

Water management in community forestry

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Water Management in Community forestry:

Case study of Lamatar VDC, Nepal

By

PRATISTHA LAXMI TAMRAKAR

A thesis submitted in the fulfilment of the requirements for the Degree of Masters of
Philosophy



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The connection between forest and watershed has been well studied in the field of forestry science. However, the social facet of this field is yet to be thoroughly understood and studied. In Nepal, community forestry is playing a crucial role in maintaining the health of watersheds which act as a crucial source of water in the mid hills. Managing these watersheds and rivers is fundamental towards providing quality water to the community. Despite a growing body of knowledge on forest and water, the needs and concerns of managing these resources remain largely unaddressed. An important question then to emerge from this is - can community that is effectively managing forests, manage the water resources emerging from the forests?

This thesis aims to investigate opportunities and challenges of water management in community forestry system. Specifically, it analyses whether and how water in the community forests is being managed at present. The study was designed using a mixed methods approach of qualitative and quantitative research. Qualitative data collection included a questionnaire survey (99 completed the questionnaire), conducting semi-structured interviews (20 interviews), attending community workshops and initiating informal discussions. The quantitative data collection also involved conducting a water quality analysis on two water streams within the Lamtar catchment. The analysis of the data indicated that the community manages water in Lamatar in a number of different ways, and with some hierarchies and different roles affecting access. User groups manage water on a small scale providing water to the community. However, within community forestry, water management is not a prime responsibility. This is because a) there is no legislation to require water management within community forestry, b) no concrete knowledge as to how water management can be done through community forestry; c) unlike other forest products such as timber, herbs, fodder, water does not belong to the FUGs, it belongs to the state, and d) there is no legislative or institutional linkage between forest and water. This thesis emphasises that community forestry users manage water on a small scale and informally-based on local norms, but they do not have legislative support or ownership for management to do so. This is leading to issues of inadequate water supply and water quality. There is a need for co-ordinated policy for integrated natural resource management to enhance sustainable resource conservation.

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ABSTRACT

The connection between forest and watershed has been well studied in the field of forestry science. However, the social facet of this field is yet to be thoroughly understood and studied. In Nepal, community forestry is playing a crucial role in maintaining the health of watersheds which act as a crucial source of water in the mid hills. Managing these watersheds and rivers is fundamental towards providing quality water to the community. Despite a growing body of knowledge on forest and water, the needs and concerns of managing these resources remain largely unaddressed. An important question then to emerge from this is - can community that is effectively managing forests, manage the water resources emerging from the forests?

This thesis aims to investigate opportunities and challenges of water management in community forestry system. Specifically, it analyses whether and how water in the community forests is being managed at present. The study was designed using a mixed methods approach of qualitative and quantitative research. Qualitative data collection included a questionnaire survey (99 completed the questionnaire), conducting semi-structured interviews (20 interviews), attending community workshops and initiating informal discussions. The quantitative data collection also involved conducting a water quality analysis on two water streams within the Lamtar catchment. The analysis of the data indicated that the community manages water in Lamatar in a number of different ways, and with some hierarchies and different roles affecting access. User groups manage water on a small scale providing water to the community. However, within community forestry, water management is not a prime responsibility. This is because a) there is no legislation to require water management within community forestry, b) no concrete knowledge as to how water management can be done through community forestry; c) unlike other forest products such as timber, herbs, fodder, water does not belong to the FUGs, it belongs to the state, and d) there is no legislative or institutional linkage between forest and water. This thesis emphasises that

community forestry users manage water on a small scale and informally-based on local norms, but they do not have legislative support or ownership for management to do so. This is leading to issues of inadequate water supply and water quality. There is a need for coordinated policy for integrated natural resource management to enhance sustainable resource conservation.

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TABLE OF CONTENTS

ABSTRACT	ii
ACKNOWLEDGEMENT	iv
LIST OF TABLES	vii
LIST OF FIGURES	viii
LIST OF ABBREVIATIONS AND ACRONYMS	ix
1. INTRODUCTION	1
1.1. Background	1
1.2. Research Problems	4
1.3. Research questions	5
1.4. Justification	7
1.5. Research Method	8
1.6. Organisation of the thesis	8
2. LITERATURE REVIEW	10
2.1. Community forestry: Definition and purpose	10
2.2. Evolution of community forestry	13
2.3. Key Challenges of Community Forestry Program	16
2.4. Water management in community forests	19
2.5. Gaps in the Literature	21
2.6. Political ecology of community forestry	23
2.7. Political Ecology of Community forestry in Nepal	26
2.8. Water situation in Nepal	29
2.8.1. Quality	30
2.8.2. Quantity	31
2.9. Conceptual Framework	33
2.10. Conclusion	36
3. METHODOLOGY	38
3.1. Research approach	38
3.2. Study Site: Lamatar VDC, Lalitpur	38
3.2.1. Location	39
3.2.2. Climate	41
3.2.3. Historical background	41
3.2.4. Demography	41
3.2.5. Occupations	41
3.2.6. Water bodies	42
3.2.7. Community Forestry	42
3.3. Sample population	42
3.4. Methods for data collection	43
3.4.1. <i>Primary Data Collection</i>	43
3.4.2. <i>Secondary Data Collection</i>	49
3.5. Secondary Research	50
3.5.1. Policy Analysis	50
3.5.2. Data Analysis	51
3.6. Limitation	52

4. RESULTS	53
4.1. Lamatar Catchment	53
4.2. Policy Analysis	55
4.2.1. Summary and discussions of the Acts	55
4.3. Interview Results	58
4.3.1. Interview summaries	58
4.3.2. Synthesis of results	66
4.4. Questionnaire Results	70
4.4.2. General features of the community	70
4.4.3. Main Water Management Body in Lamatar	71
4.4.4. Water Problems in Lamatar	72
4.4.5. Solutions to the water problems	74
4.5. Biophysical factors in Lamatar	77
4.5.2. WQI test	77
4.5.3. Climate change and recent rainfall data	80
4.5.4. Discussions of Biophysical Factors: Water Quality and Quantity	80
5. ANALYSIS	83
5.1. Water management in forestry legislation	83
5.2. Water management issues in Lamatar	88
5.3. Water management challenges of CFUGs	94
5.4. Key lessons for improving water management in CF	96
6. CONCLUSION	102
REFERENCES	106
APPENDICES	128
Appendix 1 Questionnaire for community surveys	128
Appendix 2 Question schedule of semi-structured interviews	138
Appendix 3 The mathematical expression for NSF WQI	139
Appendix 4 Study of the Operational Plan: <i>Shree Goldanda Kankadidanda</i> Community Forestry User Groups	141
Appendix 5 The summary of relevant Nepalese water related laws and policies in chronological order	143
Appendix 6 Tables and figures from the analysis	147
Appendix 7 Research rigour	154
Appendix 8 Water Conflict management	155
Appendix 9 Maps of community forestry in Lamatar	158
Appendix 10 Rainfall data from the Bureau of Meteorology, Nepal	162

LIST OF TABLES

Table 3.1: Demography of Lamatar	41
Table 3.2: List of Water User Groups (WUGs) in Lamatar VDC	42
Table 3.3: Interview groups	49
Table 4.1: General Features of Community Sample.....	70
Table 1: Summary of Relevant Nepalese Laws in Chronological Order.....	144
Table 4.2: The main water management body in Lamatar according to the people	147
Table 4.3: Role of NGOs/INGOs according to the respondents.....	147
Table 4.4: Role of NGOs/INGOs according to the members of the CFUG	147
Table 4.5: Role of the government according to the respondents.....	147
Table 4.6: Role of government according to different caste groups.....	148
Table 4.7: Role of government according to CFUG members and non-members	148
Table 4.8: No of people familiar with the water policies	148
Table 4.9: Water problems identified by the people.....	148
Table 4.10: Water problems by different caste groups	149
Table 4.11: Water problems by gender.....	149
Table 4.12: Water problems by CFUG members and non-members.....	150
Table 4.13: Water problems by to proximity.....	151
Table 4.14: Solutions to water problems by gender	151
Table 4.15: Members of CFUGs living at further or closer proximity to the CF	151
Table 4.19: Results of WQI test- Site A	78
Table 4.20: Results of WQI test -Site B	79

LIST OF FIGURES

Figure 2.1: Analytical Framework for this Study	35
Figure 3.1: Map of Bagmati Zone showing Lalitpur District	40
Figure 3.2: Map of Lamatar VDC with neighbouring Lubhu VDC	40
Figure 4.1: Headwaters of Forest Reserve	53
Figure 4.2: Water bodies of Lamatar VDC (Not to Scale)	54
Figure 5.1: Problems with Community Based Water Management	89
Figure 6.1: Dewey's Sequence of Conflict Management	155
Figure 3.4: Stages of the Qualitative Analysis Guide of Leuven (QUAGOL)	155
Figure 4.4: Percentage of respondents stating that the quantity of water in the watersheds of Lamatar has decreased	155
Figure 4.5: Percentage of people claiming that the quality of water in the watershed of Lamatar has decreased	155
Figure 6.1: Dewey's Sequence of Conflict Management	155

LIST OF ABBREVIATIONS AND ACRONYMS

BOD	Biological Oxygen Demand
CBFM	Community Based Forest Management
CBNRM	Community Based Natural Resource Management
CF	Community Forestry
CFUGs	Community forestry User Groups
DDC	District Development Committee
DFO	District Forest Officer
DO	Dissolved Oxygen
FAO	Food and Agriculture Organisation of the United Nations
FEDWSUN	Federation of Drinking Water and Sanitation Users Nepal
FUNDBOARD	Rural Water Supply and Sanitation Fund Development Board
FUGs	Forest User Groups
GIS	Geographic Information System
GPS	Geographic Positioning System
ICIMOD	International Centre for Integrated Mountain Development
INGO	International Non-Governmental Organisation
NEWAH	Nepal Water for Health
NGO	Non-Governmental Organisation
NSFWQI	National Sanitation Foundation Water Quality Index
NTU	Nephelometric Turbidity Units
OP	Operational Plan
PES	Payment for Environmental Services
QUAGOL	Qualitative Analysis Guide of Leuven
SIAS	South Asia Institute for Advanced Studies
SPSS	Statistical Package for the Social Sciences
TP	Total Phosphorus
USDA	United States Department of Agriculture
VDC	Village Development Committee
WAN	WaterAid Nepal
WQI	Water Quality Index
WUG	Water User Group

1. INTRODUCTION

This chapter provides an overview of the thesis. i) It outlines a brief introduction to the thesis, ii) highlights the research problems, iii) states the research questions, iv) provides justification for the research, v) describes the methods used vi) lays out the organisation of the thesis.

1.1. Background

Forests have served an indispensable role in the history of human civilisation and are important for social, economic, cultural, religious and environmental reasons. In developing countries and for some indigenous communities, forests are the source of livelihoods, providing direct benefits and services to people such as food, fuelwood, fodder, green manure, medicines, clean water, air and raw material for agrarian industries (Conant & Fadem, 2008). They also support agricultural systems, help maintain ecosystem services, conserve biodiversity and combat climate change (Taylor, 2011; Fisher et. al., 1997; Percy, et. al., 2003; Chowdhary & K.C, 2016). In many communities, forests also have a sacred and ceremonial significance (Falconer, 1990).

Forests provide ecosystem services including the protection of water sources. Studies have concluded that forests reduce water pollution emerged from human impact and agricultural run-off (Calder & Newson, 1989; Keles & Baskent, 2011). In particular, mountain forests play a crucial role in maintaining water quality, regulating river flow and reducing erosion and downstream sedimentation by capturing and storing rainfall (Byers et.al., 2013). The extensive root systems of the forests generate porous soil, which enhances the filtration (Fiquepron et.al, 2013; Noble, et. al., 2007). The roots also hold the soil preventing excessive sedimentation in the water bodies. Further, the presence of forest encourages nutrient cycling which removes harmful substances from the soil. For example, nitrogen cycles in the root

system remove nitrates and nitrites from seeping into the water. Forests have higher capacity to store water compared to non-forested areas and therefore increase the content of the underground aquifers of the area (Stolton & Dudley, 2007). These forest aquifers or watersheds have been providing water to communities (human and animal) since the earth's earliest forests because they are generally of high quality which reduces the cost to purify (Abusow, 2013).

Currently, about one third of the world's population procure their drinking water from forested watersheds (Stolton & Dudley, 2007). Countries like Australia and China have used the concept of improving the forestland to improve the water quality (Land and Water Australia, 2002; Zhiqiang, 2002). Although forests cannot control certain microbial contaminations, it does reduce the need for extensive purification of water (Stolton & Dudley, 2007). Thus, preserving forests is not only important for increasing the supply of timber and other forest products but it can also be a dependable way to achieve water security, especially in the present context, where getting adequate and clean drinking water is one of the biggest environmental challenges.

Forest management is crucial to support the existence of humankind and to sustain resources such as water for the future. For centuries forests have been viewed as a free resource to be exploited and used unsustainably (Conant & Fadem, 2008). The practice of exploitation of forests resulting from mismanagement has been observed in the world which has led to severe environmental, social and economic predicaments (Taylor, 2011). Many approaches have been adopted to break the malpractice of forestry based on the objective of forest preservation or conservation (Duncker, et al., 2012). Some of the approaches for improving forest management are (Wilkie et.al, 2003):

- 1) National forestry programs

- 2) Integrated mountain development
- 3) Integrated, participatory watershed management
- 4) Protected area management
- 5) Model and demonstration forests
- 6) Participatory/community forestry
- 7) Adaptive collaborative forest management
- 8) Model codes of forest harvesting practice/reduced impact logging
- 9) Integrated pest management in forestry
- 10) Integrated and participatory forest fire management
- 11) Landscape restoration
- 12) In situ conservation of biological diversity and forest genetic resources in production forests
- 13) Forest auditing and certification.

Although all of the forest management schemes, mentioned above, have their niche in forest conservation and management, community forestry (CF) is one of the most popular forest management systems implemented in many developing countries because it allows the forest dependent people to be involved in the decision-making of their local forests. The purpose of CF is to conserve forests and natural assets such as water resources and improve their livelihood through the participation of local communities living in and around the forests.

Community forests also impact the water sources of the area. In many parts of the mid hills of Nepal, where most major rivers and lakes are far from the settlement, the only source of water tends to be springs originating from forests. Here, springs originating from CF have a key role in providing water to the local community. However, there is a major gap in the study of water in community forestry (Gilmour, 2013). This thesis aims to understand

whether and how water originating from the CF is managed in the CF program. In doing so, it aims to bring out the importance of water management in CF which will be relevant to Nepal's efforts towards enhancing sustainable development outcomes.

1.2. Research Problems

CF in Nepal is often considered to be one of the most successful examples of community-based natural resource management (CBNRM) in developing countries. However, studies on CF show that water use and management have not usually been the primary concern of CF programs. It has mostly been limited to forest conservation and incentives from other forest products such as timber, herbs and food and to develop the livelihood of the people (Acharya, 2002; Ojha, et.al., 2009; Kellert, et.al, 2000; Arnold & Campbell, 1985; Acharya, et.al, n.d.; Shrestha & McManus, 2008; Gilmour, 2013). There has been limited discussion on water which is ironic as most water sources in the mid hills are either situated within the forests or have originated from community forests. Moreover it is not well understood if water management has ever been a part of consideration on community forestry. This aspect of forest management has barely been studied in Nepal.

There are three major problems with water source management in community forestry of Nepal: First, there are no cross-sectoral legislation, plans, measures and institutions (Zingari & Achouri, 2002). The quality and quantity of water helps to indicate the success of CF (Pokharel & Suvedi, 2007). However none of the forest or the water legislation in Nepal's Master Plan for Forestry Sector (1989), Forest Act (1993), Forest Regulation (1995), Water Act (1992), and Water Regulation (1993) have established linkages at the legislative level. This means that most responsibilities are left to the community groups to decide and act as to whether it is feasible to include management of water in the community management programs. In the absence of legislative provisions for the institutions, there would be

likelihoods of conflicts between the community groups for the control of resources (Pant, et.al, 2005).

Second, there is limited technical expertise that can manage both forest and water. This applies to community as well as the government. Although the community may have been managing water for centuries through indigenous practices, the gap exists from absence of effective programs linking science, policies and capacity building for the stakeholders and policy-makers (Zingari & Achouri, 2002). Understanding the science behind water and forest management can be challenging as the relation between forests and hydrology is complex and multifaceted. It is influenced by various factors such as geo-morphology, soil properties, soil degradation, vegetation type, canopy, age of the vegetation, climate (Malmer, et.al, 2009). Moreover, climate change alters the forest hydrology which further complicates the science. Combinations of local and existing scientific knowledge can be useful in understanding the hydrology of an area.

Thirdly, the community is divided into different resource sectors with different institutional norms and operations, potentially duplicating efforts and reducing efficiency. Thus, it is not clear if CF is deliberately managing water or simply shares members and responsibilities with the other resource sectors (Pant, et.al, 2005).

1.3. Research questions

Q1: Do forestry sector policies and legislation address water management issues within community forestry in Nepal?

The first research question uses policy analysis to study the existing policies and the effectiveness of current strategies and legislation in the forestry sector as it relates to community forestry and water management. This will reveal the understanding of water

management in Community forestry at a government level and whether the policies fully explore the concerns within CF and water.

Q2: How are water management issues (quantity and quality) perceived by local community and forest user groups, and to what extent are these issues addressed by local initiatives within the community forestry operational plan in the case study of Lamatar?

The second question will illustrate the problems identified by the community and the forest user groups on water management for water quality and supply (quantity and distribution). It will present the analysis of the operational plan on how it addresses water management.

Q3: What are the major challenges facing Lamatar community forestry user groups in terms management of water?

The third research question is about identifying major problems encountered by the community to enhance the quality and quantity of water from community forests. It will look at the water quality in the watershed, and also the challenges in equitable water distribution.

Q4: What are the key lessons for improving CF in terms of addressing water management issues in Nepal?

The fourth research question will convey the local perspectives of water management in community forestry. The local practices of water management (distribution, charges, maintenance, development) and the participation of community forestry user groups in the village-level water management will be clarified. The local people will also define the role played by the government within policy making, implementing and monitoring both (forest and water) the community based management programs.

1.4. Justification

The coalition in the science of forest and water justifies the inclusion of forest and water management in community forestry (Calder, 2007). Forests are believed to improve the hydrology of the area and there is anecdotal belief (section 4.3) amongst various stakeholders in Nepal to state that community forestry has improved the quality and quantity of spring water in the mid hills of Nepal.

Secondly, the water is enjoyed not only by the community forest user groups (CFUGs) but by the villages situated beyond the CF boundry as well. As payment for ecosystem services (PES) is not in practice in Nepal, CFUGs are not rewarded for the environmental services (water) they provide. If community forestry are properly recognised for managing water, just like other forest products from community forests, they can demand for compensation (monetary and non-monetary) from the government and community.

Thirdly, both these resources support local livelihoods. However, the existing evidence does not provide a clear explanation of community forestry users managing these resources together under the institutional structure of community forestry in Nepal.

Fourthly, local people's perspectives on issues and local initiatives on integrated management are not well reported. Local people, for necessity, manage a range of resources together, and they employ local practices and innovations to do so. Not sufficient local practices are reported in the literature which sheds light on how water issues are addressed by community forestry user groups in Nepal. This study will clarify how water is being managed in community forests.

Fifthly, management framework/options are not identified or recognised as to how community forestry groups can actually manage water at the local level. This study will aim to explore the opportunities for community forestry to be recognised for managing water as

well as forests, and for community management of water in forests to be formalised through legislation and operational plans.

1.5. Research Method

A mixed method approach, combining quantitative and qualitative methods is employed in this study. In-depth analysis of the policy documents complements the primary data collection and analysis. The mixed method was useful for three reasons, *viz.* a) to verify findings from one approach with the other b) to generate complete data c) to relate the results of one method with the other (Curry, et.al, 2009).

A quantitative biophysical investigation included water quality analysis of a snapshot sample of the watersheds conducted in the month of March (spring). The analysis of the water quality justifies that community forests could improve the quality of water in the watershed.

A comprehensive qualitative data collection included 1) questionnaire survey, 2) semi-structured interview, 3) policy analysis, 4) informal discussion and 5) observation by attending workshops. Residents from Lamatar Village Development Committee (VDC) were surveyed. The interviewed people involved local residents, officials from the local government, district government, central government and non-governmental organisations. A detailed discussion of this is provided in the “Methodology” chapter.

1.6. Organisation of the thesis

This thesis is divided into six chapters. A brief summary on each chapter is given below.

Chapter 1 is a general introduction to the research. It briefs the background of the study, research problems, rationale, aims and objectives, methods and the structure of the thesis.

Chapter 2 is the literature review that reviews the existing knowledge and studies that is relevant to this study. It also identifies the gaps in the literature and how this study would fill the gaps in the existing knowledge.

Chapter 3 details the methodology used in this study. It provides comprehensive discussion and justification for the approach used. It outlines the geographical features, socio-economic make-up of the population and the historical background of the study site. It also provides rationale for using the site for the purpose of this study.

Chapter 4 presents results from questionnaire survey, interview, biophysical analysis and document review, followed by the analysis of data in line with the questions outlined in Chapter 1.

Chapter 5 is the analysis Chapter which answers the research questions presented in the first chapter using the results of the study.

Chapter 6 concludes the thesis by providing key findings and the contributions of the research in the study of Community forestry and water management. It also outlines the key recommendations for water management in community forestry as well as opportunities for future research.

2. LITERATURE REVIEW

This chapter aims to contextualise the issue of water conservation, management and use in reference to the existing literature on community forestry. There are eight sections in this chapter. First, it defines the concept of community forestry and gives an overview of its purpose, focusing on how and to what extent issues of water are included in the definitions. Second, it explores the historical evolution of CF program in the world and in Nepal. Third, it identifies key challenges of community forestry and then highlights different facets of water management issues. Fourth, it looks at water conservation and management within community forestry program. The fifth, section identifies the gaps in the literature on water management and community forestry. Sixth section discusses the political ecological approach to community forestry, focussing on access to and control over decisions on water resource management in CF. Next is the conceptual framework for this study developed to analyse water management issues in CF. The concluding section summarises the key issue and challenges in the current practices in relation to management of water in community forestry.

2.1. Community forestry: Definition and purpose

There are many definitions of community forestry and the similarity between all definitions is that it includes local participation in forest conservation, use and management (Bullock & Hanna, 2012). Most literature comprehends around: benefits to the local population from protected areas; flexibility, innovation and voluntary compliance rather than command and control strategy; attention to local environment and local knowledge (McCarthy, 2005). Considering this, the definition of community forestry can be synonymous to different forest management practices such as town or municipal forestry, indigenous and aboriginal forestry, community based natural resource management, community-based conservation and co-

management (Bullock & Hanna, 2012). It was first defined by FAO in 1978 as:
(<http://www.fao.org/docrep/u5610e/u5610e04.htm>)

“Any situation which intimately involves local people in a forestry activity. It embraces a spectrum of situations ranging from woodlots in areas which are short of wood and other forest products for local needs, through the growing of trees at the farm level to provide cash crops and the processing of forest products at the household, artisan or small industry level to generate income, to the activities of forest dwelling communities”

Community forestry in the mid-hills of Nepal can be best defined as:

“A village-level forestry activity, decided on collectively and implemented on communal land, where local populations participate in the planning, establishing, managing and harvesting of forest crops, and so receive a major proportion of the socio-economic and ecological benefits from the forest" (Martel & Whyte, 1992).

This is because most forests there are situated rurally and the rural population show high dependency on the forest products (Manandhar & Shin, 2013).

Community forestry has opened a wide range of opportunities to the people and government around the world. Besides the benefits to livelihoods and cultural wellbeing, it also gives a political voice to the people (Molnar, et.al., 2011). Community managed forests have proven to be much more effective than state managed forests in many countries which has encouraged the government to give them as much importance as state-run protected areas. The program revives local knowledge on the ecosystem and has opened more employment opportunities than commercial forest enterprise in countries like Ghana, the republic of Congo and Cameroon (Molnar, et.al, 2011).

Initially, the purpose of community forestry was to address deforestation and local development focusing mainly on rural development and in fulfilling local people's need of forest products. However, more recent studies highlight community forestry in terms of mitigating and adaptation to climate change (Eryl & Gautam, 2003; Suzuki, 2012). The purpose of rural development was influenced by the rural development strategy advocated by the 1979 Programme of Action of the World Conference on Agrarian Reform and Rural Development (Arnold, 1992). Its main goals as stated by Bullock and Hannah (2012) are:

- 1) to enhance local control over decisions on forests that have a local significance for social, economic, ecological and spiritual reasons.
- 2) to improve local economy through forest-based activities, and
- 3) to develop sustainable forest management that respect the use of forests as well as protect the cultural, recreational and aesthetic values.

However, community forestry has other functions such as maintaining domestic water quality, forest industry jobs, long-term sustainability, scenery, biodiversity and wildlife habitat protection, logging according to an ecosystem-based plan, non-logging jobs dependent on forests, hunting, motorised access for recreation, non-motorised recreation, educational opportunities, spiritual values, forest fire protection, traditional aboriginal values, cultural heritage and archaeological values, and non-timber forest products (Gunter, 2004). To community forestry user groups, the purpose of community forestry is to gain access to forest resources and fulfil their daily needs such as food, fodder, timber, and non-timber products (Acharya, 2002).

Water is an important resource in the context of community forestry. However, the focus of resource management in community forestry has mostly been limited to fuel wood, timber, herbs, food and fodder. Most studies on community forests have recognised water as an

imperative by-product. Although community forests have significantly improved the quality and in some cases the quantity of water, the study of the management of water within the community forests is largely missing (Gilmour, 2013).

2.2. Evolution of community forestry

While the formalised practice of community forestry began only in the 1970s, the indigenous management of forests is longstanding (Fisher, Prabhu, & McDougall, *Adaptive Collaborative Management of Community Forests in Asia: Experiences from Nepal, Indonesia and the Philippines*, 2007). Its idea can be traced back to the forestry practice in Europe, North America and Asia. Historically, forests were looked after by local people and indigenous groups by using techniques to gain sustainable benefits, which would include collecting/harvesting timber and non-timber products including water, from the forests (Charnley & Poe, 2007). However, in the sixteenth century, with the uprising of European powers, this practice devolved into nationlisation of forests and highly unregulated commercial extraction (Guha, *Environmentalism: A Global History*, 2000). Further degradation was observed during the industrial revolution during the twentieth century when people were given incentives to clear forestland for agriculture and urban use. The recognition of environmental disasters from the heavy exploitation of forests during the industrial revolution in Europe and North America called for the state to regulate the misuse of forests (Menzies, *Introduction*, 2007). The state claimed all rights to operate and engage in scientific management of forest services (Marsh, 1864). The demarcation of forest resources from local population spread throughout many countries especially the colonised countries (Menzies, *Introduction*, 2007). This practice of forestry clearly did not work as it failed to understand the importance of environmental and economic services of the forest to the people. In fact, there was very little evidence of improved forest condition and most cases

(China, India etc.) witnessed loss of forest cover and poaching in state protected forests and National parks (Menzies, Introduction, 2007). The political upheaval in India (Chipko movement) (Shiva & Bandyopadhyaya, 1986), Thailand (ordination of trees) (Darlington, 1998), United States, Canada and Australia (Green Peace and Earth First movement) to reconsider commercial timber production towards management strategies involving local communities began to instigate the need to develop community based management schemes (Menzies, Introduction, 2007). Finally in 1970, the professionals in forest management realised the need to include local communities in resource management taking account of the social interests in forest resources (Menzies, Introduction, 2007). However with the advent of a modern forest management informed by orthodox science and operated under bureaucratic regime, forest management has become focussed on only forests, effecting separating water and other resources. This separation is primarily for maximising management efficiency.

In the global context, there is a prominent upwelling of small-scale community based forest enterprise over commercial forestry. This shows the growing popularity of community based forest management in the forest economy (Molnar, et.al, 2011). Up until 2011, about 11% of the world's forest is under community management with different strategies and purposes to attain successful forest management (Porter-Bolland, et.al, 2011; Molnar, et.al, 2011). The development is more marked in developing countries where 27% of the forest was community managed in 2008 (Molnar, et.al, 2011). This resulted from the gradual change in the conservation paradigm of state management to community management as many studies advocated that forests have and still are inhabited and managed by local people (Porter-Bolland et.al, 2011). The realisation and transition of forest policies to include local communities began in claims of indigenous and other local communities for forest resources (White & Martin, Who owns the world's forests? Forest Tenure and Public Forests in Transition, 2002).

Community based forest management such as community forestry rose in South Asia for similar reasons: failure of centralised government to include local communities in forest management. The emergence of participatory rural development also played a critical role in its evolution (Chambers, 1983). Although various indigenous communities have managed forests for centuries, India's Social Forestry was the first identified to adopt a systematic community-based forest management. However this was criticised for there being too much government control and for excluding local decision-making (Menzies, Introduction, 2007).

Nepal's community forestry program began in the late 1970s to address the deprivation of local people from accessing forest resources, which led to resentment and deforestation (Hobley, 1996). Community forestry of Nepal has evolved with the change in its political system: from privatisation (until 1957) to nationalisation (1957-1970) to decentralisation (1970 onwards) (Ojha, et.al, 2009). In the 1970s, Nepal had a panchayat system where local political bodies (panchayat) played a significant role in community forestry decision-making. With the abolishment of the panchayat system, the countries went through a constitutional monarchy and finally into the current republican multiparty system where local forest-dependent communities called community forestry user group (CFUGs) held the responsibility of managing and operating the forests (Ojha, et.al, 2009). Nepal's Community forestry program is believed to be a success by FAO for it has made achievements in forest conservation and social development relating to rural governance and institutional reform (Ojha et al, 2009) as well as economic benefits such as employment opportunities, income generation from forest preservation (Kellert et.al., 2000), timber and non-timber products and sustained fuel sources (Acharya, 2002; Arnold & Campbell, 1985).

Community forestry (CF) in Nepal involves devolution of power and responsibilities of forest management and use to the local forest user groups (or community forest user groups;

CFUGs) who are empowered to collect, use, sell and redistribute revenue collected from the products from community forestry (Chetteri, et.al, 2012). As mentioned above, community forestry is established in deviation to nationalisation of forests and gives full rights to use the allocated forest-land to Community forest User Groups. CFUGs identify themselves and the forests that they want to manage and use. They would then apply to the state forest office for handing over of the forests to the community. As such, the role of forest department has transformed from policing of forests to the facilitators of in the CF process (Pokharel, et.al. 2007). With the handover of forests, CFUGs own forest products, while the land ownership remains with the state which gives the states full right to take back the forest rights from the CFUGs if the terms and conditions are not met (Arnold, 2001). Thus it is not clear who has the final authority to forest resources (Upreti & Shrestha, 2000). Many studies have also questioned the integrity of the devolution of power to the community (Charnley & Poe, 2007; Upreti & Shrestha, 2000; Fisher R., 1999; Pokharel, et.al., 2007). Fisher (1999) states that there are obvious gaps in the policies and little clarity in the meaning of devolution and decentralisation in the policy documents.

Community forestry in Nepal is a success story in forest preservation and natural resource management. Its advantages not limited to the environmental sector only, studies show that it has also made achievements in social development relating to rural governance, democratic exercise, gender equity, community development and institutional reform (Acharya, 2002; Ojha, et.al, 2009; Kellert, et.al, 2000; Arnold & Campbell, 1985). The economic benefits include employment opportunities, income generation from forest preservation, timber and non-timber products and sustained fuel sources. The CFUGs work actively and efficiently to make community forestry program a success.

2.3. Key Challenges of Community Forestry Program

CF has several challenges. In many countries, CF has failed to provide equity in distribution of benefits from forestland and access to resources (Mahanty, et.al., 2006). Lack of funding,

institutional rigidities, effective policies, trained personnel, organisational development, devolution of ownership, harmonise inter-sectoral policies are some of the hurdles that are needed to be addressed to improve the CF (Mazur & Stakhanov, 2008; Fisher, et.al, 2005).

Failures to provide equity in distribution as well as participation have usually resulted due to top down initiation, lack of economic incentives to participants, lack of autonomy, incompatible livelihoods and opportunity costs, lack of community skills, limited funding availability, time and sufficient conservation personnel and definitions of participation used by different stakeholders (Measham & Lumbasi, 2013; Rodriguez-Izquierdo, et.al, 2010). In Nepal, community forestry has arguably failed to provide equitable distribution of power and economic benefits, reduce conflict but has increased consideration of traditional or modern environmental knowledge (Kellert, et.al, 2000). According to Rodriguez-Izquierdo, et.al, (2010), community based natural resource management such as community forestry needs effective long-term co-management approaches that define local participation, build capacity to all stakeholders and provide monitoring at various stages.

There is also no adequate emphasis in policy, legislation and program relating community forestry management with water management that provides incentives to the people for generating ecological services such as carbon sequestration, hydrological services, biodiversity conservation, aesthetic value (Maharjan, 2004). In Nepal, several studies have shown that the success of the community forestry depends how local users conserve forests and to some extent on the government legislation and facilitating institutions. When these institutions are weak, CFUGs loose effectiveness (Sanwal, 1988). Disagreements between government authorities and communities, extreme tax levies, and inflexible guidelines may hinder successful CF. There needs to be a democratic process, good government laws and meaningful people's participation as well as transparency between the government and

CFUGs on how they are managing CFs to obtain a successful Community forestry program (Khanal, 2003).

FAO has further identified several challenges in community forestry. The management guidelines as to when, where and how resources are to be used are defined as institutional arrangements. These guidelines can be implemented by The Ministry of Forestry or the authorized institution. The institutional arrangements often evolve overtime according to the needs of the people and environmental change. Sanwal (1988) has described Community forestry programs as the most complex amongst all the comprehensible forestry management schemes because its success depends on government legislation, service facilities and on nurseries. So far, many CF programs have been driven by monetary compensation rather than environmental asset and resource management. This outlook has developed domination of high value species in afforestation over the economically insignificant species which causes declines in species diversity. He has suggested several conceptual solutions to the issues. Firstly, cultivating marketable products cannot be given importance over the needs of the rural households. Secondly, there has to be flexibility in the institutional standards as the situations change. Thirdly, is has to ensure continuing benefits with decentralised decision-making. Finally, inclusion of all residents of the area is important in benefit-sharing as well as decision making.

However, the success rates of community forest programs have clashed with the views that restricted protection is the solution (Agrawal A. , 1999). Despite criticisms, community forestry programs have been adopted in many countries as a forest management program with varying degree of success (Fisher, et.al., 1997; Ojha, et.al., 2009; Price & Butt, 2000). In several states in India community managed forests are reputed to be in a better state than the government managed forests (Price & Butt, Forest in Sustainable Mountain Development: A

State of Knowledge Report for 2000, 2000). The question of water management in CF remains to be largely unaddressed.

2.4. Water management in community forests

The relationship between land and water is quite well understood and certainly, in terms of water resource in forest management systems (Calder, 2000). As a result, many countries have drawn attention into using forest ecosystem for fresh water provision by adopting the concept of protected areas for water conservation. Across the globe, there are many examples of how forests play a role in protecting freshwater sources. Watersheds located near natural forests are generally where drinking water is produced (Dudley & Stolton, 2003). According to “Running Pure” a report by World Bank / WWF Alliance for Forest Conservation and Sustainable Use, about a third of the large cities in the world obtain their drinking water from protected forests (Dudley & Stolton, 2003). Countries like Korea, Japan, China, Myanmar, Chile, Sweden, Germany, Australia and Belarus are already protecting forests for water provision (Dudley & Stolton, 2003). In India, a daily supply of 663 million gallons of water is supplied to Bombay from Sanjay Gandhi National Park. In Nepal Conservation Areas such as Shivapuri National Park provides water to 4000 gallons of water to agricultural farms (Kunwar, Payment for Environmental Services in Nepal: A Case Study of Shivapuri National Park, Kathmandu, Nepal, 2008). Likewise Biao, et.al (2010) estimated that Beijing’s forests could produce 283 million cubic meter of water in 2004 which was equal of 28.7% of the water consumption in the same year. There is a significant relationship between forest cover, water quality and drinking water costs, in fact, for every 10 percent increase in forest cover in the source area, treatment and chemical costs decreased approximately 20 percent, up to about 60 percent forest cover (Freeman, et al., 2008; Enrst, 2004). Many countries are benefiting from this. A study conducted by Fiquepron, et.al, (2013) showed that protected

forests can save €11.707 million per year in France for domestic water users. It is a better alternative to its expensive counterparts such as recycling water, rainwater harvesting, deep underground water, desalination etc.

Some literature also indicates that protected forests also increase the quantity of water produced. However, there have been several contradictory findings on whether forests remove or add moisture in the soil. The role of forests to improve the quantity of water in an area seems a well-accepted notion in scientific studies; however, many authors believe that the generalisations are weak and that forest ecosystems play an important role in water conservation but that forest plantations are detrimental because of the amount of water they use (Ferraz, et.al, 2013). In the late 1920's and 1930's the sponge theory (that forests soak up water from the soil during the wet seasons and release it during the dry seasons) and the infiltration theory (that water was stored in the soil substrate not the forests) were highly debated (Malmer, et.al, 2009). In the western Amazon, an increase in deforestation showed an increase in the rate of run-off, associated with less interception and less vegetation to absorb the water. It was predicted that "if the average rate of deforestation increases by 3.45%, the run-off could increase by up to 27%" increasing flooding (Nóbrega, mpacts of Deforestation on Climate and Water Resources in Western Amazon , 2012). Likewise, many studies have supported the 'sponge theory' and have shown that forest cover decreases stream flow. In a part of the Kumaon Himalaya, deforestation resulted in drying up of springs and reducing flow in many parts to the catchment. Consequently, the flow in the Gaula River was reduced by 38.5% within a decade between 1971 and 1981 (Valdiya & Bartarya, 1989). However, this notion does not exactly support felling trees to increase stream flow because deforestation may increase the volume of stream flow temporarily but overtime it degrades the quality of water (National Research Council, 2008). An experiment conducted by USDA forest service in 1909 showed that removal of forest increases water yield but it decreased

overtime as vegetation regenerated and with essentially no effect after 7 years (Levia, et.al, 2011). Furthermore, plantation forestry in Western Australia has had a negative influence on the water resources by causing the release of sulphuric acid and metals from soils into the streams (Government of Western Australia, 2009).

The relation between forests and hydrology is complex and multifaceted, thus it can be stated that the forest hydrology is influenced by the interaction between several factors such as geomorphology, soil properties, soil degradation, vegetation type, canopy, age of the vegetation, climate etc. (Malmer, et.al, 2009). The principal aspect that defines the hydrology of a forest is precipitation and stream flow measures. Scholars tend to agree that forests can be important for water conservation verified by the increased water quality and quantity around forested regions (Rakhmanov, 1966). However, it is important to understand that all hydrological systems vary, thus a site specific study of the hydrology is crucial to understanding the system.

2.5. Gaps in the Literature

Community forestry has improved forest hydrology, but the management of water is yet another key challenge (Gilmour, 2013; Calder, et.al.,, 2007). Despite a large body of literature in community forestry, there remains a significant gap on how and to what extent community forestry addresses issues of water in a local community. This is critical in the context that community managed forests also have tremendous capacities to conserve water. However, they have been under-recognised with respect to their contributions to water conservation. Research conducted on community forestry commonly recognises its potential in water provision (Gilmour, 2013; Calder, et.al, 2007). Yet, it is difficult to find solid understanding about the management of water within the community forests. The purpose of Community forestry has mostly been for forest conservation, social development including

rural development and local empowerment (Acharya, 2002; Ojha, et.al, 2009; Kellert, et.al, 2000; Arnold & Campbell, 1985; Acharya, et.al, n.d.; Shrestha & McManus, 2008; Yadav et.al., 2015; Toft, et.al., 2016).

Section 2.3 discussed the challenges faced by community forestry programs. It indicates that perhaps community forestry programs might not be able to handle an added responsibility of water management. Moreover, forest hydrology is a complicated science that requires high levels of expertise. Most community forestry user groups have limited knowledge in forest science and perhaps their ability to handle water management is questioned by authorities. There are many community based water management schemes around the world as well as in Nepal. Water management within community forestry needs to be further explored and understood.

Unlike the traditional forest management models, the meaning of sustainable forest management does not just limit to timber production anymore, but it has broadened into other facets such as aesthetics, recreation, soil protection, carbon sequestration and biodiversity. With growing water demand, the importance of integrating water production into forest management schemes is also being recognised worldwide (Keles & Baskent, 2011). Organisations such as WWF Forest Alliance and World Bank are advocating for “the importance of protected forests for drinking water”, supporting the inclusion of community forestry in water conservation (Dudley & Stolton, 2003). However, some scholars believe that despite the enthusiasm of the world and the scientific advances in forest hydrology, the water resource remains secondary in forest management due to a huge gap between policy-makers and scientists (Calder, 2007; Keles & Baskent, 2011). Timber is still seen as one of the major incentives for forest management while environmental services such as water resource and soil conservation only generates indirect value and/or revenue (Calder, 2007).

As discussed in section 2.1, the purpose of community forestry is focused on environmental conservation and social development. This notion developed from the fact that some of the commercial forestry management schemes in developed as well as developing countries have deprived forest-dependent people from accessing the resources due to their high value timber and other forest products (Abe, et.al, 2003). Likewise, the idea of nature reserves, protected areas and national parks were criticised by many scholars because it was inconsiderate towards the population living in the vicinity and using the resources for daily livelihoods and subsistence (Hansen & DeFries, 2007; Schonewald-Cox, Boundaries in the protection of nature reserves, 1988). However, the politics of community forestry suggests that there are challenges in obtaining optimal social benefits. Several studies have found problems with equity with common property resource management in relation to a) rich and poor members b) gender inequality c) socio-cultural differences d) proximity to the forests (Varughese, 2001; Leone, 2013). It is therefore essential to discuss the politics of community forestry in terms of environmental change and ecological services.

2.6. Political ecology of community forestry

Community forestry involves interaction between local people and the environment, usually to support livelihoods and to manage resources and the environment. However this process may produce winners and losers. Some important local issues such as water management can be overlooked. As discussed above, the decisions can be controlled by social elites, ignoring the views and perspectives of heterogeneous groups of local community. Then the important question emerges as to who makes decisions about how forests and other resources are managed and how such practices are institutionalised. In this context, political ecological approach provides useful insights to analyse how local people make decisions about managing and using resources and gain understanding on access to and control over such

decisions which prioritise some aspects of management over others, creating winners and losers in the management process and distribution of outcomes.

It is important first to define what political ecology is. According to the dictionary of human geography, “political ecology is an approach that emphasises the economic and political processes affecting access to and use of land and resources” (Castree, et.al, 2013). The concept started getting attention in the academic world around the 1960s with the growing concern of human impacts on the environment (Forsyth, 2003). It evolved from an earlier approach of cultural ecology, which looks at human adaptations both biologically and culturally with the changing environment. However, cultural ecology focuses on the local and cultural land management system while political ecology is about the political economic explanations for widespread environmental change (Forsyth, 2003). Yet both the concepts look at social justice for environmental management and development (Forsyth, 2003).

Political ecology is approached by different authors in different perspectives. Forsyth (2003) has collated various definitions identified by prominent authors of political ecology. Firstly, Blaikie & Brookfield (1987) have defined political ecology in terms of environmental problems where a problem arises from an interaction of biophysical processes, human needs and the political economic system. Secondly, Atkinson (1991) defines it in term of political activism in favour of Deep Green Environmentalism which is an outlook critiquing modernity and capitalism. Thirdly, Russett’s (1967) explains political ecology as a relationship between political systems and the social and physical environment of the ecosystem. Fourthly, Lipietz (2000) has used political ecology in Marxist theory about materialism, justice, capitalist justice and achieving fair distribution of resources. Although the definition barely mentions the biophysical environment, it is highly relevant in this study of community forestry in Nepal. Fifthly, Bryant (1992) sees it as the politics of environmental

problems. Sixthly, Forsyth himself defines political ecology as a scientific legitimisation of environmental policy.

Besides these, there are other approaches of political ecology that were not listed by Forsyth such as narrative ecology by Robbins (2012, p16) “which sets out to unravel the political forces at work in environmental access, management and transformation”, and feminist political ecology which states that

“Feminist political ecology treats gender as a critical variable in shaping resource access and control, interacting with class, caste, race, culture, and ethnicity to shape processes of ecological change, the struggle of men and women to sustain ecologically viable livelihoods, and the prospects of any community for sustainable development” (Rocheleau, et.al, 2013, p4).

In this study, rather than picking one definition of political ecology, a non-exclusive approach is adopted which integrates key elements of all of the above definitions. The integrated approach is crucial because it provides a broad framework for understanding and framing the social and environmental issues of Nepal. This dissertation investigates specific political ecology themes such as ‘access, power, equity and conflict’ and how these might shape the functioning of community forestry and its operations on water management. It also draws upon versions of political ecology that insist on engaging both biophysical and social methods in their analyses for understanding the context and management of environment and natural resources like forests and water.

Despite having abundant natural resources there are several environmental problems faced by some of the most vulnerable groups in the world. These groups come from highly marginalized communities who have been victimized by and blamed for the environmental degradation. The environmental degradation has already caused famines and ecological

decline which will be further exasperated from the growing population. Furthermore, the political instability from the decade long civil war instigated by the Maoists to uproot the monarch and feudalism ceased many aspects of the socio-economic development of the country (Adhikari & Samford, 2012; Acharya, 2008). The country is still recovering from the civil war and at the moment, there is no constitution and no proper regulations to address the environmental problems of the country. Therefore, a broad-based political ecology is a useful frame of analysis for understanding the social, environmental and political complexities relating to community forests and water resources in Nepal.

The concept of integrating political analysis and environmental explanation has been a highly discussed subject in the scientific world since the late 1800's after a Russian aristocrat Kropotkin pioneered the theory of political ecology (Robbins, 2003). However, the idea managed to get attention in the academic world in the late 1960's only which arose from the growing concern of human impacts on the biophysical environment for social and economic development (Forsyth, 2003). According to Robbins (2003), the growing realisation of the failure of "apolitical ecology"- which dismisses the politics of the country, region and the locality in environmental science, brought about great transformation in the research and study methods for 'social environmental science'. The concept of political ecology emerged as a result of 3 convergent factors; a) cultural ecology and other related positivist human-environment social sciences, b) emerging theory of green materialism, peasant studies, post-colonial theory and feminism, and c) feedback on global ecology as a result of globalization.

2.7. Political Ecology of Community forestry in Nepal

The relevance of political ecology in this study can be related to the prominent concerns of social justice, environmental disputes and resource struggles in developing countries (Forsyth, 2003). Much of this has been observed in studies of community forestry in Nepal

which is discussed in this section. The prime concern in a developing country, such as Nepal, according to Bryant and Bailey (1997) is the repression of grassroot actors by more powerful actors such as the government, businesses or social elites within the community itself. The repression comes in different forms: socio-economic factors, gender, caste and class.

i. Socio-economic Repression

With the social norms and socio-economic hierarchy in the community of Nepal, the poorer and low caste households have been found to have been forced for restricted access to resources compared to the more “richer” members of the community in some circumstances (Shrestha & McManus, 2008; Adhikari, et.al, 2004). Although Varughese (2001) has suggested that richer members have lower dependency on forest resources because they can afford alternative resources.

ii. Gender Inequality

Besides the rich and poor, gender inequality and inequity has also been recognised as a challenge that we need to overcome. Despite women having stronger interest in forest conservation and ensuring the availability of forest resources than men, there is a prominent under representation of female members in the decision making of community forestry. Participatory exclusion is rampant where many women attend meetings, but they rarely voice their needs and concerns (Agrawal, 2001). This practice is luckily phasing out with the growing recognition of the importance of female participation in the conservation of natural resources (Leone, 2013). Because of their daily interaction with the natural resource, they have developed vast indigenous knowledge and skills that could prove to be valuable for the conservation, protection, use and management programs (Adhikari, 2001). Thus, most community forestry programs in Nepal have now included and valued women’s participation

(Leone, 2013). In fact, many forest user groups are now predominantly composed of women (Maskey, et.al., 2006; Lamichhane, 2004).

iii. Social Hierarchy

To understand the social hierarchy it is first important to recognise the caste system that influences the social structure of Nepal. Social stratification by caste, class, race, gender, ethnicity and religion are some of the pertinent categories of Nepalese society. There are intricacies within the groups but based on the modern caste system, there are four principle categories of caste classified by the profession: highest are Brahmins belonging to the group of priests. Second are Chettris-the warriors and the members of the royal family. Third come Baise (Newars), merchants and traders. Sudras (Janajatis) are the labourers and the lowest caste group (Giles, 2013). One's caste is hereditary and it determines one's social status, behaviour, obligations and expectations. It also limits one's access to resources and political power. Violating these norms is considered impious and can lead to social boycott (Subedi, 2010).

Social hierarchy or caste system is another factor hindering equity of resources. Although some community forests have shown no evidence of the disparity amongst different castes, case studies from many Community forests show that the higher caste people are generally more involved in decision making and worked higher positions in the institution. They are also the ones who are more educated and bring in more intellectual skills to the program. Contrary to that, the lower castes are involved in lower level participations (Maskey, et.al, 2006). However, a study conducted by "Nepal Swiss Community forestry Program" (Carter, et.al, 2011) showed that the participation of lower caste members has increased, but the rate of increment is very low (from 5.2% to 9.9% in 8 years).

iv. Proximity

Similar disparity has also risen from the users' relative proximity to the forests. It was found that users living closer to the forests have more open, secure access to the resources and claim "primary product-rights". This works against the members who live further away and pay the same membership fee (Varughese, 2001).

The discussions above indicate that there are three main problems in Nepalese community forestry: 1) equity, 2) access, and 3) power. Bryant and Bailey (1997) have recognised that political ecologists have looked extensively into political and ecological implications of forest loss with the issue of deforestation, soil erosion and the social implications of these issues, which ultimately leads to degradation of water. But, there lacks clear, systematic work on the political ecology of water use and management. Some studies have been conducted on hydropolitics in Nepal (Petheram, 2011; Mirumachi, 2013; Rotberg & Swain, 2007; Elhance A. , 1999). Yet, these studies have not sufficiently investigated the role of water in community forestry; neither do they look at the use and control of water in the context of a hierarchical society like Nepal. The question to be proposed here is "the oppression in resource use, management and participation of the marginalised groups within community forestry program maybe phasing out in terms of forest resources such as timber and non-timber products, but is it the same in terms of water?". Besides the equity in distribution and management, there are very few studies on the politics of water availability and quality within community forestry (Bryant & Bailey, 1997) which are crucial in today's world where there are growing concerns of obtaining water security.

2.8. Water situation in Nepal

The sections above describe the advantages as well as the socio-political challenges of including water management in community forestry. However, to get a comprehensive idea on why water from community forestry is so important, it is crucial to understand the status

of water in Nepal. This section describes the water situation in Nepal highlighting the water problems and challenges faced by the water users.

In Nepal, large parts of the population are devoid of safe and adequate drinking water. According to Department of Water Supply and Sewerage in Nepal, even though 80% of the population has access to drinking water, it is not safe. It is worse for the poor and marginalised groups who have lesser access to water (MENA Report, 2014). In the remote hills of Nepal, there are very few sources of water. Because of the hilly geography and scattered settlement, it is difficult to develop centralised pipe system (KC, et.al., 2011). Thus, most people rely on springs originating from forests. These springs provide high quality drinking water however, the assigned management body for the natural springs is not clear. According to the Water Act (1992) and Water Regulation (1993), the local government is supposed to be responsible for the natural resources such as water unless specified, but the government has failed to initiate programs to protect water resource for political and economic reasons (Kunwar, Payment for Environmental Services in Nepal: A Case Study of Shivapuri National Park, Kathmandu, Nepal, 2008). Without a proper management body, the encroachment of these crucial sources is inevitable, exasperating the already existing water problems mentioned above.

The water problems of Nepal can be divided into a) quality b) quantity (Merz, et al., 2004)

2.8.1. Quality

Water quality is a global concern with 3.4 million people dying annually of water borne diseases (Berman, 2009). Therefore, it has become a necessity to combat water quality issues. In Nepal most rural and urban communities are deprived of good quality water. Poor water quality in the capital city is a result of an assortment of water management problems, requiring extensive purification before consumption. The supplied water is often insufficient

leading people to resort to groundwater. Over-extraction of ground water from a highly dense settlement has degraded the quality of ground water as well. The problems are numerous (Suwal, Water in Crisis-Nepal, n.d.). In rural areas, pollution of water resources is directly related to the negligence of water management. There are three main reasons for declining water quality in Nepal 1) dumping of domestic and industrial wastes 2) increased use of chemicals for agriculture 3) non-existent sewage system in most parts of the country (Warner, et.al, 2008; Collins & Jenkins, 1996; Jha, 1997).

2.8.2. Quantity

Insufficient quantity of water for drinking as well as agriculture is one of the primary concerns of many houses in the mid-hills of Nepal (Merz, et al., 2004). The water problems in Nepal are not exactly due to aridity or deficiency of water as Nepal has abundant water bodies fuelled by the glaciers from the Himalayas and the monsoon rain fluxed from the moist air originating from the Bay of Bengal (Wang & Gillies, 2013; Biggs, et.al, 2013). Political ecology of water suggests that water challenges are the result of the uneven distribution of water due to a) natural and b) human factors (Palaniappan & Gleick, Peak Water, 2008).

a. Natural Factor

Access to water is a basic human right (Universal Declaration of Human Rights, 1948). People should be able to access fresh and clean drinking water for their daily needs. However, accessibility is challenged in Nepal as the geographical features like rugged mountains and scattered settlements make it difficult to develop a centralised pipe system (K.C., et.al, 2011). The geography of the country is mostly hills or isolated mountainous land which slows or impedes infrastructure development. The country's infrastructure development is disparate reaching to only a few accessible groups disregarding the many

marginal groups living in remote mountainous areas (Govinda, 1985). This is more evident in the hills where water sources are scattered and irregular. People often have to travel for hours to obtain water from the closest water source. Communities living further away from the source become even more vulnerable to water scarcity and exclusion from access to water (WAN, 2008).

Furthermore, climate change has been a major concern because of its potential impacts on future water availability (Bharati, et.al, 2014). Climate change is predicted to bring changes to temperature and precipitation in Nepal. The increased temperature will result in glacier retreat threatening the water security of people reliant on the melting snow. The changes in precipitation patterns will affect agriculture as most farmers rely on monsoon rain to irrigate lands. Moreover, most springs, wells, rivers and lakes in Nepal are replenished by rain water and a decrement in rainfall will increase water shortage (Bates, et.al, 2008). Climate change mitigation and adaptation measures can be implemented but the variability and the uncertainty of the projections make it challenging to respond adequately to at a local and a governmental level (Annamalai, et.al, 2007; Kripalani, et.al, 2007).

b. Human Factor

Peluso and Watts (2001) stated that political ecology emphasises “the entitlement by which differentiated households, individuals and communities possess or gain access to resources within a structured economy. It grants priority to how the entitlements are distributed, reproduced and fought over in the course of shaping and being shaped by patterns of accumulation”. The growing influence of capitalism and globalisation means that the natural resource consumption is largely constituted by the powerful and wealthy actors in developing countries as the distribution is skewed towards the more powerful actors. In doing so, many local communities get deprived of the resource even though it is in abundant supply locally

(Kahl, 2006). Political ecologists describe the environmental impacts as a result of unequal power relations occurring between the actors at various levels of government- state, regional and local (Crifasi, 2002). Thus, the incidence of the degradation of water resources and the lack of protected water management in Nepal could possibly be due to the lack of equity between different levels of government, community organisation and the grassroot users.

Hilyard's (1990) approach of political ecology also suggests that resource shortages are caused because the socially and politically powerful groups are oppressive in resource sharing. This systematically blocks access to locals causing scarcity within the communities. The local behaviour of resource exploitation, depletion and degradation is the survival mechanism to counteract the access blockage and scarcities caused by the higher authorities and powers. These pro-scarcity politics influence the social and cultural behaviours of the communities, and this research seeks to understand if these processes are at play in a selected case study in Lamatar, Nepal.

Political ecologists have used different methodologies to understand the human-environment interactions and the causes for environmental change (Crifasi, 2002). The political ecology for this study will be actor centred following the model of Bryant and Bailey (1997). The study will use multiple methods and analyse various state and local actors involve in local water management as well as the relationship and the connection between the actors which is crucial in understanding the effective mode of water management (Crifasi, 2002).

2.9. Conceptual Framework

The above discussion on the issues of community forestry indicates the need to analyse the effectiveness of water management. In this thesis, I evaluate this by using a political ecological approach focusing on actors. However, it is first important to understand a) the

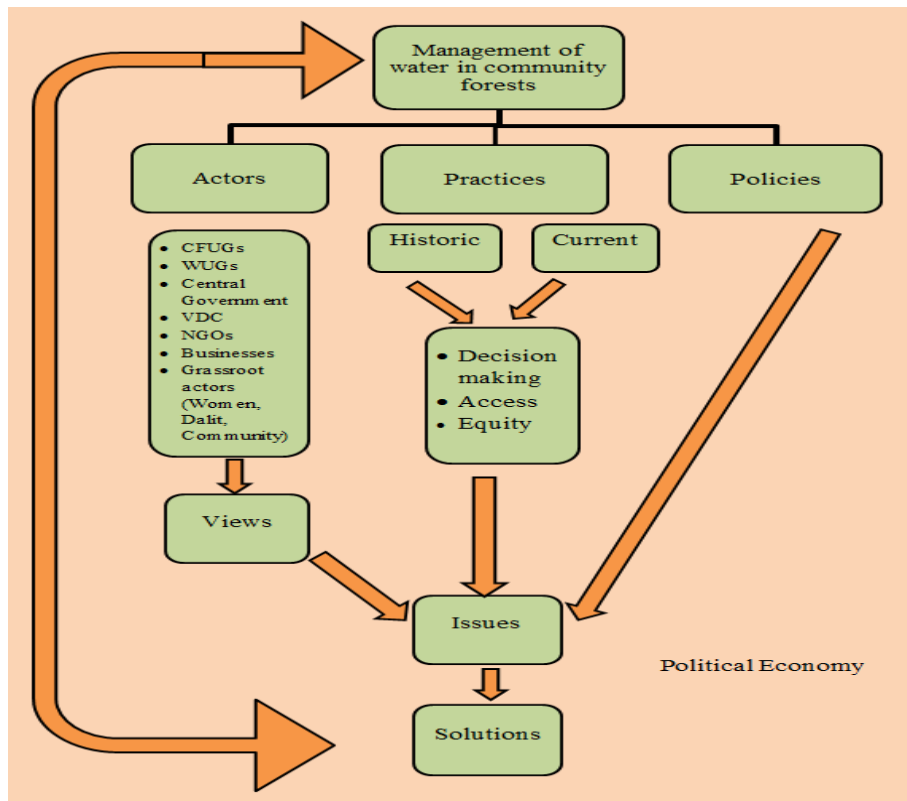
current policies on water management in community forestry and the opportunities to manage water within community forestry; b) both historic and current practices of water management and use; c) perception of actors on water management within community forests including their views, concerns, similarities and differences in views and d) key implications.

The flow chart (fig 2.1) is the conceptual framework developed to link the issues raised in the above. This study looks into the management and policy of forest amenities like “water” in this case study. To understand the current management, policies and procedures and to come up with effective management strategies, we need to evaluate and understand the role of institutions, current practices and policies of community forestry.

A review of the current practices and policies through policy analysis will identify the issues of including water management in community forests which will subsequently support the formulation of solutions. Forsyth (2003) has identified five primary actors in political ecology: Community institutions (WUGs and FUGs in this study), government, NGOs, businesses and the grassroots actors or the community. The community is the most important actor of the model as they are the main water users and will be most affected by the management processes. The community has been further classified into women, disadvantaged groups (such as low caste people, Dalits- the untouchables) and non-community forest user groups.

There will be three issues identified in the historic and current practices of water management a) decision making, b) access and c) equity. Field research will focus on local decision making processes (involving community groups, government agencies, local governments and NGOs) and outcomes by situating these in the wider social and economic processes (Batterbury, 2001). The problems with the practices and solutions will be evaluated.

Figure 2.1: Analytical Framework for this Study



(Source: Author, 2014)

Through the above framework, I analyse and understand the viability of incorporating water management and use within community forestry and to formulate management schemes. But to do this an understanding of the community forestry program and the water management schemes of rural Nepal is required. Furthermore, the characteristics of the community –the capacity to be involved in governance, equity amongst all the community groups, and conflicts need to be duly understood to foresee the potential issues of involving water management within community forestry programs.

Firstly an operational plan of community forestry program (if there are any sections on water management and use; if there are any opportunities) and the water management of rural communities is analysed independently. Then I will analyse the possibility of integration of these. This is largely achieved through extensive literature review on community forestry,

rural water management and forest hydrology as well as through document analysis. The review of the documents will respond to the first research question.

The next step is to study the current management scheme of a) how water coming from community forestry is managed, and b) who manages it. Traditionally, in Nepal and in lots of other developing countries, water is considered a ‘free’ or ‘open access’ resource used by the local people with no formal management body (Ostrom, 2007). However, the lack of a proper management body and the indifference and incompetence of local government bodies has caused mismanagement of water resources and intensified the water problems. This study aims to find out if water management in the rural hills of Nepal in areas such as Lamatar is still traditional or is managed by a formal institution. If the water is managed by the people with less stringent rules, how successful is this approach and whether the alternative would be more effective. Intensive questionnaire survey and interviews with the local government bodies will help respond to these questions. This analysis will help identify the issues of the current management schemes and the possible solutions which will answer the third and the fourth research questions.

The second research question is to investigate the perception of the actors on the role of Community forestry to water management. This will require analysis of the questionnaire survey. In terms of perspective, the analysis will explore:

- The views and concerns on the current decision making and management scheme
- Similarities and differences on the views between different actors
- Solutions to the issues addressed by the actors

2.10. Conclusion

This chapter reviews relevant theories, studies on community forestry. It discusses the issue of water conservation and management within forestry programs. It suggests that water conservation is feasible within forestry programs such as community forestry but effective management of the resource is crucial for sustainable resource management. It is therefore important to understand the ability of the community and the viability of comprising water management and conservation in community forestry program of Nepal, this includes addressing the potential social issues (caste system, norms, culture, unequal power) and also district and national level political economic factors. This research will help fill in the gaps of water management problems and solutions within community forestry. The literature review provides some analytical concepts for assessing effective water management schemes within Community forestry program. The next Chapter details the method employed in this thesis.

3. METHODOLOGY

This chapter describes the research design, research approach and methods that were employed in this research in order to answer the research questions. Both qualitative and quantitative methods were used in this study. This chapter is divided into research approach, study site, sample population, methods for data collection, secondary research, and limitations.

3.1. Research approach

The thesis adopts an actor-oriented approach of political ecology (Batterbury, 2001). This aims to understand cooperation (or conflicts) by focusing on the interests, characteristics and actions of different types of actors in a given context. The underlying assumption is that development is socially constructed within the daily life of various actors and reality can only be understood by visiting and interacting with their life worlds (Long, 1992). This approach is suitable for understanding the actions of different actors operating at different scales and socio-economic structures and is particularly valuable to understand the co-operation and conflicts related to environmental change (Bryant & Bailey 1997).

3.2. Study Site: Lamatar VDC, Lalitpur

The study of community forestry in Nepal is interesting and critical for several reasons. Firstly, community forestry program in Nepal is one of the most successful stories in the world in terms of participatory resource management (Chettri, 2005) and one of the pioneers in Asia to give property rights to the community to control and manage forest resources (Adhikari, et.al, 2004). The program is over three decades old which means it has been well established to allow comprehensive analysis on bio-physical as well as social characteristics. Existing data can be used as groundwork for this study and also to support the findings in the

later chapters. Secondly, the socio-economic status of the people in Nepal makes it feasible to relate the program with international goals such as the United Nations Millennium Development Goal. The rural population's high dependency on the forest resources and water emerging from forest for livelihoods further adds to the significance of the study.

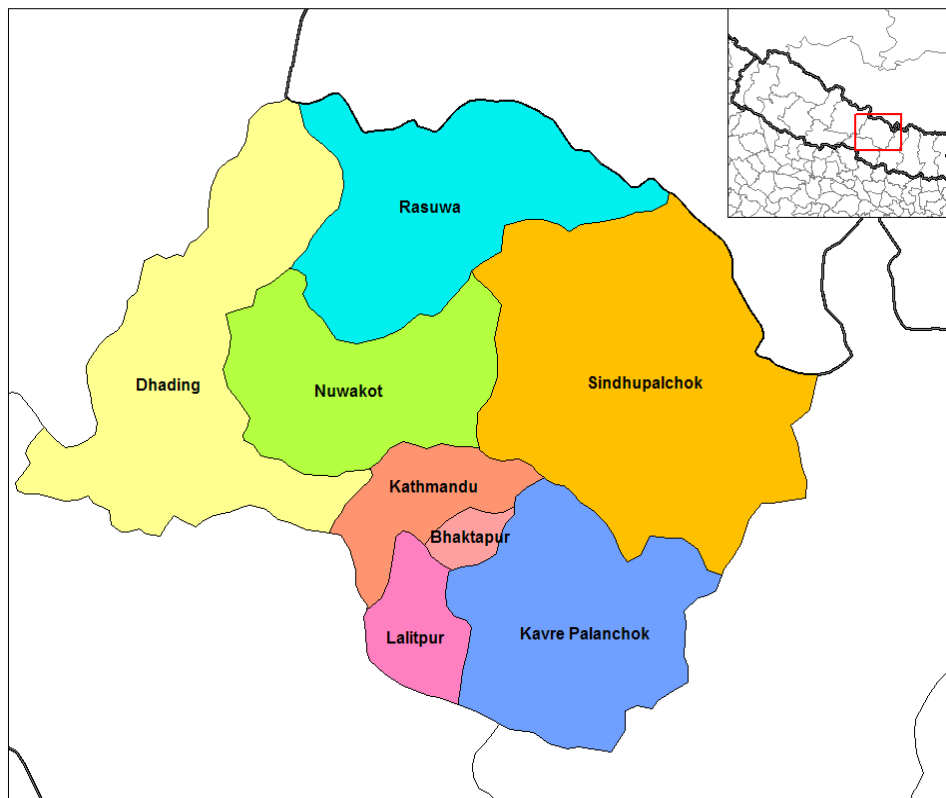
Lamatar VDC comprises of a large area of forestland most of which is managed by the Community forest User Groups (Lamatar VDC, 2012). The community forest program is well established and the CFUGs have been managing the forests successfully. There are many headwaters within the Community forests and outside the forest boundaries which make the study of the relationship between water and forests possible. The locals in Lamatar VDC are highly reliant on their forests and the water resources. All these features make it an appropriate site for this study. The detailed profile of Lamatar is given in chapter 3.

This section provides a brief overview of the study area: Lamatar VDC. The VDC is located in Lalitpur District of Bagmati Zone (Refer to Fig 3.1). The interrelation between the location, demography and water usage are described through the application of methods in this chapter.

3.2.1. Location

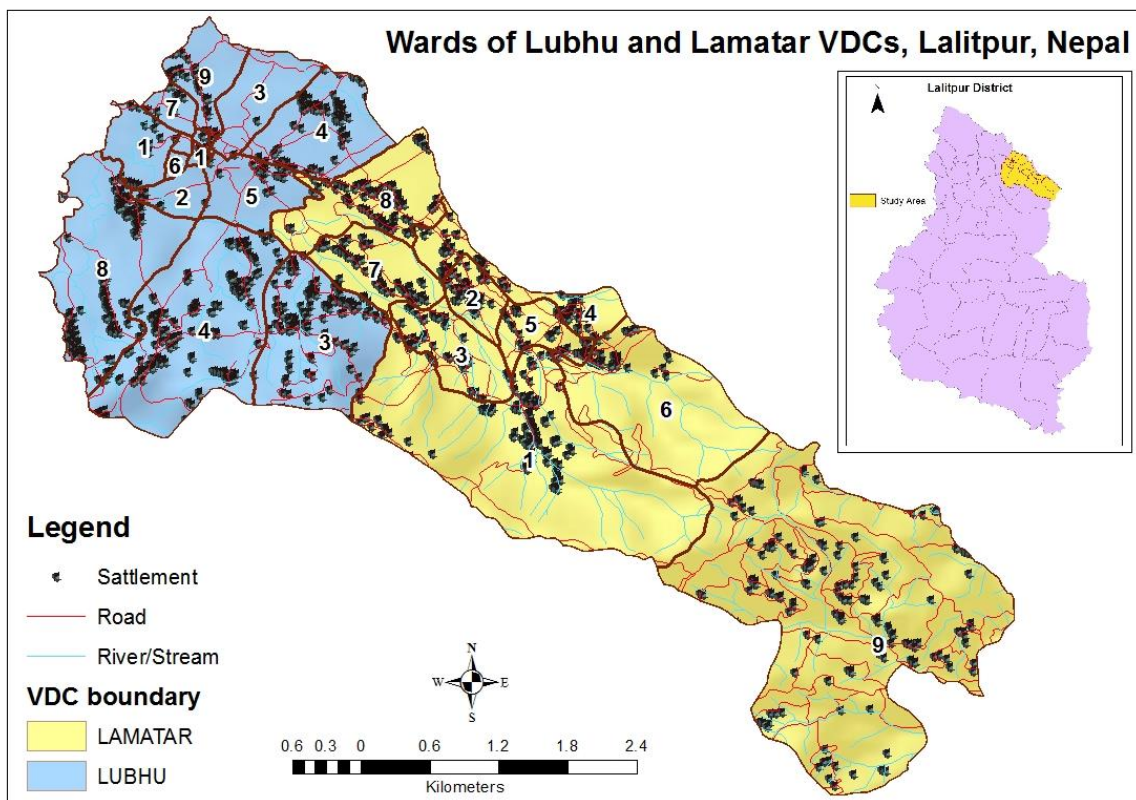
Lamatar is a rural community situated just outside the Kathmandu city, 9km from the Ringroad- road that encircles the central part of the Kathmandu Valley. It covers an area of 7.45 sq. km. and is situated within 27°25'00"N to 85°40'00"E. It has an altitude of 1200ft to 5900ft from the sea level. It shares the boundary with Ryal VDC from Kavre district in the East, Lubhu the West, Dadhikot VDC, Sirutar VDC and Gundhu VDC from Bhaktapur district in the North and Bisankhunaryan VDC in the South.

Figure 3.1: Map of Bagmati Zone showing Lalitpur District



Source: http://upload.wikimedia.org/wikipedia/commons/7/7f/Bagmati_districts.png

Figure 3.2: Map of Lamatar VDC with neighbouring Lubhu VDC



Source: ICIMOD Nepal, 2014

3.2.2. Climate

The climate is similar to the Kathmandu Metropolitan City with slightly cooler temperature. During summers the average temperature can range from 15 to 32 degrees and in winters it can fluctuate from 10-14 degrees. During winter the hills in the higher altitude can receive snowfall. It receives heavy rainfall of 293 mm every year.

3.2.3. Historical background

The VDC was named Ramtar after the establishment of the temple belonging to Lord Ram in the west of the VDC. The name Ramtar later evolved into Lamatar.

3.2.4. Demography

Table 3.1 shows that, according to the census 2064 the population of Lamatar is 7593 consisting 1457 households falling under “rural” classification. The most populous ward is 9 and the least populous ward is 3.

Table 3.1: Demography of Lamatar

Ward no	Number of households	Population		Total
		Female	Male	
1.	151	404	413	820
2.	152	406	373	779
3.	89	213	228	441
4.	203	447	523	970
5.	172	437	405	842
6.	107	274	302	576
7.	168	426	461	887
8.	150	386	366	752
9.	265	740	786	1526
Total	1457	3733	3860	7593

3.2.5. Occupations

Agriculture is the main occupation in this VDC with some people involved in other business, service provision and animal husbandry. A large area of the VDC is covered with forest which has encouraged forestry based employment.

3.2.6. Water bodies

Lamatar VDC has abundance of small and large streams. There are more than 50 natural water spouts situated in the VDC which feeds not only the population of Lamatar but the vicinity village as well as the downstream community. Some of the major rivers situated in this VDC are Dharachaur River, Kamare River, Sringeri River, Gomati River and Dhunge River. There are many water user groups that manage and use the streams. Table 3.3 lists out the water user groups in Lamatar.

Table 3.2: List of Water User Groups (WUGs) in Lamatar VDC

Drinking Water User Groups	Ward
Chapakharka Drinking water user group	8
Shringe Drinking water user group	1
Tiwari Khanda Lamatar Thulaghar Drinking water user group	2 and 8
Padali Drinking water user group	3
Datekowan Drinking water user group	4
Chisapani thungin Drinking water	5
Khatakholsa	6
Sim Drinking water user group	7
Raksidol Drinking water user group	7
Bista Yojan Drinking water user group	9

Source: Lamatar VDC Profile, 2012

3.2.7. Community Forestry

There are many community forests in the VDC. The maps of community forestry is provided in appendix 9.

3.3. Sample population

The main target population was the local residents and officials of Lamatar VDC including the government officials, community stakeholders and NGO officials. Lamatar was studied as the main site analysing the perception of people, the efficiencies of co-management between

government, people and other organisations. Out of 200 questionnaires distributed in the VDC, a total response of 120 was received.

3.4. Methods for data collection

Data collection was conducted by primary and secondary research methods. The primary research is the first hand data collection while the secondary research involves the analysis of the data. There are two modules for this:

1. Primary Data collection
 1. Direct measurement of the water quality parameters
 2. Survey research through semi-structured interviews and questionnaires
 - a) Questionnaire survey
 - b) Interviews
 - c) Informal discussions
2. Secondary Data collection (i.e. census, climate, rainfall etc.) from the government and non-government organisations.

3.4.1. Primary Data Collection

1. Direct Measurement of water quality parameters

Direct measurement or the quantitative analysis was imperative because survey methods were not enough to make definitive conclusions about the water quality in Lamatar (Mann, 1985). Although there was anecdotal evidence suggesting that water quality was good, no documented data on the water quality analysis of the water in Lamatar was found. Hence, water quality testing had to be devised to verify the anecdote. Furthermore, many political ecological studies have emphasised the need to bridge between the study of biophysical attributes and also the socio-political contexts in which environmental management concerns arise.

Among the 20 significant watershed outlets in the entire VDC, 2 sites located in ward 7 and ward 4 of the VDC were chosen for the sampling. These watersheds were chosen because they were accessible enough to avoid the hazards of carrying the water samples through the long trails in the wet and slippery hills. Moreover, the public taps led by these watersheds had high number of household users compared to the other watersheds. So although the sites represent only 1% of the total watersheds, only a limited number of samples could be taken (because of time and cost limitations) and it provides the first known public quantitative benchmark of water quality in the catchment.

Three sampling points were chosen for each of the streams, i) the main source or the primary outlet ii) the reservoir tank iii) the public tap. Multiple sample points from the outlet, reservoir tank and the tap were not considered as the water flow was small and it was transported via pipelines which would not give much chances of contamination or change in water quality from one point to the other. GPS coordinates were noted for each of the sampling point to be able to mark them in the GIS map. The GIS maps which will be used to demonstrate and understand the land use around the coordinates.

Amongst the many available indices, a standardized procedure “National Sanitation Foundation Water Quality Index” (NSFWQI) was used in this analysis as it was simpler than many other indices. Many countries including Nepal have used this index to assess the status of the water bodies. This procedure was initially proposed by Brown et.al (1970) and was further improved by the National Sanitation Foundation of America. The WQI uses nine parameters to determine the water quality, temperature, pH, turbidity, total dissolved solids, dissolved oxygen, biological oxygen demand, phosphate, nitrate and faecal coliforms. However, only 7 out of nine parameters were used to measure the Q value of this study. The value for BOD and total phosphorus had to be omitted as the laboratory in Nepal was unable

to run these tests. The WQI formula was adjusted accordingly to obtain the best WQI value. The adjusted formula gives negligible difference in the result which does not alter the category of the water body (Srivastava & Kumar, 2013). The Q value was compared with the National Drinking Water Quality Standard of Nepal, 2005 (National Drinking Water Quality Standards, 2005). The mathematical expression for NSFQI is given in the appendix 3.

The Q-value was then multiplied by the weighting factor. The weighting factor is a numerical value given to each parameter and is based on the importance of each parameter to the overall stream quality. For example Dissolved Oxygen has a weighting factor of 0.17 and total solids has a weight factor of 0.07 which means that DO has higher significance in determining the health of the water body compared to total solids. The sum of all the Q values was divided by the sum of the weighting factors of the available parameters to get the WQI value. The highest value a water body can get is 100 and the lowest is 0. The resultant value was used to categorise the water body into excellent, good, medium, poor, or very poor.

The WQI value is recommended to be used with historical data due to the seasonal and annual variation in water quality. However, for this study, only three points in the stream were chosen for testing and the testing was done only once (i.e. there was no temporal comparison) due to the time constraints of the fieldwork in Nepal and the lack of preceding data.

2. *Survey Research*

Questionnaire survey research is a method of obtaining large amounts of social data often in a statistical form in a short time. It can be explanatory, descriptive or sometimes combination of these (Mc Neill & Chapman, 2005). A combination of questionnaire and interviews were used to collect data for this study. A semi structured and unstructured interview was conducted with the relevant officials and stakeholders rather than strictly structured

interviews flexibility and adaptability of research instruments to different stakeholders, it was carried out under controlled conditions and the questions were designed in a logical and systematic fashion. The 11 stages of Survey research process explained by Rea & Parker (2012) was charted to have rigorous and unbiased research.

A community survey was selected as one of the research tools in this study as it is one of the most widely used methods to gather public opinion, attitude and preference which can be used in decision making (Groves, et.al., 2013). The questions for the survey were structured to determine i) the attitude of the people towards water ii) public awareness on water management policies iv) past and present conditions of the water bodies v) political and social aspects of water management. Despite the controversies on adequate sample representation in survey researches, it is considered an important aspect in any research because it produces statistically analysable data which can reveal reasonably adequate information on the characteristics of the communities (Rea & Parker, 2012).

In this study, a comprehensive community survey was crucial to understand the issues of water management and quality at the local level. The interviews with the officials provided integral information on the management policies and guidelines; however, it was not sufficient to understand the issue at a local level. Community surveys provide an insight on whether the implementation of the government policies is successful, and how it might benefit the residents. It would also point out the inefficiencies in government regulations and implementations.

a) Questionnaire Survey

The questionnaire survey was the most important section of the methods because it provided a cost effective method giving a perspective of the general public, their behaviour, social

trends and awareness regarding water management. There were five parts in the questionnaire:

- 1) Background
- 2) Problems and prospects of water quality and quantity
- 3) Developing partnership
- 4) Water policies and legislation
- 5) Strategies to improve the water quality

Each section was drafted at the conclusion of the literature review based on the objectives of the study and ethical factors (McGuirk & O'Neill, 2005).

The questionnaire consisted of open ended as well as fixed response questions. Closed ended questions were easier to code and analyse using statistical programs. Contrarily, open ended questions yielded in-depth responses inviting the respondents to express their opinions, experiences and understandings. Open ended questions depicted valuable and unforeseen insights. However, they were more difficult to analyse for the researcher and more difficult to answer for the respondents.

There were two approaches to questionnaire distribution- self-completion and interview schedule. A “self-completion questionnaire” where the questionnaire is handed to the respondents was allowed to some participants while an “interview schedule” where the questions were read to the respondents and the questionnaire was filled by the surveyor. This was opted for the people who were not so comfortable with English. Both methods had its advantages and disadvantages. “Self-completion questionnaire” was quicker to distribute to a large sample area. It maintained the anonymity of the respondents which was significant in answering sensitive topics. The “interview schedule” despite being time consuming produced elaborate results that uncovered social meaning that lie behind social actions (Mc Neill &

Chapman, 2005). The respondents also provided clearer and more complete answers in the presence of the interviewer; this also generated higher response rates with fewer missing answers. However, in the absence of anonymity, some respondents might have filtered their responses and provided answers that were perceived desirable by the community.

Thus, different methods were bound to lead to mixed results and biases. To prevent this, the majority of the questionnaire interviews were conducted by the research assistants/field translators (under the supervision of the researcher) who did not possess in-depth knowledge on the objectives of the survey, overcoming potential interviewer direction bias.

b) Interviews

Interviews were used to gain access to information about events, experiences, facts and policies/laws from the officials involved in water management in Lamatar. The interviews were semi-structured to allow some flexibility and discretion within a framework. This means, that there was some degree of predetermined structure but some flexibility was allowed to address the expertise of the interviewees.

The interviewees chosen were government as well as non-government and community officials. At the national level, those interviewed included that staff from the Department of Water and Sanitation, Department of Forestry and Federation of Community Forestry User Groups. At the local level, local government staffs from VDC- section officer and sub-section officer, District Forest Officer, representatives of CFUGs and WUGs, key stakeholders other than individual community members were interviewed. NGO and INGO officials involved in rural water management were also interviewed to understand the context. Overall, this provided a near-exhaustive list of relevant local stakeholders.

The interviews were conducted either in the workplaces of the respondents or in a public place. To improve the efficiency of the interview, the conversation was recorded with the

prior informed consent of the interviewee. The recordings were transcribed on the very same day as the interview. There were 20 interviewees as follows as shown in Table 3.3:

Table 3.3: Interview groups

Semi structured interview group 1 (SSI1)	Representative of CFUG X 3
Semi structured interview group 2 (SSI2)	Representative of WUG X 2
Semi structured interview group 3 (SSI3)	Lamatar VDC officers X 2 (section officer and sub-section officer)
Semi structured interview group 4 (SSI4)	Forest officers X 2 (District Forest officer, Lamatar forest officer)
Semi structured interview group 5 (SSI5)	7 residents of Lamatar (6 ward representatives from 9 wards and 2 residents)
Semi structured interview group 6 (SSI6)	NGO Representatives X 2 (FUNDBOARD director, FEDWSUN assistant director)
Semi structured interview group 7 (SSI7)	District Government officer X 1 (Department of drinking water and sewerage)

c) Informal discussions

Informal discussions/interviews were conducted in the field without a structured guide of any kind. This allowed more informal conversation rather than a survey where respondents were encouraged to talk freely without being recorded (Crawford, 1997). This type of survey helped gather more anecdotal information that was not readily available through secondary resources. This mainly included the history of the place, past information of water quality and quantity, social setting of interest and to build rapport. Informal interviews were conducted mostly in the preliminary stage and some in the later stages of the research. The advantage of the informal survey was that it required no scheduling and the respondents felt less pressure.

3.4.2. Secondary Data Collection

Secondary data was collected for the purpose of analysing an existing dataset with the aim of addressing the research questions from chapter 1. The secondary data collected are:

- i. Policy documents
- ii. Rainfall data -Department of Hydrology and Meteorology Nepal

- iii. GIS files -ICIMOD Nepal
- iv. VDC profiles- VDC office Lamatar.

3.5. Secondary Research

Secondary Research involves analysis and interpretation of the data obtained from the primary research. The details of the secondary research technique are given below:

3.5.1. Policy Analysis

According to Dunn (Dunn, 1981), “Policy Analysis is an applied social science discipline which uses multiple methods of inquiry and argument to produce and transform policy-relevant information that may be utilised in political settings to resolve policy problems”. Based on this definition, the policy analysis for this research primarily emphasises on “transforming” the information for “political settings”.

Gregg (1976) has provided criticisms and stated several problems with this methodology in research. He says that it is not possible to produce a flawless policy because the data for the interacting variables and stakeholders are complex and large. The policy makers therefore will never have enough data at the time of decision making. Also, the conditions change over time, and so will the needs of the peoples and their perceptions. This means policy analysts can only use assumptions and conceptualisations developed from often unsubstantiated data to formulate policies applicable for the future. Further, the policy scholars, the decision makers and the stakeholders are different parties and only a good mode of communication between the concerned parties can contribute towards producing an effective policy.

Despite some criticisms, policy analysis has remained a common method used in social science research as it allows the researchers to put down their own thoughts on public policy relevant to the research questions. It was deemed important in this study to gain a clearer

understanding of the approaches available and the approaches adopted by the stakeholders and the issues with equity during implementation (Bobrow & Dryzek, 1953).

The documents assessment helped conclude if the policies were operating efficiently to produced desired effect and were reaching its desired audience and finally if the program equally distributed benefits amongst the people. The documents were chosen based on their relevance in a) community forest management b) water policies c) community based-natural resource management.

3.5.2. Data Analysis

Data analysis is the second major component of the research method. There were two stages of data analysis:

- a. Questionnaire data analysis
- b. Interview data analysis

i. Questionnaire data analysis

The questionnaire data was analysed using SPSS as it is a widely used statistical tool for data analysis. SPSS analysis involved four main stages 1) data entry 2) data management 3) data coding 4) analysis. Descriptive statistics such as frequency, mean, percentage. And cross tabulations between different variable were used to find the underlying pattern and factors affecting the perception of the people on water management.

ii. Interview data analysis

The interview data obtained was large, detailed, contextual and subjective. To simplify the analysis, the coding process of Leuven (QUAGOL- Qualitative Analysis Guide of Leuven) was used as a guide (Dierckx de Casterlé, et.al, 2012). The flow chart shows the model of Leuven (QUAGOL) (appendix 6).

However, because the model is flexible, it was modified to fit the nature of the obtained dataset. After the preparation of coding process, the actual coding process was done manually instead of using software. This was considered more efficient as the sample size was small.

3.6. Limitation

Several factors constrained the fieldwork in Nepal. The small budget and time constraints of the Masters of Philosophy can be identified as my biggest limitations of the study. Furthermore, only 6 weeks were allocated for the field work, this provided insufficient time to schedule meeting with all the relevant officials as some of the highly significant officials were on leave or unavailable during the 6 week period.

4. RESULTS

This chapter presents results from questionnaire survey, interview analysis and document review conferring to the conceptual framework presented in chapter 2. It also discusses the issues as identified in findings. The section is divided into 1) Lamatar Catchment, 2) Policy Analysis 3) Interview Analysis 4) Questionnaire survey, and 5) Biophysical Analysis. Each of the sections reporting on specific results from the methods employed first includes a results section along with a discussion of the findings to aid the flow of the argument.

4.1. Lamatar Catchment

According to local residents, Lamatar VDC had an abundant supply of clean and fresh spring water (figure 4.1, figure 4.2). The headwaters for the springs emerge from the forests majority of which is managed and carefully protected by the

Figure 4.1: Headwaters of Forest Reserve



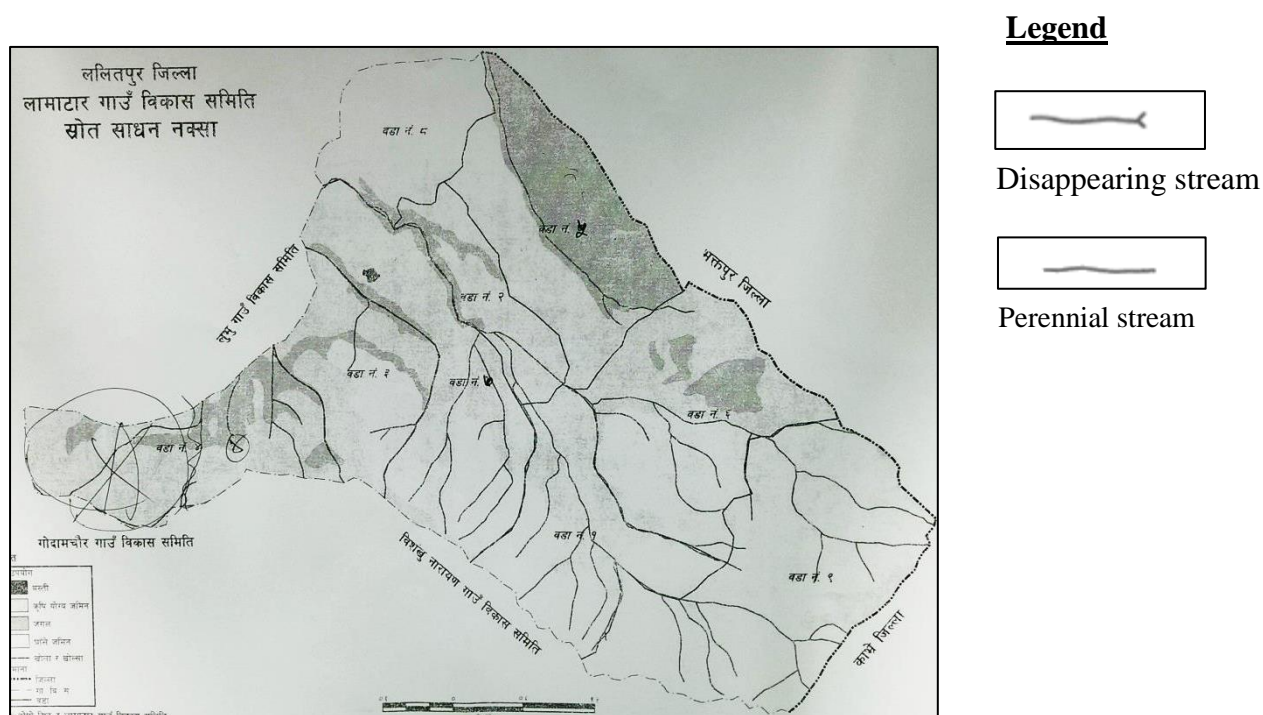
Photographed by the Author, March 2014

CFUGs. The VDC profile states that the forests purify the water, filter nutrients and control sediment loading giving high quality water which requires less or no purification.

Although the numbers for the springs are not documented, the villagers claim that there are about 50 headwaters in the entire VDC, about 20 of which provide water to the community. The rest are either too small or inaccessible for exploitation. The headwaters flow into the major rivers situated in this VDC, they are Dharachaur River, Kamare River, Sringeri River, Gomati River and Dhunge River.

Each headwater is claimed by an immediate hamlet for drinking water. Management of these headwaters is controlled by several community-based institutions such as CFUGs, WUGs, and private households. These institutions gather funds through government, community and non-governmental organisations to develop infrastructure for drinking water supply.

Figure 4.2: Water bodies of Lamatar VDC (Not to Scale)



Source: Lamatar Community Forestry Foundation Office

4.2. Policy Analysis

The policy analysis is used in this study to contextualise the central issue of water management within community forestry. It is useful to understand current policies, how they work in practice and their effects in the social, economic and environmental aspects of community forestry.

This section presents results from a policy analysis of eight documents 1) Master Plan for Forestry Sector, 1989 2) Forest Act 2049 3) Forest Regulation, 1995 4) Water Resource Act, 1992 5) Water Resource Regulation, 1993 6) Local Self-governance Act, 1999 7) Decentralised Act, 1984 8) Operational Plan of *Shree Goldanda Kankadidanda Community forestry User Groups*, 2008. The aim of this section is to answer the first research question outlined in chapter 1. It was hypothesised in chapter 1 that effective Community forestry Programs should include water as a product of forest and this must look at a) the use of water in community forests b) the management of water within the community forests and community forestry user groups.

4.2.1. Summary and discussions of the Acts

1. Master Plan for Forestry Sector, 1989

The Master Plan for forestry sector has Soil and Watershed Conservation as one of the programs highlighting the importance of forestry in Nepal. Although the program shows understanding within the policy makers regarding the improvement in water quantity and quality through an improved forestry program, the mention of water seems perfunctory with no comprehensive review. The reason being, the “Soil and Watershed Management” program looks at watershed as a whole instead of focusing in detail on the water as a resource. Moreover, the scheme focuses more on the benefits of forests in prevention of environmental disasters and natural calamities such as flood, landslide, land degradation and erosion rather

than considering and providing measures to ensure water security which would have important impacts for poverty reduction. It does not discuss the role of communities in water management either.

2. Forest Act 1993 and Forest Regulation 1995

The Forest Regulation (1995) and the Forest Act (1993) does not elaborate on the use and management of water within a forest. The documents have given higher priority to timber, firewood, acacia catechu and herbs with elaborative schemes to manage, collect, remove and replenish them, while water basically falls into the category of “other products” with no definitive policies. Moreover, the management procedure for forest, forest products and the role of different actors is unclear (Dahal & Chapagain, 2008).

3. Water Resource Act 1992 and Water Regulation Act 1993

The Water Resource Act allows the people to form committees/user groups and obtain a licence to use the water resources with an annual fee paid to the government for using the resources. The gap between CFUG and WUG is not deliberated at the policy level.

4. Local Self-Governance Act, 1999 and Decentralisation Act 1984

Decentralised Act and Local Self-Governance act provisions for community based natural resource management such as community forestry and community water management. According to these acts, the local people are given the authority to utilise and manage the resources including water and forest. However it contradicts with other government acts such as the VDC Act 1991, Municipality Act 1991 and DDC Act 1991.

5. Operational Plan: Shree Goldanda Kankadidanda Community forestry User Groups, 2008. (appendix 4)

The operational plan is a management plan which consists of management goals, activities undertaken and rules of forest product use (Ojha, et.al, 2009). The OP of *Shree Goldanda Kankadidanda* Community Forestry User Group showed that CFUGs have a systematic management scheme for forest resources. It consists of 7 chapters 1) Introduction to the forest 2) Forest organisation 3) treasury management 4) forest preservation 5) forest maintenance 6) Forest use 7) Miscellaneous

The fourth chapter is important as it lays out the duties of the user groups in order to maintain and conserve the forest resources. Some of the responsibilities laid out are: awareness programs, guarding the forests, checking encroachment, organising awards for the informers, land protection, control hunting, prevent illicit mining of resources, preserve water sources, check for land pollution and fire management. It also briefly outlines the penalty system i.e. the nature of penalty and the procedure for employing penalties to the offenders.

The policy analysis highlights four points 1) there lacks a clear correlation between water and forest governance at the institutional level of the state 2) water politics needs special attention 3) water is not seen as an imperative forest product 4) the Acts contradict each other. The comprehensive discussion of the policy analysis is provided in section 5.1 to answer the first research question.

The interview and questionnaire survey results in the following sections elaborate on the role of different actors, power and equity relating to the governance of water and CFs. Different stakeholders (e.g. locals, government, NGOs and user groups) were targeted to understand how these laws and policies are implemented locally in practice.

4.3. Interview Results

The interview results were designed to address the second component of water management in community forestry practices. The results for this chapter are derived mainly from the 20 interviews and some insights were drawn from the literature review.

4.3.1. Interview summaries

Some interviewees reported a change in water quality, quantity, accessibility and management over time, either due to human-induced or natural factors. The results showed that the residents (SSI5) commented on all the four categories listed below. However, the CFUGs (SSI1) only commented on issues relating to quantity and management. Likewise, the WUGs (SSI2) noted on quality and management only. Both the community groups did not comment on accessibility possibly because they had better access to water.

It was indicated that historically, the issues with water management were as follows:

Quality

- *Water was cleaner and plentiful few decades ago; now it is polluted and the source seems to be drying up (SSI5, March 2014).*
- *People were ignorant of the importance of maintaining water aesthetics, thus most rivers and water resources were used as a communal dumping site. This made water-borne diseases an endemic (SSI2, SSI3, SSI5, March 2014).*

Quantity

- *Water was cleaner and plentiful few decades ago; now it is polluted and the source seems to be drying up (SSI5, SSI1, March 2014).*

Accessibility

- *Water sources used to be highly inaccessible to many. Because of the hilly geography of Lamatar, the sources are often further away from the residence. So people had to travel hours to get daily supply of water. Taps are much closer to where we live now (SSI5, SSI6, March 2014).*
- *The society was highly prejudiced. The prevalent practice of untouchability, caste hierarchy meant that most of the lower caste groups were either denied of using water sources or given a separate water source (SSI3, SSI5, March 2014).*

Management

- *There were no regulations and no management body (SSI1, SSI2, SSI5, March 2014).*

The list below lays out the interview responses indicating the current statues of water management in Lamatar VDC. It shows that the community residents (CFUGs, WUGs and residents or SSI1, SSI2 and SSI5) believed that there is better access to water compared to the past. They also stated that the management of water is better as community has become more powerful, proactive and forward-thinking. WUGs (SSI2) indicated support from the NGOs which shows that WUGs get aid from local and international NGOs. Only the government officials (SSI3, SSI4 and SSI7) mentioned the laws the acts implemented by the government to drive water management while the community believed that the government had no role in water management in Lamatar.

Accessibility

- *Water is much more accessible. Although there are no private pipelines, one does not have to travel far to get water anymore. (SSI1, SSI2, SSI3, SSI5, March 2014)*

Management

- *Government has implemented water laws, decentralisation laws and forest laws that have favoured community based water management (SSI3, SSI4, SSI6, SSI7, March 2014).*
- *Sometimes there are international as well as national NGOs providing support to accomplish water management projects (SSI2, SSI6, March 2014).*
- *Women and lower caste groups are no more discriminated. We are given chances to participate in community organisations (SSI1, SSI5, March 2014).*
- *Technologically, we have come quite far. Ward no 8 is now using sand filtration system to filter river water and provide drinking to the people. It is not a large-scale project but it is definitely a start. Other wards within Lamatar and other VDCs can follow in our footsteps (SSI2, SSI5, March 2014).*
- *Prejudice is definitely fading away. People no more care if the water is being used by a high caste or a low caste, rich or poor, males or females (SSI1, SSI2, SSI3, SSI5, March 2014).*

Community Empowerment

- *The authority to govern water has been given to the people. So now, the community can decide on how to utilise the water resource available in their area (SSI1, SSI2, SSI5, SSI6, March 2014).*
- *Community has become very proactive. There are several community stakeholders such as CFUGs and WUGs involved in providing drinking water to the community (SSI1, SSI2, SSI3, SSI5, SSI6, March 2014).*

Results indicate that the government provides funding, monitoring of projects and programs, formulates policies and implements them. All the community groups as well as the local government agreed that the funds were extremely small compared to the expenses for training and infrastructure development. The higher level government authorities made no specific comments on this. All groups agreed that the government does significant monitoring of the water management projects, although, different government bodies have different roles depending on the type and phase of the project. For example: DFOs only worked on projects concerning forests while VDC checked on all the community projects. The involvement of the central government was rare except if there was a major project.

Funding:

- *VDC provides some funds for our projects- tap construction, maintenance, purchasing materials etc. Although it is not always enough. Lamatar VDC gets merely Rs. 6 lakhs a year which cannot cover the cost for all the community initiated projects (SSI1, SSI2, SSI3, SSI5, March 2014).*

Monitoring:

- *One needs to get government's permission before any project (SSI1, SSI2, SSI3, SSI4, SSI5, SSI6, SSI7, March 2014) .*
- *The stakeholders (WUGs, CFUGs) cannot conduct any projects on water without the DFOs permission if the source is situated in the forests. They also have to provide regular updates on their progress (SSI4, March 2014).*
- *The VDC makes sure that the proposed project is running smoothly and that they are following the protocols (SSI1, SSI2, SSI3, March 2014).*

- *Government's involvement in a certain project depends on the magnanimity of the project itself. If the project is small, fund and other support is provided by the VDC, if the project is major the community groups go to the DDC and if it is bigger (like the hydropower projects) the central government has to be involved (SSI7, March 2014).*

Policy level:

- *Government works on policy level (SSI3, SSI6, SSI7, March 2014).*
- *Government implements rules and regulations (SSI1, SSI2, SSI5, March 2014).*

It was suggested that NGOs have sometimes supported communities with funding, representation, introducing projects, providing technical support and training in community water management. However only three groups- WUGs (SSI2), some residents (SSI5) and NGOs (SSI6), considered their role to be significant. This shows that the sphere of influence of the NGOs is relatively small.

Funding:

- *Some NGOs such as the FUNDBOARD and Share and Care had provided community groups with some money to initiate our own projects (SSI2, SSI6, March 2014).*

Representation:

- *FEDWASUN has helped our (WUGs) voice get heard in the higher authorities. They have also helped resolve a conflict between 2 groups who wanted to use the same source for different purpose (SSI2, SSI6, March 2014).*

Technical support:

- *Water Aid built public toilets to prevent open defecation which was causing contamination in the water sources (SSI5, SSI2, March 2014).*
- *A while ago FUNDBOARD helped us to build more taps so that we save time on fetching water. It was a community initiated project but they provided everything money, engineer, they trained a villager to fix pipelines to maintain the pipes in future; they also helped form a committee for the project (SSI5, SSI6, March 2014).*

However, it was suggested that NGO/INGO support, although present, does not always benefit everyone, suggesting there are other issues of access (to funding and technical support) and equity, as follows:

Abandon:

- *Share and Care was here few years ago but after they completed their project, they handed the authority to the community and left (SSI2, March 2014).*

Limitation:

- *The project by Share and Care was only for ward no 8. Their project did not extend here (SSI5 , March 2014).*
- *We get NGOs (National as well as international) sometimes but they are not always there, it is mostly the community who is involved in water management (SSI2, March 2014).*

It was suggested that despite the support from government and NGO/INGOs, community based water management programs faced several challenges, including several political economic factors, issues of coordination, and equity, such as:

Funding:

- *We do not get enough funding from the government. The VDC budget is small and the dispute on which user group amongst the several or which development project in the VDC gets the funding each month can be malicious. (SSI5, SSI2, March 2014)*
- *There is no maintenance of the pipelines because no one has the money take responsibilities (SSI3, March 2014).*

Lack of bridge between government sectors:

- *We being the Department of Forest, we are not allowed to get involved in the water available in the forests. There are no regulations that commend us to look at water in the forests. In fact, the Forestry Offices situated inside a forest has to pay to get water from the source situated in the very forest that we manage (SSI4 , March 2014)*

Institutional changes:

- *In local VDCs, the section officers and the sub-section officers were all re-appointed. The newly appointed section officers have limited knowledge of the customary water practices and needs of the community. This limits the involvement of the VDC in effective decision making (SSI3 , March 2014)*

Political interference:

- *People have different interests. It is difficult to get a community to agree on a project (SSI6, SSI7, March 2014).*
- *Disputes between political parties are the most depressing. A supporter of one political party would not want the project to be pursued in the reign of some other*

<i>political party (SSI6, SSI7, March 2014).</i>
<p><u>Social exclusion:</u></p> <ul style="list-style-type: none"> <i>In our ward, we do not get water 24/7. The taps run water only few hours a day. It is not enough for everyone. The least priority is given to the tenants. They get their turns to collect water only after everyone is done (SSI5 , March 2014).</i>
<p><u>Technical expertise:</u></p> <ul style="list-style-type: none"> <i>We do not always get skilled manpower such as engineers and technicians. Sometimes we can't afford to hire them (SSI2, March 2014).</i>
<p><u>Delineation:</u></p> <ul style="list-style-type: none"> <i>The other ward used the water source in our ward without our consent. The VDC should not have permitted this (SSI5 , March 2014).</i>
<p><u>Conflicts over ownership:</u></p> <ul style="list-style-type: none"> <i>We can't afford to buy licence to water sources like some people. So we have to manage with whatever quality quantity of water we get (SSI5, March 2014).</i>
<p><u>Increased needs and fear of drying water sources:</u></p> <ul style="list-style-type: none"> <i>Some people have head water in their property. They are unwilling to share the water with others which is unfair. Water should be a communal resource (SSI5, March 2014).</i> <i>The water source is drying up. We get lesser water from the sources now. We have the first right to use the water. How can it be fair for us to allow the neighbouring</i>

VDCs, wards to use our water or even for some to sell water (SSI2, SSI5, March 2014)

No co-ordination between different wards:

- *The uphill community dump waste in the water source and the water the downhill community get is dirty (SSI5, March 2014).*
- *Sometimes, during dry summers people from the downhill community had to rely on the polluted river water because the spring water dries up (SSI3, March 2014).*
- *The other ward used the water source in our ward without our consent. The VDC should not have permitted this (SSI5, March 2014).*

4.3.2. Synthesis of results

The findings above highlighted several important insights on Community Water Management in Lamatar VDC. Key insights are presented below in two sections: 1) Historical practices of water management 2) Current practices of water management

4.3.2.1. Historical Practices of Water Management

Results indicated that before the 1990s (before the employment of the Water Act, Forestry Acts and Decentralisation Act), the water management in Lamatar was not formally regulated (SSI1, SSI2, SSI3, SSI5, March 2014). The government had less financial capacity and showed less political will to provide sustainable water management scheme for rural population. A greater priority was given to urban cities like Kathmandu, Pokhara, Biratnagar etc. where a pipe system provided private taps to most houses. In rural areas however, a centralised pipe system was harder to develop due to its hilly geography and sparse settlement (K.C., et.al, 2011).

This meant that spring water was generally their only source. But in sparse settlement, fetching water from a spring often meant long distance commute to fetch daily supply of water. Most families in the hills- usually the women, had to travel for hours to the nearest water source to collect water in traditional water buckets (Basnet, 2010; Shankar, 2012). The families living closer to the sources had more access to water and had the first right to the water as a customary user (Magar, Water Resources in Nepal: Institutional Analysis based on legal, n.d.).

Also, the intensity of prejudice was higher back then. As discussed in the literature review section on political ecology of community forestry, inequity to use and access water arises from different forms of repression within the stratified Nepalese society. A national level NGO Nepal Water for Health (NEWAH) noted that community water supply and water projects are often dominated by the men from the higher caste and better off families. The water supply services are demanded by them without consultation with the women, marginalised groups and other “lower” caste families. Thus the richest castes dominate all aspect of the project initiated by NEWAH putting their water demand before the needs of the poorer families and women (NEWAH, 2008). More brutal customs involved the practice of untouchability where people from “lower” caste groups were not allowed to touch water sources used by the other “higher” castes. A separate tap was allocated to the untouchable groups which often supplied poorer quality water than the taps used by higher caste groups (SSI3, SSI5, March 2014; Shankar, 2012).

Nepal has no systematic sewerage system which has been the prime cause for declining water quality. Most sewage and waste gets dumped into a local water source in hope that the water would wash away the waste (Warner, Levy, Harpp, & Farruggia, Drinking water quality in Nepal’s Kathmandu Valley: a survey and assessment of selected controlling site

characteristics, 2008; Collins & Jenkins, 1996; Jha, 1997). Although this is still in practice currently, it was more prevalent in the past due to ignorance from the people (SSI2, SSI3, SSI5, March 2014). Using the polluted water most likely increased the incident of water borne diseases, particularly for downstream users (Suwal, Water in Crisis-Nepal, n.d.).

It was also indicated that the water was of better quality and there was higher quantity available in Lamatar. With the growing urbanisation and population growth, the water demand of the community has increased putting greater pressure on the available sources.

4.3.2.2.Current Practices of Water Management

Results indicated that water management has improved significantly over the past few decades. With the construction of more public taps and the introduction of advanced technology such as sand filtration, people will have better access to more drinking water. Moreover, it can resolve the water contamination faced by the downhill community (ward 8).

The passing of Water Act, Water Regulation Act, Decentralisation Act, Self- governance Act etc. has given numerous opportunities to the community to participate in decision making; to voice their opinion on community resource management; to have better access and control to their water resources etc. It has also helped empower groups that had been considered “inferior” such as women, lower caste groups and poorer families. Moreover, community stakeholders such as CFUGs and WUGs have also had opportunities to empower and develop their organisation and participate in effective decision making.

The government was considered a critical stakeholder by the interviewees. The VDC provides funds, implements laws and regulations and monitors the community stakeholders’ workings. However, the effectiveness of the government has been questioned by many respondents from the questionnaire survey (section 4.3) as well as the interviewees. Firstly,

the funds provided by the government are insufficient to cover the costs of all the community projects that get proposed each year. Lack of funds would not only make newer proposals futile but also impede the infrastructure maintenance of the foregoing projects (Mills, 2011). Given this scarcity of domestic resources, it would not be possible for the community to implement any water management scheme without donor support. However, the donor supports are not as readily available. In fact, the interviews stated that NGO and INGO supports were sporadic (SSI2, March 2014), which is in line with common criticisms of overseas development assistance and aid funding that tends to arrive according to short project cycles of 3-5 years. If not properly implemented these programs often fail when the NGO or implementing agency withdraws, unless local institutions or community groups take control of the maintenance of the project (e.g. maintaining infrastructure with local funds).

Significant support has also been received by national and international NGOs. Organisations such as WaterAid, Share and Care Nepal and FUNDBOARD have provided substantial financial support to pursue water, sanitation and hygiene projects based on community empowerment in Lamatar (SSI2, SSI6, March 2014). NGOs like FECOFUN has been involved in facilitating capacity building, raising voice of the user groups, conducting research, working on policy advocacy, co-ordination and negotiation with the fellow user groups and providing good governance in relation to both users committee and service providers (FECOFUN, 2014). NGOs (FUNDBOARD) also provide technical support to assist with the community water management projects.

4.4. Questionnaire Results

This section presents results of 120 questionnaire survey (99 valid responses, 21 were invalid) and informal discussions. In answering the second research question, 5 sub-questions have been formulated.

- According to the respondents, who is managing water (role of government, NGOs and community)
- What are the water problems as identified by the community? What are the similarities and differences in the views of people between different wards, social class, gender, proximity to community forestry?
- Solutions to the water management problems as acknowledged by the community.

4.4.2. General features of the community

Table 4.1 describes the general features of the community sample based on survey responses. The stratified caste system of Nepal suggests that Brahmins are the highest caste group, followed by Chettris, Newars and finally Janajatis. The representation of all groups, gender, and class was not clear from the questionnaire survey. The majority (40%) of the respondents were Newars- a middle class caste group while only 10% were lower caste groups. The disparity would have been avoided by conducting a strategic questionnaire survey instead of a random survey. Therefore, further analysis in the institutions is required to further understand who influences what decisions.

Table 4.1: General Features of Community Sample

Features		Number	Percentage
Sex	Female	40	40.4
	Male	59	59.6
Age	18-24	15	12.5
	25-34	37	30.8
	35-44	21	17.5
	45-54	14	11.7

	55-64	7	5.8
	Over 65	3	2.5
Education	Primary School	5	4.2
	Middle School	13	10.8
	Year 10	23	19.2
	10+2	14	11.7
	Undergraduate	20	16.7
	Postgraduate	14	11.7
	Doctoral	1	.8
	N/A	7	5.8
Ethnicity	Brahmin	28	23.3
	Chettri	11	9.2
	Janajati	12	10
	Newar	48	40.0
Proximity	Close	34	34.3
	Further	65	65.7
Profession	farming	16	13.3
	government service	7	5.8
	housewife	12	10.0
	Private service	33	27.5
	self-employed	17	14.2
	student	14	11.7
CFUG members	CFUG non-members		72.7
	CFUG members		27.3

4.4.3. Main Water Management Body in Lamatar

Table 4.2 (appendix 6) illustrates that most people (71%) considers the community to be the main actor in water management within Lamatar VDC. Some people considered VDC to be playing the main role in water management as it is supposedly the unbiased actor providing financial and technical support to the water management programs. NGOs/INGOs were seen as insignificant as only 8.6% suggested that NGOs/INGOs had a role in water management in Lamatar.

Table 4.3 (appendix 6) reiterates the findings in table 4.2. It illustrates that 92.9% of the respondents claimed that NGOs/INGOs had no significant role in the water management. Only a few people suggested that NGOs/INGOs had supported in some way.

Although both CFUGs and non-CFUGs claimed that NGOs and INGOs had a smaller role to play in the water management, higher percentage of non-CFUGs stated that NGOs and

INGOs provide budget and training while higher percentage of CFUGs stated that NGOs gave technical help (table 4.4, appendix 6).

Most respondent did not think that the government was playing a significant role in water management within Lamatar. About one third of the respondents were not aware of the government work on water management while 45.9% claimed that the government was not doing anything significant (table 4.5, appendix 6).

Table 4.6 (appendix 6) illustrates that more than half of the respondents who stated that most (54.8%) Newars thought that the government had no significant role in water management. While some (19%) Newar respondents stated that government provided budget for water management, very few said that it gave technical help and training. About 19% stated that they did not know how the government was supporting water management in Lamatar. All of the Chettri respondents either stated that they did not know what the role of the government (77.8%) in water management or that the role was insignificant (22.2%). Similar trend was observed with the Brahmins and Janajatis as well where most respondents stated that they did not know the role of the government in water management or that the role of the government was insignificant.

According to table 4.7 (appendix 6), majority of CFUGs and non-CFUGs stated that the government had lesser role in water management. Large percentage also said that they did not specifically aware of what the government did. Table 4.8 (appendix 6) shows that 86.6% of the people were not familiar with the water policies set by the government.

4.4.4. Water Problems in Lamatar

Table 4.9 (appendix 6) shows that the most common problems according to the respondents are insufficient water and contamination of water during monsoon seasons. High percentage

of respondents also stated that seasonal availability, poor quality of water and unequal distribution were other major water problems in the VDC.

Table 4.10 (appendix 6) illustrates that different caste groups had different water problems. Majority of the Newars (24.1%) stated that the major water problem was insufficient supply. Amongst the Chettris, three prevalent water problems were identified: a) decreasing quantity b) irrigation problem c) murky during monsoon. With the Janajatis, the biggest water problem was the quality or contamination during monsoon. The highest caste group- Brahmins were more concerned with water for irrigation.

Table 4.11 (appendix 6) indicates that both genders thought that the biggest issue was the insufficiency of water. Greater percentage of men stated that irrigation problem was one of the prevalent issues, probably corresponding to their involvement in farming.

Table 4.12 (appendix 6) indicates most CFUGs were concerned with contamination of water during rainy seasons (21.7%) followed by insufficient amount (15.9%) and then irrigation problems (10.9%). For non-members, the biggest concern is insufficiency (18.4%) followed by seasonal availability (11.4%) and then poor quality of water (9.6%). So CFUGs have an advantage in terms of supply. For non CFUG it is more about availability.

Table 4.13 (appendix 6) indicates shows that people living closer to the forests were mostly concerned about the contamination of water during monsoon (21.6%) while only 8.3% of the people living further from the forests stated that their major concern was the murky water during monsoon. Here, respondents from ward 2, 4, 5 and 8 were considered to be further from the forest and respondents from ward 1, 3, 6, 7 and 9 were considered to be closer to the forests (ref. figure 3.2 and figure 3.4). 11.8% of the respondent showed concerns about the decreasing water quantity in the headwaters while 9.8% stated that managing for irrigation is the biggest challenge. Meanwhile, most respondents (22%) living further from the forests

were concerned that they get insufficient water, only 7.8% of the people living close to forests said that the water they received was insufficient. A high percentage of respondents living further from the forests were also concerned about the poor quality water and the sporadic availability throughout the year.

4.4.5. Solutions to the water problems

Table 4.14 (appendix 6) shows great variations in the opinions given by male and female respondents. Most females stated that more taps were important while most males indicated that management was essential. In comparison to male respondents, greater percentage of females voted for the importance of the community participation in water management programs (20.6%) and for equal distribution of water (20.6%). Both male and female were almost equally interested in protecting the source by preserving the forests. However, only males were interested in finding funds to support the community initiated water management programs.

Most Newars supported participation (25%) as most effective solution to water problems. About 22.9% said management is the solution and 20.8% stated that more taps is crucial which almost the same rate is as Newars stating that equal distribution of water is more important. Amongst the Chettris 44.4% stated that management would solve the water problems while 22.2% said that participation and protection of the source is crucial water management scheme. Within the Brahmins, most people voted for management (55.2%) and source protection (24.1%). Majority of the Janajati respondents also voted for management (30.8%) and source protection (30.8%).

Table 4.15: Solutions to water problems by caste

Solutions to water problems	Different castes			
	Brahmin	Chettri	Newar	Janajati
Participation	6.9%	22.2%	25.0%	0.0%
Communication	0.0%	0.0%	4.2%	7.7%

More taps	3.4%	0.0%	20.8%	15.4%
Equal distribution	3.4%	11.1%	18.8%	7.7%
Management	55.2%	44.4%	22.9%	30.8%
Protect source	24.1%	22.2%	4.2%	30.8%
Financial aid	6.9%	0.0%	4.2%	7.7%

Both the groups living closer to the forests and living further away from the forests considered management policies and schemes to be the key factor to effective solutions to water problems. The respondents living at greater proximity thought more public participation would be crucial (19.1%) while less than half of that (9.4%) of the people living closer to the forests thought that more public participation would help. Respondents living further demanded for more taps (16.2%) and equal distribution (14.7%) while fewer people living closer to the forests thought it was crucial (6.3% and 9.4%). 21.9% of people living further from the forests said that protection of source is essential while only 11.8% of the people living closer to the forests gave protection of source any importance.

Table 4.16: Solution to the water problems by proximity to the forest

Solutions to water problems	Closer	Further
Participation	19.1%	9.4%
communication	1.5%	6.3%
More taps	16.2%	6.3%
Equal distribution	14.7%	9.4%
Management	32.4%	40.6%
Protect source	11.8%	21.9%
Financial aid	4.4%	6.3%

Similar to the results in table 17, both CFUGs and non CFUGs thought management policies and management schemes were important to combat the water problems. Higher percentage of non CFUGs (17.6%) stated that more participation is fundamental compared to 12.5% of CFUGs. The non-members also declared that they required more taps (14.7% vs 9.4%). Greater disparity was seen for the equal distribution of water and the protection of source where higher percentage of non CFUGs said that equal distribution would solve the water problems whereas only 3.1% of the CFUGs supported the hypothesis. Higher percentage of

CFUG members (25.0) were in support of protecting the source compared to the non CFUG member (10.3%).

Table 4.17: Solution to the water problems by CFUG members and non-members

Solutions to water problems	Non-members of CFUG	Members of CFUG
participation	17.6%	12.5%
communication	2.9%	3.1%
more taps	14.7%	9.4%
equal distribution	17.6%	3.1%
management	33.8%	37.5%
protect source	10.3%	25.0%
financial aid	2.9%	9.4%

4.5. Biophysical factors in Lamatar

This section presents results from the WQI test and the data obtained from the bureau of meteorology. The biophysical analysis provides a snapshot indication of quality and quantity to help support or contradict the anecdotal comments on these factors by members of the community made in interview or surveys. These biophysical factors also need to be considered to implement effective water management. The questionnaire survey and the interview analysis showed that the locals of Lamatar rated the water quality highly. The WQI test will verify this. Following this, meteorological data was collated to highlight changes to rainfall which has flow-on effects for water quantity/availability, which locals have noted has been declining.

4.5.2. WQI test

Table 18 shows the results of the water quality analysis conducted on two of the water sources. Samples from site A were collected from the source in ward 1 and the samples from site B were collected from the source situated in ward 7. The location of the water sources is given in figure 4.5. Tables 4.19 and 4.20 show that the water qualities of both sources are moderate, most likely because of the high level of Coliforms and low level of dissolved oxygen. High level coliforms suggest sewage contamination possibly animal waste and low dissolved oxygen suggests low level of oxygen in ground water.

Table 4.2: Results of WQI test- Site A

S.No	Parameter	Weighting Factor	NDWQS*	Point 1			Point 2			Point 3		
				<i>Levels</i>	<i>Q value</i>	<i>WQI Value</i>	<i>Levels</i>	<i>Q value</i>	<i>WQI Value</i>	<i>Levels</i>	<i>Q value</i>	<i>WQI Value</i>
1.	Temperature	0.1	-	16	89	8.9	16	89	8.9	17	89	8.9
2.	pH	0.11	6.5-8.5	8	84	9.24	8.2	77	8.47	7.6	92	10.12
3.	Turbidity (NTU)	0.08	5	2	93	7.44	1	96	7.68	5	86	6.88
4.	Total Dissolved Solids (mg/L)	0.07	1000	95	84	5.88	87	85	5.95	104	83	5.81
5.	Nitrate (mg/L)	0.1	50	3.4	82	8.2	1.6	95	9.5	ND<0.2	97	9.7
6.	Dissolved Oxygen (%)	0.17		0.8	2	0.34	0.8	2	0.34	0.78	2	0.34
7.	Faecal Coliforms	0.16	0	1096	22	3.52	784	24	3.84	3800	15	2.4
8.	Biological Oxygen Demand		-									
9.	Total Phosphorus		-									
	Sum of				456	43.52		468	44.68		464	44.15
	WQI/0.79					55.089			56.557			55.887
	Water quality					Moderate			Moderate			Moderate

*NDWQS= National Drinking Water Quality Standard

Site A had moderate water quality

Table 4.3: Results of WQI test -Site B

S.No	Parameter	Weighting Factor	NDWQS*	Point 1			Point 2			Point 3		
				<i>Levels</i>	<i>Q value</i>	<i>WQI Value</i>	<i>Levels</i>	<i>Q value</i>	<i>WQI Value</i>	<i>Levels</i>	<i>Q value</i>	<i>WQI Value</i>
1.	Temperature	0.1	-	18	93	9.3	17	89	8.9	18	89	8.9
2.	pH	0.11	6.5-8.5	7.5	93	10.23	7.8	90	9.9	7.8	90	9.9
3.	Turbidity (NTU)	0.08	5	3	90	7.2	ND <1	96	7.68	2	93	7.44
4.	Total Dissolved Solids (mg/L)	0.07	1000	85	85	5.95	83	85	5.95	85	85	5.95
5.	Nitrate (mg/L)	0.1	50	2.3	94	9.4	3.9	72	7.2	3.9	72	7.2
6.	Dissolved Oxygen (%)	0.17		0.78	2	0.34	0.78	2	0.34	0.79	2	0.34
7.	Faecal Coliforms	0.16	0	100	44	7.04	78	47	7.52	66	49	7.84
8.	Biological Oxygen Demand		-									
9.	Total Phosphorus		-									
	Sum of				501	49.46		481	47.49		480	47.57
	WQI/0.79					62.608			60.114			60.215
	Water quality					Moderate			Moderate			Moderate

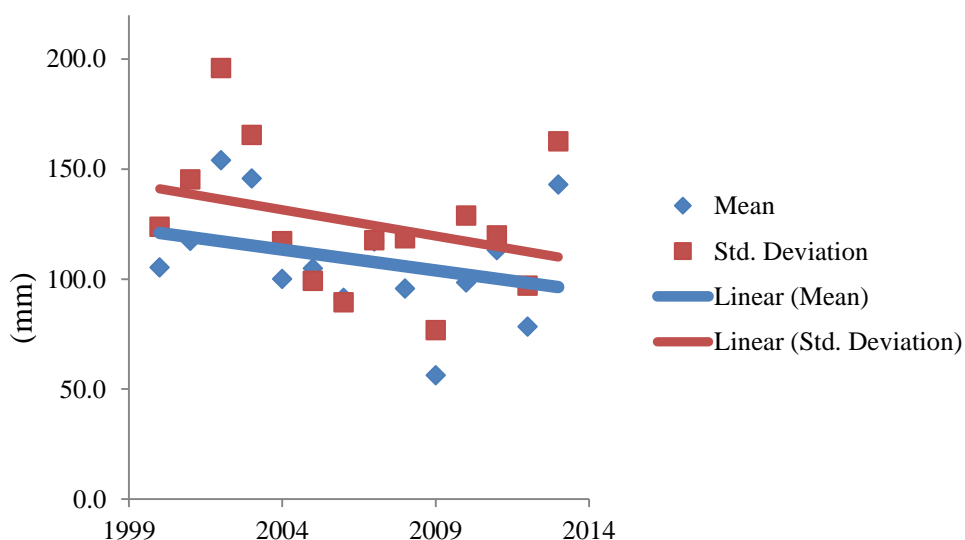
*NDWQS= National Drinking Water Quality Standard

Site B had moderate water quality

4.5.3. Climate change and recent rainfall data

The sustainability of the watersheds is determined by the rain and any alternation in the rainfall pattern will change the water availability affecting the locals dependent on it. The graph was formulated using the data obtained from the bureau of meteorology, Nepal. The graph shows the average rainfall for Lamatar for the last 15 years. It indicates that the average rainfall has decreased over the years. As watersheds are rain-fed, decrement in precipitation will decrease water availability in the catchments. The lack of any alternate water sources in mid hills such as Lamatar means that the community will suffer from water shortage.

Figure 4.3: Rainfall data from 1999-2014



Source: Data from Bureau of Meteorology, Nepal (June 2014).

4.5.4. Discussions of Biophysical Factors: Water Quality and Quantity

The water from both the headwaters have been categorised as of “medium quality” which means it can only support low diversity of aquatic life and is unsafe for direct consumption. However, it can be considered a “good” quality natural spring water that requires purification before human consumption. The local people of Lamatar consider the water from the headwaters to be clean enough for drinking.

However, the WQI test indicates otherwise. The water sources only rated as of medium or average quality. Only water falling under excellent water quality (scoring between 90-100 in WQI test) is fit for direct human consumption. Although most parameters such as temperature, pH, TDS and nitrate was within the accepted level of NDWQS, biological parameters such as Dissolved oxygen and Faecal coliforms were beyond the accepted level. The Dissolved oxygen was much lower as the water in the headwaters flowed from underground. Ground water generally consists of a lower dissolved oxygen level (White, et al, 1990). The faecal coliforms were much higher than the accepted level (1000X). This suggests contamination from sewage. However, rather than being human interfered, the faecal contamination may have been from the forest animals. Presence of faecal coliforms suggests presence of disease causing pathogens. Some of the waterborne pathogenic diseases caused by faecal coliforms are ear infections, dysentery, typhoid fever, viral and bacterial gastroenteritis, and hepatitis A (Oram, n.d.).

High level of water borne diseases exasperates ecological poverty- ecological poverty in this case is the poverty from inability to meet the demands of basic living due to environmental degradation. According to UNDP (2004), lack of safe drinking water has caused high level of mortality, debilitated health, hindered progress towards gender equality and impeded economic development. Management of water quality is therefore another crucial factor that management bodies have to be made aware of.

However, very little difference was found between the two sites. Site B had slightly higher WQI value due to it considerably low coliform level compared to Site A. Animal interaction around the sites might have had a substantial effect on the variation in the coliform level. Site A was situated in a dense forest while Site B was just outside the forest. There was probably higher animal interaction inside the forest than at the interface.

Although it was anticipated that the upstream sampling points would have better water quality than the downstream sampling points, there was very little difference between the upstream and downstream sampling sites. This could be because all the sampling points were located above the residential area. There was very little human interference to cause any significant change to the water quality. Using more sampling points and comparing the data across different seasons can give more rigorous results to determine the water quality in the watersheds.

The changes in rainfall pattern have been observed over the years. The headwaters being rain fed will be highly affected by the changes and will subsequently affect the population reliant on the water for domestic as well as agricultural use. Already people have indicated the decrease in water quantity in the water sources. However, the reason for the decrease could range from changes in rainfall pattern, increasing urbanisation and population growth, water politics as discussed in section 4.2 etc. The issue needs to be further scrutinised and extrapolated.

5. ANALYSIS

5.1. Water management in forestry legislation

Q1: Do forestry sector policies and legislation address water management issues within community forestry in Nepal?

Forestry policies and legislation have largely ignored water management issues, leading to CFUGs focusing on managing forests and ignoring water. This finding was clearly evident from the policy analysis, survey and interview. Previous studies have noted that the biggest gap in the forestry sector in Nepal is the failure to enforce and monitor the law (Shrestha, 2009; Amatya, 2002). However, the analysis of these documents shows that gap exists in developing the law that relates the two separate departments- water and forestry. Despite the robust research and investment in community forest for the past three decades, the law makers have failed to foresee the benefits of developing a law that relates the two user groups. As suggested by the interview results in section 4.3, one of the reasons could be the lack of coordination and lack of expertise in both the departments within the government sector- the Department of Water does not have a Forester working for them or vice versa.

Moreover, the forest regulation and the forest act allow CFUGs to use and utilise water from their forests as well, providing they follow the protocol and notify the District Forest Office. WUGs can also use water from the forests provided they have bought the licence to use a source. The conflicts may arise, as to who get the priority in using water, who gets which headwaters and if WUGs would be favoured against the CFUGs. The study conducted by Shrestha (2009) shows that water rights in Nepal is highly politicised and attention is required in good water governance, negotiation and collaboration for water sharing, awareness on values of water, and management of water induced disasters. The policy documents need to acknowledge some of these crucial issues that may evolve overtime.

The decentralisation act and the self-governance act play a fundamental role in supporting community-based resource management such as forest and water. The Acts allow the community to form local organisations to govern their own resource use and benefit from it. This means the community forest user groups and water user groups can use the water and profit from it. However, resource management is a complex system requiring monitoring and regulations to avoid political and social disparity. Hesselbarth (2007) has illustrated some of the aspects quintessential to conduct a successful decentralisation program which can be adopted in Lamatar by CFUGs, WUGs, local people and local government to successfully manage the water resources and forest resources. They are:

- financial resources for local governments;
- human resources and adequate institutional strengthening to comply with municipal competencies;
- transparency and accountability and
- Institutional arrangements in support of the decentralisation process from central government.

The acts do account all of these factors, but their implementation has not been without some issues. The acts also do not prompt the role of property rights of the local government in facilitating the implementation of centralised decision-making. According to Baltzer (1998), there are three forms of property rights regime:

- i. Private property where all elements of property rights are vested on an individual
- ii. Common property rights where a property is vested to a group of individuals.
- iii. Open property where the property rights are held by no one.

A property rights holder has the following rights (Khanal, 2009):

- i. Enter public properties and obtain resources.

- ii. Manage use and transform resources.
- iii. Exclude people from entering the property.
- iv. Selling and withdrawing the lease.

However, Nepal has not addressed one's right to exercise one's property rights without causing nuisance to others (Khanal, 2009). This means that if the Lamatar resident has a water resource situated within his private property, he would have the right to obtain, use and manage the resources for his own benefit without sharing it with the community. CFUGs would have a similar right to use the property situated within the community forests and deny it to the non-members of the community. This reiterates the issues that arose in the political ecology literature in many other developing country and postcolonial circumstances: access and use as discussed in chapter 2. There is a clear disparity between water access and use amongst different VDCs, wards, as well as community groups. Neither the Decentralisation Act nor the Self-governance Act has acknowledged the key issues of equal access and use. Furthermore, in accord to the government Acts (VDC Act, DDC act and Municipality Act), the government should have the right to the resources within their region. The contradiction between the government Acts and the Decentralised Act need to be addressed to avoid ambiguity.

Thus, it seems likely that the decentralisation act could be a useful tool to incorporate water management into community forestry programs. However, there needs to be deeper studies conducted on the financial, accountability, and institutional arrangements either to take the responsibility of water management.

The evolution of water laws show that there are plenty of provisions from the government that attempt to provide sound water management and usage in Nepal. Yet, water management has been a persistent problem in the country, despite these government efforts. Despite having abundant water resources, a large population in Nepal is devoid of clean drinking water (Aryal, 2011). Populations in the rocky

mountainous regions such as the upper mustang suffer from dire water scarcity due to inadequate rainfall and low snowline (Shahi, Climate Change hits Upper Mustang, 2014). In the mid hills however, despite the availability of water sources in forms of springs, brooks and rivulets, the people still suffer from water problems (Merz, et al., 2004). The problems extend from contamination of source to inaccessibility (Merz, et al., 2004). Lamatar is no exception. Despite possessing abundance of high quality water, people still suffer from inaccessibility. Most houses do not have private taps and have to rely on communal taps. There is high likelihood of water contamination through agricultural run-off or human interference. Some of these issues can be alleviated by the following ways (Aryal, 2011):

- i. Implementation of laws including firmer guidelines and penalties.
- ii. Better management of resources with resilient management bodies
- iii. Clear regulations with no contradictions between the acts/laws.

The problem could be in the implementation of the rules where the government enforcement and penalties are weak. There are fewer penalties for deteriorating water quality by polluting the source and for declining the available quantity through over extraction. The Water Resource Act states that water utilisation should be made without harming the environment. It also prohibits polluting the water resource. However, people (4.4% of the respondents) have complained of increasing pollution in the water sources (section 4.5). The problem was identified to be getting worse. Furthermore, when asked how many people had been legally penalised in the last 5 years for polluting the water, the response was “none”; most law- breakers were simply dealt with by the community (interview analysis, section 4.4).

However, it is also important to note that the Nepalese government is unstable, so the community can be responsible to monitor and enforce laws as per Decentralisation Act. Most communities already

have their own set of customary practices which over many years have become the community rules and regulations keeping law and order in the community, a proper set of government rule are essential in diverse and grouped communities of Nepal mainly because the legitimacy of the customary practices are questionable due to division of rights and norms based on caste. The customary practices are based on cultural traditions and the informal allocation of water is institutionalised through agreements and negotiations with different water groups. However, the accountability of the representation from every group is under-defined (Bhattarai, et al., 2002). Thus like other customary practices, these traditional laws can be discriminatory especially against women, children and under privileged groups (Social Development Division, 2012). However, this does not mean dismissing the customary practices completely because in some cases, the stipulation of government Acts and customary practices have clashed leading to conflict (Cuskelly, Customs and Constitutions:State recognition of customary law around the world, 2011). Studies have shown that customary laws and institutions are more influential and effective in conflict management than state laws because people view customary laws as having greater legitimacy and reverence it more than the state laws (Nkonya, 2006; Cuskelly, Customs and Constitutions:State recognition of customary law around the world, 2011). Thus the construction of government rules and regulations need to eradicate the discriminatory practices but contemplate certain beneficial customary practices.

The discussion above shows that the forestry sector policies and legislation do not entirely address water management issues within community forestry in Nepal. There are gaps in coordination and linkages between institutes at different levels based on national policies, rules and regulations (Kumar, 2002). A comprehensive plan is essential to manage water resource and to implement water resource policies that promote local empowerment and sustainable natural resource management to promote equitable and sustainable water management.

5.2. Water management issues in Lamatar

Q2: How are water management issues perceived by local community and forest user groups, and to what extent these issues are addressed by local initiatives within community forestry operational plan in the case study of Lamatar?

Despite legislative ignorance of water management issues in community forestry, local communities are interested in and committed to conserve water through local community forestry system. They see it as an integral part of community forestry. Yet, operational plan has a limited focus on water management, perhaps due to legislative silence and institutional bottlenecks between forestry and water agencies. This indicates that there is a considerable gap between policy and practice with respect to water management in community forestry. This raises an important question of why this has happened and what could be the possible implications. One explanation could be the lack of communication and understanding between the policy makers and the implementers.

According to World Bank (2007), the root causes of civil conflicts including water conflicts, in Nepal are: inequality, lack of services and poverty. However, conflicts arise in communities with abundant water supply as well. Community based water management is advocated by many political ecologists as discussed in chapter 2. The interviews identified several issues in the community water management in Lamatar. The diagram below (figure 4.3) was formulated from the interview responses. It illustrates the complexity of the challenges encountered by community water management.

Figure 5.1: Problems with Community Based Water Management



i. Funding problems

Funding seems to be the biggest problem faced by the community. Despite the drive from the community, the lack of funding hinders well-planned projects. The funds are essential for infrastructure development and maintenance, meetings and trainings. The VDC provides financial help to the User Groups, however the VDC budget is generally low and there are disputes on which user group amongst the several or which development project in the VDC gets the funding each month can be competitive. NGOs do provide financial help but the NGO supports are sporadic and one-off leaving no capital for the maintenance of the infrastructure for future (SSI3, March 2014).

ii. No collaboration between the Department of Forestry and Department of Water

The headwater of the watershed lies in the forest, thus the preservation of the forest is important to maintain the quality of the water in the watershed. Despite the connection between the forest and the water, there is no collaboration within the government sector. Interviews highlighted that the Department of Forests works independent to the Department of Water with no policies binding the two sectors. This was observed from the policy analysis (section 4.1) as well.

The Department of Water and the Department of Forests are two different units with different responsibilities. It is well understood that the Forest officer may not have enough expertise to make decisions about water supply and quality and vice versa. However, considering the important links between forest conservation and clean water supply, there needs to be some links between the functioning of the two departments (SSI4, March 2014).

iii. Changes in the institution

Institutional change can be defined as the changes in the ideas that govern institutions, as the ideas change, the rules and practices change as well (Aoki, 2007). Nepal has gone through several political changes since 1950s- from absolute monarch to multiparty democracy to the republic (Ojha, et.al, 2009). The decade long civil war has halt the economic growth of the country. The changes in the central government bring about changes to the local institutions as well. After the abolition of monarch in 2008, the country has gone through major changes in the government institutions (Ojha, et.al, 2009). In local VDCs, the section officers and the sub-section officers were all re-appointed. The newly appointed section officers had limited knowledge of the customary water practices and needs of the community. This limits the involvement of the VDC in effective decision making.

iv. Political interference

Political interference is frequently occurring in community instigated projects (SSI6, SSI7, March 2014). The involvement of bureaucrats and supports of different political parties causes conflicts of ideas hindering progress of the project. The clash of political ideologies is very common in rural Nepal. WaterAid (2012) has reported that the upheavals can be so intense that even the leaders have difficulty convincing the members to negotiate. A major problem was encountered by the FUNDBOARD when a group from one political party did not want the development to occur during the reign of other political parties (SSI6, SSI7, March 2014). The problems sometimes escalate to violence leading to withdrawal

of the project. Thus these systems can be highly biased towards the more powerful parties (WaterAid, 2012).

v. *Social exclusion*

Social discrimination is a fading norm in the societies in Nepal; however, its existence is still evident on a small scale. According to the interviews, the continued tradition of prejudice towards the “lower” caste groups, such as the practice of untouchability, is not as prevalent as in the past. However, the bigotry against tenants to collect water only after everyone has had their turns is a communal rule in some hamlets.

vi. *Lack of technical expertise*

Community Managed Watershed Programs are generally initiated by the rural community where the technical expertise is short. From interviews, it was indicated that mostly the WUGs request for an engineer from the government (VDC) to start a project proposed by them. However, once the project is complete, the engineers generally leave, leaving no one to follow up for the future maintenance.

vii. *Delineation*

Delineation of boundaries and resource access generates complex conflict. Blomquist and Schlager (2005) have stated that unclear boundary, decision making and accountability cause some degree of uncertainty in water management approaches. Community Water management is highly political and the communication between the stakeholders is often weak or lacking.

viii. *Conflict over ownership of the source*

Ownership of water source is another contested issue. A household with water sources in their private land will often consider the water as their private property and may be unwilling to share with the locality (SSI5, March 2014). The Water Act (1990) allows an individual or a group of individuals to buy a licence for a water source. This could solve some conflict of water ownership, however, this also means that only the richer families who can afford to buy the licence will have a secure supply of water

and the rest will have to use whichever source is unwanted by the licence holders. This can mean travelling a long way to the next water source or using a poorer quality source.

ix. Increased water needs and fear of drying water sources

Water Aid (WaterAid, 2012) has stated that the rural community now understands the value of natural resources located in their respective villages. Thus, communities have started trading the natural resources for other amenities. However a contradictory effect was experienced in Lamatar. The data from the bureau of meteorology shows that the rainfall in Lamatar area has decreased over the last decade (Figure 4.3). The locals too have experienced the changes in rainfall and the drying up of the watershed. About 90% of the residents in Lamatar said that the amount of water has decreased over the decade (Figure 4.4, appendix 6). This has caused a sense of alarm within the people. They fear that they will not have enough water in the future. Therefore, most residents have disapproved of the idea of trading their water (appendix 6).

x. No co-ordination between different wards

Being a large VDC, it is often difficult to have sound co-ordination between all the wards. Especially with ward 9, because the ward is situated at the hill top, detached from the rest of the VDC, communication becomes challenging. The lack of proper communication has caused conflict and disagreement in the decision-making process. Also, conflicts arose between uphill and downhill residents as the downhill residents complained that the uphill residents were polluting the water source.

The Operational plan shows that water management is not clearly stated in the document but some sections have mentioned water as a source that need to be conserved by FUGs. It shows that for the CFUGs to use the water for other purpose besides drinking, they have to either a) get an approval from the DFO and include the scheme in their OP or b) get a licence for the source and use it collectively. However, water management is not the main factor of CF mainly because CFUGs do not have the right

to water like they have the right to forest products such as timber and herbs. The water belongs to the state (Water Act, 1990). This means, the water situated in the forests can be used by CFUGs as well as the non-CFUGs for drinking and agricultural purpose, but trading of water requires a permission from the government.

As discussed in the literature, water management has not received much attention in community forestry, thus the operational plan does not have an inclusive section on water management. Despite this, the forest user groups showed high level of knowledge and understanding on the importance of community forestry for the water supply of the entire VDC. They were well aware that community forests act as an aquifer providing high quality water throughout the year and the significance of protecting and conserving their water sources.

Managing bodies such as WUGs may be highly suited to manage water in Lamatar. However considering that CFUGs are nationally recognised as a prevailing community stakeholder; CFUGs have the resources, national as well as community support and proactiveness to initiate water management in community forestry, it can be beneficial to include CFUGs for the preservation and management of water. Moreover, CFUGs are already managing water informally. Some of the evidences of water management by CFUGs are:

- CFUGs use their income to build water infrastructures like taps, filtration systems, maintain pipelines etc.
- They work collaboratively with WUGs either by sharing members or by starting water development projects.
- The OP obliges them to protect the sources situated in the forests.
- They buy licences for water sources collectively and develop pipelines to bring water sources closer to their residence.

There are many issues that need to be addressed in community based water management. The problems range from lack of stronger legislation to social exclusions to climate change and successful water management depends on fulfilling all these core elements. Because water management is localised to several smaller areas within a water source-“functional area”, the issues will have to be addressed within the function area as well as between the different function areas. Lack of co-ordination between the institutions was the prevalently seen in this study. Thus micro management and co-ordination between various organisations and institutions is important in formulating effective water management schemes.

5.3. Water management challenges of CFUGs

Q3: What are the major challenges facing Lamatar community forestry user groups in terms management of water?

As discussed in the literature review, the major challenges of CFUGs in Lamatar are- decision making, access and equity. FAO (1998) identifies that when decision of access and use are being made, there are large number of stakeholders with different and conflicting interests. Most powerful groups not only have stronger influences on decision making but also influence who makes that decision and how the decisions are made. A broader participation from all community groups is required for a good record of community forestry management and substantial increase in forest production (Khanal, 2003). Community forestry of Nepal encourages disadvantaged and marginalised groups to participate in meetings and influence decision making. Emphasis is also given to women, thus the women are increasingly participating in decision making (Khanal, 2003; Lamichhane, 2004).

The decision making for water in community forestry was definitely a bottom up approach by either the members of the water user groups or community forest user groups. However, the internal intricacies of equal participation from all the groups were not clarified from the process.

All users are supposed to benefit equally and get equal access through community forestry (Hobley, 1996; Ostrom, 2007), however, Nepal's community forestry faces unresolved equity issues (Sunam & McCarthy, 2010). Many studies on community forestry in Nepal has addressed the issues of equity where poor households, marginalised groups and women get restricted access to resources while the rich and powerful groups get better access to forest and forest products (Sunam & McCarthy, 2010; Acharya, 2002; Shrestha & McManus, 2008; Adhikari, et.al, 2004). Although this study did not identify specific solutions to the socio-economic, gender and caste related equity issues, it unravelled other forms of inequity evolving from proximity, community stakeholders and community groups

Proximity to the forests and water sources greatly affected the water supply. People living closer to the water sources not only have better access to water as they travel shorter distances to get water but they also become the customary users of the water getting the first right to use water. Consequently, households living further from the spring are put to a disadvantage.

The interview analysis showed that people belonging to user groups (WUG and FUG) had better access to water than the other residents. One explanation for this could be because the committee members made decisions favourable to them and their members (Thoms, 2008). Other explanations could be that the user groups were more aware of their resource rights and policies for resource use. So, they were able to implement them to their advantage. The interviews also suggested that only a few people benefitted from the NGO projects. Only some community groups got attention from NGOs and INGOs because they either belonged to a certain community group or by chance their residence happened to be in the area of the NGO project.

The problems with climate change and changing rainfall patterns are important issues which were not addressed by the respondents. The data from the Bureau of Meteorology (Figure. 4.3) showed a decreasing rainfall pattern over the last 15 years. The implications of climate change on decreasing

rainfall can be problematic to the community because of their geographical location and high dependency on spring water. Since there are no alternate sources of water in Lamatar, especially for the people living in higher altitudes as the major rivers are too far from their residence, decreased precipitation will affect the supply in the rain-fed watersheds which will subsequently impact the water available for the community.

Although the implications of climate change will affect everyone in the VDC, the effects will compound on poor and marginalised groups because of their limited capacity to adapt to change. They cannot afford to buy water or develop alternate infrastructure (rainwater harvesting, pipelines etc.) to deal with the water shortage. The problem will not only limit to drinking water supply but also to agriculture-their livelihood. Thus, people who already receive less water will suffer from further restrictions sinking them deeper into poverty.

The biophysical analysis highlighted that the water quality of Lamatar despite having high microbial contaminant is still considered to be of “good” quality. It is therefore crucial to conserve these water sources that are providing high quality water. The policies implemented by the law or community forestry should focus on conserving this high quality water and equal and impartial distribution of it throughout the community.

5.4. Key lessons for improving water management in CF

Q4: What are the key lessons for improving CFUG in terms of addressing water management issues in Nepal?

CFUG has the capacity to manage water because it is a well-established management body involved in community based natural resource management. However, section 5.2 and 5.3 showed that there are several problems in CF in terms of water management. Some of the ways to improve the program to address water management in CF are explained in this section.

Firstly, water management in CF must be backed up by the government and legislation. The interview analysis and policy analysis described in section 4.2 and 4.3 showed that the government plays a significant role in policy making and budget allocation. Yet, most respondents from the questionnaire survey stated that the government had a very small role in water management (Table 4.5). The differences in the response could be because the government only works on a policy level while the on-site management is decentralised to the community. Water management is dealt by the community groups such as WUGs and FUGs. Although decentralisation is a vital element for effective management, a strategic plan is essential for effective management as well as to avoid conflicts between the different community groups.

Secondly, awareness on water policies and rights amongst the managing groups and the community is essential for effective water management. Section 4.4 stated that the community groups were the most proactive in this case but very few people were aware of the water policies employed by the government (Table 4.8). There could be three reasons for the lack of awareness: a) there are lesser opportunities for the common people to learn about the water policies unless they are involved in community groups or government groups b) the community has its own customary rules that has overtime become equivalent to a law. Breaching of the community water law is considered as illicit as breaching a government law c) because the management has been decentralised to the people, the government did not take a major responsibility.

Thirdly, sufficient fund particularly for water management is crucial. The informal discussions on budget allocation stated that the budget from the government was very small and could not keep up with the projects initiated by the community (section 4.3.1). Water projects go abandoned due to lack of funds. Maintenance of infrastructures such as pipelines, taps, tanks also get neglected from low funding.

Fourthly, issues of access to resources and equity are important when considering natural resource governance and management. This thesis brought out 4 forms of inequity in terms of water usage they are: i) caste hierarchy ii) gender disparity iii) CFUG members and non-members iv) NGO target groups.

Several studies on CF, political ecology and water ecology in Nepal have found that lower caste groups such as the Janajatis have suffered significant discrimination for using high quality water. Many NGOs such as WaterAid (2008), FECOFUN, FUNDBOARD (SSI6, March 2014) have encountered similar problems where the powerful actors of the society suppress the less powerful and the lower caste groups. However, the findings of this study contradicted the previous findings on caste discrimination. Within the Janajatis, the biggest concern was not quantity. This suggests that the Janajatis were not exactly discriminated against accessing the water. However, they do not always get good quality water. The higher caste group- Brahmins were more concerned about water for irrigation which suggests that they had sufficient amount of good quality water for drinking (table 4.10). The disparity between caste groups in water access suggests that the discrimination between the caste groups is more subtle than how it was stated in past studies and past decades.

Between the genders, despite the similar concerns with water availability, men were concerned with management of water, while females were more concerned with the adequate availability of good quality water (table 4.11). This reflects a gendering of resource use that was discussed earlier and is mentioned in the literature. The results suggest that men are more concerned with management (having implications for agriculture and supply) while women were more concerned with quality (for domestic and household purposes). Because the females were more responsible for obtaining water from the sources than men, the female respondents in the study were more interested in getting equal distribution. Males on the other hand are concerned about developing policies and management

schemes to employ effective water management scheme. The males' interest in technocratic solutions and females wanting participation shows reflects equity and need-based concerns.

Between CFUG members and non-members, the members seem more satisfied with the amount of water they receive than the non-members (table 4.12). The members also have lesser concern about poor quality water. This could be the direct result of having better access to the water from the headwaters situated in the community forests, suggesting the importance of community forests for supply of water to households. From interviews and survey comments, it was noted that some of the CFUG members have bought a licence to use the water source situated in the community forests giving them better advantage to clean and abundant water.

CFUGs and non-CFUGs showed differences in their views and solutions. CFUGs were more attached to the forests and supported for protection of the forest and water sources (table 4.17). However, non-CFUGs showed greater concerns with access to water. They asked for more taps and equal distribution. The disparity could be the result of the discrepancy in the distribution of water between the CFUGs and non-CFUGs. CFUGs probably get easier access to the resources situated inside the forests, including water because of the following reasons.

a) Thoms (2008) have found that decision makers in the executive committee of CFUGs would make decisions favouring them and the interests of the same groups. Therefore, having a member of the family in the committee is a distinctive advantage for easier access of the resources.

b) Most of the members live closer to the forests (table 4.18, see appendix 6). As discussed in the sections above, the groups living closer to the resource would not only gain easier access but also customary rights to use it.

The results show that the biggest disparity of water problems was seen between the people living closer to the forests and the ones living further away from the forests. The people living further away from the forests were mainly concerned about the availability of clean and sufficient water for livelihood while the respondents living at a closer proximity were concerned about the overexploitation of the sources leading to a decrease in quantity and quality of the available water (table 4.13).

The solutions provided from the people living at a closer proximity to the forest is different from the solutions provided by the people living further away. The respondents living closer to the forests were more attached to the forests and wanted to protect it while people living further were more concerned about the water availability. This possibly resulted from higher involvement in forest and forest resource management from the people living closer to the forests compared to people living further away. The speculation advocates policies such as PES where stewards of environmental resources are compensated through direct payment for the services (table 4.16).

Several INGO and NGOs had involvement as discussed in section 4.2. However, most people did not give much credit to the NGOs. This is because most NGO projects are sporadic and short term. Most NGO projects only last a few years and after the project ended the community has to take over the responsibility of carrying over the functions. Furthermore the interviews showed that, most NGO projects are localised to a certain area, a certain water source or a certain group. This means that most NGO projects only benefit a smaller population of the VDC. The ones who got to enjoy the benefits of NGO projects acknowledged it while the rest disregarded its involvement. According to FUNDBOARD, there are two reasons for this inequity (SSI6, March 2014):

- a) Many NGOs deploy bottom up approach for their projects instead of top down to promote community involvement and empowerment, here the grassroot actors or the community has to raise

the issue to the NGO. However, not all community groups possess the will, capacity or the knowledge to address their water problems to the NGOs that would support them. Thus, these community groups get left out.

- b) NGO projects often come with limited financial and technical resources which allow only small project coverage leaving out some of the community groups.

6. CONCLUSION

It is evident that community forestry in Lamatar is managing water and providing a vital ecological service to the community. The ecological service does not just limit to forest conservation and resources such as herbs, food, firewood and fodder but extends to biodiversity conservation, providing high quality water. This is despite the lack of provision in CF legislation, which does not require water management, neither the operational plan nor the national law specify guidelines or rules for water management in community forestry. Yet forest user groups protect water sources, use their funds to build water infrastructures and develop new sources. This implies that gaps exist between policy and practice, particularly when natural resources are artificially fragmented in policy for the purpose of management and institutional efficiency. It can be argued that community forestry has the capacity to better manage the water through greater recognition for its role at the institutional level, and improved capacities and funding at both the local and institutional levels.

CF in Nepal is an evident subset for IPBES (Intergovernmental Platform on Biodiversity and Ecosystem Services). IPBES focuses on the “strengthening the science-policy interface for biodiversity and ecosystem services for the conservation and sustainable use of biodiversity, long-term human well-being and sustainable development’ (<http://www.ipbes.net>). CF likewise focuses on conservation and sustainable use of biodiversity and provides benefits to the people leading to better quality of life which is achieved by significant role of institutions, good governance and decision making (Díaz, S., et. Al., 2015).

An additional management structure (or a sub-committee) within the CFUGs can be potentially effective to address issues of water in CF management. It also means having enabling legislation that provides a suitable platform for community forestry users to devise and implement OP. Plans and policies should also recognise the water rights of CF users. This facilitates the CF users to be able to

use and sell water according to their decisions as they do for forest products. To further ensure the success of the water management program with CF, such regulation will have to be implemented by the CFUGs itself in collaboration with DoF.

It is important to note that water management occurs not only within the community forestry program, but also out of the program; mainly because water sources are situated inside as well as outside of community forest areas. Community groups such as WUGs also act as significant stakeholders to water management. WUGs may not protect the source like FUGs, but they develop the source, buy licences and distribute it to the “functional area”.

The community plays a crucial role in water management in Lamatar. The water management bodies were proactively run by the community in conjunction with the government and sometimes NGOs. This form of co-management and devolution of power to the community has shown to achieve better results in community development, economic growth, poverty reduction as well as ecological protection. This notion supports the benefit of community based water management in better management of the resource, community empowerment and prevention of resource degradation and exploitation.

The government has provisioned laws and policies to facilitate effective water management in and out of community forests. Unfortunately, the government’s laws and policies are weak at various levels. Firstly, there are contradictions between different acts where one legal act refutes the other act causing poor inclusions of water management schemes. Secondly, there needs to be greater ‘bridging’ of laws/policies and implementation between different government department as well as local committees involved in water management. Thirdly, the implementation and enforcement of the government’s regulations is poor, leading to a reliance on customary rules, which are prone to

inequities and bias. These shortcomings have led to some aspects of poor management within the community and community forestry groups, for example, resulting in moderate water quality.

To achieve comprehensive benefits, all groups and communities have to experience equal and impartial quality and quantity of water. However, the current management arrangement has addressed the issues of equity in access and decision making. This could be because the water management in community forestry is in its early stage. There are no stringent regulations within the government or the constitution of community forestry to run the management in a systematic way. Neither is there enough academic backup to encourage the community and the government to take it seriously.

It was found that there are several water problems within the VDC that are highlighted throughout the political ecology literature on management of natural resources, discussed in the literature review. With population growth and declining precipitation impacting upon availability and competition for clean water, water conflicts between communities can become systemic. Water Aid has suggested Dewey's sequence (fig 6.1.) which is likely to assist in the resolution of water conflicts in Lamatar VDC (appendix 8). Some recommendations achieved from this thesis to improve CF in terms of managing water are:

- a) resolving conflicts
- b) Including water management within CF legislation
- c) better coordination between forestry and water agencies
- d) Operational plan places greater importance of conserving water in CF
- e) Water quality and quantity monitoring and management need to become one of the central tasks of CFUGs
- f) More co-ordinated/ collective action among CFUGs, VDC, NGOs and other actors to promote integrated natural resource management at the local level

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APPENDICES

Appendix 1 Questionnaire for community surveys

Dear Residents,

You are invited to participate in an important survey of the ecological services provided by the aesthetic forestry resource in Lamatar. Please help us find out how your forest is helping to produce plentiful of clean water which is sufficient to meet the agricultural and domestic demands of the people in Lamatar as well as the surrounding villages.

The University of New South Wales

Title: Determining the role of Community forests in producing high quality water resource: Lamatar water reserve Vs. Sundarijal water plant.

My name is Pratistha Tamrakar, I am a Masters by research student at the University of New South Wales, under the joint supervision of Dr. Daniel Robinson and Dr. Krishna Shrestha. I am exploring the water resource of Lamatar and the role of its aesthetic community forests in producing high quality water. I am also investigating the role of the government in managing the water from Lamatar. You are warmly invited to participate in the questionnaire survey and share/express your concerns and comments regarding the water management of Lamatar. You have been chosen as a participant because your role in the community is directly related to the aim of the project.

If you decide to participate, we will give you the questionnaire which you can fill out and give it back to me or the VDC . For this project, we will be comparing the water quality of Lamatar and Sundarijal water plant. Laboratory analysis will be used to assess the physical, chemical and microbial properties of the water from the two reserves. My qualitative approach will be through questionnaire and semi-structured interviews to various officials.

The questionnaire is expected to take about 15 minutes. It will contain mainly open ended questions that instigated my research questions. You may skip any question that you do not wish to answer.

Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed with you permission, except as required by law. If you give you your permission by signing this document, we plan to publish the results which will be given to the University of New South Wales. All responses will be made confidential and used for the purpose of this research only. You will remain anonymous and will be referred as “the resident of Lamatar” in the report.

Few minutes of your time can help with an insightful research on Lamatar Community.

Complaints may be directed to the Ethics Secretariat, The University of New South Wales, SYDNEY 2052 AUSTRALIA (phone 9385 4234, fax 9385 6648, email ethics.sec@unsw.edu.au). Any complaint you make will be investigated promptly and you will be informed of the outcome.

Your decision whether or not to participate will not prejudice your future relations with the University of New South Wales. If you decide to participate, you are free to withdraw your consent and to discontinue participation at any time without prejudice.

If you have any questions, please feel free to ask us. If you have any additional questions later, we will be happy to answer them.

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PARTICIPANT INFORMATION STATEMENT AND CONSENT FORM (continued)

Determining the role of Community forests in producing high quality water resource: Lamatar water reserve Vs. Sundarijal water plant.

You are making a decision whether or not to participate. Your signature indicates that, having read the information provided above, you have decided to participate.

.....

Signature of Research Participant

.....

Signature of Witness

.....

(Please PRINT name)

.....

(Please PRINT name)

.....

Date

.....

Nature of Witness

1) Part I: Background

i. What is your gender?

☐
Male

☐
Female

ii. What is your marital status?

1. Married	
2. Unmarried	
3. Widowed	
4. Seperated	

iii. How many members are there in your family?

a. Just me	
b. 2	
c. 3-4	
d. 4<	

iv. What is your ethnic background?

v. What is your age?

1. 18-24	
2. 25-34	
3. 35-44	
4. 45-54	
5. 55-64	
6. 65 and over	

vi. Which ward are you from?

vii. How long have you been living in Lamatar?

☐
Less than 5 years

☐
5-10years

☐
over 10years

viii. What is your profession?

1. Farming	
2. Self-employed (please state your business)	
3. Service (government)	
4. Service (private)	
5. Student	
6. other (please specify)	

iii. Has the quality of water changed over the last 10 years?

☐

Yes

☐

No

☐

Don't Know

iv. How has the quality of water changed?

v. On the scale of 1-10 rate the importance of the following uses of water in your region.
(1 being the most important and 10 being the least important)



Domestic purpose	
Irrigation	
Fisheries	
Industrial	
Recreation	
Aesthetic	
Tourism	
Ecosystem Protection	
Stock market	
Others (please specify)	



vi. List at least 3 water problems faced by the community.

vii. Do you think that all ethnic groups in Lamatar have equal rights to use the water?

viii. What do you think is the biggest threat to the water bodies of Lamatar at the moment?

Urbanisation	
Industrialisation	
Lack of Management	
Inadequate policies	
Corruption	
Others (please specify)	

ix. What is your highest level of education?

1. Primary School (class 1- class 4)	
2. Middle School (class 5- class 8)	
3. SLC	
4. 10+2	
5. Bachelor's degree	
6. Master's degree	
7. Doctoral degree	
8. N/A	

x. Are you a member of the Community Forest User Group?

☐

Yes

☐

No

☐

Don't want to say

2) Part II : Problems and prospects of water quality and quantity in Lamatar

i. What is your main source of water?



1. River water	
2. Spring water	
3. Ground Water	
4. Tap water	
5. Rainwater	
6. Public tap	
7. other (please specify)	



ii. Have you ever bought water from a private supplier?

☐

Yes

☐

No

☐

Don't Know

iii. Are you satisfied with the amount of water you get?

☐

Yes

☐

No

☐

Don't Know

i. What would best describe the quality of water you get (tick all relevant options)

1. Clean and safe to drink	
2. Looks Clean but unsafe to drink	
3. Clean but smelly	
4. Soiled	
5. Murky and coloured	
6. Clean and safe to drink	

ii. Has the quality of water changed over the last 5 years?

☐

Yes

☐

No

☐

Don't Know



- ix. The picture represents the water pollution around the Taj Mahal in India. Do you think this picture describes the condition of the water resources in Lamatar?



1. Yes Definitely	
2. Almost	
3. Maybe	
4. Somewhat	
5. Absolutely not	
6. Don't know	



3) Part III: Developing partnership

- i. On the scale of 1-6 rate the organization that is playing the most important role in keeping the water bodies of Lamatar clean? (1 being the most important and 6 being the least important)

1. Nepalese Government	
2. Lamatar VDC	
3. NGOs	
4. Community	
5. Individual household	
6. Individuals	

- i. Do you think that the government and community are successfully working in collaboration to combat the water problem of Lamatar?

☐

Yes

☐

No

☐

Don't Know

- ii. In your opinion, what should each organization do to maintain the health of the water reservoir?

7. Nepal Government:

8. Lamatar VDC

9. NGOs

10. Community

11. Individual household

12. Individuals

- iii. Do you think the community forest is contributing to produce quality water in Lamatar? Why / Why not?

4) Part IV: Water policies and legislation

- i. What is the government doing to combat the water problems of Lamatar?

ii. Are you familiar with the water management policies of Lamatar?

☐

Yes

☐

No

☐

Don't Know

iii. How satisfied are you with the water management policies of Lamatar?

1. Yes Definatly	
2. Somewhat	
3. Absolutely not	
4. Don't know	

iv. Would you like to be informed about the water management policies of Lamatar?



1. Yes	
2. No	
3. Don't care	
4. I already know the policies	

v. Do you think the current government policies on water management benefit the local residents of Lamatar?

☐

Yes

☐

No

☐

Little bit

☐

Don't Know

5) Part V: Strategies to improve the water quality

i. What do you think should be done to solve the water problems faced by the community?

ii. Do you think that water from Lamatar reservoir should be commercialized? Why? Why not?

iii. How do you think you as a local resident will benefit from proper management of the water in Lamatar?

xx Thank you for your participation xx

REVOCATION OF CONSENT

Determining the role of Community forests in producing high quality water resource: Lamatar water reserve Vs. Sundarijal water plant.

I hereby wish to **WITHDRAW** my consent to participate in the research proposal described above and understand that such withdrawal **WILL NOT** jeopardise any treatment or my relationship with The University of New South Wales, *(other participating organisation[s] or other professional[s])*.

.....
Signature

.....
Date

.....
Please PRINT Name

The section for Revocation of Consent should be forwarded to

Dr Daniel Robinson

Phone: (02) 9385 9809

Email: d.robinson@unsw.edu.au

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Appendix 2 Question schedule of semi-structured interviews

- How was water managed in the past?
- How is water managed in Lamatar now?
- How has community forestry program changed the face of water management in Lamatar?
- Do you get better access to water now?
- Who are the main management bodies for CBWM? What are their roles?
- Can you tell me what challenges do CBWM face?
- How do you overcome them?
- Do you think community management is the best way to go for water management in Lamatar?
- Do CFUGs benefit from the high quality water from the CFs?
- What kind of problems and conflicts do you face?
- How is water managed in CF?
- How do CFUGs and WUGs coexist? Are there conflicts between the two groups?
- Are forests and water linked in policy level? Do you think it should or is it viable to connect them at a policy level?

Appendix 3 The mathematical expression for NSF WQI

$$WQI = \sum WXQX$$

$$= WBODQBOD + WDOQDO + WPHQPH + WPHOSPHATEQPHOSPHATE + \\ WNITRATEQNITRATE + WFCQFC + WTDSQTDS + WTEMP.QTEMP. + \\ WTURBIDITYQTURBIDITY$$

Here,

WX = weight factors of the water quality parameters

QX = q- value of the water quality parameters

X = water quality parameters

The modified formula of the WQI value is given by:

$$WQI = \sum WYQY / \sum WY$$

Here,

WY = weight factors of the water quality parameters

QY = q- value of the water quality parameters

Y = water quality parameters

The graph of each parameter is used to determine the Q-value or the water quality value. An online calculator from the website (<http://www.water-research.net/watrqualindex/>) was used to determine the Q –value.

The Range of WQI value is determined by

Range	Quality	Category
90-100	Excellent	A

70-90	Good	B
50-70	Medium	C
25-50	Bad	D
0-25	Very Bad	E

The Weighting factor

S.No	Parameter	Weight factor
1.	Dissolved oxygen (%)	0.17
2.	Faecal coliforms (CFU/10mg)	0.16
3.	pH	0.11
4.	Biological oxygen demand	0.11
5.	Temperature (°C)	0.10
6.	Total Phosphorus (mg/l)	0.10
7.	Total Nitrate (mg/l)	0.10
8.	Turbidity (mg/l)	0.08
9.	Total Solids (mg/l)	0.07

Appendix 4 Study of the Operational Plan: *Shree Goldanda Kankadidanda* Community Forestry User Groups

An operational plan consists of management goals, activities undertaken and rules of forest product use (Ojha, Persha, & Chhatre, A Policy Innovation for Local Livelihood, 2009). A comprehensive study of the operational plan was conducted to understand the water management procedure of Community forestry in Lamatar. The operational plan obtained from Forest Action Nepal, belonged to “*Shree Goldanda Kankadidanda* Community Forestry User Groups”, Lamatar ward no 9, prepared in the year 2008.

The OP of *Shree Goldanda Kankadidanda* Community Forestry User Group showed that CFUGs have a systematic management scheme for forest resources. It consists of 7 chapters 1) Introduction to the forest 2) Forest organisation 3) treasury management 4) forest preservation 5) forest maintenance 6) Forest use 7) Miscellaneous

7. Introduction to the forest

The introduction chapter gives an overview of the forest and the OP. It has 5 sections. Section 1 includes the history of the forest, issues identified in the historical forest management and the reasons for employing CF program. Section 2 and 3 explains and analyses the pre-handover procedure which explains the process of investigation and negotiation leading towards the development of the OP. The fourth section gives the statues of the forest- plant health, threatened species, dominant species, weed infestation etc. The final section gives the user needs and the supply capacity of the forest.

8. Forest organisation

The second chapter documents the lease agreement, user members, resource demand, supply capacity, forest organisation’s aspirations, technical knowledge and skills. This is prepared with the help of a forest technician for the scientific development and effective forest management scheme. The sections of this chapter state 1) the timeframe for the OP term (7years for this CF) 2) the prospect of the FUGs 3) long-term objectives 4) short-term objectives 5) division of forest area for effective management.

9. Treasury Management

This chapter prepares the management scheme of the revenue obtained from various sources such as forfeited money, selling forest products, government fund, interest generated from the loans given to the community members, membership fees, NGO funds, private donors etc. The chapter states that the funds will be used in development works, i.e. forest development, community development, income-generating activities, scholarship programs, rewards for informers etc. It also lays out the expected responsibilities from DFO and subordinate bodies to support the user groups, provide necessary training, involve in seminar etc.

10. Forest preservation

The fourth chapter is important as it lays out the duties of the user groups in order to maintain and conserve the forest resources. Some of the responsibilities laid out are: awareness programs, guarding the forests, checking encroachment, organising awards for the informers, land protection, control hunting, prevent illicit mining of resources, preserve water sources, check for land pollution and fire management. It also briefs the penalty system i.e. the nature of penalty and the procedure for employing penalties to the offenders.

11. Forest maintenance

Chapter 5 states the basic procedures of forest maintenance and cleanliness. It explains how and when to perform a procedure. The maintenance procedures included are weeding, bush care, pruning, transplanting etc.

12. Forest use

This chapter ensures systematic use of the forest products. It sets 1) rules and procedure for marketing forest products 2) provides employment opportunities to the community 3) provides free wood supply for religious purpose, communal infrastructure and victims of natural calamities 4) ensures systematic transaction of forest products when trading outside the community.

13. Miscellaneous

The final chapter enforces updates, reports and summaries on the CF activities. According to this, the FUGs are obligated to provide quarterly reports which will be put together into an annual report. The annual report will be made available to the community to review. The community would provide a yearly plan for the following year and reports of the past year. This will include capacity building programs, use of revenue generated, yearly account, income and employment, programs organised for the development of women and disadvantaged groups.

Appendix 5 The summary of relevant Nepalese water related laws and policies in chronological order.

(Prepared by Mr. Madhav Poudel, Joint Secretary, Ministry of Law and Justice)

1. 1854 AD (1990 B.S.): Promulgation of the Muluki Ain (National Code). One section of the National Code deals with rules concerning irrigation in general and construction of canals and priority of: water distribution in particular.
2. 1952 AD (2009 B.S.): Amendments made to the Muluki Ain to provide further legal rules with regard to canal construction and protection of fishery resources.
3. 1955 (2012 B.S.): Enactment of the Essential Commodities Protection Act, 2012 to regularize water resources as an essential commodity.
4. 1961 (2017 B.S.): Aquatic Animals Conservation Act, 2017 was enacted and introduced with a view to conserve fisheries and other aquatic animals.
5. 1963 (2018 B.S.): Promulgation of the Irrigation Act, 2018 to provide legal provisions concerning water use, construction and maintenance of canals, distribution of water, collection of water charges, sewerage etc.
6. 1963 (2018 B.S.): Enactment of the Electricity Motor or Power Transfer Act, 2018 to provide legal provision concerning the transfer of private ownership of electricity.
7. 1963 (2019 B.S.): Enactment of the Nepal Electricity Corporation Act, 2019 for the establishment of the Nepal Electricity Corporation, as a corporate body for production and distribution of electricity.
8. 1964 (2020 B.S.): Introduction of the Nepal Electricity Act, 2020 to provide legal provisions concerning policy to be developed by the Government on hydro-power, distribution of licences, fixation of power tariffs, etc.
9. 1964 (2019 B.S.): Enactment of the Village Panchayat Act, 2019 to empower the Village Panchayats in the field of irrigation, water supply and fisheries.
10. 1964 (2019 B.S.): Enactment of the Town Panchayat Act, 2019 to provide legal provisions for management and utilization of streams, wells ponds and other water resources within the jurisdiction of the concerned Town Panchayat.
11. 1964 (2019 B.S.): Introduction of the District Panchayat Act, 2019 to provide legal provisions concerning water rights to the applied within the territory of the concerned district.
12. 1964 (2020 B.S.): Enactment of the new Muluki Ain; the existing Muluki Ain (with amendments) is repealed.
13. 1964 (2020 B.S.): Commencement of the new Muluki Ain
14. 1967 (2025 B.S.): Introduction of the Irrigation, Electricity and Related Water Resources Act, 2024 to provide legal provisions related with irrigation, production of electricity and other matters concerning water resources.
15. 1968 (2026 B.S.): Commencement of the Irrigation, Electricity and Related Water Resources Act, 2024.
16. 1974 (2032 B.S.): Introduction of the Canal Operation Regulation to govern water use for irrigation.
17. 1982 (2039 B.S.): Introduction of the Soil and Watershed Conservation Act, 2039 to protect soil and watershed.
18. 1984 (2041 B.S.): Enactment of the Nepal Electricity Authority Act, 2041 to merge two institutions existing at that time, namely, Electricity Department and the Nepal Electricity Corporation.
19. 1984 (2042 B.S.): Commencement of the Electricity Authority Act, 2041
20. 1982 (2039 B.S.): Enactment of the Decentralization Act, 2039.

21. 1984 (2041 B.S.): Implementation of the Decentralization Act, 2041.
22. 1988 (2045 B.S.): Adoption of a new working policy on irrigation development by HMG.
23. 1988 (2045 B.S.): Enactment of Irrigation Regulation, 2045 to provide legal provisions for formation of water users' groups, water distribution, realization of water charges, etc.
24. 1989 (2046 B.S.): Enactment of the Nepal Water Supply Corporation Act, 2045 to constitute a public utility company to supply clean water in various regions of Nepal.
25. 1989 (2045 B.S.): Commencement of the Nepal Water Supply Corporation Act. 2046.
26. 1990 (2046 B.S.): Publication of the list of water resources and irrigation systems or projects to which the Irrigation Regulation, 2045 is applicable.
27. 1990 (2047 B.S.): Drafting and promulgation of the Constitution of the Kingdom of Nepal, 2047, The Constitution provides some leading provisions on water resources and their utilization.
28. 1990 (2047 B.S.): Introduction of the Village Development Committee Act, 2047 replaces the Village Panchayat Act, 2019.
29. 1990 (2047 B.S.): The Municipality Act, 2047 was introduced and the existing Town Panchayat Act, 2019.
30. 1990 (2047 B.S.): The District Development Committee Act, 2047 replaced the District Panchayat Act, 2019.
31. 1992 (2048 B.S.) The Village Development Committee Act, 2048 replaced the Village Development Committee Act, 2047.
32. 1992 (2048 B.S.): The Municipality Act, 2048 replaced the Municipality Act, 2047
33. 1992 (2048 B.S.): The District Development Committee Act, 2048 replaced the District Development Act, 2047.
34. 1992 (2049 B.S.): Hydro-power Development Policy, 2049 was adopted to invite private sector investors in the hydro-power development areas.
35. 1992 (2049 B.S.): Adoption of the Irrigation Policy, 2049 to clarify the government's policy in this field.
36. 1992 (2048 B.S.): Enactment of the Water Resources Act, 2049 as an umbrella Act on management of water resources.
37. 1992 (2049 B.S.): Enactment of the Electricity Act, 2049 to provide legal provisions concerning production and distribution of electricity, issuing of licences, incentives to be given to the private sector entrepreneurs, etc.
38. 1993 (2050 B.S.): Commencement of the Water Resources Act, 2049.
39. 1993 (2050 B.S.): Commencement of the Electricity Act, 2049
40. 1993 (2050 B.S.): Introduction of the Water Resources Regulation, 2050 to provide for the procedures of the Water Resources Act, 2049.
41. 1993 (2050 B.S.): Introduction of the Electricity Regulation, 2050 to carry out the objectives of the Electricity Act, 2049.
42. 1993 (2050 B.S.): Electricity Tariffs Foreign Regulation, 2050 framed and introduced to provide a mechanism for fixation of electricity tariff.

Table.1: Summary of Relevant Nepalese Laws in Chronological Order

(WaterAid Nepal, 2005)

S.NO	Act or Regulation	Areas addressed
1.	Essential Commodity Protection Act (1955)	<ul style="list-style-type: none"> Deems drinking water an essential commodity and strictly protects drinking water. Prohibits any unauthorised use or misuse, stealing, damaging etc of

		drinking water.
2.	Nepal Water Supply Act (1989)	<ul style="list-style-type: none"> • Establishes the Nepal Water Supply Corporation as the perpetual autonomous government controlled corporation responsible for the supply of drinking water. • Prohibits certain acts and provides penalties/punishment for violation
3.	Water Resource Act (1992)	<ul style="list-style-type: none"> • The umbrella Act governing water resource management • Declares the order of priority of water use • Vests ownership of water in the State. • Provides for the formation of water user associations and establishes a system of licensing • Prohibits water pollution
4.	Water Resource Regulation (1993)	<ul style="list-style-type: none"> • The umbrella Regulation governing water resource management • Sets out the procedure to register Water User Association and to obtain a licence. • Establishes the District Water Resource Committee • Sets out the rights and obligation of Water User Associations and licence holders. • Deals with the acquisition of house and land and compensation.
5.	Environment Protection Regulation (1997)	<ul style="list-style-type: none"> • Lists the water related projects required to conduct an EIA or IEE. • Deals with the control of water pollution and pollution control certificate.
6.	Drinking Water Regulation (1998)	<ul style="list-style-type: none"> • Regulates the use of drinking water • Provides for the formation of Drinking Water User Associations and sets out the procedure for registration. • Deals with licensing of use drinking water. • Deals with control of water pollution and maintenance of quality standards for drinking water. • Sets out the conditions of service utilization by consumers. • Provides for the acquisition of house and land and compensation.

7.	Local Self Governance Act (1999)	<ul style="list-style-type: none"> • Establishes a decentralised governance structure. • Sets out the power, functions and duties of the VDC, Municipality and DDC in relation to water and sanitation. • Sets out which natural resources are assets of local bodies and empowers local bodies to levy a natural resource tax.
8.	Local Self Governance Regulation (1999)	<ul style="list-style-type: none"> • Sets out the powers, functions and duties of VDC, Municipality and DDC in relation to water and sanitation. • Establishes the procedure for the formulation of water related plan and project implementation.
17.	Irrigation Regulation (2000)	<ul style="list-style-type: none"> • Deals with irrigation Water User Associations and transfer of projects to Irrigation Water User Associations. • Provide for joint management system by HMGN and Irrigation Water User Association. • Deals with Irrigation and River Control Committee • Sets out the conditions of service utilisation. • Sets out the obligations of user of irrigation and provides for service charges. • Deals with the protection, repair and maintenance of irrigation systems.

Appendix 6 Tables and figures from the analysis

Table 4.2: The main water management body in Lamatar according to the people

Management bodies	N	Percent
VDC	19	20.4%
Community	66	71.0%
NGO/INGOs	8	8.6%

Table 4.3: Role of NGOs/INGOs according to the respondents

Role of NGOs/INGOs	Responses	
	N	Percent
Not significant	92	92.9%
support	2	2.0%
Technical & financial support	1	1.0%
Training	4	4.0%
Total	99	100.0%

Table 4.4: Role of NGOs/INGOs according to the members of the CFUG

What do NGOs and INGOs do for water management	Non-members of CFUG	Members of CFUGs
Nothing significant	44.1%	50.0%
budget	16.9%	3.8%
technical	3.4%	11.5%
training	1.7%	0.0%
Don't know	33.9%	34.6%

Table 4.5: Role of the government according to the respondents

Role of the Government in water management	Responses	Percent
Nothing significant	39	45.9%
budget	11	12.9%
technical	5	5.9%
training	1	1.2%
dontknow	29	34.1%
Total	85	100.0%

Table 4.6: Role of government according to different caste groups

Role of the Government in water management	Caste groups			
	Brahmin	Chettri	Newar	Janajati
Nothing significant	38.1%	22.2%	54.8%	33.3%
budget	9.5%	0.0%	19.0%	0.0%
technical	4.8%	0.0%	4.8%	22.2%
training	0.0%	0.0%	2.4%	0.0%
Don't know	47.6%	77.8%	19.0%	44.4%
Total	25.9%	11.1%	51.9%	11.1%

Table 4.7: Role of government according to CFUG members and non-members

Role of government	Non-members of CFUG	Members of CFUG
Nothing significant	44.1%	50.0%
budget	16.9%	3.8%
technical	3.4%	11.5%
training	1.7%	0.0%
Don't know	33.9%	34.6%
Total	69.4%	30.6%

Table 4.8: No of people familiar with the water policies

	Frequency	Percent
Unfamiliar	84	84%
Familiar	13	13%
Total	97	97%

Table 4.9: Water problems identified by the people

Water Problems	Percent
Decreasing quantity	5.6%
discrimination with the tenants	0.6%
few houses have pipelines without permission	0.6%
inaccessible	1.3%
infrequent	3.8%
insufficient	17.5%
irrigation problem	9.4%
less taps	3.1%
limited sources	1.3%
murky during monsoon	12.5%
natural calamities	0.6%
no private taps	1.3%

no problem	0.6%
no reservoir management	1.3%
pipeline management	6.3%
political conflict	0.6%
pollution	4.4%
poor quality	8.8%
seasonal water availability	9.4%
tap is far	3.1%
unequal distribution	6.9%
wastage	1.3%

Table 4.10: Water problems by different caste groups

Water Problems	Different Castes			
	Brahmin	Chettri	Newar	Janajati
Decreasing quantity	10.9%	14.3%	0.0%	5.3%
discrimination with the tenants	0.0%	0.0%	1.3%	0.0%
inaccessible	0.0%	0.0%	2.5%	0.0%
infrequent	0.0%	7.1%	5.1%	5.3%
insufficient	10.9%	7.1%	24.1%	15.8%
irrigation problem	21.7%	14.3%	1.3%	10.5%
less taps	0.0%	7.1%	3.8%	5.3%
limited sources	4.3%	0.0%	0.0%	0.0%
murky during monsoon	17.4%	14.3%	7.6%	21.1%
natural calamities	0.0%	0.0%	1.3%	0.0%
no private taps	0.0%	7.1%	1.3%	0.0%
no problem	0.0%	0.0%	1.3%	0.0%
no reservoir management	2.2%	0.0%	1.3%	0.0%
pipeline management	8.7%	0.0%	6.3%	5.3%
political conflict	0.0%	0.0%	1.3%	0.0%
pollution	2.2%	7.1%	5.1%	5.3%
poor quality	6.5%	0.0%	11.4%	10.5%
seasonal water availability	4.3%	7.1%	13.9%	5.3%
tap is far	6.5%	7.1%	0.0%	5.3%
unequal distribution	4.3%	0.0%	10.1%	5.3%
wastage	0.0%	7.1%	1.3%	0.0%

Table 4.11: Water problems by gender

Water Problems	Male	Female
Decreasing quantity	6.2%	4.8%
discrimination with the tenants	1.0%	0.0%
few houses have pipelines without permission	0.0%	1.6%
inaccessible	1.0%	1.6%
infrequent	4.1%	3.2%
insufficient	16.5%	19.0%

irrigation problem	12.4%	4.8%
less taps	4.1%	1.6%
limited sources	2.1%	0.0%
murky during monsoon	14.4%	9.5%
natural calamities	0.0%	1.6%
no private taps	1.0%	1.6%
no problem	0.0%	1.6%
no reservoir management	2.1%	0.0%
pipeline management	9.3%	1.6%
political conflict	1.0%	0.0%
pollution	4.1%	4.8%
poor quality	6.2%	12.7%
seasonal water availability	6.2%	14.3%
tap is far	3.1%	3.2%
unequal distribution	4.1%	11.1%
wastage	1.0%	1.6%

Table 4.12: Water problems by CFUG members and non-members

Water Problems	Non-members of CFUG	Members of CFUG
Decreasing quantity	6.1%	4.3%
discrimination with the tenants	0.9%	0.0%
Pipelines without permission	0.9%	0.0%
inaccessible	1.8%	0.0%
infrequent	4.4%	2.2%
insufficient	18.4%	15.2%
irrigation problem	8.8%	10.9%
less taps	3.5%	2.2%
limited sources	0.0%	4.3%
murky during monsoon	8.8%	21.7%
natural calamities	0.9%	0.0%
no private taps	0.9%	2.2%
no problem	0.9%	0.0%
no reservoir management	0.0%	4.3%
pipeline management	7.0%	4.3%
political conflict	0.9%	0.0%
pollution	4.4%	4.3%
poor quality	9.6%	6.5%
seasonal water availability	11.4%	4.3%
tap is far	1.8%	6.5%
unequal distribution	7.9%	4.3%
wastage	0.9%	2.2%

Table 4.13: Water problems by to proximity

Water Problems	Closer	Further
Decreasing quantity	2.8%	11.8%
discrimination with the tenants	0.9%	0.0%
few houses have pipelines without permission	0.0%	2.0%
inaccessible	1.8%	0.0%
infrequent	4.6%	2.0%
insufficient	22.0%	7.8%
irrigation problem	9.2%	9.8%
less taps	3.7%	2.0%
limited sources	0.0%	3.9%
murky during monsoon	8.3%	21.6%
natural calamities	0.9%	0.0%
no private taps	0.9%	2.0%
no problem	0.9%	0.0%
no reservoir management	0.9%	2.0%
pipeline management	5.5%	7.8%
political conflict	0.9%	0.0%
pollution	5.5%	2.0%
poor quality	10.1%	5.9%
seasonal water availability	10.1%	7.8%
tap is far	1.8%	5.9%
unequal distribution	9.2%	2.0%
wastage	0.0%	3.9%

Table 4.14: Solutions to water problems by gender

Solutions to water problems	Male	Female
Participation	13.6%	20.6%
Communication	1.5%	5.9%
More taps	7.6%	23.5%
Equal distribution	9.1%	20.6%
Management	45.5%	14.7%
Protect source	15.2%	14.7%
Financial aid	7.6%	0.0%

Table 4.15: Members of CFUGs living at further or closer proximity to the CF

Further	Closer
29.6%	70.4%

Figure 3.4: Stages of the Qualitative Analysis Guide of Leuven (QUAGOL)

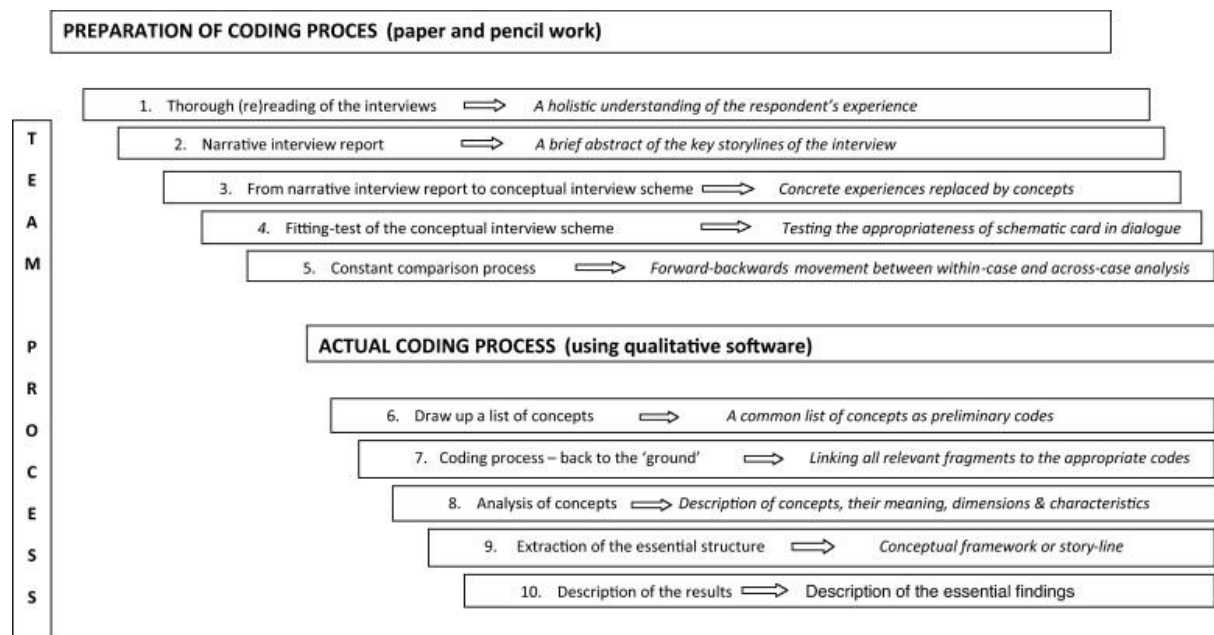


Figure 4.4: Percentage of respondents stating that the quantity of water in the watersheds of Lamatar has decreased

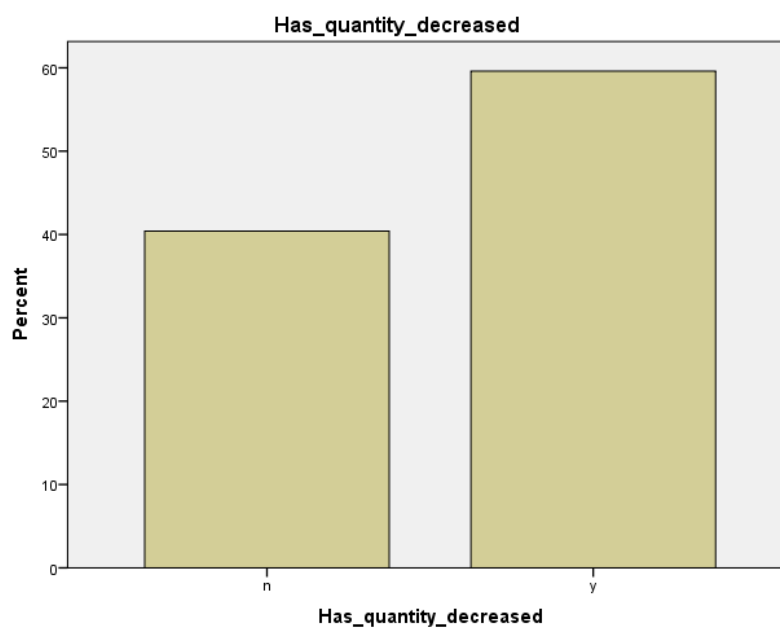
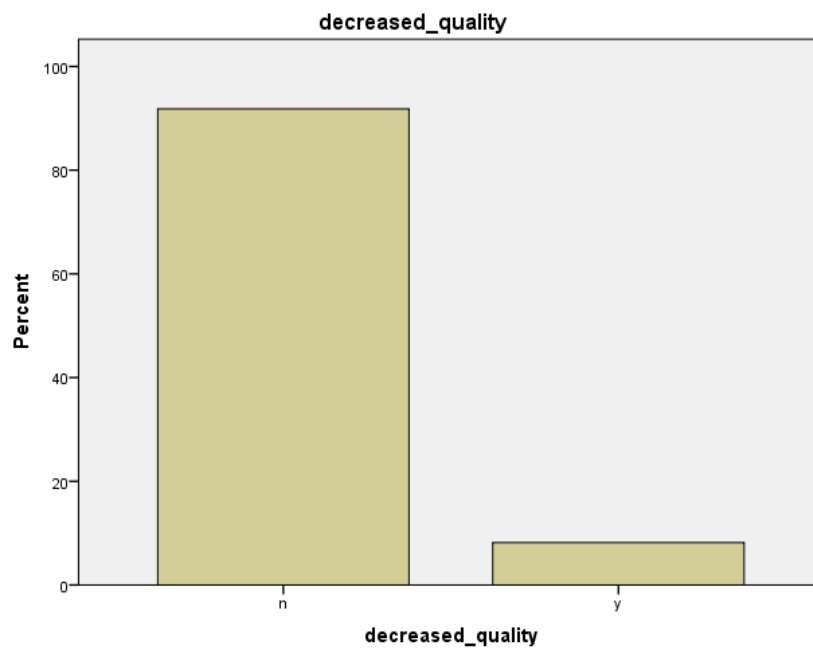


Figure 4.5: Percentage of people claiming that the quality of water in the watershed of Lamatar has decreased



Appendix 7 Research rigour

Following the model of Guba and Lincoln (1989), four factors were considered to ensure the rigour of this study, they are: credibility, transferability, dependability and confirmability. This section defines the four factors and their application in this study.

a) Credibility

Credibility involves establishing results in a way that it is believable. Credibility can be obtained by triangulation and member checks (Koch, 2006). In this study, credibility was confirmed by combination of data collection methods (primary and secondary) to allow cross checking between the available literature and the findings.

b) Transferability

Guba and Lincoln (1989) define transferability as the “degree to which findings fit within context outside the study”. In other words, the reader compares the research situation with a situation he is familiar with. A detailed description of the case study including Nepal and Lamatar along with a detailed review on the existing literature has been provided.

c) Dependability

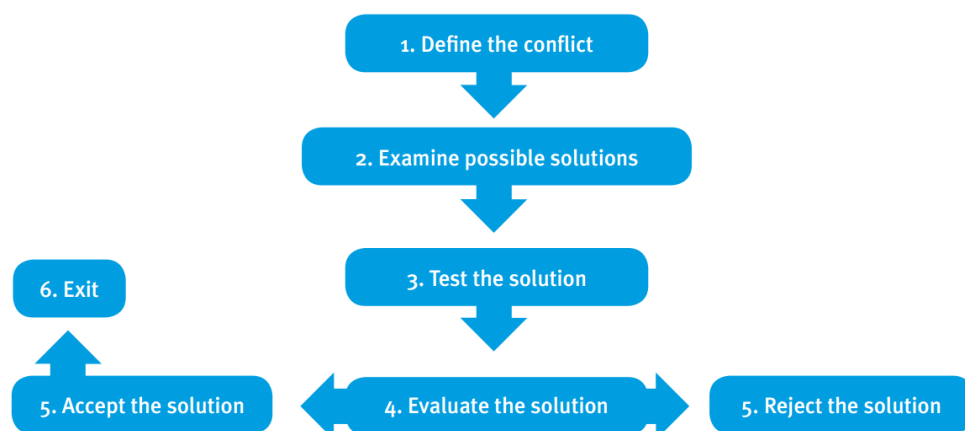
Dependability ensures that a research can be replicated. The methodology chapter has detailed all the procedures under taken during and after the field work. All data and findings have been recorded and included in this thesis. The preliminary biophysical analysis could and should be replicated with further research. Additionally, further community-based surveying in other communities could expand upon this study, but were beyond the scope allowed here due to time constraints.

d) Confirmability

Confirmability requires one to show that the findings correspond with the interpretations. To maintain confirmability, the thesis was duly audited by external researchers or the research supervisors.

Appendix 8 Water Conflict management

Figure 6.0.1: Dewey's Sequence of Conflict Management



There are 5 stages to Water Aid's conflict management: 1) Conflict cause and effect analysis 2) Identify and mobilise key social and political leaders 3) Consultations for finalising conflict management strategy 4) Adoption of win- win and compromising strategies 5) Adhere to code of conduct 6) Legal – the last option of conflict management

i. Conflict cause and effect analysis

Finding out the cause of the conflict is the first step towards effective water management within the community forests. Most conflict characterization is done by informal discussions instigated either by visiting the water sources or through discussions opened by the affected people.

ii. Identify and mobilise key social and political leaders

Generally, leaders play an important role in negotiating a conflict as the community gives high level of respect to the leaders. However, an unbiased negotiator is required who can be diplomatic with both sides. In Lamatar, water conflicts were generally discussed locally

within the user groups. More complex cases summoned the VDC. In some instances, NGOs such as FEDSWAN was also involved as a mediator.

iii. Consultations for finalising conflict management strategy

According to Water Aid, the best solution to water problem can be selected only through comprehensive community consultations and interactions. These communications were important to prevent negative effects on social harmony and water distribution. In Patle Community forestry, the forest user groups sold the water from their CF to a private buyer. The community disapproved of this because the right to use the natural resource such as water belonged to the entire community and not just the Community forests. Although the CUGs had pursued the trade only after the approval of the DFO, the disagreement between the community and the Forest User Groups for the water source caused an upheaval. Eventually CFUGs had to cease their deal.

iv. Adoption of win- win and compromising strategies

Most negotiations have to end in win-win situations to avoid upheaval and animosity. The communities in Lamatar often compromised to sharing water within the community, without much discrimination so that people were not deprived of drinking water. In some cases, when a ward suffered from water crisis-generally from drying up of the source, damaged source from natural disasters etc., the other wards were open to sharing water. This generosity was also seen between VDC, where there the residents of Lubhu were allowed to use water during extreme scarcity. However, this generosity was seen only when water was available. During the dry seasons, the ward 9, situated at the top of the hill had to cut off the water supply to downhill VDC obtain water for their own use. This is because, there is no subsidy provided to the communities of ward 9 for supplying the water to the Lubhu VDC.

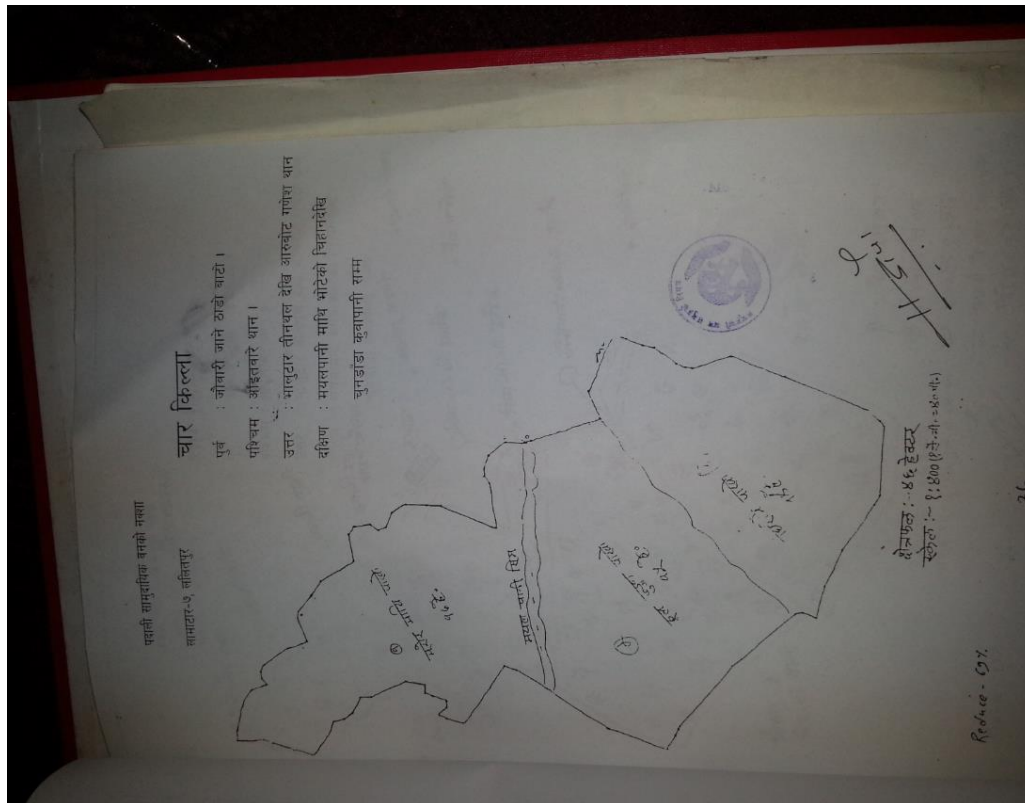
v. *Adhere to code of conduct*

The code of conduct was developed to avoid any social, ethical or moral conflicts in future. It was signed between different community organisations such as the CFUGs and WUGs, between government representatives, social leaders etc. The code of conduct was reviewed whenever the situation changed but in some cases, it was reviewed on an annual basis.

vi. *Legal – the last option of conflict management*

In extreme cases when all the other means do not work, the community/organisation or an individual has the option to appeal in the court. However, no legal prosecutions on water problems have been reported by the VDC and the community of Lamatar.

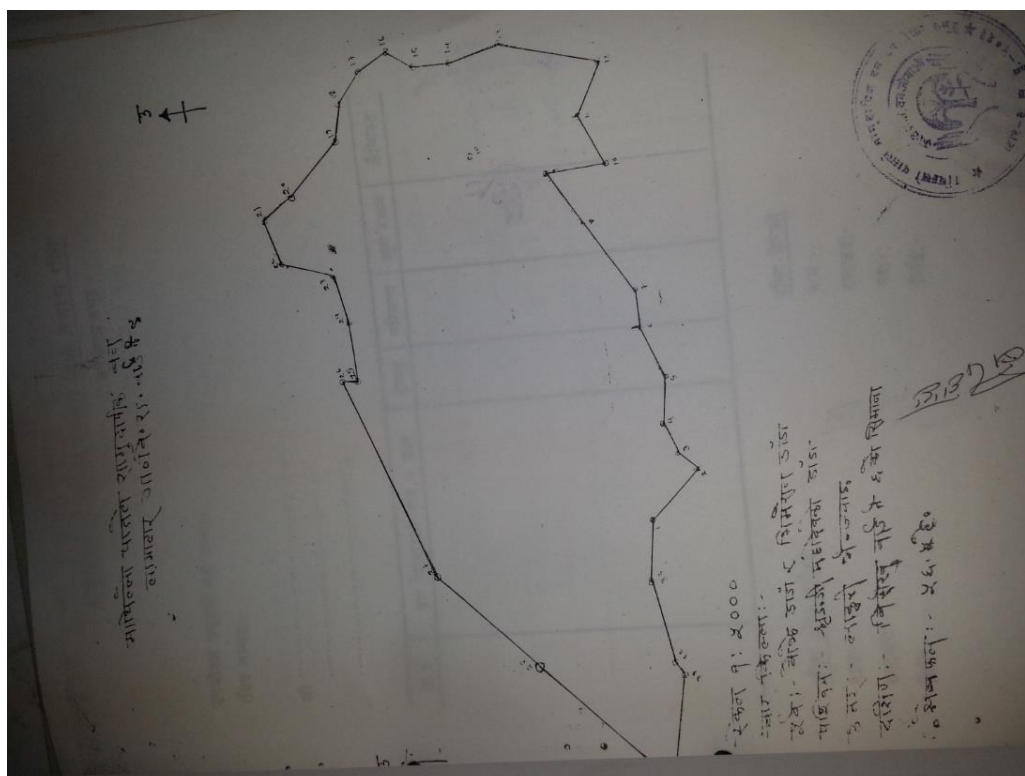
Appendix 9 Maps of community forestry in Lamatar



Area: 46
hectare

Scale:
1:400

Figure 9: Map of Padali Community Forestry, Lamatar-2



Area: 56.5
hectare

Scale: 1:5000

Figure 8: Upper Patale Community Forestry

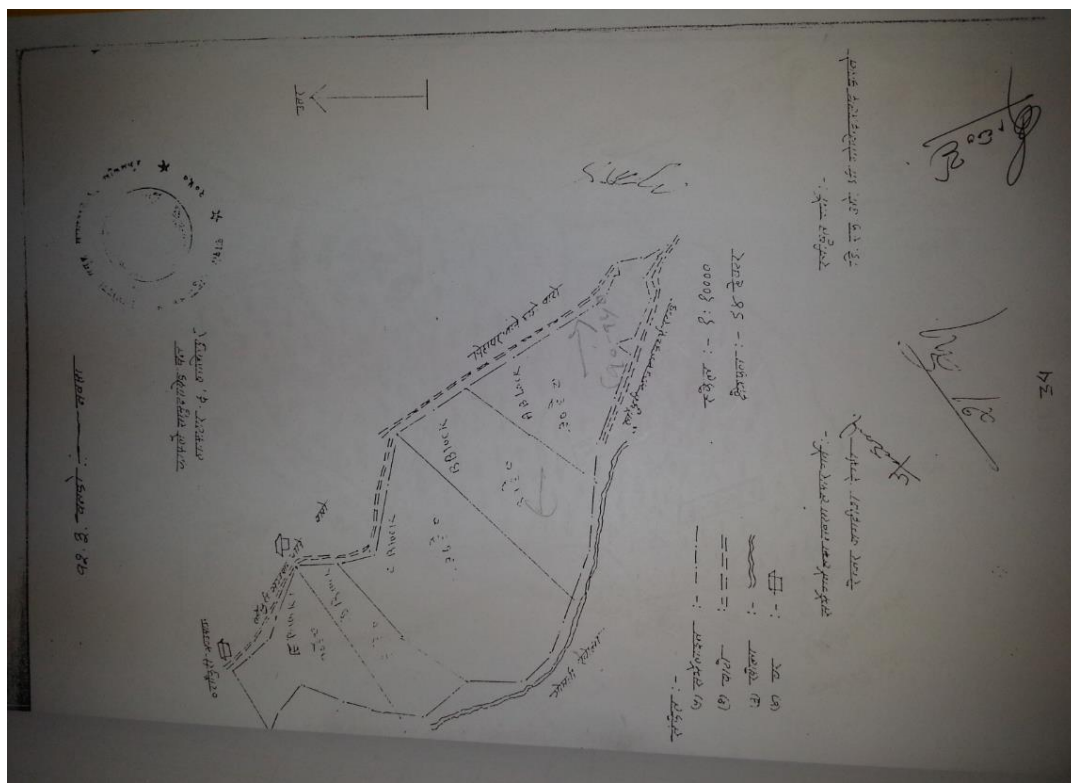


Figure 10: Grafal community forestry

Area: 56.5
hectare

Area: 5.96
hectare

Scale: 1:2400

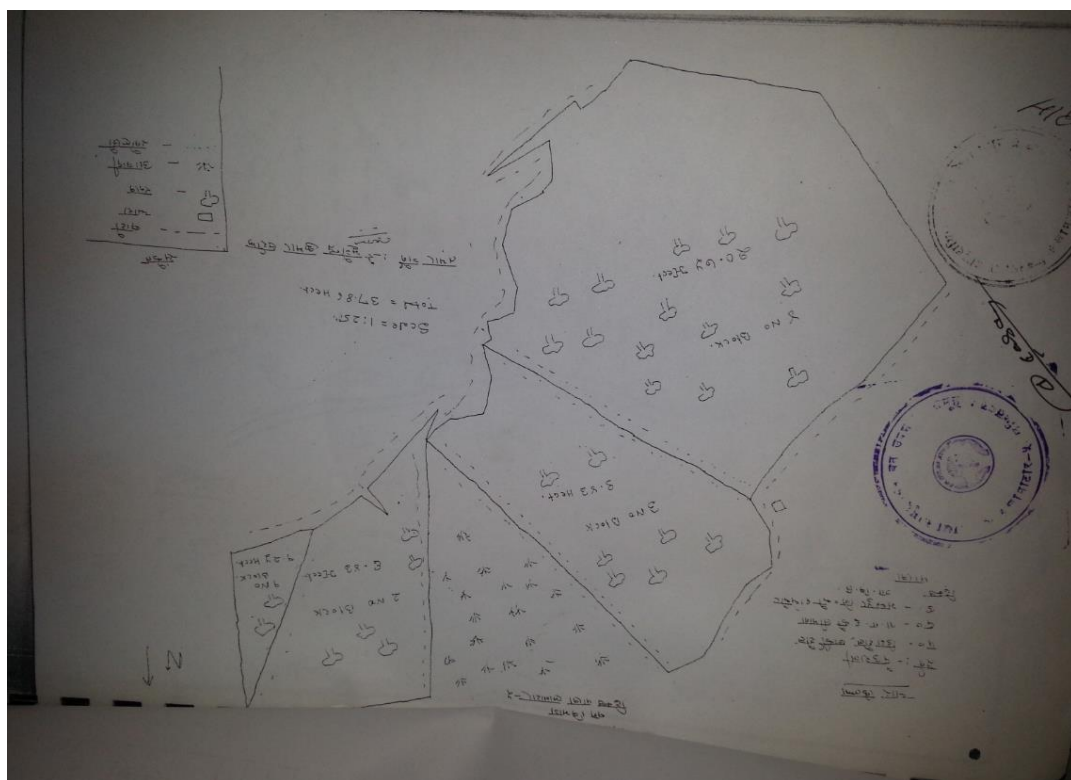
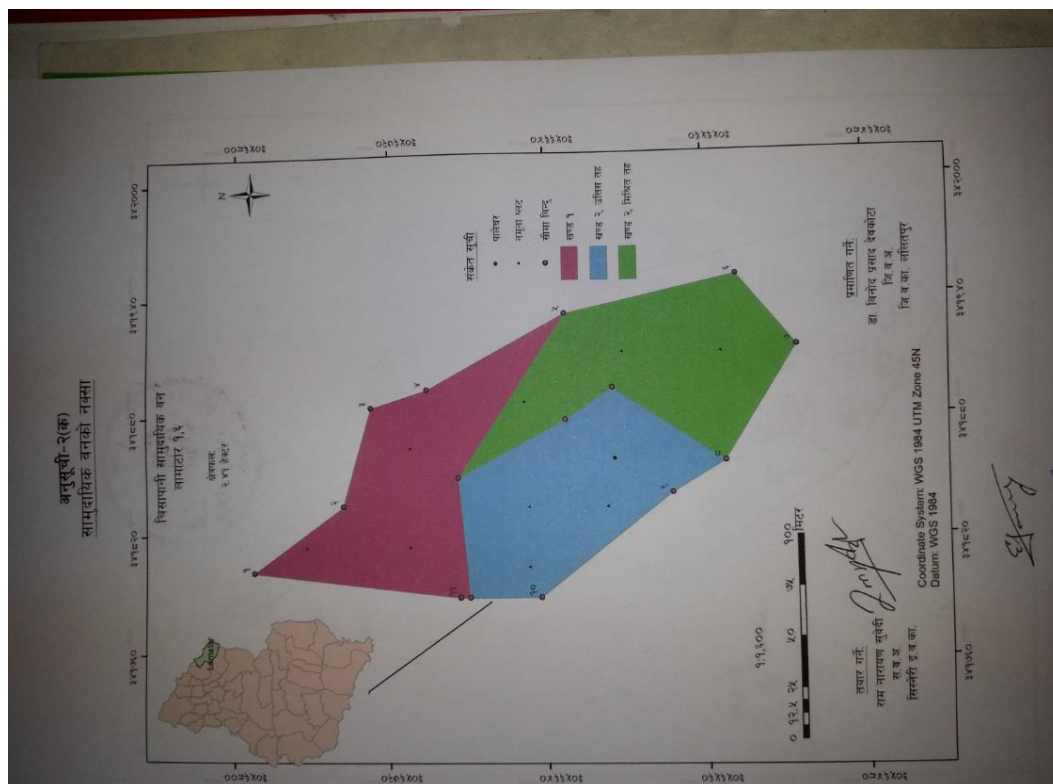


Figure 11: Shreeganesh Community Forestry

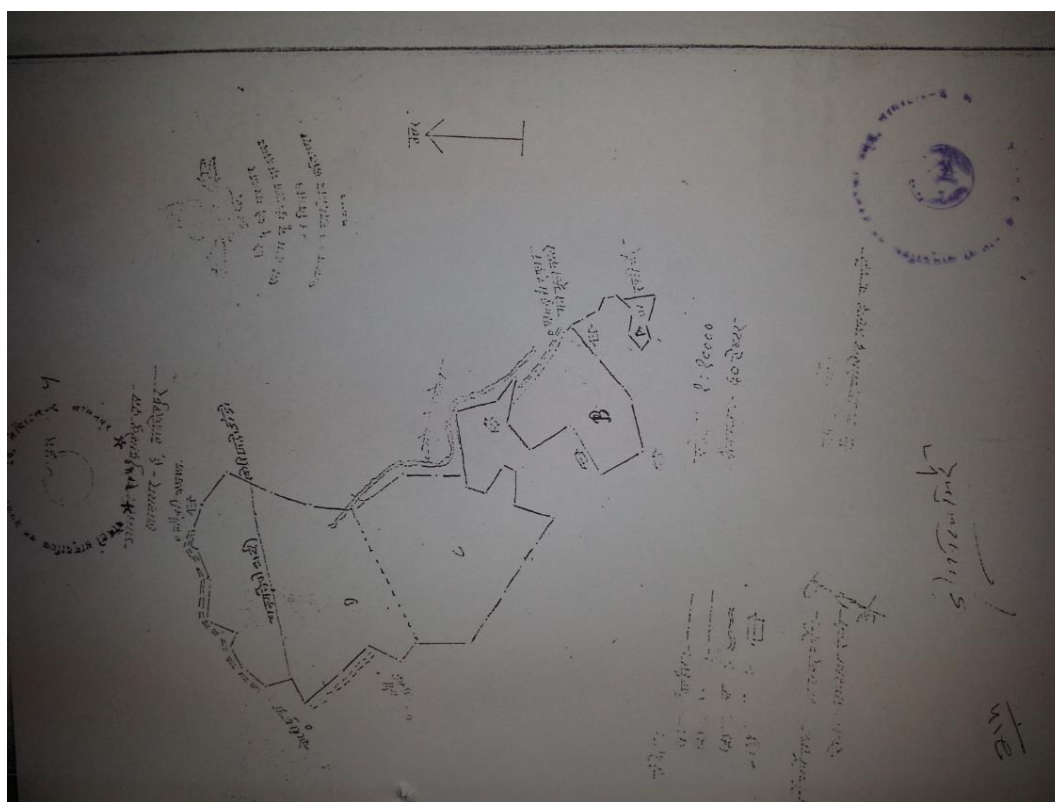
Area: 37.86
hectare

Scale: 1:2500



Area: 24.1
hectare

Scale: 1:1600



Area: 60
hectare

Scale: 1:10000

Appendix 10 Rainfall data from the Bureau of Meteorology, Nepal

Rainfall (mm) for Godavari

Latitude(deg/min): 2735

Longitude(deg/min): 8524

Elevation(m): 1400

Year	Jan	Feb	Mar	Apr	May	Jun	JUL	AUG	SEP	OCT	NOV	DEC
2000	0.4	7.3	35.6	113.5	186.8	279.8	350.7	582.5	209.3	2.2	0.0	2.1
2001	6.1	15.1	5.7	39.5	212.5	336.1	435.5	411.3	233.0	64.5	0.0	0.0
2002	44.0	35.1	25.6	88.3	171.9	173.2	811.8	710.4	275.5	16.6	14.2	0.0
2003	22.7	85.4	48.5	70.7	56.4	310.6	577.6	565.9	261.8	28.6	0.0	27.6
2004	33.5	1.5	5.5	71.8	176.7	149.5	577.2	262.1	154.4	114.7	5.2	0.0
2005	72.6	14.5	39.6	88.0	89.1	221.9	272.7	381.5	141.6	117.5	0.0	0.0
2006	0.0	0.0	24.4	88.9	163.9	272.0	285.8	321.2	249.2	23.1	1.5	24.8
2007	0.0	94.3	48.4	78.7	169.2	221.3	398.2	386.5	491.5	45.3	0.0	0.0
2008	7.1	1.0	20.7	55.4	121.5	482.4	349.6	346.4	266.7	22.3	0.0	7.9
2009	0.0	0.0	26.0	0.0	169.3	95.1	309.9	403.5	132.4	104.3	1.2	0.0
2010	4.4	22.0	0.4	49.0	89.5	173.1	337.3	353.9	0.0	75.2	0.0	0.0
2011	4.2	47.6	27.7	62.5	345.2	402.6	417.8	399.1	298.4	0.0	0.0	0.0
2012	20.2	38.8	3.1	89.0	51.8	118.4	503.8	371.2	2.7	DNA	DNA	0.0
2013 0.0	16.3	DNA	17.8	52.7	256.0	367.1	489.6	351.2	234.3	123.4	0.0	

(Source: Bureau of Meteorology, Nepal)

Rainfall (mm) for Tikathali

Latitude(deg/min): 2739

Longitude(deg/min): 8521

Elevation(m): 1341

<i>Year</i>	<i>Jan</i>	<i>Feb</i>	<i>Mar</i>	<i>Apr</i>	<i>May</i>	<i>Jun</i>	<i>JUL</i>	<i>AUG</i>	<i>SEP</i>	<i>OCT</i>	<i>NOV</i>	<i>DEC</i>
<i>2000</i>	<i>0.0</i>	<i>3.0</i>	<i>27.1</i>	<i>69.9</i>	<i>174.4</i>	<i>212.1</i>	<i>268.0</i>	<i>359.1</i>	<i>141.4</i>	<i>6.0</i>	<i>0.0</i>	<i>3.0</i>
<i>2001</i>	<i>6.0</i>	<i>0.0</i>	<i>11.0</i>	<i>49.1</i>	<i>197.1</i>	<i>219.5</i>	<i>382.6</i>	<i>363.5</i>	<i>171.8</i>	<i>9.0</i>	<i>0.0</i>	<i>0.0</i>
<i>2002</i>	<i>36.7</i>	<i>38.0</i>	<i>72.3</i>	<i>96.8</i>	<i>174.5</i>	<i>151.4</i>	<i>527.3</i>	<i>579.6</i>	<i>148.0</i>	<i>17.7</i>	<i>5.5</i>	<i>0.0</i>
<i>2003</i>	<i>26.0</i>	<i>74.7</i>	<i>60.1</i>	<i>64.2</i>	<i>58.5</i>	<i>182.7</i>	<i>502.8</i>	<i>383.4</i>	<i>319.7</i>	<i>59.2</i>	<i>0.0</i>	<i>18.7</i>
<i>2004</i>	<i>33.2</i>	<i>0.0</i>	<i>3.0</i>	<i>82.2</i>	<i>178.6</i>	<i>169.5</i>	<i>402.8</i>	<i>158.9</i>	<i>114.0</i>	<i>47.9</i>	<i>10.5</i>	<i>0.0</i>
<i>2005</i>	<i>63.7</i>	<i>10.6</i>	<i>78.2</i>	<i>48.2</i>	<i>83.8</i>	<i>192.7</i>	<i>198.2</i>	<i>332.1</i>	<i>91.0</i>	<i>160.1</i>	<i>0.0</i>	<i>0.0</i>
<i>2006</i>	<i>0.0</i>	<i>0.0</i>	<i>30.2</i>	<i>85.0</i>	<i>138.1</i>	<i>256.6</i>	<i>204.7</i>	<i>165.7</i>	<i>153.7</i>	<i>47.9</i>	<i>2.0</i>	<i>14.6</i>
<i>2007</i>	<i>0.0</i>	<i>57.0</i>	<i>41.6</i>	<i>69.3</i>	<i>61.8</i>	<i>183.3</i>	<i>202.2</i>	<i>213.7</i>	<i>401.7</i>	<i>144.4</i>	<i>30.7</i>	<i>0.0</i>
<i>2008</i>	<i>3.0</i>	<i>0.0</i>	<i>33.1</i>	<i>16.0</i>	<i>88.4</i>	<i>217.3</i>	<i>235.7</i>	<i>285.9</i>	<i>211.4</i>	<i>4.1</i>	<i>0.0</i>	<i>0.0</i>
<i>2009</i>	<i>0.0</i>	<i>0.0</i>	<i>23.4</i>	<i>0.0</i>	<i>126.7</i>	<i>35.0</i>	<i>195.6</i>	<i>194.5</i>	<i>94.9</i>	<i>5.2</i>	<i>0.0</i>	<i>0.0</i>
<i>2010</i>	<i>20.2</i>	<i>2.0</i>	<i>15.4</i>	<i>20.2</i>	<i>75.7</i>	<i>111.4</i>	<i>277.6</i>	<i>351.0</i>	<i>280.6</i>	<i>27.5</i>	<i>0.0</i>	<i>0.0</i>
<i>2011</i>	<i>7.0</i>	<i>50.2</i>	<i>14.5</i>	<i>61.2</i>	<i>129.8</i>	<i>248.9</i>	<i>302.1</i>	<i>287.9</i>	<i>227.3</i>	<i>0.0</i>	<i>30.0</i>	<i>0.0</i>
<i>2012</i>	<i>8.3</i>	<i>35.0</i>	<i>9.5</i>	<i>60.3</i>	<i>63.0</i>	<i>132.4</i>	<i>317.7</i>	<i>DNA</i>	<i>172.1</i>	<i>0.0</i>	<i>0.0</i>	<i>0.0</i>
<i>2013</i>	<i>9.0</i>	<i>42.0</i>	<i>18.2</i>	<i>DNA</i>	<i>204.0</i>	<i>187.0</i>	<i>DNA</i>	<i>232.6</i>	<i>217.0</i>	<i>106.0</i>	<i>0.0</i>	<i>0.0</i>