

# Searching for the 'watershed approach' in irrigation projects in Bolivia

*A case study of the San Pedro irrigation project, Cochabamba*



M.Sc. Thesis by Pamela Liliana Claire Gutiérrez

August 2012

Irrigation and Water Engineering Group



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Master thesis Irrigation and Water Engineering submitted in partial fulfillment of the degree of Master of Science in International Land and Water Management at Wageningen University, the Netherlands

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## Abstract

Nowadays in Andean watersheds the competition for water between different users and uses has increased, a situation that is reflected in the increment of conflicts between upstream and downstream stakeholders regarding the water use and access. In the particular case of Bolivia, an attempt to solve this situation was the incorporation of the 'watershed approach' as a requirement for the design of irrigation projects. However, the 'watershed approach' implementation in irrigation projects has proven to be difficult. In order to contribute to the development of a local framework of the 'watershed approach' in Bolivia, this research analyzed by means of a case study methodology the 'watershed approach' of the San Pedro irrigation project.

The San Pedro irrigation project design lasted for twenty five years mainly for the location of the project and the target group. The San Pedro reservoir is located in the Hio community territory, near the boundary with San Pedro community. However, due to technical constraints Hio community cannot be part of the project, so it was necessary to establish a negotiation between the irrigators (San Pedro and Miraflores community) and the non irrigators (Hio community). The main argument for the negotiation was that Hio peasants claimed for the ownership of the reservoir territory and the water sources.

The result of the negotiation process was two agreements: one of them is the *atajados* agreement that provided Hio peasants with water and the second one is the purchase of the reservoir territory agreement. Even if both agreements are subscribed, there is still one remaining source of conflict: the water use of the dam. By one hand the non irrigators claim water rights of water from the dam based on a socio-territorial mechanism. On the other hand, the irrigators claim water rights of the water from the dam as they invested money and labour. So, both valid mechanisms of acquiring water rights at irrigation system level enter in competition when scaling up to watershed level.

An analysis of the different conflicts during the design and implementation of the San Pedro irrigation project, showed that they are mainly a result of the unclarity of water rights at watershed level. This situation shows that defining water rights through a water management analysis at watershed level, considering the social and power relations among local stakeholders, is a central issue for the design of irrigation projects with a 'watershed approach'. So prior the intervention in a watershed it is necessary to identify the different water uses and users in the basin in order to understand the existing organizational dynamics recognizing cooperation and/or conflict relationships.

Even if the 'watershed approach' claims to be an adaptation of the mainstream worldwide water management approaches of Integrated Water Resource Management (IWRM) and Integrated Watershed Management (IWM), the case of the San Pedro irrigation project revealed that it was actually a 'watershed development' approach. In that sense, the objective of all the actions in the upstream area are oriented to protect the lifespan of the irrigation infrastructure located downstream, particularly the reservoir. One of the main reasons for this situation, is the conceptual confusion inside the National Watershed Plan (NWP) which is the document that guides all project interventions in the Bolivian watersheds. The NWP states that IWRM and IWM are two complementary concepts, so IWRM focuses mainly on the social aspects at watershed level and IWM is related with the technical actions in the watershed.

**Keywords:** Water rights, Integrated Watershed Management, Integrated Water Resource Management, water conflicts, irrigation project, Bolivia

## Table of contents

Abstract	V
Table of contents	VI
List of tables	VIII
List of figures	VIII
Abbreviations	IX
Acknowledgments	X
Chapter 1 RESEARCH CONTEXT .....	1
1.1 Introduction.....	1
1.2 Problem statement.....	2
1.3 Objective.....	2
1.4 Research questions.....	2
1.5 Methodological framework.....	3
1.6 Thesis outline.....	6
Chapter 2 CONCEPTUAL FRAMEWORK.....	8
2.1 Peasant water management .....	8
2.1.1 Water rights.....	10
2.2 Irrigation projects with a watershed approach.....	11
2.2.1 Water management approaches at watershed level.....	12
2.2.2 The watershed as a management unit for water resources .....	13
2.3 Water management problems analysis at watershed level.....	14
2.3.1 Water conflicts .....	14
Chapter 3 SETTING THE SCENE.....	15
3.1 Water policies in Bolivia .....	15
3.1.1 Institutional framework.....	15
3.1.2 Legal framework.....	16
3.1.3 National Development Plan .....	17
3.1.3 National Watershed Plan.....	18
3.1.4 The National Development Irrigation Plan.....	20
3.2 The research area: Hio watershed .....	22
3.2.1 Upstream Hio watershed .....	23
3.2.2 Downstream Hio watershed.....	26
3.3 General characteristics of the San Pedro irrigation project.....	27
Chapter 4 SAN PEDRO IRRIGATION PROJECT IN THE HIO WATERSHED: BATTLE FRONT BETWEEN UPSTREAM AND DOWNSTREAM STAKEHOLDERS.....	32
4.1 The cracks in the relationships of the Hio watershed communities .....	32
4.1.1 From syndicate to sub central: the emergence of community limits and the influence on water conflicts.....	32

4.1.2	San Pedro irrigation project: a quarter century of conflicts and negotiations .....	34
4.2	Water use and water access in the Hio watershed: an unfinished issue .....	40
4.2.1	Property water rights: Hio vs. the irrigators.....	41
4.2.2	Water use in the Hio watershed: a postponed issue .....	42
4.3	Conflicts in rights, access and use of water: gaps in communities relationships for the management of the Hio watershed .....	47
Chapter 5	HIO WATERSHED MANAGEMENT PLAN AS PART OF THE SAN PEDRO IRRIGATION PROJECT .....	50
5.1	The watershed approach in the design phases of the San Pedro irrigation project.....	50
5.1.1	The feasibility study and its environmental approach .....	50
5.1.2	The final design and its watershed management approach .....	51
5.2	From San Pedro irrigation project to Hio watershed action plan .....	52
5.2.1	The Hio watershed action plan.....	53
5.2.2	Problems in the implementation of the Hio watershed action plan.....	56
5.3	Irrigation in the watershed or the watershed for irrigation?.....	59
Chapter 6	ANALYZING THE INTERACTION BETWEEN THE HIO WATERSHED PLAN AND THE SAN PEDRO IRRIGATION PROJECT .....	61
Chapter 7	SEARCHING FOR THE WATERSHED APPROACH IN IRRIGATION PROJECTS: LESSONS LEARNED FROM THE HIO CASE STUDY.....	67
7.1	Conclusions.....	67
7.2	Irrigation projects with a ‘watershed approach’ in Bolivia: Reflections and recommendations .....	71
8	REFERENCES .....	75

## List of tables

Table 1. Comparison of the conceptualization of IWRM and IWM within the national legal framework and other literature .....	20
Table 2. Pilot irrigations projects with a watershed approach in Bolivia .....	21
Table 3. Main characteristics of San Pedro dam .....	28
Table 4. Affiliate number and irrigated area per community .....	29
Table 5. Total amount paid by San Pedro WUA to the affected by the reservoir.....	40
Table 6. Action plan developed during the PROAGRO intervention .....	55

## List of figures

Figure 1. Review of minute books .....	4
Figure 2. Activities during the field research area.....	6
Figure 3. Organizational structure of the MMAyA.....	16
Figure 4. Political localization of Hio watershed .....	22
Figure 5. Location of Hio, San Pedro, Miraflores and Comun Pampa communities .....	23
Figure 6. Panoramic view upstream Hio watershed .....	24
Figure 7. Goats grazing in upstream Hio watershed .....	24
Figure 8. Panoramic view of the Illumayu stream.....	25
Figure 9. Location of the main water courses in the upstream area of Hio watershed .....	25
Figure 10. <i>Atajados</i> in the upstream Hio watershed .....	26
Figure 11. Panoramic view of downstream Hio watershed .....	26
Figure 12. Maize production in downstream Hio watershed.....	27
Figure 13. Transversal section of San Pedro dam .....	28
Figure 14. Scheme of the principal canals of San Pedro irrigation project.....	29
Figure 15. Construction of the San Pedro irrigation project .....	30
Figure 16. Structure of rural peasants organization in Bolivia .....	33
Figure 17. Timeline for the design and implementation of San Pedro Irrigation project .....	34
Figure 18. Scheme of the water transfer point from San Juan watershed to Hio watershed Source: Elaborated based on SCS-Gandarillas, 2007.....	35
Figure 19. <i>Atajado</i> in the upstream Hio watershed.....	38
Figure 20. Affected families by the reservoir .....	39
Figure 21. Payment to a Hio peasant affected household .....	40
Figure 22. Soil erosion risk map .....	51
Figure 23. Reforested area in the upstream Hio watershed.....	57

## Abbreviations

CSUTCB	Unified Syndical Confederation of Rural Workers of Bolivia
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit
IWM	Integrated Watershed Management
IWRM	Integrated Water Resource Management
KfW	Kreditanstalt für Wiederaufbau
MMAyA	Ministry of Environment and Water
NDP	National Development Plan
NDIP	National Development Irrigation Plan
NWP	National Watershed Plan
NGO	Non-Governmental Organization
PDAR	Alternative Regional Development Program
PROAGRO	Agricultural Development Program
PRONAREC	National Irrigation Program with a Watershed Approach
SEAPAN	Aiquile Municipality Drinking Water and Sewage Service
SEDERI	Departmental Irrigation Service
SENARI	National Irrigation Service
VRHR	Vice Ministry of Water Resources and Irrigation
WUA	Water User Association

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# Part 1

## Introduction to the research

Chapter 1: Research context

Chapter 2: Conceptual framework

Chapter 3: Setting the scene

## CHAPTER 1 RESEARCH CONTEXT

### 1.1 Introduction

Population growth, urbanization, improved sanitation and economic development lead to the increment of fresh water requirements worldwide. Focusing on Bolivia where 80% of the water used is for agriculture (Alurralde, 2002), this situation is manifested as an increase of fresh water requirements from peasants located in the downstream areas of the watersheds, to extend the irrigated area. This situation is exacerbated due to a sensed decrease of water availability in the downstream area. The current condition is mainly caused by climate change and a decrease of the soil retention capacity in the upstream area, so, downstream stakeholders look up to the upstream watershed where the water resources are born.

Looking into the upstream watershed, in this area there is also an increment of water use for agriculture. Additionally, in some cases, the previous situation is accompanied with degradation process of soil coverage due to inappropriate agricultural practices, overgrazing or a lack of protection of the water resources. The soil degradation diminishes the retention capacity of the upstream area, so, there is a clear reduction of the base flow. Furthermore, in the case of extreme events, like river floods, the sediment dragging rate increases, jeopardizing the lifespan of the hydraulic infrastructure (especially dams) located in the downstream area. Moreover, in recent years upstream stakeholders claim more access to the water resources constructing intakes or *atajados*<sup>1</sup> in the upstream area (Bueno de Mezquita, 2011).

The picture gets even more complicated when we add to the above panorama an irrigation project. Incorporating an irrigation project implies a modification of the hydrological cycle and the water use at watershed level as there is a change in the water use and water access (ibid). Within the described scenario, the conflicts between upstream and downstream stakeholders for the use and access of water increase. However, the same irrigation project that can become the source of conflicts can become a window of opportunities to establish an articulation between the upstream and downstream watershed. Then, both stakeholders groups negotiate agreements regarding water access and use as well as the watershed conservation to secure the water availability in the watershed in order to satisfy the different uses and users.

In that sense, the role of the engineers from different projects and programs that head the irrigation projects intervention is a determinant aspect to avoid future confrontations between upstream and downstream stakeholders. Moreover, this necessity to incorporate the articulation between the upstream and the downstream watershed has been traduced in the current water political framework, establishing that irrigation projects should be designed with a 'watershed approach'. However, giving this jump from focusing mainly only on the irrigation system to the watershed level has been proven to be difficult. This caused the existence of different attempts of irrigation projects with a 'watershed approach' within the Bolivian territory. In most cases, these initiatives are promoted by international donors who attempt to incorporate principles of the global trends of water resource management such as Integrated Water Resource Management. This thesis nalyzes the 'watershed approach' of the San Pedro irrigation project located in the Hio watershed corresponding to Aiquile municipality in the department of Cochabamba.

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<sup>1</sup> '*Atajado*' means 'embanked' and describes a big earthen reservoir on a slope that collects the surface run off of the rainwater from a prepared catchment area (3-5 ha) above the reservoir. The construction typically consists of a simple earthen ditch dug with spade to collect the run off.

## 1.2 Problem statement

The increase of pressure on water resource as a result of the population growth coupled with industrialization and urbanization is nowadays worldwide recognized as an important issue. At watershed level this pressure is manifested as a demand from the different water use sectors for water in terms of quantity and quality. But, at the same time this generates conflicts of interest and vision between the different water use sectors.

In Bolivian watersheds it is more common to encounter conflicts between upstream and downstream stakeholders with respect to water access. Upstream stakeholders recognized their privileged position in the watershed and are now demanding the benefits of that position. This in most cases implies a claim for an equitable access of resources, conditioning the conservation of the upstream watershed. Within this panorama, water management approaches like Integrated Water Resource Management are considered a possible solution by local engineers and policy makers. Therefore, since 2006 the Bolivian water political framework incorporated the mentioned approach stating that irrigation projects should have a 'watershed approach'.

However, it is still not clear how to operationalize the 'watershed approach'. Neither there is a guideline to orient the engineers on how to achieve this aim. Thus, different programs and projects attempt to incorporate the 'watershed approach' according to their own ideas, criteria and perception. Also, in the different irrigation projects there is still no systematization of the different experiences.

## 1.3 Objective

The previous paragraphs highlight the necessity to systematize the experiences of the different programs and projects that have been working on 'irrigation projects with a watershed approach' in order to have conceptual and methodological contribution generated in the practice to develop guidelines. One of the first irrigation projects with a 'watershed approach' is the San Pedro irrigation project. With the analysis of the different dynamics within the design and implementation of the San Pedro irrigation project I aim to contribute to the development of a conceptual and methodological framework of the 'watershed approach' in the national context.

## 1.4 Research questions

The main research question that leads the present research is:

*Which is the current situation of the articulation between upstream water management and downstream water management in the Hio watershed product of the intervention of the San Pedro irrigation project with a 'watershed approach'?*

To address the previous main research question the following sub questions are formulated:

1. *How the San Pedro irrigation project intervention has influenced the interrelation of the Hio watershed communities?*
2. *Which is the 'watershed approach' of the San Pedro irrigation project considering the different intervention stages?*

3. *Which is the current status of the articulation between upstream water management and downstream water management in the Hio watershed after the implementation of the San Pedro irrigation project with a 'watershed approach'?*

## 1.5 Methodological framework

This research was developed based mainly on qualitative information, in a few cases supported by quantitative data, as this type of information allows understanding the different dynamics among stakeholders during the different design and implementation stages of the San Pedro irrigation project. Furthermore, as analyzing any water related issue involves analyzing social and technical aspects in a complex reality, the approach used during this research is a constructivist approach characterized by the interpretation of a complex dynamic and not seeking for the universal unique truth. Taking that into account in the following sections I will present the methodology and the methods of my research.

### The methodology

The methodology used for this research is a case study. A case study is expected to capture the complexity of a single case (Tellis, 1997) and its methodology allows to answer the questions about the "how" and "why" and to understand a phenomena that has not yet been researched thoroughly (Yin, 1984). Also, case studies are designed to bring out the details of the viewpoint of the participants by using multiple sources of data. Therefore, case studies are analyzed in a multi-perspective way as it considers not only the voice and perspective of the stakeholders, but also of the relevant groups of actors and the interaction between them (Feagin, Orum and Sjoberg, 1991).

The research is an explanatory case study as the questions 'which', 'what' and 'how' are asked. Answering the research questions allows us to understand what happened on the ground during the implementation and design of the San Pedro irrigation project with a 'watershed approach'.

### The methods

The research was conducted adopting an ethnographic approach. According to Long (2004) the ethnographic approach facilitates exploring social interest relations, cultural interpretations, knowledge and power as well as how they are mediated and transformed among stakeholder groups. Therefore, the following methods were used to recollect qualitative data during the field work phase that I executed during the months of November 2011 to February 2012 in Cochabamba, Bolivia.

- Literature review

This was a constant activity during the whole research focused on two types of sources. The first source was the design documents of the different design stages of the San Pedro irrigation project and the design stages of the Hio watershed management plan. With this information it was possible to identify the approaches used during the intervention and the main characteristics of them. The second source of data was the minutes from the Hio syndicate and San Pedro Water User Association (San Pedro WUA). These documents provided me specific information about the different historical events and positions of each stakeholder group. Additional reports were collected regarding the situation of irrigation projects with a watershed approach in Bolivia and other types of documents regarding the water political and legal framework like the National Development Plan, the National Watershed Plan and the National Development Irrigation Plan.



**Figure 1. Review of minute books**

- Interviews

The main source of data was acquired through interviews. Two different types of interviews had been used. On the one hand, semi structured interviews were used to ask facts, opinions and perceptions to identify the main characteristics of the water management at watershed level and the articulation between the upstream and downstream watershed. On the other hand, informal interviews and casual meetings were used to identify the opinions of the stakeholders regarding delicate topics as an informal environment allowed them to talk more openly.

A total of 25 interviews were done during the field stage. The first group of interviews was conducted to upstream stakeholders (peasants and local leaders), downstream stakeholders (peasants, local leaders and directive of San Pedro WUA) and local authorities (Aiquile Central and Aiquile municipality personal). To build a rapport with the interviewee the first section of the interview was focused on historical data to understand the different events and their characteristics that occur according to the interviewee perspective. The second section of the interviews focused more on the interviewee perception of the different conflictive situations to understand the conflict perception.

The first contact that I had in the research area was through the construction supervision company GANDARILLAS SRL. One of the engineers presented me to the main leaders of the Hio syndicate and the San Pedro WUA. As I did not want to be considered as part of the construction supervision, I presented myself to the community during the assemblies of the Hio syndicate and the San Pedro WUA explaining them my research aims and asking for their cooperation. My participation in the assemblies allowed me to program interviews with the current directive of both organizations and to understand the dynamics inside each of the organizations.

My role as an interviewer focused mainly on carefully listening to the conversation and motivated the interviewee to talk about the topic, intervening only when the interviewee lost track of the topic. Even if an interviewee guide was prepared according to the stakeholder group (upstream and downstream), the interview structure was re-adapted according to the information obtained during

the process and the specific topic that I wanted to deepen on. An important aspect to notice is that some interviews, especially with upstream stakeholders, were conducted in the local language *quechua*, so a translator was present during these interviews.

The selection of the interviewees was done according to geographic limits (communities), which mean three major groups had been identified: San Pedro, Miraflores and Hio. Within each group the snowballing sampling method was used as the aim of my research was to understand the different historic events. The limitation of this sampling method was that the interviewees were mostly done to ex-local male leaders. To counteract this situation during my participation in the assembly of San Pedro WUA I established contact with the women and talked with them to ask for interviews. Only one woman that was the head of the household accepted to be interviewed, other women asked me to interview their husbands. Additionally, as the Hio community is characterized by high migration rates it was more difficult to interview this group.

The second group of interviews was conducted to the engineers who intervened in the San Pedro Irrigation project and/or the Hio Watershed Management Plan (Gandarillas SRL and PROAGRO). These interviews helped me to understand the main characteristics of their intervention, the approach used during it, their role during the conflictive situations and their perception of it. The four interviews were done to the engineers that work in the execution of the Hio watershed management plan (two) during the final design phase and PROAGRO (two) intervention phase. The last group of interviews was conducted to national authorities related with the thematic (Vice ministry of Water Resource and Irrigation and the director of the National Program of Irrigation with a Watershed Approach) to deepen the comprehension of the 'watershed approach' in irrigation projects as it is recently put into practice.

- Observation

This technique was used during the whole fieldwork in two different ways. Firstly, this technique allowed me to understand the main physical characteristics of the Hio watershed and the peasants' livelihood activities in the area. Secondly, this technique was valuable while conducting the different interviews as it allowed me to identify how sensible a topic was through their facial expressions.



**Figure 2. Activities during the field research area**

### Data processing

All the data obtained during the field work stage was processed to build a data base according to the research sub questions. Therefore, I made a textual transcription of the records of the three different groups of interviewees and complemented them with the observations done during the interviews. Also all the photos from the minute books were transcribed and translated into English. Even these tasks were time consuming, I considered it extremely important as my aim was to get the position of upstream stakeholders and downstream stakeholders regarding the whole intervention of the San Pedro irrigation project and the conflicts that arose during the whole process.

### 1.6 Thesis outline

This thesis is structured in seven chapters. The present chapter provides an introduction to the research framework presenting the research problem, research questions and methodology. Chapter number two introduces the conceptual framework focusing on peasants' water management, irrigation projects with a watershed approach and water management problems analysis at watershed level. The third chapter provides the essential information to understand the context of the case study providing information about the Bolivian political water framework, the main characteristics of the Hio watershed and the principal characteristics of the San Pedro irrigation project.

The fourth chapter details the interaction among stakeholders during the historical development of the San Pedro irrigation project. A special emphasis is given to the conflicts between upstream and downstream stakeholders. These conflicts focus on the access and use of water in the Hio watershed as a result of a lack of a normative and legislative framework at watershed level. Chapter number five focuses on describing the 'watershed approach' within the different phases of the San Pedro irrigation project, providing a description of the Hio watershed management plan and the results of implementing three actions of it.

The sixth chapter of the thesis analyzes the interrelation between the Hio watershed plan and the San Pedro irrigation project, identifying the different factors that influenced it and the local dynamics among stakeholders that shape it. Finally, the last chapter of the thesis is number seven, it is divided in two main sections. The first section presents the main conclusions of the research according to the research questions presented in chapter one. The second section closes this document presenting some reflections and recommendations of the lessons learned from the 'watershed approach' in the San Pedro irrigation project.

## CHAPTER 2 CONCEPTUAL FRAMEWORK

To understand and to analyze the present case study, which is located in Bolivia, it is necessary to consider some important concepts. Taking into account the fact that the water in the watershed is mostly self-managed by peasants, the first concept that I will present in the coming section is the main characteristics of peasants' water management, emphasizing on the construction and granting of water rights within the Andean region.

Subsequently, considering the particular characteristics of the development of watershed management in Bolivia I will introduce the concept of 'irrigation projects with a watershed approach'. Then, the different worldwide approaches of managing water resources at watershed level are presented, making a special emphasis on the concept of the watershed as a water management unit, considering the challenges of this assumption. Finally, I will present a framework to analyze water management problems at watershed level based on the stakeholders' interrelation, complemented with the water conflicts analysis according to the Echelons of Rights Analysis.

### 2.1 Peasant water management

According to the online Cambridge Dictionary water management is defined as the activity of planning, developing, distributing and managing the optimum use of water resources. However the previous given definition is broad and for this research purpose it is necessary to conceptualize water management in a more context specific dimension, which in the case of Bolivia is defined as peasant water management.

*“Peasant water management is a form of social interaction: among different stakeholders, using different methods, resources and strategies, about water use and distribution activities, taking place in a given socio-technical system, consisting of a series of settings for interaction, which have: a spatial dimension in terms of the social hydraulic levels of the irrigation system (system, group of households, households), and a time dimension, linked to the agro-ecological cycle and the water delivery rate, and rooted in the culture, in the agrarian structure, in the institutional infrastructure of public and private entities and in material infrastructure (ecology, technology), continually produced and transformed through interaction.” (Gerbrandy and Hoogendam, 1998: 230)*

The definition presented is based on studies of irrigation systems in Bolivia. Moreover, there is no conceptualization of peasant water management at watershed level available in literature. Therefore, I will use this concept for my research taking into account the following considerations. First, the previous definition considers as an interaction space a group of households, but for my research, the space will be broadened into a watershed, which means I will consider interaction among communities. Also, for the research purpose the time dimension is not only linked to the agro-ecological cycle, but also to the hydrological cycle.

Even if water management considers a physical-technical dimension, for this research purpose a fundamental aspect of the concept is understood that water management is also a social interaction between the different stakeholders. Therefore, water management is a dynamic phenomenon which depends on the objectives, strategies and interests of the different stakeholders and the interactions among them. The objective of the social interaction is the water control, which expresses itself as

access and use of water. Therefore, according to the mentioned considerations, peasants' water management at watershed level for my research is defined as:

*“Peasant water management at watershed level is a form of social interaction among different stakeholders, using different methods, resources and strategies, about water access and water use, taking place in a given socio-technical watershed, consisting of a series of settings for interaction, which have: a spatial dimension in terms of the social relations among communities and a time dimension linked to the hydrological cycle rooted in the culture, in the local organization, in the ecological and economic characteristics, continually produced and transformed through interaction.”*

An important characteristic of Bolivian water management is that the peasant sector manages more than 85% of the water used in the country for irrigation and consumption (Alurralde, 2002). However, within the same country, the water management conditions differ according to the region. On the one hand, water management in altiplano and valley regions (where the case study is located) is subsistence production-oriented and strongly shaped by the cultural environment. On the other hand, in other regions (such as the mesothermal valleys of Santa Cruz and the valleys of Tarija) the water management is primarily market-oriented (Gutierrez, 2005). Most altiplano and valley inhabitants have strong roots in the Andean culture which is an agro-centric culture. Therefore farming is the centre of the Andean economy, social life, religion and culture. This agro-centric feature is related with the integrated management of the ecosystem in general and the water in particular (ibid).

The main domain in which the water management is imbedded in the Andean culture is the rural community. Most resources in this setting are under members' control, which organize distribution of use and access to resources, or seek to control them. In the case of water, 'peasants' water management' is shaped by communities' socio-territorial organization (Gerbrandy and Hoogendam, 1998). Therefore it is essential that all the activities related with water resource management are considered equitable and suitable by the users (Alurralde, 2002) because the main characteristic of water management is that it is self-managed by peasants.

Regarding to this, Bueno de Mezquita (2011) said that local organizations in the Andes developed structures to manage water sources and the land where this water will be used. Furthermore, in most cases the local organizations in charge of managing water resources recognize the supremacy of the communitarian and higher level organizations (Central, Sub central, Syndicate) (Alurralde, 2002). Even if this kind of organization is not properly a watershed management organization, it is important to understand that their principles and norms for land and water management are a product of a social construction developed through many years. The main principles of peasants' organization (Gutierrez, 2005; Gutierrez and Gerbrandy, 1998) are the following:

1. Equity: There are obvious complications when defining a concept like equity because it depends on the perception we have of the phenomenon that we want to describe. In that sense the term equity refers to the status of just and fair (according to the stakeholder perspective) access and distribution of water (Treffner et al, 2010) and should not be confused with equality which means the same. However, the conceptualization of equity will depend on the respective context within the different stakeholder groups.
2. Transparency: This principle is related with the norms and rules as all of them should be visible for all users and any change should be easily distinguished and assumed.
3. Flexibility: This principle is reflected in the possibility of changing or diversifying the organization responding to regional/national changes and/or individual goals.
4. Autonomy: Water management in most Andean systems is highly autonomous at the communal level. Therefore, the conditions are favorable for users to participate within the

organization. There is autonomy because water management systems are managed and administered by the users themselves.

5. Decision-making and collective control: The principle of governing water management is collective decision-making, based on shared agreements, which allow a societal enforcement of agreements. Even this is not a guarantee of social justice for all groups; it allows an ongoing dialogue among all users regarding these agreements. Additionally, the agro-centered culture of rural communities demands collective involvement to guarantee life. Specifically in the water management sector the different aspects of managing requires everyone's participation.

As stated previously, this type of organizations manages 85% of the water used in Bolivia. Another characteristic of peasant communities is that indigenous and original nations have a sense of ownership in relation to the water sources located inside their territory denominated socio-territorial logic (Alurralde, 2002). Within their territory, access to different water sources exists considering different water uses and users. The access rights to the water sources is known as water rights and its granting depends on different mechanisms as it will be explained in the following point.

### 2.1.1 Water rights

Even if there are plenty international approaches about water resources management at watershed level, they are based on principles (like the economic efficiency of water principle of the Integrated Water Resource Management approach) that do not match the cultural water management of the diverse cultures that live within the national territory. Therefore, any proposed approach of water management at watershed level should recognize the different local worldviews of water that is expressed in the different water rights conceptions. For the explained reason, this section focuses on the concept of water rights in the Bolivian context.

Multiple-use water management at watershed level is related to the societal distribution of water rights (Boelens, Dourojeanni and Hoogendam, 2005). Therefore, at watershed level multiple interest groups define among themselves how water will be apportioned, distributed and managed, taking active part in inter-sectorial water management (Boelens et al, 2002). According to Boelens et al. (ibid) there is a vacuum in the literature on watershed management arrangements throughout the major Andean watersheds, specifically a concept for water rights considering the watershed as a management unit. Therefore the concept to be used in the research is the one developed for Andean irrigation systems.

Gerbrandy and Hoogendam define water rights as:

*“an authorized claim to the flow of benefits from a water source”. (Gerbrandy and Hoogendam, 1998: 113)*

The flow of benefits is described as water which can be obtained from a determined water source, and can be used for all kinds of applications (Ibid). Boelens and Doornbos (2001) identify four mechanisms for accessing, using and controlling water rights in peasant systems applicable in the local context:

1. Historic and socio-territorial rights entitled for the inhabitants of the socio-territory to which the water source 'belongs'. There are two specific forms of this mechanism: riparian rights (based on the possession of land with a water source or located along a stream) and prior appropriation rights (based on 'first come' claims).

2. Transfer of water rights from one right holder to another through sale, inheritance, marriage, barter, or donation.
3. Acquisition of water rights by force from mostly peasant and indigenous people water rights by powerful groups.
4. Users' investment of their own resources (e.g., labor, capital, goods) to build or rehabilitate water use infrastructure, thereby creating hydraulic property<sup>2</sup>.

It is important to understand that water rights not only refer to the right to access and use water (quantity, quality, timing, duration, and place of acquisition) but it includes the subjects of control and authority (Boelens, Dourojeanni and Hoogendam, 2005).

The main element of the previous definition is the term authorization as water use should be certified by an authority (individual and collective) with legitimacy and power of enforcement recognized by users and non-users (Beccar et al., 2002). Water rights feature two forms: individual and collective water rights. For this research the focus is on collective water rights that are defined as the right to use water vis-a-vis other persons (individuals or collectives) with conflicting interests. These rights define the collective forms and conditions for access to the water source regarding to other parties that are interested not only in using water but also to the rights related to water use (ibid).

Therefore, water rights represent social relations among the stakeholders and are strongly related with existing social organization and power relationships. Due to the influence of the social organization and the power relationships within and among the multiple water use systems in a watershed there are different types of rights and diverse acquiring mechanism (Hendricks, 2010).

## 2.2 Irrigation projects with a watershed approach

In Bolivia, even if the term 'irrigation project with a watershed approach' is incorporated into the political water framework, there is no clear definition of it. Furthermore, the National Watershed Plan (2006) focuses on arguing why the 'watershed approach' should be implemented but does not provide a practical methodology of how to implement this approach. Therefore, to understand what is the meaning of this term, I interviewed the Vice Minister of Water Resources and Irrigation. According to him, an 'irrigation project with a watershed approach' is:

*"The management of water related issues with the extension covered by the water resource... which is the watershed, where water is used and generated...the watershed defines the physical space where water is used...the watershed is the easily perceived planning unit...Therefore there is a connotation of integration between the upper watershed and the lower watershed because any use of water, not only irrigation, needs to see beyond the use of water, considering the water resource sustainability and the effects to other potential water uses" (Interview with Vice Minister of Water Resources and Irrigation)*

The mentioned concept is the one that nowadays is guiding the intervention of irrigation projects in Bolivia. An important element in the previous concept is the term 'integration'. The term 'integration' means that one element that is integrated with another element or integrated in a system becomes operationally part of it. Integration is a fusion that incorporates aspects of the other

<sup>2</sup>For Gerbrandy and Hoogendam (2002), hydraulic property explains how farmers, government agents and development institutions invest labor and/or capital to develop irrigation projects with objects such as dams, canals, weir, and intakes). The investment they made in capital or labor entitles them to use the objects and exclude the non-investors.

system, changing and adopting new characteristics (Mendez and Bueno de Mezquita, 2011). Taking into account that in Bolivia the implementation of the ‘watershed approach’ is in an initial stage, to explore the integration process is more appropriate to refer to the articulation level between the management systems (Ibid). Articulation is defined as:

*“Connect in such a way that, both parts can work better together and together are functional in a determined management system” (Méndez and Bueno de Mezquita, 2011: 4).*

Based on the previous concept, for this research the ‘watershed approach’ in irrigation projects is defined as the articulation between upstream water management and downstream water management. This can be translated into the connection between the upper watershed and the lower watershed to jointly manage the watershed in a sustainable and coordinated manner.

### 2.2.1 Water management approaches at watershed level

To understand which is the watershed approach in the Bolivian irrigation projects I will take into account the different water management approaches developed until nowadays. Warner et al. (2008) recognize three important stages, each one with their particular approach:

- The first stage was born during the 19<sup>th</sup> century as a result of the major dam construction and is denominated river basin<sup>3</sup> development (Molle, 2006). During this period, the river basin development approach aimed to collect the flow of the basin by constructing infrastructure to regulate the water flow and protect the dam to promote economic development and human welfare (Molle, 2009).
- The second stage was born with the creation of the Tennessee Valley Authority in 1933 (Molle, 2006). Therefore, this stage was characterized by the creation of watershed organizations to plan and develop the water resources to achieve an integral socioeconomic development. Hence, during the 1980s the Integrated Watershed Management (IWM) approach was the planning tool for protection and development of water, land and other resources (Tefera and Stroosnijder, 2007). IWM is defined as:

*“The protection, improvement and rational use of water and land and other renewable resources in a watershed, in order to reach the optimal goals of ecological, economic and social benefits” (Lixian, 2002: 356)*

- The last stage started during the 1990s. This phase is strongly related to the ecosystem approach where water is considered as an integral element within it (Delgadillo and Duran, 2012). As a result of this stage the Integrated Watershed Management (IWRM) approach was worldwide accepted as the solution to solve the water related crisis. Therefore, first world countries have incorporated the IWRM approach into their framework, such as the Water Framework Directive implemented in 2000 in the European Union. The mainstream definition of IWRM is given by the Global Water Partnership (2000) that defines IWRM as:

*“a process which promotes the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems” (Technical Commission GWP, 2000: 22).*

<sup>3</sup> Even if the author refers to the basin which is a broader hydrological scale, for the research purpose I will narrow down this concept and apply it at watershed scale.

The similarities and differences between the definitions of IWM and IWRM have been widely debated (Tefera and Stroosnijder, 2007). Focusing first on the differences, according to Madema and Jeffrey (2005) cited in Tefera and Stroosnijder (2007) the main difference between IWRM and IWM is that IWRM includes time dimensions while IWM considers space dimensions. However aside previous authors, other experts consider that the evolution of the IWM approach is the IWRM approach (as explained previously) so there are no clear differences and in some cases both terms are used indistinctly. In the Bolivian political framework the National Watershed Plan (2006) also makes a differentiation between IWRM and IWM concepts as it will be presented in Chapter 3.

Focusing on the similarities, both previous definitions have two notable common points. The first one is that both consider water, other natural resources, and economic/social/ecological/environmental dimensions (Tefera and Stroosnijder, 2007) within their definition. The second common point is that both consider the hydrological watershed as the management unit, an aspect which will be developed in further detail in the following section.

### 2.2.2 The watershed as a management unit for water resources

The watershed as well as being a physical unit also has characteristics of a social unit, even if the boundaries of this social unit are not so well defined (Boelens, Dourojeanni and Hoogendam, 2005). The watershed is:

*“A zone where groups of inhabitants are interrelated, sharing its water, and organizing around its reaches. In mountainous zones, rivers or mountain ridges between watersheds commonly define the pathways for transport, exchange, and communication. The hydrological characteristics and hydraulic works strongly influence the ways that people live in the watershed, interact and generate day-to-day interdependence” (Boelens, Dourojeanni and Hoogendam, 2005: 194)*

It is important to consider that in this document for the ease of terminology I will use the term ‘watershed’ as it denotes an area of land draining into a common body of water such as a lake, a river or an ocean, which also includes the terms ‘river basin’ and ‘catchment’.

When assuming the watershed as a management unit the following aspects should be considered:

- The watershed scale is ambiguous (Budds and Hinojosa, 2012) because assuming which boundary will be used is not simple considering the nested nature of watersheds so the boundaries are defined (or are redefined) by people through a subjective process (Cohen and Davidson, 2011).
- The hydrological units poorly correspond with administrative jurisdictions, social organizations, electoral representations and environmental regulations (ibid). This situation is traduced in two asymmetries: ‘problem-sheds<sup>4</sup>’ as watersheds are impacted and impact beyond their boundaries and ‘policy-sheds<sup>5</sup>’ between authority at watershed level and at administrative level. So re-scaling to the watershed level does not directly empower local stakeholders as there is a discrepancy in power to act.

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<sup>4</sup> A ‘problem-shed’ is defined as the geographic area that is large enough to encompass the issues but small enough to make implementation feasible (Griffin, 1999)

<sup>5</sup> A ‘policy-shed’ is defined as a geographic area over which a governmental entity has legislative authority (Cohen and Davidson, 2011)

I will consider the mentioned issues for the analysis of the case study to clearly establish the constraints of the watershed as a management unit.

### 2.3 Water management problems analysis at watershed level

A variable to understand the problems related with water management at watershed level is the analysis of stakeholders' interrelation. In that sense, I understand the interrelations among communities as the social relationships and existing power structures. Boelens, Dourojeanni and Hoogendam (2005) raise a number of functional elements to analyze or diagnose the problems associated with water management at watershed level considering stakeholders interrelation. For this research the following elements are considered:

1. Stakeholders' characterization, considering their historical backgrounds, their position in the watershed and their capacity for participation and organization.
2. The objectives and criteria of stakeholders, explicit and implicit, which depend on their particular water management needs and aspirations.
3. The problems and conflicts that are related to water management, including the divergent problem perceptions by different interest groups.
4. The restrictions that limit attaining stakeholders' goals and aspirations, considering technical, political, organizational and financial constraints.
5. The different solutions that are expected by or for interest groups, on a particular or collectively basis.

#### 2.3.1 Water conflicts

An aspect that requires further explanation for my research is the one that refers to water conflicts. A water conflict is perceived as the confrontation over access to water, infrastructure or any resources linked to water, the content of the water rights, the (legitimizing) authority and control of water between two or more parties (Boelens, 2008b). These actors have opposite views and therefore, conflicting goals. The dynamics of the conflicts are related to power relations (social, economic, political) that each actor has in order to access and control the resource. Understanding that disputes over water occur at different levels, Boelens (2008a) proposes its abstraction using four levels:

- *Disputes over the resources*, refers to the conflict produced by any mechanical or natural resource that allows access to water
- *Disputes about the rules*, refers to conflicts related with the establishment of rules and norms to access and control of water rights.
- *Disputes about the regulatory body*, refers to conflicts generated in relation to the recognition and legitimacy of the authority through which water governance is conducted.
- *Disputes about the regime of representation*, refers to the struggle generated by different social discourses. Each discourse has its own principles on how rights, rules and authority must be defined, conditioning in one way or another, access and control of water.

These four abstraction levels will be considered specifically for the analysis of water rights at watershed level in this research.

## CHAPTER 3 SETTING THE SCENE

This chapter has the objective to introduce the reader into the context of the research area. With this purpose, the chapter begins presenting a brief description of the water policies in Bolivia related with the research topic. The following section provides detailed information about the main characteristics of the research area: the Hio watershed. To conclude, section 3.3 presents the main characteristics of the San Pedro irrigation project which is located in the Hio watershed.

### 3.1 Water policies in Bolivia

Since 2006, when the current president of Bolivia Evo Morales rose to power, different reforms have been implemented within the water sector. Therefore, this section will start briefly describing the institutional and legal framework regarding water resources. The following sections succinctly detail the main characteristics of the three development plans that guide the water resource management in Bolivia: the National Development Plan (NDP), the National Watershed Plan (NWP) and the National Development Irrigation Plan (NDIP).

An important aspect to consider in the following sections is that all the information was extracted from the formal policy documents existing in Bolivia. In most cases, different terms used in these documents do not provide a conceptualization and/or a clear explanation on how they are intended to be implemented.

#### 3.1.1 Institutional framework

From 2006 the new government of Evo Morales created the Ministry of Water<sup>6</sup>, joining the different institutions related with water in a single structure. Three vice ministers were created: Basic Services, Irrigation and Watershed-Water resources. In 2009 the Vice minister of Environment that was part of the Ministry of Rural Development became part of the Ministry of Water, acquiring the name of Ministry of Environment and Water (MMAyA<sup>7</sup>). This Ministry is responsible for planning, implementing, monitoring, evaluating, and funding plans and policies for water resource management. It consists of three vice ministries: Drinking Water and Basic Sanitation, Water Resources and Irrigation<sup>8</sup> (VRHR<sup>9</sup>), as well as Environment, Biodiversity and Climate change. The organizational structure of the MMAyA is presented in the following figure.

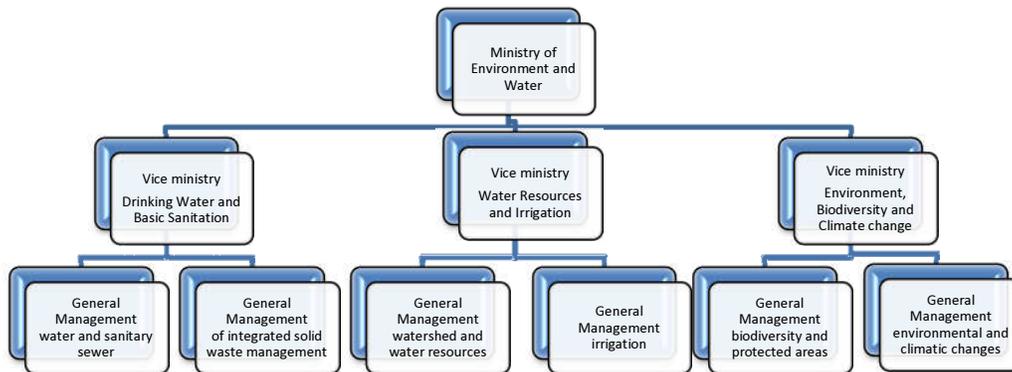
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<sup>6</sup> The Ministry of Water was created by law 3351

<sup>7</sup> Acronym in Spanish (Ministerio de Medio Ambiente y Agua)

<sup>8</sup> Previously formed by the Vice ministry of Watershed-Water Resources and Vice ministry of Irrigation

<sup>9</sup> Acronym in Spanish (Viceministerio de Recursos Hídricos y Riego)



**Figure 3. Organizational structure of the MMAyA.**

Source: PNC, 2006

The previous figure shows that inside the VRHR<sup>10</sup> are two management units. On the one hand one unit is related with the watershed and water resources; on the other hand, the second is related with irrigation. Each unit has its own objectives and plans, which means that there is no action plan that interrelate both units, even if both are responsible of the water management. In that sense, the General Management of Watershed and Water Resources proposes projects that do not consider irrigation inside the watershed and the General Management of Irrigation proposes watershed projects focusing only in irrigation.

Also, inside VRHR at national level there is the National Irrigation Service (SENARI) and at departmental level there is the Departmental Irrigation Service (SEDERI). The SENARI and SEDERI's are the participatory bodies where socio economic and productive organizations interact with the state to plan and grant water rights. The SENARI and SEDERI's are in charge to implement the irrigation Law (Law 2878<sup>11</sup>) regarding to registration and authorization of irrigation water rights. In addition, SENARI is responsible of defining public policies that identify and encourage the formulation, funding and execution of irrigation programs and projects. In an attempt for a decentralization of the institutions responsible for the water management issues, more responsibilities were assigned to the Departmental Governments and municipal levels.

### 3.1.2 Legal framework

According to the New Constitution of 2009, the government has the responsibility to manage, regulate, protect and plan for an adequate and sustainable use of hydrological resources, and to guarantee all inhabitants access to water according to the principles of solidarity, complementarity,

<sup>10</sup> For the first five year phase inside the VRHR, the NDIP projected an investment of 222.259.000 million U.S. dollars. These resources came from public funds, international cooperation and contributions of the beneficiaries, Departmental Governments and municipalities (NDIP, 2006). The implementation of the NDIP is through project and programs. The national state does not execute any project, the state contract consultancy firms for the design and implementation of projects.

<sup>11</sup> The Irrigation Law (Law 2878) formally denominated 'Law for the promotion and support to the irrigation sector' (Ley de apoyo y promoción al sector riego) was implemented in 2005 and established the norms that regulate the sustainable water use for irrigation for agricultural and forestry purposes.

reciprocity, equity, diversity and sustainability<sup>12</sup>. Hydrological resources cannot be privatized, although mixed public-private partnerships may be created for the administration of basic services for drinking water and sewage. Under the New Constitution, the state must recognize and respect traditional community customs regarding water management.

In Bolivia, water resources are regulated by the 1906 Water Law and many other sectorial laws in more recent legislations, including the Environmental Act, the Mining Code, the Electricity Act, Water and Sanitation Services Law, the Irrigation Law, and the Hydrocarbons Act.

The Water Law of 1906 is characterized by a lack of water authority, and a lack of an integral regulatory frame that comprises the multiple uses of water. So, Bolivia has made numerous attempts to create a single law to govern water resources, there are also 32 Water Law versions that the government has been trying to approve but failed to obtain acceptance of all the stakeholders. These law versions were even more threatening for irrigators' water rights because the proposal was to create water markets (Bustamante, 2002). Nevertheless, the MMAyA has prepared a Water Law project that was subject to the review of national and international consultants for their comments; this document, is still in pre-approval stage nowadays.

In spite of the regulatory progress, mainly at a sector level (e.g. the Irrigation Law), and institutional level (e.g. creation of the Water Ministry), the formal regulatory and institutional situation of water in Bolivia is still weak, incomplete, non-existent or outdated (e.g. Water Law of 1906). Therefore, at local level traditional regulatory practices prevail for water access and management based on customs and usage (customary rules or positive rights), that coexist with the formal rights, and are supported by ancient structures, or recent ones, but socially accepted or imposed by the local authority.

### 3.1.3 National Development Plan

The National Development Plan<sup>13</sup> (NDP) presented in June 2006 outlines the strategic priorities for the Bolivian government. In the NDP natural resources are assigned central importance, both as a growth engine and as a generator of employment. In the so called National Productive Matrix the relevance of the strategic sectors (Hydrocarbons, Mining, Electricity and Environmental Resources<sup>14</sup>) is emphasized. The central role assigned to the state in the management of natural resources is one of the most central changes put forward in the NDP.

Water has been given a higher priority by the new government than by previous governments. The NDP contains ambitious reform plans for the sector. The government considers water as a human right and as a public resource which should be owned and controlled by the state.

One of the objectives of the NDP is to establish a sustainable, equitable, participative and integral water resource management, contributing to social and economic development of a multicultural and multiethnic society, and to the environmental conservation with state participation. For this purpose the NDP established different policies, two of them related with this research: Policy 4 'Expansion of irrigation coverage' and Policy 6 'Water for everybody'.

Policy 4 has a technical approach, emphasizing on the adoption of technologies for water and land management. It also refers to topics related with investment in irrigation projects. Policy 6 'Water for

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<sup>12</sup> All this principles are written in the new State Constitution, however there is detailed information about the meaning of each one.

<sup>13</sup> The NDP was written by the Ministry of Development Planning before the new State Constitution.

<sup>14</sup> "Environmental resources" in the NDP includes biodiversity, forests, greenhouse gases (carbon sequestration) and water.

everybody’ emphasizes on the social character of water, indicating that the watershed is the planning and water resource management unit. Also this policy indicates that in the watershed the Integrated Water Resource Management approach will be implemented, prioritizing the human consumption, the agricultural production, flora and fauna necessities and other uses (NDP, 2006).

To implement Policy 6 ‘Water for everybody’ three strategies are formulated, two of them related with the research and are presented next.

1. Establishing an equitable, sustainable, participative, trans-sectoral and integrated water resource management.

To implement this strategy, the NDP proposes the development of a new water management framework at policy, legislation and regulation level based in three actions: (1) to define the institutional functions and roles of the political administrative levels, (2) to generate information regarding water supply and water demand for the different water uses and (3) to develop technical and operational instruments that allow the distribution, regulation and monitoring; as well as the development of economic tools.

2. Environmental water resource management

This strategy intends to develop and implement an environmental management for the protection, preservation and sustainable use of the water resources considering the watershed as the management and planning unit to allow a multi sectorial use, respecting and guaranteeing the precedence order for drinking water and irrigation.

The program in charge to implement previous strategies is the National Watershed Plan<sup>15</sup>. Therefore, all the mentioned aspects inside the NDP are considered as guiding axes for the formulation of the National Watershed Plan (NWP) and also in the National Development Irrigation Plan (NDIP).

### 3.1.3 National Watershed Plan

The National Watershed Plan (NWP) is an instrument developed for the implementation of a new modality of management, described as integrated water resource management, with the watershed as a management unit and a responsible and sustainable natural resource management in Bolivian watersheds.

Therefore, the objective of the NWP is:

*“...establish a sustainable, equitable, participative and integral water resource management, contributing to the social and economic development of a multicultural and multiethnic society, and the environment conservation with the state participation”  
(NWP, 2006: 15)*

The NWP indicates that the integral water management framework (based in the IWRM and IWM approaches) should be reflected and operationalized in all programs and projects related to the use and conservation of water resources in the country.

Moreover, the NWP builds on the content of Policy 6 ‘Water for everybody’ of the NDP and establishes that:

<sup>15</sup> Vice-Ministerio de Cuencas y Recursos Hídricos, Plan Nacional de Cuencas, 2006. See also the section “*Agua para todos*” in the NDP p. 125-127

*“The basic unit for planning and managing water and environment resources is the watershed, which links social and public management. The watershed is considered as a living space. In it, Integrated Water Resource Management (IWRM) and Integrated Watershed Management (IWM) will be implemented, prioritizing human consumption, agricultural production, flora and fauna necessities and other social, productive and economical uses”. (NWP, 2006: 1)*

Therefore, the NWP (2006) incorporates into their framework two main concepts: Integrated Water Resource Management (IWRM) and Integrated Watershed Management (IWM), defined as the following:

*Integrated water resource management (IWRM) is defined as “a process which promotes the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems.” (Technical Commission GWP, 2000 cited in NWP, 2006: 16)*

*Integrated Watershed Management (IWM) is defined as the integrated management of natural resources to achieve an integrated environmental management to improve life quality. (NWP, 2006: 17)*

The NWP considers that the two concepts of IWRM and IWM are both necessary and complementary. The concept of IWM covers primarily the technical tasks to use and natural resources in a watershed, while IWRM prioritizes and emphasizes on the social and institutional aspects of management and administration to enable an integrated and sustainable use of water resources. So, both concepts at governmental level are translated into practice as the following:

*“IWM in practice is to incorporate actions to reduce the vulnerabilities of the watershed such as preservation or erosion. IWM is strongly related to specific measures, it is establishing actions in the watershed... IWM is integral because they are complementary for other practices” (Interview with Vice Minister of Water Resources and Irrigation)*

*“IWRM is a way of management which main characteristic is the term integrated. Integrated is mainly referring to agreements for the water management considering the complementary of actions and sectors. It is nowadays part of the public policies that is why we search for the integration of all the elements under a common denominator which is the sustainable use of the water resources. As IWRM term expresses itself, it is not referring to structural measures but it is an agreement between parties for a water use in a territory” (Interview with Vice Minister of Water Resources and Irrigation)*

It is important to make a special emphasis on the difference between how the terms of IWRM/IWM are incorporated in the national political framework and the conceptualization of these terms are presented in Chapter 2. The implications of the difference in the conceptualization between IWRM and IWM, showed in Table 1, when designing irrigations projects with a ‘watershed approach’ are discussed in further detail in Chapter 6, based in the San Pedro irrigation project with a watershed approach.

**Table 1. Comparison of the conceptualization of IWRM and IWM within the national legal framework and other literature**

CONCEPT	Spanish term <sup>16</sup>	National Watershed Plan	Vice Minister of Water Resources and Irrigation	Tefera and Stroosnijder
<b>Integrated Watershed Management</b>	<i>Manejo Integral de Cuencas</i>	Technical tasks to use and manage natural resources	Physical measures in the watershed	Considers water and other natural resources focusing in the space dimension of the watershed
<b>Integrated Water Resource Management</b>	<i>Gestión Integral de los Recursos Hídricos</i>	Social and institutional aspects to manage and administrate natural resources	Focused mainly in social aspects, specifically in the agreements between parties	Considers water and other natural resources focusing in the time dimension
<b>Relationship</b>	Different meaning	Complementary	Complementary	Different management dimensions

With previous clarification, the aims of the NWP are: strengthen the IWRM/IWM approach in actions and projects, development of the institutional environment, development of local capacities, to elaborate and harmonize integral policies for water use and water management and the innovation of the legal and normative framework (NWP, 2006: 6). According to this framework, the NWP proposed to articulate and coordinate the different water use sectors, starting with basic services and irrigation that are part of the MMAyA (NWP, 2006: 11). Related with the irrigation sector the NWP mentions:

*“Agricultural development requires an adequate technological development according to the characteristics of the soils, territories, watersheds, ecosystems quality, irrigation expansion and modernization, water storage, water rights regulation, distribution, water uses coordination, all of the previous related with the social water management at watershed level and particularly to implement the water use for irrigation with a watershed approach” (NWP, 2006: 20).*

Nevertheless, since the elaboration of the plan until now it has not been possible to consolidate an articulation and coordination between the different institutional levels of the MMAyA.

### 3.1.4 The National Development Irrigation Plan

Private and public irrigation management in Bolivia is regulated through different policies; one of them is the policy 6 of the NDP, but the most important is the Irrigation Law (Law N° 2878). This law establishes the basis of public irrigation policies defining the scope, objectives and goals of the National Development Irrigation Plan (NDIP). The different aspects of this policy relevant for the research are:

<sup>16</sup> The English term ‘management’ has four different meanings when translated into Spanish: ‘*gestión, administración, ordenamiento y manejo*’ (Dourojeanni et al, 2002). But even the terms are synonyms, they acquire a different meaning when applied into the water sector within the Bolivian context. In that sense, when we refer to the concept Integrated Watershed Management - IWRM (traduced as *Manejo Integral de Cuenca – MIC*) the fact that we use the word *manejo* implicitly refers to activities related to only technical aspects. On the contrary when the term *gestión* is used, such as in Integrated water Resource Management – IWRM (traduced as *Gestión Integral de los Recursos Hídricos – GIRH*) it implies a bigger dimension that considers the social relations that shapes water and vice versa.

- The hydrographic watershed is the geographic unit, considered as a planning and water management unit, their management and protection should improve the efficiency and quality of water resources (NDIP, 2007: 36).
- Water resource management is integral, decentralized, participative, communitarian considering the cultural, ethnic and geographic diversity of the different ecosystems (NDIP, 2007: 36).

The NDIP aims to dynamize the irrigation development considering different principles, among them the integration principle which refers to: Irrigation projects should be designed articulated with the development plans at national, sectorial, departmental and municipal level, considering the inter relation with other agricultural and development programs and projects (NDIP, 2007: 37).

The NDIP establishes a general objective and several specific objectives, one of them strictly related with the incorporation of irrigation in the integrated water resource management with a watershed approach and an environmental protection approach (NDIP, 2007: 39). Therefore, the first component of the NDIP (Water rights and water resource management for irrigation) through the sub-component denominated “Social Water Management for Irrigation with a Watershed Approach” proposes the implementation of irrigation projects with a watershed approach. According to the NDIP ‘Irrigation with a Watershed Approach’ is an effective articulation between irrigation, basic services and watershed institutional sectors to plan an appropriate use of water resources at watershed level considering the different water uses through the constitution of a Watershed Management Organization<sup>17</sup>.

Also, the NDIP (ibid) indicates that irrigation infrastructure should be constructed considering a connection with the different water uses at the watershed level. The planning and programming of irrigation projects should consider a nexus with water use and natural resource use at watershed level according to the current irrigation and environment regulations.

According to the explained political panorama since 2009 all irrigation projects in Bolivia should have the ‘watershed approach’. Until now three different projects with a ‘watershed approach’ have been implemented in Bolivia in two departments: Santa Cruz and Cochabamba. Table 2 shows the main activities of the pilot irrigation projects with a ‘watershed approach’ implemented until nowadays.

**Table 2. Pilot irrigations projects with a watershed approach in Bolivia**

NAME	KUYUJ KHOCHA	COMARAPA	HIO-TAPERA
<b>Department</b>	Cochabamba	Santa Cruz	Cochabamba
<b>Activities</b>	<ul style="list-style-type: none"> <li>• Construction of a sprinkler irrigation system</li> <li>• Design of an Integrated Watershed Management (IWM) plan</li> <li>• Creation of a watershed organization</li> <li>• Reforestation measures in the upper watershed</li> </ul>	<ul style="list-style-type: none"> <li>• Construction of a dam in the middle watershed</li> <li>• Conservation actions in the upper watershed through compensation agreements</li> <li>• Drinking water endowment</li> <li>• Creation of a watershed organization</li> <li>• Design of an Integrated Watershed Management (IWM) plan</li> </ul>	<ul style="list-style-type: none"> <li>• Construction of the irrigation system</li> <li>• Reforestation measures in the upper watershed (joint work strategy)</li> <li>• Creation of a watershed organization where all local stakeholders participated</li> <li>• Design of Integrated Watershed Management (IWM) plan</li> </ul>

Source: Elaborated based on ‘Documento orientador, de consulta y guía para el trabajo del VRHyR de promoción e implementación de Organismos de Gestión de Cuencas’, 2011 and personal conversation with the Director of National Irrigation Program with a Watershed Approach (PRONAREC).

<sup>17</sup> From the translation of the Spanish term *Organizacion de Gestión de Cuenca*

One of the pilot irrigation projects with a watershed approach is the San Pedro irrigation project in the Hio watershed, which is the case study of this research. So, in the following sections I will describe the main characteristics of the Hio watershed and the main futures of the San Pedro irrigation project.

### 3.2 The research area: Hio watershed

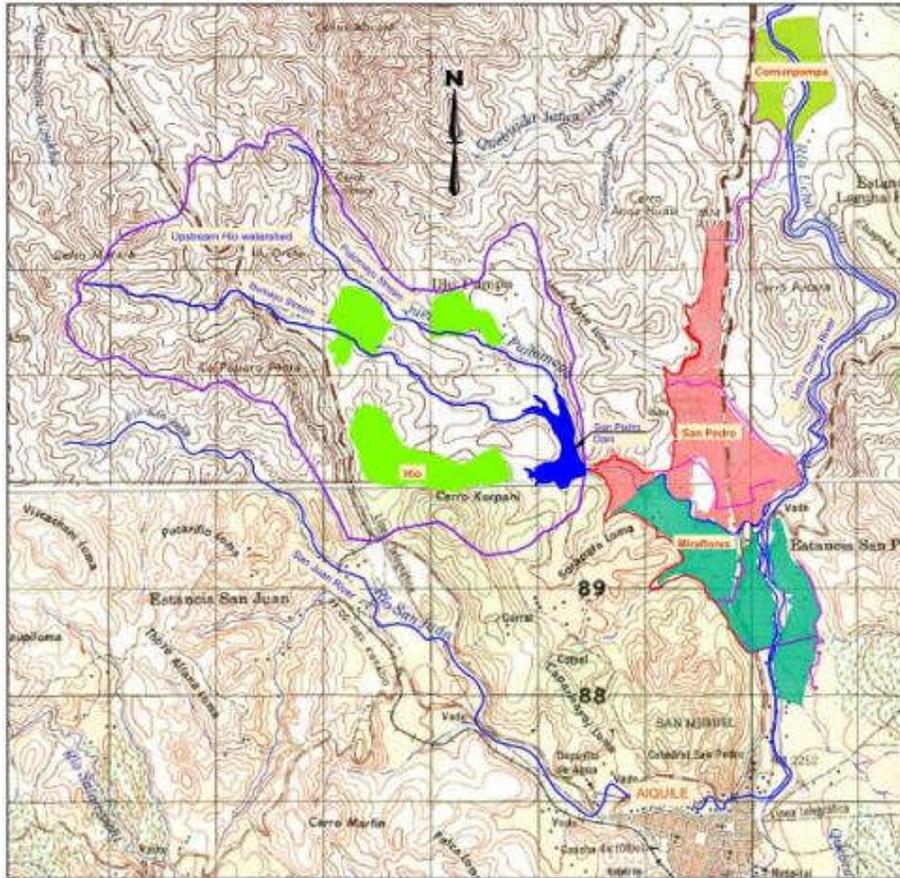
The research area is located in Bolivia, which is a country situated almost in the center of South America with an extension of 1.098.581 km<sup>2</sup>. Politically it is divided in nine departments, each department divided in provinces and each province in sections. The Hio watershed is located in Aiquile which is the first municipal section of the Campero province located in the Southwest area of the Cochabamba department. In the Hio watershed four communities are located: San Pedro, Miraflores, Comun Pampa and Hio.



Figure 4. Political localization of Hio watershed

Source: SCS-Gandarillas, 2007

Approximately 176 families live in the watershed. The bigger proportion of the families lives in San Pedro with 63 families, followed by Miraflores with 45 families. In the Comun Pampa community 42 families live and the Hio community is composed of 26 families. Figure 5 shows the location of the four communities in the Hio watershed considering the location of the San Pedro dam.



**Figure 5. Location of Hio, San Pedro, Miraflores and Comun Pampa communities**

Source: Elaborated based on SCS-Gandarillas, 2007

To describe the Hio watershed, first I will present the characteristics of the upstream area, where water is born followed by the characteristics of the downstream area, where the water will be used.

### 3.2.1 Upstream Hio watershed

The upstream area of the Hio watershed has an extension of approximately 1,090 hectares (10.9 Km<sup>2</sup>) and covers the territory of the Hio community. The soil in the mountainous area is superficial. The inferior area is an undulate valley of moderately deep soils. The altitude varies from the 2240 meters above sea level to the 2620 meters above sea level and presents an average slope of 42%. The approximately length is 5.5 km, with a predominant direction from Northwest to Southeast.

The climate is temperate with an average annual temperature of 17.6 °C. The annual precipitation is 550 mm, with a long dry season period that is normally extended from June to October. In addition, the region presents sudden floods during the rainy season (December to March) where 85% of the precipitation is concentrated.



**Figure 6. Panoramic view upstream Hio watershed**

Around 88% of the area is degraded dry forest, covered with native trees and bushes. Additionally there are some eucalyptus and cypress trees near the houses. In the remaining area there are zones without any use and also agriculture zones. In these areas Hio peasants produce by means of rain fed agriculture. The principal production in the upstream area is maize, wheat, barley, amaranth and peanuts.

The forest area is used primarily for grazing goats, sheep and cattle that Hio peasants have. Additionally some peasants use the bushes for firewood and construction wood. The current use of the forest area and the insufficient rainwater does not allow the development of the native plants to renew the vegetal cover generating a continuous erosion process, sediment transportation and topsoil erosion in slope plots.



**Figure 7. Goats grazing in upstream Hio watershed**

The average annual flow in Hio is 46 l/s and the average annual runoff is 2.94 l/s/Km<sup>2</sup>, with a sediment load of 410 m<sup>3</sup>/Km/year<sup>18</sup> to the downstream area, where the San Pedro dam is located. In the upstream area of the Hio watershed there are five different streams. The streams called Yaruj Yaku, Sauce Pujiomayu and Illumayo have an orientation from Northwest to Southeast.

<sup>18</sup> Volume estimated according the methodology from Djorovic (SCS CONSULT – Gandarillas, 2007)



Figure 8. Panoramic view of the Illumayu stream

The Millu Mayu and Kullcu streams are located in the South following the same direction as previous ones, from Northwest to Southeast. The five streams join together in the lower part of the upstream watershed to create the Hio River, the place where the San Pedro dam is located as shown in Figure 9.

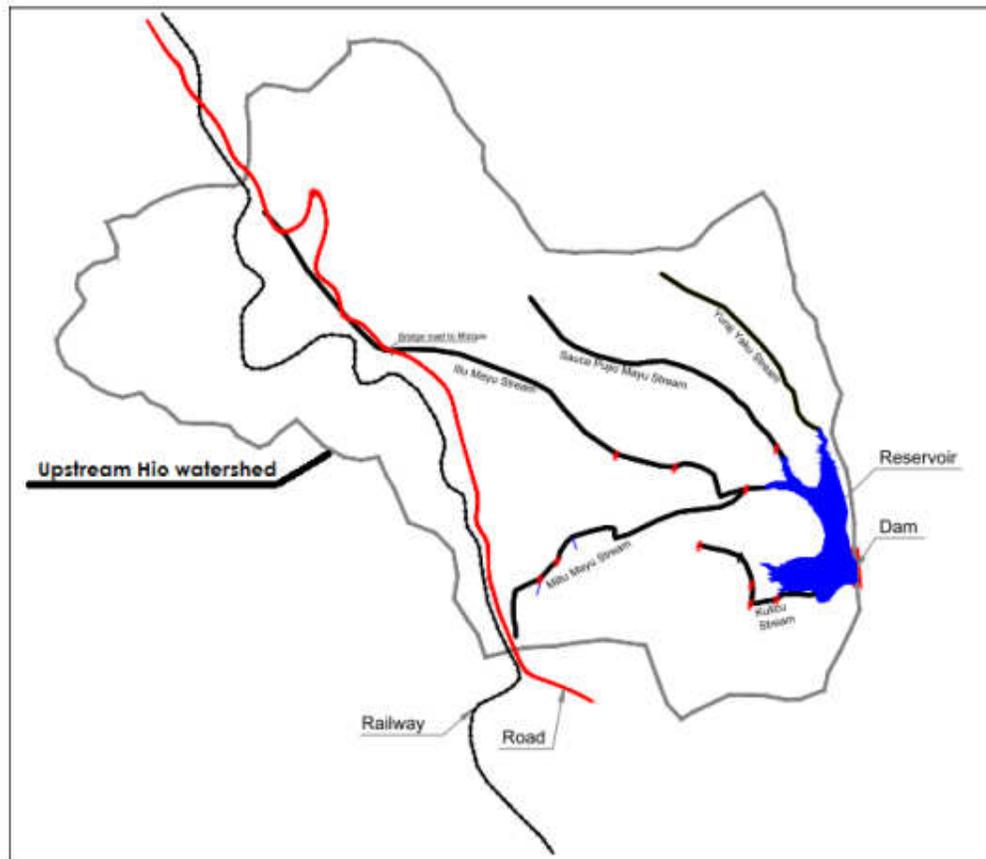


Figure 9. Location of the main water courses in the upstream area of Hio watershed

Source: Elaborated based on SCS-Gandarillas, 2007

There is no intake infrastructure for irrigation purposes in any of the five streams. In the central area of the upstream watershed there are 13 *atajados*, two of them are near the Illumayu stream, one near Sauce Pujiomayu and the remaining ten are in the Northwest where the Yurac Yaku stream is born. Each *atajado* (see Figure 10) has a capacity of 1500 m<sup>3</sup> capacity that should be filled during the rainy season (January to March) to be used primarily for the cattle. The families additionally used the water for sporadic irrigation of their small vegetal plots (onion, lettuce and tomato) and for some fruit trees (apple and plum). If there is any water remaining it will be used to wash their clothes and other basic needs.



**Figure 10. Atajados in the upstream Hio watershed**

Only some families of the Hio community have access to drinking water from a spring with an estimated flow of 0.02 l/s. The spring is located in the North area, near the Illumayu stream. The limited drinking water availability is only sufficient to cover Hio peasants' basic needs, so they cannot destine enough water for their domestic animals (fowls and pigs).

### 3.2.2 Downstream Hio watershed

In the downstream area three communities are located: San Pedro, Miraflores and Comun Pampa. The average altitude is 2250 meters above sea level and the average temperature is 19 °C. The average rainfall varies from 313 to 790 mm per year, with a dry season from June to October and a rainy season from December to March, where 85% of the annual precipitation is concentrated.



**Figure 11. Panoramic view of downstream Hio watershed**

The Illumayo stream crosses Miraflores and San Pedro communities. Water from this stream is used during the rainy season for sporadic and short time irrigation by both communities. The San Juan

River crosses part of the Miraflores community to join the Santa Ana River and flow to the Uchu Chajra River (see Figure 5). The Miraflores community cannot use the water from these rivers for agriculture because their fields are located on a higher altitude.

Approximately 97% of the families have access to drinking water with a connection inside their houses. The water source for San Pedro's drinking water system is the San Marcos spring, located on the border between the San Pedro and Hio community. The Miraflores community receives drinking water from Aiquile town and from a spring located in the Mataraska Mountain.

Water scarcity is one of the most important problems that downstream peasants have to deal with, a situation that is accentuated during the dry season from May to November. During these months the agricultural activities are restricted and the peasants migrate searching for alternative activities to maintain their families. Also the cattle suffer during the dry season due to the lack of water.

The families practice rain fed agriculture as the area is characterized by appropriate climate condition and soil quality. The main production in the area is maize, potato, wheat, kidney bean and peanut. That is why most of the families depend on livestock activity and trading. One additional income for the downstream peasants is the craftworks because people from Aiquile are known as the best *charango*<sup>19</sup> manufacturers in the country.



**Figure 12. Maize production in downstream Hio watershed**

As previously stated, the main problem in this region is that water scarcity limits the agricultural production even if the soil and climate characteristics are appropriate for it. So, to counteract the situation and increment the agricultural production, therefore the livelihoods of the inhabitants in the area, the San Pedro irrigation project is nowadays under construction. In the following section the main characteristics of this project will be described.

### **3.3 General characteristics of the San Pedro irrigation project**

The San Pedro irrigation project consists of the construction of a dam and complementary hydraulic infrastructure to store, transport and use the water from the Illumayu stream. As explained in previous sections, the dam is located in the lower section of the upstream area, in Hio's jurisdiction.

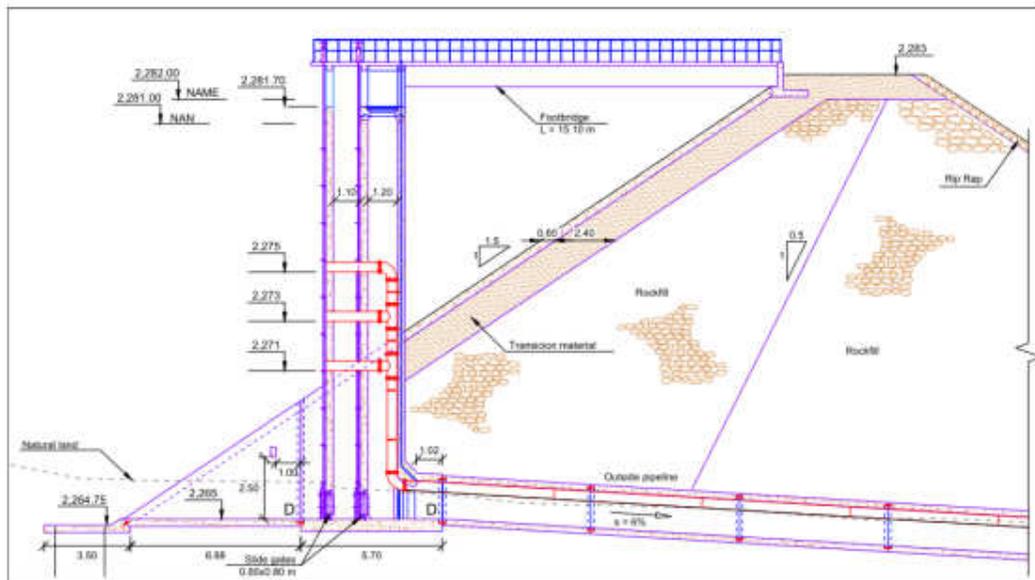
<sup>19</sup>Small Andean guitar, traditionally made from an armadillo shell

Table 3 lists the main characteristics of the dam and Figure 13 shows schematically the transversal section of the San Pedro dam.

**Table 3. Main characteristics of San Pedro dam**

<b>Height of the dam</b>	22 m
<b>Embankment</b>	Rock
<b>Capacity of reservoir</b>	1,064,000 m <sup>3</sup>
<b>Dead volume storage</b>	169,000 m <sup>3</sup> (30 years)
<b>Net volume</b>	975,000 m <sup>3</sup> (first 12 years)
<b>Crest length</b>	94 m
<b>Top wide</b>	6 m
<b>Maximum flood</b>	70 m <sup>3</sup> /s
<b>Upstream slope</b>	1.50 H: 1.00 V
<b>Downstream slope</b>	1.50 H: 1.00 V

Source: SCS-Gandarillas, 2007



**Figure 13. Transversal section of San Pedro dam**

Source: SCS-Gandarillas, 2007

Additionally, the infrastructures in the irrigation areas are the following:

- Principal North canal of 3,664 m length
- Principal South canal of 3,393 m length
- Secondary canals in the South and North irrigated area
- Complementary infrastructure: siphons, stream crosses, flumes, distribution infrastructure and others.

In Figure 14 the location of the main canals and secondary canals is presented showing the influence on the irrigated area of each of them.

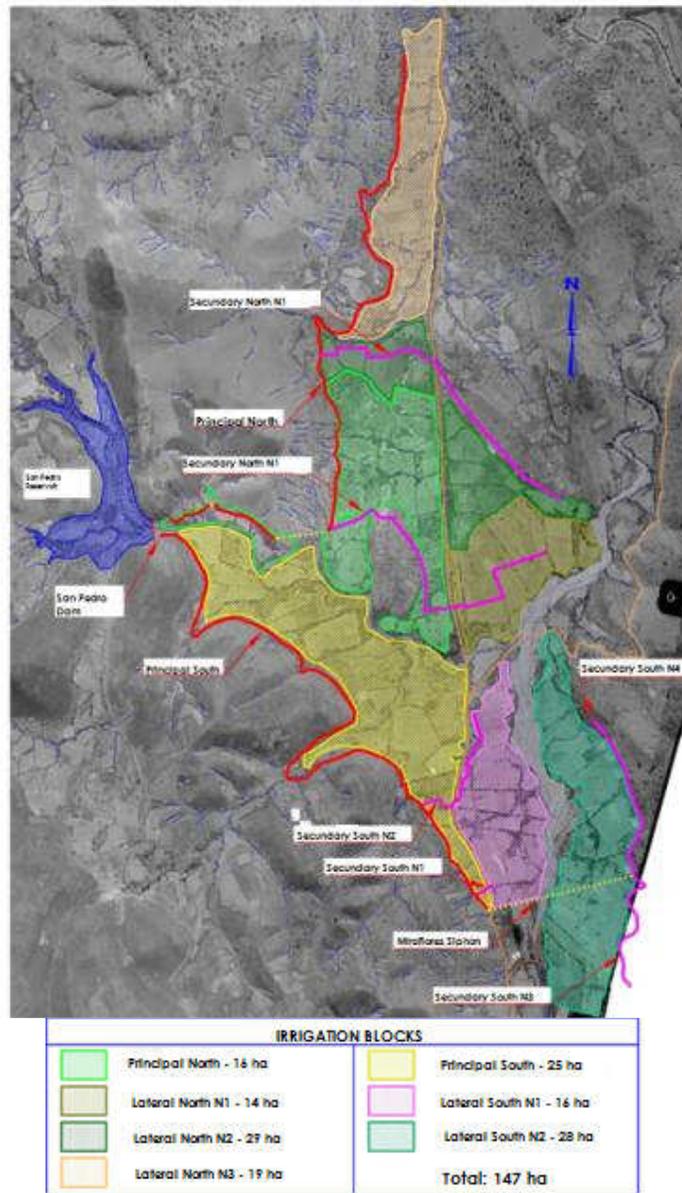


Figure 14. Scheme of the principal canals of San Pedro irrigation project

Source: SCS-Gandarillas, 2007

The beneficiary communities of the project are Miraflores and San Pedro. Table 4 shows the number of families per community and their irrigated area.

Table 4. Affiliate number and irrigated area per community

Community	N <sup>o</sup> Affiliates	Irrigated area (ha)
San Pedro	63	86
Miraflores	45	61
<b>Total</b>	<b>108</b>	<b>147</b>

Source: SCS-Gandarillas, 2007

The irrigators of both communities are organized within the San Pedro Water User Association (*Asociación del Sistema de Riego San Pedro*). This organization has its own by-laws and obtained its official status on May 2007. The mentioned organization is responsible of the administration, operation and maintenance of the irrigation system. The principal mission of San Pedro Water User Association is to achieve the sustainable self-management of San Pedro irrigation system.



**Figure 15. Construction of the San Pedro irrigation project**



# Part 2

## The results and analysis

**Chapter 4:** San Pedro irrigation project in the Hio watershed, battleground between upstream and downstream stakeholders

**Chapter 5:** Hio Watershed Plan as part of the San Pedro Irrigation project

**Chapter 6:** Analyzing the interaction

## **CHAPTER 4 SAN PEDRO IRRIGATION PROJECT IN THE HIO WATERSHED: BATTLE FRONT BETWEEN UPSTREAM AND DOWNSTREAM STAKEHOLDERS**

During the fourteen years that took the design and implementation of the San Pedro irrigation project, different issues of water competition arose between upstream stakeholders (Hio community) and downstream stakeholders (San Pedro WUA formed by San Pedro and Miraflores communities). The confrontations among stakeholders were centered on the access and use of water in the Hio watershed as a result of a lack of a normative and legislative framework to legitimize, support and deny stakeholders' claims for the use of water (Boelens et al, 2002). The establishment and local recognition of water rights among the different stakeholders claiming the use of same water source, can prevent the constant appearance of conflicts (ibid). Therefore, it is important to understand the interactions among the stakeholders in the Hio watershed to support and strengthen negotiation mechanisms to establish water rights at watershed level.

Consequently, this chapter is focused on the interactions among stakeholders during the development of the San Pedro irrigation project, focusing on the analysis of the limitations and the perspectives of the intervention itself. So in the following sections the subsequent negotiation processes for the implementation of the San Pedro irrigation project will be presented, emphasizing the remaining conflictive issue: the water use of the San Pedro dam after the finalization of its construction. As the implementation process in the Hio watershed was characterized by frequent occurrence of conflicts, a special emphasis will be on the historical relationship among the communities and the role of the local organization during the different negotiation processes.

### **4.1 The cracks in the relationships of the Hio watershed communities**

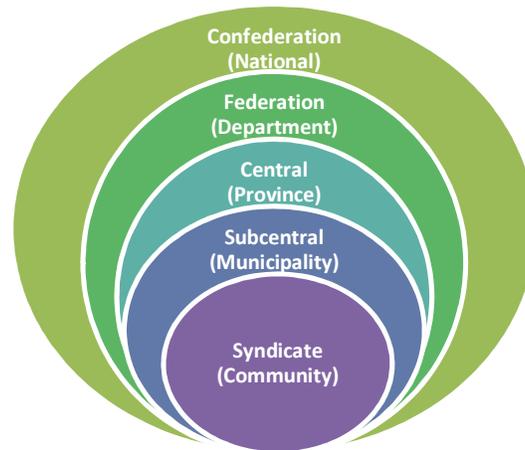
This section is focused on the process that caused the current division between the communities located in the upper part of the Hio watershed and the lower part of the Hio watershed, respectively. Focusing specifically on water conflicts, two main events are identified: 1. The creation of San Pedro sub central and 2. San Pedro irrigation project, both aspects will be developed in further detail in the following sections.

#### **4.1.1 From syndicate to sub central: the emergence of community limits and the influence on water conflicts**

The implementation of the Agrarian Reform Law in Bolivia<sup>20</sup> allowed the establishment of syndicates throughout the country as a recognized peasant organization for the rural areas. According to Machicado (2010), a syndicate is a social and productive organization managed by the community to regulate internal and external relations. Nowadays, the structure of a peasant organization is as shown in Figure 16. The association of at least four syndicates becomes a sub central. The joint of sub centrals becomes the central, which most of the times respects provincial limits. At a higher level each peasant central is part of the departmental federation and, ultimately, of the national confederation. The Unified (or Sole) Syndical Confederation of Rural Workers of Bolivia (*Confederación Sindical Única de Trabajadores Campesinos de Bolivia, CSUTCB*) is the largest union of peasants in the country.

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<sup>20</sup>Decree Law 3464 of August 2<sup>nd</sup>, 1953



**Figure 16. Structure of rural peasants organization in Bolivia**

In this context, in the case of the study area, the San Pedro syndicate was created covering the territory of the zones called: Hio, Hermita Miraflores, Comun Pampa and San Pedro. In these zones big *haciendas* had been established before the agrarian reform.

A peculiarity of the San Pedro syndicate in the creation stage was that it was directly related with Aiquile central and it was recognized as only one community named San Pedro. Until the beginning of the 90s in the Campero province only the syndicates and the central existed. From 1992 the central demanded the creation of the sub centrals. As a result, the San Pedro syndicate became the San Pedro sub central, formed by the four communities that were previously denominated zones (Hio, Hermita Miraflores, Comun Pampa and San Pedro).

Therefore, as creating new syndicates in this case study means creating new communities, it was necessary to establish new community boundaries. As the establishment of the community boundaries was not a very clear process, some conflicts regarding community limits are still nowadays latent.

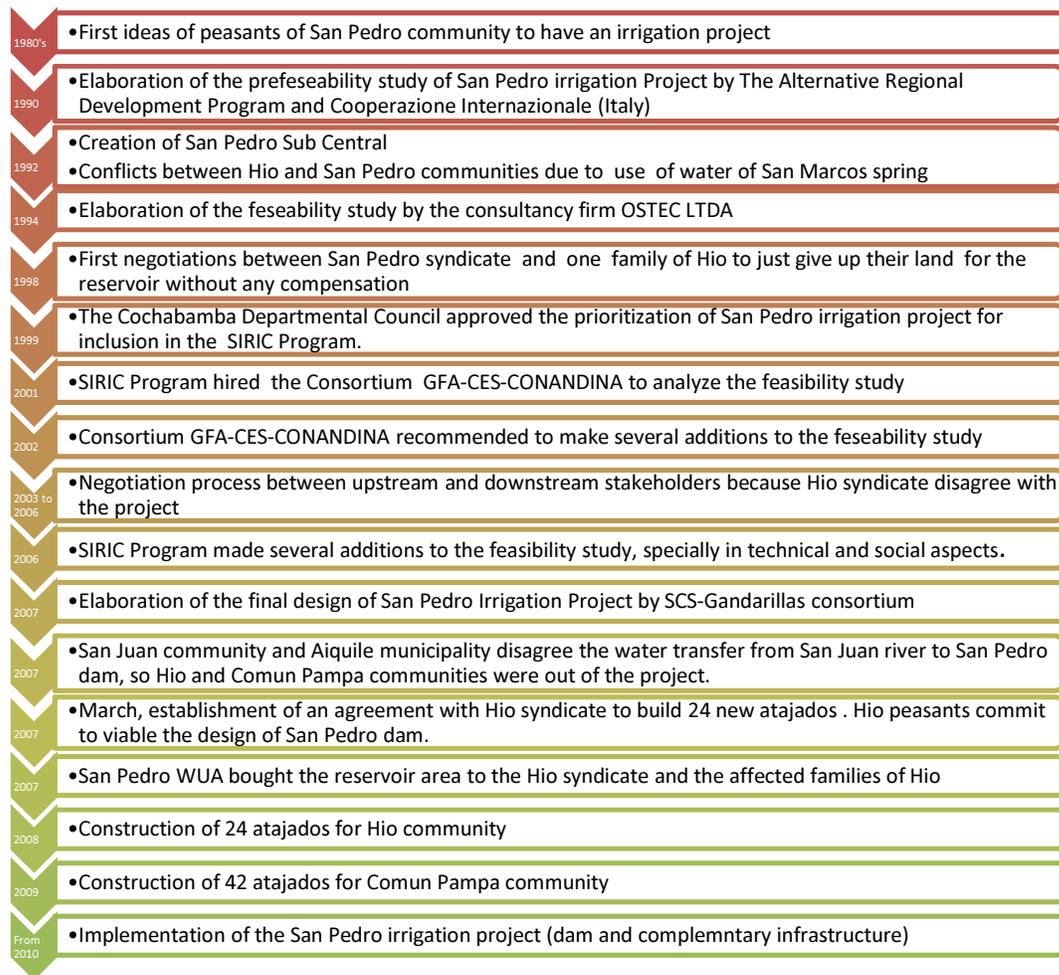
It is important to consider that the right to use water is linked with the territorial boundaries. Therefore, as the boundaries in the research area were not clearly established some conflicts regarding to water arose. The first conflict was regarding drinking water for San Pedro community from the San Marcos spring.

The San Marcos spring is the water source that provides drinking water for the San Pedro community and it is located on the boundary between the communities of Hio and San Pedro. The location of the spring (selected according to the pressure requirements for the drinking water system) and the fact that the families of Hio used to take the water of this spring for their animals resulted in a strong opposition by Hio.

In the 90s CARE International and the municipality of Aiquile supported the construction of the drinking water project for San Pedro. The implementation of this project had been the starting point that led to the detriment of the relationships between both communities. The division of San Pedro syndicate to create the San Pedro sub central and the posterior rivalries among the syndicates weakened the San Pedro sub central.

#### 4.1.2 San Pedro irrigation project: a quarter century of conflicts and negotiations

To understand the different conflicts that arose due to the San Pedro irrigation project, Figure 17 shows schematically the main events during the design of it. This chapter will cover the San Pedro irrigation project from its origins until now. A special emphasis will be put on the water rights, mainly because the lack of a clear establishment of water rights through an analysis of water management at watershed level had been the root for all the conflicts that were presented during this stage among the watershed communities.



**Figure 17. Timeline for the design and implementation of San Pedro Irrigation project**

The first idea of a possible irrigation project was born in the earlier 80's. During these first years, local leaders and peasants of the San Pedro syndicate attempted to find an irrigation water source. Their aims were answered when in 1990 they found support from the Alternative Regional Development Program (PDAR) and the Cooperazione Internazionale (Italy) to design the prefeseability study of the San Pedro irrigation project.

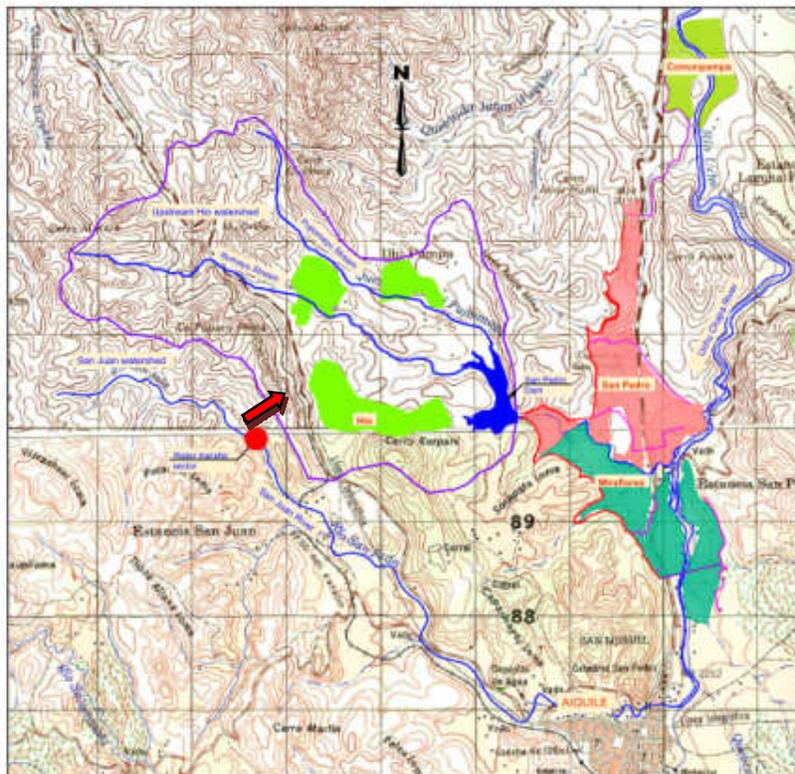
In 1994 the feasibility study of the San Pedro irrigation project was completed. This design considered the establishment of a reservoir in the Hio zone as the most suitable solution. The reservoir was designed to collect the runoff from the Hio watershed and the water transfer from a spring located in another watershed (San Juan watershed). However, as during the feasibility design

period the San Pedro sub central was created, the feasibility study document stated that the target group of the project were the four communities of San Pedro sub central.

In 2007 the final design project had been carried out by the consortium SCS-Gandarillas<sup>21</sup>. As a result of this process two different stakeholder groups were established: the irrigators (San Pedro and Miraflores communities) and the non-irrigators (Hio and Comun Pampa communities) due to the future availability of water in the dam. Establishing both stakeholder groups generated conflicts between them. Therefore it was necessary to start different negotiations with Comun Pampa and the Hio community to make viable San Pedro irrigation project.

- Negotiation with the Comun Pampa community

When the final design study had been prepared, the San Juan community was in total disagreement with the option to transfer their water to a different watershed (see Figure 18). At the same time the *Servicio de Agua Potable y Alcantarillado del Municipio de Aiquile* (SEAPAN – Aiquile municipality drinking water and sewage service) made a filter gallery to provide drinking water to Aiquile town. This gallery is near the stream where the transfer point should be located. So, SEAPAN supported the San Juan syndicate when they denied the water transfer. Therefore, the water transfer from the San Juan River to the dam was definitely not an option; this situation of course would affect the volume of water available for the San Pedro irrigation project.



**Figure 18. Scheme of the water transfer point from San Juan watershed to Hio watershed**  
Source: Elaborated based on SCS-Gandarillas, 2007

<sup>21</sup> The SCS-Gandarillas consortium is a consultancy firm composed by local engineers experienced on designing irrigation projects in Bolivia. The design team for San Pedro irrigation project included civil engineers, agricultural engineers and socio-economists.

As clearly the runoff to the dam was less without the water transfer, the irrigation area also had to be reduced. The economic evaluation conducted by the consultancy firm showed that the investment parameter per irrigated hectare<sup>22</sup> became higher than the limits set by the funders. Therefore, to make the project viable, the community of Comun Pampa should be out of the beneficiaries target group.

With the above explained criteria the negotiation with Comun Pampa started. It was difficult for them to understand why they were out of the project; even some peasants believed that they were out of the project because the San Pedro syndicate did not want to include them. Therefore, the intervention of the technical staff was necessary. As soon as the engineers in charge of the design explained that the exclusion of Comun Pampa was mainly related to technical constraints, they accepted being out of the project.

So they signed an agreement where in addition to agreeing with the design of the San Pedro irrigation project, they requested support from the other communities with other projects. At that instance, it was not stated which type of project they will ask for, but in 2009 their demand became clear.

In 2009 Comun Pampa prioritized a project that gave them access to water through *atajados*. As the San Pedro and Miraflores syndicate were conditioned with the above mentioned agreement, they supported the execution of the *atajados* project. Nowadays all the affiliates to the Comun Pampa syndicate have an *atajado* of 1500 m<sup>3</sup> financed by municipality resources. As San Pedro peasants stated the construction of *atajados* was the condition of Comun Pampa for the execution of the dam, they gave their fully support for the execution of the *atajados* even before their own project. As one San Pedro peasant mentioned: *“they have water even before us, and that is due to the San Pedro irrigation project”* (San Pedro peasant).

- The negotiation with the Hio community

With the data about the water available in the watershed, the height of the dam and the reservoir area were established. Technically speaking, with the establishment of these parameters the design was concluded. However, as the closure of the dam and the reservoir area were located in Hio territory (near the boundary of the San Pedro community) the toughest process to make San Pedro dam a reality was still remaining: to establish an agreement with the Hio community to make viable the final design of the San Pedro dam.

To make the project viable, different strategies were developed during the negotiation with the Hio community until achieving an agreement. It is important to notice that the negotiation lasted for 14 years considering the strong position that Hio maintained against the project and the constant change of leaders in the Hio syndicate. During the negotiation phase the topics were oriented to: 1. Search for possible options that allow Hio peasants to irrigate with the water from the dam and 2. Search for possible compensations for the families affected by the reservoir. In the following points both processes will be explained.

1. Negotiation to give Hio peasants water access from the dam

As engineers working in the area recognized that there would be a problem with Hio if they were not part of the project, as a first attempt they tried to include members from the Hio community as part of the San Pedro WUA. They stated that it would be possible to irrigate some fields in the upstream area pumping the water from the dam. But the Hio syndicate did not accept because they had

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<sup>22</sup> The funders parameter per optimally irrigated area was 2500 \$us/ha.

realized that only the families located near the reservoir would be able to access the water from the dam, so they refused this option.

As San Pedro and Miraflores peasants recognized that they were the main beneficiaries they also called Hio peasants to become part of the project, stating that they could also use the water to irrigate in the downstream area through mutual share crop agreements for agricultural production (*compañía*). However, this option was not interesting for the Hio peasants, so they refused also this option.

Even with previous offered solutions, the Hio position against the San Pedro project was very strong. They stated that it would be detrimental for their main economic activities and therefore, would affect them deeply. However, the negotiation process took around two years because the Hio syndicate did not clarify their interest, but it was obvious for the San Pedro WUA that they might ask for some kind of compensation.

Different meetings were held between the Directive of San Pedro WUA and the Hio syndicate. It was difficult as there were not any noticeable advances. But, finally in 2007 the Hio syndicate expressed their request as a condition to accept the San Pedro irrigation project. The following minute is a translation of the official one sent to the San Pedro WUA.

*Saturday, March 10<sup>th</sup> 2007*

*In the meeting at hours 1:00 pm we achieved a decision with 17 assistances and 19 absences that we greet Mr. Vargas (President of San Pedro WUA) and we respectfully say:*

*In today's meeting we ask to respect the measures of the reservoir area and we do not accept any other measure. The Hio syndicate wants to be a beneficiary with atajados to be equal as San Pedro and Miraflores, because they will benefit of 1 ha of irrigated area per member. The Hio syndicate wants support to build atajados. In that sense we will solve the current situation of the San Pedro dam. But if you do not accept the decision of the Hio syndicate we will never accept the construction of the San Pedro dam.*

*Signatures from Hio syndicate directive and Hio syndicate stamp*

Therefore in 2007 the mutual agreement for the constructions of the *atajados* in Hio was subscribed between the municipality and the Hio syndicate. An important aspect of the previous agreement is the commitment of the Hio syndicate to not hamper anymore the design and construction of the San Pedro irrigation project.



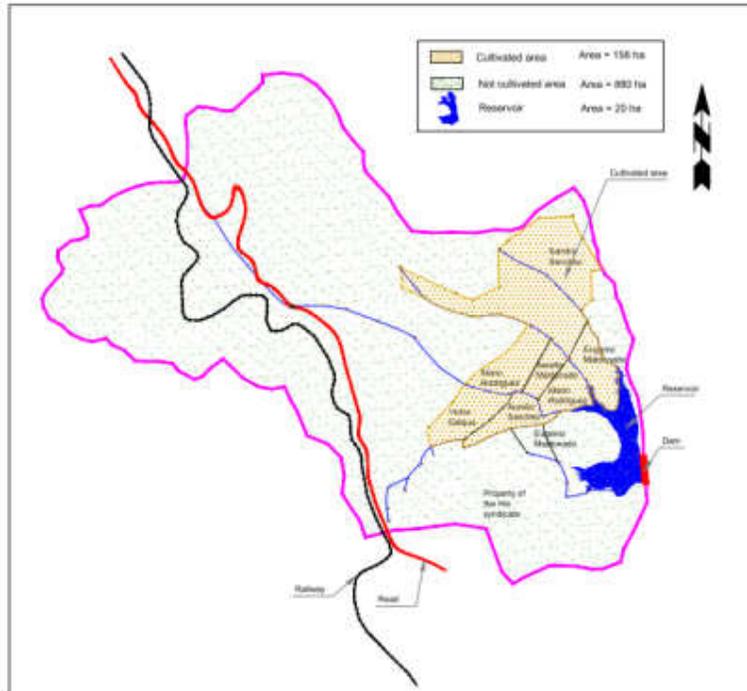
Figure 19. *Atajado* in the upstream Hio watershed

Nowadays, even with the construction of 24 *atajados* (one for each member of the Hio syndicate) Hio peasants feel unsatisfied with the current situation. During the interviews with Hio stakeholders clearly one element stand up as a petition amount their discourse and can be shortly resumed in two words: more water!

Hio peasants keep searching for other ways of water access because they consider that they should have the same benefits as San Pedro and Miraflores. The San Pedro irrigation project will benefit each irrigator with water to irrigate 1 ha, while the water from the *atajados* of 1500 m<sup>3</sup> irrigates ½ ha. In Hio's peasant understanding the current situation is not an equitable access to water, so they are demanding their water rights to also irrigate 1 ha.

## 2. Negotiation with the families affected by the reservoir

It is important to take into account that the reservoir and the San Pedro dam is located in the territory of the Hio community and affects the lands of six families and also part of a communal land. The negotiation with the affected families began in 1998. The San Pedro WUA presented many alternatives to them, but these were not accepted by the affected families. Figure 20 shows the families affected identified during the execution of the final design phase.



**Figure 20. Affected families by the reservoir**

Source: SCS-Gandarillas, 2007

Another relevant factor, as stated above, is that one portion of the affected area was property of the Hio syndicate. In that sense, the Hio syndicate was also an important stakeholder in the negotiation field. This situation was an obstacle for the negotiation because even if at family level they were in agreement with a suitable solution and the Hio syndicate board disagrees with it, the families supported the position of the syndicate board. The position of the syndicate board was to get as many benefits as possible from the current situation. However, after nine years of negotiation, finally in 2007 the San Pedro WUA and the Hio syndicate agreed on an option: San Pedro WUA should buy the affected area.

With an established price of 500 \$us/ha it was finally possible to buy the area. In that sense the following minute works nowadays as a validated sell and buy certificate:

*July 24<sup>th</sup> 2007, In Higuera Kullko was carried out the extraordinary session with the sub central leaders, the city council, the mayor, the sub prefect, media and others to participate, discuss and establish the definitive solution for the families affected by the San Pedro reservoir.*

*During the central part of the meeting the payment to all affected families was done: Eugenio Maldonado and brothers, Remigio Grageda and brothers. Additionally, Eugenio and Leonidas will be able to collect the firewood after the land clearing for the reservoir.*

*Syndicate stamp and sub central stamp*



**Figure 21. Payment to a Hio peasant affected household**

Source: SCS-Gandarillas, 2007

All the documentation that was elaborated during the whole purchase process is legally recognized and is part of the San Pedro WUA files (see Table 5). An important aspect to highlight is that due to the conflicts that the San Pedro WUA dealt with the Hio syndicate, the agreements and minutes consider even minimum details. For example, the collection of firewood that can be done by two peasants stated in the minute.

**Table 5. Total amount paid by San Pedro WUA to the affected by the reservoir**

Nº	Name	Area (ha)	Total amount (\$US)
1	Luciano Maldonado Jaldín	1.8	750.00
2	Leonidas Maldonado Jimenez	2.8	1,250.00
3	Eugenio Maldonado Prado	8.1	4,000.00
4	Maximiliana Becerra Puyal	1.5	750.00
5	Remigio Grájeda Claros	1.9	875.00
6	Virgilio Maldonado Paniagua	1.7	750.00
7	Eugenio Maldonado – Sindicato Hío	1.5	750.00
<b>Total</b>		<b>19.3</b>	<b>9,125.00</b>

Source: Minute book San Pedro WUA

Even with all the mentioned agreements, San Pedro WUA states that even with the tiny reason Hio stands against the construction of the dam. They feel that they envy the project and that is why they always try to stop the project.

#### **4.2 Water use and water access in the Hio watershed: an unfinished issue**

All the agreements established between the irrigators and non-irrigators were oriented to make the San Pedro irrigation project viable. However, none of the previous agreements considered the water rights at watershed level, a situation that remains as a latent source of conflict in the Hio watershed. On one hand, the Hio community claims the access and use of water from the dam based on two factors: their geographical location in the upstream area of the watershed (where the water sources are born) and the location of the dam and the reservoir in their jurisdiction. On the other hand, San Pedro and Miraflores claim their water rights due to hydraulic property as they invested buying the

territory where the dam and the reservoir will be located and their work for the construction of the dam and canals. Furthermore, this situation not only jeopardizes the future water use of the San Pedro dam but weakens the San Pedro sub central.

#### 4.2.1 Property water rights: Hio vs. the irrigators

There are two different perspectives between the non-irrigators (Hio community<sup>23</sup>) and the irrigators (San Pedro and Miraflores community) regarding the water that will be stored in the dam. Both of them consider themselves as the owner of the water, and therefore, have the right to use it. To understand the different stakeholder positions, in the following paragraphs both of the arguments will be presented for further analysis.

- Hio property rights as watershed header

The main springs and streams of the Hio watershed are born in the upper part of it, where the Hio community is located. So, as they are owners of the land located in that area, they also consider themselves as the owners of the water and therefore: the right to use it.

Hio peasants cannot conceive that even if the water is born in their territory, they cannot take any benefit of it. In their understanding, they should have the right to access the water before any other user or at least in some proportion. But with the San Pedro irrigation project, they cannot use it.

It is worthwhile to mention that even nowadays while the construction of the dam is in process, the feeling of dissatisfaction among the Hio peasants can be clearly noticed. The narrative that they manage is related to their right of also accessing and using the water as San Pedro and Miraflores will. This means that there is a claim to have water rights from the dam.

- Irrigators property right as owners of the reservoir territory

As part of the agreement for the design and construction of the San Pedro dam, the San Pedro WUA bought the reservoir area from the affected Hio families and syndicate. According to their perspective buying the land includes also acquiring the water rights.

*“We are the owners of the water because we even paid for the reservoir land” (San Pedro peasant)*

However, as the relationship between the San Pedro WUA and the Hio community is still very fragile, the Directive of the San Pedro WUA did not consider reasonable to establish an agreement about water rights. In their perspective the process of establishing water rights can jeopardize the construction of the dam.

Previously explained positions show that both stakeholder groups have their own arguments regarding the ownership of the dam water rights. This situation will ‘almost certainly’ jeopardize the operation of the irrigation system and can generate future conflicts. One of the reasons for the actual situation of the water rights is that during the design, engineers only focused on clarifying and establishing the water rights at the irrigation system level. Engineers completely forgot to consider the water rights at watershed level, even during the whole process when upstream peasants clearly showed that the dam should be designed considering the water management at watershed level.

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<sup>23</sup> Comun Pampa community is not considered in this section because this community did not participate any longer in the San Pedro irrigation project after the construction of their *atajados*.

#### 4.2.2 Water use in the Hio watershed: a postponed issue

To diagnose the current water management of the Hio watershed, this study focuses on the analysis of water management problems at watershed level. For this purpose, the analysis of stakeholders' interrelation will be developed in the coming sections, describing the following elements: the problems and conflicts related to water management, the objectives and criteria of stakeholders, the restrictions that limit attaining stakeholders' goals and aspirations, and the different possible solutions. It is important to take into account that even though each element will be described independently, all of them are highly interrelated.

- *Problems and conflicts related to water management*

Previous chapters allowed to understand the whole panorama regarding the Hio watershed and the San Pedro irrigation project; however an aspect that remains incomplete in the description is related to water rights. This lack is because the water rights in the Hio watershed are not yet defined. As stated above, San Pedro WUA has not worked further on this topic since they think that any type of negotiation with Hio can jeopardize the San Pedro dam construction.

Therefore, establishing clear water rights becomes a time bomb in the Hio watershed which can explode after the conclusion of the infrastructure with unwanted consequences. That is the reason why the present section will focus exclusively on the water use of the Hio watershed as a reflection to the deficiency in the establishment of water rights at watershed level.

To do this analysis, stakeholders will be categorized into two different groups: upstream (Hio community) and downstream (San Pedro and Miraflores community). These two categories are selected due to the geographical localization of stakeholders in the watershed which influences the position that each stakeholder holds and the power they have.

- The objectives and criteria of stakeholders

The main objective of the two groups is to use the water, therefore this section will essentially focus on presenting the position that each one holds. Their objectives are related to: 1. Water use for irrigation and watering livestock and 2. Tourist projects.

1. Water use for irrigation and watering livestock

Regarding the water use for irrigation and watering livestock there are different positions between the downstream and the upstream stakeholders, both of them are described in the following paragraphs:

- a. *Downstream position*

Downstream stakeholders have different narratives regarding the water use. Their abstraction is on two different levels: a specific one related mainly to the dam and a general one regarding the watershed as a water source for the dam. The discrepancy presented in their narratives shows the unclarity about water rights even within the same stakeholder group.

If we refer to the specific level, there are two main trends related to the water use of the dam. The first one expresses that Hio peasants might have rights to use the water of the dam as it is located in their territory. The second position states that Hio peasants cannot use the water of the dam to

irrigate their fields because they are not part of the San Pedro WUA and they did not contribute during the construction.

*“There is an agreement so they will not use the water of the dam. There is a written minute that says so. They will not use it. They will not pump. They are thinking about using the water but we already signed, there is no agreement for them to use, there is nothing related to this issue. They cannot use the water because they are not members of the San Pedro WUA that is clear. They will not use the water because we paid for their land, we paid for everything. But the situation with the animals is different; we will allow the animals to drink water from the reservoir” (San Pedro peasant)*

Two aspects stand out within this position. The first one is that Hio lost their water rights when they sold the area of the reservoir, therefore they do not have any right to use the water storage. However, while reviewing the minute book from the San Pedro WUA and the Hio syndicate neither of them has any agreement regarding this topic and additionally, in the land purchase documents of the reservoir area there is no mentioning of water rights of that area. The second aspect is related to the use of the dam for the cattle. Within this aspect there are also two different positions. The previous one states that animals can drink water of the dam and the second one sustains that not even animals are allowed to drink.

If we refer to a general level, the situation is not clear as well because stakeholder’s narrative stated that there is an agreement which says that Hio will let the water flow to the dam. However, again while reviewing the minute books of both organizations there is no minute or reference to any type of agreement related to this issue.

#### *b. Upstream position*

To understand the position of upstream stakeholders the same levels of abstraction previously presented will be considered. First, regarding the specific level which is the use of the water of the dam, upstream stakeholders also manage different discourses. In this sense, some of them sustain that they will be able to use the water because there is an old agreement signed by the parties that has not been respected. Other stakeholders stated that the situation is not really clear, that they do not know if they will have the possibility to use the water of the dam. But they expressed their willingness to use the water of the dam in some sense.

*“We are doubtful if we can use the water. We should have proposed them to use the water but now we do not know what we can do. It should have been good to pump the water. We do not know if they can give us water or not, because they bought the reservoir land. The only thing is that they cannot fence the dam because we will use it for our cattle. But we still have to wait and see what happens, if there is more than enough water then, I do not think it will be a problem if we use it. However there is the risk that when people see that there is water available they would like to pump, but we still do not know because we are not fortune tellers” (General Secretary of the Hio syndicate)*

The common point in all stakeholders’ narratives is that their cattle should be able to drink water of the dam. However, this situation is not clear because, as previously mentioned, in the minute books of both organizations there is no document referring to this aspect.

*“There is no agreement stating that we cannot use the water of the dam. They only said that Hio peasants cannot take water of the dam. We said that when there will be water we would like to use it, they did not accept so. We bought the land they said. I think they want to fence*

*the reservoir. They do not want to let us even touch the water” (Minute taker of the Hio syndicate)*

Among this stakeholder group there are also more radical positions about the water use that can lead to future confrontations between upstream and downstream stakeholders.

*“If there will be enough water, then we can just use it and there will be no problem. But if San Pedro comes and they do not let us use the water, we will even destroy the dam. We are not just going to sit quietly if they do not let us use the water. There can be more problems. We have to go step by step finding solutions to avoid possible confrontations. If they will let us use the water, then we will preserve the watershed. If we have benefits we can preserve the watershed” (Hio peasant)*

It is important to notice that upstream stakeholders’ perspective is that it will be possible to establish agreements to preserve the watershed only if they feel somehow favored with water.

## 2. Another use of water: tourist projects

Regarding to the future water use of the dam both stakeholders hold their own perspective on how they can get some benefit of this new infrastructure. Therefore, both positions will be briefly explained for each stakeholder group.

### *a. Downstream position*

The main project that the San Pedro WUA is willing to develop in the future is presenting the San Pedro reservoir as an option for tourism.

*“We think that this project should become also a tourist project. We want to raise different fish there. I think we have to do many projects with the dam. Now, for example we are thinking about building some bungalows around the reservoir” (Miraflores peasant)*

However all these ideas have not been discussed further neither within the same organization nor within the Hio syndicate. Within the organizations some perspectives are raising about who should be the one taking benefits of all this other possible activities or different water uses.

*“If the water from the dam will be used for tourism then together we will have to split the benefits. But we have to think better about that, because even if they do not like it, the territory is now property of San Pedro and the benefits should be also divided considering aspects like that. But these issues will develop over time; we have to go step by step” (President of the San Pedro WUA)*

Downstream stakeholders already consider that since the area is now part of the San Pedro project, they should get more benefits than Hio.

### *b. Upstream position*

Within the different members of the Hio syndicate there are different proposals regarding the water use of the San Pedro dam, but all converge in the possibility of using the dam for touristic purposes.

*“As Hio syndicate we also have been thinking that the dam is a touristic option. Therefore, we can make some shops there to sell food or other things. We have been thinking about that also.*

*But the dam should benefit everyone, not only one syndicate should take benefit of this. Even Comun Pampa should have a project there” (Ex-general secretary of the Hio syndicate)*

One interesting feature of Hio’s stakeholder narrative is with respect to who will benefit from all this different touristic activities. The perspective that upstream stakeholders have, is that everyone should benefit from the water, which means that all four syndicates from the San Pedro sub central should benefit. But they make a special emphasis on their territorial position as the dam is part of their jurisdiction and in that sense, their benefit should be bigger than any other.

However, all the different ideas that have been born within the different members of the Hio syndicate are not yet expressed to other stakeholder groups.

*“We have not talked with downstream people so they do not know anything. We have just been thinking. We are also thinking on having small boats so tourists can sail on the reservoir” (Minute taker of the Hio syndicate)*

Even within each stakeholder group their narrative regarding the water rights is different; two main perspectives can be identified. On the one hand is the San Pedro WUA perspective which states that they are the only ones that can use the water because they bought the territory where the reservoir is located. On the other hand, is the Hio syndicate perspective which affirms that they will use the water of the dam for their cattle and if possible, they will pump the water for irrigation and moreover they are also thinking about a tourist project.

- *Restrictions to attain goals*

The main restriction that both stakeholder groups have is the lack of clear agreements regarding the different water uses of the dam. The absence of a minute stating the water rights and how these water rights will be expressed for each group had led to opposite perspectives. This restriction scales up when addressing to the water use at watershed level. The San Pedro WUA was not able to establish an agreement with Hio regarding this topic, and therefore they just assume that Hio will always let the water flow downstream.

*“They have their atajados. They are the first ones that store rainwater. If they do not store water, their atajados will be useless. They are already compensated with the construction of atajados even they are not part of the dam project. They store the water in their atajados and the remaining rainwater goes to the dam” (General Secretary of the San Pedro sub central)*

The current situation is a consequence of the approach that engineers had during the design. Engineers only focused on defining water rights inside the irrigation system without considering the possible conflicts that can emerge at watershed level regarding the water rights. This possibility is very high because the water source and the reservoir are located in the Hio territory.

*“If the reservoir had been located on the San Pedro or Miraflores territory the whole process would have been easier. That is why it takes so many years. Hio knows their jurisdictions and they have their sovereignty. That is why in the beginning they obstruct the design. There was a battle front between upstream and downstream and in that scenario any kind of negotiation was not possible. There were many obstacles that needed to be solved. The first one was working between communities without looking only for personal profits. Projects should work together with the stakeholders, so in the future it will not be possible to blame on someone” (President of the San Pedro WUA)*

As the previous quote indicates during the design of the San Pedro irrigation project there should be an analysis of the possible water uses at watershed level considering the objectives of all the communities in the watershed. However, if we review the project documentation there is no explicitly mentioning of the water management at watershed level showing that this aspect was completely forgotten.

- *Possible solutions*

As indicated previously, the only possibility to solve the current and future conflicts regarding water rights is through an equitable access and use of water according to stakeholders' perception. On this subject each stakeholder group holds their own perspective presented in the coming section.

*a. Downstream position*

For the downstream stakeholders a possible solution refers to the indirect benefits that Hio and Comun Pampa can have with the agricultural production on the San Pedro and Miraflores fields. They think that there will be more productive areas and therefore more hand labor would be required.

*"People from downstream always said that if there will be water available we will require a lot of hand labor. In Hio there is not so much work available, they have another type of job. They wait for the rainy season to sow their fields and that is all. We always said that we are arguing in vain because we will need people to work on the downstream fields. It will not be possible for us to cope with the whole work. Even now during the construction of the dam there are people already working with the construction company" (San Pedro peasant)*

As it is noticed in the downstream stakeholders discourse their solutions do not include granting any water rights of the dam, they never refer to any possible access and/or use of water by Hio peasants. Their perception is that equity in the benefits could be achieved through a raise in the family income, reasoned by why the possibility of agricultural labor which will be required in downstream fields.

*b. Upstream position*

A first approach from upstream stakeholders is that the water rights assigned to people who are not affiliated to the sub central should be transferred to Hio and Comun Pampa. Hio peasants indicated that in the list of water users from the dam there are names of people not affiliated to the sub central because they are underage or they migrated. To make an official claim they demanded the list of the San Pedro WUA, however they refused the access. It was not possible for Hio peasants to get the lists from the sub central because their claim was not taken into account, which might be due to the fact that the president of the sub central is from the Miraflores community.

The second approach from upstream stakeholders is to reach an equitable water access through the sub central organization. They ask for support of the sub central to get other projects related to water. For example, they want a drinking water project from a spring because there are still families in Hio that do not have this service. Additionally, they think that this water can be used for agricultural purposes. Moreover, they demand more *atajados* to store water. In their perception they should have the same proportion of water that downstream stakeholders will have, which is 3000 m<sup>3</sup>/year.

*"In Soucepujio area there is spring water the whole year. From there we can take water for this area because we do not have drinking water. If the sub central supports us we can have a*

*drinking water project. There is even enough water to build an intake (tajamar<sup>24</sup>). Nowadays the company in charge of the construction is taking water from there because there is a lot of water. The water available there is not used by anybody” (Minute taker of the Hio syndicate)*

Analyzing both stakeholder positions to solve the conflicts, on the one hand downstream stakeholders consider a possibility of implementing “indirect benefits” through labor on downstream fields. In this sense, both stakeholders directly and indirectly will have benefits from the water of the dam. On the other hand, upstream stakeholders have a broader approach to solve the conflicts. Their approach considers the water management at watershed level in order to satisfy their necessity of water for agriculture and drinking purposes.

### **4.3 Conflicts in rights, access and use of water: gaps in communities relationships for the management of the Hio watershed**

In the case of Andean watersheds, the competition of water between different users and uses has increased (Boelens et al, 2002), generating more conflicts among the different stakeholders in the watershed, and the case of the Hio watershed is a clear example of that. Upstream stakeholders are more aware of their privileged position in the watershed and the power that they have due to their geographical location. This situation takes more relevance when a new water use (such as a drinking water project or an irrigation project) is created for the downstream area because it constitutes a window of opportunity for upstream stakeholders to manifest their power and local requirements for water. Furthermore, in the case of Hio, the particularity that the infrastructure for the San Pedro irrigation project is located in the upstream area prolonged the negotiation to make the project viable for 14 years.

Even though, two agreements have been signed between the parties (*Atajados* construction agreement and land purchase agreement) and nowadays the construction of the San Pedro irrigation project is in process, as showed in section 4.2, there is still a remaining issue: the future water use of the dam. Furthermore, all the conflicts that arose during the design of the project were related to the use of water at watershed level. The access and use of water is strongly related to the establishment of water rights (Boelens, Dourojeanni and Hoogendam, 2005), but in the case of the Hio watershed, water right issues were not presented or established in any project documentation. As water rights are not only focused on the resource itself, moreover they also represent social and power relations, thus for the analysis of water right struggles in the Hio watershed the Echelons of Right Analysis (Boelens, 2008b) approach has been selected. Therefore, the analysis presented in the following paragraphs is developed according to four levels of abstraction proposed by the mentioned approach: resources, rules, regulatory control and regimes of representation. The four abstraction levels are developed considering the two main identified parties that participated in the case study: upstream stakeholders (Hio community) and downstream stakeholders (San Pedro WUA that includes San Pedro and Miraflores communities).

Referring to the struggle over the resources, downstream stakeholders bought the territory where the reservoir and the dam are currently under construction. However, upstream stakeholders recognize that even the San Pedro WUA has the property title of the area, this territory is still inside the jurisdiction of the Hio community. Furthermore, the water sources that supply the dam are all located in the upstream stakeholders’ jurisdiction.

The second abstraction level refers to the substance and meaning of the rules. Inside the San Pedro irrigation project the acquisition of individual water rights is through the hydraulic property

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<sup>24</sup> *Tajamar* is a small intake build in a water stream or river

mechanism as the peasants invested capital and labor for the construction of the infrastructure. Additionally, the by-law of San Pedro WUA covers topics as operation and management rules, organizational structure, responsibilities of users, as well as sanctions among others. All the mentioned aspects are legitimate inside the WUA. However, in relation to collective water rights at watershed level, none of the stakeholders had considered this aspect in any of the designed phases of the project.

The third abstraction level is related with the regulatory control. In the case of the Hio watershed there is no recognized authority in charge of formulating and enforcing water rights at watershed level or commanding the water management in the watershed. Nevertheless, there is already a local peasant organization (San Pedro sub central) that represents the four communities of the Hio watershed: San Pedro, Miraflores, Hio and Comun Pampa. The sub central is in charge of organizing the social and productive relationships between the communities (inside), but also represents the communities to the outside (exterior) for the implementation of different projects. However, to make the San Pedro irrigation project feasible, the San Pedro WUA took control of the sub central for the last five years, which resulted in relegating the participation of the Hio community inside the organization. Therefore, upstream stakeholders do not recognize this organizational level as a legitimate one.

The last abstraction level is related to the regimes of representation. On the one hand the discourse which downstream stakeholders sustain is that only they have the right to use the water of the dam because they bought the area of the reservoir, therefore the water stored in the reservoir belongs to them. On the other hand, the upstream stakeholders discourse expresses that the dam and the water sources are located in their territorial jurisdiction. Therefore, they have the right to use the water even before downstream stakeholders. So, upstream stakeholders plan to use the water stored in the dam for their cattle and the peasants that have land near the reservoir expressed that they will pump water to irrigate their fields. Both discourses have a supporting theoretical framework (Boelens and Doornbos, 2001) as water rights can be obtained either by hydraulic property mechanisms (downstream discourse) or by socio territorial mechanisms (upstream discourse), but in this case both mechanisms of obtaining water rights enter in competition.

Although the analysis of each abstraction level is presented independently, the four of them are highly interrelated. In this particular case, the independent analysis of each abstraction level shows a clear deficiency about the rules and authority to formulate and enforce water rights at watershed level. Both aspects are strongly related to the legitimacy as the contest of water rights develops around two axes: resources and legitimacy (Boelens, 2008b). Moreover the legitimacy is related to the social relations between the stakeholder groups which is an expression of the existing social organizations and power relationships.

Up to now, the intervention of irrigation projects in Bolivia focused mainly on the establishment of water rights inside the irrigation system because there was no sensed requirement to establish collective water rights at watershed level. However, the increase of competence and demand for water show the necessity to consider collective water rights during the design of the irrigation project to avoid future water conflicts, as the case of the Hio watershed illustrates. Therefore, establishing water rights at watershed level is very important especially in the following situations: 1. When the water sources are located in a different territorial jurisdiction than the project target group is and 2. When the hydraulic infrastructure is not located inside the territorial boundaries of the target group. Therefore, when any of the named situations arises the project intervention should focus on establishing water rights inside the project and also water rights considering the current and future water use requirements of all the different stakeholders in the watershed.

The starting points to support the establishment of water rights are the analysis of: local normative frameworks, power structures and historical distribution of water resource usage rights inside the watershed (Boelens, Getches and Guevara-Gil, 2010). A deep analysis of the three previous aspects can help to identify if there is an existing organization that embodies the historic use of water; moreover if it is considered legitimate among the different stakeholders in the watershed to establish and enforce the collective water rights. In the case of the Hio watershed during the design of the San Pedro irrigation project there was no analysis of the historical relationship context of the different communities (San Marcos spring conflict) and the existing organization. Furthermore, the engineers approach used during the intervention of the San Pedro irrigation project highly influenced the relationship between upstream and downstream stakeholders, weakening even more the already fragile relation among the communities.

Additionally, with respect to the formal institutions in a territory, the Andean region is characterized by the presence of local and/or traditional organizations. So, to analyze the relationships between all the different forms of organization it is important to consider two aspects. The first one is if the legislative boundaries of the organizations/institutions coincide with the hydrological limits of the watershed. The second one is the recognition of institutions/organizations as a legitimate one by the different stakeholders in the watershed. Analyzing both aspects will allow identifying if it is necessary to consider the creation of another organization or empower the existing one, respectively.

However, each case should be analyzed thoroughly according to the existing interrelation among the different stakeholders (communities) in the watershed. Though the intervention of a project and the modification of the current water use at watershed level constitutes a window of opportunity to structure, administrate and control water rights within a watershed (ibid) it is also possible to incorporate natural resource management activities. So, water becomes a driving force to encourage stakeholder participation within an organizational structure and evolves from a water management perspective to a natural resource management perspective.

It is important to point out that in the case of the Hio watershed, a watershed organization had been created as part of the implementation of the Hio watershed action plan. So the following chapter will extensively describe the watershed approach used during the intervention of the Hio watershed and the different measures implemented. However for the analysis of the coming chapter it should be hold in mind the weak relationship of the communities' product of the different conflicts that arose during the design and construction of the San Pedro irrigation project which will influence the implementation of any measure in the Hio watershed.

## **CHAPTER 5 HIO WATERSHED MANAGEMENT PLAN AS PART OF THE SAN PEDRO IRRIGATION PROJECT**

A requirement by the funders to implement the San Pedro irrigation project was to incorporate the 'watershed approach' into the design of the project and in that sense, implement some actions in the Hio watershed. Several watershed management plans have been elaborated during the different design stages, but all of them with the objective to protect the dam against sedimentation. So, in the following sections I will start presenting the 'watershed approach' during the intervention of the Hio watershed, starting with the feasibility phase until the Agricultural Development Program intervention. Additionally I will describe the main characteristics of the Hio watershed management plan in each phase. Next I will describe the implementation process of three measures in the Hio watershed.

### **5.1 The watershed approach in the design phases of the San Pedro irrigation project**

In this section I will present the 'watershed approach' used in the feasibility and final design phase of the San Pedro irrigation project, to understand how the engineers perceived 'irrigation projects with a watershed approach'.

#### **5.1.1 The feasibility study and its environmental approach**

The feasibility study of the San Pedro irrigation project was designed by the consultancy firm OSTEC LTDA in 1994, as a requirement of the Regional Alternative Development Program (*Programa de Desarrollo Alternativo Regional*; PDAR). The document has several chapters; one of them has the title "Ecology and environmental impact assessment" which main characteristics will be presented in the following paragraphs.

One aspect that calls for attention of the mentioned document is that the watershed diagnoses only considered physiography, climate, soil type and coverage, as well as flora and fauna, aspects related mainly to an examination of biophysical and ecological characteristics. As a consequence, erosion caused by wood extraction, overgrazing and inadequate land use were the only problems identified in the watershed.

To overcome this problem, the proposed alternative was the rehabilitation and management of the watershed through a "Management Plan". The main objective of this plan was to obtain sustainable volumes of water storage of the dam for irrigation. Consequently, the plan proposed two strategic activities: reforestation and construction of river dikes to avoid sediment transportation. Regarding the environmental impact assessment, the document indicates that the reservoir will allow fish breeding to control the increment of insects and mosquitoes. Also, the document points out the following positive impacts: tourism, San Pedro River regulation through the sediment control, erosion control and reforestation.

All the different aspects stated previously show the weakness of the diagnosis carried out in the feasibility study since there is no natural resource management analysis in the watershed. Therefore, there is no analysis regarding the stakeholders' interrelationships for the natural resources management, especially for water resources. For the same reason, in the environmental impact

assessment the reforestation is the most important aspect to make the project viable. Therefore, the social impact is not considered as a parameter to make the project viable.

Indeed, this emphasis on detailed ecological analysis was characteristic in the 1980s and early 1990s (Walker, 2005). This is because in the natural sciences, the term ‘ecology’ has a quite specific definition: the study of the interrelationships between living organisms and their physical environment, without taking into account the social-environmental interactions.

### 5.1.2 The final design and its watershed management approach

The final design of the San Pedro irrigation project was elaborated by the SCS-Gandarillas consortium in 2007. For this design stage, the German Bank KfW, as funding institution, requested the incorporation of the watershed management approach in the design of the irrigation project. Therefore, the final design contains a volume titled “Hio Micro Watershed Management Plan”, which content is divided in two sections: a micro watershed diagnosis and a micro watershed management plan.

The diagnosis states again that erosion is the main problem in the watershed and the recommendation to solve this problem is the execution of a plan denominated “Integral Micro Watershed Management Plan” (IMMP). The objective of this plan is to avoid the deterioration of existing natural resources and the sediment loading which will affect the sustainability of the dam. However an important aspect of the diagnosis is that all the analysis was done in the upstream area of the Hio watershed as Figure 22 shows, forgetting completely the downstream area of the Hio watershed.



Figure 22. Soil erosion risk map

Source: SCS-Gandarillas, 2007

To fulfil this aim, the IMMP proposes two components. The first one is “Conservation practices and land management” which objective is to preserve the land against erosion through different activities, principally reforestation. The second component is “Hydraulic infrastructure” which goal is by one hand to minimize the sediment transportation from river-beds and by the other hand, to hold back coarse dragging during the rainy season. To achieve both objectives the suggested strategy is to control the riverbanks through reforestation, live fences and construction of transversal dikes in the critical gullies in the watershed.

In order to implement the different activities, the plan proposed the creation of a Forestry Committee with the participation of the Hio syndicate, Aiquile Municipality and San Pedro WUA. The purpose of this organization was to establish agreements with each one of the landowners affiliated to the Hio syndicate to make the reforestation possible. One of the clauses of the agreement model stays the following:

**Clause Four.-** *The forestry products, without species distinction, from the plantations or final cut will be divided as the following: 80% of the profits will be assigned to the landowner and the remaining 20% to the Forestry Committee.*

To summarize, in the IMMP again the central subject is forestry and soil conservation. The approach of the plan is oriented to protect the reservoir which benefits the San Pedro and Miraflores communities. The proposal of creating a forestry committee is to facilitate the implementation of the tasks of the IMMP.

To start the construction of the San Pedro irrigation project, the German Bank KfW decided that the actions of the IMMP should be implemented beforehand. But it was not possible to implement these actions because all of them were planned for the upper watershed without being in agreement with upstream peasants. Therefore, the German Technical Cooperation (GTZ<sup>25</sup>) decided to send staff from the Agricultural Development Program (PROAGRO<sup>26</sup>) to work further on the Hio watershed management plan and to socialize it. With PROAGRO’s intervention the actions to be developed in the Hio watershed were settled. However for further analysis it is important to provide some details about the intervention characteristics and the actions in the watershed, which will be presented in the next section.

## 5.2 From San Pedro irrigation project to Hio watershed action plan

In 2007 PROAGRO intervened in the Hio watershed with the purpose of re-designing the IMMP which was elaborated during the final design of the San Pedro irrigation project. PROAGRO’s intervention has two important results: 1. The Hio watershed action plan, which is the basis for the actual Hio watershed management plan (WMP) and 2. The implementation of three actions from the Hio watershed action plan. Therefore the following sections will describe in more detail both points.

<sup>25</sup>Since 1st January 2011 GTZ is called GIZ.

<sup>26</sup>The agricultural development program (PROAGRO) is an initiative developed by the German Cooperation through the GIZ for Bolivia. The PROAGRO program supports the Bolivian government at national, regional and local level in implementing national sector programs to help reduce poverty in rural areas and support the current national development program. Within the program three components are identified: Integrated Watershed Management, water for agriculture and agricultural production and marketing. The personal of PROAGRO is composed by senior local engineers experienced within the local context and young professionals with diverse qualifications.

### 5.2.1 The Hio watershed action plan

The first point which we need to consider in the analysis of the intervention in the Hio watershed is that upstream stakeholders did not feel the necessity to carry out any action in the upstream area. In that sense, the formulation of the watershed management plan was not a requirement born as a necessity from upstream stakeholders.

*“They just came offering us plants. They offer us plants as a benefit of the watershed management plan. They told us that downstream is getting benefits of the water and upstream should, at least, get some benefits with the reforestation” (General Secretary of the Hio syndicate)*

A second point, which is relevant to take into account is that during the design of the Hio watershed action plan the negotiation between upstream stakeholders (Hio community) and downstream stakeholders (San Pedro and Miraflores communities) to make viable the construction of the San Pedro irrigation project had been carried out. For that reason, during the first year of the PROAGRO intervention, the engineers focused their efforts on trying to resolve the existing conflict between upstream and downstream stakeholders. During the negotiation between upstream and downstream stakeholders PROAGRO became another stakeholder with a similar interest as the downstream stakeholders. The main interest of PROAGRO was to make viable the implementation of the San Pedro irrigation project. Therefore, their strategy was to explain to Hio peasants that the benefits of the actions in the watershed will be only for them, a situation which made the conflict worse because the Hio syndicate recognized the power they had due to their geographical position. With this argument they convinced the Hio syndicate to participate in the re-formulation of the IMMP.

So, the second year of PROAGRO intervention was mainly related to the re-formulation of the IMMP with the following watershed approach:

*“The watershed approach in the San Pedro irrigation project means that both stakeholders develop joint actions, because otherwise the irrigators will only focus on their activities and Hio only focuses upstream. Therefore we are considering the watershed as a whole, which includes the upstream area, where water is generated, and the downstream area, where water is used. We want to integrate the actions regarding to the protection of the watershed and the improvement of water use for agricultural production. The main reason to articulate the actions and the different stakeholders in the watershed is to protect the useful lifetime of the dam” (Engineer in charge of the design from PROAGRO)*

The previous quote clearly shows that the watershed approach according to PROAGRO’s engineers focuses on the protection of the irrigation infrastructure through actions in the watershed, in order to secure water for agricultural production. Consequently, the objective is irrigation and the actions in the watershed are means and not an end.

With this approach the Hio watershed action plan<sup>27</sup> was formulated through the use of the participative rural diagnosis methodology. In this sense, the responsibilities and the attributions of each stakeholder for each one of the prioritized activities in the Hio watershed were established as shown in Table 6. If we analyze the seven actions proposed in the Hio watershed action plan, six of them are oriented to protect the lifespan of the San Pedro dam and one of them is oriented to

<sup>27</sup>An Action plan is a tool that allows rural communities to annually plan the actions in the watershed as a strategy to establish the basis of the watershed management plan. These short term plans are an alternative to pass from the planning to the execution because they prioritize local resources and capacities. This type of strategies allowed to build trust, motivation and interest from local stakeholders (Quiruchi, 2010).

increase water access for the Hio peasants through the *atajados* construction. However it is important to point out that the *atajados* construction is not precisely part of the Hio watershed action plan because, as explained in Chapter 4, this was the condition that the Hio syndicate established to viable the implementation of the San Pedro irrigation project and there was a construction agreement with the Aiquile municipality.

Furthermore, the action plan only considers the participation of three out of the four communities of the Hio watershed. Comun Pampa is not presented in the action plan, even though this community is also part of the watershed however it is not part of the San Pedro irrigation project.

**Table 6. Action plan developed during the PROAGRO intervention**

	WHAT?	WHERE?	FOR WHAT?	HOW MUCH?	FOR WHO?	WHOM?	WHEN?
1	Commercial forestation		Reduce soil erosion on the watershed slopes	88 ha of pine and eucalyptus	26 Hio families San Pedro WUA	Hio families Aiquile Municipality San Pedro WUA Forestry committee	2008 2009
2	Native species reforestation		Reduce soil erosion on the watershed slopes	50 ha of Molle, Naranjillo, Quebracho, Tuna, Agave, Algarrobo, Jacaranda and Tipa.	26 Hio families	Hio families Aiquile Municipality San Pedro WUA Forestry committee	2008 – 2009
3	Establish agroforestry systems and soil conservation (hedges, infiltration channels, slow formation terraces)		Reduce soil erosion on agricultural plots	89 ha of Tara, Sauce, Chacatea, Retama and Pastofalaris	26 Hio families	Hio families Aiquile Municipality San Pedro WUA Forestry committee	2008 – 2009
4	Nursery garden construction and plant production		Produce native and exotic plants	Communal nursery garden of 1000 m <sup>2</sup> to produce 197338 native and exotic plants	26 Hio families	Hio families Aiquile Municipality San Pedro WUA Forestry committee	2008 – 2009
5	Gabion construction dykes	Kullcu stream MilluMayu stream IlluMayu stream	Reduce sediment transportation	Kullcu stream: 3 dykes MilluMayu stream: 8 dykes IlluMayu stream: 21 dykes	26 Hio families	Hio families Aiquile Municipality San Pedro WUA Forestry committee	2008 – 2009
6	River bank forestation	Kullcu stream MilluMayu stream IlluMayu stream	River banks protection	16 ha of Sauce, Alamo and Pastofalaris	26 Hio families	Hio families Aiquile Municipality San Pedro WUA Forestry committee	2008 – 2009
7	<i>Atajados</i> construction		Storage rainwater to reduce the risk of droughts	24 <i>Atajados</i>	26 Hio families	Hio families Aiquile Municipality San Pedro WUA Forestry committee	2008 – 2009

## 5.2.2 Problems in the implementation of the Hio watershed action plan

As I mentioned previously, before the construction of the San Pedro dam, the German Bank KfW stated that it was necessary to implement some actions in the Hio watershed in order to receive the first outlay for the San Pedro irrigation project. In that sense, it was an imposition for the San Pedro WUA to work on the upstream region of the Hio watershed with three main activities prioritized from the action plan: reforestation, construction of gabion dykes and the establishment of a watershed organization.

*“We went upstream to work with the commitment that after that the construction will start. That was the proposal of the German funding institution. They told us that we need to reforest otherwise there will not be any funding. They put the condition, first we have to reforest with the holes and then comes the dam. Personally our position was to obey them until the dam construction starts. I thought that if there is no water available on the hillside how the plants will grow? They told us that rainwater will be enough. But that was not true, during my whole life that was not true. But what else we could do? It was the condition and we had to fulfill it” (General Secretary of the San Pedro syndicate)*

To finance the execution of the three mentioned actions, the Aiquile municipality established an agreement with PROAGRO. With this agreement the Aiquile municipality was in charge of providing all the required materials and supplies, while the engineers’ team from PROAGRO provided technical support during the implementation of the activities. In the following sections the implementation of the three prioritized actions and the results of them according to local stakeholders’ perspective will be explained.

### 1. Reforestation

The first action on which the PROAGRO engineers focused was reforestation with three different species: eucalyptus, pine and native species. To achieve this objective a mutual agreement was established between the Hio syndicate and San Pedro WUA. According to this agreement the San Pedro WUA was responsible to dig the holes in the defined reforestation areas and Hio peasants were responsible to plant the seedlings and fence the area.

San Pedro WUA committed to dig 7000 holes on 23 private upstream properties. Each one of the members of the San Pedro WUA had the responsibility to dig 170 holes. Therefore, in October 2009, the San Pedro WUA peasants went to the upstream area to dig the holes under the technical supervision of PROAGRO engineers. Even though digging the holes was an obligation for each one of the members of the San Pedro WUA, not all of them were in agreement to work on a private property. Fourteen members did not work because they considered that this action would only benefit the Hio peasants as they can later on cut the trees and sell the products. Moreover, in their conception it was not possible to work for free on a private property.

After the work of the San Pedro WUA, PROAGRO engineers provided each Hio peasant the seedlings according to the number of holes on their properties. The material for the fences (barbwire and posts) was delivered to the General Secretary of the Hio syndicate. However due to some internal problems within the organization (nonpayment of fees) the General Secretary did

not hand out the barbwire to 10 families, so the reforested areas of this families were without any type of protection.

Nowadays, from the 23 families that had the holes in their land, only 5 families (approx. 2 ha) have young trees (see Figure 23). According to the Hio peasants there was a technical circumstance that led to this result (inappropriate seedling period in the dry season). But a further analysis shows that the main reason is that reforestation is not an important activity for them. The Hio peasants did not plant the seedlings and did not take care of them, because they prefer to have their cattle on the area that gives to them a short term and continuing economic income.



**Figure 23. Reforested area in the upstream Hio watershed**

San Pedro WUA considers reforestation as an unsuccessful measure. In this sense, the San Pedro WUA peasants expressed that they will not go upstream to work on reforestation again. The alternative measure which they propose to protect the dam against sedimentation is reforesting only the area around the reservoir. As their narratives point out, they are open to alternatives which do not include working on private upstream properties because their work will be in vain.

To conclude, the result of the first reforestation experience according to stakeholders' perception is that reforestation in the Hio watershed failed. Even if the process was supported by an external institution, the actual situation of the reforested area shows that it is impossible to force upstream and downstream stakeholders to work together if they do not feel that the benefits are equitable for both of them. The fact that the Hio action plan is focused on conservation measures to protect the dam does not motivate upstream stakeholders to work together with downstream stakeholders. Even though the reforestation activity can generate an extra economic benefit for the Hio peasants and the fact that all the input to develop reforestation were there, Hio peasants did not honor the agreement. This is because the Hio peasants' still refuse the San Pedro irrigation project. In Hio peasants' perspective accepting to participate in reforestation is to accept the dam and the idea of the San Pedro WUA that the water rights are only for them. For the Hio peasants to allow and cooperate in the implementation of the actions in the watershed is a condition to obtain water access of the San Pedro dam.

## 2. The watershed organization

One of the main characteristics of IWRM is the participation of local stakeholders in decision making as a strategy to strengthen the watershed management. Based on the previous approach, in 2009 PROAGRO supported the creation of the Hio watershed organization, as stated in the following minute.

*March, 7<sup>th</sup> 2009*

*Ordinary meeting minute*

*On Saturday march 7<sup>th</sup> an ordinary meeting was held at 9 am to define the Hio watershed management plan in the Hio community.*

*Hio syndicate agreed on the execution of the plan and to elect the directive of a watershed organization to administrate the Hio watershed management plan and control the execution as the following:*

- President: Hio syndicate General Secretary*
- Vice-president: President San Pedro WUA*
- Minute taker: Hio peasant*

*(In the minute there are no signs or stamps)*

When local stakeholders are consulted about the functioning of the Hio watershed organization there are two different answers. The first one is that neither upstream nor downstream stakeholders know about the existence and the functioning of the watershed organization. Probably, this is because the process was managed only between the directive of the San Pedro WUA and the General Secretary of the Hio syndicate. The second one is that some local stakeholders who previously held a position within the San Pedro WUA or the Hio syndicate are aware of the existence of the watershed organization, but they point out that this organization is not working. In fact when the person who holds the present role of president of the Hio watershed organization was consulted about his roles and functions he does not even know about the existence of the watershed organization. Therefore, the Hio watershed organization nowadays is not working and there is no clarity about the role and functions of the different members of this organization.

According to the San Pedro WUA president, who has the vice president role of the Hio watershed organization, the main reason for the unsuccessful creation of the watershed organization is that Hio peasants recognize that the actions in the Hio watershed are oriented to protect the dam, so they do not have an interest to participate. It is impossible to expect the participation of a stakeholder group in any type of action if they do not have a particular interest. Furthermore, in this case, there are still unresolved issues regarding the future water use of the dam between upstream and downstream stakeholders.

## 3. Gabion dykes

The third action prioritized in the Hio watershed was the construction of gabion dykes in the main streams to avoid sediment transportation to the reservoir. The locations of the dykes were established by PROAGRO engineers and the acquisition of the gabions was the responsibility of the Aiquile municipality. San Pedro WUA was in charge of building the dykes with the technical

support of PROAGRO. No participation was expected from the Hio syndicate for the construction of the dykes.

However even though the Aiquile municipality bought the gabions to construct the dykes in 2009, the San Pedro WUA did not build any. According to the directive of the San Pedro WUA the reason for not constructing the gabions was that the members are demotivated after the failure of the reforestation activities in the upstream watershed. Furthermore, they were conscious about the difficulties that carrying out actions in the upper watershed brings and at this moment they did not see the importance of conserving the watershed. They thought that they could protect the dam by reforesting the surrounds of the reservoir; their approach was to protect the dam in order to have water to irrigate. So their interest was only the irrigation system and not the watershed.

### **5.3 Irrigation in the watershed or the watershed for irrigation?**

An analysis of the different Hio watershed management plans in the different phases shows that the actions, objectives and goals are oriented mainly to soil conservation and forest management. In other words, an irrigation project with a watershed approach, in case of the Hio watershed, means the development of a watershed plan with actions in the upstream watershed oriented only to protect the lifespan of the San Pedro dam and the water available for agriculture. According to Molle (2009) the approach used in the Hio watershed is categorized as a watershed development approach and not as a watershed management approach.

Additionally, the Hio watershed management plan did not consider any social or political dynamics that occur inside the watershed forgetting the linkage between nature and society (Budds, 2008). According to the 'socio natural' approach there is a clear linkage between nature and society, as society shapes nature and nature also shapes society (ibid). The result of not considering the social dimensions within the environment in any analysis leads to identify only biophysical causes without considering wider multiple factors (ibid). In the case of the Hio watershed the design and implementation of the San Pedro irrigation project, with their conflicts and remaining issues as explained in Chapter 4, affects the relationship among the communities. Consequently, the fragile social relationship among the different communities affects the implementation of various actions in the watershed.

The fragile relationship among the communities is due to unclearness in the access and use of water at watershed level. Therefore, analyzing the interrelation of the different stakeholders for the water management should be considered for the diagnosis and formulation of the watershed management plan. Merely, in the Hio watershed management plan there is an assumption that the water is used only to irrigate the downstream area, forgetting completely other uses and necessities of the different users in the watershed. So, if it is expected that upstream and downstream stakeholders join forces to protect the watershed, which is PROAGRO's approach during the intervention in the Hio watershed, all different users and uses of water should be considered and not only water for agriculture. Consequently, it is impossible to involve all stakeholders in collaborative actions if they do not perceive that there is a problem which affects them or they will gain a benefit of it, as can be noticed in the three implemented actions in the Hio watershed.

Referring to the first action implemented in the Hio watershed which is reforestation, from the 7 ha intervened only 2 ha have trees nowadays. This result is because Hio peasants did not consider that the compensation of a tree instead of water is equitable. PROAGRO's approach was to offer the Hio watershed management plan (with the specific reforestation measure in the upstream area) as a compensation to the upstream stakeholders as it was not possible to achieve concerted agreements between upstream and downstream stakeholders. The Hio watershed case study shows that a watershed management plan cannot be a compensation mechanism for the lack of consensus in the water use between upstream and downstream stakeholders.

The second action in the Hio watershed was the creation of a watershed organization, an organization which never functioned. The main reason for the unsuccessfulness of this organization was that it was not born out of a local necessity. Additionally, this organization was created without: clear roles of each member, power to take decisions, economic resources to execute and maintain the different measures implemented (Dourojeanni, 2009). Also the social context was not the most suitable one, because, on the one hand, there was already a local organization (San Pedro sub central) that coincided with the limits of the watershed. So, the watershed organization was a parallel organization to do specific actions to protect the dam. On the other hand, the conflicts during the implementation of the San Pedro irrigation project weakened even the local traditional organization. For all the explained reasons, the pertinence of creating watershed organizations should be thoroughly analyzed; considering: the local relationships between stakeholders and the existing traditional organizations especially because of the Bolivian water use sectors which are characterized by being self-managed by local stakeholders.

To conclude, the Hio case study shows the necessity to analyze if the watershed management plan should be circumscribed in the design of an irrigation project or if an irrigation project should be part of a watershed management plan that considers the different water uses and users in the watershed and the interaction between nature, society and policy. The current research shows that not considering the social dimension of water and natural resource management leads to unwanted results as the conflicts between upstream and downstream stakeholders continues even when the compensations mechanisms are used. This situation jeopardizes the implementation of current and future projects. As designing a Watershed Management Plan involves an economic investment, most of the time not considered within the budget of an irrigation project, the irrigation project should not focus on designing the mentioned plan. Indeed, the present research shows that an analysis of the watershed water management (considering the organizational component) not only focused on water use for irrigation will allow to understand the local dynamics safeguarding the future use of water. In that sense, the water management at watershed level analysis becomes a base for the design of the Watershed Management Plan.

## **CHAPTER 6 ANALYZING THE INTERACTION BETWEEN THE HIO WATERSHED PLAN AND THE SAN PEDRO IRRIGATION PROJECT**

This chapter focuses on the analysis of the ‘watershed approach’ of the San Pedro irrigation project. For that purpose I will analyze the influence of the design of the San Pedro irrigation project presented in Chapter 4 and the design as well as the implementation of the Hio watershed plan described in Chapter 5. Both aspects highly influenced the current articulation between upstream water management and downstream water management in the Hio watershed.

The main issue during the development of the San Pedro irrigation project in the Hio watershed is the competition for use and access to water between upstream and downstream stakeholders. This situation came up with the establishment of the community boundaries (San Pedro, Miraflores, Comun Pampa and Hio) when the San Pedro sub central was created. A first conflict in the Hio watershed was between the Hio community (upstream watershed) and the San Pedro community (downstream watershed) regarding the water use of the San Marcos spring. The water from this spring is now used by the San Pedro community through the implementation of a drinking water project. Due to this factor, the relationships between San Pedro and Hio communities became tighter.

Considering the tense relationship between both communities, with the establishment of the San Pedro irrigation project, the conflict for access to and use of water acquired greater proportions. In this new conflict two sides can be identified: upstream stakeholders (Hio community) and downstream stakeholders (San Pedro WUA composed by San Pedro and Miraflores communities). Both stakeholders claim the access to and use of water from the Illumayo stream, water that will be stored in the San Pedro reservoir. The Hio peasants based on a socio territorial logic have the sense of ownership of the water from the Illumayu stream because it is located inside their territory and therefore, due to their geographical position they have the power to claim for water rights.

It is important to clarify that the sense of ownership of the water, like in the Hio community, is nowadays common within the Bolivian territory. The mentioned situation is a consequence of the current political framework introduced in the first term of office of Evo Morales government. In that sense, the Bolivian state recognizes the indigenous autonomies which live in the country and their competences regarding the water management. Additionally, the State recognizes and protects the collective rights and all the cultural water management forms that exist within the national territory. However, the recognition of the indigenous autonomies implicitly brings the idea of ‘property’ of the natural resources, forcing the communities to delimitate their territory and creating the ownership feeling of everything that is inside their territory. Specifically in the water sector, the traditional organizations, like syndicates, are trying to take possession and claim the property of the water sources (rivers, lakes, as well as springs, among others) even if the New State Constitution recognizes that the property of water is under the State tuition (Arratia and Gutierrez, 2010).

Therefore, the San Pedro WUA recognized the socio territorial logic of the Hio community, supported by the current political framework and started a negotiation process with the Hio

syndicate. The negotiation process to make the San Pedro irrigation project viable in the final design phase lasted for two years. This can be considered a long term negotiation if we take into account that the economic resources from the German cooperation were available, however neither the National State nor the institutions working in the area had the power to solve the conflict. As the State recognizes the indigenous autonomy and the cultural water management forms that exist inside the Hio watershed, they no longer have the power to interfere in the communitarian decisions. So after the two years negotiation between the San Pedro WUA and the Hio syndicate, finally the San Pedro and Miraflores peasants handed over the economic resources of the popular participation to the Aiquile municipality to build the 24 *atajados* in the Hio community.

But it is important to mention that water rights are not only focused on the resource itself, they also represent social and power relations (Boelens, 2008). Thus, regarding the contents of the water rights, a weakness of the San Pedro irrigation project with a 'watershed approach' is that it only emphasized on the analysis of water rights inside the irrigation system. The project designers did not consider the difficulties which could emerge since the water sources and the dam are located inside the Hio territorial boundaries. So, the San Pedro irrigation project focused on establishing water rights inside the irrigation system through the hydraulic property mechanism and forgot the current and future water use requirements of all the different stakeholders in the watershed.

The unclearness about water rights is still latent and it is a source of future conflicts, as both stakeholders are claiming for the water rights of the dam. On the one hand, upstream stakeholders claim water rights because the water is born and stored in the Hio territorial jurisdiction. On the other hand, downstream stakeholders claim their water rights because they contribute with labor and money, therefore they think that they have the hydraulic property. Thus, an important finding in the Hio case study is that two valid recognized mechanisms of obtaining water rights (Boelens and Doornboos, 2001), hydraulic property mechanisms and socio territorial mechanisms, enter in competition when we scale up into a watershed level. The main restriction that both stakeholder groups have is the lack of clear agreements between the different water users regarding the different uses of the water of the dam. This situation is because there is no legitimate organization/institution which has a recognized authority by all the stakeholders to enforce the rules and the agreements between upstream and downstream stakeholders.

The San Pedro irrigation project empowered the San Pedro WUA (representing only downstream stakeholders) because this organizational level was considered as the only interlocutor during the whole intervention process. In that sense, the engineers did not consider the San Pedro sub central as a valid interlocutor. So, they did not recognize the power that this local peasant organization had as it represents the four communities of the Hio watershed. Even if it seems logical to empower this organization, as it is traditional and legitimate to take decisions at watershed level, the San Pedro irrigation project weakened this traditional organization. To make the San Pedro irrigation project viable, the San Pedro WUA took control over the sub central for the last five years. The San Pedro WUA strategy was to elect as a General Secretary of the San Pedro sub central a representative of Miraflores or San Pedro community, taking advantage of their majority number of affiliates. So they relegated the participation of the Hio community inside the organization. Therefore, upstream stakeholders (Hio syndicate) do not recognize any longer

this organizational level as a legitimate one, so there is no organization that has a regulatory control at watershed level.

As there is not a legitimate organization, which is recognized by all local stakeholders and can resolve the competition for the water use of the dam, it is not possible to achieve an equitable use of and access to water according to stakeholders' perceptions. So the Hio community neglected the implementation of the San Pedro irrigation project. In that sense, the 'watershed approach' that the German cooperation pressured to incorporate in the San Pedro irrigation project, was used as a compensation mechanism. This compensation mechanism attempted to overcome the unresolved conflict about the water use of and access to the dam. Therefore, the 'watershed approach' of PROAGRO which was reflected in the Hio action plan, was a negotiation strategy which aimed to convince upstream stakeholders that the actions in the upstream watershed will mainly benefit them.

One of the actions of the PROAGRO intervention was the creation of a watershed organization. So, this organization was not born as a local necessity of the local stakeholders, especially of the Hio peasants. Furthermore, this organization was created on paper, however in practice, it never functioned. This situation is product of two main issues: the first one is related to the contents of the Hio watershed plan that this organization should implement and the second one, is the appropriateness of creating this organization.

Focussing first on the content of the Hio watershed management plan, this plan was formulated with a watershed development approach to protect the irrigation infrastructure. Mainly, the actions in the Hio watershed plan are measures to avoid deforestation and soil erosion in the upstream area to secure the water availability in the dam and to protect the irrigation infrastructure in the downstream watershed.

In the plan, the Hio watershed is recognized as technical management unit. This kind of technical management unit has a worldwide centennial history (Molle, 2009) and it has gained the dominance as a water management unit because it converge hydrological, geographical and ecological sciences (Warner et al., 2008). Furthermore, for the design of the watershed management plan the engineers only delimited the upstream area of the Hio watershed and evaluated the biophysical characteristics only in this area. In that sense, the project conceptualization considers only the area related strictly with the irrigation project, which is the reason why the Comun Pampa community does not appear as part of the watershed plan.

The main lack of the Hio watershed management plan with a watershed development approach is that it does not consider the water management neither the 'hybrid-nature' of the water resource which states that water not only shapes the social relations but also social relations shape water (Budds and Hinojosa, 2012). As a consequence of not considering the social nature of water, the plan does not consider all the different stakeholders that interact in the water management at the Hio watershed; hence it was not possible to recognize the different demands and/or needs of local stakeholders of Hio and Comun Pampa. As the watershed management plan did not consider the necessities of the Hio community (drinking water demand, more water for *atajados* and construction of new *atajados*) the plan is not recognized as a legitimate one by Hio peasants. In addition, the activities of the plan are not considered equitable by them as they only respond to the necessities of downstream stakeholders.

To understand why the Hio watershed management plan even if it has been named with the term 'watershed management' it is based on a 'watershed development' approach, it is necessary to focus on the National Watershed Plan (NWP) framework which oriented the design of this project. According to the NWP (2006), Integrated Watershed Management (IWM) and Integrated Water Resource Management (IWRM) are two complementary concepts, where IWM is related with the technical aspects and IWRM is mainly the social part. However according to Tefera and Stroosnijder (2007) the common point between both approaches is that both consider the water dimension for the watershed management. But in the NWP the 'IWM' considers the technical management of natural resources, not including the social dimension of water. So, in the Hio watershed management plan the "water management" is not presented or considered at all, even if this is a decisive factor for water conflicts. As previously mentioned, the water rights issue is a central theme in the Hio watershed, but the plan did not take into account this topic.

The reasons why the Hio watershed management only took into account technical activities is a consequence of the conceptualization inside the NWP framework. The NWP defines IWM as technical activities to protect the watershed. The previous definition is actually the concept of watershed development and not of IWM. Furthermore, nowadays most water experts no longer use the IWM approach as they consider that IWRM is the evolution of the IWM approach. As a result of this conceptual confusion the "Guide for the formulation of Integrated Watershed Management Projects" (Guía para la formulación de proyectos de manejo integral de cuencas, 2007) of the NWP, which was the reference guide for designing the San Pedro irrigation project with a 'watershed approach', focuses only on technical aspects to intervene in the watershed.

After this clarification, it is clear that the San Pedro irrigation project with the described 'watershed approach' did not achieve the articulation between the upstream water management and the downstream water management, as it is intended by the Vice Ministry of Water Resources and Irrigation. Furthermore, the idea that the upstream watershed is the area where water is born and the downstream watershed is the area where the water is used is a conceptual mistake, because the Hio community also claims for access to and use of water.

Regarding the second problem of the Hio watershed organization, which is the appropriateness of its creation, the result shows that the watershed organization was created only to facilitate the implementation of the watershed development activities in the upstream area in order to protect the dam. As this organization did not respond to the local stakeholders demands, it never functioned. As Shah et al. (2005) state, imposing the creation of a watershed organization model in developing countries following the experiences of developed countries is a recipe for failure because the objectives and context are completely different.

The Hio watershed organization was created as a parallel organization to the traditional existing one (San Pedro sub central), ignoring the power that this traditional organization has regarding territory management, including water. The engineers did not consider that the organizational Bolivian context around water management is characterized by the existence of local peasants organizations (syndicates, traditional authorities, indigenous communities, water user associations, drinking water associations, among others) developed historically around the management of the water sources and the territories where the water will be used (Arratia and Gutiérrez 2002, Ciales et al. 2002, Gutiérrez and Cardona 1998, Oblitas et al. 2002; Gutierrez, 2005; Bueno de Mezquita, 2011). These organizations have an established experience, knowledge, uses and costumes that are the base for the territory and water management according to the

peasant worldview (Gutierrez, 2010; Bueno de Mezquita, 2011). These kinds of organizations are recognized in the New State Constitution.

As mentioned previously, the creation of a parallel organization without considering the characteristics of peasants' organizations weakened the San Pedro sub central. The project intervention did not analyze the existing organizational dynamics in the watershed identifying the cooperation and/or conflict relationships. Due to this reason it was not possible to identify that it is not necessary in all cases to create a formal water management organization (Mollinga et al., 2007). As a result, the San Pedro sub central was not able to assume water management decisions in the Hio watershed neither was the watershed organization created by PROAGRO.

Another relevant aspect with the design of the San Pedro irrigation project with a watershed approach is that the engineers in charge of the design did not develop an analysis of the water management at watershed level. They did not recognize that the conceptual framework for the analysis of water management at irrigation level developed in Bolivia can be valid at watershed level (Duran, 2012). Therefore, the engineers identified only the biophysical components (water source, hydraulic infrastructure, water users and the service area) in the Hio watershed but they forgot the identification of the constituent components (water rights, peasants organizations, water distribution, system operation and maintenance) of the water management (Claure and Gutierrez, 1995; Gandarillas et al, 1995; Gutierrez and Gerbrandy, 1998; Gutierrez, 2005; Arratia and Gutierrez, 2009). Thus, they were not able to understand the interrelationships between upstream and downstream stakeholders and the demands of each one of the parties.

To conclude, in the Hio case study the management scale unit used for the analysis is the Hio watershed because the main focus of the research was the 'watershed approach' of the San Pedro irrigation project. However, if we scale up to a broader extent, like the basin, it is clear that the problems will not be necessarily the same as the ones identified in the Hio watershed. In that case it will be necessary to map a water-management problem from a 'problemshed' perspective (Mollinga et al., 2007) considering the hydrologic, social, economic and political conditions that affect the issue to be solved. However, it is important to not forget the interaction between the different water management levels as it is not possible to see water management in an isolated unit.

For the previous explained reason, it is not coherent to formulate a watershed management plan through an irrigation project intervention because the problems identified at irrigation system level will not correspond with the problems at watershed level. In that sense, the irrigation project should be considered as part of the watershed management plan, and not backwards. The design of the Hio watershed management plan as part of the San Pedro irrigation project gives as a result a watershed management plan oriented to secure the sustainability of the irrigation system and not the sustainability of the watershed.



# Part 3

## Conclusions and recommendations

**Chapter 7:** Searching for the watershed approach in irrigation projects, lessons learned from the Hio case study

## CHAPTER 7      **SEARCHING FOR THE WATERSHED APPROACH IN IRRIGATION PROJECTS: LESSONS LEARNED FROM THE HIO CASE STUDY**

As nowadays in Andean watersheds the competition of water between different users and uses has increased there are more conflicts between upstream and downstream stakeholders (Salm, 2010; Boelens et al, 2002) regarding to water use and access. In the particular case of Bolivia an attempt to solve this situation was the incorporation of the ‘watershed approach’ as part of the design of irrigation projects. The ‘watershed approach’ is an attempt to adapt into the local context the mainstream worldwide water management approaches of Integrated Water Resource Management (IWRM) and Integrated Watershed Management (IWM).

However, incorporating the ‘watershed approach’ into practice has been proven to be hard (Interview with the Vice Minister of Water Resources and Irrigation), so along with this document I have been analyzing the case of the San Pedro irrigation project with a ‘watershed approach’. As the aim of my thesis was to contribute to the development of a local framework of the ‘watershed approach’ this last chapter of the document is separated in two main parts. Section 7.1 focuses exclusively in the conclusions of the research, according to each one of the three sub questions formulated in Chapter 1. Then, section 7.2 provides some reflections and recommendations regarding the ‘watershed approach’ in irrigation projects as lessons learned from the Hio case study.

### **7.1 Conclusions**

All previous chapters developed in this document aimed to answer the main research question: *Which is the current situation of the articulation between upstream water management and downstream water management in the Hio watershed product of the intervention of the San Pedro irrigation project with a ‘watershed approach’?*

To answer this main research question three sub questions were defined in Chapter 1. But to answer each one of the sub questions it was necessary to consider different factors, so Chapter 4, Chapter 5 and Chapter 6 answer in detail each one of the sub questions. In that sense, the first sub-question: *How has the San Pedro irrigation project intervention influenced the interrelation of the Hio watershed communities?* is extensively analyzed in Chapter 4. The second sub question: *Which is the ‘watershed approach’ of the San Pedro irrigation project considering the different intervention stages?* is answered exhaustively in Chapter 5. To conclude, the last research sub question: *Which is the current status of the articulation between upstream water management and downstream water management in the Hio watershed after the implementation of the San Pedro irrigation project with a ‘watershed approach’?* is developed in Chapter 6.

With the previous clarification, I will resume in the coming paragraphs the main conclusions of this research according to each one of the research sub questions presented.

- The intervention of the San Pedro irrigation project and its influence in the interrelation of the Hio watershed communities

The intervention of the San Pedro irrigation project lasted for seventeen years and had three different stages: pre-feasibility, feasibility and final design. The project design in each one of

the phases was carried out by different external consultancy firms that influenced in different ways the interrelationship of the Hio watershed communities. The pre-feasibility study established as the most adequate solution for the water demand of the San Pedro syndicate (which is the traditional organization that represents the San Pedro community), the construction of a dam.

But before the design of the feasibility study, the San Pedro syndicate became the San Pedro sub central. As a consequence of the creation of the San Pedro sub central, the San Pedro community had to split into four communities, which nowadays form the Hio watershed: San Pedro, Miraflores, Comun Pampa and Hio. However, the creation of the new territorial limits was not a clear process, so the first water conflict in the watershed arose for the water use of the San Marcos spring between Hio and San Pedro communities; tighten the relationships between both communities.

During the feasibility study, the dam site was defined on the Hio community territory and a water transfer from the adjacent San Juan watershed was included into the design to satisfy the water demand of the four communities. When Hio peasants knew that the dam was located near the territorial boundary between Hio and San Pedro, they noticed that they were implicitly out of the project because water cannot flow upstream to irrigate their lands. Therefore, the Hio syndicate was completely disagreeing with the location of the dam, halting the design of the irrigation project. The argument of Hio peasants was that previously San Pedro took their water (from the San Marcos spring) without any consideration, so now they will not have any kindness with them. The previous explained historical background related with the San Marcos spring conflict was not considered by the design engineers, so they were not able to recognize the existing quarrels between communities.

Due to the fierce position of Hio against the irrigation project, it remained in status quo for 14 years until the final design phase started. In the final design phase, the design of the San Pedro rock fill dam was elaborated without considering the water transfer from the San Juan watershed. Also during this phase, the additional irrigation infrastructure required to irrigate the area of San Pedro and Miraflores was designed. But the main characteristic of this phase is the negotiation process between the San Pedro WUA (composed by Miraflores and San Pedro syndicate) with Comun Pampa and Hio syndicates to make the irrigation project viable, because both communities were excluded from the irrigation project due to technical limitations, especially water availability. As a product of the negotiation process nowadays Comun Pampa and Hio have *atajados*, because their main claim during the negotiation was strictly related with water access.

However, even that nowadays the construction of the San Pedro irrigation project is in process; the relationship between the upstream stakeholders (Hio syndicate) and downstream stakeholders (San Pedro WUA) is tense because both stakeholders claim for the water rights of the dam. This situation is now evident because in the final design the engineers established water rights within the irrigation system, forgetting the other water use rights, an aspect which is related with a lack of a water management analysis at watershed level. So two different mechanism of accessing water rights enter in competition when scaling up to a watershed level: hydraulic property mechanism (downstream stakeholders) and socio territorial mechanism (upstream stakeholders).

The explained situation was a result of a lack of a legitimate and recognized authority to take decisions and enforce them at watershed level. Even if the traditional existing organization (San Pedro sub central) was the more logical organizational level to assume this responsibility, this organization lost its power during the project intervention. The main reason was that the

San Pedro WUA took control over the San Pedro sub central to make the San Pedro irrigation project viable. The San Pedro WUA strategy was to elect as a General Secretary of the San Pedro sub central a representative of Miraflores or San Pedro community, taking advantage of their majority number of affiliates. Consequently, the Hio syndicate does not recognize this organizational level as a legitimate one. Moreover, during the final design the consultancy firm did not recognize the San Pedro sub central as an important stakeholder neither recognized the power of this traditional organization, so they assumed the San Pedro WUA as the only interlocutor.

To summarize, the San Pedro irrigation project has strongly influenced negatively the relationship between the four communities of the Hio watershed due to the following factors: 1. During the project intervention, engineers focused mainly on one single water use: water use for agriculture, so there was no analysis of the water management at watershed level. 2. The project intervention focused on the irrigation system; therefore they did not consider the context of the Hio watershed, especially the historical background of the relationships among the communities 3. The project established water rights inside the irrigation system through the hydraulic property mechanism without taking into account the socio-territorial mechanism acquisition of water rights of upstream stakeholders even though the dam and the water sources are located in the Hio territory. 4. The project intervention created and empowered the San Pedro WUA and at the same time the intervention process affected the struggles within the San Pedro sub central and the power relationships of the communities inside this organization.

- The ‘watershed approach’ of the San Pedro irrigation project in their different design stages

The first design stage of the San Pedro irrigation project is the pre-feasibility study. In this phase there is no clear proposal about activities at watershed level. The second stage is the feasibility study, as this stage was designed in the 90’s it has a strong influence of the ecological approach, focusing on the evaluation of physical and ecological characteristics of the Hio watershed. Therefore, in this stage two different documents were elaborated: a ‘management plan’ in which actions were oriented to secure the sustainability of water storage in the San Pedro dam and an ‘environmental impact assessment’ which focuses on the positive impacts that the construction of the irrigation project should have in the ecosystem. The main lack of the ‘watershed approach’ in the feasibility stage is that it does not consider the stakeholders interrelationships for natural resources management, especially around water.

The last design stage of the San Pedro irrigation project is the final design. The ‘watershed approach’ of this phase was a ‘watershed development’ approach. Therefore, during this stage the “Integral Micro Watershed Management Plan” was designed considering two main axes of intervention: the first one denominated “Conservation practices and land management” and the second one denominated “Hydraulic infrastructure”. The central subject of the mentioned plan was forestry and soil conservation in the upstream Hio watershed to protect the San Pedro reservoir, without considering the water management at watershed level as well as ignoring the different water users and uses in the watershed. Additionally, due to the rivalries between the San Pedro WUA and the Hio syndicate the mentioned plan was not elaborated with a strong participation of the Hio syndicate, even when the actions of the plan were located mainly in the upstream watershed. The plan was a requirement of the German Bank KfW to finance the implementation of the San Pedro irrigation project.

Prior the construction of the San Pedro irrigation project it was necessary to socialize the watershed plan designed in the final phase. So, the Agricultural Development Program (PROAGRO) that works with German funds, intervened in the Hio watershed. During the intervention of PROAGRO, the 'Hio watershed action plan' was designed. The mentioned action plan was offered to upstream stakeholders (Hio syndicate) as an additional compensation as there were still rivalries between upstream and downstream stakeholders, a product of the design of the San Pedro irrigation project. The activities in the action plan were oriented to protect the dam against sedimentation, focusing on the implementation of technical measures in the upstream area, considering only the participation of three out of the four communities (excluding Comun Pampa) that are part of the Hio watershed. As previous design stages, the 'watershed approach' during PROAGRO intervention was a 'watershed development' approach. The main constraint of the action plan was that it only considered the water use for irrigation, as it was scaling up from an irrigation project perspective, so it does not consider the different water uses and users demands.

- Current articulation between upstream water management and downstream water management as a result of the intervention of the San Pedro irrigation project with a 'watershed approach'

The 'watershed approach' of the San Pedro irrigation project is mainly a 'watershed development' approach which activities aimed to preserve the dam against sedimentation, focusing mainly on water use for agriculture. The main reason why the watershed approach has the mentioned characteristics is the conceptual confusion in the National Watershed Plan (NWP) between Integrated Water Resource Management (IWRM) and Integrated Watershed Management (IWM). The NWP states that IWRM is the social part regarding water management while IWM includes the technical actions for water management, which are actually watershed development activities.

In that sense, the two actions implemented (reforestation and the creation of a watershed organization) of the Hio watershed action plan were designed with a watershed development approach. However the results of both actions showed that with this approach it was not possible to achieve the articulation between the upstream water management and downstream water management, as I will explain in the following paragraph.

Referring to the reforestation action, from the 7 ha that were intended to be reforested approximately 2 ha have nowadays small trees. Even the action was supported by an external organization (PROAGRO) and all the materials and supplies were provided by the Aiquile municipality, the Hio peasants did not execute this measure. They did not do anything because their strategy is to negotiate the protection of the upstream area in exchange of water access of the dam. The second action was the creation of a watershed organization to support the implementation of the different actions in the upstream watershed. However, this organization was only created on paper, and in practice it had never functioned. The first reason for its failure was that it was not born as a local requirement, especially of Hio peasants. The second reason was that it was created as a parallel organization to the San Pedro sub central disregarding the power of this traditional organization.

Previously explained actions did not consider water and its social dimension as part of the 'watershed approach' of the San Pedro irrigation project. The 'watershed approach' of the San Pedro irrigation project only analyzed the water management at irrigation system level, forgetting the current and future water use requirements of all the different stakeholders in the watershed. Consequently, there is unclarity about water rights at watershed level, specifically about water rights of the dam. This situation is a time bomb that will explode with

the conclusion of the construction of the dam because Hio peasants do not believe there is an equitable access to water at watershed level.

For all the explained situations, with the current 'watershed approach' it was not possible to achieve an articulation between the upstream water management and the downstream water management because this approach did not consider a crucial factor: water rights at watershed level. Thus, supposing that the upstream watershed is only the area where the water is born and the downstream watershed is the area where water is used, is a conceptual confusion. As the Hio case study shows the water is claim for use in the entire watershed.

Recapitulating, with the current 'watershed approach' of the San Pedro irrigation project it was not possible to achieve an articulation between upstream water management and downstream water management, as it is intended by the Vice Minister of Water Resource and Irrigation, due to the following factors: 1. The idea that the upstream watershed is the area where water is born and the downstream watershed is the area where the water is used is a conceptual mistake because water is used in the whole watershed 2. The 'watershed approach' did not consider the articulation between the different water users and uses in the watershed, which is strongly related with water rights 3. The 'watershed approach' is interpreted by engineers as mainly technical activities in the watershed due to a conceptual confusion between Watershed Development, Integrated Watershed Management and Integrated Water Resource Management. 4. The 'watershed approach' considers the design of a Watershed Management Plan, scaling up from an irrigation project when the process is backwards because the Watershed Management Plan should consider the irrigation project.

## 7.2 Irrigation projects with a 'watershed approach' in Bolivia: Reflections and recommendations

Based on the conclusions of the Hio case study presented in previous sections, in the following paragraphs I will present the main lessons learned from the 'watershed approach' of the San Pedro irrigation project. It is important to highlight that the following aspects are not a recipe to implement 'irrigation projects with a watershed approach'; they are mainly aspects that should be thoroughly analyzed when intervening in a watershed with an irrigation project in the Bolivian context. In that sense the reflections and recommendations are divided in two sub categories, the first one is related with the political and legal framework, and the second one is related with the design and implementation of irrigation projects with a 'watershed approach'.

### Water related political and legal framework

Since the 90's different international governments, financial institutions and NGO's, such as the International Development Bank or the European Union, are embracing the 'holy trinity' of water governance that is well known as *multi-stakeholders platforms for integrated water resource management* at the *watershed level* as the solution for the different problems associated with water (Delgadillo, Quiroz and Duran, 2012; Warner et al., 2008). Following the tendencies of first world countries, third world governments, like Bolivia in 2006, incorporated into their political framework through the National Watershed Plan (NWP) and the National Development Irrigation Plan (NDIP) all the mentioned concepts. It is not possible to deny that there is a strong influence of the international cooperation for the incorporation of the 'holy trinity' water management approach in the Bolivian development plans. For example, the NWP economic resources came from a basket funding of the governments of: Switzerland, The Netherlands, Denmark and Germany. So, despite all the criticism to the applicability of this new 'holy trinity' of water management (which is not intended to be discussed in this section)

it is interesting how without thinking more about it, without knowing how to implement or even more, without knowing the meaning of this concept, the idea that an irrigation project should have a 'watershed approach' appeared in the Bolivian policy documents and became a policy inside the Vice Minister of Water Resources and Irrigation.

Furthermore, since 2009 the National Irrigation Program with a Watershed Approach (PRONAREC) was created to implement irrigation projects with a watershed approach. But from the 38 irrigations projects that this institution implemented until now, only one (Kuyuj Kocha irrigation project) tried to incorporate 'PRONAREC interpretation of the watershed approach' (Interview with Director PRONAREC). The same situation happens with different NGO's and consultancy firms that attempt to implement their interpretation of the 'watershed approach' when they design an irrigation project. The conceptual unclearness of the 'watershed approach' became a big umbrella that allowed different irrigation projects to claim themselves as 'irrigation projects with a watershed approach', but in the practice they continue designing only irrigation projects. For example, in the Pirhuas irrigation project of PRONAREC the 'watershed approach' is expressed as planting trees in the irrigation area (Interview with PRONAREC engineer).

Referring to the contents of the political framework, specifically the National Watershed Plan (NWP), the conceptual confusion between Integrated Water Resource Management (IWRM) and Integrated Watershed Management (IWM) explained in Chapter 6 should be reconsidered for the implementation of 'irrigation projects with a watershed approach' as it is not possible to omit the social nature of water. In the Hio case study, the 'watershed approach' was based in the "Guide for the formulation of Integrated Watershed Management Projects" of the NWP. This document focuses only on technical aspects to intervene in the watershed, but it is not appropriate because the research results show that not considering the water management at watershed level which is reflected in the water rights, generates conflicts among the different stakeholders in the watershed.

In addition, it is not coherent to formulate a watershed management plan through an irrigation project intervention; instead the irrigation project should be considered as part of the watershed management plan, and not backwards. Therefore, it is required to rethink the current institutional framework of the Vice Ministry of Water Resources and Irrigation, because it presents an institutional breakage. On one hand there is the General Management of Watershed and Water Resources with 'IWM' projects that do not consider irrigation or drinking water or other types of water use, in other words, there is no consideration of the water resource management. On the other hand, there is the General Management of Irrigation attempting to implement irrigation projects with a 'watershed approach' based on the NWP framework. So it is necessary to consider the watershed as a transversal axe to plan and coordinate between the different General Managements of the Vice Ministry of Water Resources and Irrigation.

### **Design and implementation of irrigation projects with a 'watershed approach'**

One of the main constraints identified in the Hio case study is that the 'watershed approach' was a water development approach directly related with the implementation of technical activities in the upstream watershed. However, focusing only on technical aspects to protect the upstream watershed without considering the water management at watershed level did not allow identifying the current and future water use and users. Previous aspects are strictly related with the analysis of water rights at watershed level. Particularly in irrigation projects, to establish water rights at watershed level has a strong relevance because it can prevent future conflicts between upstream and downstream stakeholders about water use and access.

So, at the end, it is crucial that the 'watershed approach' in irrigation projects should take into account water rights at watershed level, an aspect that should be thoroughly considered in the design phase. Moreover, it is necessary to develop further research regarding water rights at watershed level because the current research was done using an adaptation of the water rights conceptual framework at irrigation system level. Within the mentioned conceptual framework this case study identified that two valid mechanisms of accessing water rights (according to the conceptual framework at irrigation system level) enter in competition. Considering the explained aspect, it is necessary to develop a conceptual framework of water rights at watershed level according to the characteristics of the Andean context.

Other important issue which needs reflection is the creation of 'watershed organizations'. The purpose of creating this type of organization, in theory, is to manage the water resources and natural resources in the watershed, considering the different water uses and users (Bueno de Mezquita, 2011). However, in practice these kinds of organizations, as the Hio case study exemplifies, have the objective to support the implementation of conservation measures in the upstream area. So, it is necessary to analyze the appropriateness of creating a watershed organization as part of the 'watershed approach' of irrigation projects.

The first aspect that I will focus on regarding the appropriateness of creating a watershed organization is the definition of the watershed as the 'natural' water management unit (Warner et al., 2008). In Bolivia, the NWP (2006) established the watershed as a 'logical' management unit and this concept is reinforced in the NDIP. However, with the mentioned assumption the watershed is going from a technical tool to a governance unit (Cohen and Davidson, 2011) without considering the limitations that this jump involves. There are two clear constraints of this assumption: the watershed scale is ambiguous and the watershed does not coincide, in all cases, with administrative jurisdictions, social organizations, electoral representations and environmental regulations (Budds and Hinojosa, 2012; Cohen and Davidson, 2011). As a result of these challenges, several researchers proposed other management units such as the hydro-social watershed (Yañez and Poats, 2007; Delgadillo and Duran, 2012), water territories (Boelens, 2008b) or waterscapes (Budds, 2008) among others.

All of the mentioned alternative management units recognize that the social and political limits do not coincide, in all the cases, with the hydrological limits and therefore, there is the necessity of defining a different water management planning unit. However, to define which unit is the most appropriate for the water management planning, requires a thorough analysis of each particular 'problemshed' (Mollinga et al., 2007) situation and it is not possible to establish a single management planning unit which will be replicable in all the cases. A good example of this situation is the Hio case study and the Pucara case study (Cossio and Delgadillo, 2012), both located in Cochabamba. In the case of Hio, the watershed hydrological limits coincide with political, social and administrative boundaries, so in this particular case, the hydrological watershed can be also considered as a governance unit without major constraints. However, the Pucara case study established the hydro-social watershed as the governance unit because it is characterized by a water transfer from two different hydrological watersheds.

As it is noticeable, the establishment of a water management planning unit is linked with the existing organizations and institutions that in different levels have power to influence the water management at watershed level, as water management is inherently political (Mollinga et al., 2007). This is the starting point for the second aspect related with the creation of watershed organizations and the relevance of creating this type of organizations in the Bolivian context.

As mentioned in Chapter 6, the organizational Bolivian context around water management is characterized by the existence of local peasants organizations developed historically around the management of the water sources, a situation which is recognized by the State. Additionally, another relevant characteristic is that municipal governments' possess scarce powers in water management decisions but have the economic power to implement the irrigation projects (Hoogendam and Vargas, 1999; Gutierrez and Arratia, 2009; Duran, 2012). For that reason it is important to consider both mentioned characteristics when proposing the creation of a watershed organization. For example, proposing a multi-stakeholder platform composed mainly by local governments like in the case of the Jubones watershed in Ecuador (Claire, 2012) it might contradict the local organizations socially constructed management rules. Another aspect that should be also taken into account is the 'principles of peasants' organizations' like self-management, social control, collective management, equity, reciprocity, among others (Claire and Gutierrez, 1995; Gandarillas et al, 1995; Gutierrez and Gerbrandy, 1998; Gutierrez, 2005; Arratia and Gutierrez, 2009) which should also be reflected in the watershed organizations.

So, prior the creation of a watershed organization it is crucial to first understand the existing organizational dynamics in the watershed identifying the cooperation and/or conflict relationships and recognizing if there is an existing organization that can assume the water resource management of the watershed. Consequently, it is not necessary in all the cases to create a formal watershed management organization. Furthermore, when scaling up to a higher management scale, such a basin, where the problems will differ from the ones at watershed level, the appropriateness of creating a basin organization should be researched considering the existing organizations/institutions and the problems regarding to that specific context.

For the explained reason it is important that during the design of an irrigation project with a 'watershed approach' a first task is to develop an analysis of water management at watershed level. For this purpose the conceptual framework for the analysis of water management at irrigation level developed in Bolivia can still be valid at watershed level (Duran, 2012). However, further research is necessary to know other aspects which are important to understand the water management in Bolivian watersheds.

As already mentioned, an important finding in the Hio case study is that two valid recognized mechanisms of obtaining water rights (Boelens and Doornboos, 2001), hydraulic property mechanisms and socio territorial mechanisms, enter in competition when we scale up into a watershed level. Therefore, as both upstream and downstream stakeholders have the right to access and use water and considering that water is a limited resource and it is not possible to satisfy all water users' demands, a possible solution mechanism will be the establishment of 'reciprocal water agreements' (Valdez, 2010; RARE, n.d.) between the parties in the watershed. The 'reciprocal water agreements', in the water management case, are mutual support agreements between upstream and downstream stakeholders for equitable benefits based on the principles of the 'peasant water management' in the Andean area. However further research is necessary regarding this new emerging concept and the results obtained in the local context.

## 8 REFERENCES

Alurralde, J. C. (2002). *Local water management in the Andes with emphasis in Bolivia*. Comisión para la Gestión Integral del Agua en Bolivia (CGIAB). La Paz, Bolivia.

Arratia, M. and Gutiérrez, Z. (2002). *Gestión de riego y relaciones de producción afectadas por la presencia de migrantes y el mercado: Usuarios delegados y propietarios, Tensiones en la organización del riego*. Investigación Aplicada PRONAR, Cochabamba, Bolivia.

Arratia, M. and Gutierrez, Z. (2009). *Derechos colectivos de agua y relaciones de genero en escenarios de diversidad cultural: pautas para la intervención*. PROAGRO - GTZ, Bolivia

Beccar, L., Boelens, R. and Hoogendam, P. (2002). *Water rights and collective action in community irrigation*. In Boelens, R. y Hoogendam, P. (eds.) *Water Rights and Empowerment*, Van Gorcum, The Netherlands, pp. 1 – 21

Boelens, R. (2008a). *Water rights arenas in the Andes: Upscaling Networks to Strengthen Local Water Control*. *Water Alternatives*, vol.1, no.1, pp. 48-65.

Boelens, R. (2008b). *The Rules of Game and the Game of the Rules*. Normalization and resistance in Andean water control. PhD thesis, Wageningen UR, The Netherlands.

Boelens, R. and Doornbos, B. (2001) *The Battlefield of Water Rights: Rule Making Amidst Conflicting Normative Frameworks in the Ecuadorian Highlands*, *Human Organization* 60 (4) Society for Applied Anthropology.

Boelens, R., Dourojeanni A., Durán A. and Hoogendam P. (2002). *Water Rights and Watersheds*. In Boelens, R. y Hoogendam, P. (eds.) *Water Rights and Empowerment*, Van Gorcum, The Netherlands, pp. 110 – 143

Boelens, R., Dourojeanni, A. and Hoogendam, P. (2005). *Improving water allocation for user communities and platforms in the Andes*. In Bruns, B., Ringler, C. and Meinzen-Dick, R. (eds.) *Water rights reform: lessons for institutional design*. International Food Policy research institute. Washington D.C., pp. 183 – 215

Boelens, R., Getches, D. and Guevara-Gil, A. (2010). *Water struggles and the politics of identity*. In Boelens, R., Getches, D. and Guevara-Gil, A. (eds.) *Out of the Mainstream: Water rights, Policy and Identity*. Earthscan, USA, pp. 3 – 17

Budds, J. (2008). *Whose scarcity? The hydrosocial cycle and the changing waterscape of La Ligua river basin, Chile*. In Goodman, M., Boykoff, M. and Evered, K. (eds) *Contentious geographies: Environment, meaning, scale*. Ashgate, United Kingdom, pp. 59-68.

Budds, J. and Hinojosa, L. (2012). *Restructuring and rescaling water governance in mining contexts: The co-production of waterscapes in Peru*. *Water Alternatives* 5(1), pp. 119 – 137

Bueno de Mezquita, M. (2011). *Documento orientador, de consulta y guía para el trabajo del VRHyR de promoción e implementación de Organismos de Gestión de Cuencas (OGC)*. Viceministerio de Recursos Hídricos y Riego. La Paz, Bolivia.

Bustamante, R. (2002). *Legislación del Agua en Bolivia*. In Indigenous Water Rights, Local Water Management and National Legislation. WALIR Studies Vol 2. IWE, CEPAL, pp. 182-263

Claire, P. (2012). *Estrategias locales para la gestión del agua en cuencas andinas, estudio de las experiencias GIRH en el Ecuador*. Internship report, Wageningen UR, The Netherlands.

Claire, W. and Gutiérrez, Z. (1995). *El proceso social en la definición de la distribución del agua de la represa de Titora Khocha en la zona de riego de Punata*. Universidad Agraria de Wageningen, Holanda.

Cohen, A. and Davidson, S. (2011). *An examination of the watershed approach: Challenges, antecedents, and the transition from technical tool to governance unit*. Water Alternatives 4(1), pp. 1 – 14

Cossio, V. and Delgadillo, O. (2012). In Quiroz, F., Delgadillo, O. and Durán, A. (eds.) *Aguas arriba, aguas abajo. Luces y sombras de la Gestión Integral de los Recursos Hídricos: Reflexiones desde la investigación aplicada*. Centro Andino para la Gestión y uso del Agua. Plural. Bolivia, pp. 137 – 184

Criales, L. et al (2002). *La cultura local chapaca en la organización del riego, estudios de caso en los valles de Tarija*. Investigación Aplicada PRONAR. Cochabamba, Bolivia.

Delgadillo, O. and Duran, A. (2012). *La cuenca Hidrosocial: Una aproximación conceptual y metodológica para la gestión del agua en cuencas*. In Quiroz, F., Delgadillo, O. and Durán, A. (eds.) *Aguas arriba, aguas abajo. Luces y sombras de la Gestión Integral de los Recursos Hídricos: Reflexiones desde la investigación aplicada*. Centro Andino para la Gestión y uso del Agua. Plural. Bolivia, pp. 81-136

Delgadillo, O., Quiroz, F. and Duran, A. (2012). *Introducción*. In Quiroz, F., Delgadillo, O. and Durán, A. (eds.) *Aguas arriba, aguas abajo. Luces y sombras de la Gestión Integral de los Recursos Hídricos: Reflexiones desde la investigación aplicada*. Centro Andino para la Gestión y uso del Agua. Plural. Bolivia, pp. 13 – 28

Dourojeanni, A. (2009). *Análisis de factores críticos asociados a la creación de organismos de recursos hídricos por cuenca en América Latina y el Caribe*. Elaborado para el primer encuentro de organismos de cuencas hidrográficas de América latina y el Caribe. Brasil.

Dourojeanni, A., Jouravlev A. and Chávez, R. (2002). *Gestión del agua a nivel de cuencas: teoría y práctica*. CEPAL - SERIE Recursos Naturales e Infraestructura. Chile. Available at: <http://www.eclac.org/dрни/publicaciones/xml/5/11195/lcl1777-p-e.pdf>

Duran, A. (2012). *Hacia una estrategia para la GIRH en Bolivia: Lecciones aprendidas*. In Quiroz, F., Delgadillo, O. and Durán, A. (eds.) *Aguas arriba, aguas abajo. Luces y sombras de la*

Gestión Integral de los Recursos Hídricos: Reflexiones desde la investigación aplicada. Centro Andino para la Gestión y uso del Agua. Plural. Bolivia, pp. 445 – 464

Feagin, J., Orum, A., and Sjoberg, G. (1991). *A case for case study*. Chapel Hill, NC: University of North Carolina Press

Gandarillas, H. et al (1992). *Dios da el agua qué hacen los proyectos? Manejo de agua y organización campesina*. Hisbol/PRIV, Cochabamba, Bolivia.

Gerbrandy, G. y Hoogendam, P. (1998). *Aguas y Acequias. Los derechos al agua y la gestión campesina del riego en los Andes Bolivianos*. CID Bolivia.

Gerbrandy, G. y Hoogendam, P. (2002). *Materialising rights: hydraulic property in the extension and rehabilitation of two irrigation systems in Bolivia*. In Boelens, R. y Hoogendam, P. (eds.) *Water Rights and Empowerment*, Van Gorcum, The Netherlands, pp. 36 – 51

Griffin, C. (1999). *Watershed councils: An emerging form of public participation in natural resource management*. *Journal of the American Water Resources Association* 35(3), pp. 505-518

Gutierrez, Z (2005). *Appropriate designs and appropriating irrigation systems : irrigation infrastructure development and users' management capability in Bolivia*. PhD thesis, Wageningen UR, The Netherlands.

Gutiérrez, Z. (2010). *Estudio y propuesta de incorporación del enfoque de equidad de género en la implementación y desarrollo de la GIRH y MIC en el Plan Nacional de Cuencas-PNC*. Ministerio de Medio Ambiente y Agua, Bolivia.

Gutiérrez, Z. and Cardona, S. (1998). *Etnicidad, género y riego. Hacer chacra: la colectividad en el riego orureño*. Proyecto Microriego Oruro PMO. Oruro, Bolivia.

Gutiérrez, Z. and Gerbrandy, G. (1998). *Distribución de agua, organización social y equidad en el pensamiento andino*. In Boelens, R. y Dávila, G. (eds.) *Buscando la Equidad. Concepciones sobre justicia y equidad en el riego campesino*. Van Gorcum, Assen, Los Países Bajos.

GWP (Global Water Partnership) Technical Advisory Committee (TAC), (2000). *Integrated Water Resource Management*. TAC Background Paper No.4, Stockholm: GWP. Available at: <http://www.gwpforum.org/servlet/PSP?iNodeID=215&itemId=24>).

Hendriks, J. (2010). *Water laws, Collective Rights and System Diversity in the Andean Countries*. In Boelens, R., Getches, D. and Guevara-Gil, A. (eds.) *Out of the Mainstream: Water rights, Policy and Identity*. Earthscan, USA, pp. 165 – 182

Hoogendam, P. and Vargas, G. (1999). *La compleja relación entre municipalización, gobernabilidad y la gestión de agua*. In Hoogendam, P. (Ed.) *Aguas y municipios*. Plural, La Paz, pp. 21-36

Lixian, W. (2002). *Theory and practices of watershed management in China*. In Yoren, J. (ed.) Sustainable utilization of global soil and water resources. Proceedings of 12th International Soil Conservation Organization Conference, 26–31 May 2002, Beijing, China, Vol. IV, pp. 357–61

Long, N. (2004). *Actors, Interfaces and Development Intervention: Meanings, purposes and Powers*. In Kontinen, T. (ed): Development Intervention: Actors and Activity Perspectives; University of Helsinki, pp. 14-36.

Machicado, J. (2010). *Sindicalismo y el Sindicato en Bolivia*. Universidad de San Francisco Xavier. Bolivia.

Medema, W. and Jeffrey, P. (2005). *IWRM and Adaptive Management Synergy or Conflict?*. Available in: [http://www.usf.uos.de/projects/newater/Deliverables/2005/NeWater%20deliverables%201st%20reporting%20period/docs/Deliverable%201.1.1\\_final.pdf](http://www.usf.uos.de/projects/newater/Deliverables/2005/NeWater%20deliverables%201st%20reporting%20period/docs/Deliverable%201.1.1_final.pdf).

Mendez, R. and Bueno de Mezquita, M. (2011). *Fomento a la integralidad de las inversiones realizadas en el marco del Plan Nacional de Cuencas*. Viceministerio de Recursos Hídricos y Riego. Bolivia.

Ministerio de Planificación del Desarrollo (2006). *National Development Plan (Plan Nacional de Desarrollo Bolivia digna, soberana, productiva y democrática para vivir bien)*. Bolivia

Ministerio del Agua, Viceministerio de Recursos Hídricos y Cuencas (2006). *National Watershed Plan (Plan Nacional de Cuencas, Marco Conceptual y Estratégico. Versión 01)*. La Paz, Bolivia

Ministerio del Agua, Viceministerio de Riego, Servicio Nacional de Riego (2007). *National Development Irrigation Plan (Plan Nacional de Desarrollo del Riego “para vivir bien”)*. Bolivia

Molle, F. (2006). *Planning and Managing Water Resources at the River-Basin Level: Emergence and Evolution of a Concept*. Comprehensive Assessment Research Report 16 (Colombo: International Water Management Institute) Available at [http://www.iwmi.cgiar.org/Assessment/files\\_new/publications/CA%20Research%20Reports/CARR16.pdf](http://www.iwmi.cgiar.org/Assessment/files_new/publications/CA%20Research%20Reports/CARR16.pdf)

Molle, F. (2009). *River-basin planning and management: The social life of a concept*. Geoforum, 40(3), pp. 484 – 494

Mollinga, P.; Meinzen-Dick, R. and Merrey, D. (2007). *Politics, plurality and problemsheds: A strategic approach for reform of agricultural water resources management*. Development Policy Review 25(6), pp. 699-719.

Montaño, H., Veizaga, M. and Ramos, R. (2010). *Acciones en Gestión Integral de Recursos Hídricos (GIRH) y Manejo Integral de Cuencas (MIC)*. In Experiencias de la Cooperación Alemana en el Manejo Integral de Cuencas y la Gestión Integral de los Recursos Hidricos en Bolivia. Bolivia.

Oblitas, A. et al (2001). *Detrás del agua, la gente. El entorno mayor de la gestión del agua y pautas metodológicas para su análisis, los casos del chaco tarijeño*. Investigación Aplicada PRONAR. Cochabamba, Bolivia.

Quiruchi, S. (2010). *Colocando semillas en las microcuencas de Aiquile*. In Experiencias de la Cooperación Alemana en el Manejo Integral de Cuencas y la Gestión Integral de los Recursos Hídricos en Bolivia. Bolivia.

RARE (n.d.). Water for life. Available in <http://www.rareconservation.org/>

Salm, H. (2010). *Antecedentes de la Cooperación Alemana en el Manejo Integral de Cuencas en Bolivia*. In Experiencias de la Cooperación Alemana en el Manejo Integral de Cuencas y la Gestión Integral de los Recursos Hídricos en Bolivia. Bolivia.

SCS-Gandarillas (2007). *Executive Summary Final Design San Pedro Irrigation Project*. Cochabamba, Bolivia.

Shah, T., Makin, I. and Sakthivadivel, R. (2005). *Limits to Leapfrogging: Issues in Transposing Successful River Basin Management Institutions in the Developing World*. In Svendsen, M. (ed.) *Irrigation and River Basin Management: Options for Governance and Institutions*. Wallingford: CABI Publishing and Colombo: International Water Management Institute.

Tefera, B. and Stroosnijder, L. (2007). *Integrated watershed management: a planning methodology for construction of new dams in Ethiopia*. *Lakes and Reservoirs: Research and Management* 12, pp. 247 – 259

Tellis W.(1997) *Application of a case study methodology*. The Qualitative Report 1997; 3(3). Available at <http://www.nova.edu/ssss/QR/QR3-3/tellis2.html>.

Treffner, J., Mioc, V. and Wegerich, K. (2010). *A-Z Glossary*. In Wegerich, K. and Warner, J. (eds.) *The Politics of Water*. First edition. Routledge. United Kingdom, pp. 215-320

Valdez, R. (2010). *Miel y alambre por agua*. Naturalia 1. Fundación Natura Bolivia. Bolivia.

Walker, P. (2005). *Political ecology: where is the ecology?*. *Progress in Human Geography* 29, 1, pp. 73 – 82

Warner, J., Wester, P. and Bolding, A., (2008). *Going with the flow: River basins as natural units for water management? Water Policy*, 10 (Supplement 2), pp. 121 – 138.

Yañez, N. and Poats, S. (2007). *Derechos de Agua y Gestión Ciudadana. Proyecto Visión Social del Agua en Los Andes*. Agua Sustentable. La Paz, Bolivia: IDRC. Disponible en: [www.aguasustentable.org](http://www.aguasustentable.org).

Yin, R.K (1984). *Case study research: Design and methods*. Applied Social Research. Methods Series Vol. 5. Sage Publications, Thousands Oaks.