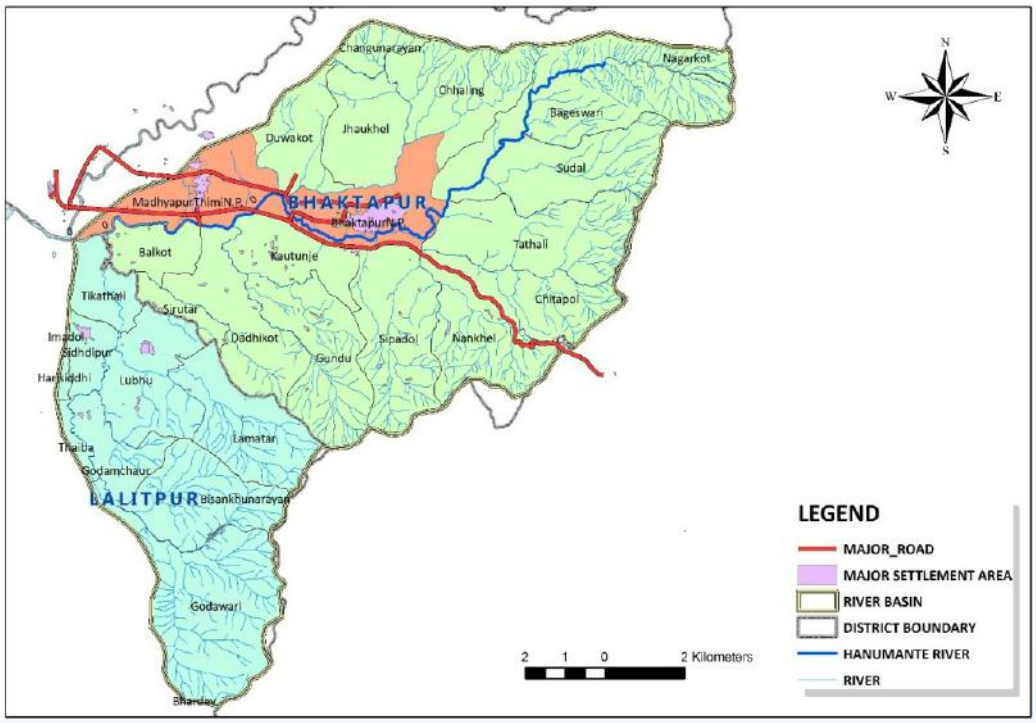
Based on: (1) the outcomes of the consultative meeting in March 2015; (2) several meetings with resource people from NEC, which has done extensive work in the Kathmandu valley; (3) the fact that in recent times much of the water resources, research and development focus has been on the Bagmati sub-basin; and (4) Godavari is a conservation area, leaving little room for intervention possibilities, the Hanumante basin was selected for more in-depth (geographical) study. The following section provides a first exploration of instances of conflict and cooperation in various areas within the Hanumante basin, based on a series of reconnaissance visits undertaken in July and August 2015.

4.1. Evidence of water-related forms of conflict and cooperation

4.1.1. Geographic study area - the Hanumante Basin

The Hanumante River (see figure 4) is an important tributary of the Bagmati River. The river originates from Mahadev Pokhari at Nagarkot and its total catchment area amounts to approximately 143 Km^2. The Hanumante River is a typical example of a river meandering through the rural, peri-urban and urban landscape. Until 2014 there were a total of 24 VDCs within the basin (part of the Bhaktapur and Lalitpur districts), but recently these have been transformed into six new municipalities namely, Changunarayan, Mahamanjushree Nagarkot, Suryabinayak, Anantalingeshwor, Godawari and Mahalaxmi. For Bhaktapur district and municipality, the Hanumante is the major waterway traversing the area, and holds ecological, economic, cultural and religious importance (Shrestha, 2014).

Figure 4: Hanumante River Basin



Source: Lunish Yakami, 2015.

One of the major problems that the Hanumante River faces is severe pollution, like many other rivers flowing through rapidly urbanising areas. The degradation of the cultural and religious significance of the river because of this, pollution is a major cause of conflict between Bhaktapur municipality and the religious groups associated with the river. In addition, pollution of the river has serious implications for

peri-urban areas downstream where farmers are using this wastewater for irrigation. This area has traditionally been and continues to be the major commercial vegetable supply area for Kathmandu city. With the degradation of traditional irrigation canals and increase in rainfall variability, farmers either depend on wastewater irrigation or invest in groundwater for irrigation. Although, this has severe implications for yields as well as farmers' and consumers' health, this issue has received relatively little attention (Shrestha 2014). An important research gap for peri-urban water security in the Kathmandu valley is understanding the dynamics of the local conflicts from river pollution and degradation of traditional water canals, which appear to be increasing. Neither has a study been conducted to understand how the changing river water quality has resulted into increasing contestation over groundwater resources and in the emergence of new forms of water conflicts.

Lubhu

Lubhu VDC is located in the Lalitpur District part of the Hanumante basin. In order to deal with water supply becoming scarcer each year, groups of women from Lubhu VDC have developed an innovative water fetching system, using a sequential lottery system. This system ensures that everyone will get a turn to fetch water at some point. At some of the public taps in Lubhu, this system has even been in place for more than 30 years. The main advantage of this system is the guarantee that households get with regard to water access, while at the same time avoiding conflicts (Sada *et al.* 2013). A field visit in August 2015, shows that apart from the community water supply, Lubhu has a newly developed water supply system (one already in operation and another in the process) that distribute water in household level. So, within the same community, a wide range of the population is seen using different sources/system in accordance with their capacity.

Jhaukhel

This VDC (now in Changunarayan Municipality) is situated in the northern part of the Hanumante basin, separated from the Bhaktapur municipality by the Khasyang Khusung river, and its groundwater resources seem to be under increasing pressure from various sides. According to the 2006 VDC profile, the majority of households are dependent on a piped water supply connection followed by dug wells, tube wells, springs, stone spouts and other sources (Shrestha *et al.* 2013). The main source of drinking water for people living within the VDC boundaries is groundwater and in 2013 there were approximately 11 community drinking water supply schemes. The field visits during this scoping period also showed that efforts are being made for other institutionalised mechanisms of groundwater extraction for both, drinking and irrigation uses which are arranged from Bhaktapur DDC and National Planning Commission (NPC).

Direct field observations in July 2015 also showed that agriculture is an important water consumption sector. During the monsoon groundwater is used as a supplementary source while during the rest of the year it is the main source of irrigation water. Farmers without access to water through their own borings or wells, need to pay other farmers an amount of between 1.64 – 2.05 EUR (200 – 250 NRS) per hour of pumping services.

Since 1990, brick kiln industries have been operational and in 2013 a total of 12 kilns was counted within the VDC. Since this is a high water consuming industry and the only reliable water sources is groundwater, its extraction is having profound effects (Shrestha *et al.* 2013).

Another major player on the groundwater extraction scene is the commercial water supply industry. This consists mainly of water bottling operators and tanker/tractor operators taking water out of the VDC

boundaries to serve an ever growing urban population (Shrestha et al., 2013). Recent field visits in July 2015, confirmed that much of the water is "exported" to Bhaktapur municipality, especially drinking water in the form of tanker trucks or bottled water.

In addition, sand mining has been undertaken in Jhaukhel for more than 30 years now. Initially the sand was used for bridge and road construction, which was connected to the development of the Araniko highway, but nowadays the resources are used for infrastructure development in other areas as well. Sand mining has detrimental effects on groundwater recharge and thus groundwater levels, because there is less sand available to act as a "sponge" (Shrestha et al., 2013). In contrast, some positive effects were observed during the field visits in July 2015; for example, sand mining creates flat terraced land and this enables farmers to use it for growing rice instead of maize, providing a higher price per kilogram of product as well as an overall higher productivity (see figure 5 and 6).

Although, there have been regulatory attempts by people from the local communities, this has not led to drastic changes in the situation sketched above. According to Shrestha et al., (2013) "The voices of local people against unregulated extraction of natural resources in the VDC have nonetheless been suppressed due to the involvement of people in these activities who have the added advantage of money and muscle power to curb such protests". Regarding water tanker extractions, continuous allegations of people from the area at the VDC office, the VDC finally issued a public notice declaring water tanker operations to be illegal. However, implementation has been very weak (see figure 7). Despite the resistance of local people against sand mining, according to Shrestha et al., (2013) "sand mines are still in operation with the involvement of influential groups, who have large stakes in such operations without following adequate monitoring mechanisms" (see figure 8).

Figure 5. Water pumped from boring for rice transplantation

Figure 6. Sand mine turned agriculture land plotted

Figure 7. Water filled in water tanker

Figure 8. Sand mine in operation

Source: Saroj Yakami, 2015.

Dhadikot

In this VDC, situated in the southern part of the Bhaktapur District, spring water sources are the most common source for both, drinking water as well as irrigation. Despite having few spring sources in the upstream areas, a large section of the VDC suffers from water scarcity. Exercises to tap water from Naichal in Kavrepalanchowk over two decades back brought tapped water supply system in Dadhikot. This system, however, had irregular supply and could not be sustainable. In the early 2000s, Syangtang and Uttisghari water supply systems started community-managed public water taps. In 2002, Uttisghari implemented the household piped water supply system, extracting groundwater resources in the VDC. Following this tapped water supply system and increasing Maoist insurgency resulted in a massive increase in population in Dadhikot. The increase in population numbers and subsequent urban expansion has led to a significant increase in water demand over recent years. As a reaction, new sources have been sought by the existing community managed water supply schemes that have been established to increase coverage. However, this is also leading to conflicts between different spring initiatives, with regard to expanding coverage and increasing profits (Shrestha 2014). Furthermore, several years ago, local community members also initiated a water conservation programme to ensure sustainability of the spring sources (Shrestha 2012[6]). Dadhikot has a recent history of wastewater irrigation from Hanumante River in the downstream areas where irrigation water from Mahadev Khola Raj Kulo has an insignificant contribution in recent years. A field visit in October 2015 shows several forms of co-existing conflict and cooperation at the community level. These are:

I. Syantang DWSS: a verbal agreement was made between Syantyan DWSS and the community in the spring source area that the leftover water will be taken for distribution in a few wards of Dadhikot. Moreover, the DWSS is responsible for the maintenance of pipelines and tap provision for the community in the spring area. Syangtang has also provided a job for one person from the spring area to ensure regular water in their system. But, during the dry season, water from the spring is diverted to agricultural land to irrigate potato farms. This is again another type of negotiation between Syangtang and the spring area community. As the number of households, depending on Syangtang increases the demand also increases. To meet the demand, in 2012 Syangtang installed a boring system to extract groundwater and pump it up to fill the storage tanks;

ii. Attempts by Uttisghari DWSS to tap water at the Mahadev Khola intake caused an insurrection, however, farmers belonging to Mahadev Khola Raj Kulo obstructed the plan because Mahadev Khola Raj Kulo is one of the sources among others used for irrigation;

iii. Dissatisfaction amongst the Uttisghari DWSS consumers due to poor water quality and declining water supply;

iv. Growing competition between two household water supply systems (i.e. Syangtang and Uttisghari) in expanding their customer services within a VDC. Also, they foresee a further expansion of the system as increased demand from other areas is perceived with the change to a municipality (few VDCs were merged to form a municipality in 2014); and

v. Conflicts and cooperation behind degrading canal irrigations and the emergence and practices of wastewater irrigation (see figure 9 and 10). The WUA is no more active in the Mahadev Khola Raj Kulo system.

[6] http://periurbansouthasia.blogspot.com/2012/07/newspaper-article-published-in-national.html (accessed 30th of July 2015).

Figure 9. Pump in operation for irrigation from Hanumante River

Figure 10. Irrigation at rice field from Hanumante River

Source: Saroj Yakami, 2015

Sudal

In this former VDC (now part of the Mahamanjushree Nagarkot municipality) the drinking water supply system was developed in 1981 with support from World Vision (an international NGO). However, major expansion took place after the formation of the community water supply committee in 2010. The system now includes a storage reservoir of 50,000 litres, a distribution chamber of 10,000 litres and makes use of gravity flow for collection and water distribution. One of the reasons that the water sources are still functioning despite the increase in demand, is probably due to the very good forest cover upstream that is managed by a community forest scheme (Paataley Ban).

An interesting form of cooperation (or perhaps dependency?) has evolved between certain farmers and brick factories. A farmer producing wheat can earn approximately 32,86 EUR (4000 NRS) per annum from a ropani of land (equals approximately 509 m2). Then again, if the farmer leases this same piece of land to a brick factory, s/he can earn about four times as much, namely 131,46 EUR (16,000 NRS). During some periods of the year when the brick factories are not operating (mainly during the monsoon season from June to September), the farmers can use the land for growing rice, whereby the water is provided by the brick factory from a borehole, ensuring timely harvest of rice, which in turn ensures that the brick kiln can start its operations on time.

Siddhipur

The irrigation system known as "Siddhipur Rajkulo", fed from Godawari River, is a source of irrigation for Siddhipur VDC and four other VDCs (Thaiba, Harisiddhi, Tikathali and Imadol). Generally, 5000 ropanis of land in Siddhipur is irrigated by this system, whereas, the command area of the system is 50,000 ropanis. The WUA was formed in 1991 (2048 BS). The current executive committee has 17 members, of which three are women. With the change in contexts, i.e. Siddhipur VDC became a part of Mahalaxmi municipality, providing guard for the irrigation system by the former VDC (Siddhipur), which is on the verge of collapsing though, the delegation is still going to support them given the circumstances.

A drinking water scheme (capacity for 2000 households) providing water for 1350 households take water with the permission from the adjoining VDCs (Thaiba and Godamchaur). After the construction of the scheme problems with drinking water vanished. In the cases of emergency (rainy season with turbid water from the river and system cleaning), they use water from dug wells, which used to be their drinking water source in the past. The drinking water system was in operation from 2005. Even when the field study was

undertaken (August 2015), the same users association that was formed in 2005 were on board. No single general assembly was held in the last 10 years (i.e. one of the reasons that triggered the increase of the water tariff). Though it is unclear why general assembly did not take place, the effect of it was clearly seen i.e. people are unready to pay more until and unless a general assembly takes place. It also indirectly affected the salary increment of the working staff in the system and other decisions on the improvement and expansion of the system.

Godavari

Godavari VDC (now in Godavari municipality), lies in the southern part of the Kathmandu valley, which is rich in water resources. The interesting scheme is Godavari drinking water supply operated by a WUC. Due to inefficient distribution (limited to nine to ten piped water supply systems and could not extend the services) by the Nepal Water Supply Corporation, with the effort from local people, the system was handed over to the 13 member user's committee. The committee distributed 1200 private taps and 15 communal taps for 150-200 households in a squatter community as well as installing a water metering system for water tariffing.

Water tankers were in operation until a few years back. But, with a visible decline of water in water sources, a dispute/discussion was noticed between tanker operators and the WUC for few months. Later the WUCs decided to stop withdrawing water for tanker supply in the premises of Godavari area.
There are few complaints about the distillery operation in the area, especially during the dry season. Few discussions or quarrels happened between the distillery operators and villagers. Also, a corruption case was revealed, where the VDC chief was involved in a large sum of money from the distillery operators.

4.2. Estimation of the roles of climate change and urbanisation

Although, climate change may not lead to conflicts over resources directly, it can aggravate already looming resource security issues and existing conflicts. As mentioned earlier in this note, there are no clear cut predictions for precipitation changes under various climate scenarios for the Kathmandu valley. Under the worst case scenario precipitation would decrease substantially and also the number of rainy days would decrease. That said, however, it is expected (and according to preliminary fieldwork and interaction with stakeholders on the ground this can be and is partially already felt) that rainfall variability will increase, bringing more extreme events. With regard to temperature, there are more accurate predictions possible: the temperature is projected to increase up to 3.8 °C by 2050 and by 9.7 °C by 2100 (Jha 2012; Jha & Shrestha 2013). This could potentially have detrimental effects on water availability downstream in the Kathmandu valley, because in the long run less glacier water will feed into the major rivers.

These potential climatic changes in combination with urbanisation could very well worsen the overall water security situation in the whole of the Kathmandu valley.

A shift in the cropping season is a common adaptive practice among peri-urban farmers in order to be able to cope with the increasing rainfall variability, especially with delayed monsoons. However, this shift also seems to increase the demand for declining agricultural labour base during the limited number of days when there is sufficient water in ponds in the fields. For certain farmers or farm labours this situation thus creates an apparent advantage to raise their labour charges leading to a situation where farmers need to spend additional money to be able to cope with all the work needed to be done in a shorter amount of time. Increasing climatic variation could thus lead to new forms of conflicts and new forms of cooperation in these peri-urban areas (Shrestha 2014).
The increase in rainfall variability has also led to a growing realisation among local people to unite and act

against unsustainable water extraction practices in certain wards/VDCs. This growing awareness within communities may lead to outbursts of dissatisfaction, perhaps even leading to conflicts. If efficiently managed, these situations may be resolved through the equitable use of water resources. However, the question remains as to what will be an efficient management system and how this can be practically implemented in the context of multiple claimants and declining water resources (Shrestha 2014).

Because of the fact that there is a lack of available detailed climate data at the level of the Kathmandu valley, we will also briefly discuss local climate perceptions here in order to gauge the general sentiment on the ground. SaciWATERs and NEC have done extensive research in Lubhu, a former VDC (now ward) within the Hanumante Basin, on this during their three years IDRC supported research project from 2010 to 2013. One of the major findings of this research endeavour was the fact that the perception of the local people with regard to the changes in temperature were quite in line with the recorded climatic trend data. However, when it comes to rainfall, perceptions were not in line with recorded trends. People indicated that they perceived delays and decreases of rainfall during the monsoon period, whereas recorded data does not show a clear long term pattern with regard to rainfall.

5. Final cases selected for further research and intervention

5.1. Area selection process and final study areas selected

As mentioned earlier in this scoping report, the selected study area is the Hanumante Basin, encompassing parts of Bhaktapur and Lalitpur Districts. The smaller study areas within the basin were selected based on the criteria presented below. A distinction is made between geographic case studies – situations specific to (an) area(s) within the Hanumante Basin – and thematic case studies – situations with regard to water (in)security, as they occur throughout the Kathmandu valley. The selection process consisted of two rounds:

Round 1: short listed study areas and thematic cases based on exploratory meetings with experts and the outcomes of the consultative meeting.

Geographic areas:

- The area between Gokarna and Sundarijal
- Sundarijal (headwaters of the Bagmati river)
- Kodku, Godavari
- Lele, Lalitpur
- Jhaukel VDC as part of the Hanumante basin
- Taudaha, Kathmandu
- Matatirtha VDC

Thematic cases:

- Peri-urban agriculture
- Real estate development
- Water distribution system in the Kathmandu valley
- Stone spouts – traditional water management systems in the valley
- Rainwater harvesting
- Dynamics of water extraction, water transfer and environmental impact
- Water rights, policies and institutions

Short listed sites round 2: Outcomes of field visits, literature review and expert consultations

Geographic areas:

- Jhaukhel
- Dadhikot
- Godavari
- Lubhu
- Sudal
- Siddhipur

Thematic cases:

- Forces that affect the peri-urban fringes: peri-urban agriculture and real estate development
- Traditional water systems – irrigation canals and stone spouts (Hitis)
- Peri-urban to urban water transfer:
  - Private tankers;
  - Municipal water supply – The Kathmandu valley Drinking Water Company; and
  - Inter-Basin Transfer – The Melamchi project.

5.1.1. Selection criteria geographic study areas

Various exercises were undertaken to develop selection criteria for zooming into more specific areas within the basin: a literature review, exploration of the outcomes of previous research projects such as, the IDRC supported the peri-urban work by NEC and SaciWATERs and the outcomes of the consultative meeting held in March 2015 with professionals familiar with water (in)security issues in the valley. Based on these inputs, the following selection criteria were formulated in order to select case studies for in-depth research:

i. Peri-urban in nature: sites in the process of urbanisation with increasing pressure on its water resources, including due to water transfers to urban areas, or areas that due to their location have to deal with the direct consequences of urbanisation such as, wastewater flows from households or industry;

ii. Sites where significant dynamics in natural resource use (for instance, multiple claimants of the water resources), livelihood, and population growth can be observed;

iii. Existence or potential for latent tensions and conflicts about or related to water use, access and rights, and/or existence of cooperation mechanisms, and institutional transformations related to peri-urban processes and characteristics;

iv. Climate variability and climate change;

v. Sites with a hydrological (either directly or virtually) linkage to the urban area; and

vi. Accessibility of the location for research and other project-related activities.

Table 1. Cumulative values as per field observation for the selection of villages

Criteria -> Area	Degree of heterogeneity in land use/land cover	Elements present for conflict/ cooperation	Degree of multiple (competing) claims	Degree of urban-peri-urban hydrological linkages	Degree of vulnerability to water stress (or perceived)	Climate change vulnerability ranking
Jaukhel	Very High (5)	High (4)	Very High (5)	Very High (5)	Very High (5)	Medium (3)
Dadhikot	High (4)	Medium (3)	Medium (3)	Low (2)	High (4)	Medium (3)
Sudal	Medium (3)*	Low (2)	Low (2)	Very Low (1)	High (4)	Low (2)
Siddhipur	Medium (3)	Low (2)	Low (2)	Very Low (1)	Low (2)	Low (2)
Godavari	Medium (3)	Low (2)	High (4)	Medium (3)	Low (2)	Low (2)

**Though during some seasons of the year agriculture products are cultivated, most of the land is covered by brick kilns*

5.2. Preliminary insights from field visits and the final study areas selected for further research and interventions

5.2.1 Geographic study areas

The preliminary insights from the various reconnaissance visits are outlined below, according to the various selection criteria.

1. Degree of heterogeneity in land use/land cover are as follows:

i. Jhaukhel: sand mining, many brick kilns, factories (e.g. tobacco, dye), commercial agriculture, water bottling plants, land plotting, rapidly growing residential areas, and road access;
ii. Dadhikot: few established brick kilns, rapidly growing residential areas, land plotting, commercial agriculture, and road access;
iii. Sudal: many established brick kilns, slowly growing residential areas, and road access;
iv. Siddhipur: rapidly growing residential areas, commercial agriculture, and road access; and
v. Godavari: rapidly growing residential areas, land plotting, commercial agriculture, and road access.

2. Elements present for conflict/cooperation are as follows:

I. Jhaukhel:

o Brick kiln owned boring is used for irrigation for timely rice transplantation (which is a form of cooperation between brick kiln owners and farmers) while groundwater table is depleting[7] and becoming inaccessible to the poor and marginalised groups.

o The priority is given to drinking water in the policy which affect the irrigation sector resulting in expansion of residential areas, shifting away from agriculture and increasing conflicts over limited water resource for irrigation.

ii. Dadhikot: Moving from a community water supply system to private water supply for equitable sharing of water (private taps at the homestead) adding both, inter and intra-sectoral conflicts and cooperation in water security. Rapid urbanisation and increased population increased the demand of water, resulting in expansion of the coverage area of the system and in search of new water sources. Searching water in other VDCs and negotiating to bring water to their area (may be a form of cooperation between VDCs). Collapse of the canal network with increasing residential areas (i.e. reduced command area for irrigation).

iii. Sudal: No distinct conflict on water uses by different stakes are observed in the area. Farmers are getting timely water for irrigation. Drinking water is not a big threat yet, however, due to slow urbanisation this may change:

o Irrigation water: In the areas where brick kilns operate, farmers get free water for irrigation provided by the brick kiln operators (a form of cooperation between farmers and owners), but this increases the dependency of the farmers with them. Therefore, what happens when the brick kilns disappear or left out? The land, farmers and boring will remain, but the brick kilns will not. Once the brick kilns are out of the system, a conflict/cooperation situation can emerge over the use of existing systems of groundwater irrigation and its operation, and distribution. Questions may arise such as, who will own the existing systems? (As it depends on in whose land the boring is located?) (A similar situation is anticipated in Jhaukhel VDC as well).

iv. Siddhipur: they provide 24 hours of continuous drinking water supply. Overflow from the system feeds into the irrigation system. However, there is one problem with the metering system. If the tap is partially open, the meter does not run i.e. meter does not function when the tap is open with a small discharge. This problem now caught the attention of many water users. Currently people started cheating by operating the taps partially. The WUC are not able to solve the problem as they claimed that there is no such meter that entered into Nepal that reads or runs when the tap is slightly turned open for a small quantity of discharge at a time. Conclusion: the meter shows a lower reading compared to the actual consumption.

[7] *Increasing urban demand, constant water supply volume by government, expansion of urban areas put pressure on excessive extraction of groundwater resulting to its depletion year after year.*

v. Godavari: good source of water. Other adjoining VDCs depend on the source from Godavari for irrigation, and drinking water.

3. Degree of multiple competing claims are as follows:

I. Jhaukhel: water transfer from Jhaukhel to Bhaktapur Municipality (Domestic purpose) is carried out either via tankers or jar/bottles; Domestic and productive use of water in Jhaukhel i.e. Brick Kiln, sand mining, irrigation, drinking water, dye factory, commercial farming, poultry, tobacco factory;

ii. Dadhikot: Water from the stream from Dadhikot (Mahadev Khola) do not enter or pass the urban area (Municipality) before it drain to Hanumante River; Different sources are utilised to distribute drinking water within a VDC (i.e. groundwater by pumping, spring sources either within and also from adjoining VDC). For Irrigation, water is diverted from Mahadev Khola through Mahadev Khola "Raj Kulo". In Dadhikot, water is used for drinking, commercial agriculture, irrigation, brick biln etc.;

iii. Sudal: The drained water from Sudal passes urban areas through Ghatte Khola i.e. hydrological movement of water from peri-urban to urban areas; Groundwater and stream water is used for brick kiln, irrigation, and spring source is used for drinking water;

iv. Siddhipur: The drainage water moves along the peri-urban areas (i.e. does not cross urban areas). It means there is no hydrological movement of surface water from peri-urban to urban areas; Drinking water is arranged from adjoining VDC via piped networks where the overflowed water from the system or storage tank is used for irrigation during night times).

4. Godawari:

The community drinking water users committee is operating a drinking water system, whilst distilleries and tanker operation are not allowed by the users association in Godawari though, a study team saw few tankers in operation. Later it was known that they are operating illegally.

5. Degree of urban to peri-urban hydrological linkages:

Only from Sudal, a stream named Ghatte Khola (later named Hanumante when it meets Chakkhu khola) enters the urban area (Bhaktapur municipality). In other cases either it flows in peri-urban areas or along the border between VDCs and municipalities.

6. Degree of vulnerability to water stress (or perceived) are as follows:

i. Jhaukhel: groundwater stress is high. Each year the groundwater table is decreasing 2.5 m.

ii. Dadhikot: the surface water source within the VDC is insufficient to supply the demand of the community in Dadhikot itself (from Mahadev Khola and other spring sources). They depend on sources from adjoining VDCs and groundwater from borings;

iii. Sudal: at present, water for drinking purpose is not a problem. They have a plan to take water from the adjoining VDC where a dam construction is ongoing, which is expected to be used for both, irrigation and drinking water purposes;

iv. Siddhipur: in the past (around nine years ago) people in Siddhipur entirely depended on groundwater through wells (for domestic and other productivity uses). Groundwater for productive use depends on the availability of rain water. During the last eight to nine years, they get domestic

water from a piped network. The source is in the adjoining VDC from Godavari stream. Also, groundwater is used when they have turbid water when supplied from the piped system; and

v. Godavari: hardly any water stress is perceived in Godavari.

7. Climate change vulnerability ranking:
Bhaktapur was ranked as very highly vulnerable as a result of the climate change variability mapping exercise undertaken in 2010 by the Government of Nepal, which was part of the NAPA. Most of the Hanumante basin falls within the Bhaktapur District.

5.2.2. Thematic case studies

The following three thematic case studies were selected after consultations and field work:
1. Forces that affect the peri-urban fringes: peri-urban agriculture and real estate development;
2. Traditional water systems – irrigation canals and stone spouts (Hitis); and
3. Peri-urban to urban water transfer:
   - Private tankers;
   - Municipal water supply – The Kathmandu valley Drinking Water Company; and
   - Inter-Basin Transfer – The Melamchi project.

Forces that affect the peri-urban fringes: peri-urban agriculture and real estate development

Movement from inorganic to organic agriculture (Bhatta, et al., 2011): Peri-urban Areas (PUA) are subjected to dramatic changes due to urban sprawl, declining farm size and increasing population density (Veenhuizen and Danso, 2007). Market driven farming methods, i.e. shifting from staple and resilient crops toward more perishable vegetable and commercial crops and increasing market oriented intensive production, which uses a huge amount of agrochemicals and mono-cropping. After almost a decade of using agrochemicals in peri-urban farming, declining yields and increasing pest tolerance have become apparent (Bhatta et al., 2011) due to declining soil fertility. Unknowingly, farmers started using more and more chemicals to cope with declining yields. With the onset of NGOs (after democracy in Nepal in 1990) and cooperatives and private initiatives (in 2000 AD) started promoting organic based agriculture. Later, the government authorities also support the concept and started initiatives to promote organic farming in peri-urban areas. The demand increased as the market of organic product increased.

Use of pumping of wastewater for irrigation: the use of untreated sewage is executed by plugging sewers to divert sewage water, through direct pumping or diversion of water from the polluted river for rice transplantation and vegetable farming. Health hazards experienced by the communities include, skin problems like itching and blisters on the hands, feet, and lower legs and some have intestinal parasites (Routoski et al., 2006).

Traditional water systems – irrigation canals and stone spouts (Hitis)

With urbanisation pressure, the agricultural land around the Hitis (in most of the cases) are already occupied with housing structures. In cases where Hitis are a major source of drinking water, the users are increasing. A similar situation with Alkwo Hiti in Patan, which serves people in the Ikhachhen area (note that Hiti is the main source for poor families and poor renters for domestic purposes). It is a perennial type of Hiti (UN-HABITAT, 2008). Patan never had sufficient water supply since the establishment of the municipal water supply system. In 1985, the Nepal Water Supply and Sewerage Committee proposed to install water collection system in Alkwo Hiti to feed the municipal pipes. Locals could not agree as they were afraid that this intervention by the government agency will make them lose the water right of the

[8] *Even in 1992, UDLE under its Patan Conservation and Development Programme proposed collecting hiti water for redistribution at household level in Ikhachhen and surrounding areas. The proposal included several options (Theophile, E. and Joshi, P. R. 1992). However, the community was not convinced as this was the external proposition to them.*

Hiti[8].

On the 10 August 2000, during the monsoon, people got sick drinking the water from this Hiti. It was discovered that it was due to leaching of the bone mill waste that was located about 100 m south of the Hiti. The monsoon rain washed the rotten bones that was stored for the preparation of chicken feed infiltrated into the aquifer. The spouts were discharging reddish and smelly water. With the pressure from the local community the municipality ordered to close the industry. This movement was supported by neighbouring community, too. This success of the movement encouraged the youth of Ikhachhen to conserve the Hiti (UN-HABITAT, 2008)

Later the municipality provided them two PVC water tanks and they inaugurated their community based water management system from Alkwo Hiti on 1 January 2003 (1st of Baisakh 2061 BS). At the beginning the system served 150 households, which was later extended to 180 households. They have their own rules and regulations with the effort of each household receiving 250 – 300 litres of water per day. The advantage of the system is the approach of supplying water at the households door step to meet the present changed lifestyle of the urban community. This shows how Hitis systems are hybridized to meet the changing lifestyle.

Other examples, such as traditional dug wells followed similar approaches before the Alkwo Hiti. They pump the water from wells and convey it through PVC pipes to the surrounding houses or store it in overhead tanks to distribute for later use (though for a small number of households).

Although, more studies are done on changes and degradation of traditional water systems in urban areas, very little has been documented about the issue and their implications in peri-urban areas. Nonetheless, these problems are growing with the increasing urban expansion into the peri-urban areas. A study by Shrestha et al., (2014) discusses on the degradation of traditional water infrastructures in Lubhu. Dovan River Rajkulo (the state sponsored irrigation system) in Lubhu has degraded since being damaged by a flood in 1996. Furthermore, local residents have been illegally draining their household sewage into this underground canal. The lack of maintenance of the irrigation systems in Lubhu can be attributed to the vastly increased building construction in the area. Similarly of the nine ponds in Lubhu (that were used as alternative domestic water sources and irrigation) that is ultimately contributing to groundwater recharge, either reduced in size or filled for the construction of the public infrastructures or privately encroached since the 2000s. Likewise, although no record was found of traditional stone spouts in the VDC, the five of the remaining stone spouts- Sankhadevi Dhara, Amrit Dhara, Bhagbati Lachi Dhara, Gaphal Dhara and Jharu Dhara are either completely dry or only partially in use, making Lubhu entirely dependent on external water sources. Degradation of traditional water systems has been observed across the sites visited during the scoping period. A detailed study over the issues will be done in the following periods.

Peri-urban to urban water transfers

Three tiers of water transfer are distinctly seen in Kathmandu valley. The first one is at the local level, i.e. from peri-urban areas to urban areas nearby. The second one consists of transfers of water within Kathmandu valley over longer distances from peri-urban to urban areas, for example, via private tankers, while the third one is inter-basin transfer. For the planned research it is important to zoom in on how these various forms (tiers) across scales interact and mutually influence each other. This will entail studying the interactions between various users and claimants ('stakeholders') in dealing with the water-related changes, and especially on the role of institutional change, cooperation and conflict. The challenge will be not so much to analyse the various uses separately (e.g. the tanker operators and the irrigators), but to design case studies for in-depth research that make it possible to get to understand more

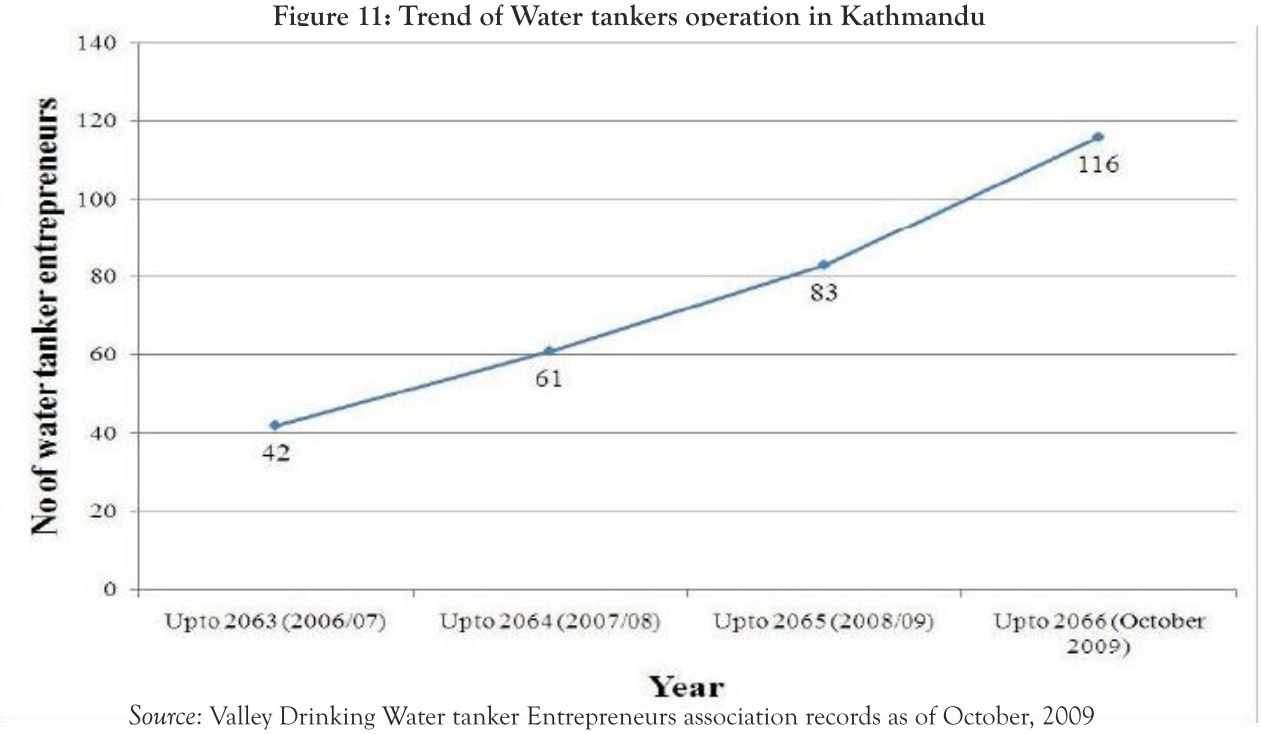
of their interactions in terms of access, rights, uses, institutions, and etc.

Private tankers

Emergence of water market (tanker operators) is due to the gap left by combined services of traditional sources and piped water supply (Moench and Janakarajan, 2006). Tanker operators supply mainly groundwater via borings and in a few cases, surface water is used from streams and springs. The tankers carry extracted groundwater from Jhaukhel VDC, Manamaiju VDC, Jorpati VDC, Gothatar VDC, Matatirtha VDC, and etc. Different sizes of tanks are available for water transfer from these locations. It ranges from small tanker trucks (5000 – 7000 litres) to large tanker trucks (i.e. 12,000 litres capacity).

According to the study conducted by the peri-urban water security project in 2009, 9 percent of the total demand in Kathmandu valley is fulfilled by private tanker operators when the total water demand in the valley was 280 MLD (KUKL, 2009). According to Moench (2001) and Moench and Janakaranjan (2006), the private tanker operators distribute an average of six MLD (19 percent of the total supply by the Nepal Water Supply Corporation). The study in 2009 (Water security in Peri-urban South Asia: Adapting to climate change and Urbanisation) shows that it increased to 25.5 MLD, which accounts for 39 percent of the total supply by KUKL. Figure 11 below shows how the tanker entrepreneur business boomed from

Figure 11: Trend of Water tankers operation in Kathmandu



Source: Valley Drinking Water tanker Entrepreneurs association records as of October, 2009

2006 to 2009.

There are a range of consumers for the private tankers i.e. private residents, hotels, restaurants, schools, construction works, pharmaceutical industries, and soft drink manufacturers.

During the study in 2009, water quality was tested at the point where water is loaded into the tankers and the results shows that:

- No traces of arsenic in all samples;
- In a few cases, the presence of ammonia, iron and manganese was beyond permissible limits; and
- E. Coli was detected at all locations except in deep boring at Balaju.

Municipal water supply – The Kathmandu valley Drinking Water Company

- Source of water distribution for KUKL[9] : 35 surface sources, 57 deep tube wells;

[9] *Groundwater use in the Kathmandu valley: An Analysis of Pre- and Post-Melamchi Scenarios by Madhav N. Shrestha. Published in Kathmandu valley Groundwater Outlook*

- KUKL facilitates its own tanker operation;
- Total water demand of Kathmandu is 320 MLD (million litres per day) as of 2010 (KUKL, 2011) and it is expected to increase further (unofficial records already show the demand has far exceeded the supply over the past years). It is assumed that KUKL in the dry season has a shortfall in supply of 60 percent and during the rainy season the shortfall accounts for 30 percent (KUKL, 2008), while KUKL is able to provide 90 MLD in the dry and 135 MLD in the wet season[10]; and

- The 2012 data shows 144 and 84 MLD of water during wet and dry seasons, respectively, against the demand of 350 MLD, resulting in shortages of 206 and 266 MLD in the wet and dry seasons, respectively.

Inter-Basin Transfer – The Melamchi project[11]

The Melamchi drinking water project is an inter-basin water supply project. The source originates from the Melamchi River in Sindhupalchowk and is perceived as the long-term solution to urban areas in Kathmandu valley through tunnelling. The details of the system is to:

- Plan and take 510 MLD in three phases (i.e. in each phase 170 MLD). The first phase will obtain water from the Melamchi river, while the second and third phase water will be channelled from Larke and Yangri river;

- Tunnel length: 26.5Kkm;

- Melamchi drinking water supply limited was established in 1995 (2052 BS);

- August 1998 (2055/2056 BS): Melamchi drinking water supply development committee was formed;

- 21 December 2001: a loan agreement was set up with the Asian Development Bank;

- 2002 (2058/59 BS): construction work started. The target was to complete the project by 2007 (2064/65 BS). However, another deadline (for 2014) was set for completion of the project. The current slow progress of work caused the government to set a third proposal to complete the project in 2016.

- Contractors:
  1. China Railway 15 Bureau group corporation, JV CMIIC (February, 2008): looking at 15.3 percent of work progress in around 80 percent of the contract period, the contract was cancelled on 25 September 2012; and
  2. Co-operative Muratorie Cementisti – DMC di Ravenna, Italy (July 2013) was selected for headwork's and tunnel construction, while for water treatment Plant, M/S VA TECH WABAG Limited – Pratibha Industries Limited succeeded to get a contract in July 2013.

- Progress of the tunnel until 17 August 2015 has been 13.385.30 m[12]. A new piped network laying is being implemented within the urban areas in Kathmandu. Excavation of water collection tanks in numerous locations are also ongoing.

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[10] *Analysis of Domestic Water use in the Kathmandu valley by Kanako Yoden from The University of Tokyo, Japan Published in Kathmandu valley Groundwater Outlook*

[11] *"Melamchi Cumulative Progress 069-70" and "After termination" report in 25th of September 2012.*

[12] http://www.melamchiwater.org/

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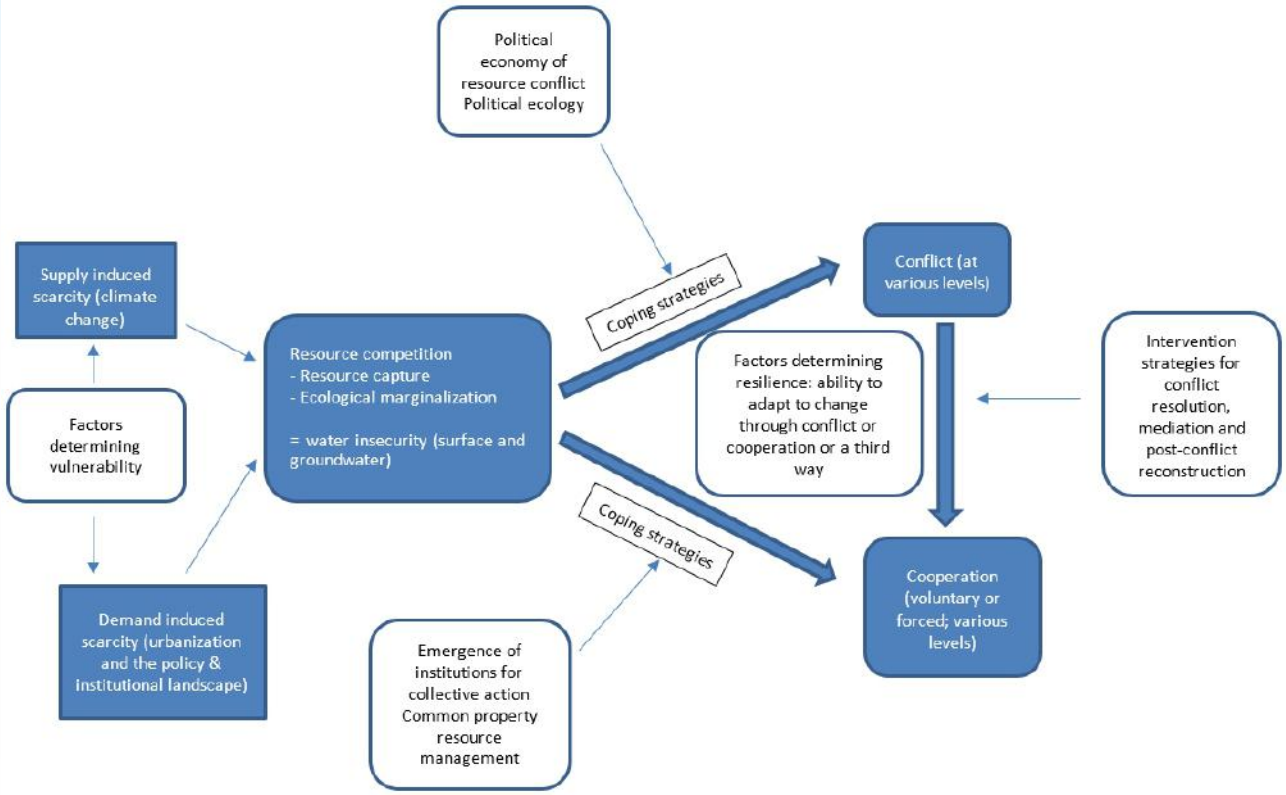
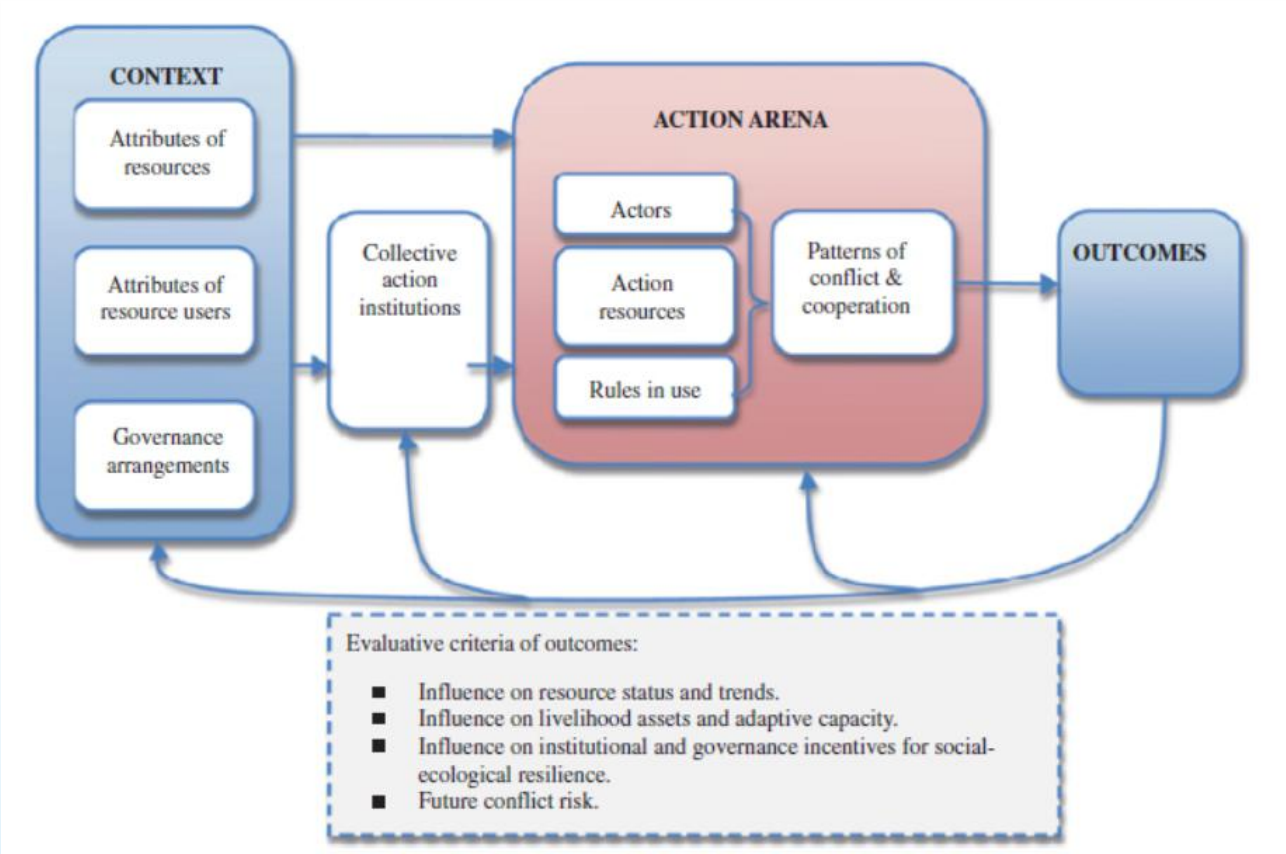
7. Annexes

Annex I: Theoretical Framework [adapted from Ratner, Meinz-Dick et al. (2013) and Bernauer, Bohmelt et al. (2011)[13]]



Conceptual framework on resource conflict, collective action, and social-ecological resilience



[13] *Bernauer, T., and Bohmelt, T. (2012). Environmental Changes and Violent Conflict. Environmental Research Letters. [Online] 7 (January). Available from: http://repository.essex.ac.uk/8620/1/1748-9326_7_1_015601.pdf. (Accessed: 30th of November 2014)*

Annex I: Theoretical Framework [adapted from Ratner, Meinz-Dick et al. (2013) and Bernauer, Bohmelt et al. (2011)[13]]

Search Keywords (Google+Google Scholar)

Kathmandu water; Kathmandu water management; Kathmandu water resources management; Kathmandu water climate change; Kathmandu water conflict; Kathmandu peri-urbanwater; Kathmandu peri-urban water climate change; Kathmandu peri-urban water cooperation; Kathmandu peri-urban water security

Results

Keywords	Authors	Title	Abstract
Urban water services; averting and mitigating behaviours; coping costs; willingness to pay (WTP); Nepal; South Asia	Subhrendu et al., 2005	Coping with unreliable public water supplies: Averting expenditures by households in Kathmandu, Nepal	This paper investigates two complementary pieces of data on households' demand for improved water services, coping costs and willingness to pay (WTP), from a survey of 1500 randomly sampled households in Kathmandu, Nepal. We evaluate how coping costs and WTP vary across types of water users and income. We find that households in Kathmandu valley engage in five main types of coping behaviours: collecting, pumping, treating, storing, and purchasing. These activities impose coping costs on an average household of as much as 3 U.S. dollars per month or about 1% of current incomes, representing hidden but real costs of poor infrastructure service. We find that these coping costs are almost twice as much as the current monthly bills paid to the water utility but are significantly lower than estimates of WTP for improved services. We find that coping costs are statistically correlated with WTP and several household characteristics.
Water conflicts; Large-scale hydraulic projects; Environmental Justice; Urban Political Ecology; International donor agencies	Domenech et al., 2013	Contesting large-scale water supply projects at both ends of the pipe in Kathmandu and Melamchi Valleys, Nepal	The residents of Kathmandu valley in Nepal face increasing water shortages that worsen during the dry season. Against this situation, the Melamchi Water Supply megaproject, supported by several foreign investors, was launched in 2000 to quench Kathmanduties' thirst by bringing water from Melamchi River through a 26 km-long tunnel. After more than 10 years, progress has been very modest. Besides the political instability of the country, opposition from certain sectors of society in both the urban and rural settings has created continuous disruptions of the works. We draw on Urban Political Ecology and Environmental Justice frameworks to analyse two distinct, although interconnected, social struggles battling against the project. The first one, anchored in the urban sphere, took advantage of the entry of the Communist Party of Nepal-Maoists, and succeeded in bringing down Asian Development Bank's (ADB) lending condition of handing over the water supply management to a private sector operator. The second one concerns the ongoing struggle of the rural residents affected by the inter-basin transfer. Local people in the rural areas mainly advocated conservation of their source of livelihood and political recognition. In the last part, we discuss how the use of local water sources and community-based alternatives may emerge as an alternative to hegemonic models of nature–society relations and contribute to overcome such conflicts and reduce negative impacts on the environment and social injustices.

Keywords	Authors	Title	Abstract
Climate change; Local hydrology; Flood; Water management; Flow trend; Nepal	Sharma and Shakya, 2006	Hydrological changes and its impact on water resources of Bagmati watershed, Nepal	For long-term planning and management of water resources, future change in the pattern of landuse, water demand and water availability should be analysed well in advance. The assessment of climate change impacts on the hydrological resources of a country is the most important assessment to be carried out, before planning any long-term water resources utilisation program. Change in the hydrology of the Bagmati River is analysed and its probable future implications are accessed. Trend analysis of seasonal flows and extreme events shows that monsoon seasonal floods are decreasing while other seasonal flows are constant. The magnitude of flood is decreasing but its frequency and duration are increasing. The hydrograph is shifting in time which is affecting water availability. In the changed scenario, hydropower production is likely to decrease in the future. Production of rice has decreasing trend while production of wheat has increasing trend. The proper modality of a water sharing agreement should be negotiated between the riparian countries Nepal and India before any conflict may arise, as the water volume is decreasing year by year. To address all the changing scenarios of the river hydrology an appropriate policy should be formulated for long-term water utilisation.
Squatter settlements; Grassroots, Housing policy; Nepal, Resettlement; Mobilization	Sengupta and Sharma, 2009	No longer Sukumbasis: Challenges in grassroots-led squatter resettlement program in Kathmandu with special reference to Kirtipur Housing Project	The paper is the outcome of a systematic effort to study and analyse the experiences of the Kirtipur Housing Project (KHP), the first ever grassroots-led squatter resettlement project in Kathmandu. It is widely hailed as a success story as it has been able to provide a legal, affordable and good quality housing solution to the Sukumbasis through grassroots mobilization. The paper analyses the dynamics of this mobilization and the roles of different actors to show how community empowerment, civil actions and local government interests have converged to create a constructive partnership in line with wider enabling principles. Apart from meeting the narrowly defined objective to rehouse 44 households, the project reflects capacity of the community, quite apart from lobbying and protest, in areas of project planning and management. While no grassroots mobilisation can be expected to replicate in a dynamic environment, the paper draws some policy insights that indicate the ability of the grassroots mobilization in Kathmandu to continue and grow. Conversely, the lessons learned from the project also point to limitations in terms lack of prerequisite critical mass or economic benefits to influence the government to prepare a policy framework under which it can foster in a more structured way.
Nepal; Urban development; Political ecology; Squatter settlements; Resource use	Moffat and Finnis, 2005	Considering social and material resources: the political ecology of a peri-urban squatter community in Nepal	Political ecology research tends to focus on rural communities. However, the paradigm is also useful in understanding the ecologies of urban and peri-urban settlements. We argue, through a case illustration of a peri-urban squatter community in Nepal that urban and peri-urban political ecology needs to explicitly recognize and analyse the relationships between materials, natural, and social resources. Our case study demonstrates that material resources such as land and social resources such as education are inseparable in the everyday lives of slum dwellers. Additionally, the internalizing of negative stereotypes can profoundly shape social capital and relationships within communities and with power holders. These issues of identity need to be fully integrated into a political ecology analysis of squatter and slum communities.

Peri-urban interface; policy guidelines; development agencies	**Budds and Minaya, 1999**	**Overview of initiatives regarding the management of the peri-urban interface**	**The aim of this paper is to provide an overview of the initiatives that are being taken with respect to the management of the peri-urban interface by development agencies, NGOs, research institutes and government authorities. The report is structured in two parts: the first will consider the initiatives being undertaken at the programme level and the second will consider interventions at the project level. This distinction has been made because the aim of this research project is to generate policy guidelines for the planning and management of the peri-urban interface with specific attention to the poor, including recommendations for effective strategies for this end. At the programme level agencies' policies are more apparent and the section on programmes seeks to reflect this, while the section on project interventions aims to highlight actual strategies for planning and management in specific cases.**
Himalaya; climate change; water-related hazards; cooperation; conflict	**Karki and Vaidya, (n.d)**	Adaptation to Climate Change Impacts and Regional Cooperation on Water and Hazards in the Himalayan Region	The rapid retreat of the Himalayan glaciers has consequences for water-related hazards, such as glacier lake outburst floods, and for water stress, as a result of the decline in fresh water supplies during the lean season. Thus there is a need to think and act seriously about cooperation among the countries in the Himalayan region for managing water resources and water-related hazards. According to the Fourth Assessment report of the Intergovernmental Panel on Climate Change (IPCC), the incidence and intensity of floods in the Himalayan region are expected to increase as a result of an increase in precipitation during the monsoon season and glacial retreat, both following from global warming. This poses a challenge for reducing the vulnerability of the more than 1.3 billion people living in the major river basins downstream from the Hindu Kush-Himalayan region. The overriding importance of climate change as a driver of environmental change makes it important to address disaster-reduction and water-management concerns in a holistic manner at the river basin level. Such an approach is considered by the IPCC to be an adaptive measure for climate change impacts.It has been suggested recently that regional cooperation on water and hazards can be facilitated by a perspective of regional economic cooperation that goes beyond the focus on water alone. This perspective would be based on water as a natural resource of central focus, around which cross-border economic exchange, primarily trade, and the development of infrastructure to facilitate it, take place. The present paper looks at these issues under three sections covering: a) conflict and co-operation, b) climate change impacts and regional cooperation on water-related hazards, and c) basin-wide regional economic cooperation.
Himalaya; climate change; water resources; livelihoods; adaptation	**Eriksson et al., 2009**	Impact of Climate Change on Water Resources and Livelihoods in the Greater Himalayas	The greater Himalayan region "the roof of the world" – contains the most extensive and rugged high altitude areas on Earth, and the largest areas covered by glaciers and permafrost outside the polar regions. The water resources from this area drain through ten of the largest rivers in Asia, in the basins of which more than 1.3 billion people find their livelihoods. The region and its water resources play an important role in global atmospheric circulation, biodiversity, rain-fed and irrigated agriculture, and hydropower, as well as in the production of commodities exported to markets worldwide. The water resources of this region are currently facing threats from a multitude of driving forces. Global warming is having a severe impact on the amount of snow and ice, which has serious implications for downstream water availability in both short and long term as up to 50% of the average annual flows in the rivers are contributed by snow and glacial melting. The warming in the greater Himalayas has been much greater than the global average: for example, 0.6 degrees Celsius per decade in Nepal, compared with a global average of 0.74 degrees Celsius over the last 100 years. Changes in precipitation are ambiguous with both increasing and decreasing trends in different parts of the region. The most serious changes are probably related to the frequency and magnitude of extreme weather events, such as high intense

Keywords	Authors	Title	Abstract
			rainfalls leading to flash floods, landslides and debris flows. There is a severe gap in the knowledge of the short and long-term implications of the impact of climate change on water and hazards in the Himalayas, and their downstream river basins. Most studies have excluded the Himalayan region because of its extreme and complex topography and the lack of adequate rain gauge data. There is an urgent need to close the knowledge gap by establishing monitoring schemes for snow, ice, and water; downscaling climate models; applying hydrological models to predict water availability; and developing basin wide scenarios which also take water demand and socioeconomic development into account. Climate change induced hazards such as floods, landslides, and droughts will impose significant stresses on the livelihoods of mountain people and downstream populations. Society will need to improve its adaptation strategies, and level structural inequalities that make adaptation by poor people more difficult. It is important to strengthen local knowledge, innovations, and practices within social and ecological systems as well as strengthening the functioning of institutions relevant for adaptation. Sound science together with credible, salient, legitimate knowledge is important to support the development and implementation of sound policies.
Rainwater harvesting, ecological sanitation, greywater reuse, sustainable water management	Shrestha, 2007	Eco home for sustainable water management. A case study in Kathmandu, Nepal	Shortage of drinking water and pollution of water bodies are the growing problem in urban centres of Nepal. Kathmandu, the capital of the nation, is severely affected by these problems where water is supplied only half of the actual demand and the major rivers are turning into open drains. Similarly, ground water is depleting at about 2.5 meters every year due to over extraction. There is no sign of increase in water supply within a decade and the nation has still not developed a concrete plan to clean up its rivers. In such circumstances, local level actions must be initiated to solve this crisis where people need to be oriented on simple techniques for sustainable management of water. Some of these techniques include rainwater harvesting, wastewater recycling, and ecological sanitation system. These techniques can be implemented from a single household to community level. In last two years, these initiatives have already been adopted by a few individuals and institutions. This paper describes a case study of a house in Kathmandu where rainwater is used for all purposes including drinking, greywater is recycled for non drinkable purposes and human excreta is utilised as a fertilizer by adopting ecological sanitation technique.
	WECS, 2011	Water Resources of Nepal in the Context of Climate Change 2011	
	WECS, 2002	Water Resources Strategy	

Papers and publications received through ICIMOD and SaciWATERs

Keywords	Authors	Title	Abstract	Conclusions and Recommendations
	Prakash and Singh, 2013	Water Security in Peri-urban South Asia: Adapting to Climate Change and Urbanisation		Key lessons: Climate variability and urbanisation interact to create patterns of peri-urban water insecurity. Disaggregating vulnerabilities: Gender, class\caste and access to water. Climate science verses local perception: Local adaptation at its best. Stakeholders' engagement is critical and paramount.
urbanisation; South Asia; climate change; water security	Narain et al., 2013	Urbanisation, peri-urban water (in)security and human well-being: a perspective from four South Asian cities	This paper examines the implications of urbanisation for water security and human health and well-being in four peri-urban South Asian locations, namely Khulna in Bangladesh, Kathmandu in Nepal, and Gurgaon and Hyderabad in India. It describes the implications of the urbanisation process for water access in communities in the peripheral areas of cities. It further discusses the implications of this for the health and well-being of peri-urban residents.	Focusing on four South Asian locations, this paper has described how urbanisation impacts water security and human well-being. Urbanisation creates new demands for water, which is moved out from agriculture and rural domestic needs to meet urban, residential, industrial and recreation needs. At the same time, urban and industrial wastes are dumped into peri-urban water sources. Thus, peri-urban residents lose access to water in terms of both quality and quantity. This translates into a wide range of impacts for human health and well-being, in terms of not only water-borne diseases but also reduced agricultural productivity and incomes and limited livelihood opportunities. From a public-policy and governance perspective, these issues arise from the links between land tenure and water (in)security, the peri-urban blindness of policy makers and the fragmentation of rural development and urban planning that precludes considering the impacts of one on the other. In the IDRC-supported project on water security in peri-urban South Asia, a range of interventions were made to improve peri-urban water security. These included: lobbying with service providers to be more responsive to the needs of peri-urban water users and providing a forum for dialogue

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				and interaction between the two to develop relationships of mutual accountability between them (Gurgaon); forming water-management committees to improve local management and distribution of water (Hyderabad, Kathmandu); and policy advocacy to prevent the encroachment, deterioration and contamination of peri-urban water bodies (Khulna, Hyderabad). In the long run, a mix of local mobilization and high-level advocacy will be needed to improve peri-urban water security and build peri-urban resilience to the impacts of rapid urbanisation.
Urbanisation, climatic variability, water, impacts, adaptation	Shrestha et al., 2013	Adapting to peri-urban water insecurity induced by urbanisation and climate change	This paper describes the implication of growing urbanisation in combination with climatic variabilities on water security and adaptation strategies of the people in peri-urban landscape of Kathmandu valley. Through multiple series of focus group discussions and key informant's interviews, the study found that the entire households at Lubhu depend on public stand posts with water supplied for few hours a day. The hydro-meteorological data analysis showed the increasing trend of temperature but clear pattern in precipitation was not found. However, people perceived the changes in both precipitation and temperature and impacts on their livelihood. People have envisioned development of filtration system to treat water from another source. However currently, they have been fetching water from spring sources in neighbouring VDCs and dug wells during the days with no water supply in stand posts. Farmers have been adapting to water scarcity for cultivating agricultural crops by switching to less water demanding crops, leaving land fallow and even by deviating towards off-farm activities to be more resilient to increasing water scarcity. The concern for sustainable water management is growing among the community however, strong dedication and unity among the communities is essential to ensure the water security in the village.	The increasing water demand with increasing urbanisation and declining water sources due to compounded effect of urbanisation and changing climatic pattern have resulted into increasing water stress in Lubhu. Considering the rapid urbanisation trend and increasing variability in climate, the concern for sustainable water management is growing among the local community however, strong dedication and unity among the communities is likely to be critical to improve their adaptive capacity and ensure the water security in the village.

	Prakash and Singh, 2013	Water Security in Peri-urban South Asia: Adapting to Climate Change and Urbanisation		Key lessons: Climate variability and urbanisation interact to create patterns of peri-urban water insecurity. Disaggregating vulnerabilities: Gender, class\caste and access to water. Climate science verses local perception: Local adaptation at its best. Stakeholders' engagement is critical and paramount.
Sand mining, history, volume, environment, implications	Shrestha et al., 2014	Environmental effects of terrace and sand mining: a case of Jhaukhel VDC in Kathmandu valley	This paper illustrates the environmental implications of uncontrolled terrace sand mining expanding in peri-urban areas of Kathmandu valley through case study of Jhaukhel VDC where terrace sand mining started since 1978. The primary information is collected from direct field observation, informal discussions and semi-structured interviews with local residents, tax collectors, sand mine operators and government officials from relevant organisations and substantiated through secondary information obtained from review of relevant published literatures and unpublished record of local organisations. The study found that terrace sand mining has been ongoing at Jhaukhel despite resistance by the local communities. Currently three sand mines are in operation. The estimated volume of annual sand extracted from these mines was 219,334 m3. This included underground sand deposits extracted illicitly in addition to sand deposited on the hillock as permitted by DDC. Groundwater depletion, landslides, debris flow and damages to farm lands have been major impacts emerging from haphazard sand mining at Jhaukhel. As the Jhaukhel lies in the northern groundwater district of Kathmandu valley, negative consequences of haphazard sand mining in the area is likely to bring negative consequences on future water security in Kathmandu valley. The study stresses on the need of intensive	Sand mining at Jhaukhel is haphazard without environmental concerns and has been damaging the local ecosystems as well as endangering the livelihood practices of the local people. Groundwater depletion, landslides, debris flow and damages to farm lands have been major impacts at Jhaukhel emerging from unchecked terrace sand mining and improper management of slope, dumped area and illegal extraction of sand deposited underground. As the Jhaukhel lies in the northern groundwater district of Kathmandu valley, haphazard sand mining in the area is likely to bring negative consequences on future water security in Kathmandu valley in addition to increasing risks of multiple environmental hazards triggered by sand mining. The unchecked sand mining in contravention with the regulatory mechanisms indicates the weak governance which has been encouraging the sand miners to extract sand rampantly. Furthermore the absence of any activity towards environmental management despite monitoring and warning from the regulatory bodies also creates doubt on the accountability of regulatory authorities. This has been bringing confrontation between community and mine extractors. Sand mining could have contributed economic opportunities and generated revenue which is beyond the scope of this study. The study found sand mining has made the local community highly vulnerable to multiple hazards. Therefore, the

Keywords	Authors	Title	Abstract	Conclusions and Recommendations
			monitoring of the mine sites and strengthening the regulatory mechanism and recommends local community and community based organisations to be proactive towards controlling haphazard sand mining and protecting the local environment.	study stresses on the need of intensive monitoring of the mine sites and strengthening the regulatory mechanism. The study also suggests the mine extractors to accept their social obligation and opt for the sustainable extraction of the resource. At the same time it recommends local community and community based organisations to be proactive towards building awareness about the consequences of over exploitation of sand and controlling haphazard sand mining and protecting the local environment.
Climate change, temperature, rainfall, perception, comparison	Shrestha et al., 2013	Comparing peoples' perceptions on climate change and the facts of changing climate: exploring reasons for inconsistencies	This paper provides an overview of changing climatic context in Kathmandu valley based on the analysis of climatic data and perception of local people on key climatic variables. Elabourating on the subjective interpretations which generated the climatic perceptions among the local people in peri-urban areas of Kathmandu valley; it correlates the two sources of knowledge on climate change. Indicating the consistency and inconsistency between two, the paper discusses on the reasons for the inconsistency that exists. Changes in climate perceived by peri-urban farmers were assessed through focused group discussions and household questionnaire survey. Rainfall and temperature data were analysed to understand the long term climatic trends. Temperature trend perceived by local people was in line with the recorded long term temperature trend, both showing an increasing trend. People perceived a decreasing trend in rainfall while the analysis of rainfall records did not reflect any clear temporal change in rainfall pattern. The possible deviation in actual and perceived change in rainfall could be the consequence of water stress increasing with water increasing population and declining sources of water at Lubhu. The study showed that the local perceptions on climate was basis of local knowledge of climate and directed decision making on climate issues. Further it showed that	The study showed that majorities of local people at Lubhu perceived changes in climate. These perceptions constituted the understanding of climatic changes and were also the basis for adaptive decisions on the impacts of climate change. However the perceptions were influenced by existing situations primarily increasing water scarcity, thus communicating findings of scientific analysis on climate change was essential in upgrading the local knowledge on climate change. Further it showed that rather than in isolation, climatic perceptions could be a relevant guide in structuring adaptive actions on climate change through validation with scientific studies.

			rather than in isolation, perceptions could be a relevant resource in understanding the changes in climate and taking adaptive actions on it through validation using scientific means as the perceptions could be influenced by other social factors.	
Peri-urban agriculture, rainfall, temperature, impacts, adaptation	Shrestha and Sada, 2013	Evaluating the changes in climate and its implications on peri-urban agriculture		
Groundwater extraction, impacts, peri-urban, urbanisation, water security	Sada et al., 2013	Groundwater extraction: implications on local water security of peri-urban area of Kathmandu valley	The rapid and haphazard urbanisation in Kathmandu valley and expansion of built-up area to the peripheral rural landscapes has resulted to formation of peri- urban areas which are now transforming into urban form. This paper examines how the increasing urban water demand has put unprecedented pressure on groundwater sources in the peri-urban areas of Kathmandu valley. Based on the semi-structured interviews with local people, focus group discussions and key informants interviews, the study found that water security at Jhaukhel is closely associated with groundwater and the dependency of local people on it has increased over the years. The implications of the groundwater extraction coupled with sand mining in the area have been manifested in the form of declining groundwater table and drying of traditional water sources. Despite the growing awareness among the local people on the consequences of depleting groundwater table, in absence of strict regulatory mechanism, the exploitation of groundwater has been adding threat to the local eco-hydrology of the area and subjecting the local community to water insecurity.	The study found that water security at Jhaukhel is closely associated with groundwater and the dependency of local people on groundwater has increased over the years. As the annual recharge of groundwater and hydro-geological settings of the study area is not known, it would not be possible to comment whether the ongoing trend of groundwater extraction in the VDC is sustainable. However, the lowering of the groundwater table and drying of water sources indicate the extraction of groundwater resources in the area is beyond the sustainable withdrawal rate and thus increasing the stresses on local environment and local water security. Despite the growing awareness among the local people on the likely consequences of depleting groundwater table, in absence of regulatory mechanism, the exploitation of groundwater has been adding threat to the local eco-hydrology of the area and subjecting the local community to water insecurity. While the local resources are being overused, the emerging threats emphasize on the need of redefining the legal and institutional framework addressing the groundwater management in the area.
	Prakash et al., 2013	Urbanisation, climate change and water security: adaptation strategies and approaches		

Keywords	Authors	Title	Abstract	Conclusions and Recommendations
Aquifer development, extraction, mapping, water quality	Pradhanang et al., 2012	Comprehensive review of groundwater research in the Kathmandu valley, Nepal		
Fossil water, groundwater districts, hard rock aquifer, hydrogeology, Kathmandu valley	Shrestha, S.D. 2012	Geology and Hydrogeology of groundwater Aquifers in the Kathmandu valley		
Arsenic, groundwater, Kathmandu valley, water quality	Chapagain, S.K and Kazama, F. 2012	Overview of Chemical Quality of Groundwater in the Kathmandu valley		
Household water consumption, household water sources choice, piped and non-piped water use, Kathmandu Metropolitan	Yoden, K. 2012	Analysis of Domestic water use in the Kathmandu valley		
Kathmandu valley, groundwater use, Melamchi water, water demand management	Shrestha, M.N. 2012	Groundwater use in the Kathmandu valley: An analysis of pre- and post-melamchi scenarios		
Groundwater, Kathmandu valley, water market	Dongol et al., 2012	Overview of water markets in the Kathmandu valley		
Groundwater policy, institutions, management	Shrestha et al., 2012	Groundwater development and management institutions and policies in Nepal		

Other publications:

Keywords	Authors	Title	Abstract	Conclusions and Recommendations
	Muzzini and Apparicio	Urban Growth and Spatial Transition in Nepal		*A predominantly rural country, Nepal is urbanising rapidly, and urban areas are a major contributor to economic growth and poverty alleviation. The Kathmandu valley constitutes the largest urban agglomeration and main cluster of economic activities in Nepal, and economic clusters have emerged in extended urban regions close to the border with India. But the spatial transformation that is associated with such a rapid urbanisation poses several challenges. Urbanisation is happening haphazardly, and under the radar in market and border towns, while the Kathmandu valley faces institutional, planning, and infrastructure challenges that deserve urgent policy attention. In order to unlock growth and make the spatial transformation sustainable, Nepal needs to foster the growth and sustainability of its urban regions, promote the development and regeneration of the Kathmandu valley, and enhance the competitiveness of strategic urban clusters. This chapter presents policy directions and actions for addressing the challenges associated with Nepal's urban transformation.* **Pillar 1: Foster the Growth and Sustainability of the Urban Regions** - *Prioritize the "Where, What, and How" of Public Interventions in the Urban Regions Based on Development Outcomes* - *Improve Internal and External Connectivity* - *Create the Enabling Environment for Sustainable and Inclusive Urban Development* **Pillar 2: Promote the Development and Regeneration** **of the Kathmandu valley Metropolitan Region**

Keywords	Authors	Title	Abstract	Conclusions and Recommendations
				- *Strengthen Planning and Its Implementation in the Valley* - *Develop an Infrastructure Financing Policy and Plan* *for the Kathmandu valley* - *Launch a Regeneration Program for the Valley's Historic City Centres* **Pillar 3: Enhance the Competitiveness of Strategic Urban Clusters** - *Promote Sustainable and Responsible Cultural Tourism Activities* - *Support the Modernization of the Handicraft Sector* - *Improve Agroprocessing Competitiveness*
Agriculture, adaptive capacity, climate change, developing countries, agrarian communities	Karki and Gurung, 2012	An Overview of Climate Change And Its Impact on Agriculture: a Review From Least Developing Country, Nepal	Climate is an important factor for agricultural production. However, in recent years consistent warming and rise in global temperature has resulted in visible impacts on the agriculture across the world. Nepal is not an exceptional case, where rising temperature has already affected the country's agricultural production thereby affecting the food security and agrarian communities. It is expected that the level of vulnerability will be higher in high altitude as compared to the lower altitude. In addition, majority of the population are subsistence farmer in rural parts of Nepal and has low land holding capacity. Nepal is one of the least developed countries in the world with low per capita income, and thus the country's ability to adapt to the extreme climatic events has direct implications in its strategies on	Nepal is much vulnerable to climate change. Nepal has already started to experience impacts of climate change in a number of ways, in which most critical one being the agriculture sector since more than 80% of the population heavily relies on this sector. Torrential rain, flash floods, mass movement, landslide, GLOFs are some of the major disasters occurring as a result of changing climatic patterns in Nepal, thereby affecting the agricultural production and food security in the country. The level of vulnerability will be more pronounced in higher altitude; in the mountains and hills, where majority of the people rely on subsistence farming. Despite receiving continuous financial and technical assistance from foreign donors, the process of adaptation to climate change is slow and discouraging.

			agriculture sector development. However, Nepal still lack strong scientific data about the cases of climate change and due to varied geographical setting, sufficient meteorological data cannot be easily obtained from remote parts of the country. This review tries to explore the current status of vulnerability to the climate change in Nepal. In Nepal, more than 80% of the people heavily rely on agriculture for their subsistence and thus, climate change will bring expectedly negative response to the agricultural sector in the country.	
Climate change, adaptive capacity, water supply, urbanisation, Kathmandu	Jha and Shrestha, 2013	Climate Change and Urban Water Supply: Adaptive Capacity of Local Government in Kathmandu City, Nepal	Climate change poses significant challenges to water resources in cities in the form of high variability and seasonal scarcity, given the weak institutional capacity of the concerned agencies. Given the massive speed and scale of urbanisation in developing countries like Nepal, the gaps in current knowledge of the role of city government in adapting to the impacts of climate change on water are considerably large. Hence, this research aims to investigate the capacity of the local government to adapt to the impacts of climate change on drinking water supply, with a case study of Kathmandu Metropolitan City. The research is based on a critical literature review, policy analysis, observations and reflections. Results indicate that drinking water supply in Kathmandu is under severe stress because of a sharp reduction in precipitation, rapid increase in urban population and poor urban water governance. There is a high degree of	The shift of government policies in Nepal shows that climate change has become one of the critical issues for the government. With rapid urbanisation in the country, the paper has focused on the analysis of adaptive capacity of Kathmandu city government to cope with the impacts of climate change on drinking water supply. The paper explains that the existing efforts of Kathmandu Municipality are limited; focusing on IBWT and due to the projected sharp decrease in precipitation, the IBWT projects cannot meet the increasing demand for drinking water of the city residents. Meanwhile, the existing climate change adaptation policy only lists some broad options. Detailed analysis of these options is lacking. Most institutions and their decisions seem to be informed by the knowledge produced by professionals and scientists. Institutions and knowledge with local communities is ignored. While the current policy attempts to provide some efforts to address water supply issue in a changing climate, the actual practice fails to do so. This failure highlights the need to look at the issues of institutions and their capacity as

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			population and poor urban water governance. There is a high degree of uncertainty in predicting the impacts of climate change on precipitation, which demands a variety of solutions engaging various actors, piloting different options, learning from piloting and adapting new institutions based on the learning. Besides, strong leadership and resources are required to deal with the insurmountable challenges of climate change. City governments involved in water supply do not have adequate capacity or resources to cope with the current and future climate change impacts on urban water. Existing efforts are focused on supply of water from inter-basin water transfers with no detailed analysis of options. The paper concludes by highlighting the need to reframe the relationship between citizens, policy-makers and scientists to bring about effective solutions to the problem of urban water supply in a changing climate.	so. This failure highlights the need to look at the issues of institutions and their capacity as central to decision making about climate and water policy and development issues. Clearly, the restricted thinking embedded within the bureaucratic culture and scientific tradition continues to inform policies about urban water issues. The restricted thinking is linked to the hegemony of 'science', which provides knowledge and skills to facilitate narrow understanding of urban planning and development problems and solutions. The policy-makers have failed to appreciate wider social, economic and political relevance of community institutions, knowledge, problems and solutions. The conventional institutions and power relations remain unchanged, as the traditional bureaucratic policy-making style maintains status quo. Therefore, there is an urgent need for reframing the relationship between citizens, scientists and policy-makers to promote knowledge-based urban planning practices. While we do not assert that improved institutions and policies may be devised and urban water supply problem is addressed, improving institutions, policy and development outcomes necessitates realising that community institutions and knowledge are important to complement bureaucratic institutions and scientific knowledge. The reframing should aim at improving the institutions, policy and development practices by providing a suitable and sufficient opportunity for urban local community participation to occur. The restricted thinking of a narrow focus on the bureaucracy, scientists and professionals should be modified so that social goals such as justice and participation are paramount and that institutions from the orthodox science are

				used to promote such social goals. This may, however, be controversial because it challenges the structures of power and privilege of scientists, experts and planning professionals. Furthermore, it may be upsetting for traditional planning and development agencies as it challenges long-held bureaucratic practices and processes. Nevertheless, an analysis of institutional history and current development practices suggests that it is overdue to question institutional assumptions and to set agendas, with which the Kathmandu Metropolitan planning policy and development practice can be advanced. We offer following specific recommendations based on this study: - Planning policies about urban development not only need to clearly reflect the intent of the overarching policies, but they also need to provide (with resources) specific institutional guidelines to implement them in practice; - There is a need for a broad range of opportunities to be created/implemented and to bring about community institutions and knowledge, a targeted social science approach needs to be employed to analyse climate change issues; - Local communities and professionals need to be re-educated so that their attitude, capacity and interests for climate change adaptation are increased; and - Detailed analysis of options and translation of suitable options into socially desired plans and activities.
Climate change, gender,	Mainlay and Tan, 2012	Mainstreaming gender and climate change in Nepal	Vulnerability is an indication of one's exposure to external risks and one's capacity to cope with and recover from these stresses. Nepal, as one of the	

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mainstreaming, Nepal, policies			Least Developed Countries (LDCs), has a high vulnerability to climate change. In these countries, women are more vulnerable to the impacts of climate change than men, since women's adaptive capacity is determined by the availability and accessibility of natural resources, which are adversely affected by climate change. Given that men and women have different adaptive capabilities, climate change has an impact on the relationships between them - the gender dynamic. In countries such as Nepal, which is already characterised by discrimination against women in its culture and traditions, climate change exacerbates these existing gender inequalities. There are clear connections between sustainable development and gender equity, and there are many resources available which can inform the development of climate change policy, where there is limited research on the linkages between adaptation and gender. The findings in this paper indicate that a gender focus needs to be an integral part of climate change policies and programmes so as to move towards the goal of achieving more equitable and sustainable development in the face of climate change. An examination of existing climate policy in Nepal, including the 2011 Climate Change Policy, the NAPAs, the LAPAs, and other international agreements, shows that despite there being.	

MSc Thesis (Pokhara University)	Sada, 2010	Processes and consequences of the degradation of the Hanumante river basin: religious, cultural and livelihood impacts.		
environmental changes, violent conflict, adaptation, migration	Bernauer et al., 2012	Environmental changes and violent conflict	This letter reviews the scientific literature on whether and how environmental changes affect the risk of violent conflict. The available evidence from qualitative case studies indicates that environmental stress can contribute to violent conflict in some specific cases. Results from quantitative large-N studies, however, strongly suggest that we should be careful in drawing general conclusions. Those large-N studies that we regard as the most sophisticated ones obtain results that are not robust to alternative model specifications and, thus, have been debated. This suggests that environmental changes may, under specific circumstances, increase the risk of violent conflict, but not necessarily in a systematic way and unconditionally. Hence there is, to date, no scientific consensus on the impact of environmental changes on violent conflict. This letter also highlights the most important challenges for further research on the subject. One of the key issues is that the effects of environmental changes on violent conflict are likely to be contingent on a set of economic and political conditions that determine adaptation capacity. In the authors' view, the most important indirect effects are likely to lead from environmental changes via economic	As noted in section 1, policy makers and scholars alike would like to know what kinds of environmental changes have what kinds of influences on what kinds of conflict or cooperation. Our letter of existing research demonstrates, however, that there is no consensus in the scientific literature on what the answers to these questions should be. We have shown that current theorizing and empirical research focuses primarily on the broader question of whether environmental changes increase the risk of violent conflict, as predicted by the neo-Malthusian perspective. The available empirical evidence, notably the evidence from qualitative case studies, shows that environmental stress can contribute to violent conflict in some specific cases. The evidence from quantitative large-N studies strongly suggests, however, that we should be very careful in drawing general conclusions from location- and time-specific case-study results. Particularly those large-N studies that we regard as the most sophisticated ones find that the effects of environmental changes on violent conflict, examined for a large population of countries and locations over long time-periods, are not robust to alternative model specifications. Overall, the existing evidence suggests that environmental changes may, under specific circumstances, increase the risk of violent conflict—but do not systematically do so. Our letter also highlights what we consider the most important problems that further research should deal with. Data gaps, particularly with respect to information on conflicts, environmental

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			performance and migration to violent conflict.	problems and environmentally induced migration, loom large. The main gaps pertain to issue coding of conflict events and data for lower-intensity non-state conflicts. Similar problems exist with respect to spatially resolved data on environmental conditions. Such shortcomings constitute a key reason why scientific research cannot, at present, identify whether particular types of environmental changes are systematically associated with particular types of conflict or cooperation. Another key challenge is to empirically identify indirect and conditional effects of environmental changes on violent conflict. Systematic consideration of intervening variables, such as economic and political conditions, which are very much emphasized by the cornucopian perspective and are to some extent also considered in the qualitative case studies literature, are crucial in this context. Recent large-Nresearch has begun to address this issue more systematically (e.g. Koubi *et al* 2012, Gizelis and Wooden 2010, Buhaug *et al* 2008, Salehyan 2008a, Miguel *et al* 2004). We believe that significant progress towards resolving these analytical problems is possible on the basis of existing datasets and that these analytical solutions can then fruitfully be applied to new environmental as well as conflict data as they become available.
	Gillinson, 2004	Why cooperate? A multidisciplinary study of collective action	The question of cooperation has fascinated and perplexed philosophers, economists, psychologists, sociologists and biologists from Aristotle to Darwin. It continues to do so today. At the heart of the debate is the relationship between the individual and the group or society to which he or she belongs: why cooperate when we	*3.1 Why cooperate?* One key message filters through every discipline – we are simply not as uncooperative as theorists objectively expect us to be. Why? Because we may be closely related, because our selfish genes dictate that we must cooperate within groups to survive, and because we learn to reciprocate good behaviour.

			believe our individual interests would be better served by acting unilaterally? This paper takes a broad, multi-disciplinary approach to answering the question 'why cooperate?' It contains three sections.	*3.2 Cooperation and imbalances of power* The 'powerful' cooperate with the 'weak' (and vice versa) to maximise efficiency and their chance of survival. When the powerful do not cooperate, it may still be to the advantage of others to do so as a 'second best' solution.
Collabourative adaptive management, conflict resolution, emotion, public policy mediation	Laws et al., 2014	Hot adaptation: what conflict can contribute to collabourative natural resources management	We analyse the impact of conflict on the adaptive co-management of social-ecological systems. We survey the risks and the resources that conflict creates and review experiences with public policy mediation as a set of practical hypotheses about how to work collabouratively under conditions of conflict. We analyse the significance of these features in the context of an approach to adaptive co-management that we call "hot adaptation." Hot adaptation is organized to draw on the energy and engagement that conflict provides to enhance the capacity for deliberation and learning around the wicked problems that constitute the working terrain of adaptive co-management.	
	Deligiannis, T. 2012	The evolution of environment conflict research: toward a livelihood framework		This review of qualitative environment-conflict research since the early 1990s finds that the state level of analysis that has dominated this research appears to have generated considerable uncertainty about the validity of hypothesized connections and considerable under specification about the myriad pathways that exist in human-environmental change interactions. This article has proposed a household-livelihood framework for future research to correct some of these problems. Such an approach will also lead to a better appreciation of the many previously-ignored local violent conflicts that

Keywords	Authors	Title	Abstract	Conclusions and Recommendations
				have their roots in human environmental change interactions.
Collective action, common pool resources, conflict, conflict management, governance, institutional analysis and development, natural resource management, policy, resource conflict, social-ecological resilience	Ratner, Meinzen-Dik et al., 2013	Resource conflict, collective action, and resilience: An analytical framework	Where access to renewable natural resources essential to rural livelihoods is highly contested, improving cooperation in resource management is an important element in strategies for peacebuilding and conflict prevention. While researchers have made advances in assessing the role of environmental resources as a causal factor in civil conflict, analysis of the positive potential of collective natural resource management efforts to reduce broader conflict is less developed. Addressing this need, we present a framework on collective action, conflict prevention, and social-ecological resilience, linking local stakeholder dynamics to the broader institutional and governance context. Accounting for both formal and informal relationships of power and influence, as well as values and stakeholder perceptions alongside material interests, the framework aims to provide insight into the problem of (re)building legitimacy of common pool resource management institutions in conflict-sensitive environments. We outline its application in stakeholder-based problem assessment and planning, participatory monitoring and evaluation, and multi-case comparative analysis.	This framework aims to improve understanding of the role of collective action in resource conflict and its outcomes, as well as the practice of intervention to improve such outcomes at multiple levels. In this concluding section we outline three such applications: (a) stakeholder-based problem assessment and planning for development interventions and policy reforms, (b) participatory action research for monitoring, evaluation, and collective learning in ongoing initiatives, and (c) multi-case comparative analysis and synthesis of lessons. The framework can be adapted for participatory problem assessments by drawing attention to the links between immediate sources of dispute and the broader contextual factors that increase or decrease conflict risk. An assessment of the contextual factors – characteristics of the resources and of the users, including the risks and assets, the governance arrangements, and collective action institutions – can help to anticipate the scope for conflict or cooperation. Examining the range of actors involved, the resources at their disposal, and the rules at play, provides a structured way to explore solutions. Equally, the framework should aid joint planning building on such assessments to scope collective priorities for policy and institutional reform efforts, or for development interventions at national, sub-national, or regional scales. As such, the process of collective analysis and problem-solving can itself become an instrument of social learning. Just as the framework can be applied to collabourative analysis and planning, it can enhance efforts at monitoring and evaluation

of ongoing initiatives, again by broadening the consideration of contextual factors and collective action strategies.

The resilience approach encourages practitioners to augment stakeholders' evaluation of outcomes in terms of their immediate interests to encompass a more integrated perspective on prospects for the social-ecological system as a whole and the longer-term implications for their own livelihood security. There is important scope as well for process evaluation, assessing the degree to which stakeholder interactions are contributing to social learning, building relationships and trust across social divides, and opening up opportunities for institutional innovation that facilitate positive expressions of collective action in the future.

In its application to multi-case comparative analysis, the framework can yield lessons on the factors that influence collective action in resource conflict so as to refine our understanding of strategies that work in policy reform and development practice across a range of conflict sensitive environments. Although recent research on violent conflicts in developing countries has found that contemporary conflicts more frequently occur within rather than between states, the unit of analysis for many comparative studies remains the nation state. When the question at hand is not simply where risk conflict is high but also what to do in response, a more fine grained analysis of institutional dynamics is required. Our framework can assist in this task by showing how resource conflicts (and successfully avoided conflicts) result from decisions made by resource users within a particular institutional and environmental context. By doing so, the framework provides

Keywords	Authors	Title	Abstract	Conclusions and Recommendations
				a basis for comparison of cases that applies across multiple scales of analysis, rather than seeing conflict as a function of national-level characteristics. Likewise, it encourages analysts to explore both the constraints of the institutional and governance context and the scope for actors to influence and shape that context over time.
	Poudel, GP. 2011	Water Consumption status in Lalitpur sub-metropolitan city area in Nepal	This research is undertaken with main objectives of surveying and analyzing the present condition of public's water consumption pattern from different water sources in Lalitpur sub-metropolitan city area. This is entirely based on field research and various steps of field research tools were used. Field observation and Key Informant Survey were carried out to collect for general data of the water sources and then to categorize them on the basis of their performance. Structured questionnaire survey was the undertaken with the users to assess the water use. Comparing different scenarios and results from users survey it is find that maximum 33% of demand fulfil by NWSC-supply,7% fulfil by private well,3% fulfil by neighbours well,10% fulfil by public well 10 % fulfil by tanker supply,3 % fulfil by rain water and 7 % fulfil by NWSC-Collection tank and 27% water demand fulfil by traditional stone spouts. Per capita water consumption of the users vary from a max 49 Lpcd to a minimum is 29 lpcd. This is mainly fulfilled by NWSC-supply, well, tanker supply and NWSC collection tank provided in different place in LSMC area and stone spouts.	Comparing different scenarios and results from users survey it is find that maximum 33% of demand fulfil by NWSC-supply,7% fulfil by private well,3% fulfil by neighbours well, 10% fulfil by public well 10% fulfil by tanker supply, 3% fulfil by rain water and 7% fulfil by NWSC Collection tank and 27% water demand fulfil by traditional stone spouts. Public water consumption pattern in LSMC area is a max of 49 lpcd and a minimum of 29 lpcd which is mainly fulfilled by NWSC-supply, wells, tanker supply and NWSC collection tank provided in different place in LSMC area and stone spouts. Community water management practices in Iku hiti, Alko Hiti and Haku Hiti were good and it is better to apply the same in other good types of stone spouts. Due to inadequacy of NWSC-Supply, stone spouts source has become the main secondary source in LSMC area. It is also found that the discharge from each stone spout is being reduced every year and conservation is becoming urgent for the future.

Wastewater, agriculture, water quality, Kathmandu valley, farmer perceptions, health impacts	Rutkowski et al., 2007	Wastewater irrigation in the developing world- Two case studies in the Kathmandu valley in Nepal	Wastewater irrigation in the Kathmandu valley is a widespread but poorly documented practice. This paper presents data from two case study sites, the Kirtipur and Bhaktapur municipalities of the Kathmandu valley. An overview of existing urban wastewater disposal infrastructure, wastewater agriculture practices and quality of water used, the health implications of these practices and the level of institutional awareness of wastewater related issues are presented and compared with wastewater irrigation in other regions of the world where irrigation with wastewater is practiced. Data for the analyses on agricultural practices and health implications were obtained from a sample of 109 farmers using wastewater within the two municipalities. Bhaktapur typified direct utilisation of wastewater by pumping from sewers whereas Kirtipur farmers used it indirectly by gravity flow from polluted rivers. Central to the discussion is that farmers here do not always choose to use wastewater but exploit its benefits when obliged to do so. Since the wastewater also changes the hydrology of the watercourse rendering it perennial, many farmers see the benefit of utilizing the resource. The negative attitude of some farmers towards wastewater stemmed from their inability to control wastewater application leading to flooding and loss of crops. The majority of farmers are well aware of negative health impacts particularly those related to	1. Informal wastewater irrigation is occurring in the urban and peri-urban areas of the Kathmandu valley of Nepal but the authorities dealing with the diverse aspects related to such practices are poorly aware of the extents and significance. Advocacy and capacity building is necessary to overcome these limitations 2. Downstream of cities, wastewater generation has changed the hydrology of river systems substantially, providing a reliable source of water to farmers in the dry season. This water allows farmers to overcome seasonal variations of water availability, and generates better livelihoods because of possibilities to cultivate high value cash crops close to the city. However, it also changes the environmental conditions downstream of these cities. 3. Due to the lack of treatment facilities, the quality of water in these rivers will not improve in the foreseeable future. However, the high nitrate and phosphate levels can be beneficial to farmers if they can control wastewater and nutrient application. Participatory action in this direction, through agricultural extension services to farmers can be beneficial. 4. The quality of wastewater used varies from diluted wastewater to raw sewage. Farmers whose sources of water are polluted or who have recourse to sewage water because it is easily accessible or the only source; are experiencing mild to serious health impacts from exposure. More detailed studies of these consequences are necessary, accompanied by measures to help farmers minimize them. 5. Institutional awareness of the complexity of the problem is very low. Wastewater use in agriculture is not regulated and national

Keywords	Authors	Title	Abstract	Conclusions and Recommendations
			skin infections, and they attempt to protect themselves through washing. No change in water quality can be expected without infrastructure investments and wastewater management changes, which are slow in coming due to the lack of institutional awareness about the complexity of the problem. Interaction amongst the various stakeholders through a formalized mechanism, to influence the disposal and reuse of wastewater is suggested.	standards or guidelines, and related planning regulations are non-existent. Interaction through a formal mechanism, among the key stakeholders who can influence the course of wastewater agriculture in Nepal, is suggested to effect beneficial changes. 6. Wastewater irrigation may play a significant role in improving water quality through sequential application on land in the Kathmandu valley systems. For this method to work, the two main ingredients are (a) land availability and (b) consultation and interaction amongst the key stakeholders dealing with the different facets of wastewater agriculture.

Authors	Title	Main ideas from main body	Conclusion
Butterworth, J. et al., 2007	**Peri-Urban Water Conflicts: Supporting dialogue and negotiation**	Disputes over water resources and problems in dealing with wastewater and pollution, similar to that observed in Cochabamba, Chennai and São Paulo, can be found in almost any rapidly growing city in developing countries. The history of many developed world cities, most famously Los Angeles as depicted in books and film (see for example the book *Cadillac Desert* [Reisner 1993] and the film *Chinatown*), tells a similar story about California's water wars. Competition and conflicts over water resources to meet the growing urban demands, and risks related to pollution, are concentrated in the peri-urban interface where cities meet their rural hinterlands. After exhausting local groundwater and surface water resources, most large cities are forced to develop extensive pipeline networks to access water from distant sources, often over tens or hundreds of kilometres. Aquifers and rivers close to cities, and often over large distances downstream, are also frequently threatened by pollution from industry and residential areas without sewage collection or treatment facilities. The expanding 'footprint' of cities desperate to secure new water supplies for growing populations puts cities into competition for scarce resources with other users of water at the peri-urban interface who are determined to protect their water rights, or to ensure that they benefit from changes in the way that water is allocated and utilised. At the same time livelihoods at the peri-urban interface are changing fast. Agriculture is normally the major water user in the catchments around cities but this may decline as labour is drawn towards the better pay available in industries and services, or conversely, become more vibrant as farmers intensify efforts to meet new demand from closer markets. Peri-urban catchments provide many important hydrologic services to cities including improvements in water quality and protection from flooding. But with changes in land use, these services are also being modified by urbanisation processes. Risks of flash flooding in particular are increased due to the larger impermeable areas of land associated with urbanisation. What leads to so many conflicts over (land and) water resources at the edge of cities? i. High and rapidly growing demands are met by a bewildering mix of formal and informal, structured and make-shift governance arrangements. ii. The different stakeholder groups have very different motives and expectations, which the existing institutions cannot adequately meet. As a consequence of competing claims and institutional gaps, those most in need of services often fail to get them. In developing countries especially, tensions over access to water and the risks of pollution are critical for some of the poorest people. In peri-urban areas, it is typical	i. The poorly planned or unplanned urbanisation processes have dramatic effects on land use, agriculture and livelihoods in peri-urban areas. Good service provision to planned new settlements could alleviate pressures but is often lacking. ii. Women in particular are more vulnerable, for they are not only losing their traditional agricultural employment but are also not as free as men to seek casual urban employment, so that women find it harder to adapt to the changing environment as a result of dumping of wastes, high level of water extraction (means: tankers, bottled water) in peri-urban. iii. Pollution from untreated wastewater and also from industrial processes and the remaining of agriculture has major impact on water quality. iv. Peri-urban zones are areas of local institutional weakness. Rural organisations are often seen to be weakening while urban orientated organisations are not yet existent or are weak and struggling to fulfil new roles. Citation: Butterworth, J., Ducrot, R., Faysse, N. & Janakarajan, S. (Editors) (2007). *Peri-Urban Water Conflicts: Supporting dialogue and negotiation*. Delft, the Netherlands, IRC International Water and Sanitation Centre (Technical Paper Series; no 50). 128 p.

Authors	Title	Main ideas from main body	Conclusion
		to find some of the poorest urban dwellers including new migrants (often living in slums) alongside existing populations struggling to adapt to changes including shifts in employment from agriculture to industries and services, and changes in lifestyles. The water and sanitation services that people get in peri-urban areas are frequently from alternative or informal service providers including the local private sector often remain invisible to policy makers Allen *et al.* (2006) said. They distinguish between 'policy-driven' mechanisms that are currently unable adequately to address the needs of the peri-urban poor, and the 'needs-driven' coping strategies that appear more effective in enabling poor people to improve their access to services.	
	Poverty and climate change: Reducing the vulnerability of the poor through Adaptation	This paper focuses on the impacts of climate change on poverty reduction efforts in the context of sustaining progress towards the Millennium Development Goals and beyond. One of the chief message emerging from this paper are: Climate change is happening and will increasingly affect the poor: The impact of climate change, and the vulnerability of poor communities to climate change, vary greatly, but generally, climate change is superimposed on existing vulnerabilities. Climate change will further reduce access to drinking water, negatively affect the health of poor people and will pose a real threat to food security in many countries in Africa, Asia, and Latin America. Third Assessment Report of the IPCC, developing countries are expected to suffer the most from the negative impacts of climate change. This is due to the economic importance of climate- sensitive sectors (for example, agriculture and fisheries) for these countries, and to their limited human, institutional, and financial capacity to anticipate and respond to the direct and indirect effects of climate change.	
	Impact of Climate change: Voice of the People **Practical Action (2010)**	Observed temperature trend The annual mean temperature over Nepal increased steadily at a linear rate of 0.4° C per decade from 1975 to 2005 (APN 2007). ICIMOD (2007) stated, the temperature rise in Nepal was within a range of 0.2 - 0.6 °C per decade between 1951 and 2001 particularly during autumn and winter. Warming trend is high in the mountains and hills compared to tarai. Community perception: The local people have experienced rise in temperature with hotter days, longer summer and shorter winter seasons. These perceptions were backed by the data provided by the meteorological stations which showed increasing trend in temperature. Observed rainfall trend There is no significant change in annual and monsoon precipitation in Nepal (APN 2007, Shrestha et al. 2000). However, a clear decreasing trend has been seen in the number of annual rainy days during the last four decades (APN 2007). A	Local people have perceived that there have been changes in local climate and it is affecting local environment and their livelihoods. However, it is difficult to isolate the impacts of climate change since a number of factors and causes are interrelated to each other. The interactions are ongoing between (1) impacts of climate change, (2) natural adaptation of plants and animals to new climate, (3) development practices and management of available resources and (4) development of new technologies that are constantly coming in the practice. Therefore, the observed impacts are not always the results of climate change. Some tools and methodologies are needed to help identify the real impacts due to climate change.

	significant variability on annual and decadal time scale was noted in the rainfall record from 1959 to 1994 (Shrestha et al. 2000). Changes in precipitation are occurring in amount, intensity, frequency and form over the locations in Nepal. The average annual precipitation trend ranged from -10 to 20 mm in the eastern region, -40 to 20 mm in the central region, -30 to 40 mm in the western region, -20 to 10 mm in the mid-western region and -10 to 20 mm in the far western region between 1976 to 2005 (Practical Action 2009). Community perception: The local communities have observed the form of precipitation has changed from snow to rain in the high mountains where temperature is in increasing trend with more hails in the middle mountains, less dews in some parts of tarai. There are deviations on the dates of precipitation from the ones that used to occur in the past. Duration of drought has increased. The nature of rainfall has also changed from more little rain over a several days to more intensive rain within few days or hours.	The increase in temperature has brought changes on germination, growth, flowering and fruiting behaviour of plants. As the cold season is shortening in most of the locations, the growing seasons are getting longer. An altitudinal upward shifting of plants was reported by communities in both forest species of day-today use like fuel and fodder, and agricultural crops i.e. crop species and varieties recommended for lower altitudes can be grown in higher altitudes risking encroaching higher altitude pasture and forest land for crop cultivation. Ground water depletion: i. Increased consumption due to population growth and increased agricultural land; ii. Untimely recharge of the ground water due to erratic rainfall patterns Local people have perceived that impacts of climate change have made their livelihoods harder in most of the cases. In case of water resources, conflicts have begun between the communities as the scarce resource becomes scarcer. When the existing resource base becomes insufficient to sustain the livelihoods, people try to access underexploited natural resources including water and forest that gives rise to increased competition and conflicts among them.
The National Adaptation Programme of Action (NAPA) in Nepal	The National Adaptation Programmes of Action (NAPA) intend to take into account the existing coping strategies at the community level and to build upon these to identify priority activities, rather than focusing on scenario-based modeling to assess future vulnerability and long-term policy at the national level. It is therefore, important for the least developed countries, such as Nepal, to identify community-based coping strategies of climate induced vulnerability and the scaling up of adaptation and integration of climate change into national development plans. The goal of a NAPA is to enable countries to respond strategically to the challenges and opportunities posed by climate change. A key strategy of the NAPA is to ensure comprehensive stakeholder input in all stages of the implementation process, involving national and local level government institutions, non-governmental organisation, civil societies groups, academia, and international organisation and donor agencies.	

Authors	Title	Main ideas from main body	Conclusion
	Climate Change and Agrobiodiversity in Nepal: Opportunities to include agrobiodiversity maintenance to support Nepal national Adaptation Programme of Action (NAPA)	Climate change is becoming one of the major environmental issues in Nepal. There is evidence that climate change is already affecting the biodiversity and weakening the livelihood assets of poor and marginalised communities. Despite this climate change has been largely left out of the Nepal Environment Policy and Action Plan. The existing government policy on the agriculture sector also takes no systematic account of the anticipated impact of climate change. The preparation of the National Adaptation Programme of Action (NAPA) is the first official initiative to mainstream adaptation into national policies and actions so as to address the adverse impacts of climate change and reduce vulnerability to changing climate and extreme events.	Citation Bimal Regmi and Apar Paudyal, edited by Paul Bordoni, 2009. Climate Change and Agrobiodiversity in Nepal: Opportunities to include agrobiodiversity maintenance to support Nepal's National Adaptation Programme of Action (NAPA) / Available on line at www.agrobiodiversityplatform.org/blog?getfile=3537
	Diversified Livelihoods in changing socio-ecological systems of Yunnan Province, China (ICIMOD & World Agroforestry Centre), 2009	This study demonstrates that government policies play a key role in shaping the extent to which rural households are able to adapt to climate change and climate hazards. Economic reform and shifts in property regime have weakened rural institutions and collective action in water resource management. Rural transformation from a centrally planned and collectively managed agrarian economy to a market-driven one has increased off-farm income opportunities and reduced exposure to risks induced by climate change. Meanwhile, agricultural intensification, which depends on large inputs of chemical fertilizer, might cause maladaptation as well as greenhouse gas (GHG) emissions. Finally, it is clear in comparing experiences at each site that a gradient of biophysical and socioeconomic conditions among the sites studied indicates varying degrees of exposure to natural hazards and climate-induced risks, as well as diverse options for adaptation.	Based on studies in these three selected sites, we conclude the following: a) Chinese government policies play a key role in shaping the extent to which rural households and villages have the capacity to adapt to risks induced by climate change. Adaptation does not occur usually without enabling policies and institutional arrangements. The Chinese government has often implemented different and sometimes even contradictory policies, however, and these have affected local adaptive capacities. b) Economic reform and shifts in property regime have weakened rural institutions and collective actions in water resource management. Large-scale water infrastructure developed during the collective period has been poorly maintained due to ambiguity in property rights and financial support after introduction of the Household Responsibility System. This is a challenge for farmers not only in terms of adapting to climate change but also in terms of adapting to changing socioeconomic conditions. c) Rural transformation and off-farm opportunities have reduced exposure to risks induced by climate change. The three decade long process of economic reforms has helped bring a great many people out of

poverty. Urbanisation is creating more opportunities for off-farm jobs and niche products for rural farmers. The remittance economy enables villagers to invest in protected farming (e.g., greenhouses for vegetables) and diversified livelihoods (e.g., livestock).

d) The gradient of biophysical and socioeconomic conditions in the three sites presents varying degrees of exposure to natural hazards and climate-induced risks. It also offers diverse options for adaptation. Villagers have different degrees of exposure to risks induced by climate change at different elevations and under different socioeconomic conditions. Shifts in monsoon patterns have triggered more frequent landslides in areas at high elevation and water stress in areas at low elevation. Women and elders in rural areas have more direct exposure to climate risks. Water poverty occurs mainly in highland and dry-hot 'valleys due to poor water-harvesting infrastructure and can be less severe where reservoirs have been constructed in the mid-elevation valleys.

e) Agricultural intensifi cation (off-season vegetables in dry-hot valleys, tobacco in the middle, and high-yield varieties of corn in the highlands) depends on large inputs of chemical fertilisers which might cause maladaptation and GHG emissions. We found that smallholder farmers used more fertiliser. Over fertilization has resulted in nitrogen leaking into underground water, watersheds, reservoirs, and lakes. Nitrate water pollution and eutrophication are becoming serious threats to water resources and human health. Improving fertiliser application practices and lowering current rates of fertiliser use by 50% can reduce embodied fertiliser emissions by 0.8 t CO^2/ha according to our first estimates.

Annex III: Checklist

Peri-urban nature of the site

1. Higher percentage of non-farm families
2. Higher percentage of migrant population
3. High incidence of daily commuting to the nearby cities for employment, education etc
4. Feminization of labour force
5. Prevalence of high value commercial agriculture and allied activities like, horticulture, aquaculture, floriculture
6. Larger are under irrigation
7. Mixed land use pattern
8. Degradation of forest lands
9. Disappearance of surface water bodies
10. High valuation of building and land
11. Political hotspots
12. Dumping of solid wastes
13. Change in the behavioural pattern, breaking of the traditional networks, creation of new associations (formal and informal)
14. Larger expenditure in education, particularly girls education
15. Higher dependence on private sources for basic service delivery
16. Connected with the nearby cities by means of transport corridor

Checklist for preliminary/exploratory investigations for CoCOON

Some questions to assess the peri-urban characteristics

1. How old is this village? How far (distance in km) is this from the nearest urban centre?
2. What is the jurisdictional status of this village? Are there any links with urban governance authorities?
3. What kinds of links/network exist with the city? (Mention about the highway/small road/feeder road)
4. Has the nature of these links changed over a period of time?
5. Who are the major groups that live in the village?
6. Are these people/ groups the original residents of the village?
7. Are the villagers are mostly migrant population?
8. If yes then why and when they migrated to this village?
9. Which political party won the elections in the village?
10. Do people are mostly farmers or do they practice other livelihood means?
11. What kinds of other occupations (apart from farming) do they follow?
12. Are people moving out from farming to non-farm employment? if yes, then what kind of occupation are they now following and since when you have observed such shift in the occupational pattern?
13. Does your village are very active in pursuing high value commercial agriculture? What is the cropping pattern? Has there been any change in the cropping pattern over last 10-20 years? Why do you think such change in the cropping pattern has occurred?
14. Is feminization of labour force/feminization of agriculture is being observed in your village?
15. What is the major land uses pattern in the village? Has there been a major change in this? What is the new and emerging land uses?

16. Have you seen any changes in the land/ building price in last 10 years? (due to the urban influence or what is the reason for the change?)

17. Does change in the land/building price has anything to do with the livelihood/occupational status of the village?

18. Does change in the land price has anything to do with the socio-cultural behaviour of the village?

19. What has the impact of such rising price on the village profile and lifestyle?

20. Has the state recently acquired land? For what purposes?

21. What is the extent of real estate development?

22. Are there any conflicts over land use? Better to use "Is there any dispute over land use in your area? For instant: land used by brick Kiln, residential area, road development etc.

23. Is some land lying idle?

24. Are there any common property land and water sources? How are they used? By whom? Any changes in the pattern of their use?

25. What is the historic relevance of these common properties?

26. Who maintains these resources? Are there any changes in the regimes?

27. If there has been a land acquisition process, what have been the new and emerging sources of employment?

28. Who is the major player in land acquisition? (Government/ Private Conglomerate)

29. For what purposes do you commute to the city? What are the means of transportation?

30. Do you observed any social and cultural impact arising from emerging links with the city (i.e. due to alcoholism, consumerism, crime, safety of women, etc.)

31. Do you belief girls education is important?

32. How much of your annual income will you spend on girls' education, or higher education of the male member of the family?

33. Is your village politically active?

34. How close are your local leaders with the national political parties?

35. Do you think political links helps to access more resources?

36. How are village level decisions made?

37. Is there a conflict resolution process followed in the villages? What were the other traditional ways followed in the past?

38. Are there any NGO activities?

39. Are there in any solid waste dumping on your village? If yes why no action has been taken?

Climate variability questions:

1. Rainfall Pattern observation

2. Temperature Pattern observation (maximum temperature/minimum temperature)

3. What were the hottest and the coldest years in the last 20 years?

4. Was there any incidence of drought or floods in the recent past? If yes, what might be the factors responsible for such climatic events?

5. How often do you realize the climatic changes for agriculture sowing/ harvesting:

Events	1	2	3	4	5 (Others)
Lack of Monsoon rain	Every year	Every two year	Every five year	No such effect	
Extra Rainfall	Every year	Every two year	Every five year	No such effect	
Soil Erosion	Every year	Every two year	Every five year	No such effect	
Drought	Every year	Every two year	Every five year	No such effect	

Sr. No.	Reason for dry wells	Options
1	Lack of rainfall	A
2	Increase in HH population	B
3	Intensive agriculture	C
4	Dependency on piped water supply	D

6. What are the changes in the crop cycle for both monsoon (M)/ winter (W) crops?

Name of the two major crop	Usual month (M)	Changed month (M)	Usual month (W)	Changed month (W)

7. During which month community feel the drinking water scarcity?
   a. Has this month changed in the last 30 years?

8. Have the drinking water sources (wells, springs, stone spout etc.) dried in the village?
   a. How many have dried and what are the reasons

9. Whom do you seek support during the time of water scarcity?
   a. Family members
   b. Community members
   c. Neighbours
   d. Do not share with anyone?
   e. Others, if any:

Questions on the pattern of water security

Drinking Water:

1. What sources are used for drinking water purposes (ground or surface water)? Were there any sources used in the past that were discontinued? What were the reasons for this?

2. Does everybody have direct piped connections in the village? If no what are the reasons? Does the village have community stand posts / tube wells /wells? Who maintains these structures? Are you happy with the quantity and quality of water that you get from these sources

3. In which year the piped drinking water connection was brought in the village?

4. Which group/community received the drinking water facility first & last in the village?

5. Is there any complaint regarding the flow of water for any specific community groups? (Like some communities may be residing at a higher altitude and do not receive water adequately)

6. Which government authority is responsible for the piped drinking water supply in the village?

7. What is the source of this piped drinking water to the village?

8. Do they have an overhead tank or any other storage system in the village?

9. What are women perceptions on these utility services in terms of drudgery linked to fetching water and time spent?

10. Are they facing any problem regarding the quantity of supply from formal sources and also the quality of water? (Reflecting their concerns on frequency of water and quality of water)

11. If there is problem of surface or ground water quality who do you think are responsible?

12. How drinking water markets are operating in the village? Please elabourate on formal and informal drinking water markets?

13. Is there drinking water sharing during summers among Households? Do people borrow from each other?

14. Do people use water tankers during the time of scarcity?

15. What are the rates for water tankers in accordance to the season?

16. Are there any tanks/ponds in the village? Are you still dependent on this particular water body? If not then why?

Irrigation:

17. What is the relative role of different sources of irrigation (figures need not be exact, but rough pie charts can show)?

18. What are the major crops grown? Any changes in the cropping pattern over the years? What are the reasons for this?

19. What are the major uses to which groundwater is put? Have these uses changed? What are the new uses for groundwater?

20. Who are the different claimants on groundwater in the village and its vicinity? Are new claimants emerging?

21. What is the predominant irrigation technology (both for surface and groundwater extraction)? Has there been a change in the groundwater extraction technology? Since when?

22. What is the pattern of ownership of groundwater extraction technologies? Has there been a change in this?

23. Is there any selling of groundwater for irrigation (are there groundwater markets)? If yes, since when? To what do you attribute the emergence of groundwater markets?

24. What are the terms of transactions (sale/purchase): a fixed rate per hour of pumping/ buyer brings diesel/ an annual payment on a contractual basis/ proportion of agricultural produce/; agricultural labour in lieu of groundwater/ any other? Which of these is more common and why?

25. Is groundwater also sold in the village for other purposes (e.g. drinking)?

26. Are there any transfers of water to other urban centres/ peri-urban areas? Where? Any sense of extent or magnitude?

27. What is the level of the water table? Any indication of the change in this level? What has been the major factor responsible for this change in the water table level?

28. What are the three most important concerns with regard to the use of groundwater in this village? Can you rank them as 1, 2 and 3?

29. Are there any water bodies in the village? If yes name them and give the historical account of that water body? (Mention their uses, current status and factors responsible for their status)

30. What is the nature of land tenure arrangements in the village? Tenancy/share cropping? Has there been a change in the relative magnitude and existence of these? What do we ascribe these to? What happens to groundwater ownership and access in these arrangements?

31. What is the prevailing understanding of the ownership of water (both surface and ground water)?

32. Are there any emerging sources of irrigation such as wastewater canal or micro level irrigation systems?

33. How does the water sharing done for these emerging sources?

34. What kinds of conflicts arise with regard to the use of water?

35. Do we notice any changes in the intensity and frequency of these conflicts?

36. What do we ascribe these conflicts to? At what stage do these conflicts become visible?

37. How are these conflicts resolved? Are they also related to other conflicts?

38. Can you describe in detail a specific case of conflict over surface water/groundwater over recent years?

39. Are there any conflicts due to lack of institutional (rules/ norms or regulations) or governance (local governance) input?

40. Are you aware of any intervention in the past to deal with the challenges of groundwater management and depletion? Were they successful? What kinds of impacts did they have?

41. What do you think might be alternative approaches to tackle this issue?

42. What kinds of new stresses do you see emerging in the future? What kinds of approaches do you think will be necessary to resolve them?

Community resilience:

1. What are the perceptions of the community on the urbanisation and changing land use?

2. How their perceptions shape their adaptation strategies?

3. How communities are managing (adapting) the shortfall in drinking and irrigation water supply?

4. How gender difference understands & shapes these different adaptation strategies for building resilience?

5. What are the governance initiatives (in terms of policies/ provisions) to build community resilience?

6. Is the community aware of these initiatives? If yes, do they find them relevant in their village? Is there an appropriate negotiating ground for these initiatives?

7. What are the perceptions of the community for resource conservation (agriculture land/ water harvesting structure/ community grazing land/) considering the changing livelihood pattern?

8. Does peri-urban politics (caste and class politics) determines their resource access?

9. How interpersonal relations are changing due to change in the climate and increasing stress from water shortage and urbanisation?

10. If the present climate change & urbanisation process continues what is the community perception on future relations with water?

11. What are the community initiatives to cope with depleting water table and land acquisition processes?

12. Are you aware of the climate change policies and initiatives linked to these changes?

Governance (water, climate change and urban governance)

1. Do you think present government is able to provide the necessary water demand of the village?

2. Do you know about any public facilitation programmes implemented by any of these departments/service providers? If yes can you list down some of the programmes and the concerned service department actively involved in your village/municipality for the last three years? Has anyone in your household benefited in the past three years from the following programme?

3. Whenever any programme does not get successful what do you think are the reasons?

4. When a new law, rule, regulation, decree or policy is proposed that would have a substantial impact on your well-being, which channel would you typically rely on to try to affect the outcome

5. If the situation has gone down for any of the services what do you think the probable reasons would be?

6. How difficult is to apply for new water connection? Can you narrate your experience about any corruption involved in accessing the water? Do you have to pay bribe to get any services from the department?

7. What are the procedures to get government water connection?

8. To what extent do you think rapid urbanisation is responsible for resource degradation (surface, ground water)?

9. How the degree of social networking operating in the village?

10. Are there any water user associations or committee present in the village? How people gets membership in this kind of organisation? Does it help in voicing opinion in the village? Who are more powerful in such kind of associations?

11. Are there any climate change committee formulated in the village?

12. Are the village head very well politically connected to the state government?

13. How any kind of conflicts (either water or otherwise) gets solved in the village?

14. If you have to rank the transparency of the election process of any decentralized grass root committees/bodies involved in providing services, how do you do so?1 being highly corrupt, and 5 being

efficient and transparent.

15. Have you notice increase in the criminal practices in the village? Have you seen particularly incidence of criminal practices happening in the village/municipalities with relation to water related issues

Annex IV: Relevant Policies in Water Resources, Climate Change and Urbanisation

Policies/Regulations/Acts (Water Resources, Climate change, Urbanisation)

A. Water Resource Act 1992

This Act is an umbrella Act, governing not only drinking water, but other uses of water and overall water resource management in Nepal. It vested the ownership of all the water resources present in the country to the state. Under this act, state is owner of all water resources. It also stipulates the requirement of licenses for bulk use of water resources except for purposes explicitly exempted by the Act.

Drinking water and domestic use has highest priority followed by irrigation, agricultural uses, animal husbandry and fisheries, hydroelectricity, cottage industry, industrial enterprises, navigation and recreation uses. The priority given to the different uses of water is set out in Section 7 of the Water Resource Act 1992 (2049 BS) as follows:

1 Drinking water and domestic use

2. Irrigation

3. Agricultural use such as animal husbandry, fisheries

4. Hydroelectricity

5. Cottage industry (e.g. water mill or grinder), industrial enterprises and mining

6. Navigation

7. Recreational use

8. Other use

The Water Resources Act of 1992 has recognized value of Water Users' Associations (WUA) in managing the water resources and it provides a legal basis to WUAs in managing the available water resources locally. It vests ownership of water in the State, and the government can hand over the ownership of water related infrastructure it has developed to a WUA. What this means is that the State can control the use of water, sell water or levy fees in relation to water, however, it does not mean that the State has an unfettered right to use water.

The use of water is subject to the strict scrutiny of various stakeholders and only 'beneficial use' is permitted. Section 2 (b) of the Water Resource Act 1992 (2049 BS) defines beneficial use as the rational use of water resources within the available means and resource. The beneficial use also connotes reasonable and equitable utilisation of optimal potential without adversely affecting the water rights of others.

The Water Resource Act 1992 (2049 BS) contain provisions for the prevention and control of pollution of water resources. Section 19 provides that: No one shall pollute water resources by placing litter, industrial waste, poisons, chemicals or other toxicants to the effect that it exceeds the pollution tolerance limit. Section 22 of the Water Resource Act 1992 (2049 BS) provides that any person or corporation who pollutes water resources will incur a fine of up to NRs.5000 and must pay compensation to any person

sustaining a loss as a result of the pollution.

The Water Resource Act 1992 (2049 BS) requires the following users of water resources to acquire a license:

1. A person or corporate body who desires to conduct a survey or to utilise water resources.

2. A person or corporate body who was already utilizing water resources prior to the commencement of the Act.

Section 4(2) of Water Resource Act 1992 (2049 BS) exempts users of water for the following purposes from obtaining a license:

a) for one's own drinking and domestic use on an individual or collective basis

b) for the irrigation of one's own land on an individual or collective basis

c) for the purpose of running a water mill or grinder as a cottage industry

d) for the use of a boat for personal transportation

e) for the use, as prescribed by regulations to this Act, of water resources confined to the land by the owner of such land

Section 21 of the Water Resource Act 1992 (2049 BS) sets out the circumstances and procedure for cancellation of a license by the DWRC as follows:

1. If the licensee performs any act contrary to the provisions of the Water Resource Act 1992 (2049 BS) or any rules made under this Act,

2. If the licensee fails to make such improvements within prescribed period, the DWRC may cancel the license.

3. Before the license can be cancel the DWRC shall give the licensee a reasonable opportunity to explain the failure to comply with the Act and/or the order.

There are two regulations under the Act, for drinking water purposes the Water Resource Regulation 1993 (2050 BS) and the Drinking Water Regulation 1998 (2055 BS).

B. Water Resource Regulation 1993 (2050 BS)

The Water Resource Regulation 1993 (2050 BS) is an umbrella Regulation covering all uses of water and providing procedural mechanisms for the implementation of the Water Resource Act 1992 (2049 BS).

The Regulation covers the formation of Water User Associations and District Water Resource Committees, licensing, provides a dispute settlement mechanism in relation to water use service charges, sets out the process to be followed by the State in relation to land acquisition and compensation and provides some forms in the Schedules to the Regulations for certain administrative procedures.

The Water Resource Regulation 1993 (2050 BS) establishes the District Water Resource Committee (DWRC) as the authority to issue licenses for the use of water resources in general (except for hydropower production). This is also confirmed by the Drinking Water Regulation 1998 (2055 BS).

C. Water Resources Strategy, 2002

http://www.moen.gov.np/pdf_files/water_resources_strategy.pdf (accessed on 25 November 2014)

Objective:

- To provide safe and adequate drinking water and sanitation to ensure health security in a

reasonable price

- To increase agricultural production, ensuring the food security.

- To prevent and mitigate water induced disasters

D. National Water Plan, 2005

The Plan mentioned about the need of IWRM and RBM as "Optimum utilisation of water for the benefit of all stakeholders in the particular river basin couldn't be achieved in terms of efficiency, equity and environmental considerations".

Environmental sustainability (Rate of extraction should not exceed rate of regeneration).

Doctrine of NWP- Integration (of all water related programmes from the lowest level of River Basin entities), coordination, decentralization (for efficient delivery of water servies), participation, Equity (women participation, social inclusion), Good Governance (Transparency, accountability, predictability).

Water Resources Strategy (2002) for Water supply, Sanitation and Hygiene

Target:

- 2007: 85% have access to Water supply; 8% have medium of high water supply service level; 50% have basic sanitation facilities.
- 2012: 90% have access to Water supply; 15% have medium of high water supply service level; 90% have basic sanitation facilities.
- 2017: 100% have access to Water supply; 27% have medium of high water supply service level; 100% have basic sanitation facilities.
- 2017: 50% have medium of high water supply service level.

Action Programmes

1. Small Towns Water Supply and Sanitation Programme (STWSSP):

a) Implement the STWSS programme to cater to about 500 emerging towns with a total population of approximately ten million.

b) Ensure and formalize ownership and O & M of the completed systems by the municipalities/WUCs under specified terms and conditions and regulated by the National Water Supply Regulatory Commission (NWSRC) in a gradual manner.

c) Enable and empower municipalities/WUCs through capacity-building initiatives to maintain and manage community-owned systems.

d) Devise mechanism for full O & M cost recovery, including partial capital cost recovery, within an agreed period.

2. Kathmandu Valley Water Supply and Sanitation Programme (KVWSSP):

a) Commission the Melamchi Water Supply Project by 2012 to upgrade services with high level to an additional population of 1,553,000 and the Yangri Water Supply Project for additional 1,500,000 beyond 2017.

b) Recruit a management contractor for the operation and management of the water utility under a

performance-based management contract for six years for the proper management and improvement in the distribution network in phases, as funds become available.

c) Draft, enact and enforce the Water Supply Board Act and the NWSRC Act.

d) Establish Kathmandu valley Water Supply Board, Water Utility Operator and NWSRC and make them fully operative.

e) Adopt a tariff policy ensuring full O & M cost recovery in the interim period, leading to partial capital cost recovery (50%) in a gradual manner.

3. Rural Water Supply and Sanitation Programme (RWSSP):

a) Provide water supply services for 11,815,000 people as an integral part of water supply, sanitation and hygiene education to services.

b) Establish and operate a District Rural Water Supply and Sanitation Development Fund (DRWSSDF), to which all development partners, including donors, HMGN, DDCs and VDCs contribute.

c) DRWSSDF to invite proposals from all interested parties in the sector and those eligible or qualified to be funded by the DRWSSDF.

d) Encourage, educate and prepare communities for implementing need responsive projects through intensive interaction and support.

e) Establish an O&M fund upfront with cash contribution from the community for meeting the O&M cost.

f) Ensure mechanisms to serve socially and economically disadvantaged groups, allowing reduction in community contribution to 10%.

g) At the grass roots level, promote gender sensitization, non-formal education and income-generating activities, where applicable

E. Water Supply Management Board Act 2006)

This is an act made to provide for water supply management board

[http://faolex.fao.org/docs/pdf/nep100340.pdf (accessed on 25 November 2014)]

Objective: To make the water supply and sanitation service reliable, accessible, regular, well managed and of standard quality within the municipal areas.

F. Water Tariff fixation Commission Act (2006)

This is an act made to provide for Water Tariff fixation commission

[http://www.moud.gov.np/acts-regulations/water-tariff-fixation-commission-act-2063-2006-e.pdf (accessed on 25 November 2014)]

Objective: To provide qualitative and reliable water supply and sanitation service to the consumers at a reasonable price by fixing tariff of water supply and sanitation service

G. National Urban Water Supply and Sanitation Sector Policy, 2009 (final draft)

CITATION:

MoPPW .2014. National Urban Water Supply and Sanitation Sector Policy, Final draft, 2009. Ministry of

Physical Planning and Works (MoPPW).

http://dwss.gov.np/file/file_down/S4Io4uNational%20Urban%20Water%20Supply%20and%20Sanitation%20Sector%20Policy,%202009,%20Final%20Draft.pdf (accessed on 25 November 2014).

Urban populations currently predominate in the Terai and valleys of the mid–hills and are concentrated in 58 municipalities, of which two thirds reside in the 16 largest settlements. Total urban populations grew from 4% of national population in 1971 to 13.9% in 20013 and are expected to reach 26.7% by 2021. Urban water demand is increasing rapidly at between 6% and 9% per annum – around three times the national population growth rate – thereby placing a strain on existing urban water supply and sanitation services.

Goal: to ensure the socio–economic development, improved health status and quality of life of urban populations, including the poor and marginalised, through the provision of sustainable water supply and sanitation services and protection of the environment.

Policy theme: Along fulfilling basin needs of urban water which needs to be safe, reliable, adequate and affordable, appropriate institutions, people participation and their role in decision making and partnership with private sector to achieve the objective in sustainable manner. Environmental factor is given a major focus.

Relevant Strategies: To ensure the policy is carried out forward:

- Promotion of conjunctive use of ground and surface water supplies to balance the dry and wet season capacities in Kathmandu valley and other areas as practical.

- Promoting collection and utilisation of rainwater harvesting and other appropriate technologies at domestic and communal level wherever feasible.

- Water conservation shall be extensively promoted through source protection works in all schemes to be implemented or rehabilitated for urban areas. Encouragement through some financial assistance shall be provided to local users groups to protect and conserve local traditional sources like stone spouts and dug wells, based on local requirements and feasibility as well as merit of such proposals.

- Ensuring participation of women and urban vulnerable groups in decision making at all practical level. An output based aid (ODA), a strategy for using explicit performance-based subsidies, will be introduced to promote connection of the poor and DAGs to the water supply and sanitation systems.

- Enhance institutional and operational capacity at local level for effective O & M of WSS services

- Human resource development to achieve efficiency in development and operation of services

- Cost Recovery and Financial Sustainability: Development of water tariff system. Deep groundwater abstraction especially for commercial and institutional purposes will be licensed and metered in the first stage to create monitoring database. A system will be worked and introduced in the second phase to volumetrically charge such abstractions.

- Environmental Protection: For sustainability of scheme benefits and essential in its own right. An Initial Environmental Examination (IEE) and/or Environmental Impact Assessment (EIA) will be included in all projects to identify potential threats in accordance with the Environment Protection Rules and Environment Protection Act- and Rules (1997). Such assessment will include consultations with major stakeholders and will include end-point users at all the practical level

- Efficient, effective and accountable urban water supply and sanitation sector: to provide Public

private partnership and to enhance sector effectiveness for improved service delivery.

H. Irrigation Policy, 2060

OBJECTIVES:

a) To provide round the year irrigation facility to the irrigation suitable land by effective utilisation of the current water resources of the country.

b) To develop institutional capability of Water Users for sustainable management of existing system.

c) To enhance the knowledge, skill and institutional working capability of technical human resources, water users and non-governmental association / organisation relating to development of irrigation sector.

The following policy will be adopted to meet objectives:

a) Principle of IWRM to ensure water availability for all stakes.

b) Trans-basin water transfer and management from water surplus large river basin to water deficit area.

c) Available groundwater shall be developed and utilised and arrangement shall be made for conservation, promotion and control in quality.

d) Private sector in construction, operation and management of irrigation system shall be pursued.

e) Irrigation system and its belongings shall be transfer from government to users.

f) Users Capacity strengthened to handle the system.

g) Dissemination of information, knowledge, and skill of manpower from training, demonstration

The working policy says about Environment protection and water supply i.e. to minimize negative effects on the environment in the course of construction, minimum level of water should be maintain in the river course while diverting water for irrigation use.

I. Environment Protection Act 1996 (2054 BS)

Environment Protection Act (EPA) and Environment Protection Regulations (EPR) in 1997 came after the formation of the then Ministry of Population and Environment (MoPE). Environmental pollution is mainly governed by the Environment Protection Act 1996 (2054 BS) and the Environment Protection Regulation 1997 (2054 BS).

Section 7(1) of the Act prohibits environmental pollution as follows: Nobody shall create pollution in a manner that has a significant adverse impact on the environment, or is likely to be hazardous to life and health of people, or dispose of, or cause to be disposed, sound, heat, radioactive rays and waste from any mechanical device, industrial enterprises, or other place contrary to the prescribed standards.

Environment Protection Act, 1996 (A.D.) mainly focus on the protection of environment with proper use and management of natural resources, taking into consideration that sustainable development could be achieved from the inseparable interrelationship between the economic development and environment protection. It also relate with legal provisions in order to maintain clean and healthy environment by minimizing, as far as possible, adverse impacts likely to be caused from environmental degradation on human beings, wildlife, plants, nature and physical objects.

This act and these regulations have given a legal context in which to approach approval of new

development activities and prevention as well as control of pollution. Pollution control certificates, inspections by environmental inspectors, establishment of environmental labouratories, establishment and use of environment protection funds, incentives for good work, and compensation for adverse impacts are included in these legislations (MoPE 2000).

Environment Protection Act 1996 requires environmental assessment of proposed projects, empowers the Government to provide incentives to any activity that has positive impacts on the environment, and has provisions for polluters to compensate persons suffering from polluting activities.

J. Climate Change Policy 2011

Goal: The main goal of this policy is to improve livelihoods by mitigating and adapting to the adverse impacts of climate change, adopting a low-carbon emissions socio-economic development path and supporting and collabourating in the spirits of country's commitments to national and international agreements related to climate change.

Objectives:

i. Establish Climate Change Centre to address issues of Climate change and strengthen existing institutions

ii. Enhance climate adaptation and resilience capacity of local communities for optimum utilisation of Natural Resources and their efficient management

iii. Improve the living standards of people by maximum utilisation of opportunities created by convention, protocols and agreements

iv. Reduce GHG emissions

Relevant Policies:

i. Implementation of actions identified by NAPA, its medium and long term adaptation action

ii. Identifying people, communities and areas impacted by climate change (CC), implementing adaptation and mitigation measures based on local knowledge, skill and technologies

iii. Building capacity from local to policy level on climate adaptation, impact mitigation etc.

iv. Ensure participation of vulnerable and marginalised community

v. Climate change related research to expand the implementation of measures for adapting the adverse impact

vi. Expanding the network of climate observation centres in different geographical regions of the country

vii. Conserving soil and water through source protection, rainwater harvesting and environmental sanitation

viii. Adopting a basin approach for water management through regular monitoring of water resource availability.

K. National Urban Policy 2007 (2064)

Urban refers to a metropolitan city, sub-metropolitan city, municipality or town

The proposed NUP has put forward mainly three objectives in order to provide a broad policy framework to guide the urbanisation process, to conserve urban environment, and to clarify the roles of the central

and local bodies in urban environment, and to clarify the roles of the central and local bodies involved in urban development. These are related to:

I. Balanced national urban structure: to achieve a balanced national urban structure through proper guidance to development of and investment in the infrastructural facilities

ii. Healthy and economically vibrant urban environment: to raise the living standard of the urban residents through development of clean, secure and economically vibrant urban environment

iii. Effective urban management: to achieve effective urban management through institutional strengthening and legal empowerment of the local bodies, as well as through promotion of proper cooperation among the different institutions involved in urban development.

For achieving these objectives, the NUP has proposed several objectives related policies and strategies. As the responsibility of implementing the NUP does not fall on a single institution only, the policy thrust is on promoting coordination and cooperation among the related central government agencies, the local government bodies, the non-government organisations, the related private sector and financial institutions responsible for planning, execution and operation of urban services and facilities.

National Urban Policy (2007) expands the definition of urban to include settlements with a minimum population of 5 thousand and a population density of a least 10 persons per hectare. Further criteria include at least 50% of the population above 10 years of age dependent on non–agricultural economic activities and access to basic infrastructure including grid electricity, telecommunications, and high school and health services.

Within this framework two further urban categories are established. These are:

1. Intermediate Town: having populations of between 10 thousand and 50 thousand.
2. Small Town: having populations of between 5 thousand and 10 thousand.

National Urban Policy (2007) highlights the historical imbalances and haphazard nature of urban development in Nepal. It views urban centres as catalysts for economic development linked to north–south and east–west access corridors and flags poor sanitation, environmental degradation and lack of services by the urban poor as requiring urgent attention. Urban Policy proposes building the capacity of Municipalities to plan and manage integrated local development activities including the preparation of urban master plans to be moderated by central and regional authorities. Private sector involvement and investment in infrastructure development is specifically sought.

L. The Local Self Governance Act 1999 (LSGA 1999)

LSGA and its Regulations in 1999 provides local bodies with greater latitude and legal framework for financial and other development responsibilities like sectoral devolution and resource mobilization. The Act and its Regulations transfer comprehensive central decision-making powers and the implementation authority of the local level development issues to the local bodies.

The Local Self Governance Act 1999 (2055 BS), which primarily deals with the decentralization of government, also gives local bodies some responsibility in relation to the utilisation, conservation and management of water resources and the maintenance of sanitation facilities and waste management. It provides the legal basis for the devolution of responsibilities and authorities for social, economic, institutional, and physical infrastructure development, including water and sanitation systems, to local government.

The Act and its regulations make local bodies (Village Development Committees, District Development Committees and Municipalities) responsible for delivering certain services in relation to drinking water and sanitation. The Act also gives local bodies the power to make policies and implement programs in relation to drinking water and sanitation and to raise revenue via local taxation, fees and other means.

The Local Self Governance Act 1999 also provides the municipalities and the Village Development Committees to carryout town development plans but it is not comprehensive enough to carry out town planning as compared to the Town Development Act 1988.

Local Self Governance Act (1999) has classified municipalities on the basis of existing infrastructure, population and potential to generate revenues as follows:

a. Metropolitan city: Settlement with a minimum population of 300 thousand and with at least Rs. 100 million in annual revenue. It should have public utilities including electricity, roads, drinking water, telecommunications and similar services.

b. Sub–Metropolitan city: Settlement with a minimum population of 100 thousand with at least Rs. 50 million in annual revenue. It should have public utilities including electricity, roads, drinking water, telecommunications and similar services.

c. Municipality: Settlement with a minimum population of 20 thousand with at least Rs. 2 million in annual revenue. It should have public utilities including electricity, roads, drinking water, telecommunications and other basic services. In mountain and hill areas, a settlement with a population of 10 thousand, annual revenue of Rs. 1 million with limited infrastructure can also be declared a municipality depending on the situation.

M. Ground Water Development and Management Institutions and Policies in Nepal

CITATION:

Shrestha, S.et. al. 2012). Ground Water Development and Management Institutions and Policies in Nepal. In: Shrestha S., Pradhananga D., Pandey V.P. (Eds.) Kathmandu valley Groundwater Outlook. Asian Institute of Technology (AIT), The Small Earth Nepal (SEN), Centre of Research for Environment Energy and Water (CREEW), International Research Centre for River Basin Environment-University of Yamanashi (ICRE-UY). pp 115-124

Government Agencies/institutional arrangement related to groundwater development and management (it is a changed version)

a. Ministry of Science Technology and Environment: DHM, DoE,

b. Ministry of Urban Development: DWSS, KVWSMB, KUKL

c. Ministry of Irrigation: Department of Irrigation, Ground Water Resources Development Board (GWRDB)

d. Ministry of Energy: WECS

Informal voluntary institutions, in research and advocating equitable and sustainable utilisation, development, management and conservation of groundwater resources, are

a. CREEW

b. ENPHO

c. Helvetas/Nepal

d. Farmer Managed Irrigation System Promotion Trust (FMISPT)

e. Jalsrot Vikas Sanstha Nepal (JVS)

f. JICA: one of the sponsor of GWRDB

g. NGO Forum for Urban water and sanitation (NGOFUWS)

h. Nepal Water for Health (NEWAH)

I. Nepal Water Conservation Foundation

j. The Small Earth Nepal

k. UNICEF

l. USAID/Nepal

m. WaterAid Nepal

n. The World Bank (IWRMP)

o. Water User Association (WUA)

Acts like National Water Plan, Urban Water Supply and Sanitation Sector Policy and Bagmati Action Plan advocate the optimum utilisation and development of the groundwater resources. Whereas, regulations like Drinking water management board rules, Water Supply Management Board Act and KVWSMB strategic plan focus on the proper management and conservation of the resources including the over and illegal extraction and exploitation. Similarly, policies like the Groundwater Policy, Irrigation Policy and Regulations and the three year Interim Plan have tried to maintain a holistic approach to develop, maintain and conserve the ground water resources.

N. Bagmati Action Plan (BAP) 2009-2014

Source: [http://www.ncf.org.np/upload/files/1132_en_1310646546bagmati_action_plan.pdf (accessed on 25 November, 2014)]

Vision of BAP: Clean and green river system that is full of life and valued by all.

Goals:

a. Goal for Peri-urban zone: To enhance the river ecosystem through effective management of urban growth.

Objectives related to water: to increase river water discharge; to improve water quality in the river.

Some Activities: promoting rainwater harvesting to recharge groundwater in household levels and rehabilitation of existing ponds to recharge groundwater through rainwater harvesting.

b. Goal for Urban zone:

Goal: to upgrade the river ecosystem and to conserve and regenerate the tangible and intangible heritage linked with the rivers.

Relevant Objectives: to improve river water quality

Relevant Activities:

i. Promotion of RWH in household levels and rehabilitation of existing ponds to harvest rainwater to recharge groundwater.

ii. Promotion of waste water treatment system in household and community level before it go to the river system

The overall goal for peri-urban and urban zone is to improve the water qualities of the river to improve the groundwater quality and increase the river discharge.

Annex V: Institutional Actor Mapping or Institutional Landscape

We mapped out institutions and actors that are already linked with the CoCooN/CCMCC project or that are relevant to engage in the future. The mapping distinguishes between institutions that are active at the governance/central level and at the operational/local level. Governance/central level institutions are mainly ministries while operational/local level actors are District Development Committees (DDC), municipalities, Village Development Committees (VDC), wards, departments of government organisations, NGOs etc. Other institutions like education and research institutes, INGO, media, politicians, laws and regulations are active at both levels.

Actors and roles

A. Governance/Central level

A.1 Ministries:

i. Ministry of Urban Development (MoUD): to provide basic services for urban development (i.e. proper residential areas, buildings, provision of drinking water and sanitation etc.)

ii. Ministry of Science, Technology and Environment (MoSTE): to create policy environment and institutional strength for promoting scientific research, innovation and capacity building to achieve sustainable practices and technologies, to minimize risks on life support systems, thus contributing to sustainable development

iii. Ministry of Irrigation (MoIr): management and use of water resources in the irrigation sector, development and implementation of policies and plans to achieve agricultural development targets.

iv. Ministry of Land Reform and Management (MoLRM): MoLRM, looking after the land administration and management activities, is responsible for ensuring efficient and effective administration and sustainable management of available land resources.

v. Ministry of Agricultural Development (MoAD): to develop and implement policies and plans for agricultural development in Nepal.

vi. Ministry of Federal Affairs and Local Development (MoFALD): It is the structural framework and accredited with the role of coordination, cooperation, facilitation and monitoring and evaluation of activities undertaken by local bodies (Village development committee, District Development committee, Municipalities)

vii. Water and Energy Commission Secretariats' (WECS): to formulate and cause to formulate policies and strategies on water resources and energy development, conducting studies, research, analysis and surveys, to establish and cause to establish the coordination among national and sectoral policies related to water resources and energy.

A.2 Education and Research Institutions:

They do Research and support in policy formulation. Institutions like Nepal Engineering College, Institute of Engineering, Kathmandu University, Centre for Research for Environment, Energy and water (CREEW), The Small Earth Nepal, Environment and Public Health Organisation (ENPHO),

Jalsrot Vikas Sanstha Nepal (JVS), Nepal Water conservation Foundation (NWCF), Nepal Development Research Institute (NDRI)

A.3 Networks and partnerships:

i. Climate Change Network (CCN): established by the government and chaired by the Secretary of the Ministry of Environment. Its function is to coordinate among various stakeholders.

ii. Climate Change Council (CCC): established in 2009 and chaired by the Prime Minister. This body is responsible for policy coordination in climate change.

iii. Multi-Sectoral Climate Change Initiatives Coordination Committee (MCCICC): It was established with the aim to function as the key national platform for ensuring regular dialogue and consultations on climate change related policies, plans, financing schemes, programs/projects and activities

A.4 International Non-Governmental Organisations (INGOs):

Introduce innovations in the water sector; support in and influence policy formulation and adaptation. Few of them are: WaterAid Nepal, UN-Habitat, UNICEF, GIZ, JICA

A.5 Federation of Drinking Water and Sanitation Users Nepal (FEDWASUN):

It facilitates the provision of drinking water, sanitation and hygiene (WASH) services to communities, advocates for water and sanitation rights (drinking water and sanitation for all and forever), brings people's issues to the attention of policy makers and service providers, and promotes good governance in relation to both user's committee/ groups and service providers.

A.6 Associations (Tankers Associations, Bottled water Entrepreneurs' Associations):

A.7 Media: Publicity, better steering public attention, influence perceptions:

B. Operational/Local Level

B.1 Government bodies:

i. Kathmandu valley Water Supply Management Board (KVWSMB): to develop policies and oversee their implementation, provide licenses to service providers for the operation and management of water supply and sanitation systems in the Kathmandu valley. Moreover, its role is to prepare a groundwater policy and regulate its extraction.

ii. Kathmandu Upatyaka khanepani Limited (KUKL): to operate and manage water and wastewater services in the Kathmandu valley. It operates under a License and Lease Agreement with the (KVWSMB) for 30 years.

iii. Water Tariff Fixation Committee: to protect the interests of consumers by providing qualitative and reliable water supply and sanitation services at a reasonable price and by fixing the tariff of water supply and sanitation services.

iv. Melamchi Water supply Development Board (MWSDB): to alleviate the chronic shortage of

potable water in Kathmandu valley on a long-term basis, and thereby to improve the health and well-being of its inhabitants.

v. Department of water supply and Sewerage (DWSS): to provide and ensure safe, convenient and adequate water supply to all Nepalese, with sanitation as an integral component.

vi. Groundwater resource development board (GWRDB): to carry out groundwater surveys, to manage groundwater for irrigation, drinking water and other uses.

vii. Department of Irrigation (DoI): to plan, develop, maintain, operate, manage and monitor environmentally sustainable and socially acceptable irrigation and drainage systems - from small to larger scale surface systems and from individual to community groundwater schemes.

viii. Department of Land Reform and Management (DoLRM): It undertakes Land Reform, Land Administration and Management functions through its nations wide distributed district land revenue offices.

ix. District Development Committee (DDC): to plan, implement, and monitor all the activities in the district

x. Village Development Committee (VDC): VDC is the lower administrative part of Ministry of Federal Affairs and Local Development. It organizes village people structurally at a local level and to create a partnership between the community and the public sector for improved service delivery system.

xi. Kulo organisation: They are responsible for supervision of water management, maintenance of the system and its component, water distribution, human mobilization for irrigation in a Kulo system. All the farmers whose land are irrigated from Kulo are the members of the Kulo Organisation.

xii. Land Fragmentation: Two reason of land fragmentation. A) Land inheritance/transfer from one generation to another & B) As a part of urbanisation, land is fragmented into number of plots for housing purpose.

B.2 Non-governmental organisations (NGOs):

They are the Implementers. For instance, Nepal Wate for Health (NEWAH), ENPHO, Centre for Integrated Urban Development (CIUD), LUMANTI support groups for Shelter, Urban Environment Management Society (UEMS)

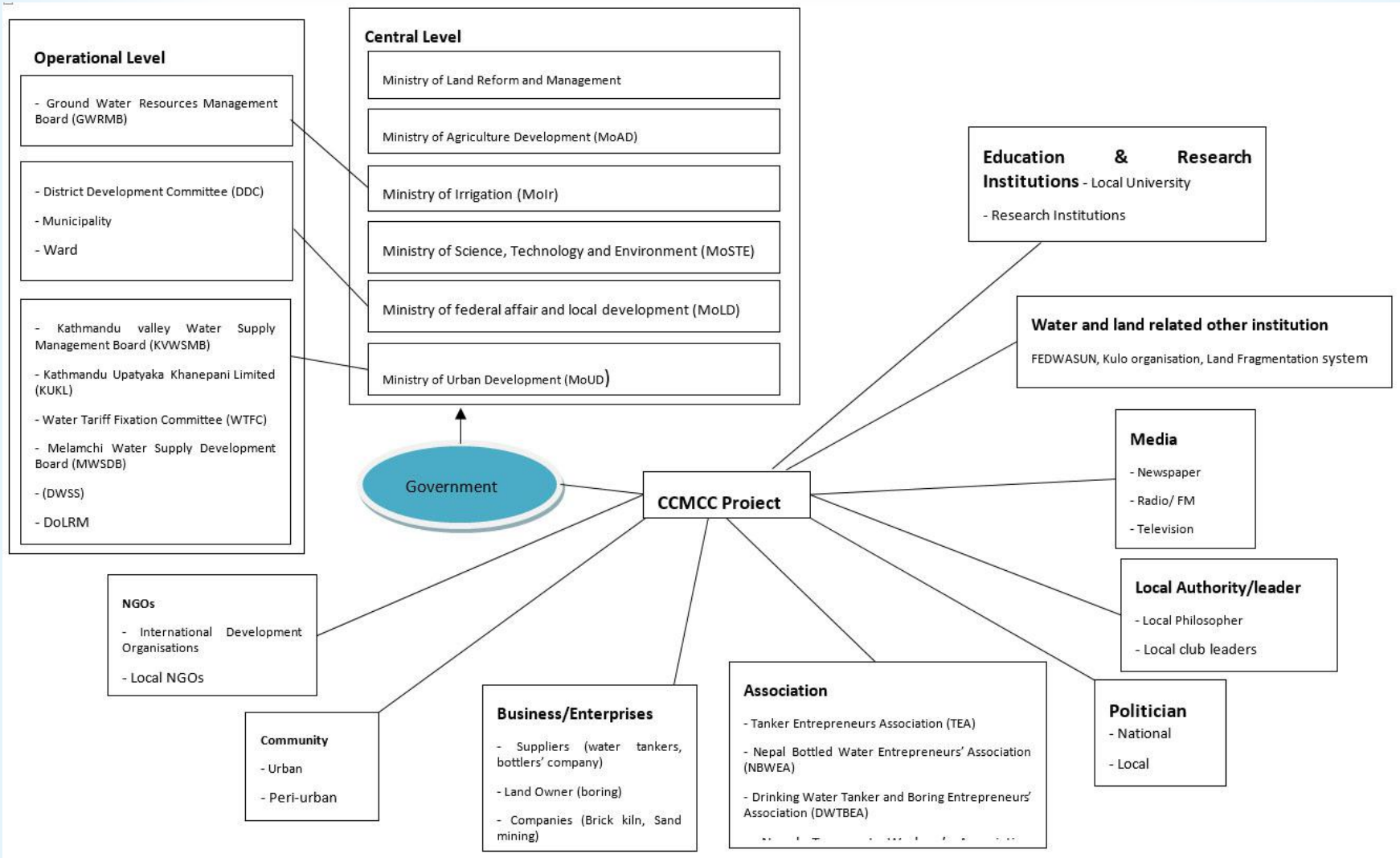
B.3 Community (urban and peri-urban)

B.4 Local Politicians/Leaders: liaise with ministers and members of the parliament. They have the capacity to influence decision-makers at the central level and to take projects to their areas.

B.5 Business/Entrepreneurs (Tanker operators, Bottlers Company)

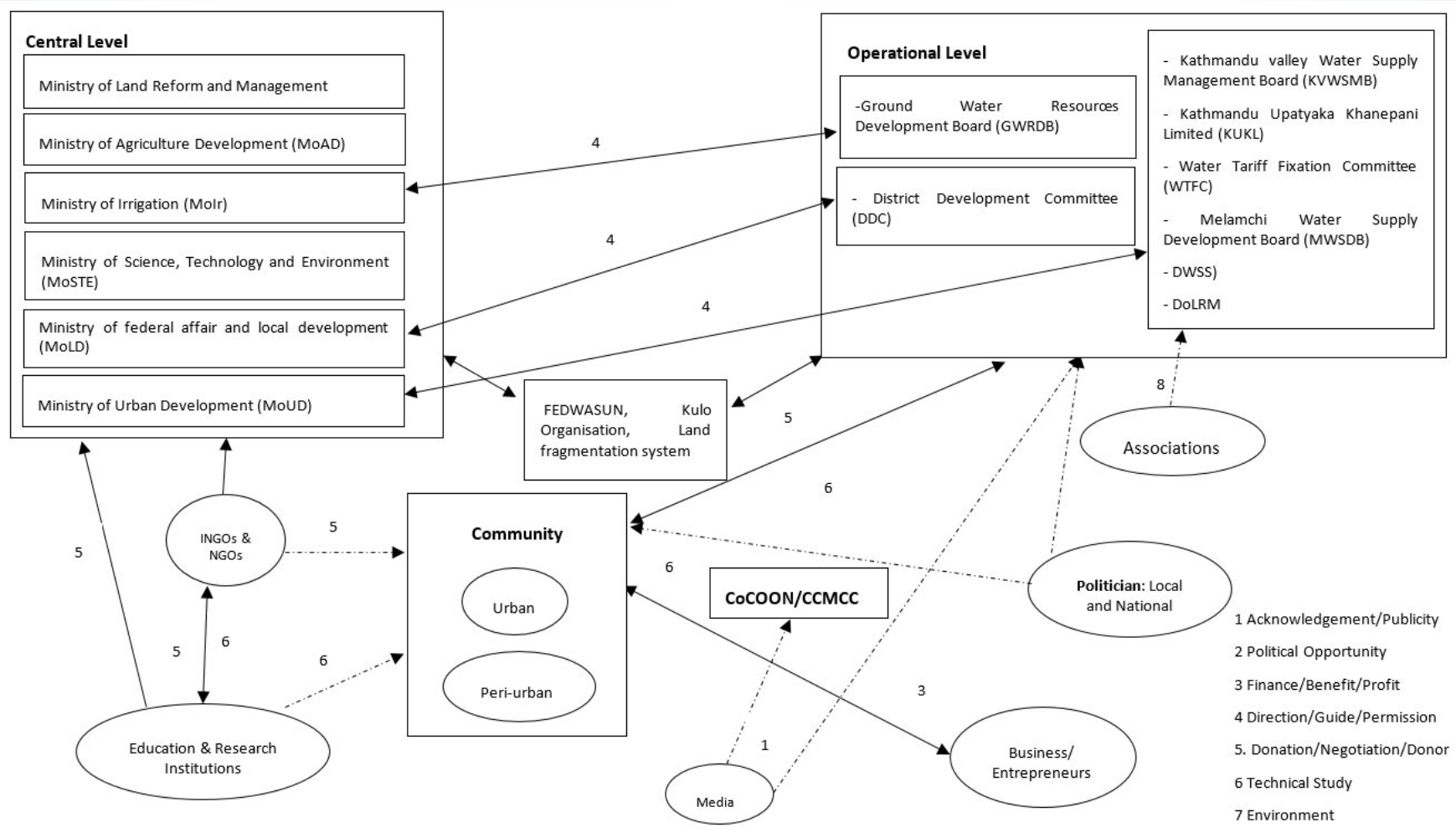
The figure 1 and 2 respectively shows the project stakeholder maps and Stakeholder relationship. Figure 3 shows the Alignment, Interest and influence Matrix (AIIM)

Figure 1: Project Stakeholder Map



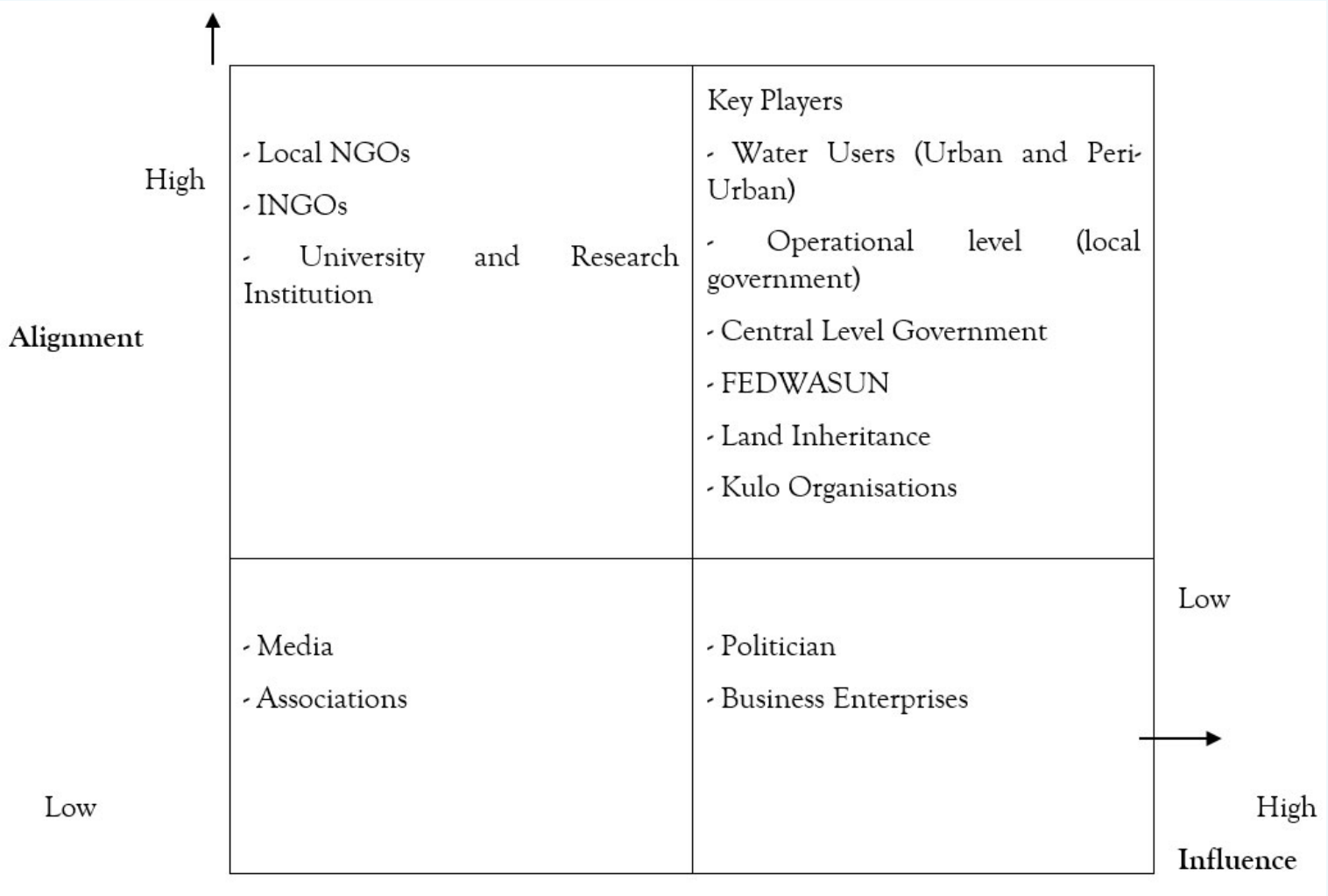
Source: Authors, 2016.

Figure 2: Stakeholder relationship map



Source: Authors, 2016.

Figure 3: Alignment, Interest and Influence Matrix (AIIM)



Source: Authors, 2016.

Climate policy, conflicts and cooperation in peri-urban south Asia: Towards resilient and water secure communities

The research project aims to improve mutual learning, strengthen institutional & community capacities to optimally manage water insecurity, and bolster resilience in periurban south Asia. It endeavors to support and empower communities to effectively use, manage and govern their water resources against a backdrop of water insecurity caused by climate change and urbanization. A consortium of north-south institutions brings together experience, skills and know-how in research, capacity-building and knowledge generation. This four-year collaborative endeavor will cover four cities:

- Khulna, Bangladesh
- Kathmandu, Nepal
- Gurgaon and Hyderabad, India

Partners

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Wageningen University (WUR), The Netherlands

SaciWATERs

South Asian Consortium for Interdisciplinary Water Resources Studies, India

ICIMOD

International Centre for Integrated Mountain Development, Nepal

Bangladesh University of Engineering & Technology (BUET), Bangladesh

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