

**IRRIGATION MANAGEMENT AND CONFLICT DYNAMICS IN THE
KHAGERI IRRIGATION PROJECT OF CHITWAN**

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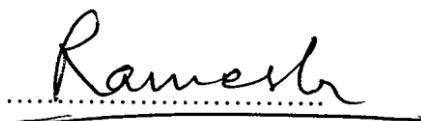
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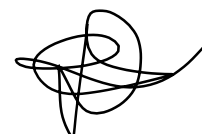
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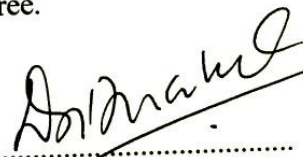
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APPROVAL LETTER

The dissertation entitled "**IRRIGATION MANAGEMENT AND CONFLICT DYNAMICS IN THE KHAGERI IRRIGATION PROJECT OF CHITWAN**" was submitted by **MR. SAJIN BIKRAM KUNWAR** for final examination to the Research Committee of the Faculty of Humanities and Social Sciences, Tribhuvan University, in fulfillment of the requirements for the **Degree of Doctor of Philosophy in Conflict, Peace and Development Studies**. I hereby certify that the Research Committee of this Faculty has found the dissertation satisfactory in scope and quality and has therefore accepted it for the degree.


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ABSTRACT

Irrigation systems play a crucial role in sustaining agricultural productivity and rural livelihoods in Nepal. However, their effectiveness is frequently undermined by conflicts arising from water allocation, infrastructure maintenance, and institutional arrangements. Despite the prevalence of such disputes, limited scholarly attention has been paid to understand their underlying dynamics and management practices. This study examines the emergence and nature of irrigation-related conflicts in the Khageri Irrigation Project (KIP) and analyzes how different conflict management mechanisms influence irrigation performance and agricultural outcomes.

The study argues that irrigation conflicts are deeply rooted in weak institutional arrangements, inequitable water distribution, deteriorating physical infrastructure, and limited participation of users in decision-making processes. Accordingly, it seeks to explore the key drivers of conflict, assess existing conflict management practices, and evaluate the role of governance mechanisms in enhancing system efficiency and sustainability.

Adopting an exploratory qualitative research design grounded in a constructivist paradigm, the study draws on primary data collected through key informant interviews, focus group discussions, and field observations. The research focuses on three command areas; Gitanagar, Shivanagar, and Mangalpur representing the head, middle, and tail sections of the irrigation system. Participants include members of Water Users' Associations (WUAs), beneficiary farmers, local representatives, and government officials, enabling a comprehensive understanding of multiple stakeholder perspectives.

The findings reveal that conflicts are escalated by institutional weaknesses, lack of accountability, unequal water distribution, and declining infrastructure conditions. At the same time, the study identifies that active user participation, effective institutional functioning, and locally embedded conflict resolution practices such as mediation, negotiation, and arbitration play a significant role in reducing disputes and fostering cooperation among users.

The study concludes that sustainable irrigation management requires a collaborative governance approach that integrates community participation with supportive state

engagement. Strengthening institutional capacity, ensuring equitable resource distribution, and promoting inclusive decision-making processes are essential for improving irrigation system performance and achieving long-term agricultural sustainability.

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LIST OF ABBREVIATIONS AND ACRONYMS

AMIS	:	Agency Managed Irrigation System
BATNA	:	Best Alternative to a Negotiated Agreement
BHNs	:	Basic Human Needs
BMPC	:	Bharatpur Metropolitan City
CDO	:	Chief District Officer
CPR	:	Common Pool Resource
DOI	:	Department of Irrigation
FAO	:	Food and Agricultural Organization
FGDs	:	Focus Group Discussions
FMIS	:	Farmers Managed Irrigation System
IM	:	Irrigation Management
IMC	:	Irrigation Management Center
ISF	:	Irrigation Service Fee
IWMI	:	Irrigation Water Management Institution
KIIs	:	Key Informant Interviews
KIP	:	Khageri Irrigation Project
O & M	:	Operation and Management
PIM	:	Participatory Irrigation Management
PIN	:	Position, Interest and Needs
UN	:	United Nations
WUAs	:	Water Users Associations
WUG	:	Water User Group

CHAPTER I

INTRODUCTION

1.1 Background of the Study

Food is the important aspect associated with life and survival. Life is not possible in the absence of food. For the production of food, agriculture remains the most essential and inevitable component. Agriculture helps to enhance food production. It supports the livelihood. Agriculture production is a combined performance of farmers and their infrastructural management. In this context, one of the effective infrastructural managements is the arrangement of an adequate water supply through the proper irrigation systems. It ensures the necessary supply of water that helps to increase the crops.

It is necessary to maintain enough water for satisfactory crop production. For this, an effective irrigation management system plays a vital role. Irrigation management is interlinked with the common good approach. Longley (2009) defined the common good as anything that provides benefits and is naturally accessible to all members of a community. Similarly, Drew (2023) described it as actions that have a positive impact on society and its members. Hence, irrigation management is for the benefit of the community, society, nation, and the world. It has its wide significance. Irrigation management is also for positivity and humanity. In this context, Molina-Ochoa et al. (2019) stated the importance of an irrigation project for the purpose of common good through the active involvement of farmers for its functioning.

Congreves (2025) highlighted the proper irrigation management for regenerative agriculture. The year round crop production is helpful for self-sustainability. It is achievable through the integrated relationship among water, vegetation, and land

productivity. In absence of one, regeneration is not possible. For regenerative agriculture, it is necessary to have proper coordination, communication, and performance among all the members who are directly or indirectly linked to the project. Baccarini (1996) also emphasized project organizational structures through proper communication channels, allocating responsibilities, and assigning tasks. It is necessary to maintain mutual understanding and efforts for the functionality of natural resources like irrigation system.

Irrigation management covers the management of technical, institutional, social, political, physical, and environmental aspects of water resource efficiency and outcome. Scholars like Nasr et al. (2018) identify key actors in irrigation management. It includes water user associations (WUAs), water users' representatives, political leaders, and irrigation and revenue bureaucracies. Ozerol (2013) added irrigation management covers the management of irrigation infrastructure and drainage system. Apart from these domains, irrigation management is wide and its scope is complex to understand.

According to Ostrom (1992), irrigation management involves various components such as the process of water production, canal management, water allocation, and its distribution. In a similar vein, Lam and Chiu (2016) elucidate irrigation management in terms of the technical processes. They describe it as the structured movement of water from sources. It goes to the farmers' fields through different channels. Bossenbroek and Zwarteveen (2014) focus on structural domains of irrigation management. It includes the management of labor, land, and materials. The collective practices help to maintain equitable water allocation, infrastructure maintenance, coordination and sound performance among users.

Munaretto and Battilani (2014) conceptualize irrigation management from a governance perspective. It encompasses the physical system that involves both the public and private actors. It helps to maintain enough water in the destined crops' land. Likewise, Burton (2010) illustrates institutional domains of irrigation management. It covers irrigation laws, policies, organizational arrangements, cost recovery and decision-making, conflict management, as well as infrastructure operation and maintenance strategies.

Lowdermilk et al. (1977) and Uphoff (1986) stated that the strong organizational structures and the behaviors of the stakeholders determine the status of irrigation management system. It is important to unite for the resource mobilization process, the system maintenance act, and conflict resolution activities. Latour (2005, as cited in Mollingo, 2010) added that irrigation systems are determined through the condition of the networks of physical infrastructure like dams, canals, and weirs. These aspects are linked with the social and institutional domains.

Irrigation management is a composition of project planning, water allocation, distribution, monitoring, and evaluation processes. The effective system ensures an adequate supply of water. As Maina et al. (2014) stated effective irrigation management is identical to the supply of the right quantity of water at the right time and place. There is the need for institutional support and arrangement systems among multiple stakeholders like community members, user group and local officials (Shukla & Sharma, 1997; Reddy, 2003). The bases of effective irrigation management cover its operational efficiency, accountability, sustainability, and institutional performance (Gorantiwar & Smout, 2005; as cited in Elshaikh et al., 2018). Irrigation management is an integrated system that combines physical infrastructure, institutional arrangements, and governance mechanisms. It also aims to ensure efficient, equitable, and sustainable water use for the transformation of agricultural sector.

The history of irrigation management can be traced back to the ancient civilizations. The practice of a water monitoring system was initiated for proper irrigation management and water supply systems. According to Michael (2009), irrigation practices were evident across different regions of the world from the earlier period. In the American West, the Hohokam, Native Americans, and Spanish settlers initially constructed a canal system on their own. Michael added that over 160 canals were built around the Rio Grande by the 19th century. In Asia, as stated by Michael, irrigation systems were initiated earlier. For example, in Myanmar, the irrigation system was occupied by the royal patronage. Similarly, in Japan, the irrigation system was in practice before 600 B.C. In the case of Mongolia, irrigation system management started during the Huns. In Taiwan and the Philippines, according to Michael, the irrigation system was initiated through those migrants. They had colonial influence. They started incorporating farming, for which irrigation came as a primary entity.

Irrigation systems were community-based and state-driven. Mostly, kings and rulers owned those irrigation system managements. Maloney and Clyma (1998) studied ancient large-scale canal systems in South Asia and exemplified the case of the Grand Anaikattu in India. It is also identified that the Central Asian irrigation systems have their history from the Iron Age (Pueppke et al., 2018). Traditional systems in the Southeast Asian irrigation systems were central to the indigenous water-lifting technologies. It emphasized local resource use, simple technologies, and collective management among the water users' group.

So far as the irrigation system management in Nepal is concerned, it has several phases of its existence. The early practice of irrigation system management started from community efforts, religious trusts, and royal initiatives (Pradhan, 1989). Benjamin et al. (1994) brought the historical reference of irrigation management practice in Nepal

and stated that irrigation practices expanded from the mid-19th century. It included state-operated canals in various districts such as Kaski, Nuwakot, Palpa, and Syangja.

The first public sector irrigation system in Nepal, according to Benjamin et al. (1994) was the Juddha Canal and Chandra Nahar. Irrigation development transformed towards centralized planning by focusing on medium- and large-scale systems after 1956 (Regmi, 2007). After the 1980s, the irrigation management system was transformed from the agency-managed irrigation system to the farmers-managed irrigation system. It gave full authority and responsibilities to the beneficiary farmers for its functioning, operation, and use. The irrigation management system was supported by various legal policies and documents like the Water Resources Act, 1992, and the Irrigation Policy, 2003. These legal documents give more power and authority to the farmers for their functioning.

The phases of the irrigation management system from the past cover traditional, community-based or from royal or religious state control practices to the participatory community paradigm. The escalation of irrigation conflict in the earlier practice was less, maybe because of low population pressure and adequate water resources. In the present context, the situation has been altered. The present irrigation management system is becoming complex. There exist multiple institutional challenges and complexities. It possibly leads towards the situation of conflict. The understanding of conflicts and their dynamics in the sector of irrigation project management is a dire need in the present world.

The necessity of this study is to explore the issues of conflict and its dynamics in the irrigation projects, which is a new area of study. Conflict dynamics is the collective domain for conflict and its resolution practices. Conflict is a state of incompatibility. It can be understood from philosophical, social, and economic perspectives. Hobbes

(1651) highlighted conflict as a state that creates terror and added that social conflict can be resolved through social contracts. He stated power is the central factor of conflict. Therefore, it needs a strong body to minimize individuality through state supremacy. Likewise, Shetach (2009) pointed out modern issues of conflict through incompatible goals, values, and interests that occur frequently in human life.

Galtung (1969) explained conflict as a foundation among attitudes, behaviors and contradictions. The attitudes of people lead to conflict if they are directed towards competition for power, resources, and values. Similarly, Marx and Engels (1848) defined conflict as an outcome of economic suppression and class struggle. Weber (1978) pointed out that the role of power and authority, if not democratic, may lead to conflict. Similarly, Dahrendorf (1959) mentioned the authority holders and common people bring tension that leads toward conflict. Coser (1956) stated conflict is a situation in which people struggle for power, status, values, and they show their incompatibility mostly with the scarce resources. These tendencies induce conflict. Other scholars like Jeong (2008) and Mills and Mene (2020) focus on incompatible interest and powers as the causative factors of conflict.

As stated by Galtung (1973), conflict is caused due to actors' incompatibility with goal achievement. It is manifested through anger, hatred, disputes, and grievances (Walker & Daniels, 1997; as cited in Upreti, 2001). The intensity of conflict ranges from minor disagreement to a major confrontation (Kirchof & Adams, 1982). Aligned with the concept of Galtung, Himes (1980) supported that conflict is a state of incompatibility. It is often driven by competition over power, position, and resource achievement. Similarly, Boulding (1963, as cited in Oberschall, 1978) stated conflict as a situation where parties are mutually exclusive in gaining power and position.

The study of conflict resolution can be traced back to thinkers like Confucius (1998) and Sun Tzu (2002). They emphasized the need for mutual understanding, respect, peace, and harmony for the resolution of conflict. There is the importance of diplomacy through the use of soft power mechanisms like reward, respect, and penalties for the conflict resolution mechanism (Kautilya, 1992). The school of conflict resolution began in the mid-twentieth century. It focuses on the process of conflict transformation through constructive and productive outcomes. It brings a conflicting situation into peace (Steele, 1976; Katz, 1989). There is a need for mutual understanding, respect, cooperation, and coordination through mediation, negotiation, talk, and discussion for the resolution of conflict (Deutsch, 1973).

Some scholars raised an optimistic view related to conflict. It cannot always be negative, but it can produce positive results (Lewis, 1976). Conflict gives a new shape to the agenda. It becomes the issue that needs to be addressed urgently. Conflict, therefore, shouldn't be understood as a negative aspect. It has its constructive motif. In the sector of irrigation management, if the issue of conflict is addressed on time, it may give a new shape for its effective functioning. There are various ways to handle conflict. It can be through avoidance, accommodation, competition, bargaining, and collaboration. Schneewind (2015) cited the concept of Habermas communicative rationality. For the resolution of conflict, it is necessary to have proper communication among the conflicting parties to the issue. It gives a way out. It promotes peace, coexistence and respect.

De Silva (1994) stated structural and cultural approaches to conflict resolution. Structural approaches are related to the government and other institutional functioning. It is associated with legal terms, conflicts, rules, and regulations. In contrast, cultural approaches according to De Silva cover cultural norms, values, kinship, social

relationship which stood as a strong motive for the resolution of conflict. Conflict is the state of dispute over scarce resources that requires a cooperative framework to tackle those issues.

Rapport (1974) highlighted the game theory perspective applicable to the conflict resolution process. The state of conflict resolution depends on the decision made by the parties. If it goes cooperatively, it will lead towards peace and vice versa. The strategic movement of the players determines the outcome of the games. Likewise, the resolution of conflict is determined through the movement of the conflicting parties. Similarly, Blake and Mouton (1964) and Thomas (1976) provided collaboration as the important key for the resolution of conflict. It is possible through cooperative problem-solving and decision-making skills.

There are different ways to resolve conflict. They are avoidance, accommodation, compromise, and collaboration (Mayer, 2000, IX; as cited in Shetach, 2009). These ways are necessary to bring the situation into normal. These are the neutral factors for handling the situation. Burton (1986) stated that it is necessary to identify the root causes of conflict for its resolution. The processes like facilitation and mediation enable maintaining mutually agreed upon situation.

Conflict resolution can be defined as a process of collective learning, institutional development, and stakeholder participation (Bruckmeier, 2005). Conflict resolution is possible through negotiation, mediation, talks and cooperation. It is a process of transforming disputes into logical and constructive outcomes. Conflict resolution is possible through consensus, dialogue, and institutional support. It is necessary to address the structural or underlying cause of conflict for its resolution. The factors like domination, discrimination, partiality, competition, grievances and power imbalances need to be addressed well for the resolution of conflict.

Irrigation projects with sufficient water are necessary for food security. The contribution of irrigation to the Nepalese economy is high (WB, 2007; as cited in Ostrom et al., 2011). In addition, a report by the department of irrigation (2018; as cited in Regmi, 2020) reported during winter only 30% of the total cultivable land can be irrigated. Similarly, Pradhan and Belbase (2018, p.58) projected data that “out of 2.7 million ha of agricultural land in Nepal, only 1.4 million ha has some sort of irrigation facility.” Limited access to irrigation constrains agricultural productivity and affects livelihoods and the overall well-being of farming communities (Kumar et al., 2025). In this context, there is a need to understand the management practices and conflict dynamics of irrigation projects like the KIP. It reflects the common irrigation projects and their present condition in Nepal.

KIP is located in the Chitwan district of Nepal. It was designed by the department of irrigation in 1960 and completed in 1967 with a 3900 ha command area (Khanal, 2003; as cited in Pradhan, 2017). Pradhan added it has nine major and four minor branch canals runs twenty-two km in length to serve the command area. It was estimated that five thousand and thirty-eight households benefited from this system (ICON, 1993; as cited in Bhatta et al., 2006). Bhatta et al. stated about seven km of the main canal passes through the buffer zone of Chitwan National Park. The catchment area receives annual rainfall of 1,600 mm, 8% of which falls during the monsoon season.

The study of irrigation projects in relation to conflict dynamics (Jones & Metzger, 2016) might help to mitigate the existing problems and increase its efficiency for the effective project implementation. Conflict dynamics refers to the study of how and why conflicts evolve, escalate and deescalate over different spans of time among different actors. In this context, this research explores the key domains of irrigation management, examines the nature, causes, and types of irrigation conflict, and assesses the conflict

resolution mechanism in the KIP. It is important to understand the state of the art of such irrigation projects for the protection and promotion of agricultural sustainability. Though the issue is complex, it remains underexplored in scholarly research. Therefore, this study examines the current realities of irrigation system management in the KIP. It highlights conflict-related challenges and their resolution practices.

1.2 Statement of the Problem

There is various scholarly research on irrigation management and conflict. Even though, the study related to irrigation management in relation to conflict dynamics is thinly assessed. Existing literature is mostly linked with irrigation conflict in relation to farmers' performance and their management system and functioning behaviors.

In a global context, Merry (1998) illustrated Asian irrigation systems and highlighted that institutional practices and individual behavior were the major sources of conflict in irrigation projects. Uphoff and Wijayarathne (2000) stated that irrigation conflict arises due to chronic water shortages, encroachment of irrigation project land, and low self-esteem among water users. Ozerol (2013) mentioned that irrigation conflict is caused due to a low degree of institutional arrangements, lack of water rights, exclusion of farmers, and ineffective monitoring and evaluation mechanisms.

Similarly, Parthasarathy (2000) concluded that irrigation conflict is caused by the improper water distribution. Goonsasekera (1985) added that unequal water supply between head- and tail-end farmers along with deterioration of physical systems, poor maintenance, and design problems were some of the causes of irrigation conflict. Haftendorn (2000) illustrated fear of water scarcity; Phelps (2007) noted improper allocation and sharing of water; Stirzaker and Pittock (2014) mentioned leakage, evaporation, and drainage; Getirana and Malta (2010) identified water scarcity and canal constraints; and Podimata and Yannopoulos (2015) pointed out uncooperative

farmers as some of the additional causes of irrigation conflict.

In Nepal, relatively few scholars have examined irrigation management in relation to the conflict studies. Poudel (2000) studied irrigation dispute management in the hills of Nepal and found that disputes occur due to limited access to water. Kattel (2006) analyzed disputes in the Geya Danda irrigation system in the Illam district and showed that conflicts arise from water use practices, resource mobilization, and domination. Devkota et al. (2018) conducted case studies of irrigation projects in Dhulikhel and Bidur, the two prominent districts of Nepal, and concluded that water-related conflicts were linked to allocation, access, and distribution of water resources.

Similarly, Ternstorm (2002), in the case of Shivapur Martal Kulo, emphasized that conflicts emerged due to differences of opinion among users and negligence during repair and maintenance activities. Sharma and Shrestha (1989) argued that inadequate water distribution patterns created conflict. Pokharel (2007), in a case study of the Harpan Khola watershed in the Phewa Lake area of Pokhara, pointed out that the behavior and denial tendencies of upstream farmers were major sources of conflict.

In the context of the KIP, Bhatta et al. (2006) conducted a comparative study of farmer-managed and agency-managed irrigation systems and emphasized the necessity of farmers' active participation for effective implementation. Shukla and Sharma (1997) stated that operation and management have always been major issues in the KIP. Singh et al. (2014) conducted a case study of the Khageri River irrigation system from a policy management and service delivery perspective.

These empirical studies collectively highlight the inducing factors of irrigation conflict in both national and international cases. The major causes include institutional policy mismanagement, users' reluctance to adequately maintain irrigation systems, lack of

cooperation among stakeholders, weak agency support, and hydraulic constraints. These created conflicts among users with users, users with authority, and authority with the local governments. Those conflicts were induced due to lack of proper planning, rules implication, a gap in the policy and monitoring system, and users' interest.

In this context, the present study problematizes the case of the KIP from the perspective of conflict dynamics, which has not been adequately discussed yet. Therefore, this study helps to address this gap by exploring key domains of irrigation management, the issues that induce conflict, the nature of conflict, forms of conflict and the practices of conflict resolution, as existing literatures is insufficient to comprehensively explain this relationship.

1.3 Research Questions

The issue of irrigation management in relation to conflict dynamics is a less-discussed issue in academia. The researcher therefore attempted to find out the key domains of irrigation management, causes of irrigation conflict, and its resolution in the KIP by formulating the following research questions.

1. What are the principal domains of irrigation management, and how do they interact to shape management outcomes in the Khageri Irrigation Project?
2. How do the identified domains contribute to the emergence of conflict in the study area?
3. What conflict resolution mechanisms operate within the study area?

1.4 Objectives of the Study

The broader objective of this study is to examine how the domains of irrigation management escalate conflict and assess the overall conflict resolution practices. Whereas its specific objectives are as follows.

1. To identify the principal domains shaping irrigation management in the Khageri Irrigation Project
2. To examine how the identified domains, contribute to the emergence of conflict in the region
3. To assess the conflict resolution mechanism, operate in the study area

1.5 Rationale of the Study

Nepal possesses land and water resources suitable for agriculture, yet its reliance on food imports continues to grow each year (Sharma et al., 2023). Beyond its agricultural significance, irrigation systems become an issue of social and institutional conflict. It escalates conflict due to the limited supply of water. It creates a situation of conflict among users and institutions. It is necessary to understand the nature, forms, and dynamics of conflict in irrigation systems because they are connected to our lives and livelihoods. It helps to know the real cause and suffering that have been faced by the irrigation projects. It gives a proper understanding of the concept of irrigation conflict. Similarly, it gives a scholarly attempt to maintain peace. Sequentially, it leads towards development through the proper irrigation management system. An adequate supply of water leads towards satisfactory production. It is connected with the notion of development.

By analyzing the KIP in Chitwan, a major paddy cultivation area in Bagmati Province (Chalise & Marahatta, 2024), the research highlights the gap between resource scarcity, governance mechanisms, and local community practices. It is helpful to shape conflict outcomes. The project faces challenges such as inadequate water supply per unit command area (Shrestha et al., 2024) and upstream disputes, such as conflicts arising from the Panchakanya Irrigation System located two km upstream (Singh et al., 2014).

Local yields of 3.7–4.0 t/ha (Sapkota et al., 2021) remain below potential. It reflects the broader developmental impact of irrigation-related disputes.

This research generates empirical evidence and theoretical insights that are helpful to inform policy design and understanding of conflict and its dynamics. Similarly, it contributes knowledge in conflict, peace, and development studies by demonstrating natural resource management in relation to social, institutional, and environmental components. It is helpful to shape cooperation, dispute management and sustainable development outcomes. The findings provide an understanding about the concept of irrigation conflict dynamics that mitigate resource-based conflicts in other contexts. Equally, it contributes to both academic advancement and practical policy management in Nepal.

1.6 Limitations of the Study

The concept of water conflict is broad and complex. It encompasses issues like water scarcity, floods, landslides, desertification, and soil salinization. This study, however, focuses specifically on irrigation-related conflicts as a subset of water conflicts. As a result, findings are limited to the framework of irrigation management and conflict dynamics and may not fully capture the broader theoretical dimensions of water-related challenges.

The study uses a combination of desk review and field research to examine irrigation conflicts. While this mixed approach provides rich insights, it is limited by accessibility of data, time constraints, and reliance on self-reported information. Certain technical factors such as migration patterns, soil characteristics, and structural engineering issues were deliberately excluded, as they are outside the scope of this research. Furthermore, the findings are influenced by the specific instruments and procedures used for data

collection, which may not capture all aspects of irrigation conflict.

The study is based on the KIP, which has a unique geography, population distribution, climate variability, and local institutional arrangements. Therefore, the results may not be fully generalizable to other irrigation projects or regions. Additionally, irrigation conflicts are influenced by dynamic social, economic, and environmental factors that might change over time. It limits the temporal validity of the findings.

1.7 Organization of the Study

This dissertation is categorized into seven chapters, each addressing key aspects of irrigation management and conflict dynamics. Chapter one is the introduction. It establishes the relevance of this research, problematizes the current state of irrigation projects and examines some of the causes of irrigation conflict along with its resolution practices. Chapter two is the literature review. This chapter has been further categorized into two sections. One is the empirical review of irrigation conflict and its domains. It highlights the review of existing secondary articles, books, journals, reports, and other useful government and non-government documents that were supportive to make the issues clearer. Another is the theoretical and conceptual review. It theories the dominant theories that had been applied by the researcher. Those theories are discussed as analytical lenses for interpreting the findings.

Chapter three details the research methodology. The study adopts an exploratory design, outlining the methods, tools, and techniques used to examine irrigation management, conflict causes, and conflict resolution practices, the demographic, climatic, and agricultural profile of the study area is located in the Chitwan district of Nepal. Chapter four deals with the first objective of this study. It provides the identified domains of irrigation management, discussion and analysis. Chapter five presents the issues that induce conflict, its discussion, and analysis as a response to the second

research question. Similarly, chapter six addresses the third research question related to the conflict resolution mechanism. Chapter seven is the summary, findings and conclusion tying together and highlighting their significance for policy, practice, and future research.

CHAPTER II

LITERATURE REVIEW

2.1 Empirical Review

A review of relevant research on irrigation management and conflict dynamics is necessary to understand how the irrigation management and conflict dynamics have been covered, operated, and functioned. The existing literature emphasizes that irrigation systems are managed and there exist different types, forms, and natures of conflict. For the purpose of this study, these reviews are helpful to shape the foundation of this research. It identifies the gap related to what has already been explored and what needs to be gone through.

This study depicts the empirical studies as conducted by scholars related to the issue in both national and international contexts. It gives a framework as well as methodological know-how to support the design and execution of the present research. This empirical review examines the secondary studies related to the area of study. It is necessary to develop the thematic understanding. It is a systematic review of literature and is important for empirical evidence to inform the current research (Gohavacyf, 2020). The review is helpful to know more about the concept of conflict, its types, and theories that are drawn from different secondary sources.

Conflict and Its Types

Galtung (1958) defined conflict as a state of incompatibility in a certain issue between or among the conflicting parties. Conflict, according to Galtung, is of two types. One is actor-oriented and another is structure-oriented. Actor-oriented leads to the exploration of values in the actor's consciousness, attitudes, and behaviors. Structure orientation leads to any kind of asymmetry built into the structure. In contrast, Deutsch

(1973) introduced the variable that affects the conflict. They are the characteristics of the parties, the prior relationship, the nature of the issue, the social environment.

Deutsch added a distinction between destructive and constructive conflicts. According to him, conflict has destructive and constructive consequences if its participants are dissatisfied with the outcomes and are satisfied with the outcomes respectively. Some of the issues of conflict, as Deutsch mentioned, are resources and their control, preferences, value, facts, and information as cooperative problem-solving. According to him, it is necessary for the conflict resolution process.

Similarly, Lewis (1976) categorized conflict into intra- and interpersonal and intergroup. He identified several sources of conflict. It includes role conflict, value conflict, and communication conflict. Role conflict arises when the positions or responsibilities of parties create tension. Value conflict occurs when individuals' beliefs or understandings become incompatible. Communication conflict escalates from gaps or misunderstandings in communication.

In the same context, O'Neill and Mclarnon (2018) further classified conflict as task conflict, relationship conflict, and process conflict. Task conflict enhances team effectiveness by encouraging discussion and problem-solving. Relationship conflict arises from negative emotions such as anger, fear, or anxiety. Process conflict relates to inefficiencies in planning, role assignment, and resource allocation. It helps teams discover and address operational weaknesses.

Likewise, Leininger (1975) distinguished realistic conflict, characterized by incompatible goals, values, or interests, from non-realistic conflict. It arises from tension relief, deflected hostility, ignorance, or errors. Wright (1951) pointed out physical, political, ideological, and legal conflicts. Galtung's (1973) phases of conflict

were origin, dynamics, and resolution. While analyzing the irrigation project, it is helpful to understand the origin, dynamics, and resolution of possible conflicts and their resolution in the study area. Leininger also categorized conflict as direct and indirect. Direct conflict is called face-to-face conflict, and indirect conflict is also called non-face-to-face conflict or the structural practices of conflict. Pandey (2011) categorized absolute conflicts, relative allocation conflicts, water pollution disputes, and development conflicts that are necessary for the cooperation.

Auerbach (2005) proposed a reconciliation-based classification for conflict studies. Auerbach distinguished tractable conflicts, which can be easily resolved, and intractable conflicts, which need a huge effort and payment for their resolution. It involves psychological investment, violence, or existential concerns. Deutsche (1990; as cited in Wall & Callister, 1995) categorized conflict at multiple levels: personal, interpersonal, interorganizational, and international. For the resolution of conflict, Wall and Callister highlighted the need for negotiation, mediation, arbitration, or consultation.

Similarly, Smeets (2021) pointed out that conflict is always managed between conflicting parties. In the context of irrigation, weak management increases the likelihood of conflict. Conflict is inevitable where interdependence exists (O'Neill & McLarnon, 2018). It has significant implications for team functioning and resource management. Irrigation involves shared natural resources; understanding the nature of resource conflict is crucial for effective governance.

Dugan (1996) cited Coser's functions of social conflict. He made a distinction between realistic conflict that arises from frustration of specific demands and conflict directed at the presumed frustrating object. Those non-realistic conflicts, according to him, are escalated by the rival ends of the antagonists. He again cited Christopher Moore's book

called *The Mediation Process*. In that book, Moore identified five types of conflict. They are data conflict, interest conflict, relationship conflict, value conflict, and structural conflict. Dugan introduced the nested model for conflict resolution. The first type of conflict is an issue-specific one. A relational conflict is one that emerges from problems to do with the interaction patterns of the parties and their feelings toward each other. The system-level structural conflict emerges from inequalities that built the social system.

According to Schellenberg (1996), conflict is understood as the opposition between individuals and groups on the basis of competing interests, different identities, or differing attitudes. He introduced four theories of conflict. The individual characteristic theory looks at social conflict in terms of the natures of the individuals involved. The social process theories see conflict as a social interaction between individuals or groups. The social structural theories see conflict as a product of the way society is formed and organized, and formal theories seek to understand social conflicts in logical and mathematical terms.

Schellenberg identified two dimensions of conflict studies. One is macro, and another is micro. Those conflicts, like wars and revolutions, are termed as an example of macro conflicts, and other small groups or disputes are as micro conflicts. Conflict resolution, according to him, is “any marked reduction in social conflict” (p. 7). The main approaches in the practice of conflict resolution include coercion or forcing parties in conflict to a particular conclusion. Another is negotiation and bargaining, which is through the involvement of the parties in a process of discussion.

Nickerson (2023) cited Max Weber’s conflict theory. It categorizes conflict into three main sources. They are economic, social, and political. According to Weber, conflict leads to the accumulation of power. Those with wealth and power try to hold it by

means of suppression of the poor. In this context, the researcher brought Hayes (2025) definition of conflict as a socio-political framework, which explains conflict was caused due to the limited resources.

Theories of Conflict

Theories are the blueprint to analyze the existing reality through different academic lenses. It brings validity to the interpretation and maintains scientific research work. The illustration of various theories of conflict helps to maintain academic validity. Some theorists, like Gurr (1968) in his theory of relative deprivation, mentioned that perceived inequality or lack of access to resources escalates frustration, anger, potential aggression, and conflict. Similarly, Beqiri et al. (2024) introduced the behavioral theory of conflict. This theory highlighted that human biological instinct is the cause of conflict because it evokes aggression in human behavior. The theory of aggression, according to them, is more psychological. Similarly, they added the theory of frustration and aggression. Aggression is the result of frustration that arises as a result of unrealized national, individual, or collective goals.

Similarly, Nickerson (2023) stated conflict theory as a struggle between groups in competition for power and resources. He cited the reference of Karl Marx and emphasized that social struggle is a natural cause of conflict as there exist two classes of people. One group is rich and the other is poor. The inequality in wealth and control of production drives social tension and change. Well (1979; as cited in Nickerson, 2023) brought the concept of a functionalist approach to conflict theory. This theory is based on the assumption that every aspect of society, such as institutions, rules, and norms, can serve some purpose to society. These systems come into social inconsistency that brings social conflict. Similarly, Crouch (2001; as cited in Nickerson, 2023) added that conflict takes place if there is something psychologically wrong in any institutions.

Theoretical explanations of conflict highlight different dimensions of why disputes emerge within social systems. The inherency perspective, as presented in the course materials of Indira Gandhi National Open University (2019), views conflict as an inherent aspect of human nature. From this perspective, violence and confrontation are considered universal tendencies rooted in human behavior. Similarly, instinct-based explanations associate conflict with aggressive impulses embedded in human psychology. Influenced by Darwinian ideas of natural selection, this perspective interprets competition as a natural condition of human survival, suggesting that conflict arises as individuals or groups struggle for advantage within limited environments. Psychological interpretations further deepen this understanding.

Freud's psychoanalytic framework locates the origins of conflict within the internal dynamics of human instincts. According to this view, human behavior is shaped by the tension between the life instinct, which seeks preservation and pleasure, and the death instinct, which drives destructive tendencies. While such approaches emphasize the psychological basis of conflict, other theories shift attention to structural and material conditions. Resource-based explanations argue that conflict emerges when multiple actors compete over limited resources, making scarcity a central trigger of confrontation. In a similar vein, the relative deprivation perspective explains conflict as the outcome of perceived discrepancies between expectations and actual conditions.

Building on these ideas, Boulding (1963, as cited in Oberschall, 1978) distinguishes between breakdown–deprivation and solidarity–mobilization approaches to conflict. The former stresses the role of deprivation in generating unrest, a position reflected in Gurr's model of civil strife, which links the intensity of conflict to the level of perceived deprivation. The latter approach highlights how social groups mobilize around shared grievances, a process also reflected in Paige's structural interpretation of domination and conflict

Galtung (1958) introduced the theory of conflicts of interest and conflict of goals. The conflicts of interest, according to him, are structurally defined. Gallo (2013) introduced Galtung's ABC triangle as a conflict paradigm. He explained it as follows:

There are interesting analogies with one of the classical and most known conflict paradigms, that is, Galtung's ABC triangle. 'A' stands for attitudes, 'B' for behavior, and 'C' for contradiction. According to the ABC triangle, a conflict is defined by three main elements: the contradiction, which is the concrete object of the conflict; the behavior of the different actors; and their deep feelings and attitudes. A conflict cannot be solved or better transformed to become constructive instead of destructive unless we tackle all three components at the same time.

These theories have been reviewed to expand the horizon of understanding of the issue of conflict. The findings that were drawn from this study are useful for giving a theoretical explanation to the existing reality. The study of irrigation and irrigation management along with conflict highlighted the importance of sustainable irrigation management and conflict dynamics.

Resource Conflict

Irrigation conflict is a unit of resource conflict. According to Wolf et al. (2011), international resource conflicts tend to emerge most in regions where resource demand is high while supplies are low. The limited supply of resources is one of the causes of resource conflict. Wolf et al. identified several factors contributing to such conflicts. They include unclear definitions of resource sovereignty, weak institutional frameworks, and rapid environmental changes affecting resources.

Collier et al. (2003; as cited in Wolf et al., 2011) also discussed the resource curse hypothesis. It professes those countries abundant in natural resources face a higher risk of internal conflicts. There exist micro-to-macro conflicts. The micro conflict is associated with ownership and possession, whereas macro conflict is labeled as civil war and war of secession.

Unlike Wolf et al. (2011), Rachmad (2022) stressed that resource scarcity can also trigger conflicts. It induces resource-rich nations as a nation of threat. Among those, Steele (1976) mentioned conflict often occurs when two parties compete for scarce resources. It creates tension over how those resources are used. Klare (2020) added the technical aspect of resource conflict. According to him, resource conflict is caused due to the impact of climate change. It induces the rise of temperature and reduces rainfall. It threatens agriculture in many developing nations, generating widespread social dissatisfaction and civil strife. Other factors that drive resource conflicts include resource scarcity, state policies, market dynamics, production patterns, and issues of ownership (Funder et al., 2012).

Gholizadeh and Niknami (2020) also emphasized that disputes over ownership and power distribution escalate into conflict. The United Nations (n.d.), in its report, reported that depletion of natural resources and environmental degradation lead towards desertification, soil erosion, and drought. These are the major sources of resource conflict.

Saymour (2022) mentioned the components of natural resources. If found abundantly, it may have a threat of natural resource conflict. Some of the examples of natural resources are oil, natural gas, timber, and diamonds. They are frequently associated with resource conflicts. In a similar concern, Sapkota (2023) added differences in interests, disagreements, and public protests fueled by conflict over resource use.

Funder et al. classified conflicts as micro-micro conflicts, such as local disputes over land or water; micro-macro conflicts that involve clashes between government authorities and local or customary institutions over resource control; and macro-macro conflicts, like disagreements between countries sharing river water.

The social complexity of resource conflicts is noted in conflicting interest values or rights in unequal power and influence of the actors (Bruckmeier, 2005). After conceptualizing resource conflict, it shapes an understanding related to the conflict related to the irrigation project. This review is helpful to enhance the cognitive knowledge related to resource use and its conflict dynamics.

Water Conflict

The understanding of water conflict is essential, as it is associated with the context and content of this study. Patras (2021) cited the example of a water conflict between two riparian countries. They are India and Pakistan. They have conflict over the Jhelum River in terms of its water distribution. As per the Indus Water Treaty, these two countries have certain misunderstandings and disputes.

Raazia and Munir (2022) added tensions between Pakistan and India. Pakistan, being lower riparian, raises concerns about Indian dams and water diversion projects, and they breach the treaty provisions. According to Thomas Homer-Dixon, water scarcity may trigger multiple forms of conflict. The nature of conflict escalates from basic shortages to full-scale resource wars and relative deprivation. It may result in civil unrest or insurgency (Pandey, 2011). Pandey further highlighted that water conflicts often emerge from unequal distribution between riparian states and their monopoly over the use of water resources. Katz and Nagabhatla (2023) added that ambiguity, allocation dilemmas, and unusual resource distribution act as a catalyst for potential water conflicts.

Similarly, Unfried et al. (2022) provided reference to international water conflict. They cited the examples of international water disputes, such as the Grand Ethiopian Renaissance Dam. The conflict was triggered between Ethiopia, Sudan, and Egypt in 2020. They reported violent clashes between herders and farmers in Nigeria in 2018. It resulted in over 1,300 deaths and mass displacement. They added that during the Syrian conflict, those extremist groups seized major dams to pressure the government and local populations.

Haftendorn (2000) argued that water shortages most of the time generate conflict, particularly between upstream and downstream users. Haftendorn added dams constructed for electricity upstream negatively affect downstream irrigation system. He cited the Paraguay dam project near Itaipu. It was criticized by Argentina for its potential impacts on the lower basin. Gabcikovo Dam on the Danube was diverted by Slovakia. It led to a legal dispute with Hungary at the International Court of Justice.

Phelps (2007) claimed inequitable water allocation as a primary cause of water conflict. He proposed a model agreement for shared transboundary water resources and emphasized negotiation, overcoming obstacles, watershed management, and flexibility for the resolution of water conflict. The violence over water in Ethiopia, Afghanistan, India, Pakistan, and Mexico and its disputes led to deaths, injuries, and civil unrest. Gleick and Heberger (2012) and Mashal (2012; as cited in Gleick & Heberger, 2012) accounted for incidents such as poisoned school water in Afghanistan, conflicts over dams, and water-related debates during the Libyan civil war.

Similarly, Kreamer (2013) reported deaths and injuries in India's Sriganagar district over water disputes. USAID (2013) cited institutional weaknesses and poor infrastructure management that induced irrigation conflicts in southern Kyrgyzstan. Ide et al. (2020) stated the cause of the water conflict is due to unresolved grievances and

a lack of effective mechanisms. Ingraio et al. (2023) warned that water scarcity is a significant driver of such disputes. Jabeen et al. (2025) projected the consequences of water disputes. It reduces available water, affecting agriculture and public health.

Water conflicts are most pronounced in agriculture, where access to irrigation water is crucial. Karamidch Kordi et al. (2024) cited the case of Iran's Zagandehrud basin, and the conflict in that basin is due to the involvement of upstream and downstream users, but their involvement is not cooperation but competition in terms of water acquaintances. Water conflict encompasses national and international boundaries (Tulloch, 2009; as cited in Gholizadeh & Niknami, 2020). Gholizadeh and Niknami identified multiple causes like poverty, inequality, production initiatives, poor governance, militarism, dam projects and scarcity, population growth, and climate change as well as pollution as some of the serious causes of water conflict.

These reviews reflect an understanding that water conflicts often arise from unequal distribution, power, ambiguous water rights, grievances, and resource scarcity. Those conflicts are manifested in the form of disputes, mistrust, and tension. Moreover, this review supports the theme of differences in values, beliefs, interests, and attitudes; limited resources can fuel water conflict. Despite these, it is necessary to understand the challenges that come while managing water conflict dynamics. This review is important as it gives a common understanding of the concept of water conflict.

Irrigation Conflict

Angelakis et al. (2021) traced out the historical context to the irrigation conflict. They cited Sargon II of Assyria, who destroyed the irrigation network of the Haldians in Armenia, and Sennacherib of Assyria, who attacked Babylon in 689 BC. It destroyed its water supply canals as revenge for his son's death. In the Eastern context, early

conflicts over water sharing are recorded in the Indus Valley. As mentioned in the Gautam Buddha Kappiyam, disputes occurred over the Rohini River between the Shakyas and the Koliyan.

In a similar context, Getirana and Malta (2010) analyzed the concept of irrigation conflict and its resolution. Those conflicts arise due to hydraulic constraints within canal systems. Similarly, Fernea (1963) suggested that poor social and cultural cooperation, lack of coordination, and insufficient unity among communities sometimes induce irrigation conflicts. He emphasized the importance of indigenous water management practices for the resolution of those conflicts. They cited the Teotihuacan Valley in Mexico, where ineffective inter-community relations hindered irrigation operations (Fernea, 1963).

Among many countries, in Iran, Bijani and Hayati (2015; as cited in Gholizadeh & Niknami, 2020) identified farmers and the government should be responsible for the resolution of water-induced conflict. The key drivers of water conflicts include scarcity, drought, mismanagement of water supply, pollution, resource variability, high demand, low efficiency, weak institutions, improper governance, and centralized control.

Merry (1998) reviewed irrigation management in Asia and stated that conflicts often stem from unclear water rights, ambiguous role structure, lack of incentives, and weak accountability. Easter (2000) added that Asian irrigation systems face multiple challenges, including poor maintenance, inadequate services, reluctance to pay water fees, and low user participation, all of which can trigger conflict.

Menon et al. (2005) illustrated similar issues in Kerala, India, where poor infrastructure management, water availability problems, exclusion of farmers from policymaking, and water theft contributed to irrigation conflicts. A case study from the South of the Kyrgyz

Republic (Acted, 2013) reported four main forms of irrigation conflict. Those were the involvement of water user associations (WUAs), powerful individuals, ordinary users, and communities. The study was conducted in Bazar Korgon AA, Otuz Adyr, and Tort Kul AA and identified primary causes such as poor canal conditions, seepage, lack of cooperation among head, mid, and tail section users, water scarcity, silted and cluttered canals, environmental hazards, and border disputes.

Podimata and Yannopoulos (2015) emphasized that rising water demand is the major cause of conflict. Historical records, such as the conflict between Umma and Lagash over the Tigris and Euphrates rivers, illustrate that disputes over irrigation water are rooted in a long period of time. In Gujarat, India, Parthasarathy (2000) disagreed with a decline in public investment for irrigation, with problems in water charges and operational funds.

Ghosh et al. (2008) conducted a study about farmers' participation in irrigation. They examined the farmers' perceptions and their participation in irrigation management under four dimensions. Those dimensions were responsibility sharing, linking the role of the irrigation department, mobilization for a participatory approach, and financial management. They applied case studies and interviews as research tools to collect the information. This study was carried out in the Namapara branch canal, under the Puri main canal irrigation system of the Mahanadi Delta Irrigation Project in Orissa. It was exploratory in design.

Similarly, Rap (2006) applied a policy model and followed the practices, means, and events as important components for managing an irrigation system. It was necessary to go through problem identification, policy formulation, and implementation in Mexico. This article highlighted WUAs that improved the recovery of operational and maintenance functioning.

In a similar vein, Khalkheili and Zamani (2009) conducted a case study of the Daroodzan Dam irrigation network in Iran and depicted the factors affecting farmer participation in irrigation management. They used surveys as a method of study. Multi-stage stratified random sampling was used to collect data from 270 farmers. They applied a structured questionnaire to collect data. The reliability of the questionnaire was measured through a pilot study using Cronbach's alpha coefficient.

Lam and Chiu (2016), unlike the others, used an appraised survey and in-depth interviews as a method of data collection and compared the processes of adaptation that had taken place in irrigation systems in four distinct ecological institutional settings in the Chianan area of Taiwan. They concluded that different modes of institutional nesting have affected farmers' choice of adaptation strategies that impact system robustness and the sustainability of self-governance.

Shivakoti et al. (2019) assessed the management issues and challenges of common pool resources through case studies of different common pool resource management in India, Pakistan, and Nepal. This study illustrated two alternatives for the solution of a common resource problem. One was restricting appropriators' access, and another was creating incentives for resource users to contribute to the resource system.

Similarly, Bhatta et al. (2006) conducted a comparative study using a case study of the KIP. Intensive case studies and semi-structured interviews were conducted for the collection of necessary data. Obtained data were studied on the basis of logit analysis and t-test methods.

Acted (2013) employed various qualitative methods, such as desk review of major legal and background information, focus group discussions, and in-depth interviews of major stakeholders, to identify domains of conflicts, dispute mechanisms, and peacebuilding

activities of irrigation water in the south of the Kyrgyz Republic.

Shivakoti et al. (1987) conducted a study related to the irrigation system in the Budhi Rapti River. This study mentioned the inventory of the irrigation systems. It is necessary to develop a picture of the numbers, sizes, and systems for conveying, distributing, and draining water. It determines rules and regulations for allocating water, repairing and maintaining physical structures, and resolving conflicts over water management.

This study was carried out on the basis of policy paper reviews. An inventory checklist and questionnaire were prepared. The questionnaire was designed for a brief historical background of the system, performance of physical systems, and agricultural services and production. In addition, key informant interviews, including members of the canal association (*Kulo Samite*), village leaders, and local farmers, were carried out. Observation of the irrigation system included the inspection of the source and intake points; headworks and types of diversion structures and the network of canal systems were formulated.

Dorre and Goibnazarov (2018) made a similar study related to irrigation management. They explored the relationship between social and physical components of the irrigation governance system. They introduced the case study as a method of study in the western Pamir of Tajikistan. Interviews with the head of the village, village elders, farmers, and teachers were conducted for the necessary data collection process.

Fundi and Kinemo (2020) conducted the study of the Mkindo Irrigation Scheme by employing the exploratory sequential mixed approach dominated by qualitative and quantitative techniques. The data collection methods as applied were in-depth interviews, documentary reviews, and focus group discussions for the qualitative data

and a questionnaire for quantitative data. Qualitative data were analyzed using qualitative content analysis and explanation-building techniques. The quantitative data were analyzed using descriptive statistics.

Ayoub and Haruyama (2016) cited the irrigation management system of Afghanistan. They pointed out some of the inducing factors of irrigation conflict. Those issues of conflict were domination, lack of support from local government, breakdown of traditional rules, and the water management system. Data were collected through in-depth interviews with the informants, including beneficiary farmers.

Thapa and Scott (2019) explored the institutional coping and adaptation mechanisms to water stress. It concluded that local irrigation institutions manage water stress using diverse and integrated approaches broadly categorized as structural and operational measures. Data were collected through focus group discussions and open-ended questionnaires. The survey was also conducted using structured questions.

Ozerol (2013) examined the relationship between farmer participation and environmental issues from an institutional perspective in the context of the Harran Plain in Turkey. A case study on farmers' participation and irrigation practices in the Harran Plain had been applied as a method of study. Data were collected through in-depth interviews; documents, including the laws, bylaws, and regulations about irrigation management; and reports of relevant public organizations.

Lynott and Stanburry (1992) studied the Kirindi Oye irrigation scheme of Sri Lanka and Lake Buhi of the Philippines. They explored the relationship between access to water resources and emergence, management, and resolution of conflicts. They applied case studies as a tool for data collection. Wolf et al. (2011) explained the nature of water conflict and cooperation through the case studies of several countries, like Argentina,

Paraguay, and the Amu Darya basin between Uzbekistan and Tajikistan. Easter (2000) conducted a study on Asian irrigation projects and explored some of the irrigation management problems involving the lack of maintenance, poor irrigation service, low rates of fee collection, inadequate institutional arrangements, and lack of users' participation.

Hoogesteger (2015) conducted a case study of the Pillaro North Canal irrigation system in the Ecuadorian Highlands. This paper argued that the external interventions by the state and NGOs imposed a new governance system that undermined the existing normative structures. It led to internal conflict. The case study suggested reformation of irrigation policies and state intervention in user-managed supracommunities could lead to a higher level of cooperation.

Chai and Schoon (2016) used a field survey in China's southern counties located in the provinces of Guangdong, Guangxi, Hunan, and Jiangxi. This study used data envelopment analysis and qualitative comparative analysis models. Other methods included field surveys, multistage sampling methods, case materials, and in-depth interviews with farmers, village leaders, WOA members, and local officials.

Parveen et al. (2015) applied a combined methodology approach, including field observations, interviews, mapping, and remote sensing analysis, in the article entitled *Irrigation in Upper Hunza*. Case studies had been conducted to find out the structure and dynamics of irrigation systems. Upper Hunza is located in western Karakoram, Pakistan. This article synthesizes the idea that the constraint on water use may bring a new approach for farmers to solve their problems. Shrestha et al. (2018) also applied a case study of two sites. These places are Dadhikot and Jaukhel in the Bhaktapur district of Nepal. Dadhikot highlights changes in rights and access to surface water, while Jhaukhel illustrates problems of groundwater exploitation.

Vaidyanathan (1994) conducted a case study of different countries like Nepal, Sri Lanka, and Pakistan and stated that greater involvement and responsibility for users is imperative for realizing the full potential of irrigated agriculture. Pant (2008) used a case study of the Gambhiri Irrigation Project area in the Chittorgarh district of India.

In conclusion, the issues of irrigation conflict were the issues of poor maintenance, limited water availability, bureaucratic control, lack of farmer involvement in policymaking, mismanagement, water theft, and inequitable distribution.

2.2 Theoretical Review

In the theoretical section, the researcher reviewed four fundamental theories that are essential to this study. The study of natural resource conflict may be incomplete if it does not consider the context through the lenses of Hardin's The tragedy of the commons (Hardin, 1968) and Ostrom's common pool resource management (Ostrom, 1990). Although these two theories contradict each other, they remain pioneers in shaping research on natural resource management. The subordinate theories discussed in this section include the theory of co-management and Burton's human needs approach. Additionally, this section briefly addresses Lederach's conflict transformation theory and the theory of positions, interests, and needs, as well as Galtung's ABC triangle, those theories aid in analyzing the context from these theoretical perspectives.

The Tragedy of the Commons

The irrigation project management is an example of a common pool resource management. The feature of a common pool resource is it has more consumption, and its care is comparatively less because of the lack of accountability and responsiveness. Hardin (1968) proposed the theory of the tragedy of the commons. It explains that while

consuming the resource, an individual turns selfish and overexploits it. He theorized the need for external institutions for the protection of common resources.

Hardin (1968) cited an example of a pastureland. He assumed that if the herders are given authority to use the pastureland, they try to make maximum gain by increasing the number of grazing animals with the hope of increasing their benefits. It finally leads towards the problem of overgrazing and destroying the common pool resources. Ostrom (2008) explained that the tragedy of the commons arises as follows:

when it is difficult and costly to exclude potential users from common-pool resources that yield finite flows of benefits, as a result of which these resources will be exhausted by rational, utility-maximizing individuals rather than conserved for the benefit of all. (p.1)

Similarly, Spilikos (2019) described it as a situation in which all individuals with access to a shared resource act in their self-interest. It causes depletion of that resource. The conceptual foundation of this theory can be traced back even further to Aristotle (1998). He observed that “what is common to the greatest number has the least care bestowed upon it” (*Politics*, Book II, 1261b34). The theory of the tragedy of the commons is helpful to theorize the issues that exist in the KIP.

Common Pool Resource Management

Broadly, the issue of irrigation management and conflict dynamics in the KIP is associated with the management of common pool resources. The empirical studies paved the way to align the theory of the common pool resource management (CPR) as illustrated by (Ostrom, 2010). Ostrom emphasized the need of community ownership for sustainable resource management. This theory is benevolent to diagnose the context and provide some scholarly output. Supporting the theme of Ostrom’s CPR

management, Bergstrom and Randall (2010) also emphasized the need for self-governance and community accountability in the management of common-pool resources.

This study considered Hardin's tragedy of commons and Ostrom's CPR management theory. Ostrom's framework emerged as a response to Hardin's (1968) tragedy of the commons. It proposed that it is necessary to include community members and user groups for the management of common resources. The lack of self-governance may bring problems like ruin of resources and cases of mismanagement. Ostrom emphasized the need for collaboration between local users and public officials. According to Ostrom (1990, p. 30), a CPR is "a natural or human-induced resource system that is sufficiently large as to make it costly to exclude potential beneficiaries from obtaining benefits from its use." The implication behind extracting these theories is to maintain a balance between community and government and their equal participation for the protection of such resources. Hardin's theorized the necessity of a central body like government, whereas Ostrom's proposed the need for community accountability. There is parallel necessity of these two entities for the smooth functioning of such common pool resources. It brings the effective implementation of this project.

Building on the framework of common pool resource management, Burton's (1986) human needs approach is considered with the understanding that addressing and fulfilling basic human needs can help reduce potential conflicts. While common pool resource management theory emphasizes collective responsibility and cooperative governance for sustainable resource management, the human needs approach complements it by highlighting that the satisfaction of essential needs such as access to water and equitable participation can transform conflicts into constructive resolutions. Together, these perspectives provide a comprehensive lens for analyzing how both

resource management structures and human well-being interact in the context of the KIP.

Theory of Co-management

The theory of co-management provides a useful framework for linking irrigation management with conflict dynamics. It emphasizes shared responsibility between government institutions and local communities for the sustainable management of common pool resources. In this study, co-management is applied to analyze conflict and its resolution in the KIP.

Co-management involves the collaborative allocation and use of resources among multiple stakeholders, contributing to long-term sustainability (Armitage et al., 2009). It is defined as the sharing of power, authority, and responsibility between the state and local users (Plummer & Fitzgibbon, 2004). Similarly, Berkes (1994) and Carlsson and Berkes (2005) highlight its role in linking formal governance systems with local practices, including the integration of traditional knowledge. This approach underscores the importance of coordination between administrative institutions and user groups.

In contrast, adaptive management focuses on learning through practice and continuous adjustment. Stirzaker and Pittock (2014) describe it as an iterative process involving planning, implementation, monitoring, and learning. This perspective complements co-management by emphasizing flexibility and ongoing interaction among stakeholders.

The co-management framework is particularly relevant for this study. It promotes cooperation, information sharing, and joint decision-making between government and community actors. These elements are essential for reducing conflict and improving irrigation management. However, reliance on a single authority, either the state or the

community, can create challenges. This concern aligns with Hardin's (1968) tragedy of the commons, which highlights the risks of resource mismanagement. In contrast, CPR theory stresses collective responsibility and rule-based governance for sustainable use. Therefore, integrating co-management with insights from the tragedy of the commons and CPR theory provides a comprehensive basis for understanding conflict and promoting sustainable irrigation management in the KIP.

Burton's Human Needs Approach

This study assessed the conflict resolution practices in the KIP. In general conflict is induced due to the lack of basic needs fulfillment. Burton (1986), in the theory of human needs, pointed out the importance of basic needs fulfillment for the conflict resolution process. Needs are motivational forces that drive human behavior (Green et al., 2017) and can be categorized into safety, security, belonging, self-esteem, and self-actualization. It follows Maslow's hierarchy. Avruch and Mitchell (2013) argued that frustration with these basic human needs (BHNs) might lead to conflict or organized violence. It is focused on Burton's position that unmet BHNs bring serious conflicts. Fisher (1990) further noted that lack of resources is a serious issue affecting both humanity and individual well-being.

Apart from fulfillment of basic needs, this study reviewed the theory of position and interest. The primary aim is to resolve those conflicting issues and transform them into peace. Position, according to Davies and Harre (1990, p. 48; as cited in Peter & Appel, 1996, p. 121), was "the discursive process whereby selves are located in conversations as objectively and subjectively coherent participants in jointly produced story lines." Peter and Appel explained that position theory illustrates the denial tendency of people. It empowered people to refuse their places and origin. Provis (1996) added position as a key element in negotiation. Drawing on Fisher et al. (1991, pp. 511), positional

bargaining is described as a process in which parties “lock themselves into” fixed positions, resulting in a “contest of will” that obscures their underlying interests. Such circumstances might distort the decision-making process and divert attention.

Apart from the theory of needs and theory of position, Galtung’s conflict transformation theory shaped the structural and cultural conditions of the conflict. Galtung (1969) argued that peace is possible through the resolution of structural issues of conflict. Those structural issues were domination, negligence, irresponsiveness, and minimal accountability. His concept of the “violence triangle” (p. 168) helps explain the necessity of a structural arrangement for conflict resolution. It focuses on the transformation of root causes for the establishment of sustainable peace.

Similarly, Michell’s (1981) conflict mapping model diagnoses the conflicting issues in the KIP. It examines the actors, issues, and parties who relate to one another, tackles those issues, and clarifies structural and manifested domains of conflict. It makes the conflict resolution process easier. Apart from those theories, Fisher and Ury’s (1981) principled negotiation model points out the need for cooperation for the resolution of conflict. It is based on the principle of shared interests rather than rigid positions. It separates the problem by identifying mutual interest, generating options, and emphasizing fair decisions. It is helpful to support dialogue and dispute management for resolving the conflicts related to KIP.

Lederach’s transformational framework is a blueprint for the conflict resolution mechanism. It states the possibility of sustainable peace and cooperation. It is necessary for the peacebuilding process. It unfolds the social structures for the outbreak of existing inequalities. Lederach’s model (1997) is necessary to diagnose the problems in local communities. Those aspects like reconciliation, empowerment, participatory engagement, and cooperation are necessary for sustainable peace. These theories show

its relevancy in this study: conflict management is not just about handling immediate problems but about creating sustainable management systems for the prevention of conflict and disputes.

This study broadly cited four basic theories of conflict resolution. They were the tragedy of the commons, common pool resource management, the theory of co-management, and the human needs approach. Apart from these, theoretical models like principled negotiation, the Leaderarch theory of conflict transformation, and the theory of conflict mapping were subordinate to visualizing the cases. These theories are essential to give a scholarly shape and to analyze the findings and the context of the Khageri Irrigation Project.

2.3 Conceptual Review

Domains of Irrigation Management

Varpio et al. (2020) emphasized that a conceptual review is essential to justify the study and provide coherence as it links theories and research design. Such reviews help to identify, categorize, and describe key concepts relevant to the research and to illustrate the relationships among them (Rocco & Plakhotnik, 2009). This conceptual review is helpful to develop the appropriate research framework, research design, and methodology.

The review of irrigation management and conflict dynamics helps to conceptualize several domains of irrigation management, including institutional arrangements, bureaucratic governance, physical infrastructure, financial management, environmental considerations, and water users' associations (WUAs).

It highlights several issues contributing to irrigation conflicts. These include poor institutional management, resource deprivation, rent-seeking, corruption, hydraulic

constraints, tedious bureaucracy, exclusion of farmers from planning and policy-making, inadequate infrastructure, and weak WUAs management, there is a lack of consensus in decision-making, limited crop diversification, and the impact of climate change.

Similarly, it is important to assess various conflict resolution mechanisms in such irrigation projects. These mechanisms include decision-based problem-solving, allocation rules, mediation, arbitration, support from local government, prevention of rent-seeking and free-riding behaviors, and direct face-to-face discussions.

The domains of irrigation management cover various areas that are responsible for the arrangement of the irrigation project. The key domains of irrigation management have been broadly categorized under five major categories based on the empirical reviews. They are the formation of WUAs, institutional mechanisms, farmers' participation, environmental sustainability, and physical infrastructures.

Institutional Arrangement System

From the reviews, it is identified that the institutional arrangement system is the most important domain of irrigation management. Several rules, regulations, laws, bylaws, and reports come under the example of an institutional arrangement system. It concerns how an institution facilitates cooperation and coordination in irrigation governance. It focuses on specific institutional mechanisms such as rules of provision, communication, decision-making, and governance that affect collective action (Wang & Chen, 2021).

According to Parajuli et al. (2024), the institutional arrangement system represents sets of working rules and social norms that are necessary to regulate human actions and behaviors. It facilitates coordination and shaped conduct within irrigation systems.

Ostrom (1992; in Wang & Chai, 2021, p. 551) defined irrigation institutions as the “set of working rules for supplying and using irrigation water in a particular location.” These institutions are helpful to establish the legal and organizational framework for the effective operation of irrigation systems. For example, Ostrom added, they are responsible for enforcing rules, managing administrative procedures, and maintaining accountability in the use of irrigation resources. Supporting the concept of Ostrom, Nikku (2002) explained institutions as socially embedded systems of norms and practices. They can influence behavior and decision-making processes.

Michael (2008), unlike others, emphasized that the institutional approach to irrigation management is necessary for strong governmental capacity to plan and control irrigation systems effectively. It addresses issues such as waterlogging and salinity. Similarly, Small (1985) classified the institutional functioning of irrigation management as the arrangement of work divisions as per the authority and command. Tandukar and Shrestha (2025) threatened weak government enforcement may find it difficult to collect fees, manage user training, and penalize. They added that improper functioning in those aspects can undermine irrigation management efficiency.

Chai and Schoon (2016), among others, advocated for decentralization and a coordination mechanism between government and local actors. These are important components that come under an institutional arrangement. They revised Tang’s (1992) framework and stated the role of institutional incentives and coordination is necessary for joint funding, administrative oversight, and participatory management. Tang proposed operational rules under the institutional dimension. They are beneficial for the proper management of irrigation projects. The operational rules cover particular boundaries, allocation policy, penalties, collective-choice arrangements, conflict management, and rule formulation. Burton (2010) differentiates political, legal, and

organizational frameworks as essential under the institutional dimension of irrigation management.

In a similar context, Ozerol (2013) warned that the institution, if found ineffective, may lead to excessive water use, inadequate access, weak monitoring policy, and farmers' exclusion from planning. Ostrom (1992; as cited in Mabry, 1996) further added design principles that help institutions sustain equity and efficiency in resource management.

Suhardiman (2016) observed that the institutional arrangement system faces unsatisfactory performance. This is due to institutional corruption and delayed maintenance. It leads to infrastructure deterioration and unreliable water delivery. Kelly (1983) also noted that institutions play a significant role in infrastructure construction and water distribution. Pereira et al. (2002) highlighted the need for effective institutions. It must design adaptive policies and practices to handle water shortages and allocation challenges.

Chai and Zeng (2018) cited the case study of Guangdong, China, to show the necessity of rules and regulations for the proper functioning of the irrigation project. They highlighted the need for social capital. It comprises shared norms, rules, and expectations. Institutions that foster such social capital enhance collaboration and trust among stakeholders. North (1990) and Ostrom (1998; as cited in Ozerol, 2013) added the need for institutional rules to ensure accountability and cooperation. Menon et al. (2005), unlike others, stated the need for institutional support for effective administrative efficiency.

Reviews show the institutional arrangement system is one of the crucial domains of irrigation management. Institutional frameworks with strong rules and regulations are helpful for the effective irrigation management system and its performance. It is

necessary to eradicate corruption, promote efficiency, and increase social capital. It ensures the best bureaucratic functioning, rule implementation, and sustainable water governance.

Water Users' Associations (WUAs)

From prior reviews related to the domain of irrigation management, WUA. It has been marked as the primary executive domain responsible for implementing and enforcing rules in irrigated areas (Kattel, 2006). Similarly, Pradhan (1989) highlighted some of the tasks of WUAs. It includes water acquisition, allocation, distribution, conflict resolution, and resources. Pradhan added that WUAs are formed through the beneficiary farmers. They have the right to operate and manage irrigation systems. Sampath (1992) added that they have their own responsibilities, including collecting water fees and dues, coordinating between farmers and irrigation authorities, and ensuring cooperation among users.

Both Kattel and Pradhan stated the general function of the WUAs, unlike Regmi (2007), who explained WUAs are organized for regular and emergency functioning of the irrigation project. He added regular activities include de-silting and canal maintenance, while emergency maintenance involves washed-out canal maintenance and settling out disputes that are caused due to unnoticed water diversions. WUAs form executive officers, led by a chairperson. It is the responsibility of the chairperson to mobilize resources, supervise system operations, maintain records, and manage conflicts.

In a similar context, the function of WUAs as stated by different scholars, for instance, Schoengold and Zilberman (2007) highlighted the WUAs play a crucial role for managing and distributing water supplies among farmers. Pradhan and Bandaragoda (1998) emphasized the role of WUAs in sustainable irrigated agriculture. They added

the need for legal authority and institutional support to strengthen those WUAs. The functions of WUAs are to maintain water infrastructure, mobilize local resources, and implement management activities effectively. In a similar context, Pant (2008) highlighted the need for leadership for the effective functioning of the WUAs. Besides, it is necessary to provide periodic training for their result-oriented performance through modern irrigation practice systems, management strategies, and familiarization of irrigation technology. Easter (2000) pointed out that WUAs should function effectively by ensuring water delivery and service to the beneficiary farmers.

Ozerol (2013) added that the functioning of WUAs is related to raising awareness, mobilizing capital, educating farmers, distributing water, collecting fees, and enforcing compliance. Along with this, effective information circulation and decision-making within WUAs are key components of irrigation management (Getirana & Malta, 2010).

Reviews have shown that WUAs are a crucial domain of irrigation management. They facilitate cooperation between farmers and authorities, engage in maintenance and water distribution activities, manage conflicts, and mobilize local resources. Moreover, they contribute to the sustainability and efficiency of irrigation systems.

The Level of Farmer's Participation

Based on the empirical reviews, the eagerness of farmers' participation is noticed as an important domain of irrigation management. It signifies the outcome of any irrigation project. It promotes collective learning and strengthens unity, ownership, and incorporation of local knowledge by implementing necessary rules and regulations (Ozerol, 2013; Ostrom, 1990; Ostrom et al., 1994; Baland & Platteau, 1996; Meizen-Dick & Bakker, 1999). In addition, it ensures that the full function of an irrigation project is through the adequate participation of farmers while managing and functioning of the irrigation project.

Irrigation management in the Republic of South Korea implemented an innovative program to operate and maintain new irrigation projects effectively (Easter & Welsch, 1983; ADB & IIMI, 1986; as cited in Sampath, 1992). Similarly, Thapa (2002) added the importance of training to the farmers and WUA members before project implementation. The adequate participation of farmers helps to develop institutional capacity. It further brings farmers to fully understand their roles, responsibilities, and system management after the project is handed over. Menon et al. (2006) cited the case of the village panchayat in Kerala. They stated that the success of irrigation projects depended on the participation of farmers. Projects performed better when water users engaged actively and interacted closely with one another.

Suhardiman (2016) studied the issue of irrigation management in Indonesia. He found that local organizations play a significant role in irrigation management. He warned of the need for accountable farmers to ensure the sustainability of irrigation infrastructure. Lam and Chiu (2016) emphasized that farmers are the strong pillar for good management of irrigation. It is necessary to give them adequate roles and responsibilities to enhance system performance.

From these reviews, it is concluded that the eagerness of farmers' participation is essential for effective irrigation management. It fosters a sense of ownership by enabling local knowledge integration and ensuring proper operation, maintenance, and resource management. The maximum engagement and interaction among farmers are key determinants of the success and sustainability of irrigation projects.

Environmental Concerns

Environmental protection is one of the important domains of irrigation management. Easter (2000) identified environmental issues as a key domain of irrigation management. He drew a case in Orissa and emphasized that environmental issues were

related to proper drainage, salinity, water-logging, and resettlement programs for communities displaced by reservoir construction. Those issues, as explained by Easter, are necessary to solve the equal and equitable functioning of any irrigation project. Irrigation project failure can sometimes be observed due to adverse environmental outcomes, including soil and water degradation, pollution, and ecosystem imbalance (Ozerol, 2013). Thus, it is necessary to maintain the environment and its protection to mitigate those negative impacts, incorporating conservation, erosion control, and flood and landslide management.

Dahal et al. (2023) use a delphi survey to define environmental issues in agricultural water management. Their findings are concerned about water quality and availability, the protection of ecosystems, and preventing over-exploitation of water resources. Similarly, Quinn (2020) added environmental concern as central to irrigation governance. He cited the case of the San Joaquin River Basin and identified major environmental issues, including salinity, drainage, water quality impairments, and ecological destruction.

Velasco-Munoz et al. (2019) reviewed literature on sustainable irrigation and identified environmental impact, conservation of natural resources, and water-use efficiency as an environmental dimension of irrigation management. FAO (n.d.) added that there are various environmental challenges in the irrigation project. It includes inefficient water use, salinization, deforestation, and waterlogging. In this context, Pandey et al. (2023) stressed the need to incorporate environmental sustainability within irrigation governance. It is essential to ensure long-term productivity, resilience, and ecological balance. Therefore, environmental protection is a crucial thing that connects technical, social, and institutional dimensions of irrigation management.

Physical Infrastructures

Reviews identified physical infrastructures as one of the integral domains of the irrigation management system. The management depends upon the existing condition of the physical infrastructure of any irrigation project. Pradhan (1989) explained the physical infrastructure of an irrigation system, including intake structures, canals, cross-drainage works, the size of the command area, farm types, water availability, and methods of water delivery.

Kolavalli and Brewer (1999; in Wang & Chen, 2021, p. 330) emphasized that “the physical characteristics of irrigation infrastructure, whether canal, lift, or tank systems, are closely linked to appropriate rules and property institutions.” Unlike Lam and Ostrom (2010), who in their study of irrigation systems in Nepal stated that investment in physical infrastructure alone may not guarantee effective irrigation performance. It is necessary to keep structural elements such as canals, sluice gates, headworks, and dams in a working condition. Besides, it needs good maintenance, regular monitoring, and effective operation.

Burton (2010) noted that physical infrastructure encompasses canals, drains, roads, and field layouts. The proper condition of those infrastructures can only ensure the hydraulic efficiency of irrigation systems. Small (1985) explained the physical infrastructure in terms of water engineering. He categorized the function of the physical domain of irrigation management. It encompasses the movement, storage, maintenance, and utilization of materials and structures. Easter (2000) identified the function of irrigation infrastructure for operation and linked physical performance with governance and resource allocation.

Physical infrastructure, according to Easter, is the backbone of irrigation management. It identifies the accessibility, distribution, and reliability of water delivery systems. Moreover, it is necessary for the functioning intakes, canals, and cross-drainage networks. In addition, along with enhancing agricultural productivity, it reduces the likelihood of disputes over water access and makes the physical domain integral to sustainable irrigation governance.

Issues of Conflict in the Irrigation Project

This review categorized the major causes of conflict in irrigation projects. One is the weaknesses in institutional arrangements and governance mechanisms. It leads to poor coordination among stakeholders. There is lack of accountability and ineffective management of water user associations. Hydraulic constraints such as limited canal capacity and seepage create inequality in water access among farmers. It brings conflict in the irrigation project. The deterioration of irrigation infrastructure, for example, damaged canals, siltation, and lack of maintenance disrupt the equitable flow of water. It creates various problems related to water adequacy. This is also the cause of irrigation conflict.

Similarly, inadequate systems of water sharing, allocation, and distribution generate disputes between upstream and downstream users. These issues of water distribution, allocation, and rotation also undermine the sustainability and cooperative management of irrigation systems. It has become the cause of water conflict. Some of the issues of conflict as pointed out from the reviews are categorized and explained as follows.

Low Degree of Institutional Arrangements

Weak institutional practices bring less performance and functioning. In the irrigation project, the reviews have shown that a low degree of institutional arrangement system

leads towards ineffective functioning of the irrigation project. Merry (1998) cited a reference to Vermillion's irrigation management in Asia. She explained that the most common problem in Asian irrigation systems is a lack of clearly defined water rights. There is ambiguity between authorities and beneficiary farmers in their roles and work division. There is a trend of users' reluctance to follow set rules and regulations. It ultimately leads towards conflict.

Similarly, Menon et al. (2006) analyzed irrigation management in Kerala, India. They highlighted that poorly maintained irrigation infrastructure had become a major cause of conflict. Farmers were excluded from policymaking, and there was no proper implementation of a water rotation system. Merry et al. (1988) reviewed irrigation management in Sri Lanka and reported that there is inadequate control, cross-regulation issues, and irregularities in water delivery timing.

In Gujarat, Parthasarathy (2002) observed the need for public investment in irrigation, which was declining. It is accompanied by problems related to water charges and the collection of operational and management funds. Menon et al. (2005) also noted that in the Chalakudy River system, bureaucratic control over irrigation could not fulfill the farmers' needs. It resulted in mismanagement in distribution, weak policy implementation, and water theft.

Cambaza et al. (2020) reviewed irrigation management in Sub-Saharan Africa and found that in Malawi and Zimbabwe due to weak institutional capacity, the functioning of irrigation projects is not satisfactory. Mosse (1999) brought the context of village-level institutions managing tank irrigation systems in Tamil Nadu, India. He found that many tanks had fallen into silted-up, encroached-upon, and damaged weirs. They were not in working condition.

In Nepal, irrigation conflict, as shown by the study, is caused due to weak physical infrastructures. Sharma and Shrestha (1989) highlighted that in the Handetar irrigation system of Nepal, insufficient and untimely release of maintenance budgets caused conflict in the irrigation system management. Shrestha (1987), in a case study of the Arugat Vishal Nagar pipe irrigation project, reported challenges such as political interference, inadequate training for farmers, poor wage structures, and weak resource management, bringing problems for the project's improvement. Regmi (2007) argued that unplanned development policies, construction of new canals without proper coordination, and the low prioritization of existing irrigation systems are some of the causative factors of irrigation conflict.

Hydraulic Constraints

The scarcity of water is one of the major causes of irrigation conflict. Getirana and Malta (2010) claimed that irrigation conflicts emerge from physical limitations and weak physical infrastructures. It creates a problem of waterlogging and seepage in the canal systems. Similarly, Bijani and Hayati (2015; as cited in Gholizadeh & Niknami, 2020) stated that agricultural water conflicts commonly arise from water scarcity, drought, and inadequate water management practices. Menon et al. (2005) further noted that the limited availability of water to farmers is another cause of irrigation conflict.

Uphoff and Wijayaratna (2000) conducted the study of the Gal Oya irrigation scheme in Sri Lanka. They pointed out that chronic water shortages were a key source of conflict among farmers. Similarly, Goonesekera (1985; as cited in Merry et al., 1988) highlighted that insufficient water supplies in the Kaudulla irrigation scheme in Sri Lanka led to conflict among users. Haftendorn (2000) supported Goonesekera and stated that water shortages induce conflict in irrigation systems.

Getirana and Malta (2010) conducted another case study in Rio de Janeiro State, southeastern Brazil. They found that scarcity of water in canals resulted in water unavailability, and it triggered conflicts among users. Podimata and Yannopoulos (2015) emphasized that as water demand for irrigation continues to rise, conflict becomes almost inevitable due to its shortage. They added that irrigation conflicts can occur at multiple levels, for example, in local, interstate, or even international ones. They cited the case of irrigation conflict between the ancient Mesopotamian cities of Umma and Lagash over the diversion of water from the Tigris and Euphrates Rivers.

In the Nepalese context, Poudel (2000) studied irrigation dispute management in the hill regions and found that disputes typically occur when limited water resources need to serve large agricultural areas. He noted that water-related conflicts are caused by natural disasters, unplanned development policies, poor operation and management of irrigation systems, and the construction of new canals without adequate planning.

Similarly, Devkota et al. (2018) conducted case studies in Dhulikhel and Bidur, two major hilly towns of Nepal. They found that rapid urbanization and declining water had fueled competition and conflict over water resources. The Irrigation Management Center (1989) reported the case of the Hardinath Irrigation Project and concluded that unreliable and inequitable water supply were the key factors that caused dispute among farmers.

Lack of Water Allocation, Sharing, and Distribution

Reviews have shown that inequitable water distribution among users is a major cause of conflict in irrigation projects. In Iran, Bijani and Hayati (2015; as cited in Gholizadeh & Niknami, 2020) stated the main source of irrigation conflict was the unequal distribution of water between upstream and downstream farmers. They added that apart

from inequitable water distribution, other contributing factors to water conflict included water scarcity, pollution, and weak governance and poor participation.

Menon et al. (2005) illustrated some of the challenges in the Asian context. They cited the case of irrigation systems of Kerala, India, and observed that the absence of proper water rotation systems and frequent incidents of water theft had induced conflicts among farmers. Likewise, Ozerol (2013), in his study of irrigation management in the Harran Plain of Turkey, attributed conflicts to the lack of clearly defined water rights. He added that the exclusion of farmers from planning and ineffective monitoring and evaluation mechanisms were subordinate to the cause of irrigation conflict.

Parthasarathy (2000) emphasized that most irrigation systems suffer from chronic problems in the distribution and effective use of water. It also generates disputes among users. Nikku (2002) supported Parthasarathy and stated that water accessibility is unusual among the head-end and tail-end farmers. It is one of the causes that creates inequality and tension within irrigation systems. Phelps (2007) argued the same and stated conflicts over irrigation are due to not having equitable sharing mechanisms.

Kreamer (2013) recalled the incident of a severe irrigation conflict case in India's Sriganganagar district, near the Pakistan border, where, in October and November 2004, four people were killed and thirty injured during a protest over the allotment of water from the Indira Gandhi Canal. Podimata and Yannopoulos (2015) added that rising water demand for irrigation has escalated conflicts at local, interstate, and even international levels due to its serious scarcity and inappropriate distribution. They cited the first historically recorded irrigation conflict between the ancient cities of Umma and Lagash in Mesopotamia over water diversion from the Tigris and Euphrates rivers.

Azizi Khalkeili and Zamani (2009) conducted a study on the Doroodzan Dam irrigation

network in Fars Province in Iran. They concluded that unequal water distribution among farmers was a central cause of conflict within the project. Similarly, Brewer et al. (1997; as cited in Hussain & Hanjra, 2004) discussed tank irrigation systems in Tamil Nadu, India, and noted that rigid water allocation rules imposed by government agencies and the economic disadvantages faced by tail-end farmers induced tensions and disputes.

So far as the irrigation conflict in Nepal is concerned, Kattel (2006) claimed that inequitable water delivery between head-end and tail-end farmers led to conflict in the Geya Danda Irrigation System in Illam District. IMC (1989) reported that in the Hardinath River Irrigation Project, conflicts were primarily caused due to a lack of cooperation in water distribution. The downstream farmers complained about unfair diversion and excessive use by upstream users. Sharma and Shrestha (1989) added that in the Handetar irrigation system, water-use conflict mainly arose due to improper water distribution. Pokharel (2007), in his study of the Harpan Khola watershed in Phewa Lake, found that disputes over irrigation were due to the unequal distribution of water between head-end and tail-end farmers.

Deterioration of Irrigation Infrastructure

The deterioration of irrigation infrastructure is another major factor contributing to conflict in irrigation projects. Easter (2000) pointed out that irrigation systems in Asia face multiple challenges like inadequate maintenance of infrastructure, poor irrigation services, and users' reluctance to pay water fees. These are the inducing factors of conflict. These issues lead to the degradation of irrigation structures and generate conflicts among water users. Similarly, Menon et al. (2005) noted that in Kerala, India, irrigation conflicts emerged due to poorly maintained infrastructure. It resulted in reduced water availability for farmers and weak irrigation functioning.

Goonesekera (1985; as cited in Merry et al., 1988) cited the case of the Kaudulla

irrigation scheme in Sri Lanka. It identified the deterioration of physical systems, design flaws, and inadequate maintenance caused by insufficient funding were the main sources of irrigation conflict. Stirzaker and Pittock (2014) pointed out similar issues in the Chokwe Irrigation System in southern Mozambique. The issues like leakage, evaporation, waterlogging, and salinity were identified as a trigger factor of conflict among water users.

Some of the triggering factors of irrigation conflict were the poor canal conditions, seepage, and the accumulation of mud, silt, and trash within canals. Talati and Pandey (2007) examined the Sardar Sarovar Irrigation Project. It is the world's largest irrigation scheme in Gujarat, India. Talati and Pandey highlighted that poor canal construction, inappropriate design, and the use of substandard materials led to frequent breakages and technical faults, which generated tensions and conflict.

Jaglan and Qureshi (1996) documented evidence of rising water tables and widespread irrigation-induced alkalinity in the Indira Gandhi Canal command area. Soil salinity posed significant constraints on agricultural productivity. It threatens farmers' livelihoods and contributes to conflict. In Tamil Nadu, Mosse (1999) noted that the traditional tank irrigation system was declining due to physical constraint and siltation of tanks. It limited water storage capacity and became a source of dispute among users.

Irrigation conflict denotes a state of mismanagement within irrigation projects. It arises from a constraint caused by institutional, hydraulic, social, and infrastructural factors. Conflicts emerged due to hydraulic constraints in the canal system. It leads to chronic water crises that are difficult to mitigate because of its excessive demand. There is a lack of social and cultural cooperation among water users. It further intensifies these disputes. Moreover, the absence of unity and coordination among farmers and disharmony among inter-community groups act as inducing factors in the escalation of irrigation conflicts.

These reviews revealed that there is a need for clear water rights and well-defined roles and responsibilities among all the stakeholders, like the beneficiary farmers and authorized members, to promote harmony and effective management within irrigation systems. The ambiguous institutional roles create confusion. It further leads to conflict. When users are reluctant to pay water fees, it escalates financial constraints and hinders maintenance and operation. Finally, it aggravates tensions among stakeholders.

Irrigation Conflict Resolution

The easier aspect of this study is to probe the causes of irrigation conflict. As per the reviews, conflicts in irrigation projects often arise due to hydraulic constraints, weak institutional arrangements, improper water distribution, and the deterioration of irrigation infrastructure. Addressing these issues is crucial for conflict resolution, as this is one of the major objectives of this research.

Based on the reviewed literature, conflict in irrigation systems can be resolved through several approaches. First, there is the necessity of development and maintenance of proper physical infrastructure. It ensures the efficient delivery of water. The provision of accountable stakeholders, including water user associations (WUAs), local authorities, and farmers, fosters transparency and trust within the system. It indirectly helps to deescalate irrigation conflict. There is also the need for an equitable and systematic water rotation mechanism that shall guarantee fairness in water distribution among the riparian. In addition, promoting collaboration and dialogue helps to resolve irrigation conflict. It encourages participatory decision-making and constructive communication among community members. It is equally helpful to transform disputes into cooperative solutions.

Proper Physical Infrastructures

One of the ways that helps to deescalate conflict in the irrigation project is through effective management practices. It covers the proper channel clearing and the removal of silt and weeds. For instance, in the Gal Oya irrigation project, community-based maintenance activities were found effective in reducing disputes and ensuring a smooth water distribution policy (Uphoff & Wijayarathne, 2000).

Haftendorn (2000) cited a case of transboundary water conflict between Slovakia and Hungary. Slovakia constructed a dam project by building a side channel that diverted the Danube River from Hungarian territory and began generating electricity at Gabčíkovo in 1992. Hungary claimed that the diversion caused severe environmental damage. The bilateral negotiations failed, and both governments brought the dispute before the International Court of Justice. It illustrates how unresolved water-related conflicts can escalate to international legal arenas. Similarly, Phelps (2007) proposed a model agreement for the shared use of transboundary water resources. It emphasized four key principles for conflict resolution: negotiation, integrated water management, overcoming obstacles, and flexibility in water sharing. These models can help to resolve the would-be conflict in the irrigation project.

The working condition of physical infrastructure and its proper functioning help to deescalate most of the irrigation conflict. Effective water management systems and physical infrastructure improvements such as channel clearing by voluntary groups and the removal of silt and weeds enhanced the well functionality of the system. Similarly, the Malebagar irrigation system in Tanahu, Nepal, highlighted the importance of an operational management system for resolving potential conflicts (IMC, 1989). Operational levels include the proper arrangement, maintenance, and functioning of physical infrastructures. Kattel (2006) further assessed that sustainable infrastructure,

including the repair of water leakage and other maintenance activities, is remarkable for resolving possible conflicts.

Accountability of the Stakeholders

Among several conflict resolution mechanisms, stakeholders' accountability towards their work plays a significant role in the reduction of conflict. In this context, Easter (2000) explained that water management problems can be effectively addressed if there is the establishment of appropriate institutions and organizations. Such institutions help to better understand and manage water-related issues. He cited examples like the International Water Management Institute (IWMI) and the International Network on Participatory Irrigation Management (INPIM). Both systems emphasize user participation as an integral form for the resolution of irrigation-related conflict.

Kattel (2006) explained that there are several approaches to resolving irrigation conflicts. It includes the implementation of a proper water rotation system, the provision of water security guards, and resource mobility. Kattel thoroughly explained the resolution mechanism of the Geya Dada irrigation project. According to him, the *pani pale* (water guard) is responsible for delivering notices of general assembly meetings to all members. He imposes fines on those who fail to attend. Most conflicts, however, are resolved informally at the community level. Sometimes, elderly people often act as mediators, and they are involved in community conflict management. Upreti (2021) highlighted that sometimes the role of women in such processes brings pressure on male family members to achieve compromises. It is understood that accountable and active stakeholders in irrigation system management play a central role in conflict resolution.

Similarly, like that of Easter (2000), Fernea (1963) emphasized that irrigation conflict often arises when irrigation project management stakeholders lack social and cultural cooperation, coordination, and unity. According to him, such conflicts can be resolved when water users demonstrate accountability and shared responsibility and cooperation and coordination among the users. Similarly, Fisher et al. (2011) stated that conflict resolution is possible through collaborative dialogue and problem-solving skills. It helps to achieve mutually acceptable agreements.

Michel (2020) stressed the importance of cooperation in the management of shared water resources. He argued that conflicts escalate when certain groups are deprived of their basic needs and rights. Therefore, irrigation projects must operate with equality and equity. Neglecting any group can escalate conflict and social division. Michel added that water scarcity can lead to conflicts. It weakens users' participation to dip their toes in the water challenges effectively. Similarly, Lewis (1976) identified several fundamental tools for conflict resolution. It includes avoidance, smoothing, forcing, bargaining, confrontation, and problem-solving. These approaches are relevant for managing disputes within irrigation systems.

Third-Party Intervention

In any conflict-handling process, the presence of a third party marks a significant difference in values and roles. In this study, the significance of third parties can help to manage or resolve the conflict. Ternstrom (2002) cited the case of the Shivapuri Martal Kulo and noted that existing conflicts related to labor contributions were resolved through the presence of third-party intervention. In this case, the Chief District Officer (CDO) acted as a mediator to settle the dispute among the concerned parties.

Ostrom and Gardner (1993) provide an example from the Marpha farmer-managed irrigation system in Mustang, Nepal. There exist clearly defined rules that help to prevent and manage conflicts. Water distribution follows a structured rotational mechanism. It was based on cropping patterns. The head-end farmers receive priority during one crop season while tail-end farmers are prioritized in another. This alternating arrangement helps to maintain equity and reduces conflict among users.

Similarly, in the Yampa Phant irrigation system, water distribution is based on alternating days allocated to the head-end farmers. On even days to the tail-end farmers and on odd days to the head farmers of the season. Canal maintenance responsibilities are also shared. The head-end farmers maintain the canal for one period, and the tail-end farmers maintain it for an alternative but equal period (Ostrom & Gardner, 1993).

Conflict resolution mechanisms involve organizational interventions. It includes organizing general assembly meetings, implementing a fine system, and negotiation and talking among the disputant farmers. Third-party mediation is effective in resolving disputes. As cited in the Geya Danda irrigation project, elderly community members acted as mediators. They further needed skills through practice for negotiation. The IMC (1989) highlighted the need for proper canal lining in the Hardinath irrigation project to address potential conflicts. Similarly, Menon et al. (2005) referenced irrigation conflicts in Kerala, India, noted that poorly maintained infrastructure was a key constraint, and proper maintenance facilitated conflict resolution.

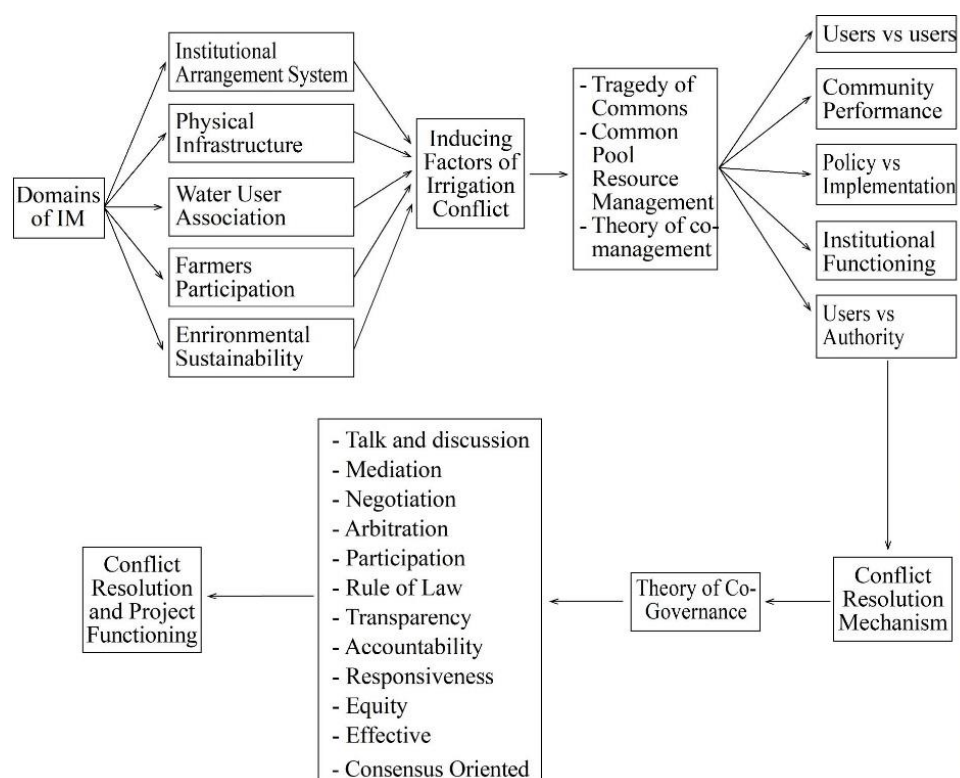
This review conceptualized the need to address the structural causes of conflict. The structural model of conflict resolution considers the characteristics of conflicting parties. It reflects their internal structuring or personalities and the context in which they interact (Thomas, 1976). Cooperation and competition among stakeholders play a significant role in the resolution of conflict. It depends on the nature, attitudes, and behaviors of the parties involved.

Deutsch (1973) explained that positive attributes among parties promote cooperation, while negative one foster competition. In irrigation projects, cooperation among farmers during canal repair and maintenance enhances project outcomes. Unlike competitive behavior, it undermines system performance. In irrigation conflicts, resolution is achieved through conflict management committees supported by government-employed irrigation experts and local peasant associations (Stanbury & Lynott, 1992). This combination of structural, institutional, and community-based strategies provides a constructive approach to mitigating irrigation-related disputes.

2.2 Conceptual and Theoretical Framework

Figure 2.1

Conceptual and Theoretical Framework of the Study



Source: Developed by the Researcher based on the Literature Review.

The conceptual and theoretical framework of this study illustrates the relationship between irrigation management practices, the emergence of conflicts, and the mechanisms used to resolve such conflicts. Irrigation systems are not limited to the technical arrangements for delivering water to agricultural fields. They represent complex socio-institutional systems where multiple stakeholders interact within a shared resource environment. The framework connects the domains of irrigation management, the factors that generate conflicts, the types of conflicts, and the mechanisms through which these conflicts are resolved for the effective project functioning.

The first element of the framework focuses on the domains of irrigation management. It represents the structural and functional components that influence the performance of irrigation projects. One of the primary domains is the institutional arrangement system. Institutional arrangements include the rules, norms, policies, and organizational structures that regulate water allocation and management within irrigation systems. Effective institutional arrangements provide clear guidelines regarding responsibilities, water distribution procedures, and decision-making processes. When institutions function transparently and fairly, they encourage cooperation among water users. Weak institutional arrangements may create ambiguity in roles and responsibilities that can lead to dissatisfaction and disputes among stakeholders.

Another significant domain is physical infrastructure, which includes canals, diversion structures, headworks, and other technical facilities that enable the distribution of irrigation water. The efficiency and reliability of irrigation infrastructure determine effectiveness within the command area and its water flow. Poorly maintained or technically inadequate infrastructure may disrupt water distribution. It may intensify competition among farmers and increase the likelihood of conflicts.

The water users' association (WUA) is another domain in irrigation governance. WUAs are community-based organizations. They are responsible for organizing water allocation, maintaining irrigation structures, and facilitating communication among users. The effectiveness of WUAs depends on accountability, transparency, and inclusive decision-making. When these associations fail to function properly, disputes related to water distribution and institutional legitimacy may arise.

Similarly, farmers' participation is a vital factor for the sustainable management of irrigation systems. Active involvement of farmers in planning, management, and maintenance activities strengthens collective responsibility and enhances the effectiveness of irrigation institutions. When participation is limited or when certain groups are excluded from decision-making processes, tensions and dissatisfaction may develop within the community.

Another important domain is environmental concern, which emphasizes the responsible and balanced use of water resources. Irrigation systems operate within ecological constraints, and excessive extraction or inefficient water use may lead to environmental degradation. When water resources become scarce, competition among users tends to intensify, which may further contribute to conflicts.

The interaction among these domains may generate conditions that lead to irrigation-related conflicts. Two theoretical perspectives provide useful insights into this process. One is the tragedy of commons and common pool resource management. The concept of the tragedy of the commons explains how excessive individual interest and their immediate benefits ruin the natural resources and impact the collective benefit. In irrigation systems water is treated to open natural resources, which bear the common tragedy of misuse and degradation.

In contrast, common pool resource management stated the need for local participation or community monitoring for the protection of such common pool resources. Since water is the common resource, its protection is possible through community-shared rules, clear water use policies, water allocation, distribution, and monitoring practices. These theoretical perspectives help explain the dynamics of irrigation conflicts. Weak governance structures and lack of cooperation may intensify competition for water resources, whereas effective collective management can promote equitable distribution and reduce tensions among users. The framework further identifies several forms of conflicts that may occur within irrigation projects.

One common type is user-to-user conflict. It occurs when farmers compete with each other over water access, allocation, or distribution. This type of conflict is particularly common between upstream and downstream users. Another form of conflict relates to community performance. The form of disagreement arises regarding the functioning of irrigation institutions. Such conflicts may involve disputes over maintenance, financial management, and the distribution of responsibilities among members.

Conflicts may also emerge in relation to policy implementation. Government policies and irrigation regulations may sometimes be understood as incompatible with each other. Local people deny accepting those existing rules and regulations. When policies do not align with local realities, it may escalate conflict. Similarly, institutional functioning can become a source of conflict when irrigation organizations fail to operate effectively. Similarly, conflict escalates when actors are perceived as biased or inefficient.

Another important category is users versus authority conflict. It occurs when irrigation users disagree with government agencies or project authorities. Generally, disagreement is observed in water allocation, infrastructure management, or policy

enforcement. In order to address these conflicts and maintain effective irrigation management, various conflict resolution mechanisms are employed. The most basic mechanism is talk and discussion, which involves open dialogue among stakeholders. Through communication and mutual understanding, conflicting parties can often identify solutions that satisfy their respective interests.

Mediation represents another approach, where a neutral third party facilitates communication between disputing groups. The mediator helps clarify misunderstandings and encourages compromise. Negotiation is a structured process in which stakeholders directly discuss their concerns and attempt to reach a mutually acceptable agreement. Negotiation emphasizes cooperation and the recognition of shared interests among participants. Sometimes, conflicts may be resolved through arbitration, where an external authority evaluates the dispute and provides a binding decision.

Arbitration can be particularly useful when conflicts become highly contentious. The conflict resolution process within irrigation systems can also be understood through the concepts of co-management and co-governance (Ansell & Gash, 2007). The co-management approach emphasizes shared responsibility between local communities and government institutions in the management of natural resources. This approach encourages joint decision-making, shared authority, and collaboration between different stakeholders.

Similarly, the co-governance approach highlights the importance of participatory governance in which multiple actors, including local users, institutions, and state agencies, collectively contribute to decision-making processes. Through such collaborative arrangements, stakeholders can address conflicts more effectively and strengthen institutional relationships (Ansell & Gash, 2007).

The final element of the framework demonstrates that effective conflict resolution contributes to the improved functioning of irrigation projects. When disputes are addressed through dialogue, negotiation, and collaborative governance mechanisms, the irrigation system becomes more efficient, equitable, and sustainable. Successful conflict management strengthens trust among stakeholders, improves institutional performance, and promotes responsible use of water resources.

Besides, in irrigation governance, certain key attributes help minimize and resolve conflicts among water users. Participation ensures that stakeholders are involved in decision-making. It fosters cooperation and shared ownership. The rule of law provides clear and consistently enforced regulations for water use, reducing disputes. Equity and equality promote fair and just distribution of water resources. It addresses both equal rights and varying needs. Transparency ensures openness in decisions and information sharing. It builds trust among users. Responsibility emphasizes the duty of institutions and individuals to manage irrigation systems effectively. Accountability ensures that actions are answerable and that mechanisms exist to address grievances. These attributes are helpful for the effective irrigation management and descalation practice of conflict.

In a nutshell, the conceptual framework highlights that conflicts within irrigation systems are closely linked to governance arrangements, institutional effectiveness, and the collective behavior of resource users. Understanding these relationships provides valuable insights into the causes of irrigation conflicts and the strategies that can be adopted to resolve them and ensure sustainable water management.

2.3 Research Gap

Many studies related to irrigation management focus mostly on technical, institutional, or socio-economic domains, but conflict is considered as a subordinate or byproduct

rather than a central entity (Thapa & Scott, 2019). Existing literature doesn't maintain systematic frameworks that link irrigation management practices with conflict dynamics. It has been studied relating to different issues of irrigation management, barely touching upon the issues of conflict and its resolution practices. Empirical studies have raised the issue of irrigation conflict in relation to rule enforcement, participation, and infrastructural weaknesses, but those issues are often ignored and generalized (Pradhan, 1989; as cited in Ostrom, 1992). This highlights the need for detailed studies that can address everyday conflicts and the mechanisms used for their resolution in irrigation sector management.

Previous research emphasizes management efficiency and governance that gives limited attention to how conflicts are negotiated, mediated, or institutionalized within irrigation systems. Conflict resolution mechanisms are still a new topic of study. The domains of irrigation, like technical, institutional, and socio-economic aspects, are documented, studied, viewed, and reviewed, yet the concept of conflict is not considered as a serious issue. Therefore, there is a need to integrate conflict into irrigation management frameworks, which can help to mitigate this academic gap.

This study, therefore, addresses the issue of irrigation management and conflict by exploring the relationship between these two disciplines. It draws upon a comprehensive review of the literature to provide an in-depth understanding of the topic. The study of the KIP from the perspective of an irrigation conflict and its resolution represents a novel approach. This study considered the theory of co-management, the tragedy of the commons, Ostrom's common-pool resource management, and the human needs approach as theoretical lenses to help visualize the case for its reliability. This literature review plays a vital role in developing a comprehensive understanding of irrigation conflict and its resolution practices at both

national and international levels. It provides a conceptual and theoretical framework for the effective conduction of this study. It highlights research gaps that are identified in prior scholarly journals, reports, and books.

Conclusion

The most challenging aspect of this research lies in examining the domains of irrigation management and conflict dynamics. The reviewed literature provides valuable insights into irrigation from empirical, methodological, and theoretical perspectives. It helps to situate this research within the broader academic discussion. Previous studies have extensively explored institutional arrangements, collective action, and community participation in irrigation management as the major domains. These works provide an important conceptual foundation for understanding how irrigation systems are organized and governed and operated.

Most existing studies primarily focus on institutional performance, governance mechanisms, and resource management outcomes, while the dynamics of conflict emerging within irrigation systems and their influence on management practices have received limited empirical attention. In particular, there is a lack of research that systematically examines how conflicts arise among irrigation stakeholders, how they are negotiated, and how these conflicts shape irrigation governance effectively at the local level. This issue is especially underexplored in the context of Nepal.

Therefore, this study seeks to fill this gap by investigating irrigation management from the perspective of conflict dynamics. It focuses on how conflicts emerge, evolve, and are addressed within irrigation systems. Hence, the research contributes empirical evidence to an area that has remained relatively new in previous irrigation governance studies.

CHAPTER III

RESEARCH METHODOLOGY

3.1 Research Paradigm

A research paradigm is the perspective from which research is undertaken and conducted (Daries & Fisher, 2018). It consists of a set of assumptions about “what is reality, how knowledge is created, and what is valuable to learn” (p. 23). Rehman and Alharthi (2016) defined a research paradigm as “a basic belief system and theoretical framework with assumptions about ontology, epistemology, methodology, and methods ... our way of understanding the reality of the world and studying it” (p. 51). Irrigation management and conflict dynamics in the KIP are an attempt to explore the domains of irrigation management, factors that induce conflict, and its resolution practices. Informants raised the existing reality and constructed the scenario for the project. This study is exploratory and qualitative, following social constructivism.

Ontology

Ontology is the nature of reality and the assumptions that it holds about what exists in the world (Killam, 2013). According to Welty (2003), it is concerned with the existence of knowledge and specifies how concepts are understood. It guides how reality is conceptualized and frames the understanding of phenomena. This research adopts a constructivist ontology, which assumes that reality is not objective or fixed, but it is socially constructed through people’s perceptions, interactions, shared meanings, ideas, and values.

In the KIP, those stakeholders include farmers, local elites, bureaucratic members, and water user associations. Their understanding, views, and perceptions are necessary to capture the multiple perspectives, values, and meanings.

Epistemology

Epistemology deals with the nature of reality. Rehman and Alharthi (2016) stated it as concerned with the nature and forms of knowledge. It can be acquired and communicated to other beings. It addresses what we know and how we know. Reality is known through close interaction with farmers, water users' associations, and local government officials; the existing knowledge was perceived. It allows one to understand how these actors perceive, interpret, and experience issues related to water allocation, collection, and distribution; conflict induction; and its resolution mechanisms.

Blumer (1969) argued that social scientists attribute a point of view and analyze individuals' interpretation and their actions. Based on this fact, the behaviors, interactions, and levels of cooperation among water users and other relevant groups in the KIP enable us to interpret how stakeholders understand their actions, assign meaning to events, and relate to one another within the irrigation system.

The existing reality was constructed through detailed conversations from both formal and informal interviews. It examines causes related to irrigation conflicts. Policy and planning were identified through the key informant interviews (KIIs). Later on, an interview with the beneficiary farmers brought further proximity to the reality. These allow participants to express their lived realities in their own terms and locality.

3.2 Research Design

This research adopts an exploratory qualitative research design. It is necessary to explore the perceptions, experiences, and interactions of individuals involved in the KIP. Creswell (2011) stated that research design is necessary to bring a study that supports responding to the research questions. It provides an approach to investigating research questions and fulfilling the objectives. Qualitative research is essential to

understand individual views and opinions; “conversations or discussions with individuals ... sometimes enable investigators to achieve more understanding about why and what the individuals’ perceptions are about the research topic” (Manu, 2018, as cited in Akyildiz & Ahmed, 2021, p. 2). Similarly, they emphasized that qualitative research seeks to provide a detailed explanation of human attitudes, feelings, and perceptions.

Accordingly, individuals construct their meanings that are directed toward particular objectives. This study explores the domains of irrigation management, examines the causes of irrigation conflict, and assesses the conflict resolution practices in the KIP. Data were collected aiming to respond to the research questions and meet those objectives.

3.3 Nature and Sources of Data

This study is conducted with the stakeholders involved in irrigation management in the KIP. Data were collected from the beneficiary farmers, members of the water users’ associations (WUAs), local bureaucrats, and local government officials in their natural settings. Apart from these, research observed the existing condition of the project during the field visit. Several attributes were considered during observation that were listed in the observation checklist. It ensures that the information reflects the lived realities of the research participants and the study area.

The data collection process involved several steps. It includes setting the boundaries of the study. The methods of data collection tools included interviews in the form of semi-structured and unstructured questions. Along with additional tag questions, responses, and reviewed secondary documents such as government reports, project records, and previous related studies were conducted. These methods allowed for a comprehensive understanding of irrigation management and conflict dynamics. The selected study sites

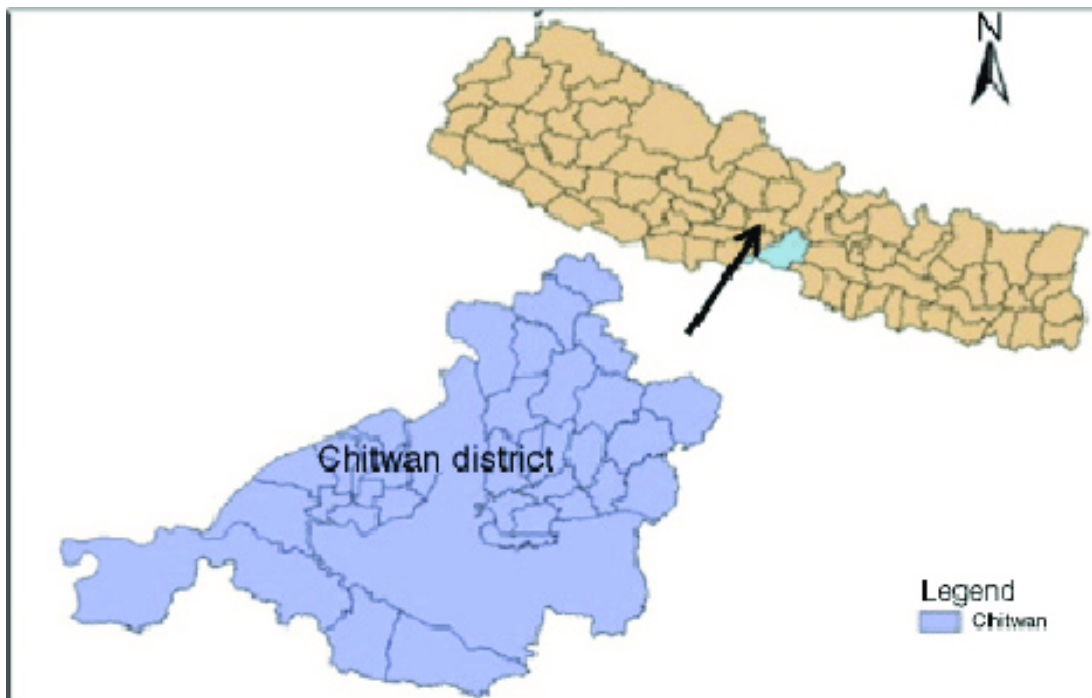
ensured that those research participants could clearly understand the research problems and questions.

This study followed the Miles and Huberman model for data collection (Creswell, 2011). The data collection setting was defined by the location of the KIP. The research participants involved farmers, WUAs, local elites, bureaucrats, and civil society members. Primarily, those elderly farmers were considered a key source of information. They are familiar with the Khageri River and its irrigation system. Their perspectives provided lived historical experiences. It enables one to understand the pattern of irrigation management and the conflict dynamics. Those interviews, observations, and document analysis help to collect a rich, qualitative dataset for an in-depth exploration of irrigation management and conflict dynamics

3.4 Study Area

Figure 3.1

Map of the Study Area



Source: Researcher adopted from Malla and Karki (2016, p. 48).

Demography of Chitwan

According to the National Statistical Report 2021, the total population of the Chitwan district was 719,859. The number of families was 179,345, and the average size of a family was 4.01 members. The sex ratio was 95.58. It denotes that for every 100 females, there were approximately 95.58 males in the population. An annual population growth of 2.07% means that the population of the area was increasing by 2.07 percent every year. A population density of 325 denotes there were 325 people per square kilometer, and a literacy rate of 83.68 denotes that 83.68% of the population aged 7 years and above can read and write with understanding.

Situation of Agricultural Production

The Chitwan district has its major investments in agriculture. The major crops in the district are cereals, oilseeds, and pulses, except vegetables, fruits, and cash crops. It lies in a highly vulnerable zone. The summers are becoming hotter and the winters colder, with decreased numbers and quality of water resources. Monsoon rainfall has increased. Winter rainfall has become scarcer, and periods of drought have become longer (NAPA, 2010; in IFRC, 2021). It brings a threat to agricultural production. There are impacts on the yield of crops like wheat and maize (Bastakoti et al., 2010). They added that the transplanting season of rice and maize has also changed by 15 to 25 days due to drought and irregular rainfall.

Agricultural Households

According to the National Statistical Report 2021, the total farm population of the Chitwan district was 444,915. The total population that spent all the time on agricultural activities was 33,752. 69% of the household reported that they were using surface irrigation methods for irrigated land. 15% reported no irrigation, and 8% of holdings reported sprinkler or spray irrigation methods used for irrigation purposes in Chitwan.

According to the same survey, 84.1% of crops were irrigated crops, and 15.1% didn't have irrigation availability. The major cash crops in Chitwan were cereal crops, followed by vegetables, followed by legumes, followed by fruit crops, followed by grass farming.

Land Topography

The Chitwan Valley is formed mainly by detrimental depositions from the lower slopes. It is enclosed by Mahabharat Lekh in the north and northeast and the Chure range in the south. The average altitude of the valley is about 244 meters above sea level. It is made of terraces of various ages created by the Narayani and Rapti river systems. It is divided into an eastern area and a western area by the Khageri River. It is a tributary of the Rapti running from north to south in the valley. The area south of the Rapti River is called Madi Valley (Shukla et al., 1987). Perennial rivers like Luthar and Manahari flow along the eastern boundary, and Khageri flows along the western boundary in Chitwan. The rivers including Kair Khola, Pampa Khola, Tanhi Khola, Chatra Khola, and Martal Khola, flow into the valley from the Mahabharat Hills. These rivers are the seasonal in nature.

Irrigation Status in Chitwan

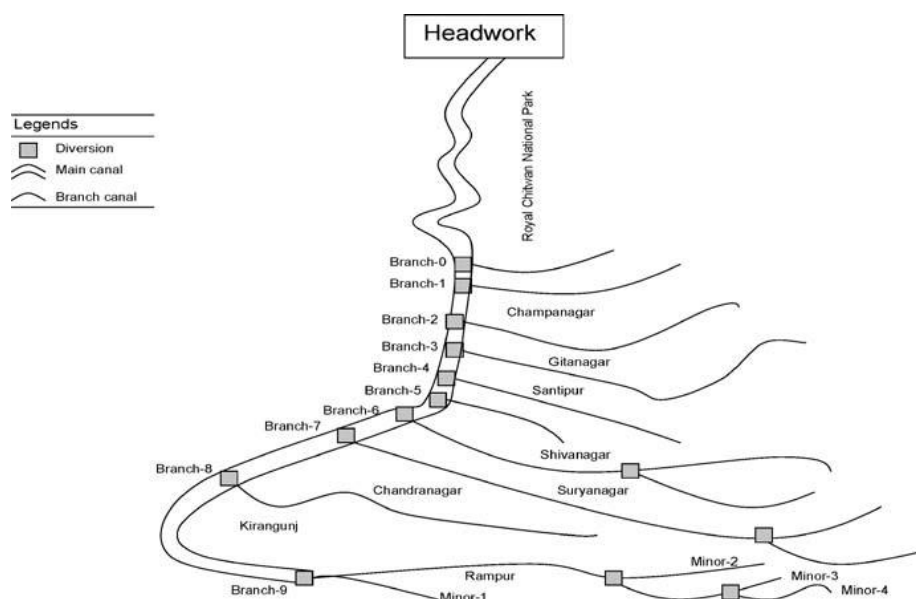
Irrigation is a prerequisite to securing rice yields in the monsoon and other produce during the dry season in the Chitwan district. The majority of farmers depend on rain for irrigating their crops. The total irrigated area in Chitwan is 29623 ha. 15374 ha is under the Farmer Managed Irrigation System (FMIS), and 10900 ha is under an Agency Managed Irrigation System (AMIS) or managed by the Department of Irrigation. The total surface irrigation management is 26274 ha. 3349 ha is privately irrigated land. Adhikari et al. (2013) conducted a study of irrigation management in the Chitwan

National Park buffer zone and stated that increased water availability and reliability through irrigation development have improved crop diversity, intensity, and food sufficiency.

The Khageri Irrigation Project

The KIP is located in the Chitwan district in the southwestern part of Bagmati Province, an area well known for its agricultural productivity, particularly rice cultivation. Several major rivers in the district, including Narayani, Rapti, Lothar, Kayar, Rigdi, and Rieu, serve as important water sources for irrigation. Farmers in the district rely on multiple irrigation practices such as canal irrigation, deep and shallow tube wells, cooperative irrigation schemes, private water pumping, and wells (Ruwali et al., 2022). These irrigation arrangements reflect the diversity of water management practices in the region.

This section presents a short overview of the study site. It highlights the agricultural households, households with access to irrigation facilities, and population growth trends. Furthermore, it examines the socioeconomic characteristics of the beneficiary farmers and provides a contextual understanding of the community that depends on the irrigation system for their livelihood and agricultural productivity. The following pictures show the study area in detail.

Figure 3.2*Schematic Diagram of the Khageri Irrigation Project*

Source: Researcher Adopted from Bhatta et al. (2006, p.181).

The canal was constructed with limited agro-meteorological information, incomplete crop duty data, and engineers' limited experience, as it was the first large-scale project undertaken by the Department of Irrigation (Khanal, 2003; as cited in Pradhan, 2017). Since its formation, water availability in the canals has been insufficient. The system has also faced competition over water use due to the proximity of the Panchakanya Irrigation System intake, located approximately 2 km upstream, leading to tensions between farmers of the two systems (Singh et al., 2014).

KIP is significant as it represents one of the first irrigation projects in Nepal where management responsibility was transferred from the government to a Water Users' Association (WUA) (Khanal, 2003, as cited in Pradhan, 2017). Comparative studies of farmer-managed and agency-managed systems in the KIP revealed that equity in water distribution and leakage improved after management transfer to farmers (Bhatta et al., 2006).

Operation and management issues remain persistent, including free riding of water and the limited effectiveness of formal activities such as water demand assessment, rotation scheduling, and preparation of agricultural operation schedules (Shukla & Sharma, 1997). Singh et al. (2014) further emphasized that effective policy-making for service delivery requires considering external factors that influence irrigation governance, such as promoting financial autonomy and encouraging user participation, which can empower marginalized rural communities.

Total Number of Households in the Study Area

KIP has not covered all the wards of Bharatpur Metropolitan City. It has covered Ward No. six, Gitanagar; Wards Nos. thirteen and twenty-two, Patihani; Wards Nos. fifteen, seventeen, eighteen, nineteen, and twenty, Gunjanagar and Shardanagar; Ward No. fourteen, Shivanagar; and Ward No. twenty-one, Parbatipur.

As per the statistical report (2021), the total population of Gitanagar in the census year 2068 was 10824. This number was increased to 13,349 in the census year 2078. Similarly, in the Khageri region, the number of households recorded in the year 2068 was 2610, and this number has been increased to 3464 in the year 2078.

Likewise, the total population of Shivanagar in the census year 2068 was 9329. This number was increased to 11134 in the census year 2078. Similarly, in Shivanagar, the number of households recorded in the year 2068 was 2292, and this number has been increased to 2819 in the year 2078.

The total population of Gunjanagar and Shardanagar under the Mangalpur section in the census year 2068 was 37741. This number was increased to 43472 in the census year 2078. Similarly, in Gitanagar, the number of households recorded in the year 2068 was 8887, and this number has been increased to 13123 in the year 2078. It shows there is an increment in population density in the study area. Apart from this, the number of

households is also increasing. With the increment in the population, there is increasing pressure on managing and consuming water from KIP.

The annual operation and maintenance cost of KIP is about \$500 per hectare. WUA collects revenue as an irrigation service fee (ISF) from the users at a rate of Rs. 60/ha per crop (Khanal, 2003; in Pradhan, 2017). The existing problems with the KIP have been categorized as the close intake of the Panchakanya irrigation system near the KIP and the problems of seepages, silting, and environmental pollution. It created some issues of water scarcity and unequal water distribution among the head, mid, and tail-end farmers. Moreover, the WUAs' leadership consists of high-caste migrant farmers who have sound political connections and networks. They do not follow rules and regulations while distributing water (Singh, et al., 2014).

3.5 Universe and Sampling Method

The universe is a broad population or setting where research problems exist. This study examined irrigation management and conflict dynamics in the KIP as a universe of the study. This study adopted a systematic area purposive sampling approach. Purposeful sampling involves selecting participants who possess knowledge and experience relevant to the research focus (Akildiz & Ahmed, 2021). Under area sampling, the total study area is divided into smaller, non-overlapping geographical clusters.

According to Parahoo (1997), purposive sampling is a method in which the researcher deliberately chooses participants based on their ability to provide necessary data, often emphasizing accessibility and relevance. Kothari (2004) noted purposive sampling is particularly desirable when the population is small. In this study, the informants were taken from the Gitanagar, Shivanagar, and Mangalpur sections of the KIP that represent the head, middle, and tail-end sections, respectively.

Three farmers from each head, mid, and tail end section of each section, including two females, were interviewed. It means nine farmers from each section took part in the general interview. Altogether twenty-seven farmers were interrogated. The selection of twenty-seven informants for this study was guided by the principles of qualitative research. The researcher applied the concept of data saturation. Rather than aiming for a large sample size, the study focused on obtaining in-depth and meaningful insights into irrigation management and conflict dynamics, considering fewer but needful informants of the study area.

Interviews were conducted until recurring patterns and themes began to emerge. It indicates that additional data collection would yield limited new information. The equal distribution of informants—nine each from Gitanagar, Shivanagar, and Mangalpur—was intentionally designed. It ensures balanced representation across different sections of the irrigation system. This approach allowed for a comparative understanding of variations in water access, institutional practices, and conflict experiences along the canal.

For the FGDs, a total of twenty-one farmers participated across the three sections of the irrigation system. They include six from Gitanagar, eight from Shivanagar, and seven from Mangalpur. The variation in the number of participants across sections was influenced by the practical challenges. The researcher found it difficult to organize group discussions. It was often time-consuming and required careful coordination. FGDs involve lengthy interactive exchanges of ideas; it was difficult to gather a larger number of informants at the same time. Additionally, farmers' availability and their willingness to openly participate in group discussions on sensitive issues such as irrigation conflicts brought further constraints. A range of shared experiences and collective perspectives on irrigation management and conflict dynamics was effectively captured.

In addition to the household interviews and focus group discussions, a total of five key informants were consulted through KIIs. These informants were purposively selected based on their extensive knowledge, experience, and involvement in the irrigation system and its management. The KIIs are essential for in-depth insights into institutional arrangements, governance practices, and conflict resolution mechanisms that were not easily captured through general interviews with the respondents. The information obtained from these interviews was rich and detailed in complementing and validating the findings from other data sources.

The informants were categorized in four groups. Authorities involved members of the water bureaucracy who were connected to water resources and management committees, such as members of WUAs, beneficiary farmers, experts, and community stakeholders. They included political leaders, activists from youth clubs, and women's pressure groups. They were directly or indirectly involved with this project. They know the regular functioning, issues, and other necessary information for the study.

To ensure transparency and methodological rigor in the selection of research participants, specific criteria were applied while identifying informants for this study. Since the research focused on irrigation management and conflict dynamics, participants were purposively selected based on their direct involvement, experience, and knowledge related to the irrigation system.

The study adopted a systematic area-based qualitative sampling approach. It ensures a comprehensive understanding of irrigation management and conflict dynamics across the command area. The irrigation system was deliberately divided into 3 geographical sections, Gitanagar, Shivanagar, and Mangalpur, representing the head, middle, and tail reaches of the canal, respectively. This classification was essential because water availability, access, and associated conflicts often vary significantly across geography

and space. By purposively selecting these sections, the study was able to capture spatial variations in irrigation practices, institutional arrangements, and user experiences. The approach ensured that respondents were selected based on their relevance to the research objectives rather than random selection. It enables a more focused and context-specific analysis of governance and conflict issues within the irrigation system.

Informants were selected from each of these sections to ensure balanced representation of the farmers based on their experiences across the project network. The primary criteria for selection included long-term engagement with irrigation activities, familiarity with water distribution practices and management procedures, involvement in irrigation-related institutions such as water user associations (WUAs), and the ability to provide information about conflict situations and their resolution mechanisms. Priority was given to farmers with several years of irrigation experience within the age group of 45–80 years. The assumption is they possess historical knowledge of the project's functioning and institutional changes.

Efforts were made to include both male and female participants for maintaining gender neutrality and individuals from different spatial groups. It includes beneficiary farmers, irrigation management committee members, local government representatives, technical experts, and community stakeholders such as political activists and social leaders. The selected informants could provide reliable, diverse, and contextually rich information related to irrigation governance and conflict dynamics.

3.6 Fieldwork

The fieldwork was conducted in the KIP area on four separate occasions. The first field visit was conducted in the second week of October 2021. Farmers were engaged in harvesting their crops. They expressed dissatisfaction with the limited access to irrigation. The researcher stayed there for fifteen days from October 15 to November 2.

The second visit was in the first week of April 2022 for fifteen days, during the pre-monsoon season from April 4 to April 20. The Khageri River was completely dry, and many farmers were concerned about the availability of water for their seasonal crops, such as maize. A large portion of the land remained barren due to lack of irrigation access. Some portions of interviews, including FGDs and KIIs, were conducted during that time. The third visit was in the third week of June, 2023.

The researcher stayed there for twenty days from June 25 to July 15, 2023. Many farmers were sowing paddy, and several expressed grievances regarding the inadequate supply of irrigation water. Farmers were found in a problematic condition as they failed to secure equitable water distribution for their fields. It reflected ongoing conflicts over water allocation. All the remaining interviews, FGDs, KIIs, and observations were completed during the allocated time schedule. The final visit was in the second week of October 2025. The researcher stayed there from October 10 to October 20. On this visit, water was visible flowing in the KIP canals.

Some gatekeepers, locally known as *Dhalpas*, were planning to divert water from the headwork site because it was paddy harvesting time, and irrigation demand was low. This visit was effective to develop knowledge related to the water management practices, seasonal adjustments, and local decision-making mechanisms. These multiple field visits enabled me to observe the temporal variation in water availability, the challenges faced by farmers, and the interactions among stakeholders. It provided a rich empirical basis for understanding irrigation management and conflict dynamics in the study area.

3.7 Data Collection Tools and Techniques

The study employed multiple qualitative tools for primary data collection. It includes FGDs, KIIs, general household interviews, and field observation. The use of these

methods allowed for a comprehensive and in-depth exploration of irrigation management practices and conflict dynamics in the study area. FGDs facilitated interactive discussions. It captured collective views and shared experiences among farmers. Interviews enabled the collection of individual perspectives at the household level. Field observation offered opportunities to understand real-time practices, behaviors, and physical conditions of the irrigation system. The combination of these methods enhanced the richness of the data. It allowed for cross-verification of information. It strengthened the overall reliability and validity of the study findings.

The researcher conducted FGDs with beneficiary farmers from each command area of the irrigation project, namely Gitanagar, Shivanagar, and Mangalpur. Each FGD included local farmers who were directly involved in irrigation use and management. The purpose of these discussions was to explore the key issues related to irrigation management and existing mechanisms and procedures, as well as the nature and dynamics of conflicts experienced within the project.

Based on the preliminary understanding developed from the FGDs, the researcher then conducted KIIs with policymakers, irrigation officials, and other authoritative personnel who possess institutional knowledge and administrative experience related to the irrigation system. The information obtained from these KIIs helped to verify, clarify, and expand the issues raised by the farmers during the FGDs.

Furthermore, informal interviews were conducted with the selected farmers, and stakeholders were carried out to gather additional insights and individual perspectives that might not emerge during group discussions. The information collected from KIIs and interviews was analyzed with beneficiary farmers to confirm its relevance and accuracy. This process allowed the researcher to identify information from different sources. It ensured data triangulation and enhanced the reliability of the findings.

In addition to these tools, field observation was conducted to gain an understanding of the existing physical and social conditions of the irrigation project. This approach enabled the researcher to directly examine the condition of canals, water distribution practices, and on-ground management activities. Field observation complemented the information obtained through interviews and discussions. It provided real-time insights into actual practices and behaviors, rather than relying solely on reported data. It also helped to validate and evaluate responses from participants. It enhanced the credibility and reliability of the overall findings.

The researcher identified domains like irrigation infrastructure, farmers' participation practices, and management arrangements in the KIP through FGDs, observation, and KIIs. By using information generated through these four tools, the researcher identified and analyzed the domains of irrigation management, the issues and forms of irrigation-related conflicts, and the existing practices of conflict resolution in the findings section.

Interview

The research was conducted in three command areas of the KIP: Gitanagar, Shivanagar, and Mangalpur, representing the head, middle, and tail sections of the canal system, respectively. The canal length in these sections is approximately seven km in Gitanagar, nine km in Shivanagar, and seven km in Mangalpur.

From each section, nine beneficiary farmers were purposively selected for interviews. It included three farmers, each from the head, middle, and tail ends. In total, twenty-seven farmers participated in the study. The selected participants belonged to the age group of 45 to 80 years. They possess long-term experience and knowledge of the irrigation system and its functioning. Their insights were valuable in understanding both the operational aspects of the irrigation project and the ground realities of irrigation management.

The interviews were conducted using an open-ended questionnaire. It allows participants to freely express their views and experiences. In addition to the prepared questions, probing techniques were employed to elicit insights where necessary. This approach enabled the exploration of farmers' perceptions, experiences, and interactions related to irrigation management, as well as the conflict dynamics observed over time.

Informants were identified through a contact-tracing method, whereby initial respondents facilitated connections with other knowledgeable farmers. To support fieldwork and communication, a local assistant was engaged. Interviews were conducted in natural and convenient settings, including tea shops, agricultural fields, and *chautara* (traditional resting places under large trees). These familiar environments helped participants feel comfortable and encouraged open responses.

The duration of the interviews ranged from approximately 20 to 50 minutes, depending on participants' availability and the depth of discussion. Most interviews were conducted between 4:00 pm and 5:00 pm, a time considered suitable after the completion of daily agricultural activities and to avoid extreme daytime temperatures.

All interviews were guided by a checklist included in the appendices section of this dissertation, and participants' identities were protected through the use of pseudonyms. In addition to formal interviews, informal conversations were also conducted to gain further insights and validate the information obtained. This process of cross-verification strengthened the credibility and reliability of the findings. The interviews ensured that diverse perspectives and experiences of farmers involved in irrigation management and conflict dynamics were adequately captured and contributed to a comprehensive understanding of the study area.

Focus Group Discussions (FGDs)

Focus Group Discussions (FGDs) were conducted in three command areas of the KIP: Gitanagar, Shivanagar, and Mangalpur, representing the head, middle, and tail sections of the canal system, respectively. These discussions with beneficiary farmers were fruitful in identifying key issues related to irrigation management, conflict dynamics, and project functioning.

A total of three FGDs were conducted, involving six participants in Gitanagar, eight in Shivanagar, and seven in Mangalpur. Farmers' availability, willingness to participate, and the time-intensive nature of group discussions were some of the factors that brought irregularities and inconsistencies. Despite these constraints, the selected group sizes allowed for meaningful interaction and the inclusion of diverse perspectives, which helped to enrich the data.

The FGD in Gitanagar was conducted outside a local tea shop. It was a common gathering place for farmers. Participants were mostly between 45 and 50 years of age. They consist of 5 males and 1 female farmer. The discussion lasted approximately one hour. In Shivanagar, the FGD was held inside a tea shop with participants primarily above sixty years of age, including two female farmers. This discussion extended for more than one and a half hours. It allows in-depth sharing of experiences and issues closely aligned with the research objectives.

Organizing the FGD in Mangalpur initially proved challenging due to unfavorable timing and weather conditions. Farmers were unwilling to participate during the midday heat. Following a local suggestion, the discussion was rescheduled and conducted in the evening at Bakhan Park. With the assistance of a local farmer, seven participants, including four males and three females, had participated in the FGD. The discussion

took place in an open and comfortable setting. Those farmers were actively participating.

FGDs were conducted in this study to promote interactive dialogue and collective reflection among participants. This method was introduced by Bogardus (1926) and later developed by Lazarsfeld in the 1940s (Suter, 2000). It enables participants to exchange ideas and build upon each other's responses and generate insights (Akildiz & Ahmed, 2021). Consistent with Krueger (1994), the group sizes were kept relatively small to ensure effective participation and discussion.

All FGDs were conducted using a prepared checklist and were audio-recorded with participants' consent. The recordings were subsequently transcribed for analysis. The data were analyzed using thematic analysis following Braun and Clarke's (2006) six-step approach: familiarization with the data, generation of initial codes, identification of themes, review of themes, definition and naming of themes, and final report production.

The FGDs provided rich, context-specific insights into irrigation practices, conflict issues, and local governance mechanisms. They also complemented individual interviews and contributed to data triangulation through the depth and reliability of the study.

Key Informant Interviews (KIIs)

Key Informant Interviews (KIIs) were conducted to obtain in-depth and specialized information on irrigation management. It includes plans, policies, implementation strategies, institutional arrangements, and farmers' participation in repair and maintenance activities. These interviews were particularly useful in identifying policy and implementation gaps and in understanding the broader governance context of the irrigation system.

A total of six KIIs were conducted with individuals possessing extensive knowledge and experience related to irrigation management and local governance. To ensure confidentiality and ethical considerations, all informants were anonymized using pseudonyms.

One of the major KIIs was conducted at the informant's office in Shivanagar at around 10:00 a.m. and lasted approximately one and a half hours. The discussion detailed insights into organizational structure, decision-making processes, water fee collection mechanisms, maintenance practices, and farmers' participation in the irrigation system.

The remaining five KIIs were conducted with purposively selected individuals to capture diverse perspectives and experiences related to irrigation management. The inclusion of multiple informants helped to gather a broad range of views. It was fruitful for the understanding of institutional practices, governance mechanisms, and conflict-related issues.

KIIs are particularly useful in qualitative research for exploring institutional dynamics, social relationships, and contextual realities (Pahwa et al., 2023). The selected informants were associated with different sections of the command area, Gitanagar, Shivanagar, and Mangalpur, representing the head, middle, and tail regions of the canal system. Their perspectives are effective for a comprehensive understanding of water allocation practices, management arrangements, and conflict situations within the irrigation project.

For the credibility and reliability of the study, the researcher maintained a balance among KIIs, farmer interviews, and FGDs. FGDs and interviews were effective to identify key issues experienced by farmers. KIIs were necessary to check with data from interviews and FGDs. It facilitated triangulation and strengthened the overall validity of the findings.

Observation

In addition to KIIs and FGDs, observation was considered as a supplementary data collection tool in this study. This method enabled the researcher to obtain firsthand insights into irrigation practices, farmers' interactions, and water allocation processes within their natural setting. It also facilitated a close examination of the physical condition and operational efficiency of irrigation infrastructure that includes canal lining and water distribution mechanisms.

Observation allowed the researcher to capture both social and technical aspects of irrigation management. It provided valuable information on social cohesion among farmers, levels of cooperation during water distribution, and the overall functioning of the irrigation system. This method was particularly useful in generating contextual data. It could not be fully captured through interviews or FGDs alone.

The researcher conducted multiple field visits over a period of approximately 6 months between December 2022 and October 2025. During this period, the researcher remained engaged with farmers, water user groups (WUGs), and local irrigation management bodies. This prolonged engagement helped in understanding daily practices, social interactions, and behavioral patterns related to irrigation management.

An observation checklist was prepared to guide the fieldwork. Based on this checklist, the researcher systematically observed key aspects of irrigation infrastructure and management practices, including the condition of headworks, sluice gates, and channel gates as well as the status of main, branch, and tertiary canals. Additional observations included canal lining conditions, leakages, siltation, waterlogging, and issues related to canal maintenance and cleanliness. The researcher also examined farmers' behavior and responses during water distribution and conflict-related situations.

Observation, as a methodological approach, involves careful and systematic recording of events, behaviors, and physical conditions (Dewalt & Dewalt, 2011, as cited in Kawulich, 2005). In this study, detailed field notes were maintained throughout the observation period. It ensures accurate documentation and analysis.

The use of observation enriched the data by providing contextual and experiential insights into irrigation management practices, infrastructure conditions, and conflict dynamics. It complemented the information obtained from KIIs and FGDs and contributed to triangulation and strengthened the reliability and depth of the research findings.

3.8 Data Analysis Process

Qualitative research emphasizes the analysis of words, behaviors, expressions, and contextual information rather than numerical data (Hammersley, 2012). This approach enables an in-depth exploration of participants' meanings, experiences, and perspectives. It provides a rich understanding of social phenomena within their natural context. In this study, data collected through interviews, FGDs, KIIs, and field observation were systematically organized, coded, and interpreted to identify recurring themes, patterns, and relationships related to irrigation management and conflict dynamics in the KIP.

Data were collected through audio recordings and detailed field notes. The audio recordings were transcribed, while written notes were carefully reviewed and categorized. The data were organized into thematic categories. It allows for the integration of information from different sources into coherent analytical themes.

Hammersley stated qualitative inquiry seeks to understand how individuals interpret and construct their social world. It adopts a flexible, data-driven approach and

acknowledges the role of subjectivity. In this study, both emic and etic perspectives were incorporated. The emic perspective reflects the meanings and experiences of participants, while the etic perspective represents the researcher's interpretation and theoretical framing of the data (Smith, 1987). This combination enabled a balanced and comprehensive understanding of irrigation practices and conflict dynamics.

The data were analyzed using a systematic process involving several key steps. Familiarization with the data through repeated reading and review, coding of meaningful units, categorization of codes into themes, and synthesis of findings into coherent interpretations (Kunwar & Karki, 2020). This analytical approach facilitated the identification of major domains of irrigation management, patterns of conflict, and existing mechanisms of conflict resolution within the project.

The analysis encompassed the historical development of the project, farmers' experiences and perceptions, and the current practices of water management and distribution. This approach contributed to a comprehensive understanding of irrigation governance, stakeholder interactions, and conflict dynamics in the study area.

3.9 Coding and Transcription

The process of data analysis in this study involved systematically interpreting information collected through interviews, FGDs, KIIs, observations, field notes, and relevant documents. Creswell (2011) stated qualitative analysis emphasizes understanding the broader meaning of data while accurately representing participants' perspectives and experiences. Throughout the research process, analytical memos were maintained to record reflections, emerging ideas, and preliminary interpretations. It supported the identification of patterns and themes.

Data coding was conducted manually, with partial support from QDR Minor Lite qualitative data analysis software. This approach aligns with Ngulube (2015), who argues that complete reliance on software may limit the depth of qualitative interpretation. Coding involved breaking down textual data into meaningful units, assigning categories, and organizing them into patterns. It provided a structured basis for thematic analysis.

The analysis followed a systematic process, including familiarization with the data, coding, categorization, and thematic development (Kunwar & Karki, 2020). Both verbal and non-verbal expressions were considered during analysis. Data were recorded through audio recordings and field notes, with the latter comprising descriptive notes such as informant characteristics, physical settings, and observed activities and reflexive notes like capturing the researcher's insights and potential biases.

Axial coding was used to identify relationships among categories, and selective coding was applied to construct coherent narratives (Delve, 2018). Initial codes were derived from the interview guides and were expanded inductively as new themes emerged during transcript review. Frequently occurring themes included institutional arrangements, physical infrastructure, farmers' participation, and environmental concerns.

The coding process revealed that these four domains constituted the primary analytical framework of the study. For instance, informants, as identified using pseudonyms such as Informants A–K, frequently discussed issues related to water users' associations, operation and maintenance practices, budgeting, government support, and water distribution systems, which were categorized under institutional arrangements and physical infrastructure. Farmers' participation and environmental concerns emerged as additional thematic areas reflecting local engagement and sustainability challenges.

Further analysis indicated that conflicts within the KIP were shaped by multiple interrelated factors. These included physical infrastructure issues like unlined canals, seepage, siltation, and weak technology; institutional challenges like ineffective water rotation, poor coordination, free-riding, and weak rule enforcement; behavioral factors among farmers like water stealing and lack of cooperation between head- and tail-end users; and environmental conditions like floods, landslides, water scarcity, and climate variability. These factors were consistently highlighted across multiple coded segments. It demonstrated the complexity of conflict dynamics within the system.

Thematic analysis also identified key conflict resolution mechanisms practiced within the project. These included discussion and negotiation among farmers and water user groups, mediation by local leaders and experienced farmers, formal adjudication through meetings and assemblies, and technical interventions such as water diversion and infrastructure adjustments. These mechanisms reflect a combination of social, institutional, and technical approaches to conflict management.

All transcripts were analyzed using verbatim quotations to preserve the original meanings and expressions of participants (Baxter & Eyles, 1997; as cited in Ngulube, 2015). This approach ensured that the findings remained grounded in participants' lived experiences and enhanced the credibility and transparency of the analysis.

Thematic analysis was employed to ensure that patterns and interpretations were firmly rooted in the data. To maintain ethical standards, all participants were assigned pseudonyms to protect their identities. This systematic and rigorous analytical approach enabled the generation of rich, context-specific insights into irrigation management practices, conflict dynamics, and resolution strategies within the KIP. It helps to strengthen the overall validity and reliability of the study.

3.10 Reliability and Validity

Bannigan and Watson (2009) emphasize that a conceptual framework serves as a foundation for ensuring and explaining the reliability and validity of research. It clearly outlines key concepts, relationships, and assumptions and provides a structured lens through which data can be interpreted and analyzed. A well-defined conceptual framework helps align research design, data collection methods, and analytical procedures with the study objectives to strengthen methodological rigor.

In this study, the conceptual framework guided the examination of irrigation management practices, conflict dynamics, and resolution strategies within the KIP. It ensured that the findings were systematically connected to both theoretical perspectives and empirical evidence. It helps to maintain the credibility of the research.

Ensuring reliability and validity in qualitative research depends on the careful collection, interpretation, and verification of data. This study adopted several strategies to maintain rigor. The conceptual framework was continuously revisited throughout the research process. It allows the researcher to refine interpretations and ensure consistency with theoretical foundations.

Multiple data collection methods, including KIIs, FGDs, individual interviews, and observation, were employed to strengthen the study. FGDs were conducted in identifying key issues. The findings from KIIs were further cross-checked with responses from beneficiary farmers during individual interviews. This process of cross-verification contributed to data triangulation. It enhances the validity and reliability of the findings.

In addition, the use of systematic qualitative methods, documentation of field data, and analytical procedures signified that the research remained closely aligned with real-

world conditions. Overall, the integration of a strong conceptual framework with multiple methods of data collection and verification strengthened the trustworthiness and rigor of the study.

Reliability

Reliability refers to the stability and consistency of research findings. It indicates the extent to which similar results would be obtained if the study were repeated under comparable conditions (Bannigan & Watson, 2009). In qualitative research, reliability is closely associated with methodological rigor, transparency, and the systematic documentation of research procedures. It allows others to trace and understand the analytical process. Roberts and Priest (2006) further emphasize that reliability, together with validity, serves as a key indicator of the trustworthiness and credibility of the research.

In this study, data were collected systematically using multiple techniques, including interviews, FGDs, KIIs, and observation. The use of consistent interview guides, along with detailed field notes and accurate transcription of audio recordings, helped maintain consistency in data collection. Careful attention was given to capturing participants' responses verbatim for preserving the authenticity and meaning of the data.

To strengthen reliability, the researcher repeatedly reviewed transcripts and cross-referenced codes and their definitions. Similarly, those emerging codes, categories, patterns, and themes were continuously reviewed throughout the analysis process. This iterative approach helped ensure consistency in coding and interpretation.

The study also incorporated triangulation to enhance reliability. Issues identified through FGDs were further explored through KIIs to understand policy and institutional perspectives. It was subsequently cross-verified through individual interviews and observational data. This process enabled the researcher to compare and validate

findings across multiple sources.

Additionally, elements of investigator triangulation were applied, whereby interpretations and analytical decisions were reviewed to minimize potential bias (Johnson, 1997, as cited in Golafshani, 2003). This approach strengthened the credibility of the findings, which ensured that conclusions were not solely dependent on a single perspective. The combination of systematic data collection, rigorous analytical procedures, and triangulation techniques contributed to the reliability and consistency of the findings related to irrigation management and conflict dynamics in the KIP.

Validity

The validity of research begins with the careful selection of the research theme and the methodological choices made throughout the study. In qualitative research, validity refers to the accuracy, credibility, and authenticity of findings from multiple perspectives, including those of the researcher, participants, and readers (Creswell & Miller, 2000, as cited in Creswell, 2011). Ensuring validity requires alignment between the research design, data collection methods, and analytical procedures, along with the use of strategies such as triangulation, member checking, and systematic documentation of the research process.

Validity was strengthened through the use of multiple data sources. It includes interviews, FGDs, KIIs, and field observations. Cross-verification of data obtained from these sources ensured that the findings accurately reflected the lived experiences and perspectives of participants within the KIP. This process helped minimize bias and enhance the credibility of the interpretations.

Data triangulation was a key strategy employed in this research. It integrates information from multiple sources and perspectives to identify convergent themes and

categories. This approach enabled the researcher to compare, validate, and refine findings. It ensures consistency across different datasets. As a result, the analysis remained closely connected to the empirical realities of the study area.

Construct Validity

To ensure validity, the researcher conducted an extensive review of relevant books, journals, and scholarly sources before selecting the appropriate methodological and conceptual approaches for the study. The data collection tools, methods of analysis, and other research procedures were carefully examined and evaluated prior to finalization, ensuring that they were suitable for addressing the research objectives. All necessary data were systematically collected, and the information gathered was aligned with the focus of the study. It allows accurate measurement and interpretation. This careful preparation and methodological rigor provided a solid foundation for exploring the key concepts of irrigation management and conflict dynamics within the KIP. It ensures that the findings are credible, accurate, and meaningful.

3.11 Operational Definitions of Key Concepts

Operational definitions help clarify the specific meaning of key concepts used in a study and delimit the scope within which they are examined. They ensure consistency and focus in analyzing irrigation management and conflict dynamics in the KIP. For the purpose of this research, the major concepts used in the conceptual framework have been operationalized as follows.

Management

In this study, "management" refers to the coordination and administration of activities related to the implementation and functioning of the irrigation project. It includes processes such as strategy formulation, planning, organizing, coordinating, and supervising tasks among different stakeholders. Management also involves operational

functions such as mobilization of resources, administration, circulation of information, and distribution of irrigation water within the system.

Irrigation Management

Irrigation management encompasses the institutional and technical processes required to ensure the effective availability and use of water for agricultural production. It includes the roles and responsibilities of water users' associations (WUAs), farmers, and other institutional actors involved in the irrigation system. This concept also covers legal and institutional arrangements, development and maintenance of physical infrastructure, and the processes of water acquisition, allocation, distribution, and utilization necessary for sustaining irrigation activities.

Conflict Dynamics

Conflict dynamics in this study refer to the patterns and processes through which conflicts emerge, develop, intensify, transform, and eventually reach resolution within the irrigation system. It highlights the interactions among actors, interests, and contextual conditions that influence the occurrence and progression of conflicts. Conflict is operationalized here as any form of incompatibility, disagreement, or dispute that arises during the management and use of irrigation resources. These conflicts may range from minor misunderstandings to serious confrontations and may take both violent and non-violent forms.

Conflict Resolution

Conflict resolution is understood as the constructive process through which disputes are addressed and managed to achieve mutually acceptable outcomes. It involves negotiation, dialogue, mediation, and cooperation among the disputing parties to reconcile their interests and restore functional relationships within the irrigation management system.

Institutional Arrangements

Institutional arrangements refer to the formal rules, regulations, policies, and legal frameworks governing the operation and management of the irrigation system. These include laws formulated by government agencies, guidelines for water distribution, and organizational mechanisms that regulate the roles and responsibilities of different stakeholders.

Physical Infrastructure

Physical infrastructure denotes the technical structures required for the functioning of the irrigation system. In this study, it includes canals, gates, channels, shafts, and other mechanical or engineering components that facilitate the storage, control, and distribution of irrigation water.

Water Users' Associations (WUAs)

Water Users' Associations are community-based organizations formed by local water users for the management and regulation of irrigation resources. They play a key role in coordinating water distribution, maintaining infrastructure, resolving disputes among farmers, and ensuring collective participation in irrigation management.

Farmers' Participation

Farmers refer to the local agricultural households who utilize water from the KIP to irrigate their farmland. They are the primary beneficiaries and key stakeholders in the irrigation management system. It represents the presence of farmers during the maintenance, distribution, and monthly meetings.

Environmental Concern

Environmental concern refers to issues affecting the cleanliness and ecological condition of the irrigation canals and surrounding areas. These include problems such

as excessive weed growth, rat holes, disposal of animal carcasses, and other forms of pollution that obstruct water flow and create environmental and health risks within the irrigation system.

Head-End Farmers

Head-end farmers are those whose agricultural fields are located in the upper section of the irrigation canal system. Due to their location near the water source, they typically receive irrigation water earlier and with greater reliability.

Tail-End Farmers

Tail-end farmers are those whose fields lie at the lower or terminal section of the irrigation canal system. Because of their downstream position, they often face challenges in receiving adequate water supply, which may contribute to disputes within the irrigation management process.

Co-Management

Co-management is a governance approach in which the management of resources is shared between government authorities and local users, but the primary role of local stakeholders is operational execution. It focuses on day-to-day management activities such as water allocation, canal maintenance, and conflict resolution. Local actors participate in implementing decisions, but decision-making authority and ownership largely remain with government bodies, giving local stakeholders limited control.

Co-Governance

Co-governance is a governance approach where both formal authorities and local stakeholders share decision-making power and ownership equally over resource management. It emphasizes joint formulation of policies, rules, and long-term planning, rather than only operational tasks. Local actors have equal authority, responsibility, and

accountability with government bodies in governance and management processes.

3.12 Ethical Considerations

In qualitative research, the potential for researcher bias is higher due to strategic, ethical, and personal influences (Creswell, 2011). The researcher maintained neutrality against reflexive biases while interpreting information. In this study, there is respect for research participants' values, backgrounds, histories, cultures, and socioeconomic statuses, which was ensured throughout the study. Ethical considerations were sensitively addressed. Any sensitive or potentially conflicting information shared by participants was kept confidential as per their wishes.

All informants were represented using pseudonyms in sequential alphabetical order. It ensures both anonymity and ethical integrity. Creswell (2011) emphasized that qualitative research includes reflections by the researcher on how background, gender, and culture may shape interpretations. To minimize such biases, this study relied on systematic field findings, analyzed events openly and honestly, and triangulated data from multiple sources.

The prolonged engagement in the field allowed to develop an understanding of irrigation management and conflict dynamics within the KIP. This study ensured ethical rigor and trustworthiness by maintaining transparency, respecting participants' perspectives, and applying careful reflection in both data collection and interpretation. The researcher consulted the community member and others, maintaining "Do No Harm" and controlling any kind of threat that may arise and assuring their self-image, feelings, and dignity.

CHAPTER IV

DOMAINS OF IRRIGATION MANAGEMENT IN KHAGERI IRRIGATION PROJECT

4.1 Introduction

The effective management of an irrigation system is a multidimensional process. In the context of the KIP, understanding the domains of irrigation management is important for ensuring equitable water distribution, sustainable resource utilization, and conflict resolution among stakeholders. It focuses on how water allocation, operational practices, maintenance strategies, and community participation interact to influence the overall performance of the system. Moreover, it identifies the challenges, strengths, and opportunities in managing KIP.

These domains of irrigation management were explored based on the secondary review, field study, observation, and interrogation among farmers and local officials through FGDs, KIIs, and interviews. The narration, as stated by the informants, was relevant to coming up with the domains of irrigation management. Because of the case sensitivity, the researcher has intentionally kept the name under pseudonyms. Those names as written inside don't reflect the real informant, as the researcher had already clarified in the ethical concerns. Mainly five domains of irrigation management, listed as the institutional arrangement and legal framework system, farmers' participation, water users' associations, physical infrastructures, and environmental considerations, were explored in the study area.

4.1.1 Institutional and Legal Framework

One of the informants, during an interview, stated that there were many staff members in the KIP, and each had specific duties to perform. He added he had to remain loyal to his institution. As a guard (pseudonym) in the office, he narrated his role as follows:

I work here as a guard (pseudo occupation). My duty is to maintain and repair the machinery equipment. I should keep the water gate in working condition. I should lubricate and grease the equipment, such as the handlebar, water gate bar, crown, and shaft, and keep it in working condition. I should work as per the rules and regulations of my office. I should obey my senior officers. Repair and maintenance activities are carried out once a month. I have to distribute water as per the rotation system. The source of water in the Khageri River is decreased day by day (A. Khadka, pseudonym, KII, June 25, 2023).

The rules and regulations set by the KIP office should be followed by all farmers while consuming irrigation water. In the same context, during a focus group discussion (FGD) conducted in Shivanagar among eight farmers, one female farmer discussed the functioning of KIP as follows:

I am B. Tamang (pseudonym). I am 48 years old. The KIP functions in activities such as water distribution, calling beneficiary farmers for repair and maintenance, and collecting water fees. I am not happy, as the main canal committee members do not coordinate properly while distributing water to the farmers. I have seen many farmers who neither pay water fees nor follow rules and regulations. There is also the practice of nepotism and favoritism while distributing water. The Khageri Water Division Office does not take any action against them, which makes me feel bad (B. Tamang, pseudonym, FGD, July 4, 2023).

The informants repeatedly stated that there is a need for strict rules and regulations for wrongdoers in the KIP. The dedication and proper functioning of any institution can produce the best results. Farmers like B. Tamang (pseudonym, personal communication, 16 July, 2023) were disappointed due to the lack of legal action against

free riders and rent seekers. This indicates that the existing institutional arrangement system still requires improvement.

Similarly, in an interview, one of the informant farmers, aged sixty-eight, from Ujelinagar under the Gitanagar section, described the functioning of KIP as follows:

The water rotation system is still not satisfactory. I have seen many farmers encroaching upon the canal and building their houses. The KIP office has failed to manage the concrete lining of the canal, which creates problems related to water seepage. Many farmers do not pay water levies. There are problems of siltation, free riding, and water stealing. Farmer participation during maintenance activities is weak (G. P. Bantawa, pseudonym, personal communication, June 27, 2023).

It is evident that the concerned officials, such as the soil office (pseudonym), are not sufficiently serious about the effective functioning of this irrigation project. There is a strong need for strict rule formulation for the proper implementation of the project. The concerned offices should take necessary steps to penalize farmers who do not follow rules and regulations. This clearly demonstrates that one of the crucial domains of irrigation management in KIP is the institutional arrangement system and its legal framework.

The management of irrigation systems in Nepal encompasses several national acts, policies, and institutional frameworks that define the principles of water governance, equitable distribution, and conflict resolution. There are three government bodies responsible for looking after the irrigation management sector. They are the federal, provincial, and local bodies. Each of them has specific roles and responsibilities. At the federal level, the ministry of energy, water resources, and irrigation is the central body

responsible for formulating national policies, strategies, and plans for water resource management. Under its supervision, the department of water resources and irrigation has been established to plan, develop, operate, maintain, and monitor irrigation projects throughout the country (Government of Nepal, 2023).

At the provincial level, the provincial ministry of energy, water resources, and irrigation coordinates provincial water resource policies and supports the implementation of federal policies and plans. Similarly, the provincial water resources and irrigation development division is responsible for implementing irrigation-related projects and policies within the province. At the local level, the district water resources and irrigation development division manages local irrigation schemes and ensures coordination with both federal and provincial institutions. Local government units such as municipalities and rural municipalities play a key role in implementing community-based water management practices and supporting localized irrigation needs.

In Chitwan district, the Khageri irrigation management division manages the operation and management activities of the KIP. This division conducts maintenance and repair work, particularly focusing on the main canal, and assists with branch canals when major issues arise (Government of Nepal, 2023).

There are several key acts and policy documents that provide the legal basis for irrigation management in Nepal. The Water Resources Act, 2049, establishes the legal framework for the management, utilization, and conservation of water resources in Nepal. Water Resources Rules, 2050, outlines the procedures for implementing the Water Resources Act. It includes licensing provisions and the formation of Water Users' Associations (WUAs). The Irrigation Master Plan, 2019, provides strategies for sustainable irrigation development, modernization of existing systems, and improved governance mechanisms. These frameworks emphasize community participation, cost-

sharing mechanisms, and the strengthening of local institutions for effective irrigation governance.

KIP functions as a jointly managed irrigation system, integrating both government oversight and community participation. KIP is not a fully farmer-managed irrigation system (FMIS); the system operates through cooperation between the department of irrigation and local farmers. KIP maintains a small team of technical and administrative personnel. It includes three engineers, one serving as the division chief, an administrative head, and several office assistants. *Dhalpas* (gatekeepers) are periodically appointed to regulate the head-works and water gates. There are no permanent staff dedicated to canal operation, which poses challenges during the irrigation season.

The irrigation service fee in the KIP is set at NPR 300 per hectare, with a penalty of 10–20% imposed on those who fail to pay. Of the total revenue collected, 5% is transferred to the national treasury, while 95% remains within the WUAs. Within the WUA structure, funds are distributed at 20% to the main committee, 65% to the branch committees, and 10% to tertiary committees. The district irrigation office, located at Bharatpur metropolitan city, provides technical and financial assistance, particularly for issues related to the main canal.

Irrigation management involves the equitable distribution of water and the timely repair and maintenance of canals and structures. In the KIP, however, water scarcity remains a persistent issue. Water is available for irrigation for only about four months each year. It forces farmers to rely on deep boring systems during dry periods. While it provides short-term relief, it poses long-term environmental risks, including the depletion of groundwater. Government institutions such as the district irrigation office periodically conduct maintenance works and allocate budgets for canal infrastructure,

including the construction of village road bridges. They also disseminate codes of conduct and monitor irrigation activities.

A local official from the Bharatpur Metropolitan Irrigation Division mentioned that there are two major irrigation systems in Bharatpur, the KIP and the Narayani Lift Irrigation Project. According to him, Nepal's government provides funds for alternative water sources like deep boring. It has been less effective in addressing the root causes of water shortage in the KIP. The headworks of the KIP experience the least flow during the lean season. It suggested that improved regulation and control mechanisms could enhance water availability.

Interviews with local representatives revealed differing perspectives on authority and responsibility. A ward chairperson, P. Tamang (pseudonym, personal communication, 22 July, 2023), stated that KIP operates as an autonomous institution, with limited direct control by the local government. Nonetheless, the ward offices contribute financial and logistical support when possible. Other ward leaders from the Bharatpur metropolitan city reported that they have coordinated with the central government to allocate budgets for infrastructure renovation. In the tail-end sections, such as Mangalpur, local representatives often act as mediators between farmers and WUAs to resolve disputes over water allocation and distribution.

4.1.2 The Practice of Farmers' Participation

Farmers' participation is widely regarded as an essential element of effective irrigation management. Active involvement of farmers in planning, maintenance, and decision-making helps ensure equitable water distribution and sustainable use of irrigation resources. In Nepal, water users' associations work to strengthen local ownership and collective responsibility. Such participation is expected to improve both the operational efficiency and long-term sustainability of irrigation systems.

In an FGD conducted in the Gitanagar section, the head section of the KIP, the farmers emphasized the necessity of farmers' participation for the effective implementation of the project. According to them, a lack of farmers' cooperation in water rotation sometimes leads to situations of conflict. They described the situation as follows:

We find a water shortage in our region. Farmers from the head section always control water. I am the real victim. Once, I went to manage water for sowing paddy in the head section. We belong to the tail-end section of Gitanagar. I brought water by closing all the water holes. However, another farmer, without any notice, diverted the water to his field. Because of less water, I could not sow paddy (C. Ramtel, pseudonym, FGD, April 7, 2022).

This narration from a farmer during the FGD highlights the importance of cooperation among farmers for the effective implementation of such projects. It indicates that a proper water rotation system among farmers can help ensure proportional access to water. Similarly, to understand the existing institutional practices related to farmers' cooperation strategies, a key informant interview (KII) was conducted with the chairperson of the Khageri. He described the water rotation system among farmers as follows:

Altogether, there are 13 branch canals, and water is supplied based on a rotation system: 4 days for Gitanagar, 5 days for Shivanagar, and 6 days for the Mangalpur section. This is the existing practice of water circulation among farmers in these three sections. During the time of water rotation, sometimes there is less water available at the source. In such cases, if 2 days are sufficient for Gitanagar, water will be circulated for more days in other sections if required (D. Karki, pseudonym, KII, July 13, 2023).

The system of water rotation appeared to be quite well designed. However, the main problem lies in farmers' attitudes and their level of cooperation. Findings show that cooperation among farmers plays a crucial role in the effective functioning of the project. The KII with the chairperson also highlights some existing practices in the KIP. Nevertheless, it remains a matter of concern, as officials may sometimes provide exaggerated information. To address this concern, an interview was conducted with a beneficiary farmer from the tail-end section to verify whether the rotation system was functioning effectively. According to him, the existing institutional practices and farmers' cooperation in the KIP are as follows:

I am E. Sen, aged 60. It is true that there is limited availability of water in the Khageri River. As a farmer, I am not satisfied with the farmers who are involved in this project. There is a water rotation system scheduled by the irrigation office, but the problem is that farmers are neither attentive nor cooperative. They throw dust and garbage into the canal as if it were a dumping site, which deteriorates the canal condition. Some farmers have a habit of water stealing and do not follow the water rotation practice (E. Sen, pseudonym, personal communication, June 29, 2023).

From the information acquired through interview, KIIs and FGDs, it can be stated that one of the principal domains of irrigation management in the KIP is the participation of farmers. Most of the informants showed their dissatisfaction as farmers do not take part during the time of paying water bill, they are found uncooperative. They even consume water breaking the existed practices.

As stated by Ostrom (2009), irrigation management is productive through the collective effort of the community users. In the case of the KIP, farmers have formed different committees. They make their regular discussion. They create their duty hour. Those

water users' associations and their executive bodies like chairperson, secretary and other members work to rotate water during the emergency. Some collect water fees. Generally, elderly farmers work to resolve conflict. They call the disputant parties and bring them in a talk. Farmers apologize to each other if not then elderly farmers act as a mediator to normalize the issue of conflict.

Here, the farmers are the integral part whose cooperation would be important in achieving efficient irrigation. In an FGD carried out in Ujelinagar among farmers aged 40-45 who were part of the Gitanagar area, informants expressed their grievances as follows:

I am D. Shah, aged fifty-seven. Personally, I am not happy with the performance of those water users' groups. They barely conduct regular meetings. They do not formulate and implement any rules and regulations. They are found to be active. I know for the effective implementation of such an irrigation project, those water users' associations should lead and unite all the users. They are the strong pillars. I know proper coordination among the head, mid, and tail-end farmers during the urgent period of water distribution makes a meaningful outcome (D. Shah, pseudonym, personal communication, June 27, 2023).

Many of the informants stated that the participation of farmers for the maintenance and repair of canals, cleaning the drain, and handling other equipment like gates and channels is found nominal. Most of the farmers neither participate nor contribute wealth. It shows weak cohesion among farmers in the study area. There is monopolization in the water use. Those head section farmers do not cooperate while supplying water to their crops. They found that they are strong in their position. They do not respect the rights of mid- and tail-end farmers to acquire water. Those WUAs are not showing interest in speaking to the rights of the tail-end farmers. Many of the

informants blamed the WUAs' members for working for their personal benefit; they followed the trend of nepotism and favoritism. There is high politicization.

However, Mr. F. Rojaiya, aged 61 years and a farmer in Mangalpur, was disappointed when he complained about his lack of water accessibility during the period of scarcity. He stated the issue as follows.

I belong to the tail end section of the KIP. In our area, generally we get water in the last week of July, if not the first week of August. We plan accordingly for the paddy plantation. I remember once there was a water shortage. I was not able to acquire water even to the second week of August. I went to the irrigation office and lodged the complaint. I was hopeful to acquire water, but the situation turned upside down. Those officials who were working for the water distribution became selfish. They were distributing water by giving priority to their relatives, kin, and Keith (F. Royaiya, pseudonym, personal communication, June 26, 2023).

Likewise, G. Tamang (pseudonym, personal communication, June 25, 2023), a farmer of fifty years from Shivanagar, showed his rage as he failed to acquire water even if he had repeatedly taken part in the repair and maintenance of the canal and cleaning of tunnel activities. These problems infer that those official members should give privilege to the hardworking farmers. If they show their concern for the canal maintenance and system management, their work should be rewarded. The working environment of those user groups is found still not satisfactory.

4.1.3 Physical Infrastructures

In interviews with beneficiary farmers, most of them commented on the outdated physical infrastructure of the project. They reported that much of the equipment was

not in working condition. Most of the branch and tertiary canals were unlined, and there were persistent problems related to water seepage and siltation. According to the gatekeeper, many of the water gates were not functioning properly. In this context, one of the farmers stated the condition of machinery and other infrastructure during an interview as follows:

I think the effective implementation of the KIP is possible only if there is full lining inside the canal. It prevents problems such as water seepage, waterlogging, and siltation. It is necessary to implement effective maintenance and repair activities. I would also like to draw attention to the fragile condition of canal gates, channels, and iron rods (H. Yadav, pseudonym, personal communication, July 3, 2023).

Most of the farmers expressed serious concern about the existing condition of the project site. The iron bars of the water channel were covered with rust. The main canal was found to be in a relatively working condition; the branch and tertiary canals were not functioning properly. These canals were filled with piles of dust particles. Additionally, problems of water seepage were evident due to the absence of a lining system inside the canals.

During the FGD conducted with farmers from the Shivanagar section, most participants raised serious concerns regarding the existing condition of the KIP. They expressed dissatisfaction with the concerned authorities, such as the Water Users' Association (WUA) office and the local government, for failing to protect and maintain the condition of the project. One of the participants in the FGD expressed her dissatisfaction as follows:

I am I. Gurung (pseudonym), a female farmer aged 55. I belong to the Shivanagar section. In our area, due to the poor condition of the canal, water cannot flow properly. The edges of the canal are not in working condition. There is no lining, which creates problems of water seepage (I. Gurung, pseudonym, FGD, July 4, 2023).

Most of the informants emphasized the need for functional materials and equipment in the KIP. They believed that the project infrastructure could improve if the local government showed greater concern. To understand local government planning regarding infrastructural development in the project, a key informant interview (KII) was conducted with a teacher (pseudo-professional) from the Khageri Irrigation Division Office. According to R. Shrestha (pseudonym), the equipment must be in proper working condition; otherwise, it becomes difficult to circulate water to the fields of beneficiary farmers. He explained the importance of such equipment and the role of the local government as follows:

I am R. Shrestha (pseudonym), a journalist (pseudo-profession) at the Khageri Water Division Office, Bharatpur. My role is to monitor the performance and existing condition of the entire project. The division office provides lining facilities and conducts desiltation activities by hiring local workers. We have introduced the VRB system, known as the village road bridge, which helps protect the edges of the canal. However, I am not satisfied with the existing condition of the gates. Their operation, maintenance, and farmers' habits do not follow the rules and regulations (R. Shrestha, pseudonym, KII, June 29, 2023).

Based on interviews, observations, FGDs, and KIIs, it can be concluded that one of the key domains of irrigation management in the KIP is the management and operation of physical infrastructure. Weak and deteriorated infrastructure hampers the effective

functioning of the project. Most branch and tertiary canals were found to be unlined, resulting in serious problems of water seepage. Therefore, concerned authorities must pay attention to addressing these infrastructural issues.

The efficiency and reliability of an irrigation system depend on the condition and performance of its physical components. The physical infrastructural condition of the main, branch, and tertiary canals was lower than their working condition. They were fragile. Most importantly, equipment, like water gates, shafts, and canals, was below working condition. The damaged wooden ladder, as noticed at the headwork site, surprised the researcher. They forget that irrigation system management is linked to humans' lives and livelihoods. Irrigation brings transformation to the soil. It helps to produce larger crops, which ultimately protect soil.

E. Sen (pseudonym, personal communication, June 29, 2003) stated that the physical infrastructures of the KIP, like the canal, shaft, and water gate, were not in working condition. They were old and outdated. The condition of the canal was weak. Those park authorities denied us entry inside during the emergency. The canals run through the dense forest. Dead leaves, branches, and stumps of trees created problems like siltation and water blocking. He added that the main canal, about seven km long, remains inside the CNP.

In some cases, gates meant to divert or block water had developed large holes. In several stretches, tall grass and weeds had overgrown the canal banks, and discarded materials such as plastic bottles and animal carcasses were visible in the water channel. A recurring problem noted by both farmers and local stakeholders was water seepage, attributed primarily to the unlined structure of the canals. A female farmer from the Ujelinagar branch explained that due to severe seepage, adequate water rarely reached the agricultural plots, especially during the dry season.

Informants expressed dissatisfaction with the poor state of canal infrastructure. They mentioned that most branch canals lacked proper lining and many structures such as gates, handrails, and scaffolds were not in functioning condition. A 62-year-old farmer, J. K. Rimal (pseudonym; personal communication, April 10, 2023), from the Gitanagar section recalled that, in earlier years, the canals were in a working condition, but now many segments have become non-functional due to neglect and water seepage.

L. Rojaiya (pseudonym, personal communication, April 7, 2022), another informant farmer who belonged to Branch No. 6, in the Shivanagar section, commented that irregular inspection and maintenance were the main causes of infrastructural degradation. A local leader and social activist from Saradanagar from the tail end of KIP, M. Rathi (pseudonym, personal communication, April 9, 2022), voiced similar concerns, stating that water availability had declined so drastically that rice could be cultivated only until the first week of Bhadra. He attributed this scarcity to seepage and the deteriorated canal structure. He added that obtaining sufficient irrigation water from the project today is nearly impossible.

One of the informants' farmers, R. Dhakal (pseudonym, personal communication, April 8, 2022) of Shivanagar, confirmed that the aging infrastructure was the main reason for water loss. He explained rodents such as rats and snakes had dug holes in the canal embankments. It further aggravated seepage. Another farmer from Devnagar Branch No. 1, T. Kunwar (pseudonym, personal communication, April 10, 2022) reiterated that the absence of lining was a principal cause of water leakage. Members of the main canal committee also emphasized that this structural weakness had led to frequent water-related conflicts among farmers.

Scarcity often triggers disputes between upstream and downstream users. Several farmers lamented that poor irrigation management had accelerated infrastructure

deterioration. Many informants attributed it to insufficient monitoring and maintenance, combined with limited support from both the WUAs and government authorities. Farmers felt that WUA members lacked sincerity and that government agencies had not paid adequate attention to infrastructure repair and upkeep.

One of the key informants, A. Khadka (pseudonym, personal communication, July 23, 2023), a gate operator locally referred to as *Dhalpa*, explained that flooding from the Khageri River frequently damages canal structures and sluice gates. He stated flood control and infrastructure protection were major challenges for the project. A local representative also noted that rodents such as rats and snakes caused further canal erosion, though the ward office was making efforts to mitigate these problems.

The field observation concluded that the main canal and its function are satisfactory. The main canals were found lined. The gates were functioning well. It shows the government is providing attention to the main canal. Those branch canals and tertiary canals were found deteriorating. Inside the canals, there existed tall grasses, snakes, and rat holes. Those canals were unlined. There existed the problem of water leakage and siltation. The pattern of irrigation management is divided into two parts. It is the responsibility of the local government or district irrigation office to look after the main canal. Unlike the branch and tertiary canals, they came under the responsibilities of the water users' association and community members. Maybe because of budget constraints, those users remain less active in its functioning.

This institutional arrangement has resulted in uneven levels of maintenance across the system. The condition of KIP's physical infrastructure reveals systemic neglect and poor maintenance. It resulted in inefficient water delivery, seepage, and user dissatisfaction. Unless timely rehabilitation and regular inspections are institutionalized through coordinated action between the government and WUAs, the project's sustainability remains at risk.

4.1.4 Environmental Concern

During interviews with beneficiary farmers, most of them raised concerns about the shifting of settlements near the headworks of the Khageri River. According to them, that has led to problems of water scarcity and environmental degradation. Similarly, the informants expressed dissatisfaction with the increasing trend of pollution created by farmers inside the canal. During the lean season, many farmers accumulate dust inside the canal, which creates a foul smell. Farmers from the head-end section were reported to throw dust particles, including animal carcasses, into the canal. This practice causes pollution and degrades the environment. One of the farmers from the Mangalpur section expressed his dissatisfaction as follows:

My name is F. Rojaiya (pseudonym). I am the real victim of this project. I belong to the Mangalpur section, the tail-end section of the KIP. I am facing problems with environmental pollution and dust in my area. Farmers from the head-end section throw animal carcasses into the canal. It results in water-borne and eye-borne diseases. It causes environmental pollution (F. Rojaiya, pseudonym, personal communication, July 2, 2023).

There is a strong need for proper monitoring and a penalty system for wrongdoers. The interview revealed that farmers from the tail-end sections were facing multiple problems, largely related to environmental degradation. Another farmer from the Shivanagar section also explained how the shifting of settlements became a cause of environmental degradation in the project. He described the situation as follows:

I think the problem in the KIP is induced due to the shifting of the Padampur settlement near the headworks of the Khageri River. Initially, it was inside the Chitwan National Park. This shift created problems such as water scarcity and

environmental degradation. People in that region pollute the water and divert it on their own without obeying existing rules and regulations (X. Tharu, pseudonym, personal communication, June 29, 2023).

Both interviews reflect serious concerns regarding environmental protection. It is necessary to prioritize environmental considerations before conducting any kind of development activities. To verify the concerns raised by X. Tharu (pseudonym, personal communication, June 28, 2023), the researcher discussed the issue of the Padampur settlement shift with the shopkeeper (pseudo-profession) of the Khageri Irrigation Water Consumption Committee. He stated that the relocation was a planned activity carried out by the local development office. To further clarify this issue, a key informant interview (KII) was conducted with K. Baral (pseudonym, KII, 11 April, 2022), an official of the Bharatpur Local Development Office and spokesperson for the irrigation department. He explained the overall situation of the KIP as follows:

I can say that the shifting of Padampur village near the headworks of the Khageri region was a decision made by the local government of Bharatpur Metropolitan City. I admit that it has brought several issues, including environmental problems and water scarcity for tail-end farmers. I think the government should think seriously before implementing such decisions. There is water scarcity in the region. To mitigate this problem, we are providing subsidies to farmers. We provide two lakh rupees to each farmer for the purpose of deep boring. I know that providing subsidies for deep boring is not a long-term solution, as it may create several environmental disturbances in the future (K. Baral, pseudonym, KII, June 27, 2023).

Before conducting the developmental activities, it is necessary to assess the environmental impacts. Failure to properly assess environmental consequences can lead

to serious degradation. It includes water division, allocation, and distribution shortages. The concerned authorities should be careful before taking such actions. It is necessary to maintain a feasibility study before such forced migration practices. Those government bodies should make necessary exercises and plan accordingly for such sensitive issues. Similarly, local government distributed a budget for the deep-boring system. It may have its negative impacts in the future. Rather than working to increase the water capacity, the government signals for boring. It leads to environmental destruction. The forceful practices of extracting underground water without searching for other options might have serious effects in the future.

During the observation, the researcher noticed the overall condition of the project was deteriorating. The canal had acted as a big dustbin for the villagers. They accumulate and throw dust particles inside the canal. It escalated issues like health hazards and pollution. Researchers had seen animal carcasses, plastic bottles, and other waste materials inside the canal. There was a threat of spreading communicable disease.

The farmers from upstream were not attentive. They were not responsible for creating such pollution. Farmers from the head section throw garbage, and it reaches the mid- and tail sections, and their locality. It became an issue of conflict among riparians. During an FGD, one of the informant farmers showed his rage against such malpractices. R. Shrestha (pseudonym, personal communication, June 21, 2023) stated that those head-end farmers monopolized their decisions and actions. He added that once his ten-year-old daughter became ill, he found the causative agent of her illness was the foul smell and pollution that was near the canal attached to his house. Therefore, it is a serious issue. Every user should be humanizing and empathetic before doing anything wrong to others.

Other participants during the FGDs showed their dissatisfaction and strongly condemned such activities. One of the informants mentioned his dissatisfaction as follows:

We are the real victims; we stay in the tail end section of the KIP. We hardly get water. We face the problem of water scarcity and pollution, resulting in foul smells all the time. What the hell are we living? Many times, my family members were suffering from headaches, nausea, and vomiting. We want to know the reasons behind shifting the Padampur settlement farmers to the headwork side of the Khageri River. It has a direct impact on us. They consume water; as a result, we are compelled to face the problem of water scarcity (R. Chaudari, pseudonym, personal communication, June 18, 2023).

Those WUAs were formed for the effective implementation of the project. They are supposed to provide equal and equitable water to all the farmers regardless of their regions, caste, gender, class, and occupations. In contrast, those WUAs formed in the KIP were responsible for their duties. They do not encourage the farmers to protect and promote such natural resources. They were biased and selfish for personal gain. Findings show that they prioritize their relatives, friends, and those who follow their political ideologies. Hence, it is evident that politics is universal.

In an interview, S. Tamang (pseudonym, personal communication, July 23, 2023) expressed his opinion that the functioning of the WUAs was not satisfactory. Most of the members do not know the importance of environmental protection. He thought that there was a serious need for training for those WUs.

4.1.5 Water Users Associations

One of the important domains of irrigation management is the cooperation and collaboration of the water users' association. They function as a medium to link farmers' communities and government.

During FGDs, most of the farmers expressed their reservations about the work carried out by WUA members. They stated that WUA members were not sincere in addressing farmers' issues. According to the informants, the elected members lacked accountability and responsibility. They were also perceived to show biased attitudes during water distribution in the fields. B. Tamang (pseudonym), one of the female informants from the Shivanagar section, described the behavior of WUA members during an FGD as follows:

I don't like the attitude of the WUAs. I requested the branch committee chairperson to manage some water for my field, as my land belongs to the tail-end section of Mangalpur. Although there is a water rotation system, I always have to rely either on rainwater or deep boring. Many times, I requested the chairperson, but he did not show any concern. Later, I came to know that a person just above my field had bought some land. He had a connection with the secretary of the water users' committee. He easily received water in his field without any hassle. Therefore, I consider those members to be biased and guided by partiality (B. Tamang, pseudonym, personal communication, July 4, 2023).

This indicates that although WUA members are elected by beneficiary farmers, they were not sufficiently sincere in performing their duties. While this generalization may be fallacious, the findings of this study reveal such tendencies. In a key informant interview (KII) with the businessman (pseudonym) of the Khageri water consumption

committee office, D. Karki (pseudonym) explained the functioning of the WUAs as follows:

WUAs members are elected through a voting system. There are several associations at the main, branch, and tertiary levels of the project. However, in some cases, members may show biased attitudes, which is not acceptable. As a businessman (pseudo-profession), I will take necessary action against such wrongdoers (D. Karki, pseudonym, KII, July 13, 2023).

WUAs are the integral domains of the irrigation project. This study shows the functioning of the WUA members is not satisfactory. They fail to collect the water fee. Those members are not found to be serious and result-oriented. In the case of KIP, those WUA members conduct regular meetings, but it was nominal.

The WUAs are formed through the election and voting practice. The representatives are formed from different ethnic groups, castes, and genders. The members and executives, like the chairperson and secretary, were formed through the voting of the beneficiary farmers. Those elected chairpersons of the *Kulo Samite* became members of the branch committee. Those chairpersons of the branch committee became members of the main committee. The executives of the main canal committee, including the chairperson, secretary, and treasurer, were elected as per the consensus of the committee members. Those executive committees should be responsible towards all the beneficiary farmers. They have to conduct a general assembly every year and show the details of their performance and financial condition. Information regarding the date, time, and venue of the general assembly is communicated through mobile phone notifications and word-of-mouth among farmers.

The KIP was established in 1969 with the goal of irrigating approximately 3,900 hectares of agricultural land. It was initially monitored by the government, and later on, ownership was transformed to the community members. Under this joint management arrangement, the DOI retained responsibility for the intake and main canal operations, whereas ownership and management authority over physical, financial, and human resources were transferred to the WUA. The WUA thus assumed key roles in water distribution, maintenance, and management of the irrigation infrastructure below the main canal level.

Financially, the WUA collects an irrigation service fee (ISF) of NRs. 300 per hectare from the users. In addition to ISF, the WUA generates revenue from other sources such as land leased from the Department of Irrigation, fishing contracts in the canal, cooperative ventures, and sales of fertilizers and seeds. The research notices that those main canal committees and branch canal committees have their own role and functioning. The main canal committee should be accountable and responsible to all the beneficiary farmers. Unlike those branch canal committees, they should work to solve the problems of their particular section. If they find any issue, they can consult and coordinate with the main canal committee.

One of the informants during the general interview, P. Ghale (pseudonym, personal communication, July 19, 2023), narrated the system of KIP and its functioning. According to him, there is a main canal committee. It is formed under the chairperson of the branch committees. The president, vice president, and secretary were elected through the annual general meeting. Three females are nominated to the main committee. There is gender inclusion.

It is found that the branch committee is comprised of seven members. It includes a president, a vice president, a secretary, and four other members. The additional

members are included from the *Kulo Samite*. WUAs' coordinates to operate the KIP. In difficult cases. Local government officials and the district irrigation office monitor the project operation and functioning. There is frequent coordination among the farmers, institutions, and local bodies. The project runs with the levies raised by the water users. Some of the farmers praised the performance of the WUAs. They were involved in the planning and procedural management. They divided the work. The planning of the main canal is the duty of the district irrigation office, and the remaining canal is the duty of the WUAs and beneficiary farmers. The government provides economic support for its repair, maintenance, and cleaning-up activities.

Based on the researcher's observation, the coordination and working practices of the project are not satisfactory. There is the issue of siltation, blockages, and seepage. The administrative state hardly visits the project area. WUAs members do not inform the farmers about the scheduled meeting timing, place, agendas, and activities. There is the need for an effective communication mechanism among all the beneficiary users for the collective protection of such resources.

The work criteria, schedule, and routine have not been clearly illustrated. Those WUAs should maintain their daily work schedule, agendas, meetings, talks, and discussions. The canals were frequently found below the working condition, yet those WUs do not provide a serious concern.

It is concluded that the principal domains of irrigation management in the KIP include institutional arrangement systems, water users' associations, farmers' involvement, physical infrastructures, and environmental concern. These domains are functioning directly or indirectly in the project. The physical infrastructures like the canal, gate, shaft, and chain should be in working condition. The gate was found with a hole, which

could not function effectively. Those WUAs should work without having any bias. Moreover, the users should know the importance of environment protection before throwing any kinds of dust inside the canal.

4.2 Discussion and Analysis

There are basically five principal domains that work to manage the irrigation system of the KIP. One of the domains is the institutional arrangement system. It refers to the bodies that have their legal rights and ownership. In this study, "institution" refers to the government bodies that are working for the protection and promotion of irrigation projects. At the national level, there are ministries and irrigation offices that work to strengthen the project functioning.

At the provincial level, the provincial irrigation ministries and irrigation development division issue, monitor, and draft the necessary rules and regulations for its functioning. At the local level, local government units, municipalities, rural municipalities, and irrigation divisions are functioning. In the KIP, the district irrigation division and Khageri water consumption office jointly work to steer the project. Set necessary rules and regulations by coordinating with each other.

The institutional bodies make necessary rules and decisions and communicate with other stakeholders. It supports effective irrigation management. Wang and Chiu (2021) stated the institutional domain of irrigation management shapes farmers' cooperation and collective management behavior. Largely, those institutions in the KIP are working for the management of farmers' cooperation and their collective benefit. Yet, they fail to keep those users under the established rules and regulations. Those institutional bodies formulate rules, but those rules were not effective. Those wrongdoers are not provided with necessary legal actions.

The findings indicate the overall condition of the KIP and its functioning. Those physical infrastructures were not in working condition. The physical components, for example, water gates, crowns, and shafts, were below working condition. The observation also reminded me of the existing condition of the project. The canals were not lined. It created the problem of water seepage. It is affecting the functionality of the project.

Jeniffer et al. (2025) stated the theory of institutional management, in which they explore how rules, systems, behavior, and professionalism shape the condition of any institution or project and its functioning. In this context, the institutional practice of the KIP remains weak. The rules, systems, and behavior of the users show there is still the need for strict institutions to control such systems. In this context, Ostrom (1990) emphasized the collective management practices for the use of such natural resources. This practice is lacking in the study area. The users were reluctant to unite for the project's betterment. Now, farmers even hesitate to pay their water fee.

Tang (1992); Kelly (1983) and Suhardiman (2016) stated the necessity and importance of institutions for their meaningful functioning. According to them, institutional arrangement should ensure sufficient water distribution and long-term water project functioning. In the case of the KIP, the users deny rules and regulations. They considered those established rules and provisions granted. They do not have fear. It is also necessary to have a fear-arising tendency within the institution. The users or members should follow it by remembering the would-be danger and threats. The institution should be able to penalize those who go against the existing rules. It is lacking in the KIP.

There are adequate rules as formed in the KIP office, yet the implementation part is weak. For example, there is a rule related to water fees and the mandatory presence of

farmers for the repair and maintenance activities. However, the members hardly take part in the meeting. There are no penalties made mandatory for those wrongdoers. Some farmers do not abide by the system of water rotation. There is a system of water monopolies. Usually, those upstream farmers don't show cooperation to the tail-end farmers. It is necessary to implement rules for effective system management.

Nikku (2002) stated institutions are socially embedded systems of norms and practice. In the KIP, institutions are formed based on democratic practices and acceptances. Violating rules is proportional to questioning self-existence. It is necessary to emphasize that if we don't pay the water fee, there might exist the problem of financial crises. It resulted in further deterioration of the project.

As stated by Michael (2008), the institutional approach to irrigation management is necessary for government capacity to plan and control irrigation systems effectively. The government bodies in the local context were passive in taking action against those who do not follow the rules and regulations. Small (1985) defined institutional arrangement systems as those that should run as per authority and command. It is true that no organization or institution can function without the proper implementation of rules and regulation. Such an institution can be considered dysfunctional. In the case of the KIP, if farmers do not obey rules, it affects the position of the institution. The planner should consider its reframing. Any institution that fails to enforce rules and penalties for issues like fee collection and user training is marked as a failure organization (Tandukar & Shrestha, 2025).

The institutions of the KIP can be marked as a weak governing body. Chai and Schoon (2016) advocated for the decentralized coordination mechanism between government and the local actors under the institutional arrangement system. According to them, it is necessary for findings, administrative management, participation, and monitoring and evaluation. Those government bodies are responsible for managing the main canal.

Those community and user groups have responsibilities to look after the branch and main canal. They have divided their areas, and their functioning is not found well.

Lack of enough financial sources, so those community members could not line the canals. It results in water seepage. As stated by Ozerol (2013), the institutional bodies, if found not effective, bring mismanagement in terms of excessive water use, access, weak monitoring, and farmers' exclusion from planning. Similar in the KIP and its functioning. The findings show that there is rotational practice, but due to the institutional shortcomings, the function of the project is becoming weak. There is the case of the exclusion of farmers in a meeting. The water is unevenly distributed. And the monitoring and evaluation part is weaker. As stated by Ostrom (1992; as cited in Mabry, 1996), institutions should support the equitable and efficient resource management.

Unlike in the KIP, the institutional bodies cannot work as per the system. They can be considered a failed agency for maintaining law and order. They are unable to equip themselves with binding rules and regulations. The institutional personnel should be morally sound. It is true that the performance of the institutional members is not satisfactory, but during the study, no officials were found corrupt. They tried their best to implement the rules, but the farmers refused to follow. This creates a problematic situation for the project. The irrigation projects in China were effective (Chai & Zeng, 2018). The beneficiary farmers, according to them, follow the existing rules and abide by the law. In the case of KIP, the rules, unlike Chai and Zeng, couldn't be effective. It might be the cause of institutional arrangements and their shortcomings.

An institutional arrangement system should be organized for the implementation of strong rules and regulations (North, 1990). It is, therefore, the institutional arrangement system that must run strictly. Those officials and authorized bodies should take

necessary actions for those who do not obey rules and want to acquire the resources free of cost. Similarly, it is necessary to maintain a quick response model for those who do not pay water fees or participate during the repair and maintenance activities. The level of farmers' participation determines the project management and its implementation. Participation is necessary for the expected output. The collective participation of farmers and their interaction is necessary for the regular functioning of such projects.

Ostrom (1990), Baland and Platteau (1996), and Ozerol (2013) stated the collective participation of farmers plays a significant role in maintaining irrigation infrastructure. It ensures equitable water distribution and resolves conflicts among users. Unlike in the KIP, the farmers' participation is weak. Farmers show less concern related to the project functioning. Those farmers think that it is the responsibility of government and WUAs to provide them water at any cost. Such misunderstandings bring about a case of violence. In reality, acquiring, managing, arranging, distributing, and circulating the resource are common acts for all. In case the situation demands meeting those government officials, those farmers should move hand in hand for its effective implementation.

The findings from the KIP reveal that farmers' participation in maintenance and operation activities is relatively weak. Informants during the interview stated that farmers' participation is not satisfactory. Some farmers were selfish, as they did not even bear their responsibilities. The farmers from the head section do not cooperate with the farmers of the tail section. It shows farmers' attitudes and their way of perceiving reality are still not satisfactory. Suhardiman (2016) noted that effective irrigation systems depend on the cooperative nature of the farmers, which is lacking in the KIP management and system performance.

The farmers of the KIP were less committed in their work and action. Most of the farmers, as per the study, were busy with their personal work. They do not pay attention to the canal. They own a bore, which they found easy for irrigation management.

Ozerol (2016) highlighted the necessity of farmers' commitment to the collective irrigation management and its best outcome. Thapa (2002) added the need for adequate farmers' participation and training. Such trainings help them to ensure the way of project handling is correct. These things are weak in the KIP. Suhardiman (2016) studied irrigation management systems in Indonesia. He showed the importance of farmers' participation for the implementation of such projects. Therefore, these findings are important to assess the existing condition of the irrigation project. There is a need for farmers' participation for the successful implementation of the project. If farmers show their concern, it will help to make the institution accountable and responsive. These issues are not as expected.

WUAs are another principal domain in KIS handling and management. These associations are responsible for settling the issues of conflict, ensuring an adequate supply of water, raising water fees, maintaining a rotation system, and linking the farmers and the government bodies to settle their existing problems. Scholars like Kattel (2006), Pradhan (1989), and Sampath (1992) highlighted the necessity of WUAs. They help to maintain effective institutional practices. In the KIP, there are different categories of WUAs, but their functioning is still below expectations.

During an interview, many informants show their concern related to the functioning issue of the WUAs members. Those members largely work to maintain their personal gains and benefits. It is necessary to improve such behaviors for the sustainability of the project. The study also shows those WUA members became biased while distributing and circulating water. They intentionally violated the rules and rotation

system. It is also true that WUA members fail to collect water fees and penalize the wrongdoers.

Those WUA members are also necessary to provide adequate training about the functioning of such projects, as stated by Pant (2008). There is the need for proper communication among the members of the WUA, farmers, and other water users. They should compulsorily inform the farmers about the meeting date, schedule, agenda, and time. These things are lacking in the KIP.

SamPATH (1992) highlighted the major roles of WUA members. They have to operate and manage the irrigation system, collect fees and dues, coordinate between farmers and irrigation authorities, and ensure cooperation. As stated by SamPATH, the WUA members should work to maintain such effective practices in the KIP. Regmi (2007) stressed the need for a WUA during the emergency functioning of the project. Those activities include canal reconstruction, clearance of debris, maintenance of cracked lining, and siltation and seepage management. The final decision worked as stated by Schoengold and Zilberman (2007) for any irrigation functioning and management of the WUA members.

Hence, those members become as neutral as possible and use their rationality for the equal, effective, and equitable resource allocation, distribution, and functioning of the project. Similarly, Pradhan and Bangaragoda (1998) emphasized the role of WUAs for sustainable irrigation management. They should develop leadership in their work and performance (Pant, 2008). These aspects are nominal in the study area.

Environmental concern is an important domain of the Khageri irrigation project. Those canals were not properly lined. Because of this, it creates problems like water seepage, siltation, and sedimentation. Those gates that are supposed to block the water have

holes. It is not in a functioning condition. Even though Easter (2000) focuses on the physical infrastructures of the irrigation project as the backbone for the irrigation management system, these serious aspects are not given much consideration.

In this concern, Lam and Ostrom (2010) also highlighted that reliable infrastructure is necessary to maintain effective irrigation system management. The concerned authorities should pay attention and care to the improvement of the physical infrastructure and its functioning. Burtons (2010) listed out the physical infrastructures. It consists of the conditions of the canal, drains, road access, and field layout and planning. As stated by Wang and Chen (2021), the condition of those infrastructures will be functional only if the concerned authorities pay enough attention to their functioning. Those authorities can be either government officials or water users' committees.

Environmental concern is a serious issue. KIP creates serious environmental hazards. Those farmers who belong to the upper section throw dust particles, dead animal bodies, and other harmful substances inside the canal. They take the canal as a dustbin. It has its serious impact on the lower-section farmers. Those farmers who settle near the tail end and those who have their houses near the canal feel it is difficult to live. It creates the problem of foul smells and environmental pollution.

Easter (2000) pointed out environmental concern as an important domain of irrigation management. Easter criticized the case of shifting settlement or resettlement programs. While shifting the settlement from the construction area to other places, the concerned people should make adequate feasibility studies. The shifting of Padampur village near the headwork site of the Khageri River induces various environmental hazards, like pollution, water shortages and distribution, and allocation practices. Ozerol (2013) professed the issue of soil and water degradation, pollution, and ecosystem imbalance

in most of the irrigation systems. The KIP cannot be isolated from such problems. There exists the problem of canal degradation, seepage, erosion, and landslides. These issues are necessary to solve on time.

These domains of irrigation management have been thoroughly discussed and analyzed based on the empirical studies and secondary review along with the strong participation of the researcher by contributing his analytical views. The next chapter deals with the issues that induce conflict in the Khageri irrigation project.

CHAPTER V

ESCALATING FACTORS OF CONFLICT IN KHAGERI IRRIGATION PROJECT

5.1 Introduction

This chapter examined the major factors that give rise to conflict within the KIP. The findings of the study revealed that water scarcity is the primary cause of conflict. Since water is essential for crop production, competition for its use becomes inevitable when the supply is limited. The deprivation of water among certain users created incompatible goals among farmers.

Several additional issues drive conflicts within the system. These include the denial of riparian rights, persistent water scarcity, disputes over resource ownership and usage rights, encroachment along canal alignments, restrictions related to park or protected areas, increased irrigation service fees, legal and administrative barriers, transboundary water treaties, and the impacts of climate change. Each of these factors further complicated the equitable management of irrigation water and increased the potential for disagreement among stakeholders. These issues were identified through the field study and interviews with the stakeholders.

5.1.1 Denial of Riparian Rights

One of the main canal committee members from the 0 and 1 branch sections of Gitanagar, during the interview, reported that conflicts in the KIP often emerged due to the behavior and attitudes of water users. A primary cause of conflict was the tendency of head-end farmers to deny water access to those located at the tail end. He recalled an incident of mishap as follows:

Once, a member of the main canal committee representing the Gitanagar section attempted to divert water forcefully to the Shivanagar section. It was our turn to

use water. We belong to Gitanagar. When I refused to release water, the other member tried to seize the water gate key and pushed me. It resulted in the loss of my gold chain during the scuffle. Although my friends wanted to retaliate, I stopped them, and the aggressor later apologized (G. P. Bantawa, pseudonym, personal communication, June 27, 2023).

Another recorded incident occurred in section no. 3 of the Gitanagar branch canal: the conflict due to the construction of a house near the irrigation canal. It blocked the free flow of water. The incident was narrated as follows:

A house was constructed near the canal alignment. It obstructed water flow. The owner of the house initially refused to permit water passage, but the WUAs intervened by calling the police. The police compelled the owner to allow water to pass, and a pipe was installed to ensure continuous flow. This led to a heated argument between the house owner and WUA members. Later on, the house owner was compelled to dismantle some part of his house (D. Karki, pseudonym, KII, July 13, 2023).

It shows the mentality of people who sometimes create conflict. Actually, no one can destroy the public property. The man who tried to construct his house by blocking the free flow from this study could be foolish. He should not forget the consequence. Due to the construction, farmers who belong to the tail end section could not get water for cultivation. Such events showed that one of the major causes of conflict is the issue of riparian rights. It means the farmers who belong to the mid- and tail-end sections shall have equal and equitable rights to acquire water for their crop cultivation.

A forty-six-year-old female farmer, S. Sharma (pseudonym, personal communication, July 17, 2023), from the Mangalpur section during the FGD shared that head-end

farmers received sufficient water, while tail-end farmers were deprived. She recounted an incident where a tail-end farmer threw a stone at a head-end farmer after being refused water. She also recalled hearing about a stabbing incident that occurred in a similar dispute. She, along with other farmers during an FGD, expressed their dissatisfaction that head-end farmers frequently refused to share water during cultivation as follows:

I find it difficult to obtain water for cultivation because the head-end farmers do not allow us to use it. Once, a farmer from the Bahun community, who was from the head-end section, threatened to hit me with a spade when I asked for water while sowing paddy. We had a verbal argument, and other farmers overheard our quarrel (S. Sharma, pseudonym, FGD, July 10, 2023).

This situation reflects a lack of coordination and cooperation between the head- and tail-end farmers. The budget allocated for the infrastructure repair and maintenance is not sufficient. It is necessary to maintain strong finance for the effective flow of this project. This study focuses on the fact that there should be a proper lining system for all the canals. But the problem lies with the limited budget. The government needs to provide financial support for the effective infrastructural management system. The issue of conflict is natural when those upper riparian or head section farmers deny providing water to the tail-end section farmers.

Most of the farmers enjoy excessive water in the head section due to their locational advantages. It is considered a wrong practice. All the users should know the value of natural resources like water. It is a common property resource, which means everyone shall have the right to consume it. It is called an unalienable right. One of the farmers of age 60, P. Prajapati, who belonged to Shivanagar (pseudonym, personal communication, June 17, 2023), stated that one of the causes of conflict is the nature of

those water users. Those farmers, mostly in the head section, do not obey the rules. They monopolize the water. They don't follow the rotation system. He expressed his sorrow that those farmers were not given any sort of punishment.

One of the members of the Gitanagar section reported the issue of irrigation conflict as follows:

In the KIP, once, a person started constructing his house despite knowing it would block the free flow of water to other regions. Other main canal members, including me, went to stop such acts. He didn't obey us. I immediately called the police from Gitanagar. Police arrived. I, along with some other main canal committee members and the house owner, went to the police station. Police informed him of the result of house construction near the canal. Only then did he become flexible and change the foundation of his house (G.P. Bantawa, pseudonym, personal communication, July 6, 2023).

There is an interplay between power politics and influences. Those powerful or elite farmers do not follow rules and regulations. They have their domination simply because they are economically powerful. Those authorized WUA members even could not keep them inside the rules and regulations. In contrast, those normal, poor, or so-called untouchable farmers who often belong to the tail-end sections have to follow all the rules and regulations and accept the dominance, inferiority complexes, and submissive character. In an FGD, one of the female farmers who belong to the tail end section, R. Karki, stated the situation of violence as follows:

I am R. Bhusal. I belong to the so-called lower caste. I am from *the Damai* community. I remember the incident of domination. Last year, I was about to plant paddy on rented land, which is located near my rented house. It was my

turn to use the water for paddy planting. I called all the workers. While we were about to plant the paddy, one of the old men, age 70, who belonged to the head-end section, forcefully cut the water supply canal and took it into his field. I was surprised. I went to talk to him. He stated that he belonged to the upper section and it was his right to use it whenever and wherever possible. I remember he is from *the Bahun* community. I requested him to provide water as I was about to plant the crops. He shouted using the slang words. I feel disappointed while remembering such an incident. When will we get justice for our fundamental rights as living beings, like humans, not animals (R. Bhusal, pseudonym, personal communication, July 27, 2023).

These kinds of incidents made researchers emotional. She is the representative character in the project. Many farmers are living such a suppressed life. Similarly, K. Tamang (pseudonym, personal communication, 11 July, 2023), the informant during an interview, stated the inducing factors of conflict in the KIP. Farmers show a limited response to the resource division and allocation practices. One of the farmers, who belonged to Shivanagar (P. Bogati, pseudonym, July 4, 2023), stated that disputes between the East and West Chitwan farmers over the use of water from the Khageri River are as follows:

I remember there was a physical confrontation between East and West Chitwan farmers in the name of water allocation and distribution. The eastern region lies in the Ratnanagar municipality. The origin of the Khagri River lies in Ratnanagar. The flow of water, in contrast, covers West Chitwan, which is the Bharatpur metropolitan city. This KIP lies in the Bharatpur metropolitan city. They denied sending water to Bharatpur. It turns the situation into violence. All the farmers from Bharatpur went and there was a physical fight. Some of the

farmers were injured. Later on, police came and turned the situation back to normal (P. Bogati, pseudonym, July 4, 2023).

One of the farmers who belong to Mangalpur, the tail end section of the KIP, became emotional while interacting with the researcher. He showed his dissatisfaction and anger at the same time. He stated the pattern of water rotation as follows:

I am S. Gurung. Generally, I get water during mid-August. It's been four years; I am not getting water for the paddy plantation. I should rely on a deep boring water source. I realize being a farmer who belongs to the lower section is like a curse. Water from the KIP is more suitable for adequate crop production instead of that boring water. Those WUAs do not work to favor us. If we then institutionalize the water rotation system, we will acquire water. I am tired of observing the attitude of the farmers who belong to the upper section. They are misusing water, and we are getting this reward (S. Gurung, pseudonym, personal communication, July 7, 2023).

One of the farmers from Mangalpur narrated another case of violence among the regions of Chitwan. T. Dhital (pseudonym, personal communication, July 8, 2023) stated some of the farmers from West Chitwan went to East Chitwan carrying some knives, or khukuris, as the farmers from East Chitwan intentionally blocked the water supply. It again turned the incident into violence. Many were injured. Later police controlled the situation.

Disputes were common among farmers from Ujelinagar, the headend section, and the farmers from the Gitanagar area, the tailend section. One of the female informant farmers who belong to the head end section of the KIP narrated the issues of conflict as follows:

It is our right to consume water first, as we belong to the Ujelinagar, the head section of this project. Other farmers stated that it is also our right to consume water. We are in dire need of water. If you do not let us consume water, we would take necessary actions (S. Shrestha, pseudonym, personal communication, June 30, 2023).

Tail-end farmers, particularly those from marginalized castes, reported being discriminated against during water allocation. A younger farmer from the same section stated that his community lacked the financial means to install boring systems, and their maize crops had failed due to water shortages. He added that upper-caste farmers acted arrogantly and often displayed superiority when asked to share water.

One of the informants' farmers, T. Kunwar (pseudonym), from the Gitanagar section, revealed in an interview that common farmers were deprived of water access in their fields, but powerful farmers who were in power and authority enjoyed water access. Such kinds of biased practices induced a situation of conflict in irrigation management. He mimicked a situation between two farmers to show the problem of water distribution. The first farmer said that he wanted to plant his field that day, and it was his turn to acquire water. But another farmer threatened that it was not possible because the paddy he planted in his field some days ago was in need of water. And the first farmer denied. Those kinds of conversations and tussles were found common in KIP because instead of following the rules or turns of distribution, it was more about personal fights or power tussles.

5.1.2 Water Scarcity

During the field observation conducted in the pre-monsoon, there was minimal water flow in the canals. The main and branch canals remained dry, and instead of water, the

channels were littered with garbage, dirt, and plastic bottles. Many farmers were deprived of irrigation facilities; as a result, large areas of farmland remained barren. Informants reported that while paddy cultivation was previously possible twice a year, the current water scarcity often prevents even a single sowing season.

One of the informant farmers from the Gitanagar section revealed the issue as follows:

Water shortage exists in KIP due to the unlined canal structure. Once, when there was water scarcity, we agreed to contribute economically as well as manually for lining the canals. After being aware of the farmers' commitment, the local government also initiated some action to provide necessary financial support (D. Pariyar, pseudonym, personal communication, June 29, 2023).

The interview with D. Pariyar (pseudonym) shows water scarcity is natural in the KIP. It is due to the lack of proper lining in the canal section. There is the problem of water seepage. In this context, a 57-year-old farmer from Shivanagar, C. Panta (pseudonym, personal communication, 15 July, 2023), during an interview, highlighted that water scarcity, particularly during the lean season, frequently induced conflicts in the KIP. S. Gurung (pseudonym, personal communication, July 22, 2023), in an interview, reflected his dissatisfaction as mostly the farmers from the tail section were the real victims. He shared the issue of conflict as follows:

I went to complain to the district irrigation office. We, more than ten farmers, were there. We raised the issue of water shortages in our section. The chairperson of Khageri water consumption, Gitanagar, stated the trend of water scarcity despite the proper rotation system. Meanwhile, one of our friends, D. Tamang (pseudonym), became so furious and about to hit the chairperson. There is not any rotation system. That chairperson, along with other canal committee

members, was busy doing politics. There is monopolization. The issue turned into a heated argument (S. Pant, pseudonym, personal communication, July 27, 2023).

D. Kumal (pseudonym, personal communication, July 18, 2023) explained that the head-section farmers affected the tail-enders. There was the problem of water scarcity. Those WUA members could not manage adequate water as per the demands. He said as a member of the main canal committee, they had to perform a water rotation system. He had to allocate only four days' worth of water to each section; this indicates that water shortage has been identified as a major source of conflicts in KIP.

From the observation and analysis of data from the Rampur meteorological department, it is identified that one of the reasons behind the scarcity of water is due to the chronic rise of temperature. It results in global warming. It has its serious impact on the biosphere. Similarly, the settlement of Padampur village near Sagun Tole, located at the upper section of the Khageri River, brought some conflicting cases. It escalates the problem of water scarcity for the tail-end farmers. It became the contributing factor of conflict, as stated by M. Pandit (pseudonym, personal communication, July 16, 2023).

According to R. Dhakal (pseudonym, personal communication, 13 July, 2023), disputes related to water issues were escalated due to the condition of water unavailability and weak project functioning. Even at times when farmers were in urgent need of water, either there was a water shortage or they needed to wait in a long queue. He was a member of the main canal committee; he talked about a situation in the past. There was such a serious scarcity of water in KIP. The Irrigation Office sent three representatives of WUA to each section of KIP to try to ensure fair and peaceful water distribution. Farmers from every section were furious because of the shortage of water. All the farmers united, and they descended upon the irrigation office. They started breaking

window glass and pounding on walls of the offices. He narrated the incidence as follows:

We, along with the protesting farmers, went to the Khageri Irrigation and Water Project Office to demand water to solve the problem of water scarcity. But the officer denied this request. The farmers were furious and about to tie the irrigation officer on a pole and beat him. We intervened and urged the farmers not to carry out such misconduct. We told them if they went ahead with this wrong conduct, they would have to bear so many troubles. Realizing that, we had controlled the situation from becoming violent (R. Dhakal, pseudonym, personal communication, July 3, 2023).

Another informant, P. Pandit (pseudonym, personal communication, July 4, 2023), from the Managalpur section, said in an interview that due to the limited water source, farmers in the tail-end section hardly receive water. The water scarcity situation was so dire. At one point, the WUA nearly gave up their responsibilities because they could not manage the situation. He stepped in to handle the situation. He assigned four days of water access for each section. He said that it was really challenging to manage the situation at that time.

These many incidents as narrated by the informants in the Khageri region make us believe that water scarcity is a major cause of irrigation conflict. The scarcity was caused by not having a proper canal lining system. Moreover, the fragile physical infrastructures.

5.1.3 Resource Rights Dilemma in Federalism

Several causes of irrigation conflict, as identified from the field study, were the dilemmas in resource management, rights, and ownership in a federal state. Federalism allocates power and authority to the federal, provincial, and local bodies. The limited

knowledge about authority and autonomy among the resource users induces conflict at the local level. The key source of conflict in the KIP arises from disputes over resource rights under the federal governance structure of Nepal. One informant farmer representing the Gitanagar section, S. Shrestha (pseudonym), in an interview explained the issue of resource rights and conflict as follows:

The farmers from Ratnanagar Municipality, an upper section of the KIP command area, often denied supplying water from the Khageri River to the farmers in Bharatpur Metropolitan in West Chitwan. Ratnanagar farmers claimed that because the river passes through their municipality, they had exclusive rights to its water. This created tension between the two local bodies. Negotiations were eventually held, during which it was clarified that refusal to supply water could lead to retaliatory restrictions by Bharatpur farmers. It highlighted the potential for escalation in water disputes under federal governance (S. Shrestha, pseudonym, personal communication, July 2, 2023).

One of the issues of conflict in the Khageri irrigation project is due to the limited understanding of the concept of federalism. It suggested that the concerned authority should provide essential knowledge related to the local ownership of the resource model among the farmers in the Khageri region. The limited understanding brought a state of confusion mostly between the farmers of Ratnanagar municipality and Bharatpur metropolitan city.

Similarly, a farmer from Shivanagar, in an interview, described a violent episode resulting from such disputes. He stated that farmers from Ratnanagar had denied providing water to the farmers of Bharatpur. It brought a violent battle between these two local bodies. He narrated the incident as follows.

Farmers from Ratnanagar blocked water supply to lower riparian users in Bharatpur. In retaliation, we farmers from Bharatpur confronted them armed with household weapons, including *khukuri* (metal knives), swords, stones, and *bhala* (iron rods traditionally used for defense against wild animals). The confrontation escalated into violence. It caused injuries on both sides. Some of my friends, including me, were seriously injured in that mishap. After that, there was police intervention and subsequent arrests of many farmers, including me. Later on, police took action against the farmers of Ratnanagar, as police said they should not block water to the tail-end section (T. Tamrakar, pseudonym, personal communication, July 6, 2023).

For the cross-verification of the issue, the Chairperson of the Kaberi section (pseudo section), Ward No. 50 (pseudo number), of Lanka (pseudo local level), A. Suhal (pseudonym, personal communication, 13 April 2022), was interrogated about this concern in the KII. He stated that it was the real incident. There was the physical fight in the name of water use between the farmers of Ratnanagar and Bharatpur. He stated the issue in the KIP as follows:

I am A. Suhal (pseudonym), ward chairperson of Lanka Ward No. 50 (pseudo ward). I heard about the incident of physical confrontation related to irrigation issues of the KIP. Twelve years ago, there was a physical confrontation between the farmers of Ratnanagar and Bharatpur over the issue of water consumption rights. The farmers of Ratnanagar showed their possession and forbade the farmers of Bharatpur from consuming the water (A. Suwal, pseudonym, KII, July 12, 2023).

According to the ward chairperson, those issues are not in the present context. During the FGD, many participant farmers stated that the farmers from the head-end section

generally show their supremacy in water use. One of the participants from the Mangalpur section stated the issue of conflict as follows:

I belong to the Mangalpur section, the tail section of the KIP. I forget the real date. Once, my father-in-law requested me to go to the assembly and make a protest against the farmers of the eastern side. Those eastern farmers belonged to Ratnanagar. During that time, those farmers denied water access to us. They claimed that the origin of the Khageri River is in Ratnanagar, so it was their right only to consume water. This issue reached a climax as many farmers from our region went to protest against it in the irrigation office (K. Koirala, pseudonym, FGD, July 10, 2023).

The issue of resource rights dilemma is still a persistent issue in the KIP. Though the ward chairperson M. Tamang (pseudonym, personal communication, 16 July, 2023), stated that farmers were provided necessary awareness programs in the area, the situation was not like he said. Many farmers had a common misunderstanding related to the issue of resource use. The issue was vibrant after Nepal became a federal state. Most of the farmers during an interview raised the issue of obstruction caused by the farmers of Ratnanagar.

5.1.4 Human Encroachment of the Canal

Human encroachment along the irrigation canal emerged as another significant factor driving conflict in the KIP. There was a police report in the district police office in Chitwan regarding the construction of a house by the side of the canal of KIP. In the KII, the deputy senior police officer who was also in charge of his office stated the case as follows:

Some of the farmers from the Shivanagar section of KIP came to visit our office, and they complained about the construction activities, which blocked the free flow of water. One of the farmers said there was the case of house construction near the side of the canal, which is illegal. He also added that in some cases, squatters with no legal land ownership settled along canal banks, obstructing the free flow of water and causing shortages, which in turn fueled conflicts among farmers. I requested to go against such acts. Later on, we followed the case with the help of the chairperson of that ward, and accordingly, the cases were solved (M. Pandit, pseudonym, KII, June 17, 2023).

One informant farmer, R. Prajapati (pseudonym, personal communication, July 13, 2023), from the Mangalpur section, shared in an interview a specific example where a person intended to build a house too close to the canal, threatening water flow. The committee organized a meeting with other farmers and strongly opposed the construction. Only after sustained protest does the individual comply with the legal requirement to maintain adequate clearance between the house and the canal. Female farmers from Mangalpur expressed similar concerns about farmers planting crops adjacent to the canal, which obstructed maintenance activities for tail-end farmers.

5.1.5 Restriction on Entering into the Chitwan National Park (CNP)

The 7 km long main canal of the KIP is situated inside the Chitwan National Park, which gives rise to tension between the park and farmers. During the observation, the researcher noticed that broken trees were blocking the free flow of water in the canal. There were tall grasses and dead leaves that acted as blocking substances. The farmers found it hectic to enter the park for the cleaning and repair activities. They were restricted from taking objects like axes and knives inside the park. Those farmers and WUAs found the process hectic, and they have to bear various administrative hurdles

to enter. It induced conflict between the farmers' group and park personnel. The concerned government or local bodies should provide easy access to entering the park for the speedy cleaning activities. An aged farmer, T. Thapa (pseudonym), from the Devnagar branch, the head section of the KIP, described the obstruction as follows:

It is quite difficult entering the CNP for the regular maintenance, repair, and cleaning of the canal as it lies inside the park. We are not allowed to carry axes. Bear hands are not functional for its sanitation and woods management. Obtaining permission to clear these obstructions was a lengthy process, delaying canal maintenance and reducing water availability for downstream users. The restricted access to CNP and the resulting obstructions were therefore a major factor contributing to conflict in KIP (T. Thapa, pseudonym, personal communication, July 8, 2023).

A member of the main canal committee and the informant farmer from the Mangalpur section explained in an interview the bureaucratic process required to access the park. According to him, entering inside the park is a tedious process. It takes a long time. Because of it, water gets accumulated and blocked in a specific place inside the national park. He narrated the discussion as follows:

My name is E. Sen (pseudonym). I am a beneficiary farmer of the KIP. The major issue of conflict is between the farmers and the administration of CNP. It is necessary to maintain the main canal. It is a tedious process to enter the park and conduct cleaning activities. First, farmers had to obtain a letter from the District Irrigation Division, which would then be sent to the CNP headquarters (Kasara) and finally to the warden inside the park. Delays were frequent. There were no wardens available to receive the letter, further postponing urgent maintenance activities. I suggest park rules should recognize the importance of

KIP to farmers' livelihoods (E. Sen, pseudonym, KII, June 28, 2023).

The issue of restriction inside the park is a major cause of conflict among farmers and park authorities. The concerned authorities should pay their proper attention to this case. It seems farmers were facing a real challenge. It is necessary to make them easier for their regular cleaning and repair activities.

5.1.6 Inundation of House and Market-Created Conflict

Flooding in the Khageri River had been another significant source of conflict in KIP. One informant, a member of the main canal committee in an interview, recalled an event when overflowing water from the canal inundated a mud house. The affected house owner called the police. It resulted in the temporary arrest of some WUs. Main canal committee members.

The chairperson of the main canal committee later intervened and mediated the situation to resolve the conflict. The flash floods and landslide create disturbances and dismantle the canals. It was unlined. These resulted in further water shortages and less production of crops. Almost all farmers complained about water scarcity during the interview. Farmers were deprived of crop plantations. In the past there used to be twice the crop cultivation, but in the present situation, farmers find it even difficult to cultivate once due to the water shortages in the Khageri River.

A member of the main canal committee in an interview recalled an event when flooding occurred in KIP. Due to flooding, water overflowed in the KIP canal, which inundated a house made up of mud. The house owner called the police. Police then arrested some of the main canal committee members of WUA. Later, the chairperson of the KIP main canal committee arrived at the police station. He mediated to resolve the issue. He gave a detailed description of the event as follows:

There was a heavy rainfall that lasted for a week. All water channels of KIP had been closed to prevent flooding the canal. A long drain pipe to the nearby Narayani Lift Irrigation Project was kept for discharge close to the KIP canals. The main gate of KIP in the Khageri River was closed throughout the rain. But the water reached the village area via that drainage pipe. It inundated the many mud houses, vegetable shops, and parts of local market infrastructure. Without investigating the truth, the local FM circulated the news that the flood from the Khageri River through the KIP canal damaged the market and houses. Afterward, police from Gitanagar arrived and caught the members of WUA. They tried to explain that the water was not from KIP but from the drainpipe of the Narayani Lift Irrigation Project. Initially, the police did not believe them and took them to the police station. Only later did the police learn about what actually happened (E. Sen, pseudonym, personal communication, June 28, 2023).

A main canal committee member from Shivanagar in an interview emphasized that farmers in the tail-end sections faced acute shortages due to limited water sources. At one point, the WUA nearly relinquished its responsibility because managing the scarce water resources became extremely challenging. It developed the trend of water rotation systems.

5.1.7 Climate Change as a Factor Induces Conflict

The analysis of 30 years of meteorological data from the Rampur Weather and Meteorological Department reported that there is a slow increment of gross temperature in the study area. The present temperature during the field study had slightly increased. It indicated that natural causes, alongside anthropogenic ones, contribute to irrigation conflict. In this study, natural causes refer specifically to climate change and its impact

on water availability. It was observed that rainfall, its duration, and frequency had been decreasing, while drought severity and duration had increased. These changes have altered the overall ecosystem, affecting both biotic and abiotic components, and consequently, the water supply for irrigation in KIP. The officer (pseudo post) of the Khageri Irrigation Division Office during the KII stated the decreasing trend of water sources in the Khageri region as a serious issue. He described the situation as follows:

The source of the Khageri River is decreasing. In the past couple of years, farmers used to plant paddy twice a year. There was sufficient water. But the situation has changed. Farmers do not get water to crop their paddy even once a year. It is a serious concern. Moreover, I am observing these unnatural happenings in the project area. In the rainy season, the rainfall pattern is comparatively low, and the temperature-increasing pattern is slightly high these days (R. Shrestha, pseudonym, KII, June 29, 2023).

Findings indicated that the local temperature of the Khageri region is increasing. Unlike anthropogenic causes, one of the natural causes of irrigation conflict in the KIP was the impact of climate change. It creates the situation of water scarcity.

5.2 Discussion and Analysis

The empirical findings from the KIP reveal several interconnected factors that contribute to the emergence of conflicts among irrigation users. One of the major issues identified during the field study is the weak institutional arrangement within the irrigation management system. Informants frequently reported that the irrigation management authorities have been unable to enforce strict rules and regulations against those who violate the agreed provisions. Those institutional bodies function weakly. They cannot penalize the wrongdoers and rule violators. It is necessary to maintain strict institutions for its betterment. Those institutional bodies working for the project were the Khageri water consumption committee located in Gitanagar and the district

irrigation office located in Chitwan. Observation of the existing condition of the canal reflects the passive role of the authority for the project management.

Merry (1998) and Menon et al. (2006) stated the need for a strong institutional system for the effective management of such common pool resources. In the KIP, there is the need for some training for the institutional officials regarding the project functioning. The low degree of institutional arrangement in the KIP became one of the inducing factors of conflict. It failed to monitor the budget management issues, penalize the rule breakers, and protect such common pool resources. It brought a situation of conflict. As those wrongdoers may take the issue personally, the lives of such institutional personnel are in threat.

Parthasarathy (2002) highlighted public investment to accompany the problems related to water allocation, operation, and maintenance in the field. In the KIP, as stated by Parthasarathy, there is a need for fund management either through the public or from the government bodies. Those allocated funds could be necessary to redesign the project infrastructure. As per the observation, if there is lining of entire canals, it will help for the productive outcomes in the KIP. Cambaza et al. (2020) pointed out that a weak institutional arrangement system connotes the weak functioning of the project. In the KIP, the condition of the project is deteriorating due to its weak institutional arrangement system.

Likewise, Sharma and Shrestha (1989), Shrestha (1987), and Regmi (2007) stated the need for a budget, adequate training for the institutional members along with farmers, proper coordination, and construction of new modern canals to help increase the sustainability of the project. Similarly, it is in the KIP. Institutional arrangement in the project requires the management of an adequate budget, planning, training for the officials and farmers, adopting new policies, and adequate coordination among all the

stakeholders, from the government to the farmers in the KIP. It would help to increase the functionality of the project. The lack of those infrastructures is driving or escalating conflict in the study area.

Similarly, the participation of farmers plays an important role in the canal's functioning and management. Those misunderstandings among the riparian farmers play a significant role in conflict escalation. Bijani and Hayati (2015, as cited in Gholizadeh & Nikanmi) stated the need for mutual understanding among the head, mid, and tail-end farmers to settle the issues of conflict. Unlike in the KIP, those head section farmers were less cooperative. It is concluded that those head section farmers of the KIP were self-centered. They do not have empathy and respect for others. They monopolize the water use simply because of this geographical positioning and power dynamics.

Phelps (2007) argued that the proper water distribution practices are necessary for the project functioning. Thapa (2002) emphasized adequate training for the farmers to be cooperative and knowledgeable. The farmers of the KIP were in need of training. They are unaware of the scientific use of such a project. It includes the pros and cons as well as benefits and liabilities. As stated by Lam and Chiu (2016), farmers are the strong pillars for the irrigation project management and functioning. But the farmers from the Khageri region seem less interested in engaging in project operation and functioning. They show less interest in the irrigation system because they are easily acquiring water from boreholes. It can be an alternate way for water management, but in the long run, it has its destructive outcomes. The use of water through boreholes is a challenge to nature and natural resources.

The mismanagement of those physical infrastructures often leads to conflict. Researchers identified how physical structures function, operate, and allocate water to the destined croplands. It has its own functioning mechanism. The physical

infrastructures, including channel gates, shafts, cranks, and canal structures, should be in working condition for the supply of water. Scholars like Easter (2000), Meizen-Dick et al. (2005), Ostrom et al. (2011), Uddeland (2013), and Talati and Pandey (2007) emphasized that well-maintained irrigation infrastructures can play an important role in the long-term project functioning. It is necessary to manage proper physical infrastructures in the KIP. It should be kept in a working condition.

Pradhan (1989) stated intake structures, cross-drainage works, the size of the command area, types, water availability, and water delivery methods all come under the physical infrastructures. Similarly, Burton (2010) highlighted that canals, drains, roads, and fields are under the physical infrastructure. The arrangement of physical infrastructures and the periodic monitoring and evaluation system are necessary for the project functioning. Easter (2000) listed physical infrastructures as the backbone of irrigation projects. These aspects are mostly missing in the KIP. The responsible bodies should work to maintain the status of the project in a working condition.

Some of the scholars like Easter (2000), Goonsekera (1985; as cited in Merry et al., 1988), Pandey (2007), and Jaglan and Qureshi (1996) stated that one of the inducing factors of irrigation conflict is the weak physical infrastructure. They added in some of the irrigation system; there is the problem of siltation, seepage, unlined canal structures, inadequate maintenance, poor irrigation service fees, users' reluctance, insufficient funding, leakage, evaporation, waterlogging, and salinity. They are the drivers of conflict. For the normal operationalization of the project, there is the need for the settlement of such issues by the presence of adequate and effective physical infrastructure.

The issue of water scarcity is the major driver of conflict in the study area. As stated by Bijani and Hayati (2015; as cited in Gholizadeh & Niknami, 2020), irrigation

conflict arises from inadequate water management practices and water scarcity. Both of the factors are causative in the Khageri region. Scholars like Uphoff and Wijayarathna (2000), Goonesekera (1985; as cited in Merry et al., 1988), Getirana and Malta (2010), Podimata and Yannopoulos (2015), and Haftendorn (2000) expressed their similar view that the shortage of water induces conflict in the irrigation project, which this study also concludes.

Steele (1976) pointed out resource scarcity was the cause of conflict. In the KIP, water is getting scarce. It is the cause of conflict. It induces the situation of misunderstanding. It causes behavioral changes. Such factors induce an environment of conflict. Klare (2020) stated the cause of resource conflict is the rising temperature. It helps to raise the global temperature of the area. This study is identical to the conclusion as drawn by Klare. The study of thirty years of metrological data from Rampur College, Chitwan, shows that the temperature of the KIP area is slightly increasing in order. As a result, the water flow pattern in the Khageri River is deteriorating.

Funder et al. (2012) stated that ownership issues can be the cause of irrigation conflict. It is a serious concern identified in the study area. The farmers of Ratnanagar municipality claimed that it is only their right to consume water, as the origin of the Khageri River lies in their municipality. It brings the conflicting environment, as the farmers of Bharatpur Metropolitan also claimed that water of the Khageri River flows to their area, and the KIP lies in west Chitwan. During the study, it was noted that more than three times there were violent physical assaults between the farmers of these two local bodies in the name of resource allocation, rights, and their consumption.

Gholizadeh and Niknami (2020) highlighted ownership and power distribution as the issues of water conflict. Those officials inside the CNP denied entry to farmers inside the park area, though an almost 7 km long main canal lies inside it. They assume that

CNP is under their ownership. Those officials think themselves superior. They turned selfish. Instead, they should understand the problem of farmers. They must know the importance of water during emergency farming. Those farmers need to face various problems entering inside the park for cleaning, repair, and maintenance purposes. They were not allowed to enter by carrying an axe and other supportive tools. Rather than banning such a practice, park administration should support the farmers working to clean such debris. Water is a common property resource. It is for humanity and life. It has its regenerative agriculture.

The United Nation's report illustrated that while constructing, implementing, and functioning the project, it creates environmental degradation. It leads to desertification, pollution, soil erosion, drought, and its impacts. They throw dust particles in the canal area. It resulted in a foul smell and pollution. Mostly, the farmers from the mid- and tail-end sections were facing such problems. During the observation, the researcher noticed animal carcasses in the canal. It had a serious impact, as it created odor, degraded water flow, and spread some communicable diseases. There were tall grasses and rat and snake holes in the canal area. The community members, farmers, and WUAs showed less concern for cleaning the physical infrastructures of the Khageri irrigation project.

Studies have shown that farmers of the upper section were not cooperative. They do not pay attention to the farmers of lower sections. Such behavior leads to a situation of conflict. Galtung (1958) defined conflict as a state of incompatibility. In the study, it has been identified that those farmers of Ratnanagar were not cooperative with the farmers of Bharatpur. The physical infrastructures were not in a compatible condition. Similarly, so-called upper classes do not show their understanding with the lower class, which leads to various disputes and misunderstandings.

Galtung categorized conflict as actor-oriented and structure-oriented. In the KIP, a study has shown both types of conflict. The suppressive and dominant nature of farmers, members of the WUAs, local government officials is categorized as actor-based conflict. In contrast, some of the farmers feel inferior in terms of caste and class. They were suppressed and even curtailed from their fundamental rights of getting water, which can be categorized as a structural type of conflict. It takes time to resolve those conflicts and their domination. The state should make strict rules and their implementation for the possible resolution of such conflict.

Deutsch (1973) distinguished conflict as destructive and constructive. In the study area, some farmers from Ratnanagar and Bharatpur engaged in a physical confrontation. It brought some casualties. Those conflicts can be called "destructive conflicts." Similarly, there was a recorded conflict between the farmer of Ujelinagar, the head end section, and the farmer from Gitanagar on the issue of water rotation; initially, the farmer was one-sided and stubborn. He thought being the upper riparian, it was only his right to take water at whatever time he liked. Later, an elderly farmer arrived and mediated with both the conflicting farmers. He acted as a mediator. He reminded the conflicting farmer that water is a common property resource. It has its rights for all. He brought the theory of riparian rights. Unlike others, he introduced the theory of riparian rights. The farmers of the tail-end section shall have the right to occupy and consume the resource. It made the conflicting farmers enlightened. He began cooperating with all the farmers regardless of section, class, and caste groups. It shows sometimes conflict is constructive. It helps to change the thought process of human beings.

Lewis (1976) categorized conflict as intra-, interpersonal, and group. All forms of conflicts were visible in the study area. Intrapersonal conflict is a conflict within one's own self. Those who show hatred and a selfish nature to others can be listed under

intrapersonal conflict actors. Domination, suppression, harm, and wrong attitudes toward others are some of the examples of intrapersonal conflict. Such types of conflict were visualized during the study of the KIP. The conflict between one farmer and another in the name of water use, sharing, distribution, and allocation can be listed under the interpersonal conflict. Once, the farmers went to the Khageri irrigation office and broke some windows, creating a hot discussion and showing anger with the officials due to scarce water in their area, which can be categorized under group conflict.

Similarly, the conflict between two local bodies, Ratnanagar and Bharatpur, can be categorized under intergroup conflict. Lewis also categorized role conflict, value conflict, and communication conflict as other types of conflict. The position and responsibilities of those members of the water users' association were interrogated many times. It brought a state of tussle. Such conflicts can be categorized as role conflict. Similarly, the role played by the farmers often created conflict in the project. Likewise, the so-called higher caste and class male farmer showed his supremacy to the so-called lower caste and class female farmer. It was a serious issue. We can categorize this conflict as value-based. Those so-called high-class and caste farmers fail to judge and control their false beliefs as well as understanding. These are the characteristics of the value-based conflict. Sometimes, lack of proper information sharing leads to conflict. In the study area, some of the farmers showed their rage against the members of the user committee. They didn't circulate information about the meeting schedule, time, or venue. This communication gap leads to a situation of conflict. This conflict can be categorized as a communication conflict.

O'Neill and McLarnon (2018) classified conflict as task conflict, relationship conflict, and process conflict. The purpose of task conflict, according to them, is to enhance effectiveness through discussion and problem-solving motives. These conflicts are

similar to the constructive conflict. The relationship conflict denotes conflict that arises due to anger, fear, and anxiety. It brings trouble into existence. The conflict as studied in the KIP can be categorized under this relationship conflict.

Leininger (1975) distinguished conflict as realistic conflict and nonrealistic conflict. Conflict in the KIP was related to water scarcity, domination, and less cooperation. These are the realistic phenomena in human life. These attitudes create a situation of incompatibility in goals, values, and interests. But its intensity is high. The forms of somatic harms and killing can be categorized under such nonrealistic conflict.

Galtung (1973) has projected the different phases of conflict. They are the origin phase, dynamics phase, and resolution phase. In the origin phase, certain misunderstandings, domination, and resource scarcity trigger the origination of conflict. In the study area, water scarcity and the nature of head-end farmers help to ignite conflict. It takes on different forms. Some issues of conflict end with positivity and awareness, whereas some end with destruction. For example, one of the farmers came to realize the importance of water to the tail section farmers. These can be perceived as the dynamic phase of conflict. It focuses on how an actor perceives conflict. The positive dynamics lead to conflict resolution, and negative ones, as per Galtung's cycle, lead to violence.

Auerbach (2005) divided conflict into tractable and intractable conflicts. For example, a common misunderstanding or minor verbal assault can be categorized as a tractable conflict. Its effect is less. Violence and existential concern are the issues that create intractable conflict. The suppression is structural, and conflict is similar to the intractable conflict. Its result will be destructive. It resulted in existence. If it goes deeper, it might bring serious harm to human civilization. Schellenberg (1996) categorized conflict into two types. They were macro and micro conflicts. Similarly, the conflict related to misunderstanding and realization can be categorized under minor

conflict. These conflicts can be easily resolved. But conflict related to bodily harm and attack, mass murder, and genocide can be understood as the macro conflict. In the context of the KIP, most of the conflicts and their natures were categorized as microconflicts. Researchers identified some group battles among farmers from Ratnanagar and Bharatpur. It can be categorized under macro conflict.

Max Weber categorized conflict into economic, social, and political (Nickerson, 2023). As stated by Weber, all forms of conflict were visible in the study area. The intention of farmers is to acquire water for the larger crops' production. They want to strengthen their economy. Hence, economic conflict is natural and universal as it drives human civilization. Similarly, the conflict related to caste, gender, class, identity, and ownership can be categorized under the social type of conflict. Conflict in the name of resource ownership in federalism can be categorized under political conflict.

Gurr (1968) stated the theory of deprivation as a leading cause of conflict. Those head section farmers deprived those tail section farmers of water circulation. Such deprivation develops dissatisfaction and leads to conflict. Similarly, the CNP-deprived farmers entering the park during emergencies also became an issue of conflict. It develops the feelings of hatred, inequality, and domination. It results in conflict and destruction.

Beqiri et al. (2024) introduced the behavioral theory of conflict. It highlights the biological instinct of human beings to determine the stage of conflict and cooperation. Some people have developed aggression by nature. These are some of the circumstantial factors that lead to conflict. The actors who were identified during the study had their aggressive behaviors suppressed. It escalated conflict. This behavioral theory shapes frustration. It created aggression and finally resulted in conflict. The farmers from the tail section were deprived of water. It brings them to a state of frustration.

As Nikerson (2023) stated, Karl Marx's theory of class struggle essentially deals with the conflict. Marx stated the domination of rich people over the poor is the cause of conflict. In the Khageri region, those head section farmers suppress those poor farmers. Those upper-section farmers were the oppressors, and those in the lower section were the oppressed. In the study area, Bahun community farmers were the elites, and female farmers from the Damai community of the Mangalpur section were the oppressed. Such conflict between these groups is natural, and it takes time to maintain equality and freedom.

If farmers break rules, regulations, norms, values, and understanding, it invites conflict. Those functionalists (Well, 1979; as cited in Nickerson, 2023) developed the theory of conflict in relation to the functionalist approach. Those common misunderstandings, unclear provisions, and existing practices can knowingly or unknowingly create a conflicting situation. Indira Gandhi National Open University (2019) discussed the concept of Freud's psychoanalytic framework that became the origin of conflict. The human mind is shaped by various issues, responsibilities, agendas, and instincts. The calculative attributes of human beings resulted in violence. It is manifested in the form of conflict. They failed to control the drive, maybe because of their multiple responsibilities and tasks. They have anxiety to complete every task on time, which resulted in conflict.

Boulding (1963, as cited in Oberschall, 1978) categorized the theory as breakdown deprivation and solidarity mobilization. The role of deprivation leads to anger and inferiority in life. It resulted in a violent action that leads to conflict. The physical assault between the farmers of Bharatpur and the farmers of Ratnanagar can be perceived as a conflict guided by the theory of the breakdown deprivation model. Similarly, frustration leads to dissatisfaction. It resulted in violent war.

CHAPTER VI

CONFLICT RESOLUTION PRACTICES IN KHAGERI IRRIGATION PROJECT

6.1 Introduction

Conflict resolution is the process of bringing conflicting states into peace. It is conducted through negotiation and mediation between and among the conflicting parties. Conflict resolution takes place in a formal and informal way. In formal practice, there is the presence of government or an authorized third party. In an informal way of conflict resolution, those conflicting parties make the environment normal through informal dialogue, talk, discussion, begging pardon, or apology.

Irrigation conflict resolution involves the presence of elderly farmers in the KIP. Those farmers negotiate the case. Those who committed mistakes were warned, and victims were rewarded through sympathetic consolation. Some of the members of the WUA explained that sometimes police personnel and local government representatives were called to manage those conflicting issues. The conflict resolution mechanisms were categorized and listed below under the respective subheadings.

6.1.1 Talk and Discussion and Negotiation

One of the informant farmers from the Mangalpur section stated in an interview that conflict in the study area is primarily resolved through talk and discussion. The farmer from the Gitanagar section stated the process of conflict resolution as follows:

Regarding the issue of conflict resolution, as far as I know, it is resolved through talk and discussion among the conflicting parties, sometimes in the presence of elderly farmers. Those parties slowly forget the past events and start to talk and cooperate. They realize their mistake and apologize to each other. The conflicting issues are not that serious (P. Pandit, pseudonym, personal communication, July 2, 2023).

One of the members of the main canal committee and the informant farmer from Shivanagar shared that he had successfully resolved several disputes related to the KIP through dialogue. He called both disputant farmers together, emphasized the priority and urgency of water needs, and mediated the conversation. He shared the process of conflict resolution. He kept conflicting parties inside the tea shop. He said there were some other elderly farmers who made apologies to each other. Those conflicting farmers obeyed. They begged for their apology and committed not to do such activities again. Accordingly, the issue was resolved. He shared the process of mediation as follows.

I am L. Rojaiya (pseudonym). I am a member of the main canal committee. I mediated so many conflicting issues in this project. I request the conflicting farmers to maintain cooperation during water use. I let the conflicting farmers sit together and discuss their misunderstanding. Those head-end farmers denied providing water to the tail-end farmers. The lower riparian area was in dire need of water. They had their paddy-plantation schedule. Later on, I requested the upper riparian farmer not to do that. I said water is the common pool resource. Everyone shall have the right to utilize it. Mostly, the upper riparian farmer should cooperate with the lower riparian. Accordingly, they negotiate with each other. They should realize their mistakes and maintain harmony with each other (L. Rojaiya, pseudonym, personal communication, July 9, 2023).

It is concluded that talk and discussion are important mechanisms for conflict resolution in the KIP. Through discussion, farmers can understand each other's perspectives and suffering. For instance, the farmer (pseudo-profession) at the headwork of the Khageri River during KII stated that water-related conflicts were resolved by maintaining water rotation among all users and by organizing discussions with disputing parties. He noted

that most conflicts in KIP were caused by water scarcity, which could be managed more effectively if the river's source flow were increased. Similarly, a member of the main canal committee of the Devnagar branch under the Gitanagar section described a specific resolution process as follows:

I encountered a quarrel between farmers from the head-end and tail-end sections in Ujelinagar. I managed the situation by explaining that water is a common property, and all of us should have the right to use it. The farmers obeyed my words, perhaps because I was an authorized person. Later, one of the farmers apologized to me at the district irrigation office. Therefore, I believe conflict mitigation takes place through negotiation, talk, apology, and arbitration (A. Khadka, pseudonym, KII, June 25, 2023).

The main canal committee members of KIP consistently stated that conflicts were mitigated through both formal and informal discussions, often involving main and branch canal committee representatives and the chairperson. Minor disputes were frequently settled with the help of experienced farmers and branch committee members. The process typically involved persuasion, dialogue, and sometimes formal arbitration, with wrongdoers acknowledging their mistakes and seeking pardon.

One of the informant farmers from Mangalpur described the process of conflict resolution as follows:

In the KIP, conflict was resolved through third-party intervention. Those members acted as guardians, and they mediated and arranged for peaceful talks to resolve the conflicting environment. I know some of the words spoken by WUA members during such a mediation, as everybody needs water. We cannot say that only I have the right to use this water. We have to distribute it to everyone (K. Rawal, pseudonym, personal communication, July 3, 2023).

Another member of the WUA, during an interview, explained that conflicts in irrigation were generally resolved by the presence of main and branch canal committee representatives along with the chairperson and vice chairperson from the conflicting areas. There was a constant negotiation and mediation process going on. Generally, at the end of such mediation meetings, the people who were in the wrong realize their mistake and apologize, and a cordial relationship was again established between disputing farmers. Similarly, the herdsman (pseudo-profession) of KIP stated the process of conflict resolution as follows:

Conflicting issues in KIP were handled by a management committee of 3–5 members. If that committee could not handle the situation, then the chairperson, vice-chairperson, and ward representative managed such cases. The chairperson, vice chairperson, and secretary of KIP negotiate with conflicting groups if any conflict arises. They threatened the wrongdoers. They had to pay a fine, and if necessary, they would take the case to the district irrigation office (S. Shrestha, pseudonym KII, July 6, 2023).

Another informant, a farmer and a member of WUA from KIP, E. Sen. (pseudonym), explained that members of WUA called disputing parties to the WUA office. Then a long discussion took place in which the real cause of conflict and the culprit were investigated. After this, the offenders were either penalized with cash or they were made to apologize to the innocent party. This was the common system of managing conflict in KIP.

According to T. Gurung (pseudonym, personal communication, 22 July, 2023), conflict in the KIP is resolved by the presence of WUA members. The WUA members warned, threatened, or penalized the offender, and they made them apologize. This was the prevalent system of conflict resolution.

The informant farmer belonged to the Mangalpur section; S. Shah (pseudonym, personal communication, 23 July 2023) stated that conflict in the study area is resolved through talk and discussion. Farmers agree to rotate water. D. Kumal (pseudonym, personal communication, 25 July 2023) stated in an interview that he had solved several conflicting issues related to the KIP through talk and discussion. He called both farmers who were in dispute in the name of water use. He consoled each of them by focusing on the priority and urgency. Accordingly, they obeyed, and the conflicting issues were solved.

Talks and discussion are the tools to resolve the conflict. Those conflicting farmers can understand each other's suffering if there is serious discussion. One of the informants, the gatekeeper on the headworks site of the Khageri River, stated in an interview that the conflict related to irrigation is resolved through talk and discussion. He stated that he arranged so many issues of conflict by maintaining water rotation among all the users. He opined that conflict in the KIP is caused mostly by water scarcity, and it can be managed easily if the source of the Khageri River is increased. One of the members of the main canal committee of the Devnagar branch stated that the conflict in the KIP was resolved by the presence of the members of the WUA. He shared the mitigation process with the researcher as follows:

I encounter a quarrel between the farmers of the head end section and the tail end section in Ujelinagar. I went and managed the incident by requesting those farmers not to be fooled. I consoled them, stating that water is a common property, so all of us should have the right to consume it. They obeyed what I said, maybe because I was the authorized person. The farmer apologized to me in the district irrigation office. Therefore, I believe conflict mitigation takes place through negotiation talk, apology, and arbitration (G. P. Bantawa, pseudonym, personal communication, June 29, 2023).

The member of the main canal committee of KIP stated that conflicts related to this project are mitigated by those members of WUAs through formal and informal talks. He stated those conflicts were resolved by the presence of the main and branch canal committee representatives along with the chairperson. Another member of the main canal committee of KIP added that during conflict, mostly the chairperson and vice chairperson held negotiations with the conflicting parties.

6.1.2 Proper Water Rotation System

There is the practice of the water rotation system for conflict resolution. It is necessary to distribute water on an equal basis. G. P. Bantawa (pseudonym), a farmer from Gitanagar, stated the system of water rotation in the project as follows:

The WUAs have implemented a water rotation system. The project was divided into three main sections and twelve branches. One was the Gitanagar section; others were the Shivanagar section and the Mangalpur section. The water rotation schedule divides water as the Gitanagar section receives water for four days, the Shivanagar section for five days, and the Mangalpur section for six days. If Gitanagar only required water for two days, the remaining two days will be given to Shivanagar, the mid-section of the KIP (G. P. Bantawa, pseudonym, personal communication, July 2, 2023).

The herdsman (pseudo-profession) of the Khageri Irrigation Office stated the same system. He emphasized that it helped de-escalate conflicts as it maintains predictability and fairness in water allocation. During an FGD, farmers from the tail-end section of Shivanagar section no. two expressed their thought regarding the WUAs' functioning. They reported dissatisfaction as there was favoritism, nepotism, and corruption in water distribution. According to them, there is the need of a proper and transparent rotation system to prevent disputes and ensure fairness. Elderly farmers also emphasized the

necessity of a clear rotation system to mitigate conflicts. A farmer from Ujelinagar-13, section-1, in an interview, remembered past issues of water theft, where farmers would divert water from canals into their fields. It led to verbal quarrels. These conflicts were later resolved by the WUAs through the implementation of the water rotation practice.

6.1.3 Through Administrative Monitoring System

According to an informant farmer L. Rai (pseudonym) from Kirangunj, Mangalpur in the interview, conflicts related to the KIP were resolved by the help of WUAs through administrative monitoring system. She explained that disputant farmers were called to the water office. WUA members mediate and negotiate between the parties. In most cases, the disputing farmers accept the proposals as put forward by these representatives. She explained the issues as follows:

I am L. Rai (pseudonym). I belong to the Kirangunj section. I come to know there was conflict between two farmers in the name of water use. The conflict was serious. It led to the situation of physical assault. Meanwhile, one elderly farmer contacted the member of main canal committee. They went to the irrigation office and settle the disputes inside (L. Rai, pseudonym, personal communication, July 4, 2023).

Farmers from Gitanagar and Mangalpur added that conflict resolution also involves the presence of elderly community members, local representatives, and other stakeholders. They conduct discussion and try to solve the conflicting issues. They conducted the process through talk, discussion and negotiation. If necessary, these processes were facilitated by members of the main canal committee, branch canal committee, local political leaders, the chairperson and vice-chairperson of the project office, and even police personnel.

6.1.4 Improvement of the Physical Infrastructure

One of the informant farmers, T. Tamang (pseudonym), from the Shivanagar section in the interview stated that conflicts in the KIP were caused by water scarcity. He stated the issues as follows:

The existing condition of the canals is not good. Most of those canals need concrete lining. It is necessary to solve the issue of water seepage. In the Khageri region, water scarcity is caused due to the fragile condition of the canal. There is limited flow of water in the Khageri River. The problem lies with those canal lining systems, gate functioning, sedimentation, and siltation. These issues block the free flow of water in the field (T. Tamang, pseudonym, personal communication, July 2, 2023).

While interviewing, a member of the main canal committee, R. Ghale (pseudonym, personal communication, 15 July, 2023), narrated that the conflicting issues were solved by the presence of the police personnel. Another WUA member who represented the Mangalpur section noted unequal water distribution caused by scarcity. It contributes to conflict. He suggested that diverting water from the Narayani River to Shaktikhor could help to reduce the problem of water scarcity. He also reflected on the management issues of KIP as follows:

I found there is mismanagement in water distribution. The water source of Khageri has decreased because the Padampur settlement shifted near the headworks side of the Khageri River. Villagers do not pay attention to its protection. There exist problems like siltation, seepage, and economic mismanagement (E. Sen, pseudonym, personal communication, June 29, 2023).

The informant farmer who belongs to the Mangalpur section stated that conflict in the study area is resolved through talk and discussion. Farmers agreed to rotate water. If any farmers are in urgent need of water, they will be provided priorities for water use. One of the members of the main canal committee of Shivanagar, in KII, stated that he had solved several conflicting issues related to the KIP through talk and discussion. He called both farmers who were in dispute over the name of water use and consoled each of them by focusing on the priority and urgency. Accordingly, they obeyed, and the issue of conflict was solved. From the study area, it is identified that talks and discussion are some of the ways for the resolution of conflict. Those conflicting farmers can understand each other's suffering if there is serious discussion.

One of the informants, the herdsman (pseudo-profession) on the headworks site of the Khageri River, in an interview stated that the conflict related to irrigation is resolved through talk and discussion. He arranged so many issues of conflict by maintaining water rotation among all the users. He opined that conflict in the KIP is caused mostly by water scarcity, and it can be managed easily if the source of the Khageri River is increased. One of the members of the main canal committee of the Devnagar branch under the Gitanagar section stated that the conflict in the KIP was managed by the WU. As through negotiation with those disputing farmers. In an FGD with 8 farmers, participants emphasized the importance of effective participation and cooperation among head, mid, and tail-end farmers for efficient irrigation management. Proper coordination between farmers and WUA members was highlighted as essential for reducing conflicts.

Talk and discussion are ways to resolve conflict. In a conflicting situation, both conflicting parties can settle their issue through discussion, with or without keeping the third party.

A farmer in his early forties who belonged to the Gitanagar section added the conflict management practices as follows:

I think the conflict in the KIP is because of the water scarcity and not following the proper rotation system. In my view, if there is the possibility of water diversion from the Narayani River to the Khageri River through a national plan, farmers could get enough water even in a lean season, and these issues of conflict could resolve permanently (T. Kunwar, pseudonym, March 28, 2023).

For the resolution of conflict in the KIP, those WUAs prepared a rotation system. According to the WUA member, there were three sections and fourteen branches on that project. The Gitanagar section covers zero, one, two, and three branches. The Shivanagar section covers four, five, six, and seven branches, and the Mangalpur section covers eight and its minor one, two, and three tertiary canals. There was the system of water rotation, as the Gitanagar section for four days, the Shivanagar section for five days, and the Managalpur section for six days. If two days were sufficient to supply water in the Gitanagar section, the remaining three days could be added to the Shivanagar section that lies in the mid-section of the KIP.

This model is also a form of conflict resolution because it helps to establish a proper water rotation system. It helps to deescalate conflict. A rotation system is the way to manage water during scarcity. The secretary of the Khageri irrigation office stated that there was a water rotation system of water rotation, such as the Gitanagar section for four days, the Shivanagar section for five days, and the Managalpur section for six days. In case two days are sufficient to supply water in the Gitanagar section, the remaining three days could be added to the Shivanagar section that lies in the mid-section of the KIP. This model is also a form of conflict resolution because it helps to establish a proper water rotation system. It helps to deescalate conflict.

In an FGD with some of the tail-end section, farmers who belonged to the Shivanagar section no. 2 stated the need for a rotation system. They stated that those WUAs did not give much concern to us. They were not satisfied with the way those members of WUAs were functioning. They were corrupt, as they favored kinship and nepotism while circulating water. Therefore, there is the need for proper rotation while distributing water. It can only help to mitigate conflict in the KIP. One of the aged-old farmers was also focusing on whether the proper rotation system could help to mitigate conflict in the KIP. A farmer who belonged to Ujelinagar-13, section-1 of the KIP, stated in an interview that, in the past, there was the practice of water stealing. It created conflict. He shared the practice that he had to go for repair and canal maintenance. During his time of water use, some other farmers stole water and diverted it into their fields. They verbally quarreled with each other. Later, that issue was managed by the members of the WUAs. They implemented the practice of water rotation. This is how conflict management took place in the KIP.

6.2 Discussion and Analysis

As identified from the study area, some of the ways to resolve conflict include talk, discussion, and negotiation among the conflicting parties. Sometimes, there is the presence of a third party, and in some contexts, disputant farmers realize their mistakes. In formal practices, there is the presence of government officials in sensitive cases. As stated by Uphoff and Wijayarathne (2000), community-based maintenance activities are helpful to solve the issues of conflict in the irrigation project. Unlike in the KIP, the community participation was found weak.

Ostrom (1990) emphasized that talk and negotiation among users are crucial for building trust, creating shared rules, and preventing resource conflict. She stated that negotiation is the central aspect of water governance and communities. It can define

water rights and solve problems through communication. The findings of this study reflected a similar view.

Pradhan (2000) illustrated the same: open talk and local negotiation helped farmers solve disputes about canal access and water rotation. Through discussion, those incompatible issues come to a logical ending. In the case of the resolution of conflicts, the responsible body is the conflict management committee, with the assistance of government-employed irrigation experts and peasant associations (Abiyu & Tebeje, 2016). They added the techniques of conflict mitigation, such as public involvement, public group meetings, and other forms of continuum, for example, negotiation and arbitration.

Leininger (1975) pointed out some of the ways to resolve conflict. It can be through maintaining a friendly relationship, persuasion, interpersonal skills, a charismatic approach, a leader's personal style, open and direct confrontation. Haftendorn (2000) cited the case of Danube River from Hungary. The construction of a dam in the Hungarian territory diverted the water, and it created conflict. In the context of KIP, it is essential to construct the infrastructures, but it is necessary to adopt proper engineering for the effective outcome. This helps to resolve the possible conflict. Phelps (2007) proposed a model agreement for the shared use of transboundary water resources. It works based on the four ways for conflict resolution. Negotiation, integrated water management, overcoming obstacles, and flexibility in water sharing are the key domains essential for the conflict resolution process.

In the KIP, those issues of conflict resolution are working their best. Negotiation is a very common tool used by the mediators to settle the conflict. From the study it was identified that mostly the elderly farmers negotiate and normalize the issues in front of the conflicting farmers. Once, M. Chaudary (pseudonym, personal communication, 14

July 2023), a seventy-year-old farmer who belonged to Mangalpur, stated that he went to handle the conflicting cases between the farmers. He came to know one of the farmers showed his rage as he became victimized many times in the issue of water sharing and distribution. He first made an attempt to normalize the debate. He said not to make verbal disagreements.

From the talk and discussion, one can easily solve the issue. He called the disputant farmers in one place near the *chautara*. He let them speak their disagreements and incompatibility. He came to know that they belonged to the riparian and lower riparian farmers who were becoming victimized. He later requested them to follow the existing rules and practices. He made each of them apologize. It shows talk, discussion, apology, and forgiveness are the natural tools for the conflict resolution process.

Accountability is the important tool for the resolution of the possible conflict. If a person is accountable towards their duties, it seldom creates a conflicting environment. As stated by Kattel (2006), irrigation conflict can be resolved if those stakeholders, like water user association members, government officials, and beneficiary farmers, are responsible and accountable towards their work and duties. It is effective to reduce the possible conflict in the irrigation project. Quite the contrary, those stakeholders in the KIP were not found accountable for their duties. This is the main cause of conflict in the project. This has been supported by scholars like Easter (2000), Ferna (1963), Fisher et al. (2011), and Michael (2020). Collectively, they highlighted the need for social, cultural, and economic cooperation; collaborative dialogue; and fulfillment of basic rights, which are the important components for conflict resolution in the natural resource management context. These aspects were identified nominally in the study area.

The practice of third-party intervention is one of the ways to resolve conflict in the KIP. During the interview, informants stated that conflict cases are generally handled by the elderly farmers and occasionally by the presence of government officials like ward chairpersons and members and in front of the police personnel. Those who committed mistakes apologized, and the innocent were rewarded with respect and pardon. Several scholars like Ternstrom (2002), Ostrom and Gardner (1993), Menon et al. (2005), Thomas (1976), Deutsch (1976), and Stanbury and Lynott (1992) prioritized the necessity of third-party intervention for the resolution of conflict. They denote those third parties like the government officials like irrigation department local officials, police personnel, and those elderly farmers. In the case of the KIP, minor conflicts were settled within the group, and major conflicts like heated arguments and physical harm were resolved by the presence of those parties.

The practice of a water rotation system is a way to resolve conflict. In the KIP, there is the system of rotation, yet the performance couldn't take its shape nor function well. Ostrom and Gardener (1993) cited the case of the Marpa farmer-managed irrigation system. Those clearly defined rules and proper water rotation system marked that project as a successful irrigation project in the Mustang district of Nepal. Similarly, they cited the case of the Yampha Phata irrigation system. There was the practice of alternating days' allocation. On even days, water is distributed to the tail-end farmers, and on the odd days, water is distributed to the head-end farmers. There was the sharing of canal maintenance responsibilities for one period with the head-end farmers and for another period with the tail-end farmers. In the KIP, such a system of rotation and duty schedule is urgent. It is necessary to follow the model of Yampha Phata irrigational practices in the KIP for its meaningful, result-oriented, and sustainable functioning.

In his discussion, Schneewind (2015) highlighted Habermas' idea of communicative

rationality and noted the significance of effective communication between the stakeholders for conflict resolution. On the other hand, within the KIP setting, inadequate levels of communication and collaboration between the farmers and WUA members might escalate conflicts.

It has been noted that collaboration is one of the most suitable approaches to conflict resolution (Blake & Mouton, 1964; Thomas, 1976; Brown, 1992). However, it is apparent from the results of the study that there is no cooperation amongst the farmers of the Khageri region. This can be because of poor levels of participation and trust between the parties involved.

The primary concern of this study is related to the provision of irrigation management and the domains that are directly or indirectly influencing the project and its implementation. This study reflects the theme that still the management system of the KIP is not satisfactory. Those managerial bodies lack proper rule implementation and project functioning. Most of the WUA members and beneficiary farmers were not accountable and responsible towards their work and duty. The phenomena of irrigation management systems have been viewed from the perspective of collaborative management. This approach in short is called the theory of co management.

Armitage et al. (2009) stated co-management is necessary for the collaborative allocation and use of resources among the beneficiary users. It contributes to the sustainable management of such natural resource projects. Using this concept as a lens, researchers noticed that the management practices of this KIP do not focus on sustainable resource allocation and use. Rather, those stakeholders think for a short period of time. Carlsson and Berkes (2005) explained the need for co-management as it helps to link formal government bodies to the community members and users. It provides a linkage between the traditional knowledge and modern infrastructures.

The KIP management should be guided by the philosophy of co-management for its durability. Studies have shown that there exist certain incompatibilities among the farmers, WUA members, and government officials in the issue of its criteria and limited monitoring area as well as schedule. The theory of co-management is essential as it theorizes the systems like planning, implementation, monitoring, evaluation, and feedback (Stirzaker & Pittock, 2014).

As per the guidelines, it is necessary to plan, implement, monitor, and evaluate the functioning of the KIP. Lack of these activities induces the situation of volatility. The theory of co-management helps to promote cooperation, coordination, information sharing, and joint decision-making processes. It gives all stakeholders, mainly the government and community, a cordial environment for its operation and functioning. Only critics argue that the principle of co-management is limited to the technical and mechanical aspects. Along with these, it should make a wider horizon. It means the theory of co-management should have certain limitations on covering the governance aspects of the overall irrigation management and its operating systems.

Similar to the theory of co-management, the researcher has reviewed the irrigation management and the possible reasons for the degradation of such natural resources. To make this study scientific and closer to the natural reality, the researcher has adopted the theory of the tragedy of the commons as proposed by Hardin (1968). According to Hardin, human beings want to get more profit by excessively using the natural resources because they are common pool resources and they can be obtained at no cost. He had cited the example of herders and pastureland. The natural problem of overgrazing according to him definitely creates the problem of overgrazing and resource degradation.

Using the scenario in the context of KIP, KIP is an example of natural resources. Most of the users want to get as much profit as possible from the consumption of this resource, but hardly any farmers will come during the maintenance and repair activities. It is a serious issue. This study has shown the nature and character of those farmers and the WUA members. Many of the farmers do not obey rules, and they even do not pay the water fee. This is a universal problem. While managing such natural resources, it is necessary to be strict, and immediate actions are required for those who breach laws and order. The condition of the KIP is becoming worse day by day. It might be because it is an example of the common pool resource. The nature of such resources is cared for by none but consumed by all.

In this regard, Ostrom (2008) explained the characteristics of the common pool resources like irrigation systems. It is difficult and not possible to bypass the users from the use of such common pool resources even if those users do not pay and participate in the repair and reconstruction activities. This is a serious concern in the KIP. Because of this quality as stated by Ostrom, irrigation management, monitoring, exclusion to the wrong doers is a real challenge. Because of this, irrigation management, being an example of a common pool resource, is hard to manage well.

Similarly, this study is observed from the theory of common pool resource management theory. Ostrom (2010) brought this theory to light after she had repeatedly studied the issue of natural resources, especially irrigation management. According to Ostrom, for the sustainable use of natural resources like irrigation projects, there is the need for community ownership and its protection from the members of the respected community. Those farmers and WUAs should have knowledge to handle such resources. She stated that community members are innocent and they bear ownership to run such projects properly.

The emphasis of Ostrom on the community members is proved wrong in the context of the KIP. As Ostrom while propounding the theory of common pool resource management, she considered those WUA members and farmers' innocent and worked to protect the resources. Unlike those WUA members and beneficiary farmers, they were not found dutiful, responsible, or accountable towards their duties and responsibilities. It gives the conclusion that only Ostrom's common pool resource management and Hardin's Tragedy of the Commons in their independent dimensions can never function the project well.

Hardin focuses on the need for government control, and Ostrom's choice on WUA members and farmers positioning in isolation cannot function the project well. It has been justified through this study, as KIP was initially under the management of the government, and now it is under the control of beneficiary farmers. But the project is not functioning well. All the theories like the theory of co-management, tragedy of the commons, and common pool resource management are not enough to understand, visualize, and interpret the condition and functioning character of the project. This study concludes with the idea that such natural resources should be protected by the government along with the farmers and WUA members.

The equal participation of all these tires shall help to protect and promote this KIP. Both agencies should be responsible, accountable, result-oriented, and progressive. The theory of the co-governance approach persuades those resource users to maintain all the qualities of governance through equity, equality, consensus orientation, and responsiveness.

This study gives concern to Burton's human needs approach as a major concern of conflict. Analyzing the findings from this theoretical lens, it can be concluded that water is a basic need of all humans along with all plants and animals. The deprivation of water resulted in conflict. In the KIP, water is not sufficiently distributed. Those mid- and

tail-end section farmers are found deprived of water. It resulted in a heated argument among the farmers. Green et al. (2017) stated that needs are the forces that drive human behavior. Those needs are categorized as safety, security, belonging, self-esteem, and self-actualization. Those farmers from the study area do not feel secure, as they barely get water for the crops' production. It is the cause behind conflict in the KIP.

According to Davies and Harre (1990, as cited in Peter & Appel, 1996), the system of mismanagement and conflict is sometimes caused by the positional differences. They highlighted the theory of position. In the KIP, those lower riparian farmers are facing problems because of their position. By nature, those farmers who are located in the head section of the project can get water easily. It is necessary to coordinate the users regardless of their position. Such mentality can only help to maintain cooperation and effective project functioning.

This study can be observed through the lens of Galtung's (1969) theory of conflict transformation. For the successful implementation of the project, as stated by Galtung, it is necessary to identify the structural and cultural causes of conflict in the project. A study has shown that so-called higher-class and caste farmers repeatedly insult and bypass those so-called lower-caste farmers. It develops a hatred complex among each other.

Hence, it is necessary to know the root cause of conflict and identify different mechanisms of conflict resolution, and it leads to a phase of conflict transformation. It means from then onwards, there won't be the issues that trigger conflict in the project. Transformation gives a new dimension by erasing all existing problems and gives a new shape to the resource utilization and management. Michell (1981) had introduced the theory of conflict mapping. This model helps to diagnose the conflicting issues in the KIP. In addition, it examines the causes, actors, issues, and parties of conflict. It is effective for the conflict resolution mechanism.

CHAPTER VII

SUMMARY, FINDINGS AND CONCLUSION

7.1 Summary

The study of irrigation management and conflict dynamics is motivated by social welfare and the common good. Irrigation management is for the purpose of production and linked with humanity and life. It is relevant to maintaining agricultural sustainability and regeneration. Irrigation is defined as a process to allocate, circulate, distribute, and arrange water to the destined croplands. It is a systematic process of water distribution. The purpose of irrigation is to bring water to the crops as per the proper time and procedures. An adequate irrigation system can ensure agricultural transformation. It is a process of artificial circulation of water for the fulfillment of water requirements. Some of the types of irrigation systems are surface irrigation, sprinkler irrigation, drip irrigation, center pivot irrigation, and manual irrigation systems.

Management is the process of administrative and community arrangement for the fulfillment of targeted goals. It shapes organizational functioning. All offices, projects, and administrative bodies require a result-oriented management system. Irrigation management is a social and administrative coordination among various actors. Those actors were beneficiary farmers, members of WUAs, local officials, and representatives. Irrigation management components include water allocation, distribution, canal management, mobilization of human resources, water rotation system arrangement, and repair and maintenance of physical infrastructures. In addition, it ranges into roles, rules, regulations, water allocation, distribution, planning, monitoring, and evaluation.

Conflict is a state of mutually exclusive behaviors between and among the resource users in the name of resource use, acquiring positions, getting shares, and holding authority. It is a social structure. There is a struggle over power, status, and interest. Sometimes, conflict is inevitable to solve problems. The conflict dynamics are the interplay between conflict and its resolution practices.

The study is exploratory based on social constructivism. The ontology of irrigation conflict was shaped by the experiences, interpretations, and relationships among diverse stakeholders, including beneficiary farmers, water users' associations, local representatives, and bureaucratic members. Knowledge is constructed through close interaction with farmers, local elites, and other stakeholders. The interpretivist approach facilitates an understanding of the social realities embedded in irrigation practices and community relationships. The research design was qualitatively suited to explore the perceptions, experiences, and interactions of individuals involved in the KIP. The informants included members of WUAs, beneficiary farmers, local representatives, and local bureaucrats. Data collection methods consisted of KIIs and FGDs. Interviews allowed informants to express their views and experiences. It provided rich contextual insights.

The study was conducted in the Khageri irrigation project. It was designed by the DOI in 2017. The project comprised a diversion barrage, a 23 km long main canal, 11 branch canals totaling 55 km, and tertiary canals extending 100 km. This study adopted a systematic area qualitative sampling approach. The total area was divided into smaller, non-overlapping geographical clusters. The informants were categorized into 4 groups. Authorities who were involved in water bureaucracy. It included local government officials connected to water resources. The informants were the WUA members, the beneficiary farmers, irrigation water experts, and community stakeholders, including civil society members, political leaders, and government teachers.

The research was conducted across three command areas of the KIP: Gitanagar, Shivanagar, and Mangalpur, which represent the head, middle, and tail sections of the canal system. From each section, nine beneficiary farmers were selected for interviews, comprising three farmers each from the head, middle, and tail ends. It resulted in twenty-seven interviews with farmers. The informants were considered to be from the age group of 45 to 80 years. Those informants provided information related to the functioning of the irrigation project and existing grounded realities. The interviews were conducted based on the open-ended questionnaire, including some newly generated issue-based tag questions.

Furthermore, five KIIs were conducted with local government bureaucrats and local representatives, including the chairperson and other members, to reflect the policy and procedures. To understand the collective perspective and the ground realities, 3 FGDs were organized, 1 in each section. The fieldwork was conducted 4 times between 2021 and 2025.

The data collection process included several steps, from setting the boundaries to conducting interviews and observations and reviewing secondary data. Data was collected through the verbal and nonverbal expressions of the informants. Audio recording and written notes were two major forms of the data recording process. Written data were categorized as per the theme, and audio recordings were transcribed and regrouped as per the category. Memos were maintained throughout the study to capture ideas, hunches, and reflections. Data coding was carried out manually and partially with the assistance of QDR Minor Lite qualitative data analysis software. Coding involved breaking down the narration, assigning categories, and organizing it into patterns. Initial codes were created based on the interview guide, and new codes were added as required.

The key domains of irrigation management were institutional arrangement systems, physical infrastructure, farmers' participation, performances of the water users' association members, and environmental sustainability. Similarly, the inducing factors of irrigation conflict as identified were the weak physical infrastructures, flaws in institutional arrangement systems, ineffective water rotation, the nature of the users, and the condition of the physical infrastructures. The conflict resolution mechanism was coded as talk, discussion, mediation, and arbitration.

This study was based on the consultation with numerous empirical reviews, developed a conceptual framework, visited and revisited theories, properly addressed narration, and applied scientific research methodology and design. Data triangulation was employed, integrating multiple sources and perspectives to identify convergent themes and categories. KIIs are effective to identify the policy gaps, and FGDs are to know the grounded facts. These methods of data collection increased the validity of this research. Given the sensitivity of this study, the researcher has maintained informants' privacy through using a pseudonym to ensure anonymity and ethical integration.

The five key domains of irrigation management were examined in the KIP. They were the WUAs, farmers' participation, institutional arrangement system, environmental concern and the physical infrastructure. The WUAs represented as one of the integral domains of irrigation management. The members of WUAs were elected through the voting system. The chairpersons of tertiary canal committees serve as members of their respective branch canal committee and the chairpersons of branch canal committees become the members of the main canal committee. The WUAs operate under a formally registered constitution. A general assembly was held annually. The executive committee presented their financial statement. The WUAs collected irrigation service fees. The main canal committee included nineteen executive members; twelve were elected from the branch committees.

Farmers' participation was another domain of irrigation management as identified in the KIP. Beneficiary farmers in the Khageri project performed routine activities such as canal cleaning, minor repairs, water allocation meetings, fee collection, and local dispute resolution. From the study, physical infrastructure was identified as another crucial domain of irrigation management. The physical infrastructure of the KIP included canal linings, culverts, diversion canals, water sluice gates, shafts, culverts, and diversion canals. Several of the infrastructures were in poor or deteriorating condition. Many branches and tertiary canals had non-functional gates. Tall grasses and weeds had overgrown the canal banks. The plastic bottles and animal carcasses were visible in the water channel. There existed rodents such as rats, and snakes had dug holes in the canal embankments.

Similarly, environmental concern had been considered as an important domain of irrigation management in the KIP. It was identified that farmers located near the head end frequently disposed of garbage into the canal. It then accumulates downstream, creating a foul smell and pollution. The institutional arrangement system was the major domain of irrigation management in the KIP. This project is guided by several national acts, policies and frameworks.

At the federal level, there is the Ministry of Energy, Water Resources, and Irrigation, which is the central body responsible for formulating national policies, strategies, and plans for water resource management. Along with it, the Department of Water Resources and Irrigation is also mandated to plan, develop, operate, and monitor irrigation projects throughout Nepal. The Provincial Ministry of Energy, Water Resources, and Irrigation coordinates provincial water resource policies and supports the implementation process. In the Chitwan district, the Narayani Lift and Khageri Irrigation Management Division oversees the management and operation of the KIP.

The second objective of this study was to examine the issues that give rise to conflict within the KIP. Findings indicate that the denial tendency for exercising riparian rights is a cause of conflict in the study area. Generally, the head-end farmers were denied water access to those tail-end farmers. It induced conflict in the irrigation project. There was no proper coordination and cooperation among the head, middle, and tail-end section farmers. It brought a situation of intrigue and hatred. Some ordinary farmers were deprived of water accessibility.

There was a notable violent conflict between East Chitwan and West Chitwan. East Chitwan farmers refused to share water with West Chitwan. West Chitwan armed themselves with weapons. It led to a physical confrontation near the headworks of the KIP. Another crucial factor that induced conflict in the KIP was because of water scarcity. In the Khageri River, there was minimal water, mostly during the lean season. Many farmers were deprived of water for irrigation. Disputes were visible when limited water was diverted without prior notification. Farmers had to wait in a long queue. Extreme scarcity in the KIP provoked widespread unrest among the farmers. It finally induced conflicts.

The resource rights dilemma in federalism was an interesting factor that caused conflict in the Khageri region. In the KIP, farmers from Ratnanagar municipality often refused to supply water from the Khageri River, being an upper riparian of the KIP, to the farmers of west Chitwan. Ratnanagar claimed the Khageri River passes through their municipality, and it was their right to use its water. This created a tension between two local bodies. Human encroachment along the irrigation canal emerged as another significant factor inducing conflict in the KIP. Many individuals constructed houses near the canal side without considering the legal provisions for the canal protection. It induced conflict.

Another serious issue of conflict induced in the project was the restriction on farmers entering the CNP. Almost 8 km of the main canal passes through the park and farmers were reported facing numerous hassles and legal barriers when attempting routine sanitation, repair and maintenance of the canal section. It induced conflict between the authorities and the beneficiary farmers. Beside these, the presence of farmers for the maintenance and repair activities was nominal. They failed to pay the water levy. It created both financial and management challenges.

The flooding along the Khageri River induced conflict as it affected the farmers who stayed near the canal side. Climate change is a cause of conflict. Findings show that scarcity of water in the Khageri River was due to the change in climate. Findings from the study indicate that the local temperature of the project is rising in order. It is affecting the regular flow of water due to its impact on regular rainfall, duration, and frequency patterns. It was a natural cause of conflict.

The final objective of this study was to assess the conflict resolution mechanism in the study area. Generally, conflicts were resolved through talk, discussion, mediation, negotiation, and arbitration. The trend of maintaining proper water rotation and administrative monitoring systems solves the problems of water scarcity. For the resolution of conflict, the concerned authorities prioritize the improvement of the physical infrastructure.

Elderly farmers conducted a talk and discussion with the disputant farmers. They emphasized the priority and urgency of water needs and mediated the conversation. It helps farmers to understand each other's positions and suffering. The members of the main canal committee play a role in resolving conflict. Elderly farmers act as mediators to settle the conflict. At the end, parties who were wrong admit their mistake and promise not to repeat the same. They maintained their cordial relationship. Mostly, the

management committee of 3–5 members handled those conflicting issues. In case the conflict is serious, the chairperson, vice chairperson, and ward representative manage such conflicts. For the resolution of conflict, there was the practice of a water rotation system. The WUAs implemented a structured water rotation.

The project was divided into three main sections and twelve branches. One was the Gitanagar, another was the Shivanagar, and the other was the Managalpur. The current water rotation system allocated water as Gitanagar, the section that received water for four days; Shivanagar, the mid-section, received water for five days; and Mangalpur for six days. The rotation model served as a practical mechanism for resolving conflict. The conflict resolution process was conducted through both formal and informal means. It included discussion, negotiation, mediation, and agreement. The members of the main canal committee, the branch canal committee, and local political leaders facilitate the process for conflict resolution.

The theoretical framework helped the researcher justify the research questions and objectives. It guided the research design and methodology, justified the research problem, and interpreted the findings. Ostrom's common pool resource management is the fundamental theory applied as a lens to observe and analyze the issues. Her theory emphasized that sustainable resource management relied on trust, communication, and collective decision-making among the community members rather than the external actors. It highlighted that the local community members are required to provide ownership for the effective management of natural resources.

Similarly, this study visualized the context from the lens of Hardin's *The Tragedy of the Commons*. It prioritizes the need for external actors for the protection of such a common pool of resources. It highlighted the necessity of government actors along with private bodies to develop ownership of such projects. Both Ostrom's common pool

resource management and Hardin's The Tragedy of the Commons are not enough for the proper functioning of the KIP. The most appropriate approach to handle the KIP is through the concept of co-governance. This theory sheds light on the importance of equity, equality, responsiveness, accountability, and fairness in the performance from both stakeholders.

The concept of co-governance was considered meaningful in the context of KIP, as it theorized the need for ownership among the stakeholders. Unlike co-management, co-governance gave attention to its ownership from both the government bodies and community members. It can help to manage such a common pool resource in its own effective way. This study is fruitful for policymakers, scholars, and academics, as it helps them to identify the management domains of such common pool resources and resolve the existing and future conflicts in such projects.

7.2 Findings

There are five domains of irrigation management working in the KIP. They were the institutional arrangement system, the trend of farmers' participation, the effort of water user association members, the condition of the physical infrastructure, and the environmental concerns. These domains are interrelated and interfunctional with each other.

Similarly, the drivers of conflict in the KIP as identified from the study area were the low institutional arrangement system, weak participation of farmers, exclusion of beneficiary farmers from the regular meetings, not having accountable and responsible members of the water users' association, weak physical infrastructures, limited understanding about the ownership of resources and its rights, legal provisions in the federal state, and legal restrictions to enter into the CNP for those farmers who need emergency cleaning of the main canal that lies inside the park area. The conflict

resolution practices involve mediation, talk, discussion, and improvement of the physical infrastructures of the canal, gate, and bar. Along with this, to resolve the possible conflict, there is the practice of a water rotation system, but it doesn't seem effectively implemented in the KIP.

The management of the irrigation system runs with different national acts, policies, and rules as formulated by the irrigation institutional agencies like the federal ministry of energy and water resources, provincial water and energy sections, and the district irrigation office. In the KIP, there were institutional agencies like the Khageri water consumption committee and the Khageri irrigation district office located in the Chitwan district. These offices work to run this project.

The main problem lies in the nature and attitude of the farmers and their level of participation. In the study area, it was found that farmers were not serious and engaged in the regular maintenance and cleaning of canal activities. Some of the farmers even had not paid their water fee. The condition of the physical infrastructures like the canal, water gate, and bar handle was found below the working condition. It created problems like water seepage, water blockage, siltation, and sedimentation. There is lining in the main canal, but the condition of the branch and territory canals is fragile.

The shifting of settlement near the headwork side of the Khageri River created problems like environmental pollution and water shortages. During the lean season, most of the farmers throw the dust particles inside the canal. They make it as a dumping site. They accumulated dust, which created a foul smell and water pollution, and even there was the spread of communicable diseases.

The function of the WUA members was not found satisfactory. This study finds the issue that WUA members, as per the informants, were self-centered and worked to

fulfill their vested interest. They prioritize their relatives and favored persons while distributing water and give less interest to the needs of the common farmers.

One of the factors that drive irrigation conflict is the denial of riparian rights. Those farmers who belong to the head end section usually found not cooperative towards the farmers of the mid and tail end sections of the project. It drives a situation of conflict. Studies show that there was physical confrontation between two groups of farmers. Those farmers belonged to Ujelinagar once denied water distribution to the farmers of Mangalpur as Ujelinagar belongs to the head section and Mangalpur belongs to the tail end section of the project.

Another serious issue that drives towards conflict is the scarcity of water in the Khageri River. Both human and natural causes were identified as factors affecting water sources and scarcity. There is slow rise of temperature in the Khageri region according to the metrological data of Rampur college. It means the area has its effects of global warming. Human-induced causes were that they failed to line the canal and there existed the problems of water seepage, siltation, and sedimentation.

One of the particular causes of irrigation conflict in the KIP is due to not having adequate knowledge related to the distribution and ownership of resources in federalism. There is the false belief that the origin of the Khageri River lies in the Ratnanagar municipality, which means only the farmers of that municipality have the rights to consume water. Because of such a misunderstanding, the farmers of Ratnanagar created a blockage of water to the farmers of Bharatpur. It turned into a physical confrontation in the study area.

Another common issue of irrigation conflict is the encroachment of a canal while constructing houses and other structures. It disturbs the free flow of water from one

section to another. This induces conflict among the users and the owners, between government officials and the beneficiary farmers, and sometimes among the policymakers.

An almost 7 km long main canal passes through the Chitwan National Park. Those farmers who needed emergency maintenance of that section had to bear different challenges to enter inside the park. They were not allowed to enter the park with axes and metal weapons, without which clearance of wooden trees, dead leaves, and debris is not possible. It induces conflict between park authority and beneficiary farmers.

Some of the conflict resolution practices as noticed in the study area were through talk and discussion, a proper water rotation system, an administrative monitoring system, and improvement of the physical infrastructure.

Talk and discussion were considered as a direct whereas water rotation, strict administrative monitoring and improvement of physical infrastructure were the indirect ways of conflict resolution practices in the study area. Sometimes, those conflicting parties were being called by the elderly farmers. By the presence of third parties like elderly farmers, government officials, even police personal, those conflicting issues and parties come to a logical conclusion. Those who committed mistakes realise and beg a pardon and innocent got rewarded through formal and informal talk.

The administrative functioning needs to be strict which is a way to resolve conflict in a long run. During the KIIs with the policy makers and government officials, they stated that they were working to strengthen the KIP through strict administrative functioning. Those concerned offices need to seriously take such projects. It helps to reduce conflict and resolve the issues.

One of the issues that drive towards conflict is the weak physical infrastructures. It is necessary to make the technical and mechanical aspects of the project in working condition. If the concerned official simply constructs those lining canals in the branch and territory canals, it is helpful to control the problem of water seepage. It could be the way to resolve the conflict.

7.3 Conclusion

The sustainability of irrigation projects like the Khageri irrigation project is possible through the action and interaction among social, institutional, physical, environmental, and cultural dimensions. There is the need for cooperation, mutual trust, friendship, understanding, and social cohesion for the effective implementation of such projects. This study shows some of the domains of irrigation management in the KIP were the institutional arrangement system, trend of farmers' participation, condition of the physical infrastructures, performance of the WUAs, and environmental concerns.

The Khageri irrigation office and the Khageri water consumption office were working to monitor and supervise the project with its legal rules and regulations. Farmers' participation in the regular cleaning of the canal and maintenance and repair activities wasn't satisfactory. Those WUA members were turned personal and biased while distributing and allocating water to the users. Similarly, the condition of the canal was weak. Those machines were below the working condition, and those farmers used the canal as their dustbin to throw the dust. It created pollution and there was spread of communicable eye diseases.

This study identified multiple drivers of conflict. The denial of riparian rights, the problem of water shortages, consistent inequalities while distributing water, the reluctance of farmers for the repair and maintenance of the canal, environmental pollution, and the impact of climate change lead the project towards the conflicting

situation. Those upstream farmers do not cooperate with the mid- and downstream farmers. The increase of global temperature and human-induced causes like mismanagement of canal structure induce conflict and it resulted water seepage problems. The biased nature and functioning of users' associations is another cause of conflict. The attitude of some farmers is that they do not pay the water fee and participate during the general meetings, orientation, maintenance, and repair activities as well as accumulate dust and throw it inside the canal drive in the situation of conflict many times.

The study finds that conflict resolution in KIP takes the form of formal and informal talk, discussion, and mediation. The processes of mediation and negotiation take place with the presence of third parties. Mostly, those elderly farmers, members of the WUAs, community heads, school teachers, and local government representatives like chairpersons and members and sometimes police personnel act as mediators. They try to mediate the issues of conflict. There were many recorded incidents of conflict and mediation processes for conflict resolution that were discussed in the earlier sections of this study.

From a theoretical perspective, the issues of irrigation management, conflict, and its resolution have been visualized from three dominant theories. The theory of co-management, tragedy of the commons, and common pool resource management. The theory of co-management strengthened the importance of institutional bodies and beneficiary farmers. These two bodies are called the agency and the farmers' community; cooperatively, they can function such project well. Eventhough, the theory of co management failed to address the broader aspects of governance and only limited to the technical aspects and its management. There is the need of co governance which helps to view the cases from the perspective of governance, its ruling sytem, project

functioning, problems identification, feasibility studies and policy implementation and recommendation.

Similarly, the theory of tragedy highlighted the need of central body to control, supervise and function the project as there is less care upon such natural resources. Unlike Ostrom's, common pool resource management gives authority and ownership to the community members. She believes all human beings are serious and dedicated towards their work. It has been proven wrong in the case of the KIP. Most of the community members are found reluctant for the protection of such common pool resources. The best option for running such a project is with the blending of community and government functions with providing co-ownership, sharing of ideas and knowledge, and maintaining respect and accountability.

7.4 Contribution of Knowledge

The theory by Ostrom is based on the assumption that human beings are cooperative and rational. In the case of Nepal, however, resource management needs to be understood from the broader perspective judging every character and livelihood pattern. Unlike Ostrom's cooperative assumption, most of the stakeholders, like those beneficiary farmers, water users' association members, and local officials, had not seriously perceived the beauty of the project. They lack cooperation, accountability, and responsiveness. Ostrom's prioritization of the need for community participation for the protection of such common pool resources was proven wrong. Those community members, as perceived by Ostrom, do not function well. The condition of the KIP was deteriorating because of the nature and acts of those members of the region.

Ostrom challenged the central planning system, stating that state institutions lack adequate knowledge and show inefficiencies (Obeng-Odoom, 2016). She raised her disagreement to the concept of the Pigouvian approach that emphasizes the need for

external authority for the protection of such resources (Bergstrom & Randall, 2010). Despite this, the findings of this study emphasized the need for central authority for the effective implementation of natural resource management. In the case of KIP, those main canals were functioning well because of the lined canal system. It was operated by the government. In the KIP, the water users' association and district irrigation management are looking after the project on their own.

As stated by Hardin, tragedy occurs if resource ownership is given to the beneficiary farmers or the community members in his theory called the tragedy of the commons. He gives a special position to the institution or government bodies that are important for its effective functioning. In the case of the KIP management and functioning, this study concludes that isolating those users' association and giving authority only to the government bodies or institution is not found to be effective.

The practical implementation of such institutional arrangements remains a big question. There is the need for blending Ostrom's common pool resource management and Hardin's tragedy of the commons for the effective implementation of such projects. It supports the system of coexistence, authority, responsiveness, shared ownership, and accountability not only among the institutional bodies like government bodies but also to the users' associations and farmers' communities.

Based on the findings, this study proposes the theory of co-governance. It highlights the hybrid approach. For the effective implementation of such project, those institutional approaches should integrate community participation. Their mixing of these two entities helps to run the project effectively. It enables integration of local knowledge with institutional resources. It results in a sustainable and effective irrigation management system.

7.5 Recommendations for Further Research

This study is limited to the issue of irrigation management, conflict, and its resolution practices. The researchers covered the domains of irrigation management and other driving factors of conflict and its dynamics. The researcher notices some significant directions for future research that could be explored through other researchers interested in this field. The issues like the effects of migration, climate change, and hydrological dynamics on irrigation management were noticed as some of the factors driving conflict. It could be a fertile zone for those who want to conduct their study of irrigation management and conflict dynamics purely linked with these domains.

This interdisciplinary approach of study might help to increase the horizon of knowledge in this field. Interested researchers can conduct a comparative study of irrigation system management in Nepal by taking multiple cases of irrigation systems of Nepal. It leads closer to the reality. The concept of irrigation management is more technical. Any study that can incorporate both technical and environmental elements like soil composition, hydrology analysis, effects of climate change, and structural engineering would help to give a broader insight into biophysical causes of irrigation disputes.

Longitudinal studies would help to capture the dynamics between social, institutional, and environmental variables. It results in irrigation conflicts over time, resolving issues inherent to cross-sectional studies. The use of interdisciplinary tools such as geospatial analysis, hydrology, and socioeconomic models would be useful when examining quantitative aspects of institutional performance, participation, and conflict resolution.

APPENDIXES

Appendix I: Beneficiary Farmers Who Participated during Interview**Date: In between 26th June, 2023 to 15th July 2023**

S.N.	Farmer Name	Section	Branch / Canal	Head / Mid / Tail	Age	Gender	Key Interview Questions
1	G. H. Aryal	Gitanagar	Branch 1	Head	65	M	How is irrigation water distributed? What advantages or problems do head-end farmers face? Have water-related conflicts occurred? How were they resolved?
2	R. M. Neupane	Gitanagar	Branch 1	Head	58	M	Is water availability sufficient throughout the season? Have disputes arisen with mid or tail users? What role does WUA play?
3	R. Koirala	Gitanagar	Branch 1	Head	52	F	How fair is water allocation? Do women farmers participate in decisions? How are conflicts managed?
4	B. Bastakoti	Gitanagar	Branch 2	Mid	60	M	How is water shared within the branch? Are mid-section farmers affected by head or tail shortages?
5	R. Dhakal	Gitanagar	Branch 2	Mid	63	M	What causes water disputes here? How do they escalate and who resolves them?
6	L. Dhungana	Gitanagar	Branch 2	Mid	55	F	Are rules followed during water scarcity? Do women have a voice in conflict resolution?
7	T. Dhungana	Gitanagar	Branch 3	Tail	50	M	Do tail-end farmers receive sufficient water? What conflicts arise due to scarcity?
8	A. Dhakal	Gitanagar	Branch 3	Tail	59	F	How does water shortage affect farming? How effective is WUA in addressing tail-end problems?
9	D. Adhikari	Gitanagar	Branch 3	Tail	61	M	What coping strategies are used during scarcity? How

S.N.	Farmer Name	Section	Branch / Canal	Head / Mid / Tail	Age	Gender	Key Interview Questions
							are disputes resolved?
10	R. Dahal	Shivanagar	Branch 4	Mid	62	M	How is irrigation managed in this section? What conflicts are common and why?
11	H. Dahal	Shivanagar	Branch 4	Mid	57	M	Are institutional rules effective? How is coordination maintained among farmers?
12	K. Chapagain	Shivanagar	Branch 5	Mid	53	F	Is water allocation equitable? Are women involved in irrigation decisions?
13	B. Dahal	Shivanagar	Branch 5	Mid	66	M	What institutional weaknesses lead to conflict? How are disputes settled?
14	K. Bhatta	Shivanagar	Branch 5	Mid	61	M	How effective is WUA in water distribution and conflict resolution?
15	A. Sodhari	Shivanagar	Branch 6 East	Mid	55	F	What challenges exist in water access? How are conflicts addressed?
16	R. Sapkota	Shivanagar	Branch 6 East	Mid	59	M	Are maintenance and rule enforcement adequate? Why or why not?
17	B. Shrestha	Shivanagar	Branch 6 East	Mid	50	F	How inclusive is decision-making? Are women's concerns addressed?
18	K. Sodhari	Shivanagar	Branch 6 West	Mid	68	M	What types of conflicts occur here? How do they escalate?
19	R. Dahal	Shivanagar	Branch 6 West	Mid	60	M	How is coordination managed across branches during scarcity?
20	N. Subedi	Shivanagar	Branch 6 West	Mid	52	M	What role does leadership play in conflict resolution?

S.N.	Farmer Name	Section	Branch / Canal	Head / Mid / Tail	Age	Gender	Key Interview Questions
21	K. Aryal	Shivanagar	Branch 7	Mid	63	M	How effective are institutional arrangements in managing irrigation conflicts?
22	K. Sapkota	Mangalpur	Branch 8	Tail	61	M	Do tail-end farmers receive timely water? What conflicts arise due to shortages?
23	D. Magar	Mangalpur	Branch 8	Tail	50	F	How does water scarcity affect women farmers? Are disputes fairly resolved?
24	M. Timalina	Mangalpur	Branch 8	Tail	60	M	What mechanisms exist to address tail-end grievances?
25	K. Gurung	Mangalpur	Tertiary Canal 1	Tail	55	M	How is water managed at tertiary level? What conflicts arise?
26	S. Gurung	Mangalpur	Tertiary Canal 1	Tail	53	M	How are disputes resolved at local level? Is WUA effective?
27	T. Ghale	Mangalpur	Tertiary Canal 1	Tail	59	M	What improvements are needed for equitable irrigation and conflict management?

Appendix II: Focus Group Discussion (FGD) Checklist with Details of the Participants

1) **Research Focus:** Irrigation Management and Conflict Dynamics

Location: Gitanagar section, Chitwan

Participants: 6 Farmers (Age: 45–68 years)

FGD Type: Semi-structured

2) **Date:** 7th April, 2022

S.N.	Name	Gender	Age	Occupation
1	Prakash Timalsina	Male	52	Farmer
2	Sakuntala Hamal	Female	47	Farmer
3	Tul Raj Koirala	Male	62	Farmer
4	Sabitra Poudel	Female	48	Farmer
5	Ramakanta Rimal	Male	68	Farmer
6	Udaya Raj Tiwari	Male	50	Farmer

3) **Research Focus:** Irrigation Management and Conflict Dynamics

Location: Shivanagar section, Chitwan

Participants: 8 Farmers (Age: 45–69 years)

FGD Type: Semi-structured

Date: 4th July, 2023

S.N.	Name	Gender	Age	Occupation
1	Toya Nath Aryal	Male	58	Farmer
2	Anuradha Sodhari	Female	48	Farmer
3	Ram Krishna Giri	Male	63	Farmer
4	Keshar Bahadur K.C	Male	66	Farmer
5	Ramchandra Dahal	Male	51	Farmer
6	Rishi Ram Baral	Male	50	Farmer
7	Bhupal Singh Gurung	Male	69	Farmer
8	Durga Maya Tiwari	Female	55	Farmer

4) Research Focus: Irrigation Management and Conflict Dynamics

Location: Mangalpur section, Chitwan

Participants: 7 Farmers (Age: 45–75 years)

FGD Type: Semi-structured

Date: 10th July, 2023

S.N.	Name	Gender	Age	Occupation
1	Santosh Timalsina	Male	58	Farmer
2	Devi Thapa	Female	47	Farmer
3	Guna Raj Dawadi	Male	61	Farmer
4	Jyoti Wagle	Female	46	Farmer
5	Somnath Subedi	Male	65	Farmer
6	Krishna Bahadur Gurung	Male	68	Farmer
7	Ramnath Kafle	Male	70	Farmer

FGDS CHECKLIST FOR THE FARMERS

S.N.	Discussion Theme	Guiding Questions	Probes / Follow-up Points
1	Irrigation System Overview	Can you describe how the irrigation system functions in your area?	Water source, canals, rotation system
2	Water Availability	Is irrigation water sufficient throughout the year?	Seasonal scarcity, monsoon vs dry season
3	Water Distribution	How is water distributed among head, mid, and tail farmers?	Fairness, priority users
4	Access Inequality	Do some farmers receive more water than others? Why?	Power relations, location, influence
5	Conflict Occurrence	What types of conflicts arise related to irrigation water?	Frequency, actors involved
6	Conflict Causes	What are the main causes of these conflicts?	Scarcity, rule violation, infrastructure
7	Conflict Escalation	How do small disputes turn into bigger conflicts?	Triggers, leadership role
8	Conflict Resolution	How are irrigation conflicts usually resolved?	Informal talks, WUA involvement
9	Role of Institutions	What role does the WUA play in managing water and conflicts?	Effectiveness, limitations
10	Participation	Who participates in decision-	Inclusion of women,

S.N.	Discussion Theme	Guiding Questions	Probes / Follow-up Points
		making?	elderly, tail-end
11	Gender Perspectives	(Especially for Mangalpur FGD) How do irrigation issues affect women farmers?	Workload, voice in decisions
12	Infrastructure & Maintenance	Are canals and structures well maintained?	Responsibility, labor contribution
13	Rule Enforcement	Are irrigation rules followed by all farmers?	Sanctions, compliance
14	Equity & Justice	Do you think the system is fair to all users?	Head vs tail, marginalized groups
15	Changes Over Time	Have irrigation conflicts increased or decreased over time?	Reasons for change
16	Coping Strategies	How do farmers cope during severe water shortages?	Alternative sources, negotiation
17	Lessons Learned	What has helped reduce conflicts in the past?	Successful practices
18	Recommendations	What improvements are needed in irrigation management?	Policy, infrastructure, governance

Appendix III: KIIs Checklist with the Local officials and representatives

Date	Informant	Position / Institution	Condensed KII Checklist (Guiding Questions)
27th June, 2023	Purushottam Tiwari	6th Level Officer, Bharatpur Agriculture Unit	<ul style="list-style-type: none"> • Existing institutional and policy arrangements for irrigation management • Role of agriculture offices in supporting farmers and WUAs • Coordination among local government and irrigation agencies • Capacity-building and farmer awareness programs
25th June, 2023	Shyam Kumar Maharjan	Gate Keeper	<ul style="list-style-type: none"> • Role of ward-level institutions in irrigation governance • Local mechanisms for water distribution and maintenance • Nature and causes of irrigation-related conflicts • Conflict resolution practices at community level
12th July, 2023	Rajendra Sankhi	Ward Chairperson, Bharatpur-14	<ul style="list-style-type: none"> • Legal and institutional authority in irrigation management • Equity in water allocation between head, mid, and tail users • Power relations influencing irrigation decisions • Role of local government in conflict mitigation
13th July, 2023	Bel Bahadur Gurung	Chairperson Khageri Water Consumption Committee	<ul style="list-style-type: none"> • Functioning and effectiveness of WUAs • Participation of farmers in decision-making • Institutional challenges and governance gaps • Financial management, fee structure, and accountability
29th June, 2023	Achyut Raj Poudel	Engineer, Khageri Irrigation District Office	<ul style="list-style-type: none"> • Type and performance of irrigation management system (FMIS/AMIS) • Condition of headworks, canals, outlets, and maintenance practices • Seasonal water availability and infrastructure constraints • Technological use, environmental sustainability, and disaster management
17th June, 2023	Mukunda Kuikel (pseudonym)	Inchagre, DSP, District Police Office Chitwan, Bharatpur	<ul style="list-style-type: none"> • Cases of conflict, conflict resolution procedures, any serious incidents recorded or not

Appendix IV: Observation Checklist for the physical infrastructure

S.N.	Observation Focus/Item	Condition	Remarks
1	Main canal condition (lining, width, flow)	<input type="checkbox"/> Good <input type="checkbox"/> Fair <input type="checkbox"/> Poor	Well-maintained, smooth flow, minor sedimentation at corners.
2	Branch canals condition	<input type="checkbox"/> Good <input type="checkbox"/> Fair <input type="checkbox"/> Poor	Some minor blockages and erosion at edges; needs routine cleaning.
3	Water distribution structures (sluice gates, regulators)	<input type="checkbox"/> Good <input type="checkbox"/> Fair <input type="checkbox"/> Poor	Functional but occasional sticking; some rust present.
4	Check dams / weirs	<input type="checkbox"/> Good <input type="checkbox"/> Fair <input type="checkbox"/> Poor	Structures stable, water flow properly regulated.
5	Intake structures	<input type="checkbox"/> Good <input type="checkbox"/> Fair <input type="checkbox"/> Poor	Intake clear; minor debris removed by farmers regularly.
6	Irrigation channels / field channels	<input type="checkbox"/> Good <input type="checkbox"/> Fair <input type="checkbox"/> Poor	Minor blockages; flow to some fields slightly reduced.
7	Storage tanks / ponds	<input type="checkbox"/> Good <input type="checkbox"/> Fair <input type="checkbox"/> Poor	No major leakage; water storage sufficient.
8	Condition of embankments / bunds	<input type="checkbox"/> Good <input type="checkbox"/> Fair <input type="checkbox"/> Poor	Some erosion spots; requires minor reinforcement.
9	Maintenance and repair needs	<input type="checkbox"/> Good <input type="checkbox"/> Fair <input type="checkbox"/> Poor	Routine maintenance needed for gates and branch canals.

S.N.	Observation Focus/Item	Condition	Remarks
10	Access roads and transportation facilities	<input checked="" type="checkbox"/> Good <input type="checkbox"/> Fair <input type="checkbox"/> Poor	Roads mostly passable; minor potholes.
11	Safety measures (signs, barriers)	<input type="checkbox"/> Good <input type="checkbox"/> Fair <input type="checkbox"/> Poor	Few signs missing; barriers at some critical points weak.
12	Vegetation or obstructions affecting flow	<input type="checkbox"/> Good <input type="checkbox"/> Fair <input type="checkbox"/> Poor	Some canals have overgrown vegetation; occasionally obstructs flow.
13	Structural damages or erosion	<input type="checkbox"/> Good <input type="checkbox"/> Fair <input type="checkbox"/> Poor	Small cracks and erosion in branch canals; no major collapse.
14	Observed innovations or improvements	<input type="checkbox"/> Good <input type="checkbox"/> Fair <input type="checkbox"/> Poor	Farmers have implemented minor local improvements to channels.
15	Other relevant observations	<input type="checkbox"/> Good <input type="checkbox"/> Fair <input type="checkbox"/> Poor	Conflict sometimes arises when minor repairs are delayed; generally manageable.

Appendix V: Research Questions

Basically, there are three questions made to fulfill the objective of this study. To support the major research questions, some relevant sub questions are also formulated.

- 1) What are the common conflicts in the irrigation sector and their management in a community and why do these conflicts occur?
 - What are the major issues of conflict?
 - How are these conflicts managed, mitigated or transformed?
 - Who are the major actors involved in these conflicts?
 - What processes, mechanisms are used to resolve those conflict?
 - Why are those mechanism or process used to resolve those conflicts?
 - What are the roles of State, State- Instituted agencies like courts, police, municipal or rural municipal administration?
 - Who are responsible for conflict mitigation or which local institutions are responsible to resolve conflicts? (Water User's Committee, FMIS community or AMIS community)
 - How do power relation affect conflict management practices?
 - What is the nature and behavior of Headend farmers to the Tail end and vice-versa?

- 2) How can irrigation conflict be effectively managed at the local level?
 - Who are the actors responsible to resolve the conflict in a local level?
 - What are the legal and customary practices used to settle those conflicts at

a local level?

- What are the conflict management tools and mechanism applied to settle those conflicts?
- how far those mechanisms work to settle those conflicts?
- Mostly, who are the victims of irrigation conflict in general?
- What is the role of Irrigation water users in order to resolve those conflicts?

3) How can we maintain irrigation cooperation among users?

- What are the ways to maintain water cooperation?
- What are the existed laws, treaties, conventions related to irrigation management and how far those legal practices have been followed?
- Who are the stakeholders responsible to maintain water cooperation?
- What is the role of Gos, NGos and other local bodies including civil society to maintain irrigation cooperation?
- What is the state of Art of the farmers in terms of water use and distribution?
- What are the views of scholars and academics to maintain water cooperation in terms of Irrigation management?

Appendix VI: Some of the collected photos during the field study

Picture 1



Maize being cultivated with Khageri irrigation water

Picture 2



Existing canal and gate condition of KIP

Picture 3



Researcher during FGD with Gitanagar tail end section farmers

Picture 4



Researcher during FGD with Shivanagar head end section farmers

Picture 5

प्रदेश सरकार
सानेपानी, ऊर्जा तथा सिंचाइ मन्त्रालय
नारायणी लिफ्ट स्वगेशी सिंचाइ व्यवस्थापन कार्यालय
बागमती प्रदेश
भरतपुर, चितवन

नागरिक वडा पत्र

कार्यालयमा नारायणी लिफ्ट र स्वगेशी गरि २ वटा सिंचाइ प्रणालीहरू रहेका छन्।
यस कार्यालयबाट प्रदान गरिने सेवाहरूको उद्देश्य कार्यालय अन्तर्गत पर्ने प्रणालीहरूको कमाण्ड क्षेत्र भित्र रहेको कृषि योग्य जमिनका लागि पानी पुऱ्याइ कृषि उत्पादन गर्न सहयोग पुऱ्याउने

सि.नं.	सेवा मुविधाको विवरण	सेवा उपलब्ध हुने प्रकृया	सेवा बापत लाग्ने दर/रु.	लाग्ने समय	सम्पर्क गर्न पने व्यक्ति/ फोर्ट
१	यस कार्यालय अन्तर्गत पर्ने नारायणी लिफ्ट, स्वगेशी सिंचाइ प्रणालीको आवश्यकता अनुसार संस्था गठन गर्ने।	विधान मस्यौदा समितिद्वारा जल उपभोक्ता संस्थाको विधान पारित। संस्था गठन भएपछि कार्यालयमा ज.उ.स को दुर्ता गरि दुर्ता प्रमाणपत्र समेत दिइनेछ।	१००/-	प्रत्येक शान्ता १(एक) महिना ७(सात) दिन भित्र	द.ओ. / संस्थागत विकास शाखा
२	जल उपभोक्ता संस्था नविकरण गर्ने।	ज.उ.स ले लेखा परीक्षण प्रतिवेदन पेश गर्नु पर्नेछ। सम्बन्धित शाखा नहरको ज.उ.स बाट संस्था नविकरणको लागि निवेदन लिइनेछ।		प्रत्येक ज.उ.स को जसोज मसान सम्म	जा.प्र. शा. / प्रसाशन शाखा/ संस्थागत विकास शाखा
३	मूल नहर तथा शाखा नहर संचालन:-	उपभोक्ताको माग अनुसार नहरमा पानी संचालन गरिनेछ।		धान बालि अवधिभर	सम्बन्धित ईन्जिनियर तथा सर्व इन्जिनियरहरू
क	पम्प नहर सिंचाइ प्रणाली अन्तर्गत B नहर तथा C नहर प्रणाली अन्तर्गतका मूल नहर तथा शाखा नहर संचालन	पम्प हाउस A तथा B मा रहेको पम्पको क्षमता अनुसार पम्प संचालन गरि पालो प्रणाली अपनाई पानी पुऱ्याइने व्यवस्था मिलाइनेछ। ज.उ.स स्थाले कृषकको मीठा बसोजिम समेत सम्भार कास गरि नहर संचालन गर्ने कार्य।		"	"
ख	स्वगेशी सिंचाइ प्रणाली अन्तर्गत मूल नहर तथा शाखा नहर संचालन	ज.उ.स स्थाले कृषकको मीठा बसोजिम समेत सम्भार कास गरि नहर संचालन गर्ने कार्य।		"	"
४	सिंचाइ सेवा शुल्क संकलन गर्ने व्यवस्था लागत फर्डा गर्ने	प्रत्येक शाखा/प्रशाखा नहरका सिंचित क्षेत्र भित्रमा उपभोक्ताहरूको सिंचित क्षेत्रको लागत तयार गरिने छ। जा-जाफला शाखा नहरको ज.उ.स तथा कार्यालय बिच सम्बन्ध गरि संकलन गर्ने व्यवस्था मिलाईने छ।		स्वगेशी सिंचाइ प्रणाली तर्फ रु २००/- प्रति बिघा नारायणी लिफ्टको लागि रु प्रति बिनाहा	द.ओ. / संस्थागत विकास शाखा
५	जन सम्पर्क सेवा	योजना सम्बन्धि तथा कार्यालय सम्बन्धि सम्पूर्ण विषयको जानकारी हब सोधपुछ।		जति सर्वो चीडो	सु.ई.टी.

Citizen Charter of KIP division office Bharatpur

Picture 6



Main canal lining work at KIP

Picture 7



KIP head works office Tikauli forest area

Picture 8



Existing condition of canal sluice gate

Picture 9



KII with migrant farmer at KIP

Picture 10



Current operation mechanism of irrigation sluice gate

Picture 11



Current condition of weeding, siltation, and pollution inside Khageri irrigation canal

Picture 12



Broken tree inside Khageri main canal located inside CNP

Picture 13



Water flow inside head works of Khageri river

Picture 14



Researcher with the farmer who belongs to Kirangunj

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