COMMUNITY-BASED WATER RESOURCES MANAGEMENT FOR LIVELIHOOD IMPROVEMENT AND POVERTY REDUCTION A CASE STUDY OF LAO NYA VILLAGE, PATHOUMPHONE DISTRICT, CHAMPASAK PROVINCE, LAO PDR

NOUTTHONG ALOUNTHONG

MASTER OF SCIENCE

PROGRAM IN NATURAL RESOURCES AND ENVIRONMENTAL MANAGEMENT

MAE FAH LUANG UNIVERSITY

2009

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2009

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ABSTRACT

Water is one of the most fundamental components of socioeconomic development in any society. In the agricultural-based society of Laos, including Lao Nya village, water plays a critical role in livelihood improvement and reduction of poverty. This research focuses on water issues related to both direct consumption of drinking water and also its use in supporting agricultural production for self-sufficiency and for profits from crop sales. The analyis is concerned with people living in the buffer zone of a protected area (a very sensitive upstream landscape). Their livelihood and well-being always have a causal relationship with the quality and quantity of water, as well as with biodiversity in these protected areas. Ensuring sustainable livelihood and the well-being of these people is both critical and necessary.

This research analyzed the livelihood options and poverty conditions of the residents at Lao Nya village. The demand, supply and management regimes for water as well as local practices were assessed. The principal aim of this research was to address the following three questions: (1) How can water be better managed throughout the participatory processes encompassed in the community-based approach? (2) How can local initiatives on water management contribute to livelihood improvement and poverty reduction for local village residents? (3) What appropriate water management practices can be integrated based on existing conditions? Social equity and water governance between upstream and downstream communities are also taken into consideration in order to ensure the sustainability of the whole watershed.

The main findings of the research include the fact that a local initiative on water management (construction of a dam, fishpond and water diversion canal) has increased rice production by 60 tons per year and adds some 30 hectares of paddy land (61% of 48.96 hectares) of total that is cultivatable in the dry season. In addition, three more hectares of cash crop land was made available for cultivation by this irrigation, while water quantity and quality increased and improved, respectively. In addition, new integration of water management strategies include a community fishpond, combined rice-fish production in paddy fields, river bank cropping practices and promotion of hygiene awareness among villagers. Benefit sharing from the water initiative within Lao Nya and another village downstream (Na Bon) is being managed through negotiation and cooperation among these village committees. Water governance covers watershed protection, water sharing, and operation of existing water facilities, namely a dam, a canal and water wells.

Keywords: Lao PDR / water resources / livelihood / poverty reduction / community-based water management / water governance / social equity

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LIST OF ABBREVIATIONS

ADB	Asian Development Bank
BCI	Biodiversity Corridors Conservation Initiative
CBR	Community-based Approach
CEP	Core Environment Program
CWRM	Community-base Water Resources Management
GAPE	Global for People and Environment
GMS	Greater Mekong Sub-region
HHs	Households
IUCN	International Union for the Conservation of Nature
IWRM	Integrated Water Resources Management
KI	Key Informants
LEP	Law on Environmental Protection
LNMC	Lao National Mekong Committee
LWWR	Law on Water and Water Resources
MAF	Ministry of Agriculture and Forestry
MCM	Million Cubic Meter
MEM	Ministry of Energy and Mine
MRB	Mekong River Basin
MRC	Mekong River Commission
MPH	Ministry of Public Health
MPWT	Ministry of Public Works and Transport
MTT	Ministry of Trade and Tourism

LIST OF ABBREVIATIONS (continued)

NGOs	Non-Government Organizations
NTFPs	Non-timber Forest Products
NWRP	National Water Resources Profile
ODI	Oversea Development Institute
PDR	People Democratic Republic
PEP	Poverty-Environment Partnership
PHAST	Participatory Hygiene and Sanitation Transformation
PM	Prime Minister
PRA	Participatory Rural Appraisal
PRF	Poverty Reduction Fund
RECOFTC	Regional Community Forestry Training Center for Asia and the Pacific
RRA	Rapid Rural Appraisal
SARAR	Self-esteem, Associative strengths, Resourcefulness, Action-planning and Responsibility
SL	Sustainable Livelihoods
SNV	Netherlands Development Organization
SUFORD	Sustainable Forest and Rural Development
SWELL	Securing Water to Enhance Local Livelihoods
TA	Technical Assistance
TST	Ten Seed Techniques
UN	Unites Nations
UNESCO	United Nations Educational; Scientific and Cultural Organization
UNHCR	United Nations High Commissioner for Refugees

LIST OF ABBREVIATIONS (continued)

UNICEF	United Nations International Children's Emergency Fund
1 US	8,474 kip (the official rate of exchange February 17, 2010)
WEDC	Water, Engineering and Development Centre
WRCC	Water Resources Coordinating Committee
WREA	Water Resources and Environment Administration
WWDR	World Water Development Report
WWF	World Wildlife Fund
WHO	World Health Organization
WELL	Resource Centre Network in Water, Sanitation and Environmental Health

CHAPTER 1

INTRODUCTION

1.1 Background

Lao PDR (Lao People Democratic Republic) possesses great wealth in terms of its water resources. The country's northern region captures approximately 1,300 mm of rainfall per annum while the southern region captures even more, some 3,000 to 3,700 mm yearly. The watersheds within Lao PDR contribute around 35% of the Mekong River's total flow. These watersheds form 26% of the Mekong Basin's total watershed area. About 80% of the water flows during the rainy season (from May to October) and the remaining 20% during the dry season (from November to April (Lao PDR: State of Environment 2001).

The mean annual discharge of the Mekong is approximately 475 cubic kilometers (km^3). Of this amount, about 16 percent comes from China and only 2 percent from Myanmar. In comparison with other countries amongst Mekong River Basin, Lao has the longest and the highest catchment area and water flow, as shown in Table 1.1

Almost 90% of the total basin area lies inside Laos, Thailand, China's Yunnan province and Cambodia, whereas Vietnam and Myanmar share 8% and 3% of the basin area respectively. However, due to regional variations in rainfall and hydrological characteristics, the contribution of flow (runoff) is not shared proportionally within the basin area. The 25% of the basin area lying inside Laos produces 35% of annual runoff; in contrast, and 23% of the basin area inside Thailand contributes only 18% while 21% by area in Yunnan province contributes only 16% of the annual runoff. Runoff contribution from the remaining portions of the basin is more or less proportional to their share of the basin area.

Table 1.1 Territory of the six Mekong River Basin countries within the catchments*

Country	Area(km^2)	Catchments as % of MRB	Flow as % of MRB	Average flow(m^3/sec) **
Cambodia	155,000	20	18	2,860
China	165,000	21	16	2,410
Laos	202,000	25	35	5,270
Myanmar	24,000	3	2	300
Thailand	184,000	23	18	2,560
Vietnam	65,000	8	11	1,660
Total MRB	**795,000**	**100**	**100**	**15,060**

Source: * Overview of the Hydrology of the Mekong Basin, MRC, 2005, * * State of the Basin Report, MRC, 2003

Although the overall Mekong riparian area generally enjoys abundant water resources, water availability (that is, annual internally renewable water resources) varies widely by country, by region within countries, and by season. Water availability in Laos and Cambodia depends virtually entirely on the Mekong. In Thailand and Vietnam, large regions are fully dependent on the Mekong River Basin resources. The Mekong is a major water source in Yunnan Province, China. Only Myanmar is not that dependent on Mekong waters.

On a per capita basis, Laos has the region's largest internally renewable water resources at 55,305 m3/yr, whereas Thailand has the lowest per capita resources availability among the riparian countries in the lower basin, at 3,559 m3/yr, as indicated in Table 1.2.

Table 1.2 Water resources availability and withdrawal in Mekong Basin States, 1995 (Ringler, 2001)

Country	Availability		Withdrawals		Withdrawals share of availability
	(km3 /yr)	(m3 /cap/yr)	(km3 /yr)	(m3 /cap/yr)	%
Cambodia	88	8,585	1	98	1
China	2,812	2,292	500	407	18
Laos	270	55,305	1	205	<1
Myanmar	606	13,024	4	86	<12
Thailand	210	3,559	33	559	16
Vietnam	318	4,479	65	915	20

According to the National Water Resources Profile, 2008, key data for Lao PDR are:

- Average annual rainfall is 1,935 mm or 462 km^3
- Average runoff is 1,055 mm or 250 km^3
- Average river inflow to the country is 73 km^3 from China (Mekong) and 9.5 km^3 from Myanmar (Mekong). The total national annual surface water supply (national runoff plus flow from other countries) is therefore 332.5 km^3.
- Average river outflow to other countries is 18 km^3 to Vietnam (from outside of the Mekong River Basin), 1,330 mm or 29 km^3 to Cambodia in the Sekong River, and 600 mm or 330 km^3 to Cambodia in the Mekong river.

Since the country's population is approximately 6 million, total available surface water resources of 332.5 km^3 is equivalent to more than 55,000 m^3 on annual per capita basis. In comparison to other Asian countries, Lao PDR has the highest per capita water supply (see more detail in Table 1.2). However, to date little of the national available water supply has been developed. Total storage capacity of the large reservoirs is 7,000 MCM or (7km3) which is equivalent to only 2.8 % of annual water supply.

Water quality throughout the country as well as in the Mekong River has generally varied between “very good” and “good”, although there are concerns about the impacts of future hydropower, mining and other development efforts. Laos has in place drinking water quality standards based on WHO standards and has finally approved Lao National Environmental Standards, both ambient and emission standards, which went into affect as of January 14, 2010.

Water quality issues may be very important at a local level where they apply to small streams and other water bodies. These local issues may have a large impact on the safe water supply for human consumption and other uses, fisheries and other aspects of the environment. The most effective way to identify and deal with these local water quality problems may be through watershed planning and management.

The major policy and legislation on water quality is the Law on Environmental Protection (LEP) (adopted 3 April 1999) and related legislation. Water and Water Resources (adopted in 1996) determines principles, rules and measures relative to the administration, exploitation, use and development of water and water resources. The Ministry of Health in conjunction with WHO and UNICEF has developed drinking water quality guidelines. The Decision on the Management of Quality Standards for Drinking Water and Household Water Supply (2005) defines standards for drinking and household water supply, including bacteriological, physical-chemical (aesthetic), and health-significant chemical parameters (Souphasay, K, 2008). As noted above, WREA has just introduced comprehensive Lao Environmental Standards which cover all water quality parameters.

1.2 Water policy, regulation and management practices

The Law on Water and Water Resources (LWWR) was passed in 1996 and its implementation decree was enacted in October 2001 (Prime Minister Decree No. 204/PM). The law and implementing decree have introduced some aspects of Integrated Water Resources Management (IWRM), including ownership of specified water resources, national and river basin planning, monitoring and assessment of water resources, water resource allocation according to an integrated river basin plan, specialized funding mechanisms, public consultation requirements and watershed protection (NWRP, 2008). Implementation of the LWWR, however, remains quite limited. Poor

implementation is the result, in part, of the incomplete policies and inadequate secondary legislation as well as gaps and areas of the law that remain unclear.

One of the LWWR's weaknesses is its delegation of water resources policy and regulatory functions to water development ministries whose water development and service delivery roles conflict with the LWWR's fundamental conception. The "decentralized" implementation approach relies on a "coordination" role for the Water Resources Coordination Committee and the Lao National Mekong Committee. This was, in the past, unrealistic given their small size and limited capacity as well as the lack of clarity on these agencies' respective roles.

Provincial water resources management faces problems of poor information and limited capacity on IWRM. Provincial departments are organized in parallel with, and are linked to, national ministries. Up to the present no clear water resources management organization (agency) has existed at the provincial level.

The LWWR established the responsibilities of different ministries, agencies, and local authorities with regard to the management, exploitation, development and sustainable use of water and water resources. According to the implementing decree the relevant Ministries and Agencies need to coordinate with the Local Authorities on detailed determination of responsibilities and scope of activities within their sectors in order to avoid conflicts and to achieve the maximum benefit from water development and use (NWRP, 2008)

According to the Prime Minister Decree No. 204/PM, October9th, 2001 on implementing of LWWR, the responsibilities of different Ministries, Agencies, and Local Authorities with regards to the management are as below:

1. MAF is responsible for the management, exploitation, development and use of water and water resources in the field of agriculture, for the survey and control of flooding in agricultural areas, for survey and collection of meteorological and hydrological data of the Mekong, its tributaries, and other rivers outside the Mekong Basin and for preparing, updating and disseminating the inventory of water resources and river basin.

2. MPWT is responsible for management, exploitation, development and use of water and water resources in the field of communication, transportation, town water supply, urban drainage,

protection of river banks, prevention and control of flooding, and for collection of hydrological data and hydrographical for navigation.

3. MEM is responsible for the management, exploitation, development and use of water and water resources in the field of electricity and mining

4. MPH is responsible for the management, exploitation, development and use of water for the rural domestic consumption, and health care

5. MTT is responsible for the management, exploitation, development and use of water and water resources in the field of tourism

6. WREA is responsible for ensuring coordination between different line agencies in establishing rules and regulations pertaining to the management of environment, and to research scientific, and technological services related to water and water resources.

7. LNMC is responsible for coordinating different line Agencies and carry out studies, and implement policies, strategies plans and programs of Mekong development projects. It is also responsible for drafting laws and regulations.

8. WRCC is responsible for coordinating line agencies in drafting strategies and action plans, programs, and regulations. It is also responsible for monitoring, controlling, promoting, and reporting on the implementation activities related to water and water resources.

The above-mentioned Ministries and agencies shall coordinate with the Local Authorities on the detailed determination of responsibilities and scope of activities within their sectors.

The concerns regarding coordination between water-related agencies at the national level are reflected in microcosm at the local level throughout the country. Provinces, districts and villages play important roles in the national water planning process. Provincial planning departments, in particular, are responsible for coordinating development plans that are forwarded to them from the village and district levels.

In spite of ongoing attention towards health, hygiene, and improved rural water supply and sanitation services, health and its relationship to safe drinking water and sanitation remains a pressing social issue for Laos. Access to health care services is often limited in rural areas. Government ability to fund and coordinate the necessary investment and the ability of users to pay for services are both severely limited.

1.3 Rationale / Problem Statement

Water is a fundamental resource that is of paramount importance as a necessity for human well being to foster socio-economic development of any society. Unfortunately there is a serious decline worldwide in available water quantity and a decrease in water quality caused by human activities. It is therefore necessary to manage water resources in a sustainable manner in order to ensure the availability and wise use of this vital resource.

During the Water and Poverty Initiative in the 3rd World Water Forum in Kyoto, Japan, 16-23 March 2003, water was recognized as the key natural resource. Tadao Chino, President of the Asian Development Bank, quoted that "[The World Summit on Sustainable Development in] Johannesburg defined the challenge against which all development activities must be judged—how the actions we take contribute to the reduction of poverty." "Our common goal is to improve the water security of the poor." Ayako Sono, Chairperson of the Nippon Foundation, stated that "[The] wealth of the twentieth century may have been land and gold, but in the 21st century, wealth will probably be expressed by the amount of water available for utilization."

Those above-mentioned quotes clearly define the importance of water to human society. For an agricultural-based society like Lao PDR, water is one of a critical productive input for agricultural practices. Water is the blood and life of the Lao (all) people. Water is the key attribute for socio-economic well-being improvement and poverty reduction in this country.

In Lao PDR's rural areas, water-related problems generally reflect a dependency on rainfall as the needed agricultural input, since irrigation systems are lacking. As a result, farmers have less agricultural production during the dry months. Besides water for production, water for domestic use is constrained due to lack of safe water sources. And lacks of water storage as well as inadequate awareness of hygiene practices have negative impacts to the local people.

Lao Nya is one of three ADB-MFU survey villages, in the ADB funded project on Biodiversity Corridors Conservation Initiative (BCI)[1]. This Village was selected as a research site because its physical conditions are different from those of the other two villages in the survey. Paddy land in Lao Nya cannot be used during the dry season, while other villages nearby like Nam Om can do so. Furthermore safe and clean drinking water is also limited. At the same time poverty incidence is high -- up to 88% -- and the villagers rely more on forest resources for their livelihood options and income generation.

Lao Nya is one of the villages located in the corridor areas of two national protected areas called Donghuasao and Xepian, in Pathoumphone District, Champasak Province, Lao PDR, the poverty reduction and the livelihood improvements of the villagers are therefore very important. When villagers have more sustainable livelihood options, especially sustainable agricultural practices that need water as a main productive input, then villagers have enough rice to consume year round. Adequate water allows villagers to generate additional income from other agricultural productions, for example, cash crop diversifications, aquatic resources raising, etc. at the same time food security and well-being of the local people will be improved and the dependencies on forest resources can be reduced. Then they will have positive consequences to the broader context of Biodiversity Conservation.

So far, there are many projects in which both government agencies and NGOs are active in this area. These include Poverty Reduction Fund (PRF), Sustainable Forest and Rural Development (SUFORD), and GAPE (Global for People and Environment). One more is the Biodiversity Corridors Conservation Initiative (BCI) whose implementing agencies are the International Union for the Conservation of Nature and Natural Resources (IUCN) and the World Wildlife Fund (WWF).

According to BCI Pilot site Implementation Status Report (2007), its vision is to "establish priority conservation landscapes and corridor for maintaining the quality of ecosystems, ensuring sustainable used of shared natural resources and improving the livelihoods of the people". Moreover, the BCI aims to succeed in "maintaining and improving the cover, condition and biodiversity of forestlands and associated ecosystem in priority biodiversity conservation landscapes and corridors"

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[1] GMS Core Environment Program and Biodiversity Corridor Initiative, (CEP-BCI ADB TA 6289)

The BCI project has five interrelated components[2] or building blocks. These five components can be understood in the way they carry forward the objectives of the project in a logical manner:

a. poverty reduction - *The reason the corridor is a special place*

b. land use management - *The system that makes the corridor work*

c. ecosystem connectivity - *The form of development in the corridor*

d. capacity building – *Improving the capabilities of the people who make it happen*

e. sustainable financing - *How the corridor is kept alive financially*

Increased local poverty impacts the environment through degradation of forests or ecosystems. In order to prevent such negative impacts the poverty of the people who live in and around BCI need to be reduced or eradicated by promoting conservation principles and sustainable use of the natural resources, promoting wise management of the available resources, improving and sustaining of their livelihoods, increasing stable household self-sufficiency as well as increasing stable household income. With an improvement of living standards and livelihood strategies of those people, pressure on forests and other natural resources is expected to decrease.

Water resources represent a paramount factor to livelihood improvement and require priority attention to address poverty reduction in Lao Nya village and other villages within BCI. Since productive water is important to their agricultural practices and for generation of household income, and consumption of water is important to decreasing expenditures and conservation of a finite resource, such resources must be managed in the sustainable way. Inefficient or wasteful management will affect the well-being of the people and result in negative impacts on biodiversity and habitats in the BCI as well. It then will impact the whole ecosystem -- that means the well-being of the society.

In Lao Nya village has three main tributaries, namely Hong Bueng, Hong Nongbon, Hong Tham, which are the main sources of water supply for the villagers' consumption. Connected to these tributaries are four streams -- Huay Lao Nya, Huay Loh, Houay Ban Vang Pa Khao, and Huay To Mo. Besides, the village also has one common 'protected' pond named Vang Tae (its size is 500mx200mx2m deep) and three other small ponds (field survey, May 2008).

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[2] Vision Document for Biodiversity Corridors, ADB-TA 6289-REG Greater Mekong Sub-region Core Environment Program (CEP) and Biodiversity Conservation Corridors Initiative (BCI), Lao PDR: Xe Pian - Dong Hua Sao Biodiversity Corridor, September 2008

The village still lacks basic infrastructure, such as water supply, health care, sanitation, irrigation, and electricity. Because of these conditions, almost all households (up to 99%) consume untreated water directly from surface streams; and there are no toilets at all within the village. The bacteria levels in local surface waters are believed to be responsible for the villagers' many health problems. Diarrhea, in particular, reportedly costs the villagers a considerable portion of their income every year for sickness treatment. Such costs not only affect their livelihood but also lessen their well-being because of sickness and loss of work.

Income of the villagers in Lao Nya is generally derived from several different activities, ranging from agriculture to gathering of non-timber forest products (NTFPs), trading, wage labor, and handicrafts trade.

Farming is the most important source of livelihood and income for the people of this village. Two main types of farming exist in Lao Nya, namely lowland paddy rice cultivation and upland paddy rice growing. A large majority of the households practice lowland paddy rice cultivation. Villagers still generally practice their own traditional farming system and essentially follow the traditional practices of previous generations. Farmers depend highly on natural inputs and do not use any chemical fertilizers or pesticides. As a result, productivity remains rather low and only covers partial food security needs.

Access to and use of most upland areas is restricted by government policies; however, some households still cultivate portions of these lands. These are often individuals from households that have no official land or do not own draught animals. They are left with little choice, and therefore resort to clearing land near the foothills to grow rice, even though productivity remains very low in such cases.

Lowland paddy rice growing can further be split into two main farming types. Villagers practice rainy season paddy land rice growing during the rainy season (from May to October). Agricultural outputs during this period are high as conditions are favorable for rice farming, with high monthly rainfall. In contrast, dry season rice farming is quite difficult as water supply is very limited. Farmers have no irrigation systems and generally only have limited small-scale natural drainage in place to drain excess water during the rainy season for use later when it is more needed. Currently excess water in the rainy season is often lost or unused; such water could potentially be stored to

supply agricultural activity for at least some time during the dry season. Consequently, in comparison to rice cultivation in the rainy season, dry season rice cultivation is far less productive. Despite low production, such dry season rice paddy cultivation is vital for many villagers to meet their annual household consumption needs and generate at least a small income during the drought months.

In order to lessen these problems, many projects have been proposed by both government and non-government agencies, which are seeking ways to solve the area's poverty problems. One of these, the BCI project, proposes to implement some interventions such as improving existing irrigation systems, supporting a piped water supply system using well water, etc. (year 2009).

Since the paddy lands could not be cultivated and cash crops also could not be planted, the villagers had inadequate food security especially during the dry season. Under the leadership of the head of this particular village as well as with support from the government and related NGO projects, a water community-based project was initiated by transferring water from one higher supply stream into a lower one in order to have a more secure water supply for agricultural inputs. Higher production, better well-being, and cleaner/better water quality were expected to be the outcomes from this community initiative. However, together with many advantages from that water conversion there are some points that need to be taken into consideration carefully because this village was located in a watershed area. Social equity and water governance between the upstream and downstream users are therefore issues of concern.

In conclusion, three main problems related to water resources significantly impact the villagers' livelihood, well-being, and income generation:

1. Crop cultivation in the dry season is very limited due to lack of water accessibility, even though water is available within the village.

2. Villagers have no adequate access to clean and safe drinking water. Even the few water-well pipes available within the village are supplementary sources only. Water for daily consumption is partially taken directly from the streams/wells and drunk as raw water without any treatment, such as boiling or filtration.

3. There are no sanitation facilities, especially toilets. The nearby forests and streams are used as defecation places instead of toilets. Thus fecal coliform bacteria are introduced into water

sources. These bacteria cause contamination of water quality and thus result in health impacts to the villagers.

1.4 Hypothesis

The hypothesis for the research is as follows: "**Community-based water management will ensure food security, rice sufficiency, improve the overall quality of life, and reduce poverty.**"

1.5 Research Questions

The main research question is how to manage water resources sustainably at the local rural level in order to contribute to improved livelihood options and poverty reduction. The specific research questions focus on:

1.5.1 What are the patterns of current water utilization within the village -- both quantity and quality?

1.5.2 What new initiatives for community-based water management could be introduced in the village?

1.5.3 What are the expectations of the villagers for water management and how would these affect their livelihood options and poverty reduction? Are these expectations adequate to fulfill the objectives? And how?

1.5.4 Could any other appropriate community-based water management tools be integrated into the new initiatives?

1.6 Research objectives

This research aims to investigate current and improved means for sustainable water resources management at the local level under this particular village's existing conditions. Key research

findings and recommendations contribute to improved livelihood and reduced poverty, while being compatible with the biodiversity conservation context.

The specific research objectives are as below:

1.6.1 To study current water uses, water budgets, and potential water accessibility

1.6.2 To find out suitable and sustainable ways of water management that blend with the villagers' traditional ways of productive and consumptive water uses.

1.6.3 To integrate appropriate techniques and methods from other successful cases -- including rules and regulations that can be empowered at the local level – those are useful and applicable to this particular case.

1.7 Expected Outcome

The expected outcomes of this study are:

1.7.1 Design of an improved small-scale, community-based water management system that will optimize local water demand within carrying capacity of the natural water supply while improving water quality.

1.7.2 A new initiative for a community-based river bank cropping system and community fish pond practices for water resources management that will benefit to both the moderate poor and the very poor socio-economic groups.

1.7.3 Improved community-based water resources management that will improve village earning capacity through better farming opportunities.

1.7.4 Water quality analyses that will be the key indicators and information to come up with the recommendations on water and health safety related to water treatment, rainwater storage, potential cleaner sources or behavior changing, which are expected to lessen the villagers' expenditures on health treatment while improving their well-being.

1.7.5 Lessons learned from Lao Nya will be useful and applicable to the other villages within the Biodiversity Conservation Corridor Initiative (BCI).

1.8 Scope of Study

This study will focus on water budgets and demand and supply within the village for both production (agricultural use) and consumption (domestic use) in both quantity and quality.

The research will cover socio-economic, environmental and technical (management) aspects in order to make sure those findings from this research will be useful not only for Lao Nya Village itself. It will be useful and applicable to the other villages within BCI as well as the villages outside. The main points of the scope are as below:

1.8.1 Water accessibility -- both quantity and quality

1.8.2 Water demand and supply in both dry and rainy seasons

1.8.3 Potential sources in terms of both water quantity and quality

1.8.4 Community-based water management practices that could optimize local demand within the carrying capacity of the natural water supply; and the additional extension of water utilization can come up.

1.8.5 Lessons learned and recommendations that could be applied in other villages within BCI and outside villages

1.9 Conceptual framework

The conceptual framework of this study is to demonstrate the contribution of community-based water resource management to the livelihoods and poverty reduction of the local people. Increasing water quantities will result in more agricultural outputs and lead to more stable income generation, while water quality improvement will benefit them in terms of cleaner water accessibility and that helps them to have better health. This in turn is important to their well-being and can reduce their expenditures for health care. When the local people have rather stable food security from agriculture they will become less dependent on NTFPs. Therefore they will need to go into the forest less often, which in turn will lessen impacts on biodiversity.

Details of the conceptual framework of this study are illustrated in the diagram shown in Figure 1.1 below:

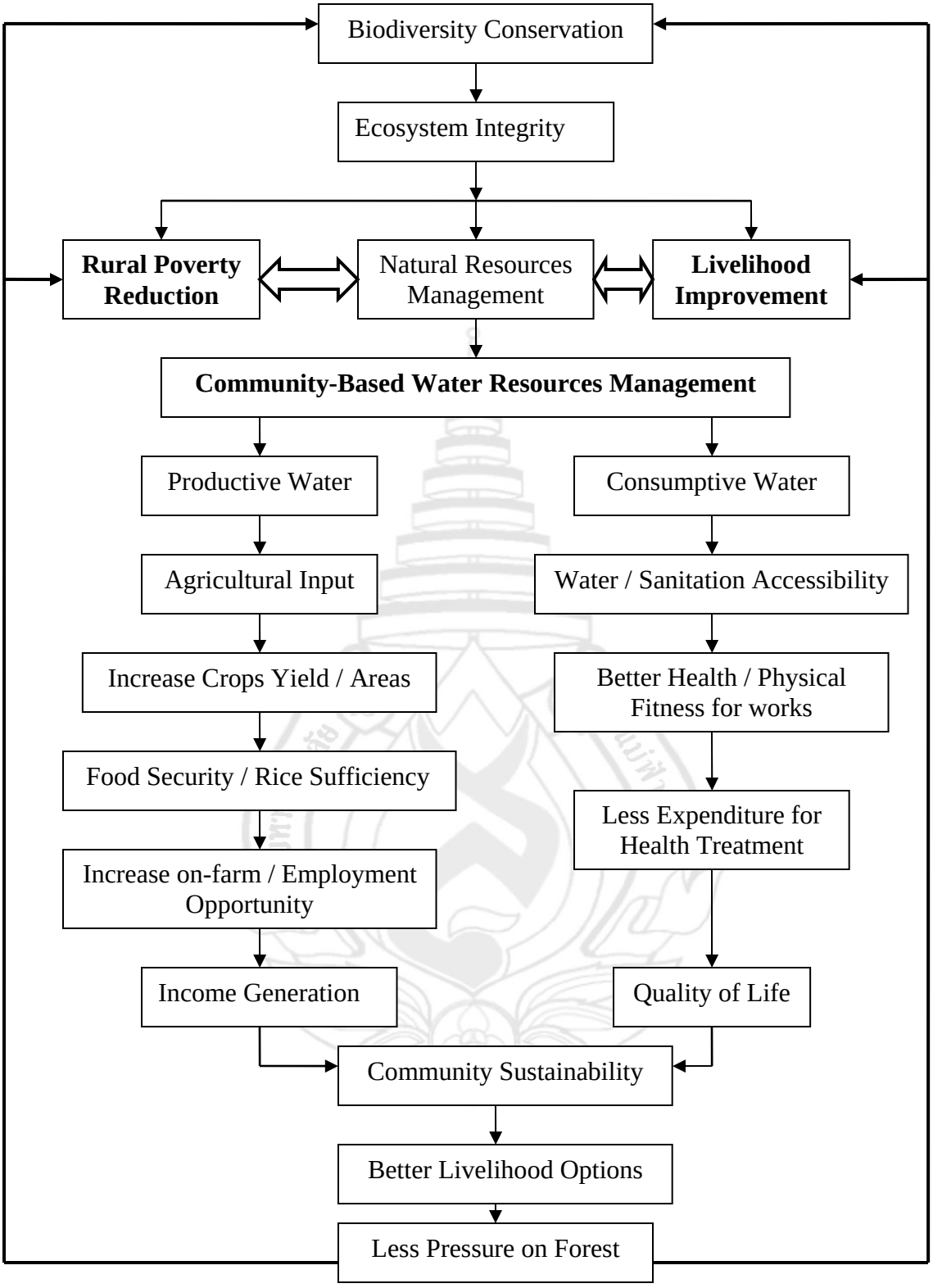

Figure 1.1 Conceptual framework diagram for the research

CHAPTER 2

LITERATURE REVIEW

2.1 Community-based Water Resources Management

Community-based natural resources management (CBNRM) is a broad concept referring to the involvement of beneficiary communities in management of nearby land, water, forest, wildlife, and aquaculture resources. According to the International Water and Sanitation Center (2003), the notion of community involvement in water use was first officially introduced by the international community at the World Water Conference in 1977 (Argentina) for the International Drinking Water Supply and Sanitation Decade in 1980s. More recently, community management and decentralization in water supply (and sanitation) became strengthened and there was increased growth in the 1990s, particularly in developing countries after the Global Consultation on Safe Water in New Delhi (1990), the Dublin Statement on Water and Sustainable Development (1992) and the Earth Submit in Rio de Janeiro (1992). Recently, one of the six "Bonn Keys" from the International Conference on Freshwater in Germany (2001) recognized the importance of community management by stating: "Decentralization is the key. The local level is where national policy meets community needs"

In any form of CBNRM, the core principle is participation of communities in the planning, implementation/operation and maintenance of the water supply systems of which they are the beneficiaries. According the Molle (2005), participation can be conceived as a tool (for better management) or as a process (for empowerment).

Madeleen (1998) identified three key aspects of CBNRM: responsibility, authority and control.

Responsibility: The community takes on the ownership and attendant obligations to manage the water supply system to ensure that its operation and maintenance are successful.

Authority: The community, acting as water user and manager, has the legitimate right to make decisions related to control, operation and maintenance of its water resources and associated water supply system.

Control: The community is able to carry out and determine the outcome of its decisions relating to the water system. This basically refers to the capacity of the community, in terms of technical, labor and financial contributions, and the institutional support that they are able to have in planning, implementation/operation, and sustainability of water supply system.

CBNRM is a process of participation in which the community is at the heart of effective water management. Community participation varies depending on local context and size of the community, national legislation, local institution and capacity building, and technology used. It may range from consumer association and community groups in urban areas to water user groups and irrigation cooperatives in rural areas (Bandara, 2005).

This does not imply that communities have to be responsible for every aspect of the water supply system they use. They may be involved in one, some, or all of the managerial, operational, technical and financial aspects of a water supply system. According to Bruns (1997), the degree of community participation is varied, ranging from merely information sharing for water plans, to discussions that allow community members to suggest ideas; or from participation as a form of "cheap labor" or as "cost sharing"; or from participation with decision making, based on mutual agreement, to full transfer of responsibility authority to local control.

2.1.1 Capacity, Technological Transfer and Resources Mobilization

By participating in CWRM, the capacity of the community is certainly improved because they join in training and discussions on water management and protection in general. Special training in system design, technical performance and monitoring and financial management is usually given to community representatives who directly operate and manage water works. The system of traditional/indigenous knowledge plays a significant role in CWRM, particularly experience and practices of the communities in protection of watersheds, water collection and water deification.

Technologies used for rural irrigation and water supplies are generally simple and inexpensive. This is suitable for local capacity and resources as CWRM models usually take place in rural, poor and remote areas. It has been proven that lack of clarity in ownership rights affects the process of mobilizing communities to make contributions. This may lead to confusion over ownership rights, causing disputes between different stakeholders. Clarifying property rights at the outset will help avoid later conflicts in management and operation (Van den Berge, 2002).

2.1.2 Sustainability of Community-based Water Resources Management

The sustainability of a CWRM system is likely defined by the combination of different key aspects social, financial, institutional, technical and environmental. Identifying a CWRM best practice must come from this and therefore it is extremely challenging. In this context, some aspects that do not quite reach the level current CWRM models should also be considered as a good performance. There is worldwide recognition that water user-oriented or demand-responsive approaches have had positive impacts on the sustainability of water management systems. Community consensus as a result of social performance has proved a success with CWRM models. There is much evidence that women have actively participated in the construction and monitoring of the water systems (Dung and Tinh, 2006)

Numerous approaches to community-based management of capture fisheries have been applied in southern Lao PDR. These have been developed either by a village implementing some form of traditional management on its own initiative, or through projects implemented in partnership between communities, local governments, external agencies, and academic institutions. These management systems vary according to the type of resource and the objectives of management. The different approaches may be classified as community fisheries management, fisheries co-management, community wetlands, conservation wetlands, or deep pool fish sanctuaries (also called Fish Conservation Zones). In all cases, the unifying theme is the strong role that the community plays in management decisions and enforcement. The motivation behind developing community-based management systems and the community perception of the benefits received will vary according to factors such as the type of resource under management and the use of the resource by local people, as well as socio-cultural and geographic characteristics of the community (Mollot al et, 2007)

At the same time, Mollot et al also stated that successful approaches to management of common property fishery resources must recognize the complexity of managing aquatic resources both within and between communities along the length of a river system. Benefit sharing mechanisms attempt to ensure the equitable use of common property resources in these systems. To ensure continued benefits from the availability of freshwater for future generations, the concept of benefit sharing must also support the responsible use and management of fishery resources. This may make it necessary to reduce excessive competition for fishery resources and strengthen management incentive and capacity within a community; this can create a situation, however, where community management capacity is strengthened at the exclusion of former users of a communal resource.

2.2 Water for Production

2.2.1 Rice-Fish Culture

Bangladesh, China, India, Indonesia, Malaysia, Thailand, Vietnam, and other Asian countries have a long history of integrated agri-aquaculture systems. Rice-fish production is possible in both of these systems under either capture systems where wild fish enter, reproduce and are harvested from the flooded fields, or culture systems where the rice fields are stocked with fish either simultaneously or alternately with the rice crop. Today, this farming system is fast becoming a favorite option among resource-poor fish farmers in the developing world, mainly because of its ability to remove many risks associated with the stand-alone pond aquaculture of both intensive and extensive scale (Prein, 2002).

Culture of fish within rice fields can increase rice yields, especially on poorer soils and in unfertilized crops where the fertilizing effect of fish is greatest. Improvement in income levels attributable to rice-fish interaction in seven countries has been summarized by Demaine and Halwart (2001) in Table 2.1. Brummett (2002) reports 6 times as much cash as typically generated by Malawian small farmers resulting in 3 times higher net income than staple maize crop and homestead combined. In his review of trends in rice-fish farming, Halwart (1998) reports that together with savings of pesticides and earnings from fish sales, these increased yields result in net incomes that are 7 to 65% higher than for rice monoculture. However, the future

outlook of fish culture in irrigated rice paddies is not very bright. There has been a gradual reduction in water subsidy and therefore irrigation is getting expensive over time. As a result, farmers are in general using less water for rice cultivation.

Table 2.1 Selected economic indicators of rice and rice-fish farming

Indicator	Country	Change (%)	Comments
Increase in rice yield equivalent	Indonesia	+20	Research station results, fish yield expressed in rice equivalent
Income from fish as per cent of total farm income	Malaysia	+7 and +9	Figures for owners and tenants, respectively, in double rice cropping area
Net return	Philippines	+40	Summary of results from nation-wide field trials during the late 1970s to 1987 in irrigated rice areas
Net return	China	+45	Results from four farm households in Hubei Province

Table 2.1 (continued)

Indicator	Country	Change (%)	Comments
Net farm income	Thailand	+18 and +35	Figures for research station and farmer fields, respectively
Net profit	Bangladesh	+64 and +95	Net benefits are higher in the wet season and lower in dry season
Total farm cash return	Vietnam	+69	20% of the trench construction costs considered in capital costs. Operating costs increased by 83% for labor and 100% for irrigation, but had savings in the use of pesticides

Source: Demaine and Halwart (2001)

A different situation exists in flood-prone ecosystems that can be used for additional fish production and thereby make use of this unutilized and free water resource. Generally, three rice-fish culture systems can be established in flood prone areas: (1) alternating culture of dry season rice followed by stocked fish only during the flood season (i.e. without rice) in the enclosed area (e.g. as in a fish pen); (2) concurrent culture of deepwater rice (with submergence tolerance) with stocked fish during the flood season followed by dry season rice in shallow flooded areas; (3) concurrent culture of deepwater rice (with elongation ability) with stocked fish during the dry flood season, followed by dry season non-rice crops. In these ecosystems, the opportunity exists to fence in large areas (up to several hectares) by creating enclosed water bodies and stocking

these with fish. In this case, the communities who usually access and utilize these lands and waters can form community management groups that jointly decide on management and share of benefits, based on agreed rules (Dugan at el, 2005)

Recent work in Bangladesh and Vietnam has shown that Community-based Fish Culture (CBFC) in flood-prone rice fields is technically feasible, economically profitable, environmentally non-destructive and socially acceptable (Dey and Prein, 2003, 2004a,b). The results show that adoption of CBFC in flooded rice fields can increase water productivity per ha per year substantially; it can increase fish production by about 600 kg/ha/year in shallow flooded areas and up to 1.5 tonnes/ha/yea in deep-flooded areas, without reduction in rice yield and wild fish catch. For the overall system, additional income ranging from US $135 per hectare in southern Vietnam to US $437 per hectare in Bangladesh was achieved, which is an increase of 20%–85% over the previous profitability. The arrangements involved landholders and landless, who received shares of the returns based on their contributions to management and upkeep. The landless, who were seasonal fishers in the area, had income gains from their labor and additionally were able to conduct fishing for indigenous non-stocked fish and thereby meet their family nutritional and income requirements during this period.

2.2.2 Combined Rice-Fish Production in Laos

Innovative approaches to water management, such as combined rice-fish production can result in both higher total incomes and more secure livelihoods; if one type of production has problems then the family has other products to fall back on. The key is to look at water management from the viewpoint of poor people, not that of technical experts. As part of this, there has been an increasing interest in traditional management systems and local knowledge: traditions of resource management that have built up over generations to produce effective and sustainable models of resource management that are the basis of people's livelihoods.

Combined rice-fish production in Lao PDR has extensive water resources in the form of rivers, lakes and wetlands. Rice is the main crop in most areas and fish are an important part of the national diet. In upland rain fed areas, bunds are often raised to increase water depth for fish cultivation. In some cases, a small channel is constructed to facilitate fish capture. In the Mekong River plain, rice-fish farming is practiced in rain-fed rice fields where soils are relatively impermeable as well as in irrigated rice fields, which offer ideal conditions for fish cultivation.

Accurate data is not available, but outputs of 125 to 240 kg/ha/year have been reported. The fish are mostly used for home consumption and are a key element of the community's nutritional balance. Rice-fish farming is popular with farmers, but support to integrated pest management (to reduce harmful pesticide use), access to credit and ensuring the availability of fingerlings would all further spread this creative use of limited resources. However, an adverse side effect in this part of the world, where consumption of raw or slightly fermented fish is common practice, is the risk of infection with food-borne trematodes, generally worms with complex life-cycles in snails and/or fish (WWDR, 2003)

2.2.3 Water Productivity as Value per Unit of Water

Water as a natural asset forms part of the asset range available to households and its economic value as well as its cost needs to be properly understood in order to understand the linkages with livelihood strategies. This is the case not just because this points towards ways of strengthening asset bundles through improving access to natural capital, but also has methodological implications for demand assessment. The structure of demand for water within a community – particularly demand over and above the survival level – may be informed just as much by its productive uses as by its routine daily consumptive uses. Calculating anticipated demand at the household and community level may, therefore, require greater depth of analysis of household livelihood uses (and potential uses) than is commonly undertaken by demand-assessment. This also has policy implications for notions of scarcity, particularly in terms of the presence or absence of other assets critical to gaining sustainable access to supplies. Scarcity can be determined by the unavailability of physical and human capital as well as by the absence of the water (Nicol, 2000)

Increasing net benefits or value per unit of water has key implications for farmer decisions, economic growth, poverty reduction, equity, and the environment. There is much more scope for increasing value per unit of water use in agriculture (economic water productivity) than in physical water productivity, which is becoming increasingly constrained. Strategies for increasing the value of water used in agriculture include (Steduto, 2007):

1. Increasing yield per unit of supply or depletion.
2. Changing from low- to high-value crops
3. Reallocating water from low to higher valued uses

4. Lowering the costs of inputs (labor, water technologies).
5. Increasing health benefits and the value of ecological services of agriculture.
6. Decreasing social, health, and environmental costs (for example, minimizing degradation of other ecosystems).
7. Obtaining multiple benefits per unit of water (for example, using water for drinking and agriculture).
8. Achieving more livelihood support per unit of water (more jobs, nutrition, and income for the same amount of water).

2.2.4 Irrigation and Poverty Alleviation Impacts

Water as a natural asset forms part of the asset range available to households, its economic value as well as its cost can be properly understood in order to understand the linkages with livelihood strategies. This is the case not just because this points towards ways of strengthening asset bundles through improving access to natural capital, but also has methodological implications for demand assessment. The structure of demand for water within a community – particularly demand over and above the survival level – may be informed just as much by its productive uses as by its routine daily consumptive uses. Calculating anticipated demand at the household and community level may, therefore, require greater depth of analysis of household livelihood uses (and potential uses) than is commonly undertaken by demand-assessment. This also has policy implications for notions of scarcity, particularly in terms of the presence or absence of other assets critical to gaining sustainable access to supplies. Scarcity can be determined by the unavailability of physical and human capital as well as by the absence of the water (Nicol, 2000)

Water productivity improvement can provide two pathways to poverty alleviation. First, targeted water interventions can enable poor and marginalized people to gain access to water and use it more effectively. Second, across-the-board increases in water productivity may benefit poor people through multiplier effects on food security, employment, and income. Improvements in water productivity that indirectly increase food security and generate employment opportunities and income through multiplier effects can also reduce poverty. The full ranges of economic benefits from agricultural production are much greater than the simple measure of the value of local production (Hussain and Hanjra 2004).

The direct and indirect net benefits of irrigation contribute to poverty alleviation. Evidence from comparisons of poverty across irrigated and non-irrigated settings shows that, on average, poverty incidence is over 21 percent less in irrigated than in non-irrigated settings, with substantial variation in poverty incidence across countries/systems. Evidence using quantitative methods shows that irrigation and agricultural output are significant positive determinants of incomes/expenditures and negative determinants of poverty (Hussain, 2005).

A study by Hussain et al. (2004) confirms that access to reliable irrigation water can enable farmers to adopt new technologies and intensify cultivation, leading to increased productivity, overall higher production, and greater returns from farming. This in turn opens up new employment opportunities, both on-farm and off-farm. It can improve incomes, livelihoods, and the quality of life in rural areas. The same study identified five key dimensions of how access to good irrigation water contributes to socioeconomic uplift of rural communities: production, income and consumption, employment, food security, and other social impacts contributing to overall improved welfare.

Lack of well-defined irrigation water rights is one of the causes of poor irrigation performance, adversely affecting the poor more than the non-poor. The traditional customs and laws relating to water resources and their use are now being increasingly questioned in the context of irrigation-performance improvement and institutional reforms. It is being argued that the customary rights lack legal standing. In contrast, formalized secure water rights offer a way to the poor to protect their water resources from being taken away. The intent is that a different system of water rights has to be brought into being to remedy the ills plaguing the water resources sector. Clear and secure water rights can play an important role in providing water allocation equity and efficiency, and in expanding opportunities for poor people to move from poverty to prosperity. On the other hand, there is also an argument that reforming water rights is not easy and may require changes in many institutions and laws and may face many obstacles (Hussain, 2005).

Improvements in agricultural productivity can provide a pathway out of poverty for rural households in several ways (Faurès and Santin, 2008):

1. For poor households that own land, increases in crop and livestock yields will generate greater output and higher incomes per unit of land and labour.

2. For households that do not own land but provide farm labor, improvements in yields will increase the incremental productivity of labor, thus stimulating the demand for farm labor and raising farm wages.
3. For households that do not own land or provide farm labor, improvements in yields will generate greater aggregate output, thus increasing the local supply of agricultural products, with consequent reductions in prices.
4. Higher agricultural incomes and higher net incomes in non-agricultural households that are net food purchasers will generate greater demand for food and other goods and services that might be provided by local farmers and other non-farm residents.
5. Improvements in crop yields made possible by enhancing water management will increase the incremental productivity of complementary inputs, such as labor, fertilizer, chemicals, animal health services, animal traction, and machinery. Greater demand for these inputs might stimulate economic activity that benefits households providing non-farm labor.
6. Improvements in the yields of crops and livestock might also stimulate labor demand in local processing and marketing activities, particularly in areas near urban centers.

2.2.5 Water Resources Management Options

2.2.5.1 Promoting community-based small-scale irrigation

In most cases, design of small-scale irrigation systems holds the key to their sustainability. Operational simplicity is among the most important criteria for the success of small-scale community-based irrigation schemes. The number of users sharing a common infrastructure should remain low, and be based on existing social constructs. Systems must have low maintenance requirements. All these factors contribute to an easier appropriation of the technology by its users. Planning and design of small-scale irrigation schemes must also give greater attention to water resources and ensure that the schemes will be provided with adequate water supply throughout the cropping season. Community participation in design and realization of small-scale irrigation schemes is the only way to ensure beneficiary appropriation, which in turn will facilitate sustainable management of the investment. In the past, too many irrigation systems were designed without considering people's requirements and management

considerations. This resulted in blueprint designs that were not adapted to local conditions, had unnecessarily high operation and maintenance costs, and worked through complex organization settings (Faurès and Santin, 2008)

2.2.5.2 Facilitating multiple use of water

When possible, investments that provide water for more than one household purpose are likely to be more effective than single-purpose investments in improving livelihoods. For example, constructing a village pond or investing in a community tube well might provide water for irrigation, livestock production, and household chores. Such investments might also reduce the time required by household members to obtain water for drinking and other purposes from distant sources. Providing water nearer to homes and villages can reduce drudgery and enable household members to spend more time on productive activities (Faurès and Santin, 2008)

2.3 Water and Poverty

2.3.1 Linking Poverty and Water Management

The PEP poverty reduction framework is based on four key factors that need to be addressed in any poverty reduction strategy (Soussan el at, 2005):

1. ***Enhanced livelihoods security***: ability of poor people to use their assets and capabilities to make a living in conditions of greater security and sustainability.

2. ***Reduced health risks***: mitigation of factors that put poor and most vulnerable individuals (especially women and children) at risk from different diseases, disabilities, poor nutrition and untimely death.

3. ***Reduced vulnerability***: reduction of threats from environmental, economic and political hazards, including the impact of both sudden shocks and long-term adverse trends.

4. ***Pro-poor economic growth:*** enhanced economic growth is essential for poverty reduction in most parts of the world, but the quality of growth, and in particular the extent to which it creates new opportunities for the poor, also matters.

The 2006 World Development Report describes economic growth as the main driver of poverty reduction and suggests that 1 percentage point growth in a country's income allows it to

reduce the incidence of poverty in that country by about 2.4 percentage points. Economic expansion raises income and consumption levels across the income distribution spectrum, and means more opportunities for the poor. Water can make a major contribution to economic growth and development, both as a critical factor of production in many crucial sectors and through enhancing health, reducing vulnerability and ensuring greater livelihoods security that in turn create a climate more conducive to investments and enhance labor productivity (Soussan el at, 2005)

In many rural areas, poor people depend almost entirely on their ability to access and use natural resources as the basis for their livelihoods. Water is a key to this process, as a direct input into many productive activities and a determinant of the health and availability of other natural resources such as plants and animals from local ecosystems. Few livelihood activities are possible without access to water. Water resources involve not just water itself, but also the flows of other resources (such as hydro power or fish - see box 2) that water resources bring, the investments and knowledge (including traditional knowledge) needed to access these resources, and the social and institutional structures that define how they are accessed and managed. From this broad perspective, water management is often a critical factor in sustainable livelihoods development, and, where problems exist, a constraint upon the same result (Soussan el at, 2005).

According to the aquatic resources in nutrition and livelihoods of rural of Lao PDR, a recent study has shown the importance of resources gathered from rivers and wetlands in the livelihoods and nutritional balance of poor rural communities in Southern Lao PDR. Although the main livelihood activity is rice production, detailed discussions with local communities showed the universal importance of fishing, of gathering crabs, amphibians and crustaceans, of gathered aquatic plants, and of associated activities such as net and boat making. These gathered foods were an important supplementary source of income, were the main source of food in periods of poor food security, and were critical in providing essential nutritional variety. In particular, these foods were the major source of protein for many poor people and provided a range of essential micro-nutrients. The people of these communities, and of similar communities in many other parts of the world, could not survive without access to these resources. Anything that restricts their availability has a severe impact upon the sustainability of their livelihoods (Meusch, 2003).

2.3.2 Agricultural Water and Poverty Linkage

Strong direct and indirect linkages exist between irrigation and poverty. Direct linkages operate via localized and household-level effects, and indirect linkages operate via aggregate or national-level impacts. Irrigation benefits the poor though higher production, higher yields, lower risk of crop failure, and higher year-round farm and non-farm employment. Irrigation enables smallholders to adopt more diversified cropping patterns and to switch from low-value subsistence production to high-value, market-oriented production. The transition to the market economy integrates the poor into land, labor, and commodity markets and empowers the poor by putting them at a level playing field with other market entities, including the non-poor. Increased production makes food available and affordable for the poor. The poor and the landless are main beneficiaries of low food prices as they are net buyers of food (Hussain al et, 2004). More detail on the linkages between irrigation and poverty are in Figure 2.1.

Indirect linkages operate via regional, national, and economy-wide effects. Irrigation investments act as production- and supply-shifters, and have a strong positive effect on growth, benefiting the poor in the long run. The magnitude of indirect benefits could be many times more than the direct and household-level benefits. Further, irrigation benefits tend to fall more squarely on the poor and the landless alike in the long run. However, in the short run relative benefits to the landless and land-poor may be small, as the allocation of water often tends to be land-based. Allocating water to the land and not to the households is inherently biased against the landless. Despite of that the poor and the landless also benefit in both absolute and relative terms from irrigation investments. Recent advances in irrigation technologies, such as micro irrigation systems, have strong antipoverty potential (Hussain al et, 2004).

The International Water Management Institute (IWMI) and its partners recently undertook detailed empirical studies on irrigation and poverty in seven Asian countries: Bangladesh, China, India, Indonesia, Pakistan, Sri Lanka and Vietnam. These countries together account for around three-fourths of Asia's total irrigated area. The results from these studies suggest that (1) irrigation has strong poverty- reducing potential through its direct and indirect growth, promoting linkages and positive impacts at local, regional and national levels; (2) poverty is much more and deeper in marginal and non-irrigated areas compared to that in irrigated areas, and the latter areas also continue to be homes to large number of the poor; (3) poverty varies significantly across systems, so do its causes and characteristics; (4) the impacts of irrigation on

poverty vary across settings and the magnitude of the anti-poverty impacts of irrigation depend on a number of factors, which include: a) structure of land distribution – (in) equity in land distribution – and land quality; b) condition of the irrigation infrastructure and its management, c) irrigation water management, allocation and distribution procedures and practices, d) irrigation and production technologies/methods, cropping patterns and crop diversification, e) support measures, e.g., information, input and output marketing; and 5) indirect impacts of irrigation on incomes and poverty, which are often much larger than the direct impacts realized at the micro/local level (see Ahmad et al., 2004 for Bangladesh, Wang et al., 2004 for China, Sivamohan et al., 2004 for India, Arif et al., 2004 for Indonesia, Jehangir et al., 2004 for Pakistan, Hussain et al., 2004 for Sri Lanka, Tuan et al., 2004 for Vietnam, and Hussain, 2004 for summary of country studies).

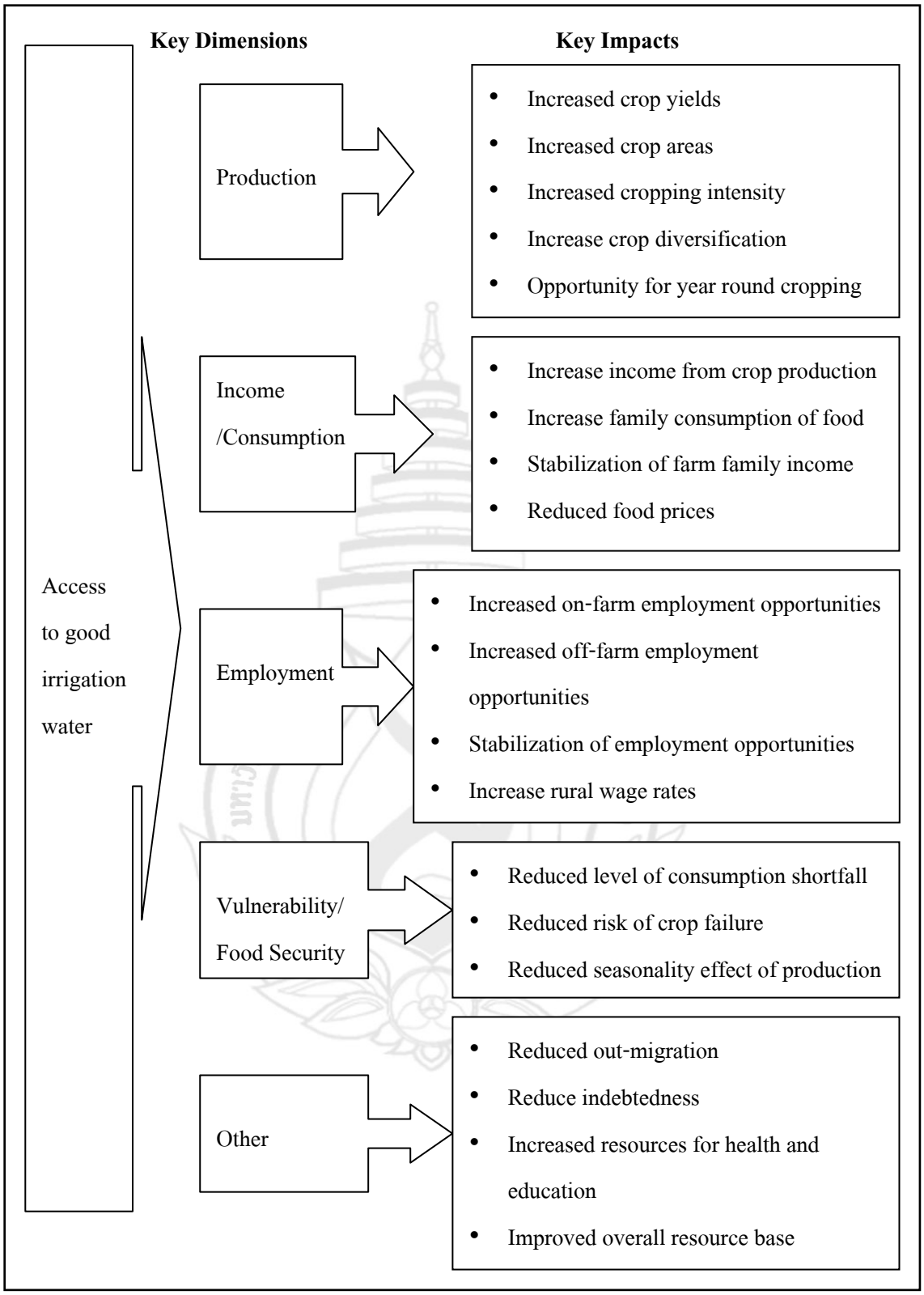

Figure 2.1 Agricultural water and poverty alleviation: key dimensions

2.3.3 Water Security

General Comment No. 15 by the United Nations Committee on Economic, Social and Cultural Rights in 2002 recognizes water as a public good, fundamental for life and health, and supports the opinion that water is a prerequisite for the realization of other human rights. Drawing on a range of covenant rights and general comments, it states: "Water should be treated as a social and cultural good, and not primarily as an economic good" [and] "the right to water clearly falls within the category of guarantees essential for securing an adequate standard of living, particularly since it is one of the most fundamental conditions for survival" (UN, 2002).

According to ADB (2004a) the concept of water security is based on creation of mechanisms that ensure the poor have secure and sustainable access to water resources, which in turn means strong links to participation and the governance conditions that dictate this access. A key part of this is to ensure that the rights and entitlements - especially of poor people -- over their access to water resources are protected, and their voices heard where decisions over these resources are made. This includes the basic framework of laws and government policies, traditional rights and entitlement systems, an institutional framework through which the poor can realize their rights, and finally, the existence of basic governance conditions that provide for the fair and legitimate representation of the interests of all in water management decisions.

If we are to achieve water security, water resources must be used sustainably: that is, in ways that do not damage their quality or future availability. For this, the balance between the different uses of water resources across the full range of a catchment's area is critical: sustainability is not just about one use or one place, but about how different uses can be balanced against each other within the overall hydrological process.

The governance conditions through which water resources are controlled are crucial in deciding matters of water allocation, infrastructure investment, conflict resolution, water cost and pricing, etc. A priority goal for these institutions must be to understand the specific needs of the poor for access to water resources and take the steps needed to ensure they have this secure and sustainable access.

There are no easy prescriptions, no panaceas or universally applicable solutions for water security. But some fundamentals apply everywhere, including the need to create fair and representative governance conditions and means of participation for all and ensure efficient and

sustainable levels of service provision. There is also the need to ensure that water is mainstreamed into wider national and international development approaches such as the Poverty Reduction Strategy Programs. Water can (and often does) make a major contribution to poverty reduction, but water management alone—without improved water security—will not solve poverty problems or reduce poverty(ADB, 2004a)

2.3.4 Improvements to Livelihoods and Pro-Poor Economic Growth

Three essential components of livelihoods need to be considered if improved water management to contribute to sustainable livelihood development (ADB, 2004a):

1. People draw on a set of capital assets as a basis for their livelihood. We can identify five: human, natural, financial, physical, and social (including political). The capital available to individual households reflects their ability to gain access to systems (the resource base, the financial system, and society) through which these capital assets are produced.

2. Based on the choices made, household members will undertake a series of livelihood activities (e.g., growing crops, fishing in a lake). Some activities may be dominant, but it is rare for a poor household to rely exclusively on one source of livelihood. Most combine complex sets of activities to augment their income.

3. The livelihood outcome covers the set of material and non-material conditions that define the specific forms of individual and communal poverty. This ultimately is what any pro-poor strategy is trying to improve and the nature of poverty in different settings needs to be better understood.

Water management plays a key role in many aspects of these livelihood processes, and in particular is essential to many livelihood activities: both productive such as agriculture, household maintenance activities. Focused efforts to meet the needs of the poor must reflect an understanding of the different roles that water security plays in their livelihoods. Prescriptive assumptions must be avoided as these roles vary from community to community.

Water management is also a key to ensuring the sustainability of many types of new economic ventures that provide investment or employment opportunities for poor people and that contribute to the wider process of national economic development. Ensuring that water is available in the right quantities and quality for these pro-poor forms of economic growth is itself a key focus for water investments and management activities. To achieve this, poverty reduction

will have to be the top priority, even when that means accepting lower initial economic cost-benefit ratios.

There are, consequently, many ways in which water can and does contribute to improving the livelihoods of poor people. These efforts need to continue to be supported and extended, through such means as ensuring that politicians and policymakers are aware of the many poverty and economic benefits that investments in water can bring. The potential of water management as a motor for economic growth and a basis for sustainable livelihoods is often not realized, and indeed the focus on health and hygiene issues has, to an extent, been to the detriment of this issue. The compelling evidence that is found needs to be more widely presented, and the case for water, more effectively argued in discussions on development and economic strategies (ADB, 2004a)

2.3.5 New Ideas Confirmed

From analysis of 30 case studies covering 20 countries and regions in Africa, Asia, and Micronesia, Frans and Soussan (2003) have reached some conclusions about ideas for water and poverty initiatives. The single most obvious idea that is confirmed in most, if not all, case study papers is that water is a necessary, but by itself an insufficient, precondition for poverty alleviation. Poverty alleviation is possible only if the poor have secure access to safe and sufficient water for domestic and productive purposes. However, the full impact of water on poverty alleviation will be realized only if local people and organizations gain stronger voice and organizational capacity, along with increased access to appropriate technologies, credit, markets, etc. Poverty alleviation also requires macroeconomic stability, security, and political backing to focus developments on the poor.

The water sector is as dynamic as are the lives of people in development. Water management should therefore not be seen as static but as an ongoing process in which changing people interact with water, itself transient in nature, and a otherwise rapidly changing world. There are consequently no final solutions, but only step-wise improvements on the present situation. In due course these improvements will turn out to be insufficient, and will require further enhancements. This observation confirms two trends in water sector projects. The first is to give people choices, such as the type of water supply system or latrine that they want to install, rather than go for the “one size fits all” approach. The second is the current stress on building

capacity at all levels for ongoing management of water. Technologies and infrastructure come and go, but water management capacity that is institutionalized is likely to stay and equip the organization to tackle tomorrow's challenges. The adaptive and incremental approach seen in several case studies shows that these characteristics can be and are integrated into pro-poor water management.

Lack of access and control over water resources is a major bottleneck for the poor in their efforts to improve their water security. Often the local power structure prevents the poor from getting a better deal. In such cases external assistance should not only support people in their coping strategies, but should also assist them challenging the power structure. Lobbying on behalf of the poor at all levels is rightly included in more and more programs.

People have their own logic for doing or not doing things. Unless direct stakeholders get a chance to make up their own mind, and unless outside actors understand what they think and feel, external assistance may not be of much help. This is confirmed in many cases: for example, in some sanitation programs where people choose options not recommended by outside agencies, as well as in irrigation, where in parts of South Asia many low income households have selected for the less expensive, lower quality but reliable like treadle pumps.

Changes in government agencies that lead to improvements in implementation are crucial to successful water resources development. The case studies suggest that poor implementation is the real bottleneck in most interventions by government agencies. Quite often the national policies, strategies and plans are not that bad, but what actually happens at grassroots level is a totally different story. Therefore the current stress on capacity building of government agencies, so that they can actual implement more bottoms-up and participatory approaches is well taken.

When designing water management or water supply facilities it is necessary to look forward and include options that allow for change and growing use. The case studies suggest that there is a fine balance between doing what people need now and can afford to maintain and ensuring that infrastructure has a reasonable life span. The solution seems to lie in designs that allow expansion and additional service provision by building on existing facilities.

2.3.6 Rights and Responsibilities

In November 2002, the UN Committee on Economic, Social and Cultural Rights agreed a General Comment on the right to water. This new legal standard guaranteed the human right of every individual to sufficient, safe, affordable water for domestic and other needs and made clear the duties of the state and non-state actors in respecting, protecting and fulfilling this right.

How can poor people's water needs be assured, their rights to water fulfilled and protected? Much discourse emphasizes the importance of good water governance in order to achieve water security for all, not just the poor. Indeed, at the Second World Water Forum, Ministers declared that the world's water insecurity is not due to scarcity, but is in fact due to a crisis of governance. Good governance hinges not just on effective and transparent government, but also on active citizenship. The rights of individuals to sufficient water and adequate sanitation are bound up with their responsibilities in achieving that right.

Achieving good governance over water resources and systems in poorer developing countries requires the ability and capacity of the people, especially poor women, men and children and their advocates (Calaguas and Francis, 2003):

1. to participate meaningfully and advocate effectively their interests in processes of decision-making over water,
2. to hold decision-makers to account for decisions that trample on or present a barrier to their achievement of water security, and
3. to gain redress for their grievances.

In practice, evidence shows that community management can achieve a great deal. It is certainly a factor in ensuring the operational sustainability of water facilities. Community management arrangements are not limited to simple, stand-alone community water supply schemes, but have been shown to be effective even with large piped systems in poor rural or urban slum areas. However, people's ability to carry out their responsibilities need support. Poor communities cannot do it on their own. Sooner or later, community management schemes break down. The reasons for failures are many; they include policy, operational, resource and institutional barriers, not to mention professional attitudes that need to be overcome.

There is today a growing emphasis on community management and ownership of water facilities, both for irrigation and community water supplies. However, the jury is still out on

whether transfer from government to farmer associations is successful as far as smallholder incomes are concerned. Community management of drinking water supplies has also had mixed results, depending on technical support, skills transfer, and managerial back-up; and it is not necessarily cheaper. Unless handled carefully, decentralization can have disastrous effects if government merely perceives it as having fiscal advantages and a way to pass responsibilities down to others who have limited resources to respond effectively. Allocation of water through licensing and regulation also presents problems for equitable distribution. Where administrations are inefficient, callous or corrupt, regimes for pricing, licensing and adjudicating property rights may be designed to benefit the better-off (Black and Hall, 2003)

2.3.7 Water Governance

What can organizations interested in reaching the poorest of the water-poor do to enhance these people's water security? Several strategies come to mind. The first and foremost strategy is to place poverty alleviation at the top of the agenda. Only when the overriding goal is to reach the poor can one overcome all the other real obstacles along the way. The policy statements of the major donors, and many developing nations, now in fact give poverty alleviation the highest priority. If practice follows rhetoric then the single most important precondition to enhance the water security of the poorest of the poor will have been met. National government policies must be made coherently pro-poor.

The next most important strategy is to identify the extreme poor and locate them both geographically and socially. Who are the water-poor, where do they live, what is their social status, what are their main livelihood strategies, what resources do they have, and what do they see as the main bottlenecks in enhancing their water security? Answering these questions is a precondition for action, and the answers will have to be given at international, national, regional and local level. For maximum impact resources and effort will have to prioritized and allocated according to need (Frans and Soussa, 2003)

Another strategy is to develop self-targeting mechanisms that favor the poorest of the water-poor. Such self-targeting mechanisms already exist in certain micro-credit and food or cash-for-work programs, but more innovation and experimentation is needed in the water sector. Water supply and sanitation are obvious areas to develop self-targeting mechanisms, but they are

also needed in the use of water for small-scale production (mini-pond fisheries, small scale irrigation, etc.) and reduction of vulnerabilities (Frans and Soussa, 2003)

Strategies must be developed to enable the poor to graduate from subsidies and outside assistance to self-financing. With improved livelihoods and water security people should be able to gradually start sharing the burden of operating and maintaining the systems that have allowed them to grow out of poverty (Frans and Soussa, 2003)

According to Soussan (2004), governance has been stressed as a key issue throughout discussions on water and poverty. Good governance will depend on stakeholders (and in particular local communities) having the knowledge and skills needed in areas such as water management, infrastructure maintenance, and administration, to fulfill the roles assigned to them. There is a need to make laws and policies more coherent and consistent, to ensure that state agencies in particular are better equipped to respond to and meet the needs of poor people, and to ensure that intentions of more transparent and participatory approaches are carried through into practice. Three main elements of the governance context can be identified:

1. The wider economy and society, including the structure of society and the nature of participation and strength of civil society; the strength of institutions at different levels of society from the local to the national; the form and effectiveness of government institutions and political participation; the structure and dynamism of the economy; the availability of different skills, services (such as health), and infrastructure and education and media services.

2. Water laws, policies, and institutions that set the context within which water management takes place and the poor have access to water resources. This can be seen as the immediate national-level governance context for water, and its character will reflect the wider economy and society.

3. The local social and institutional structure, both directly related to water management and in the wider setting of social, gender, and political relations at the local level. These are critical in three senses: they in many ways define (and limit) the extent to which the poor can be empowered, they are the existing capacities on which new institutional processes for participation and management should be built, and they are the channel through which the poor interact with the external world including policymakers and institutions seeking to improve their water security and their livelihoods.

Any approach to improving water management must understand all three components of the governance context. Too many approaches concentrate on just one (e.g. improving government institutions or mobilizing local-level participation) or, at best, two. The wider economy and society are rarely acknowledged but are of critical importance in defining the basic approach and potentials for change at the local and institutional level (Soussan, 2004).

Broader governance (law and policy) and resource related factors can contribute to an understanding of benefit flow to communities, while local governance arrangements and socio-economic conditions ("community conditions") can shed light on distribution of benefits at the community level. Figure 2.2 maps out these relationships, and highlights the links between these factors. (RECOFTC, WWF, SNV, 2007).

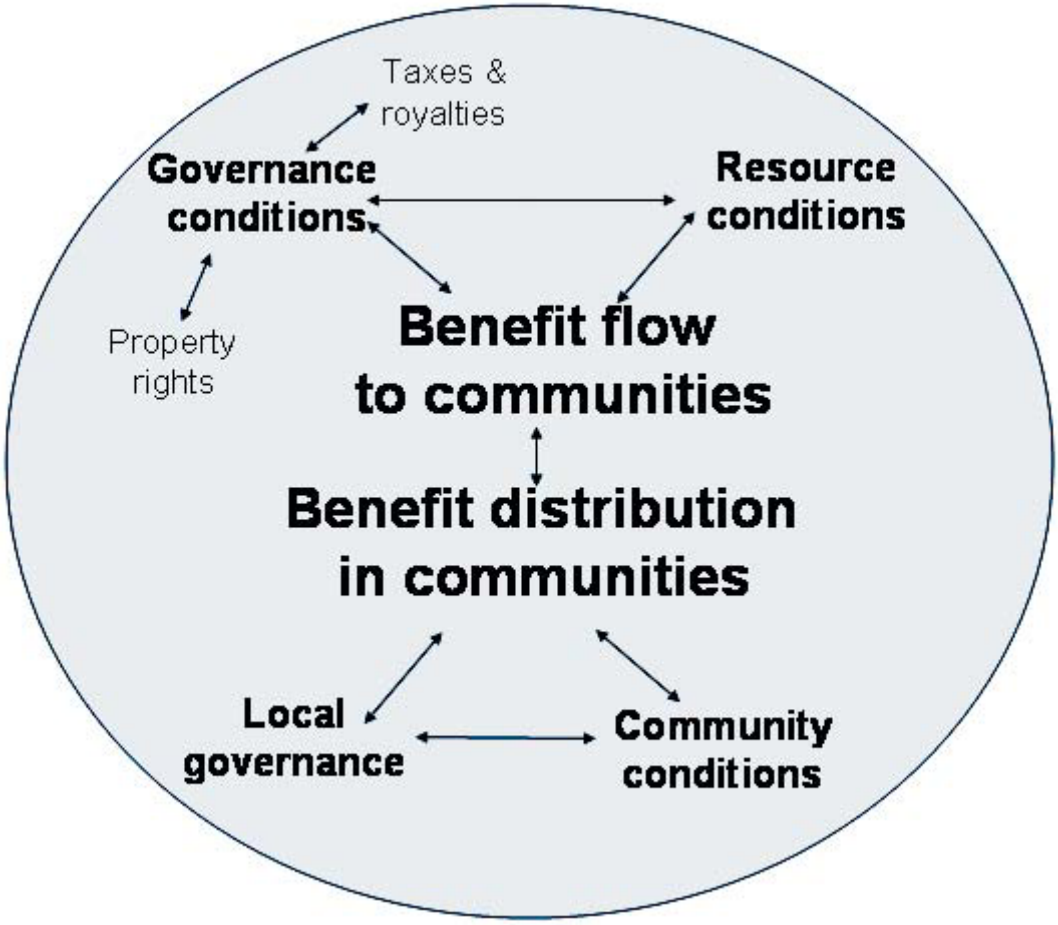

Figure 2.2 A Framework for analyzing benefit sharing

Rijsberman and Molden (2001) stated that while the reasons behind lack of access to water are many, they can be grouped into three situations that relate to water availability. The first is due to physical water scarcity. When an area has little or no additional water supplies to meet additional uses, it is difficult for poor people to tap into existing, already allocated supplies. The poor are often the most vulnerable group when water is reallocated to higher valued uses, as they are likely to lose access. The second case is one where development efforts have led to exploitation of water resources, but these are not equitably managed. Pockets of water scarcity exist because of inadequate rights, infrastructure, or management efforts to deliver water services to all people. This is a chronic problem in many irrigation systems, particularly in Asia. The third problem involves a lack of financial or human resources to tap available water resources.

Water rights are mechanisms through which a user can access water for a particular use without jeopardizing another user's right. Water rights can be local or customary, i.e., means by which users may access water and establish allocation mechanisms among themselves without necessarily having a written document to define volumes and times for abstraction. Water rights are, however, mostly thought to be statutory, i.e., a blueprint document issued by the government, defining volumetric allocation of water and, sometimes, period for that particular allocation, and to whom it is provided for. There are many lessons to learn from the local institutions; there is much fire to collect from the ashes. The key lesson learnt from the study in Usangu plains is that local institutions play a significant role in water management. Some local arrangements such as local water rights, water rotations and one-to-one conflict resolution mechanisms are more efficient, more cost-effective, longer-lasting and more widely accepted among local water users than most top-down state-driven institutions (Sokile and Koppen, 2004).

Social equity implies fair access to resources and livelihood; the concept of what is ''fair'' reflects the ethical values shared by the society, as well as economic values associated with resource uses. Social equity also reflects a principle that each citizen regardless of economic statuses or personal traits deserves and has a right to be given fair treatment by the political system, giving special attention to the needs of weak and vulnerable populations. In the context of resource allocation, social equity refers to a bundle of rights and duties of government, collective, and/or individuals, which are applied to protect weak and vulnerable populations in society (Ximing Cai; 2008).

2.3.8 The Debate about Irrigation and Poverty Reduction

Hussain and Hanjra (2004) describe three pathways through which irrigation affects poverty: the micro level, meso level, and macro level. At the micro level, irrigation enhances returns to the physical, human and social capital of poor households. It enables farmers to achieve higher yields and earn larger revenues from crop production. Higher net revenues can be invested in productive inputs or used to diversify farm and non-farm activities. Accumulation of net revenues over time can enable poor households to implement measures that reduce their vulnerability to shocks, and possibly to escape from chronic poverty.

The meso level impacts include new opportunity for landless laborers to work in irrigated farms or to earn higher wages in rain fed farms. If the availability of irrigation water increases the incremental productivity of labor, the demand for farm workers will increase, all else being equal. The consequent rise in wages will be determined by the amount of idle labor available locally and the degree to which farm workers migrates in search of job opportunities. Meso level impacts also include the reduction in local food prices that might occur when irrigation enables farmers to generate greater output per unit of land and per person. Increases in demand for locally produced non-agriculture goods and services also can generate employment opportunities and stimulate economic activity (Mellor and Johnston, 1984).

The macro level effects occur through interactions in national and international markets. Improvements in agricultural productivity made possible by irrigation can stimulate aggregate policies and investment. When such actions are implemented by state and national governments, improvements in productivity and reductions in average cost of producing crops and livestock products can also provide new opportunities for gaining benefits through international trade.

Similarly, Lipton, Litchfield and Faures (2003) have described the direct and indirect ways in which availability of irrigation reduces poverty. Direct effects include: higher yield and increased diversity of cropping made possible by irrigation; higher wages from enhanced employment opportunities; and lower food prices. Indirect effects include: stimulation of activity in input and output markets, impacts on non-rural labor and product markets; and reduction over time in the variability of output and economic activities. This stabilization effect of irrigation generates substantial benefits across economic sectors, when operating on a supportive policy

environment that ensures that farmers have affordable and timely access to key inputs, and they receive adequate prices for their output.

The main conclusion here is that irrigation has a major role in improving agricultural productivity and reducing poverty, but it has to be carried out in a more strategic way, with more in-depth assessment of the cost and benefits, both direct and indirect. It is also essential to have meaningful local participation in design and operation of the schemes and to provide other supporting intervention (especially access to input and output markets and the promotion of higher value crops) as appropriate (Magistro et al; 2007).

2.4 Water and Livelihood

2.4.1 Sustainable Livelihoods Approaches

Sustainable Livelihoods (SL) approaches provide a useful, logical way of thinking through the complex and multiple linkages between water, poverty and livelihoods. SL provides a tool to analyze, in a holistic manner, factors affecting availability, access and use of water. A key strength of SL is in understanding how existing policy and resulting institutions and structures influence livelihoods outcomes and strategies of the poor and in suggesting multiple entry points for water supply interventions (e.g. access to resources, transfer of technology, institution building, etc). The sustainable livelihood principles which were adapted from Norton, A and Foster, M (2001) are as below:

Assets: the assets upon which people draw in order to implement a livelihood strategy may be characterized in five types of capital: human, social, natural, physical, and financial;

People-centered: local people are key actors in identifying and planning livelihood strategies; if local initiatives are to be successful, external support needs to focus on what matters to people, to understand the differences between groups of people and work with them in a way congruent with their current livelihood strategies, social environment and ability to adapt;

Links: an important aim of the livelihoods approach is to understand links: daily life at the local, "micro" level combines and naturally crosses "sectors"; policies and initiatives at 'meso'/'macro' level need to be sufficiently flexible to encourage inter-sectoral working;

Multi-level: poverty elimination is a major challenge which will only be overcome by working at these multiple levels, ensuring that micro-level activity informs the development of policy and an effective enabling environment, and that macro-level structures and processes support people's strengths;

Dynamic: external support must recognize the dynamic nature of livelihood strategies, respond flexibly to changes in people's situations, and reflect the long-term;

Sustainable: sustainability has four key dimensions –economic, institutional, social and environmental; all are important; the challenge is to find a balance between them.

At the same time Faurès and Santin (2008) describe the livelihood capital assets and how they can be improved:

Human Capital: is about knowledge and skills. Many farmers and their families have adequate knowledge and skills to operate within a given level of technology and within their resource constraints. Efforts to intensify or diversify production require investments in new knowledge and skills. Farmers and households need to enhance their human capital, but many poor households do not have sufficient resources to make such an investment. With regard to water in agriculture, important enhancements in human capital include knowledge of methods to improve water management in both rain fed and irrigated areas. Such methods might involve small changes in existing techniques or use of new equipment, crop varieties, and complementary inputs

Natural Capital: is about natural resources, mainly land and water. Many poor households rely on the environment for key inputs in their production and consumption activities. Water is perhaps the most important of these inputs. All households require water for consumption. Farming households also require water for producing crops and raising livestock. Rainfall is important in maintaining the quality of rangeland and other common areas. In arid areas with a substantial population density, the demands placed on natural capital can exceed the sustainable supply. Severe degradation of natural resources can reduce the livelihood status of households that depend on them for production and consumption.

Physical Capital: is about infrastructure. Typically, investments in irrigation enhance physical capital. New or refurbished irrigation systems add to the physical capital of households and communities. So do investments in other forms of infrastructure. Inadequate

physical capital can constrain household production for consumption or for sale. Physical depreciation owing to inadequate maintenance has caused the decline of many irrigation schemes. The likelihood of maintaining physical capital is strongly related to the other four types of capital available in a given community. Wealthier communities, and those with greater social cohesion, might have greater success in maintaining irrigation infrastructure. Human capital is also helpful in understanding the need for the maintenance and the methods required to perform necessary tasks. Natural capital might refer to the quality of the setting in which the irrigation infrastructure is placed. Settings prone to rapid siltation or structural degradation might be associated with more rapid decline of irrigation infrastructure.

Financial Capital: many poor households have inadequate financial capital. This limits ability to pay for water and the costs of operating and maintaining and irrigation system. Inadequate finance can also prevent households from investing in new methods of crop production and irrigation. In addition, many households are risk averse because they have limited financial ability to respond to unexpected shortfalls in income. Limited finance also prevents farmers form accessing all of the complementary inputs required to maximize the productivity of land and water resources. Farmers with access to affordable credit can purchase inputs. However, in many areas, the risk of a shortfall in production prevents farmers from using the option. This is particularly important in rain fed areas where crop yields can vary substantially with annual rainfall, and where insurance can play an important role.

Social Capital: is about solidarity and community action. Many small-scale irrigation schemes are operated by community associations. These associations and farm villagers more generally represent a form of social capital that provides value to individual households. For example, a village or community can assist individual households in times of financial stress. Social capital is also helpful in organizing the operation and maintenance of a community irrigation scheme and brings workers together to perform necessary tasks. Inadequate social capital can leave household more vulnerable to unexpected shortfalls in crop yield. Strong social capital helps in allocating water resources among farm households in ways that are acceptable to community members and beneficial to the community as a whole.

2.4.2 Water, Poverty and Sustainable Livelihoods

The multi-dimensional aspects of water-poverty-livelihood linkages alluded to above present a challenge for policy and planning. The water sector has been dominated for many years by a perspective that emphasizes the health impacts of improved water supply and sanitation. SL analysis requires interveners to take a more holistic view of the role of water in support of livelihood activities of the poor. This demands a broader understanding of factors affecting availability, access and use of water as a productive asset and how it is combined with other assets not only to sustain life directly, but also to bring in the income, financial and non-financial, to sustain livelihoods. There are undoubtedly important health benefits resulting from improved access to safe drinking water and sanitation facilities. However, the livelihood impact of water supply interventions can extend far beyond consumptive and reproductive uses of water to include opportunities for productive water uses including agriculture, livestock, fishing and numerous other small-scale income-generating activities. Furthermore, significant opportunity costs are associated with accessing water resources, both in terms of productive time/labor expended on water collection activities and often direct costs in the form of cash expended on water tariffs (ODI, 2002)

Maluleke et al (2005) point out that in rural areas people use water for activities such as drinking, bathing and cooking (domestic uses) and also for other “productive” activities such as such as small-scale irrigation, livestock watering, post-harvest processing or micro-enterprises. The majority of rural people depend upon multiple strategies for their livelihoods and a number of activities are water-dependent. These can make a meaningful contribution to poverty reduction through improved food security and nutrition, income generation, time saving, etc. To perform the multiple activities that directly sustain or enhance their livelihoods, people use multiple sources of water. For example, people may make use of a piped domestic system for drinking and other household activities, a well for watering livestock and gardening, and rainwater harvesting for supplementary garden irrigation. Equally, people can make use of a rainwater-harvesting tank, originally designed for gardening, as a source of water for drinking and/or cooking. There is growing evidence, based on empirical research, that access to multiple water sources to perform multiple activities is a key issue to ensure multiple benefits to people’s livelihoods (Maluleke, et al, 2005).

The relationship between multiple livelihood strategies, multiple water uses, multiple water sources and multiple benefits is summarized in Figure 2.3.

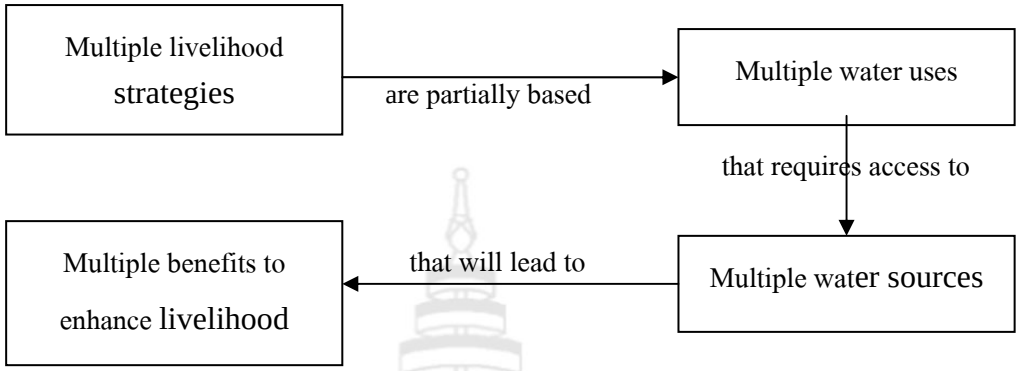

Figure 2.3 Relationship between livelihood strategies, water and benefits

2.4.3 The SWELL Approach

The Association for Water and Rural Development (AWARD) has developed a community-based planning approach (known as SWELL - Securing Water to Enhance Local Livelihoods) that aims to enable improved allocation and use of water resources for water-related livelihoods and to help reduce poverty. The SWELL methodology is based on a participatory process, which enables villagers, water service implementers and enablers to gain a clearer understanding of available water resources and how these can be further developed and matched with multiple uses and livelihood opportunities. The process enables stakeholders to develop a greater and shared understanding, and to develop strategies and plans together from a collective platform (Maluleke, et al, 2005)

Association for Water and Rural Development (AWARD) and Natural Resources Institute (NRI) of United Kingdom (2004) give more detail introduction about the SWELL Approach below, as supplemented by Figure 2.4.

SWELL is an initiative to develop a good way of supporting rural people in villages to get water for use in productive activities that can improve their livelihoods. That is, for uses beyond domestic drinking, cooking, washing and hygiene needs. SWELL is about better participatory planning to use water to reduce poverty and to increase water security for households and villages. SWELL involves rural village people in planning and getting water for productive and domestic uses through engaging with government and other supports. People in a focus village or area develop, in partnership with water role players and stakeholders, a greater and shared understanding of the ways in which village water resources might be better allocated and their productive use sustainably enhanced.

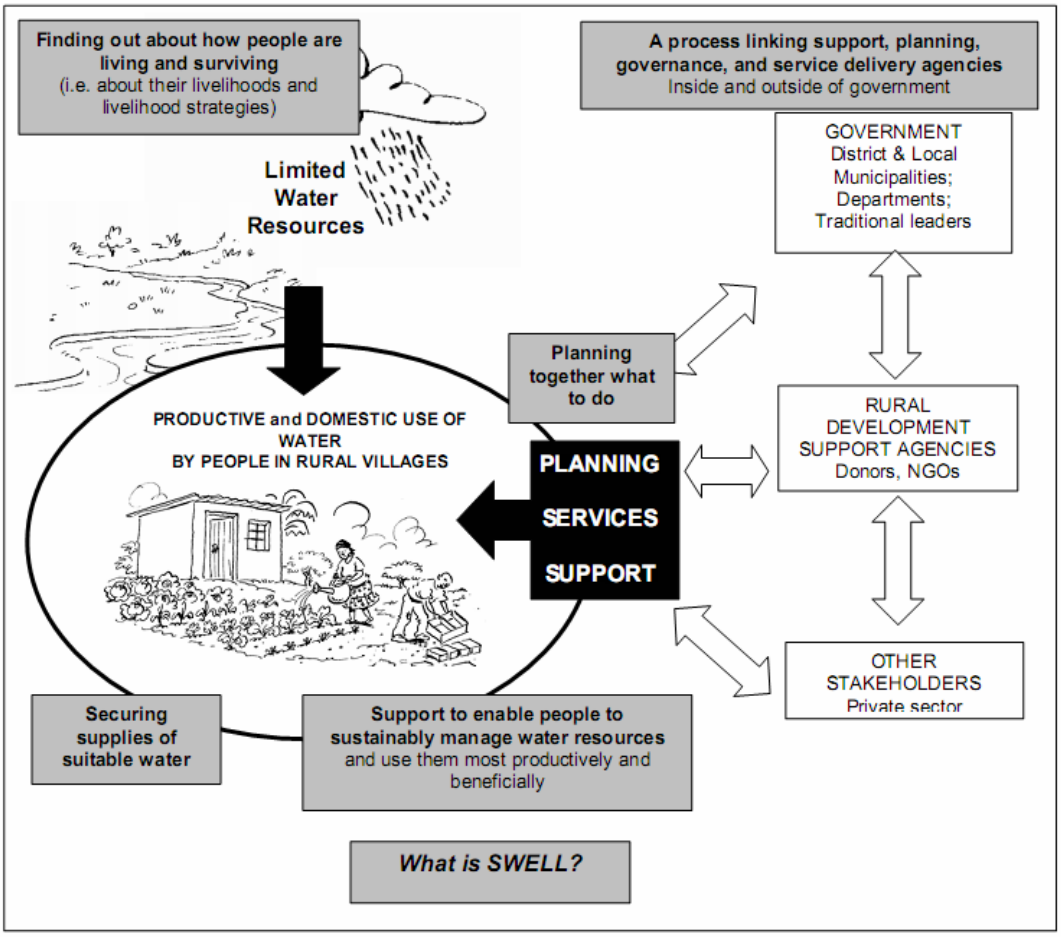

Figure 2.4 The SWELL component framework (AWARD and NRI, 2004)

2.4.4 Principles of SWELL

a. Rationale and Development of SWELL

SWELL seeks to provide a comprehensive integrated framework and set of tools for participatory assessment of 1) people's water-based livelihoods; 2) water resources and services; and 3) management capacity for effective use of water and for integrated planning on the basis of such assessment to sustain and enhance these livelihoods. SWELL is informed by a number of key principles, and has drawn on the sustainable livelihoods framework (Chambers and Conway, 1992) and the RIDA (Resources, Infrastructure, Demand and Access) approach (Moriarty et al., 2004b). These are set out in brief below.

b. Principles of SWELL

Our priority: the poorest and most vulnerable people: Activities emerging from the SWELL planning process should give priority to understanding and addressing the needs of the most vulnerable households within any community.

Villagers as key actors: Poor people have access to different resources and follow complex livelihood strategies, which should be the basis of our work. The SWELL methodology is designed to make villagers central actors in the processes of analyzing their problems, needs and opportunities around their water system, and designing strategies to improve it.

Integrated approach towards water management: Water services need to be developed and managed in a way that integrates the perspectives and interests of different user groups and external service providers towards meeting the multiple water needs of people. It also implies taking an IWRM approach to water resources, considering impacts of any intervention on other users.

Empowerment and capacity building*:* SWELL aims to empower and strengthen village voices (especially those of the poorest and most vulnerable) in identifying and planning water services, and so to create accountability to the customers. At the same time, capacity building efforts also apply to stakeholders in water services provision, such as municipal staff, for whom SWELL will help to provide a better understanding of villagers' realities and analyzing options to meet their needs.

c. The SWELL Framework

One definition of a sustainable livelihood reads:

A livelihood comprises the capabilities, assets (including both material and social resources) and activities required for a means of living. A livelihood is sustainable when it can cope with and recover from shocks and stresses and maintain and enhance its capabilities and assets both now and in the future, whilst not undermining the natural resource (Chambers and Conway, 1992).

The conceptual framework for livelihoods is given in the diagram below:

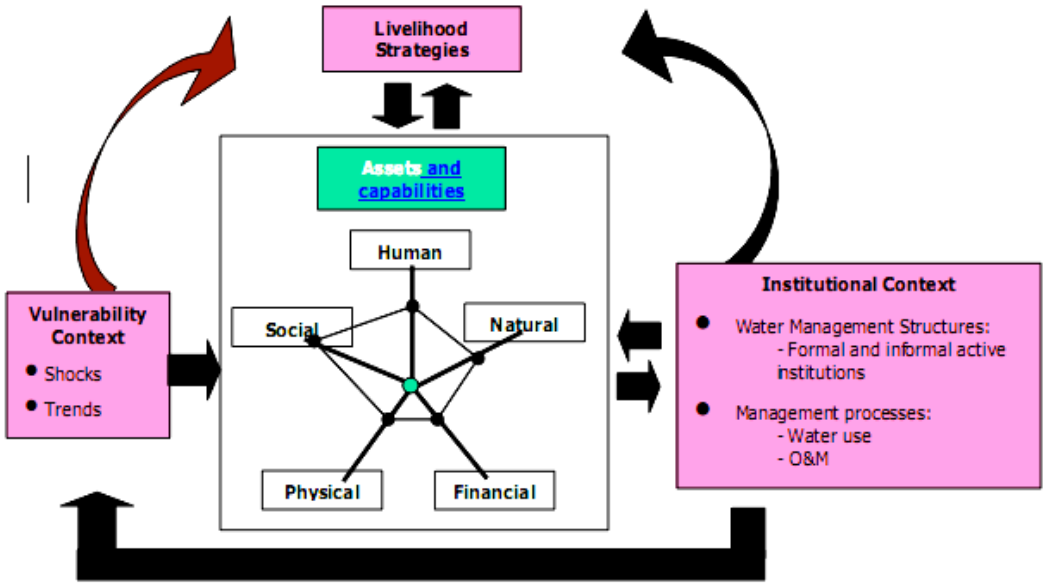

Figure 2.5 Livelihood frameworks as simplified for SWELL

(Based on Joubert and Radebe, 2004)

The core components of a livelihood have been defined in various ways. SWELL used the following working definitions:

Assets: Assets can be seen as resources of different types. A distinction is made between social assets such as social networks and material assets to engage in activities to pursue livelihood strategies. Assets can be broken down into human capital, natural capital, social capital, financial capital and physical capital.

Capabilities*:* Household capabilities have to do with the capacity of a household to secure a livelihood. Capabilities are the knowledge, skills and abilities that the household draws on to secure its livelihood. It is the capabilities of household members – their combined knowledge, skills, state of health and ability to labor or command labor – that enable them to make best use of their assets and engage in different livelihood activities.

Activities*:* Livelihoods activities are not only the activities that bring in money and food, they are all the different activities that the household undertakes to survive and reproduce itself. We distinguish between productive, reproductive and community maintenance activities.

Strategies: The livelihood strategies are the outcome of livelihood activities linked to an understanding of the choices and decisions underlying them. They include: how people combine their income generating activities, the ways in which they use their assets, which assets they choose to invest in and how they manage to preserve existing assets and income.

A main characteristic of poor people's livelihoods is that they constantly change due to a dynamic environment. To capture the dynamic part of livelihoods, it is important to understand the influence of the **vulnerability context** surrounding them. One needs to consider the shocks and stresses affecting people's assets and strategies on the one hand, and people's ability to cope with that on the other hand. *Shocks* are defined as sudden events, usually with negative impacts and include things like natural disasters, losing one's job, etc. *Stresses* on the other hand are ongoing pressures, which households and individuals face, such as national economic decline, water scarcity or frequent technological breakdowns.

The final element of the livelihood approach is the policy and institutional context that influences people's livelihood strategies. A specific issue in this context is the different formal and informal organizations that play a role on water management at local level. The strength of the livelihood framework is that it offers a way to recognize and take account of the complex realities of poor people's lives. However a potential pitfall here is that of losing focus, collecting too much information and designing unmanageable integrated projects. With this in mind, SWELL focuses on identifying different villagers' needs around water services in order to perform their specific livelihood activities and possible new activities. In addition, it identifies issues other than water that contribute to the success of people's water related activities. Specifically, this means that the following issues are analyzed:

1. The role and importance of water in people's livelihoods.
2. The role and importance of water relative to other assets that make these livelihoods possible
3. The role of vulnerability in people's strategies linked for water use
4. People's assets (including capacities) to draw on for potential water related livelihood strategies.

d. SWELL Methodology or Guideline

According to Maluleke et al (2005), the SWELL planning process is divided into four phases: (1) Preparation with stakeholders, (2) Water and Livelihood Strategy Assessment (WLSA), (3) village synthesis, and (4) Ward Synthesis and Planning. Each of this is described further more as following:

Preparation: Planning of the assessment is done with village structures and officials of relevant departments and levels of government. This may include preparatory training, if the concepts are new, and team building. An assessment team is established, if possible including officials from different departments and levels, and village people. What is appropriate and possible in this regard will clearly vary from situation to situation. What is important is building institutional understanding and buy-in, which is a reiterative process.

The Water and Livelihood Strategy Assessment (WLSA) analysis phase*:* In each village local structures convene open meetings. The village level assessment is carried out first, setting out broad trends and patterns in the village, across the socioeconomic spectrum, of the water and livelihoods situation, water resources and infrastructure, institutional roles and relationships, and including a village welfare classification. Some work may take place with focus groups, and verification through transect walks and key informant interviews are included. Participatory, visual tools are used such as:

1. Mapping – of the village layout and water resources and infrastructure.
2. Income and expenditure trees indicating the sources of income and expenditure in the community and which of these activities require water.
3. A timeline of the history of the village water situation.
4. Task and role players' matrix looking at water related tasks and the roles local institutions play in these
5. Sources and uses table to set out the various sources of water for the village, and what water from each source is used for.
6. Social mapping,
7. Well-being or welfare ranking

This is followed by assessments of selected households across welfare categories (as locally defined). Semi-structured interviews within households are held to understand household

livelihood strategies, water use, and how factors such as age and gender affect vulnerability and resilience of households.

The village synthesis: The assessment information is then collated and presented by the facilitators to a village gathering to confirm or add to the information, and to then collectively analyze. This forum identifies and prioritizes responses to problem areas. The village synthesis prepares villagers to engage in the multi-stakeholder platform from a considered and mandated position.

The Ward Synthesis and Planning: The objective of the Ward Synthesis is to develop plans for improvement of water services in the ward to be included in the municipal planning process. Village assessment and synthesis information is collated and presented to a Ward Synthesis and Planning platform. This brings together village representatives and service providers, to collectively analyze the outcome of the assessments and to develop agreed strategies, plans and prioritized projects. The projects and plans are then assigned to individuals within institutions for tabling for resource allocation.

2.5 Water for Consumption

2.5.1 Poverty and Health

The links between poverty and health are well-established. From the earliest development of the 'sanitary revolution' it has been recognized that poor households suffered the greatest health burdens. Indeed, a significant driver for the sanitary revolution was to address ill-health among the poor. Studies in both developed and developing countries continue to point to the greater health burden carried by poor households compared to their better-off neighbors. The relationship between poverty and health is complex and operates through a number of direct and indirect factors, affecting both communicable and non-communicable disease. Poverty is often associated with increases in exposure to agents that cause communicable diseases. Poor families frequently live in contaminated and degraded environments where pathogens (micro-organisms that cause disease) and toxic chemical agents are abundant and often in high concentrations in the air, soil and water. Such environments also often support development of habitats that allow breeding of vectors that transmit disease such as malaria and dengue fever. At the same time,

services such as water supply, sanitation and drainage are often less well developed, have a lower quality of service or are of high cost or poor reliability. In addition, the quality of housing and over-crowding increase the likelihood of infectious disease transmission. Poverty increases vulnerability or susceptibility to disease. Poor people tend to have lower levels of nutrition and increased disease burdens. This in turn increases the likelihood of further infection as immunity is suppressed (Howard and Obika, 2003).

2.5.2 Water and Heath

Water is an essential requirement for health. It is needed to maintain physiological functioning, to grow and cook food and to maintain personal and domestic hygiene. The lack of access to water for use by households is closely linked to disease, both directly (for instance, poor domestic water supply) and indirectly (such as poor nutrition resulting from lack of access to water for irrigation). The effective use of water in activities that promote good health and are protective against disease is therefore essential to the improvement of public health. The importance of access to water is mirrored by the importance of removing excess water and the waste produced from its consumption – which can be described as environmental sanitation. Good sanitation, water and hygiene could prevent much of the morbidity and mortality from diseases such as diarrhoea, poliomyelitis, Hepatitis A, roundworm, whipworm and hookworm (Howard and Obika, 2003).

2.5.3 Water Resources and Impacts on the Health

Rural poverty in many parts of the world is closely related to the ability of households and communities to have access to adequate resources (in terms of both quality and quantity) to support the production of crops for direct consumption and for sale. As with domestic water supply, inequity in access to water resources results in inequity in socio-economic status. Such inequity is not solely a function of unequal inter-community distribution of resources, but also intra-community allocation of abstraction rights. Resolving such issues is an important component of sustainable rural development (Howard and Obika, 2003).

Water, poverty and health are closely linked. Poor access to domestic water and sanitation leads to increasing levels of disease and contribute towards continuing poverty. Access to broader water resources and effective management of those resources is essential to reduce

health burdens and promote sustainable livelihoods. Reducing water and sanitation related health burdens is achievable at relatively low cost and will contribute to reducing poverty. To achieve increases in access, more flexible and innovative approaches are required to promote uptake of services and to develop incremental improvements.

2.5.4 Water, Health and Poverty Linkages

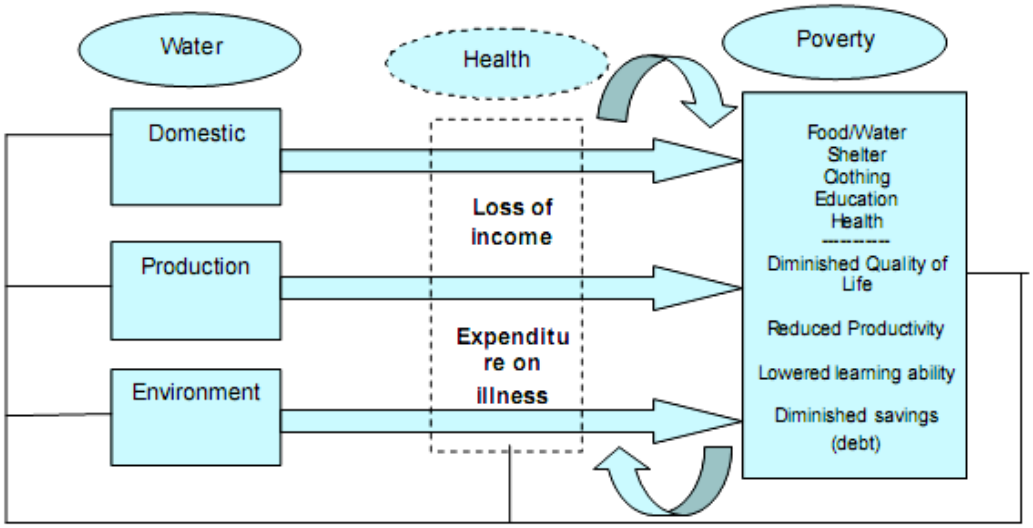

Figure 2.6 Water, health and poverty linkages - A simplified framework

Health and poverty have a two-way relationship: poverty is both a cause as well as a consequence of poor health. Poor people remain unable to secure even the basic necessities of life – adequate food, adequate safe water, clothing, shelter and health care. Poverty restricts or deprives access to healthy living conditions, access to nutrition, access to preventive measures, and effective treatment, therefore poor are more likely to suffer from adverse health effects, and more often.

Conversely, poor health and illnesses have a negative effect on the livelihoods. Unhealthy people are much less productive. To escape from poor health and to treat sudden illnesses one requires money which the poor can ill afford. The loss of income and the inability to

pay for the cost of treatment can push a family further into debt plunging them into the cycle of poverty (Sarath and Hussain, 2002)

It is evident from the linkages framework shown above that any positive actions towards reducing poverty will have a cyclic effect resulting in improved productive output and health and consequently a further reduction in poverty; hence an upward spiral improvement. Similarly, adverse effects can make it spiral downwards.

In order to understand pathways and linkages between water, health and poverty clearly, water use is classified into three broad categories; water for domestic consumption, water for production purposes, and water use for environmental sustainability (Sarath and Hussain, 2002)

Water for Domestic Consumption: Water is a basic human need and essential for survival. Access to basic minimum quantity of safe water (roughly around 20 liters per person per day) is every one's right. Unlike all other goods, the utility and value of a glass of water for an extremely thirsty person is infinity. Similarly the value of water for other domestic uses such as food preparation, hygiene and sanitation is also very high. These uses of water are directly related to health. A large number of diseases, including, diarrhea, dysentery, and cholera are caused by these direct uses of insufficient or unsafe water, leading to impacts in both short term as well as in the long term. Lack of availability of adequate safe water for domestic uses forces the poor to extract water from alternate sources: (a) often fetching water, generally of poor quality, from long distances with much drain on time and energy, particularly of women and children, sometimes preventing them from spending time on income generating activities and on schooling respectively or (b) incurring higher financial costs by buying water from informal vendors.

Water for Production - Irrigation/Agriculture: Water for production, especially in the agricultural sector, has been regarded as a powerful factor for providing food security, protection against adverse drought conditions, increased opportunities for more employment and stable income, and for offering opportunities for multiple cropping and crop diversification. Access to reliable irrigation enables farmers to adopt new technologies and intensify cultivation, which lead to increased productivity, overall higher production, and greater returns from farming. This, in turn, opens up new employment opportunities, both on-farm and off-farm, improves income and livelihoods, and the quality of life in rural areas, and reduces the vulnerability caused by seasonality of agricultural production and external shocks. All these factors contribute to

alleviation of poverty. However, there are also negative impacts of irrigation (mostly associated with poor management of irrigation) that tend to increase poverty resulting in the development of unfavorable conditions in relation to health in terms of vector breeding, pathogen transmission etc.

Water for Environmental Sustainability: Water is essential for environmental health/ecological balance, just as safe water is essential for human survival and good health. In addition to its role in maintaining ecological balance, water use for environment has the five key dimensions similar to those for water use in the production process particularly in agriculture - production, income/consumption, employment, vulnerability/food (in) security, and overall welfare. Therefore, water use for environment has direct linkages with poverty, as is clear from the following statement: "the poorest often suffer most from the consequences of environmental degradation because of their immediate dependence on the natural resource base for their basic necessities (food, energy, water and housing). Much of the income of the rural poor is derived from natural resources and environment-dependent agricultural activities. Surveys from 13 developing countries show that the rural poor depend for 40 to 85 percent of their income from agriculture" (Pinstrup-Andersen and Pandya-lorch, 1994)

2.5.5 Links between Water Supply, Hygiene and Disease

Bradley (1977) suggests that four principal categories relate to water (that are not mutually exclusive):

1. water-borne - caused through consumption of contaminated water (for instance, diarrhea, infectious hepatitis, typhoid, guinea worm);
2. water-washed - caused through use of inadequate volumes of water for personal hygiene (for instance, diarrhea, infectious hepatitis, typhoid, trachoma, skin and eye infections);
3. water-based - where an intermediate aquatic host is required (for instance, guinea worm, schistosomiasis); and,
4. water-related vector - spread through insect vectors associated with water (for instance, malaria, dengue fever).
5. Other workers have suggested a change in this classification system to replace the waterborne category with fecal-oral (to reflect multiple routes of transmission) and to restrict

the water-washed diseases to only those skin and eye infections that solely relate to the quantity of water used for hygiene (Cairncross and Feachem, 1993). The original Bradley (1977) system has particular value as its focus is on the potential impact of different interventions. The occurrence of particular diseases in more than one group is a legitimate outcome where distinct interventions may contribute to control. Thus guinea worm, for example, is classified as both a water-based disease and water-borne disease.

It is obvious that lack of sanitation and hygiene is a public disaster that deserves the highest priority. Most of these infections are preventable. Diseases such as diarrhea and parasitic worm infections need to be tackled by making improvements to water and sanitation facilities. However, such improvements must go hand in hand with hygiene behavior change, if transmission of disease is to be prevented (Vajpai, 2005).

The recent drinking water quality guidelines (WHO-2004) explain that the safety of drinking water supplies is based on multiple barriers and management approaches, mostly by reducing reliance on treatment processes alone. It advocates a preference for checking or reducing entry of pathogens into water sources from the microbial risks associated with contamination from human or animal feces, which is the source of pathogenic bacteria, viruses, protozoa and helminthes. Improved water supply reduces diarrhea morbidity by between 6 and 25 percent; if severe outcomes are included improved sanitation reduces diarrhea morbidity by 32 percent (UNESCO-water facts 2005).

It has been observed that if improved water supply and basic sanitation were extended to the present-day unserved population, the burden of infectious diarrheas would be reduced by some 17 percent; if universal piped, well-regulated water supply and full sanitation were achieved, this would reduce the burden by some 70 percent. Hygiene interventions (including hygiene education and promotion of hand washing) can reduce diarrhea cases by up to 45 percent (UNESCO water facts-2005).

2.5.6 Relationships between Water, Sanitation Hygiene and Diarrhea

Diseases primarily transmitted through the fecal-oral route (shown in Figure 2.7) include infectious diarrhea, typhoid, cholera and infectious hepatitis. Fecal-oral diseases are associated with acute symptoms (with a probability of death) and in some cases with delayed problems. Transmission may occur through a variety of mechanisms, including consumption of

contaminated water and food as well as through person-to-person contact (Bradley, 1977). These are dealt with together here, in order to emphasize the importance of local disease patterns rather than applying generic models. The available evidence from health studies suggests that interventions are likely to be locality-specific and are determined by timing and the interaction between different factors.

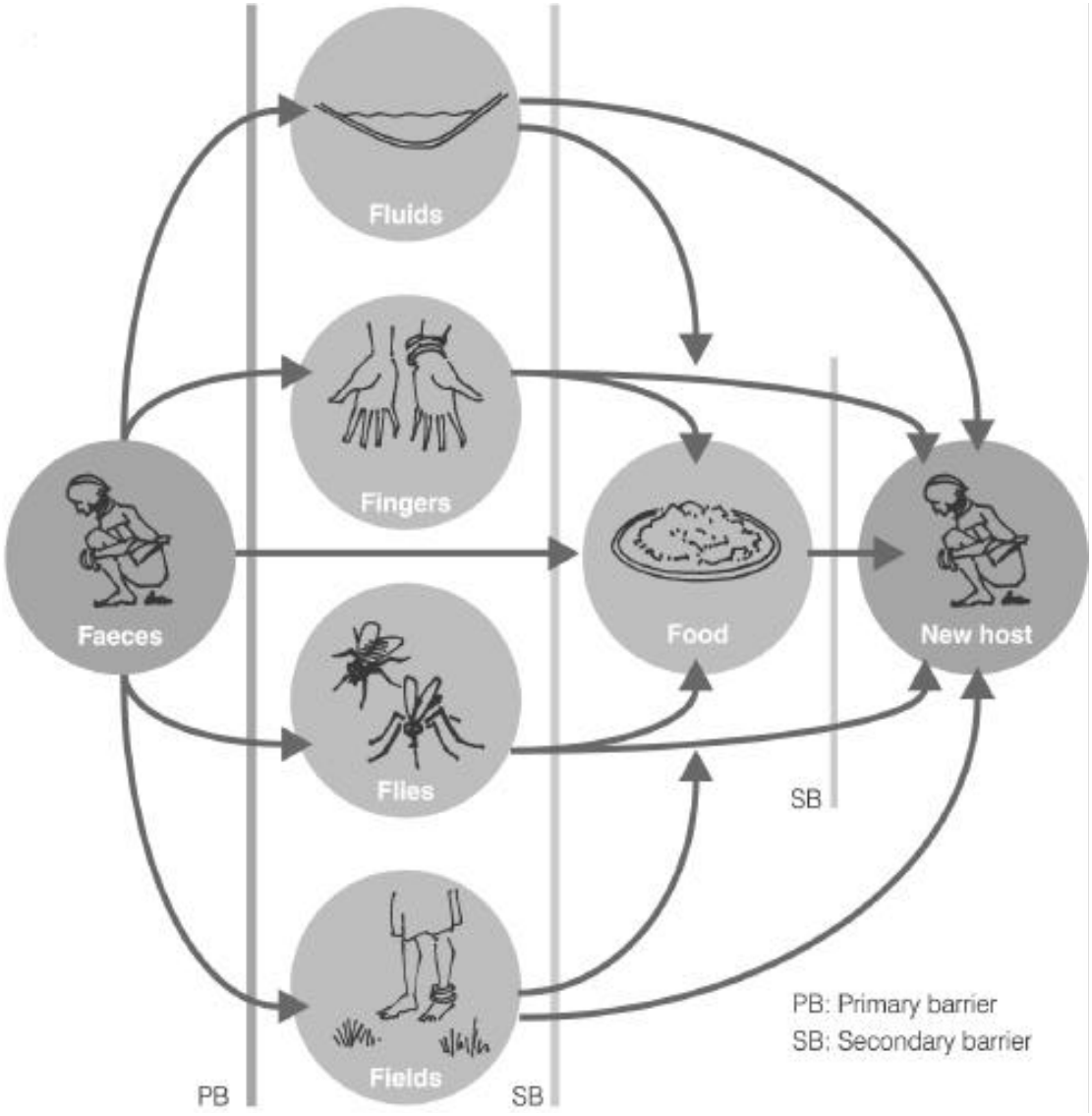

Figure 2.7 Fecal-oral route transmission of disease (taken from WELL, 1998)

In Malawi, Lindskog and Lundqvist (1989) discovered that the fecal coliform and fecal streptococci counts of water collected from all sources (wells, river, springs, and taps) increased significantly during storage—fecal coliform by as much as 41 percent for piped water and fecal streptococci by up to 33 percent for river water. The quality of stored water was best in households that used the same container to both draw and store water—so that the container was rinsed frequently—rather than keeping at home a separate storage container that was easily contaminated by users and rarely washed. Huttly et al. (1990) came to similar conclusions in Nigeria about diarrhea disease rates and the likelihood of water contamination during storage. If these findings reflect conditions elsewhere in the region—and given that the high cost of fuel wood precludes boiling water to destroy bacteria for most households—then reducing the incidence of fecal-oral diseases is likely to require changes in water storage practices.

The one study that measured volumes of water used for different purposes (Cairncross and Cliff 1987) found that water use for cooking nearly doubled when households had access to a nearby water supply. We found no evidence to confirm that lack of water for cooking is or is not an important cause of malnutrition or disease

A meta-analysis of studies of the efficacy of water supply and sanitation projects in reducing disease found average reductions of 26 percent in diarrhoeal morbidity, 55 percent in child mortality, 77 percent in schistosomiasis, and 27 percent in trachoma (Esrey et al. 1991). A study in Malawi (Lindskog and Lundqvist 1989) found that even when water is taken from a protected source, it often becomes contaminated during storage

2.5.7 Storage and Treatment of Household Water

Sobey (2002) had the conclusive ideas about the purposes and benefit of household water treatment and storage as below:

The purposes of household water treatment and storage addressed to improve and maintain the microbial quality of the water for drinking and other potable purposes, such as food preparation and essential hygiene in child care and treatment of illness (breast feeding and preparation of infant foods and oral rehydration solutions) and thereby reduce disease transmission. The main benefit of microbiologically safe water for these purposes should be obvious: reducing the risks of diarrheal and other waterborne infectious diseases. The alternative, unsafe water is a major source of pathogen exposure and increased risk of waterborne infection,

illness and death. Hence, the provision of microbiologically safe household water has the potential to reduce the infectious burden of the developing world's population.

Notably, it is now well documented that the provision of safe water alone will reduce diarrheal and other enteric diseases by 6 to 50%, even in the absence of improved sanitation or other hygiene measures. Reducing household diarrheal disease by more than 5% is an important achievement, because this is the minimum achievable target reduction in disease burden considered worthy of promotion and implementation by health authorities. It is also clear that the combined roles of safe water and adequate hygiene and sanitation are likely to achieve the greatest reduction in infectious disease burden compared to either intervention alone. However, it is now apparent that improving household water collection, treatment and storage is one option for achieving a beneficial health effect by reducing diarrheal and other infectious diseases. Household water treatment and storage systems are one of many waster, sanitation and hygiene options that deserve due consideration in the identification, prioritization and implementation of water, sanitation and hygiene measures for use at household, community levels (Sobey, 2002)

Some of the key factors influencing the impact of storage vessels and conditions on household water quality are: (1) portability and ease of use, based on capacity, size, shape, weight, presence of handles, (2) durability, weight and other properties related to resistance and longevity, (3) presence of a coverable (preferably screw-cap) opening for filling and cleaning access but small enough to reduce the potential for introducing contaminants by contaminated hands, dipping utensils and other vehicles (e.g., airborne dust), vectors, or other sources, (3) ability to withdraw water in a sanitary manner, such as via a tap, spigot, spout or other narrow orifice, and (4) presence and accessibility of documentation describing how to properly use the container for water treatment and sanitary storage. The most desirable water storage vessels for many household treatment and storage options are: (1) between 10-25 liters capacity, rectangular or cylindrical with one or more handles and flat bottoms for portability and ease of storage, (2) made of lightweight, oxidation-resistant plastic, such as high-density polyethylene or polypropylene, for durability and shock resistance, (3) fitted with a 6-9 cm screw-cap opening to facilitate cleaning, but small enough to discourage or prevent the introduction of hands or dipping utensils, (4) fitted with a durable, protected and easily closed spigot or spout for dispensing water,

and (5) provided with pictorial and/or written instructions for use affixed permanently to the container, as well as an affixed certificate of approval or authenticity (Sobey, 2002)

a. Boiling or heating with fuel

Boiling or heating of water with fuel has been used to disinfect household water since ancient times. It is effective in destroying all classes of waterborne pathogens (viruses, bacteria and bacterial spores, fungi and protozoans and helminth ova) and can be effectively applied to all waters, including those high in turbidity or dissolved constituents. Although some authorities recommend that water be brought to a rolling boil for to 1 to 5 minutes, the World Health Organization's Guidelines for Drinking-water Quality recommend bringing the water to a rolling boil as an indication that a high temperature has been achieved. These boiling requirements are likely to be well in excess of the heating conditions needed to dramatically reduce most waterborne pathogens, but observing a rolling boil assures that sufficiently high temperatures have been reached to achieve pathogen destruction.

Although boiling is the preferred thermal treatment for contaminated water, heating to pasteurization temperatures (generally 60 ºC) for periods of minutes to tens of minutes will destroy most waterborne pathogens of concern. Even heating to as little as 55 ºC for several hours has been shown to dramatically reduce non-spore-forming bacterial pathogens as well as many viruses and parasites, including the waterborne protozoans Cryptosporidium parvum, Giardia lamblia and Entamoeba histolytica (Feachem et al., 1983; Sobsey and Leland, 2001).

It is also recommended that the water be stored in the same container in which it has been boiled or heated, preferably one with a lid or other protected opening, in order to reduce opportunities for recontamination. It is further recommended that boiled or heat-treated water be consumed soon after it has cooled and preferably within the same day. This is because of the potential for microbial recontamination during prolonged storage. Introduction of microbes from hands, utensils and other sources is a major concern. A major disadvantage of boiling is its consumption of energy in relation to the availability, cost and sustainability of fuel. It is estimated that 1 kilogram of wood is needed to boil 1 liter of water. However, where affordable and sustainable sources of fuel are available without causing environmental degradation, heating household water to a rolling boil is an effective and accessible method of treatment for collected household water (Sobey, 2002)

b. Educational, behavioral and related socio-cultural considerations for household water treatment systems

A number of studies and considerable field experiences have shown that the introduction of water treatment technology without consideration of the socio-cultural aspects of the community and without behavioral, motivational, educational and participatory activities within the community is unlikely to be successful or sustainable. Therefore, initiatives in water, hygiene and sanitation must include community participation, education and behavior modification. A number of systems have been developed and successfully implemented for this purpose. One of the most widely used and successful of these is termed PHAST, which stands for Participatory Hygiene and Sanitation Transformation (WHO, 1994). It is an adaptation of the SARAR (Self-esteem, Associative strengths, Resourcefulness, Action-planning and Responsibility) method of participatory learning. PHAST promotes health awareness and understanding among all members of a community or society in order to change hygiene and sanitation behaviors. It encourages participation, recognizes and encourages self-awareness and innate abilities, encourages group participation at the grassroots level, promotes concept-based learning as a group process and attempts to link conceptual learning to group decision-making about solutions and plans of action for change and improvement of the current situation. It encourages internally derived decisions and both material and financial investment of the community to affect change.

c. Proposed best practices

The materials used in construction of gravity-feed water systems have to be carried into the project site by community members. All construction is done by hand onsite with community labor. Simplicity and flexibility are key factors for cost effectiveness and sustainability in design and implementation. By providing the labor the communities easily learn how the water system is constructed, ‘own’ the process, and become committed and knowledgeable in how to maintain the system (Jensen and Abel, 2005)

Hygiene and sanitation behavior change programs must be integrated into the water supply project construction. It is best to keep these programs simple and focused on no more than five behavior change goals – such as washing hands, use of toilets, cutting the grass in the village or avoiding stagnant pools of water through poor drainage (Jensen and Abel, 2005)

d. Reducing health risks

Good health is a key to poverty reduction, directly affecting the quality of life of poor people and an essential pre-requisite for sustainable increases in income. Ill health is a double burden: it reduces productive capabilities and means limited resources (time and money) have to be spent on caring for the sick. It is the most vulnerable, women and children, the extreme poor, the elderly, the malnourished, who bear the burden of ill-health the most and are the least able to cope with it. Sustainable improvements to health conditions are a key to poverty reduction, and in turn improvements to water management are a key to improving health conditions (Soussan el at, 2005)

Water and health are intricately linked. A workable public health perspective of all water issues requires a clear definition of the nature and magnitude of the links between water and health. There are basically two types of links between water management and the incidence of ill health: water as the conveyance medium of pathogens and water providing the habitat for vectors and intermediate hosts of pathogens. To these can be added the significance of water availability in rural areas in determining food security and nutritional status (itself a key determinant of health) and, in some parts of the world, the growing significance of water-related disasters such as floods, storms and major pollution incidents resulting in injuries, deaths and the incidence of many diseases (Soussan el at, 2005).

As Cairncross et al (2003) show, the impact of water on health relates to both the quality of water and the quantity of water available to households. The quality issue is obvious: unsafe water directly causes illness and infection. The quantity of water is particularly important for the regularity and effectiveness of hygiene practices: where water is scarce then far less is available for cleaning. The significance of this collective knowledge based on water and health links lies in the options they provide for effective ways to prevent ill health and disease, and to promote the health status of communities. Access to safe drinking water, combined with sanitation that prevents contaminants from reaching sources of drinking water and with hygiene behavior such as hand washing and proper food handling, supported by sufficient quantities of water, are the main tools in the fight against gastro-intestinal infections. These principles, in turn, lead in the fight to improve the livelihood of the poorest segments of society.

CHAPTER 3

MATERIAL AND METHODS

3.1 The study area

Lao Nya village is located in the corridor areas of two National Protected Areas, named Dong Hua Sao and Xe Pian. It is in Pathoumphone District, Champasack Province. Lao Nya is a typical rural village in a very remote area of the country, approximately 77 km from the nearest center city of Pakse.

Lao Nya is far from the Center of Pakse City or the South of Champasak Province 79 km, far from th East of Pathoumphone District 34km, and is 26 km away from the nearest paved road. This village shares borders with four neighboring villages: Somsouk to the North, Nam Om to the South, Nong Ake to the East and Nabone to the West. More details about village location and borders with other villages are shown in Table 3.1 below, supplemented by the location map (Figure 3.1).

Table 3.1 Location of the Villages

Village Name	Location direction	Bordering
Lao Nya	79 km South of Province	Somsouk village to the North
	34 km East of District	Nam Om village to the South
	26 km West to paved road	Nong Ake village to the East
	Mean Sea Level: 187 m	Nabon village to the West

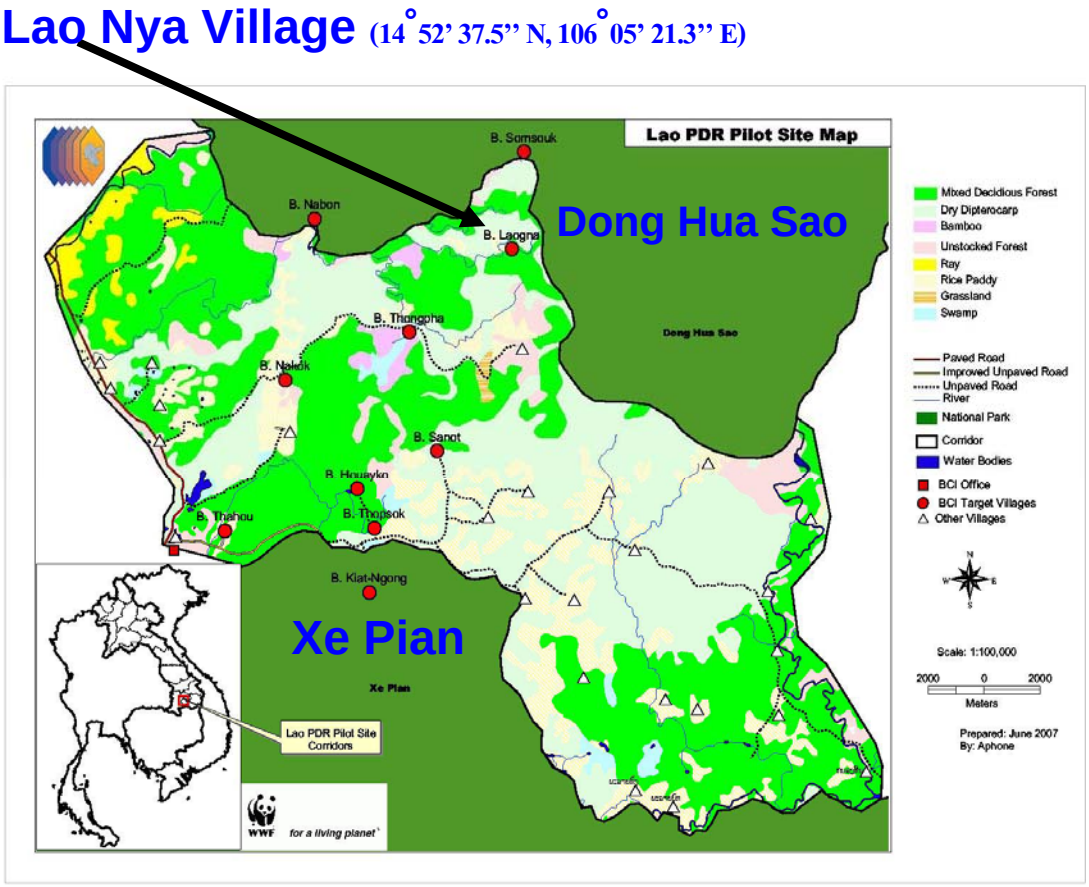

Figure 3.1 Map of Lao Nya Village with settlement (World Wildlife Fund, 2007)

3.2 Data Collection

3.2.1 Primary Data

According to some relevant indicators such as housing, land holdings, physical assets, livestock (draft animals), labor, rice sufficiency, and main occupations, the villagers can be classified into four groups, namely: well-off, moderate poor, marginal poor and very poor.

The overall conditions go down from the well off group to the poorest one for almost all indicators that we already used for classifying the poverty in the village based on local villagers' perceptions and facilitated by the researcher and field assistants. More details about the characteristics and the indicators in classification of each group are in Table 3.2 below

Table 3.2 Main characteristics of each grouping of villagers

Indicator	Well-off	The poor		
		Moderate poor	Marginal poor	Very poor
Housing	Permanent house: metal roof, wooden walls and floors, large size, some having more than one house	Half permanent and/or temporary house: half metal roof, half bamboo and wooden walls/floors, medium size	Half permanent and/or temporary house: half metal roof, half bamboo and wooden walls/floors, medium size	Temporary house: grass roof, bamboo walls and floors, small size
Land Holdings	Average paddy land 0.76 ha	Average paddy land 0.27 ha	Average paddy land 0.05 ha	No paddy land
Physical Assets	Trucks, Kubota, motorcycles, rice mill, retail shop, color TV, mobile phone, etc	Kubota, motorcycles rice mill, black & white TV, mobile phone, etc	Limited housing materials or physical assets	Limited housing materials or physical assets
Livestock (draft animals)	Own more than 10 buffalos or cows	Own 5-9 buffalos or cows	Own1-4 buffalos or cows, or none	Own no buffalos or cows
Labor	Have sufficient productive laborers (on average 4 people)	Have almost enough productive laborers (on average 3)	Have insufficient productive laborers (on average 2)	Have insufficient productive laborers (on average 2)
Rice Sufficiency	Rice exceeds consumption all year round	Rice is almost enough for consumption, but some HHs lack rice for 1-3 months	Rice is lacking from 4 - 11 months	Rice is lacking all year round

Primary quantitative and qualitative data were collected for each of these four groups of villagers. Two specific methods were used: Rapid Rural Appraisal (RRA) and Participatory Rural Appraisal (PRA). RRA and PRA include structured interviews and group discussions with key informants (KI) respectively, and development of land use information and socio-economic conditions (criteria for ranking households into the group classification scheme, household income and expenditures, livelihood options).

The sample size for households selected for RRA (structured interviews) was based on the Yamane formula (Yamane, T, 1973).

$$n = \frac{N}{1 + Ne^2}$$

Where

n = sample size

N = Population size

E = level of precision (0.05 significant levels)

With 98 households in the target village, the sample size was therefore 78:

$$n = \frac{98}{\{1 + 98(0.05)^2\}} = 78$$

Initially all the village households were appraisal targets since the number of households are not too many, all 98 households were expected to be interview all rather than only 78 households result from the above calculation. The formula above just shows that the actual numbers of interviewed households are under the acceptable range of this particular formula. However, since the RRA was carried out during the growing season, some households temporarily moved to stay in their fields outside the village. Therefore, 92 households out of 98 were interviewed. Profiles of the interviewed households are presented in Table 3.3.

Table 3.3 Household profiles for RRA interviews

No	Well Group	Total Households	Selected households	Percent
1	Well-off	12	11	92
2	Moderate poor	48	46	96
3	Marginal poor	34	31	91
4	Very poor	4	4	100
5	**Total**	**98**	**92**	**93.9**

3.2.2 Secondary Data Collection

Secondary data were gathered from all the key sources and implementing agencies in the area, both government offices and non-governmental organizations: Biodiversity Conservation Corridors Initiative (BCI), International Union for the Conservation of Nature and Natural Resources (IUCN), World Wildlife Fund (WWF), Champasak Agriculture and Forestry Division, Department of Public Health, village records, etc.

3.3 Research Approach

3.3.1 Community-based approach (CBR)

As it is identify clearly in the topic of this research that the community-based approach is the main method, however both quantitative and qualitative methods are also applied. These two approaches are discussing in more detail later on. At the same time, the research methodology is interdisciplinary in both physical and social sciences.

3.3.1.1 Principles of community-based research

While the critical research model of community-based research draws on multiple diverse historical influences, it is guided by three central principles that represent its core tenets.

In this way, CBR engages the resources of colleges and universities to help communities address pressing problems (Bacon, 2003). The 3 central principles are:

1. CBR is a collaborative enterprise between academic researchers and community members.

2. CBR validates multiple sources of knowledge and promotes the use of multiple methods of discovery and dissemination of the knowledge produced.

3. CBR's goal is to achieve social justice through social action and social change.

A community-based approach can help communities to work together to prevent social problems and to deal directly with those that do arise, instead of having external actors step in and assume these responsibilities. It supports persons of concern in re-establishing familiar cultural patterns and support structures. Indeed, the goals of the community-based approach are to reinforce the dignity and self-esteem of people of concern and to empower all the actors to work together to support the different members of the community in exercising and enjoying their human rights (UNHCR, 2008)

3.3.1.2 Advantages and limitations of community-based approaches

Top-down approaches, emphasizing centralized government authority and control, often encounter limited effectiveness in managing water and other natural resources. While there is now increased acceptance and support, for community-based approaches to natural resources management and conservation, at least in policy aspirations, such approaches are also subject to growing critical scrutiny (Bruns, 2005; Agrawal and Gibson, 2001; Agrawal, 2003; and Mansuri and Rao, 2005). Efforts to strengthen community roles and devolve responsibilities to local bodies may be combined or may conflict with decentralization efforts within government agencies (Knox and Meinzen-Dick, 2001; Mosse, 2003; Ribot, 2003).

Community-based approaches may also be pursued for practical reasons, as an instrument to achieve goals such as increasing equity or water productivity, or simply shifting costs away from government to local residents. Many of the advantages of community-based approaches potentially apply in situations where water rights are negotiated as part of basin water management (Bruns, 2005). Such advantages may be summarized as:

1. Water users possess detailed local knowledge about how they use water, their needs, and the possible consequences of changes. Community-based approaches cultivate channels through which this information can be considered in making decisions.

2. Collective action to manage water weaves water users together in webs of relationships. These relationships build social capital of trust and shared understanding that facilitates cooperation.

3. As part of their daily activities, it is often easy for water users to observe whether their neighbors are fulfilling their commitments and obligations in using water. Each participant can monitor and detect nearby violations with relatively little time and effort.

4. Communities can selectively apply sanctions unavailable through formal institutions. The threat of being shamed or of losing one's reputation as a respected and trustworthy member of the community may compel compliance. Water users possess strong incentives and willingness to struggle for their access to water.

5. Community-based approaches may be able resolve many conflicts at a local level, by those most concerned, with little cost or complication. Such actions, customized to local circumstances, reduce the transaction costs of coordinating resource use and implementing agreements.

6. Involving communities in decisions actually affecting them builds legitimacy and support, reducing risks of rejection and resistance. Participation realizes principles of democracy and empowerment.

7. Water management may become more effective when it utilizes the capabilities of participant water users, not just as individuals but also as members of communities that are linked by ongoing relationships, with shared views and common interests that facilitate ongoing cooperation.

Community-based approaches have sometimes been advocated and applied with inadequate attention to the variety of people involved in using and managing resources in local areas, and the intricate arrangements through which they compete and cooperate. Simplistic stereotypes of isolated, small, stable, and homogeneous groups sharing the same interests and traditional norms for preserving local resources often fit poorly with the complexity of how diverse local and external actors actually struggle to make and break rules about exploiting and

replenishing resources that may be mobile and interconnect broad areas (Agrawal and Gibson 2001).

The special local conditions in any target area and the evident limitations of community-based approaches both need to be considered along with the inherent advantages of these approaches. Critiques of community based natural resources management concentrate on core themes of conflict and contextual contingency, or, in simpler terms, politics and history.

3.3.2 Qualitative approaches

Qualitative data collection and analysis is a useful starting point for studying collective action, especially when and the area's key institutions are not well understood and neither are all the manifestations of collective action. Qualitative methods are flexible, allowing researchers to adapt hypotheses and methods to fit the local situation. While many may see qualitative and quantitative methods as being opposed to each other, in reality they can be highly complementary, particularly in studies of collective action (Meinzen-Dick, R et al, 2004)

Qualitative methods can be used to design and implement quantitative methods and to interpret quantitative information when used in an iterative manner. On the other hand, information from quantitative studies can help researchers choose case study sites for more in-depth analysis (Meinzen-Dick, R et al, 2004)

Specific data collection techniques include participant observation, detailed case studies, unstructured or semi-structured interviews with key informants or focus groups, oral histories, a range of participatory research and visualization techniques such as community mapping exercises, seasonality charts, matrix ranking exercises, and Venn diagrams (Meinzen-Dick, R et al, 2004)

Many qualitative techniques have the advantage of allowing researchers to build rapport with respondents, who in turn can provide the insider's view and understanding of the situation. The process can identify relevant institutions that might otherwise be overlooked, as well as elicit information on rules, norms, and attitudes that have a strong bearing on collective action. Qualitative information can also be collected on the process by which people actually make and implement collective decisions, and the process of institutional change. (Meinzen-Dick, R et al, 2004)

3.3.3 Quantitative approaches

Quantitative approaches are particularly useful for generating results across a sample population, since the sample itself should be drawn with the express intent of ensuring representativeness. Multivariate analyses enable researchers to isolate the impact of one variable on collective action and/or the outcomes of collective action, holding constant the impact of all other variables thought to affect collective action or its outcomes (Meinzen-Dick, R et al, 2004)

Quantitative analyses can be extremely useful for exploring the determinants of successful collective action, but a lot of preparatory fieldwork must be done up front in order to identify collective action outcomes and indicators of cooperative capacity that truly reflect the real-world situation and are comparable across the population under consideration. Careful thought must also be given to issues of endogenous impacts and thus what information can be collected that would enable researchers to create instrumental variables that can be used in place of potentially endogenous variables (Meinzen-Dick, R et al, 2004)

3.3.4 Data Collection Method

This research is focused on understanding a single target community, calling for a mix of qualitative and quantitative social study methods to gather all required and necessary information especially approaches. Both Participatory Rural Appraisal (PRA) and Rapid Rural Appraisal (RRA) were the key tools used for data collection in this research. Especially important were structured interviews, open interview, group discussions, participant observation and participant mapping. For water demand/supply and water quality accessibilities, float flow measurements and laboratory testing were used, respectively. The details of each method are described below.

3.3.4.1 Rapid rural appraisal (RRA)

Based on the research objectives, research questions, expected outcomes and other requirements to obtain enough data for the analysis, structured interviews which is one out of many approaches under RRA were designed. They were used to gather relevant data not only about the water resources but also other socio-economic indicators, incomes and expenditures, and similar topics.

Structured interviews with household heads and housewives were conducted by questionnaire in July 2009. Interviews were carried out in the Lao language. The preliminary

review was carried out to validate the questionnaire and some revisions were made to improve the questionnaire to the desired standard.

This household questionnaire had four parts: background information (household profile), socio-economic data, community-based water consumption, and available water production. Details are shown in Table 3.4.

Table 3.4 Structure of the household questionnaire

Part	Content
Part1	Basic household information: This includes the registration number, location, material uses. (This information was used to classify the household classification in terms of its well-ranking.) This part also consists of the numbers of people or even separate families in the house, detail of family work habits and other information on productive labor, land ownership, history of villagers' settlements, and how they see changes in available natural resources.
Part2	Information on hygiene and health: This part aims to gather data on common diseases, infant mortality, sickness treatment as well as their thinking about toilet construction in the village.

Table 3.4 (continued)

Part	Content
Part3	Information on water resources: This section starts by asking about water in general, like their observations on changes in water supply over the past 10 years, and their feedback on proposed rules and regulations on water management. It also consists of villagers' expectations about outsiders' support in terms of water. Lastly this part ends with daily water uses and sources, especially water for domestic and gardening uses. After general water information this part follows by data collection about water for consumption in order to search for their perspectives on how they think about the available water sources: which ones they are currently using; whether they are clean or not; whether they boil water before using it, or not; and how their use of unboiled water affects their health. Current water collection practices and potential drinking water sources such as rainwater and ground water are also asked about in this part. Part 3 ends by asking about water for production, which aims to see the benefits of extending water availability, such as the information on dam and channel construction, river bank cropping systems, community fish ponds, rice field/fish raising combination practices, and the potential productive water resources.
Part4	Income and expenditures: The objective of this part is to find out main annual incomes and expenditures of different groups within the village. The questions helped determine their sources of income and the main items that they have to spend for. Answers not only help us to understand the economic situation here but also give us a social perspective in terms of their livelihood options. We can find reasons why the well-off can earn more while the poor earn less, or why some groups have lower expenditures than others or vice versa. Part 4 has two main points. The first involves income sources such as from crop products, livestock, NTFPs, trading, handicraft, labor wage, fishery, etc. The second is about general expenditures, their total amounts; items purchased, and purchase prices.

3.3.4.2 Participatory rural appraisal (PRA)

Group discussions under the PRA approaches were used to gather some relevant information particularly about qualitative topics for which information cannot be collected by household interviews and that can provide more important indicators as well as suggestions. At the same time, group discussions can also cover a bigger group of people and in broader dimensions. During the discussion participants also interact with one another and often come up with similar agreements on key topics of interest. That is the reason why focus groups were part of this study's method.

Group discussions were carried out three times. The first group discussion took place in May 2007. The main points discussed were a preliminary survey of general and basic information related to the village itself, mostly the village profile, socio-cultural profile, bio-physical conditions, land and forest resources use, economic situation, production input use, production constraints/problems, and physical and social infrastructure. Most of these data were collected in percentage terms by using the rapid tool called Ten Seed Techniques (TST).

The second group discussion was carried out in May 2008. The main focus was on more detailed discussion on poverty assessment, livelihood analysis and land use management using the livelihood-ranking classification among the villagers themselves, with relevant indicators. The proposed interventions for livelihood improvement as well as land use management were discussed during that particular discussion. Small-scale irrigation system improvement was one of those possible livelihood interventions.

The third discussion occurred in July 2009. In this discussion, group livelihood-ranking information was updated, and other specific information on water resources were raised, such as: general issues related to water and sanitation within the village, villagers' expectations on water resources management, potential accessibility of the water supply for both productive and consumptive water uses, traditional water ceremonies, benefits from possible channel construction, proposed plan for benefit sharing from that irrigation improvement, villagers' feelings about

community fish ponds, river bank cropping practices, rules and regulations on water management as well as their effect on water use in the downstream community.

In total, 30 participants (male 29, female 1) were involved in all 3 group discussions. All key informants are from village authorities and other relevant sectors in the village. More details on Focus Group No. 3 are summarized in table 3.5.

Table 3.5 Key informants participating in the 3rd focus group

No	Participant	Total number of people
1	Village chiefs	2 out of 3
2	Head of administration unit	6 out of 7
3	Elders (senior citizens)	4
4	Foresters	3
5	Women ‘s representative and health care volunteer	1
6	Customs representative and Communist Party Secretary	1
7	Security Representative (Policeman)	1
8	Defense Representative	1
9	Other villagers	11
10	**Total**	**30**

3.3.4.3 Stream flow measurement

Stream flow measurements (using a float) were made in three streams that traditionally have been very critical water resources for the village. The measurements were taken during two peaks: during the driest month (April) and wettest month (September).

From these measurements, water velocity is estimated based on the total distance and travel time of the float.

Water velocity, V (m/s) = $\frac{L}{t_{average}}$, where $t_{average}$ (s) = $\frac{t_1 + t_2 + t_3}{3}$

After that, water flow can be estimated based on the velocity and the cross-section area, A (m^2), then water flow, Q (m^3/s) = V (m/s)* A (m^2).

The results of data collect from above measurement are presented in next chapter on result and discussion.

3.3.4.4 Water quality assessment

According to the climatic information, April is the driest month of the year. It is therefore significant in terms of water quality assessment, since the villagers still have to rely on the water from the stream for their daily consumption.

Samples of water from two related streams, Huay Lao Nya and Huay Loh, were taken for analysis at the nearest laboratory: at the Division of Environment and Water Supply, Department of Health, Pakse District, Champasak province. Huay Lao Nya is a daily consumptive water source, while Hauy Loh is the stream containing the village's small scale irrigation project. Water from that particular stream will be diverted to increase the water supply of Hauy Lao Nya.

The required parameters for water testing with the standard of Lao government are shown in Table 3.6.

Table 3.6 Water testing parameters and Lao standard on drinking water quality

No	Sampling Parameters	Unit	Standard
1	pH	-	6.5 – 8.5
2	Turbidity	NTU	<10
3	Taste and Odor	mg/L	Acceptable

4	Conductivity	µS/cm	1000
5	Iron	mg/L	<1
6	Manganese	mg/L	<0.5
7	Arsenic	mg/L	<0.05
8	Fluoride	mg/L	<1.5
9	Nitrate	mg/L	50
10	Thermo tolerant coli form	No/100ml	0
11	Total hardness	mg/L	<300
12	Nitrite	mg/L	3
13	Residual chlorine in chlorinated water supply	mg/L	0.2

3.4 Data analysis and Interpretation

Data gained from the structured interviews and group discussions, and data on the water budget as well as the other information on climate and relevant secondary data were subsequently entered into a computer and then analyzed and interpreted by using program EXCEL and Statistic Package for the Social Sciences (SPPS) version 16.0. The intent was to see the varied dimensions of water resources to villagers' socio-economic conditions as well as to see broader expectations of local people on water use and make sure that new initiative will be integrated successfully into the existing condition and contribute to livelihood improvement and poverty reduction as the main objectives of BCI context.

The result of water quality analysis was compared with the current Lao PDR standard to see the water quality of the stream that is currently being used by the villagers, and then find out the suitable solution for such particular problems.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Baseline Information on Interviewed Households

4.1.1 Information of HH Respondents

As mentioned under the "methodology" section, 92 out of 98 (93.9%) of local households were selected for structured interviews. Most interviewees (69) were household heads (mostly men) who seemed to know better the conditions within their households and be able to explain those broadly; however, the housewives (23) were also important in providing some specific data, especially about monetary expenses, income generation, water consumption, water collection, etc. Because the interviews took place during the time for villagers' farming activities, it was impossible to interview both of these groups equally. However, most of the time, both husband and wife were interviewed at the same time, except when the women had to do the housework or were not at home. This explains why the number of men interviewed is higher than women. Another reason is cultural -- the wife let the husband give information since men are considered to be able to do so.

According to the results of the household interviews, almost all households (87 out of 92 or 88.8%) reportedly were satisfied with the ranking groups to which they were assigned; only 5 households were dissatisfied. These few cases included households placed in the moderate poor group that thought they should be in the marginal poor or very poor group, and some households assigned to the very poor group that wanted to be in a better one, plus well off households that wanted instead to be considered in the moderate or marginal poor grouping.

The youngest interviewee was 19 and the oldest one 69, with a mean age among respondents of 37.45. Age levels fell into 5 categories, with respondents 26 to 35 years old accounting for the largest set; details are shown in Table 4.1.

Table 4.1 Age levels of respondents

Age range (years)	No. of Respondents	Percent
19-25	11	12.0
26-35	32	34.8
36-45	22	23.9
46-55	20	21.7
>56	8	8.7
Total	**92**	**100**

Almost all respondents (53%) had finished primary school grades 2 or 3 only; most of the rest (41%) are illiterate; only 5 respondents have completed lower secondary school. See more detail in Table 4.2.

Table 4.2 Educational levels of respondents

Educational Level	No. of Respondents	Percent
Illiterate	38	41.3
Primary school	49	53.3
Lower secondary school	5	5.4
Total	**92**	**100**

4.1.2 Household Size

Based on the household information gathered by questionnaires, sizes range from 1 to 15 people, with an average household size of 5.84. Under Lao tradition, married children still live with their parents in order to take care of them, thus explaining why average household size is a bit large. However, medium size accounts for the single highest percentage, followed by large and then small ones, respectively. Details are in Table 4.3.

Table 4.3 Household size

Household Type	Family members	No. of Respondents	Percent
Small size	1-3	13	14.1
Medium size	4-6	47	51.1
	7-9	26	28.3
Large size	10-12	5	5.4
	13-15	1	1.1
Total	**-**	**92**	**100**

4.1.3 Migration

The majority of the interviewees (75 households, 80%) are original citizens of Lao Nya; the rest (17 households, 20%) moved here from outside. Of that group, 41 percent (7/17) originated from nearby areas of Pathoumphone District such as Khong, Pakse, or Sanasomboun. The other 59 percent (10/17) were from villages near Lao Nya like Nam Om, Nathong, Thongpha and To Mo. Their main reasons to move into Lao Nya were inter-community marriages.

The duration that villagers have settled in this village were divided into four periods. Details are shown in Table 4.4. Those living here less than 20 years are mostly outsiders, while those who have been lived here longer than that are local citizens. As shown, 56% of respondents have lived in the village more than 30 years.

Table 4.4 Respondents' length of residence in the village

Duration	No. of Respondents	Percent
1-10	13	14.1
11-20	3	3.3
21-30	24	26.1
>30	52	56.5
Total	**92**	**100**

According to villagers, 39 young local residents (male 22, female 17, all 15-20 years old) have worked in Thailand. Some have gone for more than 5 years and never come back; others came to visit their families and then returned to Thailand again. Based on the information from household interviews, most of them send money to support their families, but the actual amounts cannot be estimated since they send money just once in a while. Moreover, these details are sensitive since their parents do not want to provide exact details about those amounts of money because they would have to pay some tax to the village. The village authority normally collects tax based on the amount of money each household gets monthly or annually; this money is used as the village's fund.

4.2 General Socio-economics and Demographics of Study Site

4.2.1 Population

Lao Nya has a population of 612 (317 male and 295 female) living permanently within the village in 98 households (there are a total of 113 families, since some households include 2 or 3 families living together). All villagers are Buddhists, with no minorities at all. Almost all villagers are farmers, working on a combination of paddy land and upland rice fields plus gardening and livestock raising.

Household interviews show that number of people from 0-10 years old account for the largest group, followed by people from 11 to 20 and 21 to 30, respectively There are many more younger people in this village than older ones. Overall age structure is shown in Table 4.5.

Table 4.5 Age structure of Lao Nya Villagers

Age Range	Number of People	Number of Males	Number of Females
0-5	95	53	42
6-10	101	45	56
11-15	63	29	34
16-20	66	29	37
21-25	49	24	25
26-30	37	18	19
31-35	31	13	18
36-40	19	9	10
41-45	20	13	7
46-50	23	12	11
51-55	14	7	7
56-60	9	6	3
>60	18	11	7
Total	**545**	**269**	**276**

4.2.2 Occupations

In addition to farmers who comprise the main occupation, students and children, elders, and disabled people were also included in the occupational classification. According to the interviews, from the 545 people included in the interviews (out of a total of 612), farmers are by far the highest percentage. The second one belongs to the group who cannot do any work and the lowest one covers students; see Table 4.6

Table 4.6 Occupations of the villagers

Occupation	No of people	Percent
Students	88	16.1
Farmers	286	52.5
Non-working (children, elders, and disabled)	171	31.4
Total	**545**	**100**

Besides going to school, the students also have to help their family based on their ability and capacity. During farm work some have to be absent from school in order to take care of their younger siblings or go to the fields with their parents.

4.2.3 Educational Information

The primary school in Lao Nya village covers grades 1 to 5. There are 2 teachers for those 5 grades, one responsible for grades 1 to 3 and the other responsible for grades 4 and 5. There are many more students in the lower grades than at the higher level. Table 4.7 shows that 43% of students are in grade 1; students in grades 2 to 4 are 16% each; and the remaining 9% are in grade 5. Most students stop their studies after they finish either grade 3 or grade 5 since higher levels are available only in schools located far from the village. Their parents cannot support them to attend there, and they have to work for their family. Only a few students from the well-off families can continue their studies outside the village. Statistics are in Table 4.7.

Table 4.7 Student statistics (academic year 2008-09)

Grade	No. of students	Male	Female	Percent
1	38	21	17	43.2
2	14	8	6	15.9
3	14	6	8	15.9

Table 4.7 (continued)

Grade	No. of students	Male	Female	Percent
4	14	6	8	15.9
5	8	2	6	9.1
Total	**88**	**45**	**43**	**100**

The illiterate people still cover the highest percent, followed by the group who finish primary school; however, almost all of these people can just finish grade 2 or grade 3. At the same time, a very few are able to attain secondary and high schools. The former village chief graduated from college in agriculture, and led the community initiative in the water management conversion. Data on years of schooling completed and illiteracy rates for the village as a whole are presented in Table 4.8

Table 4.8 Educational levels completed

Educational level	No. of people	Percent
Illiterate	311	57.1
Primary school	224	41.1
Lower secondary school	7	1.3
High school	2	0.4
College	1	0.2
Total	**545**	**100**

4.2.4 Household Productive Labor

The productive laborer category covers those family members from 15 to 50 years old who are able to work. According to the result of household interviews, the well-off households have more productive laborers than the other groups; the moderate poor have medium amounts of labor available, and the marginal poor and very poor groups have least.

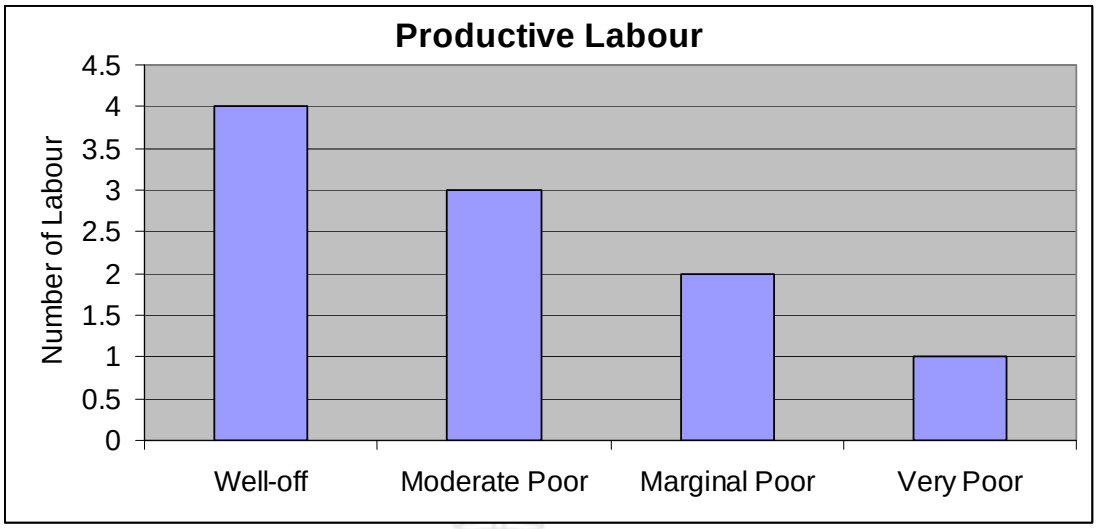

Figure 4.1 Average productive laborers by group

As shown, the well-off group has 4 productive laborers in each household, the moderate poor has 3, while the marginal poor and the very poor have 2 each (only half as much as the well-off households)

4.2.5 Land ownership

4.2.5.1 Communal land ownership

According to village records, land use in Lao Nya falls into four types: settled land, agricultural land, forest land, and other land. Forest land accounts for the highest percentage (84%), followed far behind by other land, agricultural land, and finally settled land. Within the last small category, residential land accounts for the highest percentage. Lowland rice is the main type of agricultural land, while protected forest is the main forest type in this village (accounting for almost one-third of all land in the village). Certain sub-categories are shown in the Table 4.9. No estimates could be made of upland rice land since the villagers move such cultivation from one place to another year by year. “Other” land means the kinds of land that have not yet been classified. Maps on land and forest cover with some more updated information of land use types in Lao Nya village are shown in Figure 4.2.

Table 4.9 Land use types with land size

Land type	Land size (ha)	Percent
1. Settled land	**4.51**	**0.3**
Residential	2.01	44.6
School	0.50	11.1
Temple	0.50	11.1
Worship area	0.50	11.1
Graveyard	1.00	22.2
2. Agricultural land	**48.96**	**2.9**
Home garden	0.50	1.0
Lowland rice	48.46	99.0
Upland rice	-	-
3. Forest land	**1,438.00**	**84.2**
Protected Forest	600.00	41.7
Productive Forest	342.00	23.8
Conservation Forest	355.00	24.7
Regenerated Forest	141.00	9.8
4. Other Land (unutilized land)	**216.43**	**12.7**
Total Land Area	**1,707.90**	**100**

Source: Extracted from the village records, June 2007.

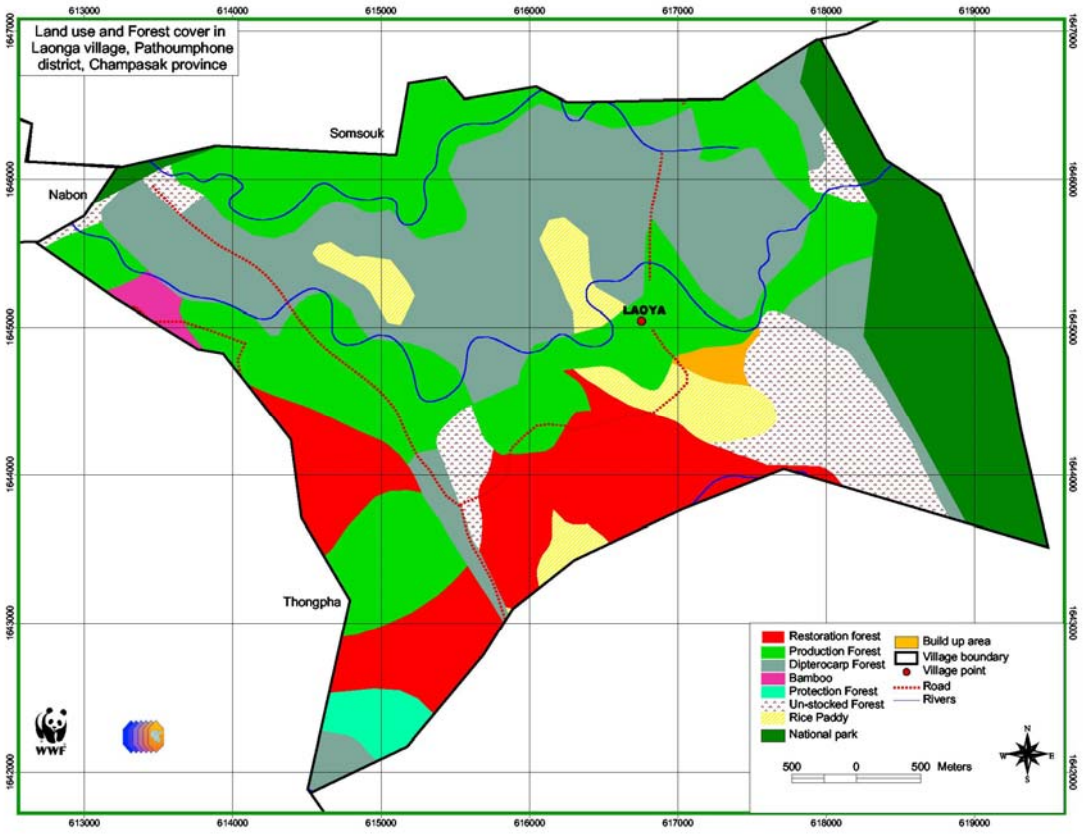

Figure 4.2 Map of land use and forest cover of Lao Nya Village (World Wildlife Fund, 2009)

All households have land use certificates that were issued at the district level, but these cover only residential and agricultural lands. These documents can be used if they choose to sell the land, exchange it, or hand it over to their children. Every year each household has to pay taxes based on the size of their residential and agricultural land (paddy land).

4.2.5.2 Household land ownership

Household land types consist of paddy land, settlement land, unutilized paddy land, gardening land and fishponds. Each household has to pay annual tax according to their land types and sizes. The well off own very large plots of paddy land in comparison to the moderate and the marginal poor; and the very poor have no paddy land at all. The well off also own more unutilized land as well as fish ponds. Moreover, the well off also have large gardens while these are very small for the moderate and non-existent for the marginal and the very poor. The smaller settled

lands are less commensurately from the well off to the very poor group. Average land ownership of each group is in Figure 4.3.

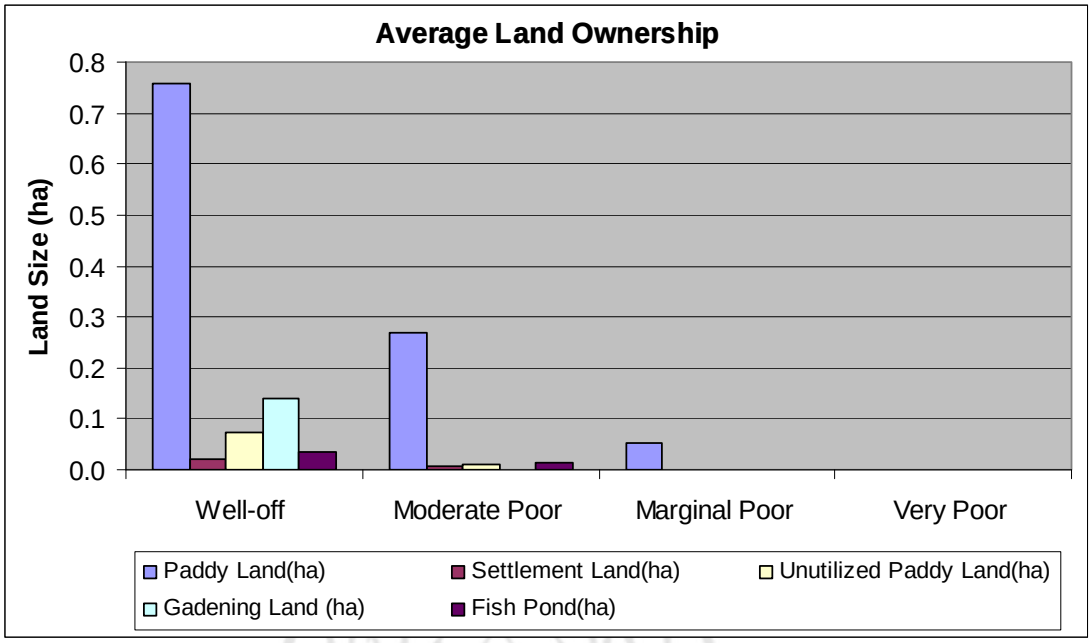

Figure 4.3 Average land ownership by group, Source: Village records, 2009

4.2.6 Changes over time in use of natural resources

From group discussions and household interviews, most of participants and interviewees pointed out some changes in the area's available natural resources use over the past 10 years.

Water: In general, both water quality and quantity have changed negatively over this time. Water flow in the stream used to be much larger than at present. The villagers claimed that in the past it was not easy for them to cross any of the local streams (Huay Lao Nya, Huay Loh, Huay Mak Nao and Huay To Mo) because they were very deep and wide even during dry seasons. Now those streams have changed a lot, such that people can cross them on foot with no need to swim at all. These years during the dry seasons some streams, especially Huay Lao Nya, turn into many small ponds without any real flow at all. Water quality also has changed considerably. Previously these streams looked clean and clear, now they have more turbidity; they are unclean and unclear.

Forests: Big dense forests are now gone. It is hard to see any more big trees in the forests due to the logging concessions, shifting cultivation, and population growth. Some of the timber was used for house construction within the village. Also, due to the limited cultivated paddy land upland rice areas have had to be created from forests. In addition, more and more people now live in the area. Now the village has rules and regulations order to reduce exploitation of the forest. Cutting timber for house construction and clearing the forest for cultivation now need prior permission from village committees who base their decisions on the defined needs households requesting the timber or land.

Non-timber Forest Products (NTFPs): In years past, NTFPs were more abundant that at present. As a result, the time and distance needed for collection has expanded. NTFPs have been declining due to unsustainable harvesting and lack of control regulations, as well as population growth. The village therefore now has had to devise relevant regulations to control further losses. As NTFPs are sources of both food and income for the villagers, there is no doubt that NTFPs are very important to their lives. These days, while they can no longer rely on NTFPs for their daily foods, having to rely instead on food from the market, NTFPs still make important supplemental contributions to their livelihood options.

4.3 Poverty Assessment

4.3.1 Poverty Classifications

According to the results of group discussions in June 2007 and January 2008, the villagers divided their living conditions into three groups: well-off, moderate poor, and very poor. These categories were based on such indictors as housing, land holdings, physical assets, livestock (draft animals), laborers available, and rice sufficiency. A subsequent field trip in July 2008 produced some updated information, allowing further division into 4 groups instead of 3. Some households previously placed in the moderate poor and very poor groups were both reclassified as marginal poor. The result shows that almost all households in this village are still poor (87.8%); the well-off group is only 12.2 %. Within the poor, moderate accounts for 48 households, follow by marginal poor with 34 households; only 4 households fall in the very poor group. Details are in Table 4.10.

Table 4.10 Poverty incidence in the village

Household groups		Well-off	The poor		
			Moderate poor	Marginal poor	Very poor
Number of households	98	12	48	34	4
Percent	100	12.2	49.0	34.7	4.1
Total	**100**	**12.2 %**		**87.8 %**	

4.3.2 Characteristics of Village Poverty

The village's 86 poor households in share several things in common, because their livelihoods are largely based on natural resources. They all go to the forest to collect NTFPs and other wild animals to supplement their daily food supplies and generate added income. They also partially exchange these items with other village residents for other staple foods, such as rice; and they collect NTFPs for sale. The poor rely on outside labor wages as their main source of income.

The well-off households here clearly differ from the poor ones, since they rely more on agricultural products and trading activities rather than collecting NTFPs or labor wages. Nevertheless, NTFPs still consitute an important food source and a source of additional income for these families.

As living conditions can be typically reflected in housing conditions, this specific factor was one of the indicators in assigning households to the different groups. The well-off have solid, large, permanent houses that are mainly constructed of pinewood. These houses have wooden walls and floors and their roofs are covered by zinc or galvanized iron. In contrast, the moderate and the marginal poor have medium-sized, semi-permanent houses with zinc roofs, walls that are half-wood and half-bamboo, and wooden floors. Households in the very poor group have temporary, very small houses with grass roofs and bamboo walls and floors.

In addition to the indicators used for livelihood classification (housing, land holdings, physical assets, livestock [draft animals], laborers, and rice sufficiency), each group main occupation was a primary indicator; details are described below.

The Well-off: Most households in this group have many activities contributing to their livelihood. The main one is farming, for which they normally hire labor from those poor villagers who have limited if any cultivation land themselves. They use tractors more than draft animals. Besides farming, they also seasonally gather NTFPs by themselves. In addition, they buy rice produced in the village at a low price for later sale to middlemen (at a higher price). Draft animal raising is another activity that contributes to their income. Furthermore, they are engaged in trading activities of various kinds, such as retailing consumer goods and selling medicines. Some households in this group earn extra income by lending their land and vehicles to families in the moderate poor and marginal poor groups. Some well-off families also earn cash by transporting local villagers to markets elsewhere and back again, or in delivering some agricultural products.

The Moderate Poor: These households consist mainly of farmers who use their own labor and draft animals as inputs for agricultural production; some need to hire some laborers and tractors/trucks or draft animals to supplement their own inputs. Their second source of livelihood comes from collecting NTFPs and fishing. Some people go to work as the seasonal laborers outside the village, after their own farm work has less demand; and others sell their labor within the village in both on-farm and off-farm work or forest work like wood sawing, forest clearance for cultivation, gardening, etc. Apart from these, some family members of this group (especially the women aged between 15-20 years) have gone to work in Thailand, earning more there to support their families than they could earn in Laos.

The Marginal Poor: The main occupations of this group are similar to the moderate poor, but differ in terms of the amount of income generated and the number of productive inputs owned. The biggest difference is that whenever these households need rice for daily consumption they obtain it from a well-off or moderate family, repaying later a bigger amount after harvesting their own rice. In addiction, some households in this group still have to rely more on the upland rice cultivation, more wage labor, etc.

The Very Poor: Because households in this group have no cultivated land of their own, their main activities to earn income and supplement their daily livelihood rely more on wage labor (especially by providing farm labor to well-off households) and on collecting NTFPs. These activities are of small scale, more or less for their own household consumption and to earn enough cash to support their daily survival. Some of them are involved in upland rice cultivation

mainly adopting shifting practices, resulting in very low productivity. Besides normal NTFPs collection, wildlife hunting and fishing are among their main activities, with some people spending more time in the forest than in the village. At times their labor is paid not in cash but in the form of agricultural products, especially rice. They may repay their debts by working for others.

4.3.3 Annual Household Income and Expenditure

In order to estimate income and expenditure, questionnaires were used to interview almost all representative households in each of the four groups. Both incomes and expenditures in this study were calculated based on average annual values within each group. Such numbers were then used as representative of each group. Details of income and expenditure by each group are as below:

Income: Income sources for each group are diverse and mixed, from agriculture, trading, NTFPs gathering, and wage labor. Almost all the well-off earn mainly from agriculture and trading; the moderate poor and marginal poor mainly from NTFPs collection, wage labor, and agriculture (to a lesser extent). The very poor rely for their income (indeed, for their survival) on NTFPs (due to their limited paddy land), and wage labor. These sources provide for their rice consumption and other minimum necessities. Handicrafts do not generate much income amongst these four groups. Finally, the category “Other” refers to the money sent back to the village by their young persons who work outside the village and in Thailand. Figure 4.4 shows income sources of sample households from different sources and for different household groups.

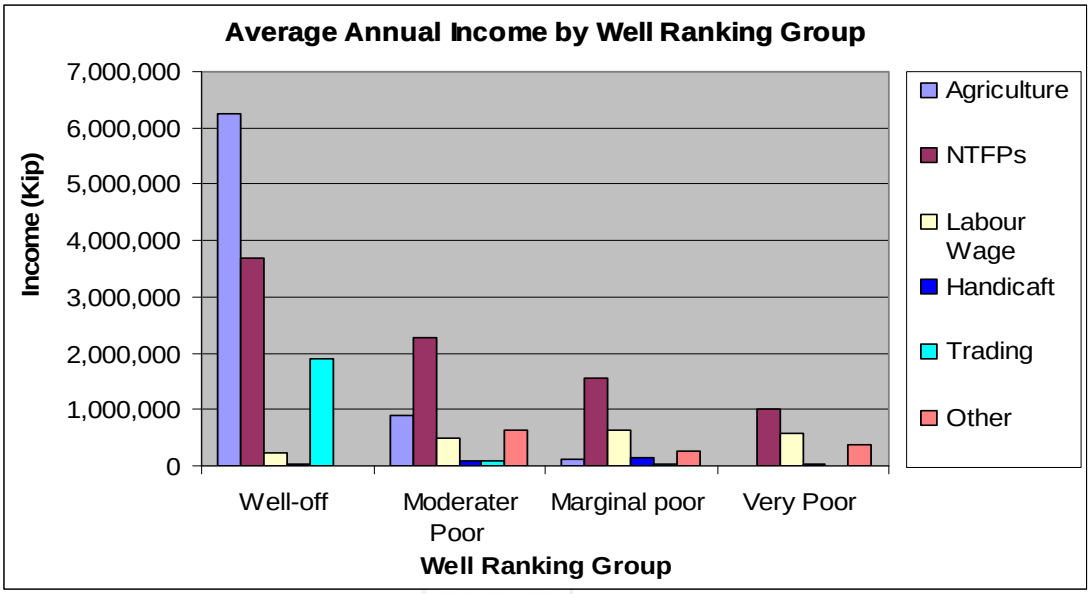

Figure 4.4 Average annual income sources by group

Figure 4.5 shows that rice is the main source of agricultural income for the well-off; draft animals especially cows and buffaloes generate added income to households in this group. The well-off have much higher income from agriculture than do the moderate poor and the marginal poor, while the very poor gain almost nothing from agriculture.

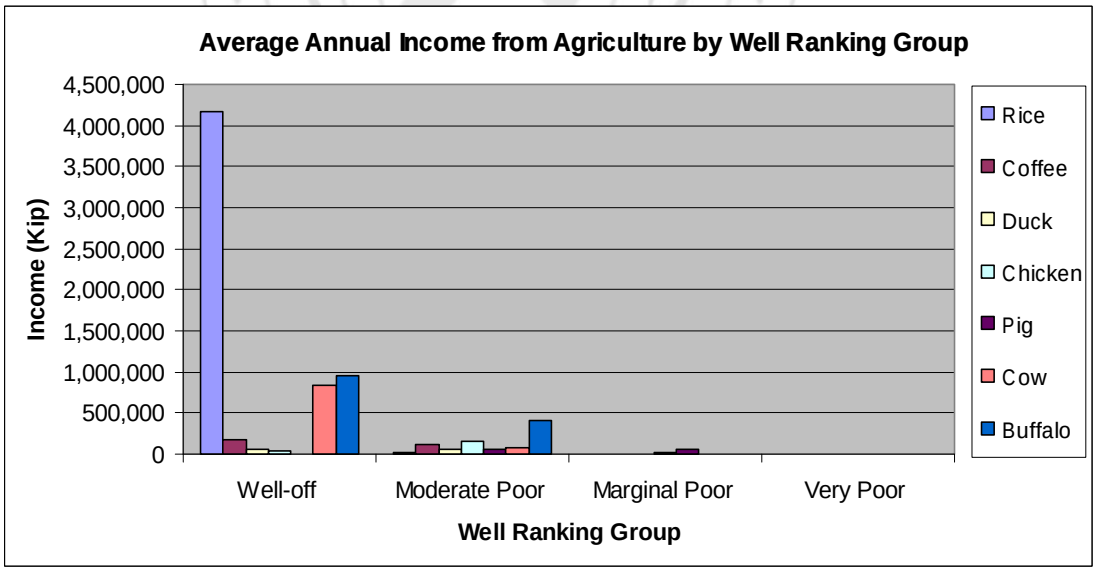

Figure 4.5 Average annual income from agriculture

In terms of income from collecting and selling NFTPs, Figure 4.6 shows that Mak Jong (Scaphium Macropodium) -- a tree seed that can be used as an herb and food ingredient -- is the main NTFP for the four groups. The well-off earn most from this particular spice since they are able to buy Mak Jong at a lower price from local villagers and then sell it at a higher price at one time directly to middle men or even sell it themselves outside the village. Honey from bees is the second-most-important NFTP source, declining in importance from the well-off to the moderate and marginal poor groups. (This source is a bit higher for the very poor than for the marginal poor, interestingly.) Cardamom generates the highest income for the marginal poor, followed by the well-off, moderate poor and the very poor. Khua Ham (Coscinium fenestratum), which is used for making mats, is rather small for all four groups. Din Kee Jear (soil from rats' excrement, used as fertilizer) only appears as an income source for the moderate poor.

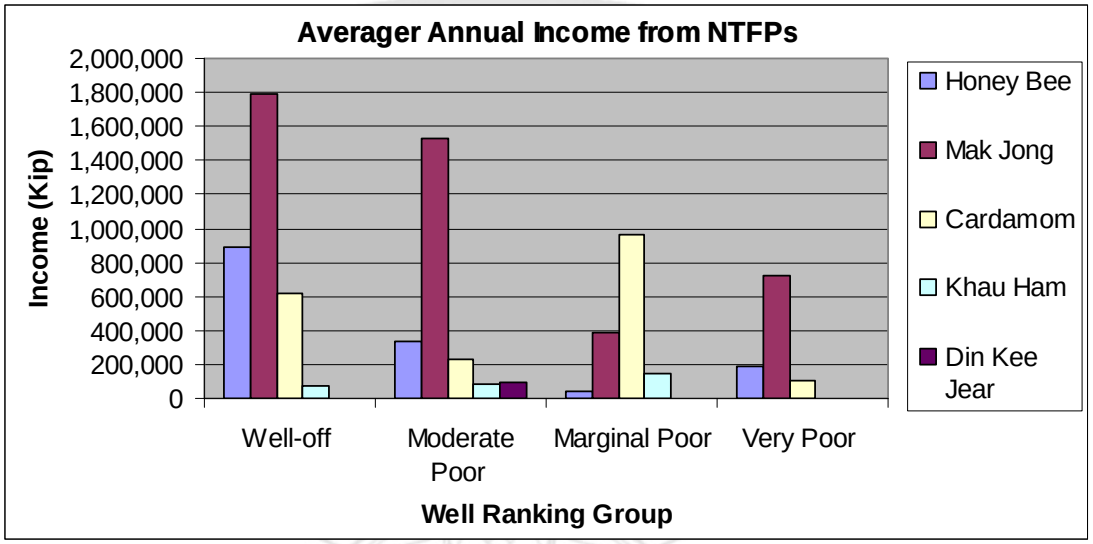

Figure 4.6 Average annual income from Non-timber forest products (NTFPs)

Figure 4.7 shows income by group from two different types of wage labor: off-farm and on-farm. Marginal poor earn the highest from their off-farm work, followed by the very poor and the moderate poor. The well-off don't do any off-farm work. On-farm work contributes an equal amount to the moderate and very poor, followed by the well-off and the marginal poor. The

well-off appear here because they sometimes transport agricultural products or provide truck services for ploughing.

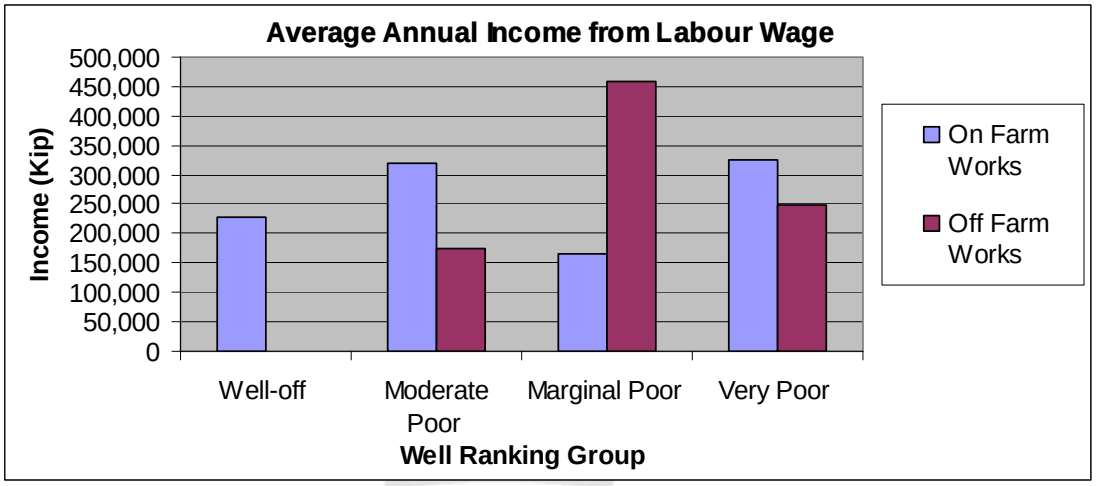

Figure 4.7 average annual incomes from wage labor

Handicraft is mostly women's activity, practiced when they are free from farm work or household chores. Men contribute to this work by cutting raw materials from the forest. Figure 4.8 shows income from the two kinds of handicraft in the village: making mats and rice containers. (Mats are a much larger source of income of this kind.) Marginal poor obtain the highest income from mats, followed by the moderate, the well-off and the very poor.

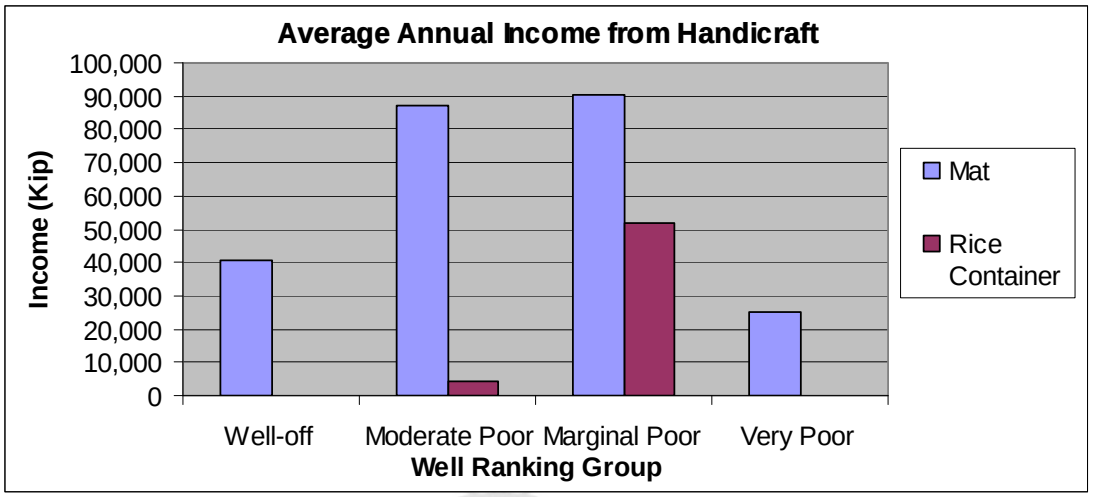

Figure 4.8 Average annual incomes from handicrafts

Income from trading mostly accrues to well-off households who invest in small-scale enterprises or retail shops at which they sell food and materials to the villagers for daily consumption. These items typically come from city markets far from the village. Having access to them locally therefore helps the villagers acquire what they need. The well-off also buy rice at harvest time then sell it later to the villagers, middle men or outside the village when prices are higher. NTFPs are also bought and consolidated by the well-off, who then sell them in bigger amounts in district or provincial markets. Some of them provide trucks for transport back and forth from the village to the city, a service from which they can earn additional incomes.

Expenditures: Household interviews show how villagers in the different groups spend their money with different proportions for various purposes. Primary expenditures are for rice, other food, household materials, education, health care, social contributions, agricultural equipment, and transportation. Figure 4.9 illustrates that the highest expenditures on health care occur in the well-off households, followed by the very poor, then the moderate poor and finally the very poor. The well-off spend much more on agricultural equipment in comparison to the other groups, for all of whom this is a very small category. Expenses for buying food, social contributions, transportation and household materials go down from the well-off to the very poor; the very poor have the highest cash expenditures for rice. In addition, the well-off spend more on education than do other groups.

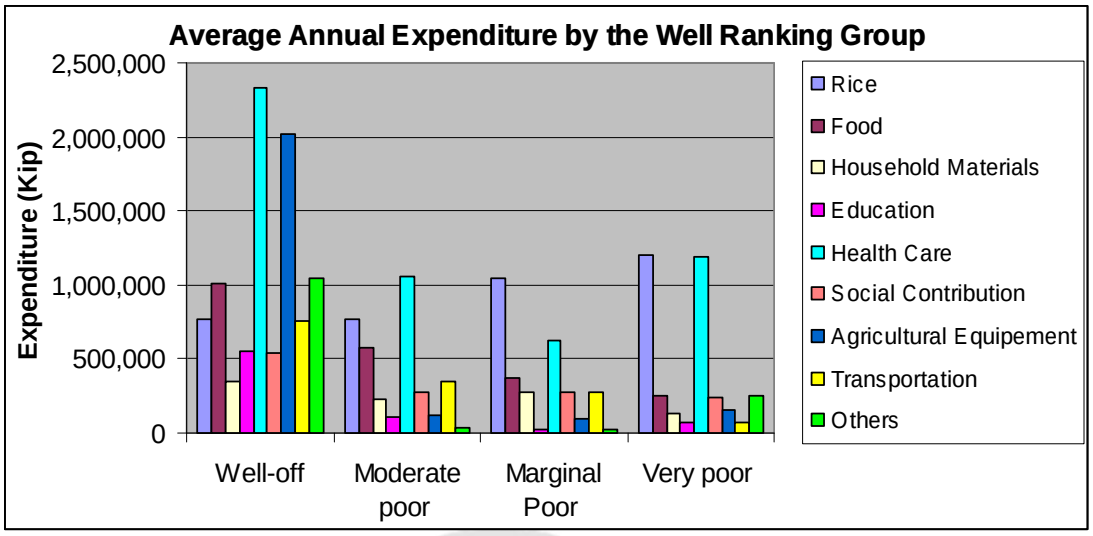

Figure 4.9 Average annual expenditures by different groups

4.4 Local Livelihood Options

4.4.1 Main Livelihood Components

As noted above, data collected during the field research in Lao Nya Village through observations, group discussions, and structured interviews show that villagers' livelihood options are farming, collecting NTFPs, livestock raising, small scale retailing, and wage labor. They can be categorized into several main activities and several supplementary activities.

All households are engaged in similar livelihood activities, but in highly varying amounts. Different kinds of NTFPs are collected throughout the year: Mak Jong (fruit seed), Kee See (tree oil), honey, cardamom, rattan, bamboo shoots, wildlife, wild vegetables, mushrooms, Khuea Ham (forest trees) and medicinal plants.

It is difficult to allocate specific occupations to specific wealth groups, as livelihoods generally derive from many sources simultaneously. General trends show that the well-off group is more active in agricultural activities (rain-fed paddy rice cultivation, draft livestock raising, coffee/cardamom planting) plus small enterprises and transport services. The moderate, marginal and very poor groups tend to be more active in physical collection of NTFPs as well as in wage labor (both on-farm and off-farm work).

Interviews showed that the well-off earn their highest income from agriculture, followed by NTFPs and trading, but much less from wage labor. The moderate poor gain most from NTFPs, then agriculture and wage labor and handicrafts. Marginal poor also get their highest income from NTFPs and then from wage labor. Handicrafts and agriculture contribute very little to them. The very poor have small income from NTFPs, with wage labor as their only category. See more detail in Figure 4.10

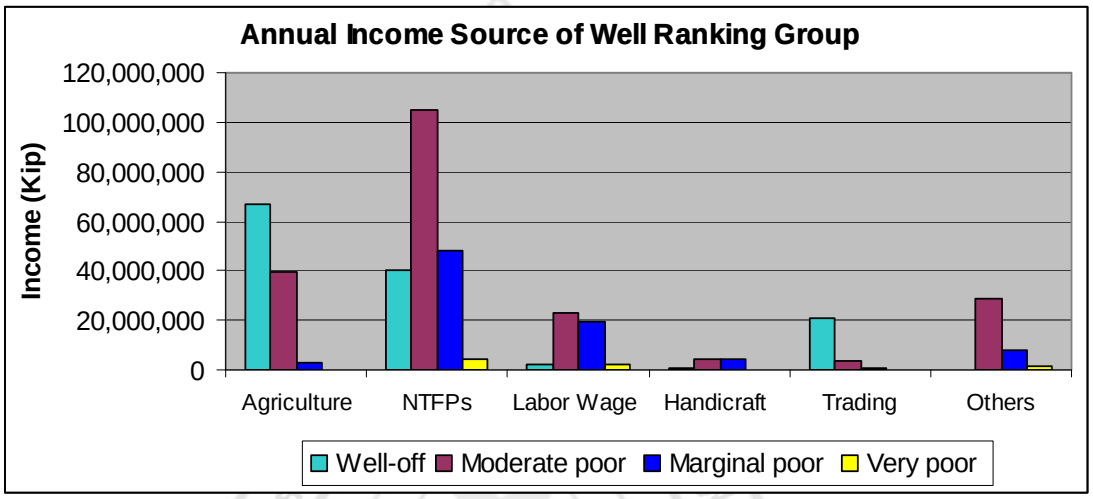

Figure 4.10 Annual income sources for different groups

The contributions from all the livelihood options together for the Lao Nya village as a whole are shown in Figure 4.11. Annual income sources in percentage terms are shown for all 92 households interviewed. Income from NTFPs accounts for fully 46% of the village's annual total; cash income generate from agriculture adds 26%, wage labor 11%, and trading 6%; handicrafts add just 2%. Other income covers the money sent to the village from their children who work in Thailand, plus cash earned by a few households that sell real property.

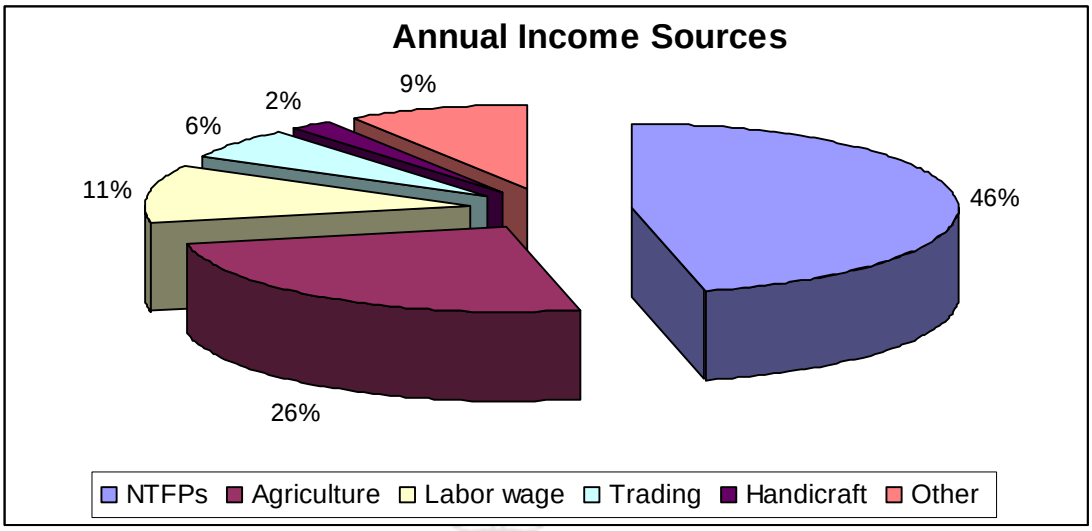

Figure 4.11 Annual total village incomes from different sources

4.4.2 Characteristics of the Villages' Main Livelihood Activities

Agriculture: Generally, Farming is one of the most important sources of livelihood for the people. Two main types of farming systems are practiced in Lao Nya Village: paddy land rice and upland rice. A large majority of the households practice low land paddy rice cultivation. Access to and uses of most upland sites are restricted by government policies; however, some households still cultivate portions of these lands. These are often individuals from households that have no official land and do not own draught animals. Thus they are left with little choice but to resort to clearing land near the foothills to grow rice, even though this may be illegal and productivity remains very low in such cases.

Lowland paddy rice cultivation can further be split into two main farming types. Villagers grow paddy land rice during the rainy season (from May to October). Agricultural outputs during this period are high as local conditions favor rice farming, with high monthly rainfall amounts. During the dry season, only those few households that have their rice fields near streams continue their cultivation practices from November to April with a second rice crop. In contrast to rainy season farming, this farming is quite difficult as water supply is limited. Farmers here have no irrigation systems and must rely on natural drainage to supply water, often not enough for the needed period of rice cultivation. As a result, compared to rice cultivation in the rainy season, dry season paddy rice cultivation is far less productive.

Villagers still generally use traditional farming practices, essentially following the same ways as in previous generations. Farmers highly depend on natural inputs and do not apply any chemical fertilizers or pesticides. As a result, productivity remains rather low. Rice produced and only covers their partial income needs and/or provides just enough for their own consumption all year round. For some households each year and for others in some years, these crops are not even enough to meet their true needs.

Besides rice growing, villagers plant in their homestead gardens different kinds of the crops such as coffee, cardamom, and fruit trees like banana, longan, jackfruit, mango, and coconut. They plant those trees mostly for subsistence consumption, but crops like coffee and cardamom generate additional income. Some households also plant industrial trees, particularly teak, on small areas around their rice paddy fields. Almost all households cultivate vegetable gardens near the Huay Lao Nya river for their daily food needs. In general, these gardens do not fully supplement their food demand since they are just at very small scale.

Livestock in Lao Nya consists mainly of cattle or large draught animals (buffalo, cow) that are used for paddy land rice cultivation. Bulls are often used as draft animals and are frequently traded; cows can be sold for a high price as well. Moreover, poultry (chicken and ducks) or other smaller livestock animals (pigs) are reared mostly for local consumption; they are sometimes sold. Large livestock graze in the area around the village while smaller animals are kept near their owner's homestead. No real breeding system exists, nor is there a clear management system. In some years, livestock numbers may dramatically decrease due to disease. There are no veterinary services or periodic livestock vaccinations. Livestock numbers therefore remain too low when compared to demand. SUFORD, who supported the funds for the cattle, gave also some vaccines which can contribute more security of the livestock raising.

NTFPs collection: Villagers in Lao Nya collect various types of NTFPs, and have done so for many years. The remoteness of this area and the abundance of NTFPs explains these villagers' continuing high dependency on forest resources through collection of NTFPs. NTFPs consequently have been a main source of income for as long as many respondents could remember. Collection of these NTFPs occurs throughout the year, while different NTFPs are collected in their respective seasons. As mentioned above the main NTFPs available in the area are tree seeds (Mak Jong Bann), honey, cardamom, tree oil (Kee See), rattan, Khuea Ham,

bamboo shoots, medicinal plants, herbs and wild vegetables. The majority of Mak Jong Bann, honey, cardamom, Kee See, and rattan are collected for trading purposes, while bamboo shoots, medicinal plants, and wild vegetables make up part of their daily consumption needs. Products like Khuea Ham are used as materials in making handicrafts.

According to the villagers NTFPs have decreased in quality and quantity over the last years. They report that this decrease is mainly because no effective NTFP management system is in place, so that people currently collect to their maximum capacity ("tragedy of the commons" at work in this regard). Even though village leaders have set out local regulations for NTFPs management, these requirements are not being effectively implemented.

Trading and small-scale enterprises: Because Lao Nya village is situated far from any city, and has inconvenient road access, people here are unable to travel frequently to purchase basic needs. Several shops in the village run by local well-off households offer basic items to accommodate villagers' basic needs. Retail shops sell household materials, food ingredients, and items for daily use (soap, detergent, shampoo, etc.). Those shops also buy some kinds of NTFPs from the villagers, consolidating them into larger amounts for later sale to middle men or directly in city markets. Rice mills are also owned by the well off; by now these mills have largely replaced traditional rice milling practices. A small pharmacy sells medicine for use in emergencies. One Lao Nya household has a truck that they use to provide transport services to and from the larger towns. People use this service to reach markets for their farm products as well as to go to the hospital when they are sick.

Wage labor: Wage labor is an important activity for many villagers in Lao Nya. They do this work in between or after they completed their own priority farm work. Laborers, particularly men, accept work both inside and outside the village. This activity typically consists of agricultural work like planting or harvesting rice/coffee, timber sawing, clearing the forest or bush, but may also involve labor in off-farm activities or other work when available (like housing construction or timber cutting). For individuals from well-off households, such activities provide additional income and are carried out during free time. In sharp contrast, individuals from poor households use wage labor as a way to meet their minimal daily needs. Some poor households even have to rely on wage labor as their main sources of income or for their daily survival.

Handicrafts: Handicrafts are mostly practiced by women who collect from the forest a special kind of natural tree called Khuea Ham. Men help women by cutting this tree from the forest and bringing it home. This particular NTFP is used to weave mats, some of which are used within their own households while most are sold to other people in the village or to middlemen from outside. Such practices provide some additional income but they remain limited because these mats outsiders often consider them too simple with thus little market value. Some households cut bamboo to make rice buckets or other household accessories. Some of these items are even sold, but not regularly.

4.4.3 Villagers' Livelihood Constraints

Villagers in Lao Nya Village face many constraints in their efforts to improve their living standards. The main difficulty voiced by villagers is the absence of adequate infrastructure: roads, electricity, reliable water supply and irrigation, proper healthcare, education and sanitation.

The area's natural drainage system cannot support year-round farming, so that many paddy lands during the dry season have low or even no real productivity. Such dry season rice paddy cultivation is vital for many villagers to meet their household consumption needs and generate at least a small income during the drought months. However, the limited water supply combined with further crop damage from natural disasters and pests means that production outputs remain very low over the dry season months. Villagers still lack adequate agricultural skills and do not have enough inputs for their farming. Lastly, paddy land is limited, as many areas are too rocky or have slopes too steep to accommodate growing rice.

Moreover, many villagers face food insecurity all year round because mostly they rely on the natural resources rather than anything else that they can produce. For example, besides rice no other cash crops are planted. The current gardening near the river banks just gives supplemental vegetable sources, it is not yet managed in the proper systems, they just plant naturally and it is very small scale which can contribute very less products. Besides fishing in the natural streams there are no household or village fishponds.

When sick, villagers cannot access proper healthcare on time. They remain sick for long periods, which in some cases have led to disability and even death. Moreover, infant mortality is high in the village. Although the village has a first aid kit and has two medical volunteers, these facilities are only ever used in emergency cases and cannot provide regular adequate healthcare

services to villagers. Moreover, the village has no sanitation system. As a result, neither household has toilets or clean water, making the villagers prone to health problems. Such health issues are quickly followed by financial consequences, as farmers are not able to work their farms to generate income. Lastly, households in the village do not practice any real form of family planning and do not use any real hygiene practices especially boiling water for drinking, washing their hands, etc.

In order to get better understandings about livelihood aspects and to go along as the same as the Sustainable Livelihood Approach as mentioned in early Chapter, the villager's livelihood need to look at five basic categories: financial capital, human capital, social capital, political capital, and physical capital. Conclusions about livelihood constraints in terms of these categories are as below:

Financial Capital: Although some cash sources are available for villagers on a loan basis most villagers do not want to take out a loan, as past experiences of others have shown that many have difficulty repaying such funds. Most HHs choose not to borrow cash but rather to borrow directly what they need. For example when one falls ill, the HH would ask to borrow medicine from villagers who have it in return for things like rice or labor. In cases where they have no direct barter product to offer, HHs may return loans through upcoming harvests. Difficulties experienced in HH finances can also be explained due to the lack of proper HH financial management. In drastic cases whereby HHs are in dire need of money or have long outstanding debts, they have had to resort to selling HH assets like land or large livestock, which in the long term only makes them poorer.

Human Capital: Newly married households have little productive labor. Normally such HHs have only the husband, as the wife works within the HH and takes care of children (whereby pregnancy limits labor capacity), thus increasing dependency. In addition most of them lack adequate family planning. Duration between two children is often very short. Frequent and/or long sickness makes people immobile. Health limitations or disability lead to increased dependency also as they cannot work efficiently. Most farmers still largely depend on traditional farming techniques that appear no longer sustainable and suitable with the current situation.

Social Capital: Since many experience difficulties in daily life within the village, a lot of young laborers have little choice but to work outside in Laos' urban areas or even outside the

country, especially in Thailand. This has become a common trend in the community. Even though some young people are not aware of the working/living conditions elsewhere, they still choose to follow their friends. This is one of the limitations on social capital in the villages. Another limitation to social capital is evident in the changes taking place in community interaction and lifestyle. The traditional sharing culture is increasingly being replaced with a more individualistic pattern, from a more cooperative situation to competitive one. Although there are a still sign that the sharing culture exists it appears to be decreasing with increasing external influence in the villages. Because social changes have affected different HHs in different ways over time, a growing gap now exists between HHs in the villages. Rates of development of poorer households have been less compared to other well-off HHs. This in turn causes a degree of resentment among households.

Political Capital: Mainly due to the remoteness of this area, connections between local and higher political levels are not continuous, leading to poor cooperation. Rules and regulations for land access appear to not have the desired affect in real practice. Similarly, other regulations on the natural resources extraction see the same inefficacy. Most current policy is of a top-down nature. Villagers have little opportunity for participation and generally are expected to follow whatever higher level orders state. They lack political voice or leverage to stop outsiders coming to the village to gather local natural resources.

Physical Capital: Largely due to the remoteness, villages have no adequate basic infrastructure: no national electricity grid connection (only a few households have hydro turbines), lack of access to a healthcare center (only first aid kits are available for emergency cases), and there are not adequate communal household water supply systems (only a few water wells). Furthermore, large parts of land around the village have rocky soils making land less suitable for production purposes. With other areas having steep slopes or under formal government protection, villagers are left with little land that is suitable for crop cultivation. Lastly there are a lot of sources of crop damage such as natural disasters (flood or drought) and wildlife/insects that destroy agricultural crops and land resources.

4.5 Main Health and Sanitation Problems

4.5.1 General Information about Hygiene and Health problems

Generally, there is no health care center within the village. The first aid kit available with the health care volunteer can provide some medicine for emergency cases. No households have a toilet, except only two in the temple.

The health care volunteer reported that two common diseases always occur in the village: diarrhea and malaria. Diarrhea always occurs during the summer times, while malaria always appears in the rainy season. Whenever diarrhea occurs, due to lack of sanitation facilities it always spreads from one person to others within the household and spreads out from one household to almost all the households in the village. Statistics on the number of people who got diarrhea are not available at the village level, unlike malaria disease, some information about this situation has been obtained from household interviews.

According to the village's health volunteer, 112 people (18.3 %) contracted malaria in three years (2007 through 2009). This information comes from village records of simple testing done using special liquid to test the blood of patients who had the relevant symptoms for this disease.

Table 4.11 Cases found on malaria in the village, 2007 to 2009

Related Months	Jan	Feb	Mar	Apr	Jun	Jul	Aug	Nov	Dec	Total
Year 2007	0	0	0	0	10	27	9	0	6	52
Year 2008	1	0	0	0	0	4	0	3	3	11
Year 2009	0	6	9	15	7	12	0	0	0	49
Total	**1**	**6**	**9**	**15**	**17**	**43**	**9**	**3**	**9**	**112**

Table 4.11 shows data on the people who got malaria: 52 in 2007, 11 in 2008, and 49 in 2009. This disease happens mostly from March to August. The highest monthly numbers in

total were during July (43 people), followed by 17 people in June and 15 people in April. Several other months had the same number (9 people). There are few cases reported for January, February and November.

4.5.2 Common Health Problems or Common Diseases

From the interviews with 92 out of 98 households, it was found out that the common diseases in their households are malaria, diarrhea, headache, fever, bond, weak/tired/, stomachache, cough, chest ache, and liver disease. Data on common health problems in the households are in Table 4.12. Malaria was the highest (23.2%), while diarrhea and headache are second at 22.6% each. Fever is next while the bone disease is only 4.9%.

Table 4.12 Common household diseases in the village

No	Common disease	Number of respondents	Percent
1	Malaria	76	23.2
2	Diarrhea	74	22.6
3	Headache	74	22.6
4	Fever	64	19.5
5	Bond	16	4.9
6	Weak/tired	9	2.7
7	Stomachache	7	2.1
8	Cough	4	1.2
9	Chest ache	2	0.6
10	Liver	2	0.6
11	**Total**	**328**	**100**

4.5.3 Infant Mortality

Results from household respondents show that in selected periods over the past 40 years a total of 104 babies died from malaria, diarrhea, fever and other unclear reasons. Periods covered were 1968, 1975, 1978-1980, 1983-1986, 1988-1999, and 2001-2008. There are more or less in some years than in others. Unknown causes for death was the largest category (47.1%), while malaria accounts for 28.8% followed by diarrhea at 14.4% and fever, 9.6%. Details are in Table 4.13.

Table 4.13 Infant mortality with related reasons

No	Related reason	Number of infant deaths	Percent
1	Die after born (unclear reasons)	49	47.1
2	Malaria	30	28.8
3	Diarrhea	15	14.4
4	Fever	10	9.6
5	**Total**	**104**	**100**

4.5.4 Medical Treatment

As mentioned earlier, no health care center is located within the village; there is only a medicine box stored for emergency cases. The villagers therefore apply a combination of various ways to cure their sickness, using herbs and medicines available in the village. Those who have very serious symptoms have to go to the hospital which quite far from the village. In the past when the road access to the village was harder compared to the situation right now, the patients had to be carried to the hospital or walk there. Many died on the way before they could reach the hospital.

Villagers' sickness treatments rank from taking medicine themselves (41.8%) to using herbs (32.4%) and then going to the hospital (25.8%). Almost all households try first to cure their sickness themselves, going to the hospital just for serious cases that they cannot deal with on their own. In addition to the long distance to reach the district and provincial hospitals, going there also

requires more money. As a result, villagers go there only when absolutely necessary. Further information on household sickness treatment is in Table 4.14.

Table 4.14 Sickness treatment of villagers

No	Treatment type	Number of households	Percent	Location/source
1	Taking medicine	89	41.8	Buy or get for free from the health care assistant in the village
2	Using herbs	69	32.4	These are available in the forests in the village
3	Go to the hospital	55	25.8	District hospital is 34 km from the village and provincial hospital is 74 km away
4	**Total**	**213**	**100**	**-**

4.5.5 Public and Household Toilet Construction

All 92 interviewed households agreed that construction of a toilet for their household would be a positive development. They reported that toilets are very important and very necessary for their daily lives because they can help them in terms of hygiene and prevent transfer of disease. Currently no local households at all have a toilet because they do not have enough money to invest in one. Out of rural necessity they have somehow become familiar with their own ways of living, and thus can rely on the open forests nearby the village for defecation. Even though they are aware that open defecation is unsuitable and unsafe to their living conditions, this practice still exists in the face of no available alternative.

When possible construction of a public toilet was discussed, unanimity broke down among respondents. About half (50 out of 92) agree with construction of a village toilet, while the other half (42) disagree. Their reasons included concern about difficulties in terms of maintenance, cleanliness and disease transfer.

Regarding toilet construction, a majority of respondents reported that they really would like to have a household toilet, for which they would only need to be provided with the tile, tank and cement. Labor and other materials for the structures are available in the forest, especially the timber for toilet house and grasses for the roof. They are willing to improve their sanitation themselves if provided with such limited external assistance.

4.6 Local Water Resources

4.6.1 Background Information on Water Resources

In comparing water supply 10 years ago with that of the present time, all 92 households interviewed stated that local water supplies had been changing rapidly. In the past, all the streams in the village were very big and deep and not easy to across, unlike now when those streams are very shallow. Some streams, particularly Huay Lao Nya, in some years even become just partial non-flowing ponds during the dry seasons. In general, these changes are due to forest degradation from shifting cultivation practices and logging in the forest concession; other causes include population growth and the limited amount of land suitable for cultivation. Interviews pinpointed the causes of water supply change over the past 10 years as due to two major causes: forest degradation (59.7%) and population growth (31.5%). Details are shown in Table 4.15.

Table 4.15 Causes of changes in water supply

	Cause of change	Number of respondents	Percent
1	Forest degradation	89	59.7
2	Population growth	47	31.5
3	Limited cultivated land	9	6.0
4	Do not know	4	2.7
5	**Total**	**149**	**100**

4.6.1.1 Comparison of water quality and water quantity over time

In comparing 10 years ago with the present time, the majority of the respondents reported declines in both quality and quantity of water -- especially in Huay Lao Nya and Huay Loh. From the results of group discussions as well as household interviews, the comparison of those two periods as shown in Table 4.16.

Table 4.16 Comparison of water Changes over Time

Time Period	Status	Number of respondents	Percent
10 years ago	More supply or deeper (during dry season)	48	46.6
	More convenient	33	32.0
	Cleaner	22	21.4
Total	**-**	**103**	**100**
Present time	Very dirty (during dry season)	33	50.0
	Less supply or shallow	27	40.9
	Inconvenient	6	9.1
Total	**-**	**66**	**100**

4.6.1.2 Local Perspectives on Establishing Rules or Regulations on Water Management

All 92 households interviewed agreed with the proposed regulation establishing rules for water resources management as well as the proposed approach to participatory water management. The villagers see that if no suitable management approaches are in place to control or manage their water resources, water will be scarce or out of control. They have seen the changes in water supply in Hauy Lao Nyain when comparing the situation now with that in the past. They therefore think that other streams in the village should be protected so that these problems are not repeated the next time drought occurs. A proper management approach might

give them benefits as well as provide for the younger generations. A majority reported that if those streams within the village are not protected or left naturally, there will be no more water in the near future. However, if their village has the right kinds of rules and regulations, some households -- especially the landless worry -- that this will impact their alternative livelihood activities since they have to rely on shifting cultivation to make a living. They report that nearby watershed areas have fertile soil and are good for growing crops. Some stated that no matter how hard they protect the related forest within the village, at the end there is always encroachment from outsiders. This is especially true in the forest concessions because they are very large scale in comparison to their livelihood activities of the whole village.

4.6.1.3 Villagers' expectations on water resource management

Currently only three water wells exist within the village (an average of 33 households per well). People often have to wait to get their water. Villagers see that three wells are not enough for them. Some households are located far away from any well. There are some conflicts among the households in getting water. Some have to go back to other sources, relying on stream water or rain water. They still lack water for agriculture. And there are not enough water containers especially to collect rain water. According to the interviews, villagers' expectations are in Table 4.17.

Table 4.17 Expectations of villagers about water

No.	Expectation	Number of households	Percent
1	More water wells	66	33.2
2	Rainwater containers	57	28.6
3	Household water supply	46	23.1
4	Irrigated water	12	6.0
5	Better water quality	10	5.0
6	Cash crop in dry seasons	4	2.0
7	Additional paddy land	4	2.0
8	**Total**	**199**	**100**

4.6.1.4 Sources of local water use

Water here comes from three sources: streams for surface water, groundwater, and rain water. Villagers combine those three sources for their drinking, bathing, and washing. The water for gardening, especially in the river bank gardens, mostly comes from the streams. Paddy land rice practices mainly rely on rainfall since right now no irrigated water structures have been built. Rain water allows for supplemental uses during the short rainy season. Villagers reported that even though water wells are available within the village, they are not accustomed to drinking this kind of water; they find the stream water to be a lot tastier. Groundwater sometimes has an unfavorable smell and taste that make the villagers concerned about it. However groundwater is still being used widely due to its convenience to many village houses.

The water sources used by the different households are shown in Table 4.18. For domestic water use they rely in order on groundwater (46.8%), stream water (40.4%) and rain water (12.7%). A majority of households (79) use groundwater (from the water wells) for drinking; 48 households use stream water and the other 19 households use rain water. Stream water is the main source of water for bathing, followed by groundwater and rain water respectively. For washing, groundwater is used most, followed by stream water and rain water.

Table 4.18 Water sources and water usage by households

No.	Usage type/ Sources	Drinking	Bathing	Washing	Total	Percent
1	Groundwater	79	43	69	191	46.8
2	Stream water	48	63	54	165	40.4
3	Rain water	19	15	18	52	12.7

4.6.2 Climatic Information

Climatic data such as temperature, humidity, dew point, evaporation, rainfall, and duration of sunshine are available in Sukuma Station and Pakse Station. Unfortunately, for the Pathoumpone Station or Pathoumphone Districts where Lao Nya village is located climatic data only cover a single item: rainfall. Information for the other items must come from those nearest

stations -- Sukuma Station and Pakse Station. More details are presented in Tables 4.19 – 4.21, supplemented by related diagrams.

Table 4.19 Rainfall records of the Pathoumphone Station (Altitude: 96.00 m, Latitude: 14°50' 20", Longitude: 105°50' 36")

Year	Rain days	Maximum (mm)	Total annual (mm)
1998	87.0	85.3	1576.7
1999	99.0	171.0	3040.4
2000	101.0	180.0	3250.8
2001	101.0	113.8	2767.2
2002	88.0	218.0	3240.1
2003	65.0	102.0	1954.0
2004	102.0	107.0	2234.7
2005	87.0	109.5	2522.7
2006	89.0	131.0	2705.7
2007	75.0	163.0	2138.5
2008	81.0	58.0	1958.0
Average	**88.6**	**130.8**	**2489.9**

Source: Champasak Meteorology and Hydrology Division

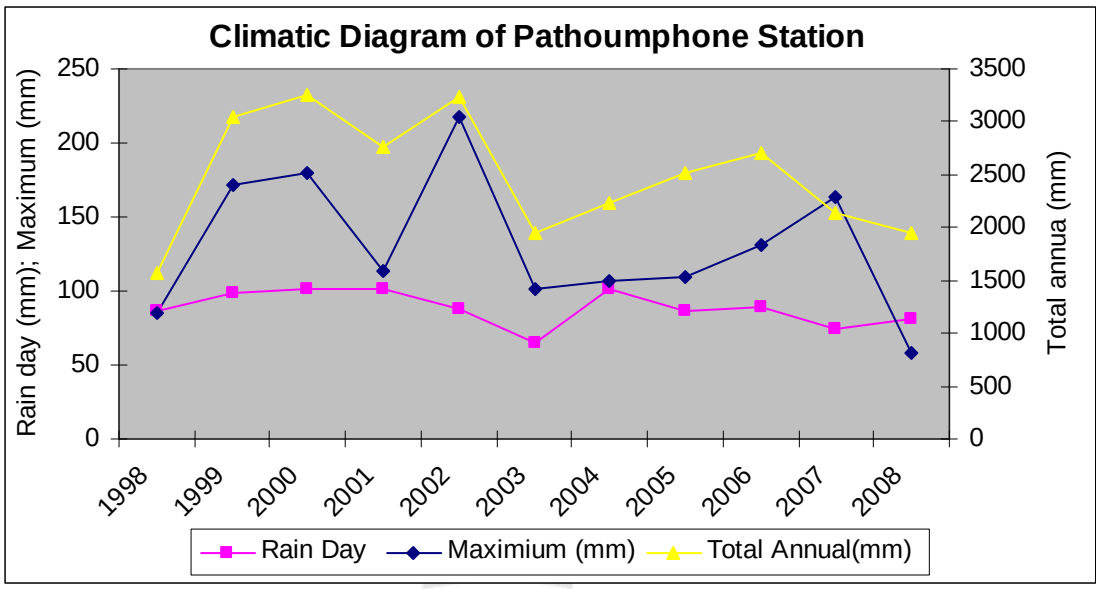

Figure 4.12 Climatic diagram of the Pathoumphone Station

Table4.20 Climatic information of Pakse Station (Altitude: 101.50 m, Latitude: 15°07' 43", Longitude: 105°47' 04")

Year	Mean Temperature (°C & 1/10)	Mean Relative Humidity (%)	Dew point (°C & 1/10)	Mean Evaporation (mm & 1/10)	Wind m/sec	Total Rainfall (mm & 1/10)	Mean Duration of Sunshine (h & 1/10)
1998	28.8	68.0	21.8	1314.0	3.0	1733.5	7.0
1999	27.5	71.0	21.3	1256.9	3.0	2446.5	5.8
2000	27.7	71.0	21.6	1092.5	2.6	2598.4	6.4
2001	28.0	70.0	21.5	1238.1	3.0	2348.6	6.7
2002	28.3	69.0	21.4	1230.0	2.3	2793.9	6.8
2003	27.8	70.0	21.1	1012.2	2.0	2029.1	6.8
2004	27.8	69.0	20.8	1354.0	2.0	1982.9	6.7
2005	28.1	71.0	21.5	1592.5	2.5	1951.5	6.1
2006	28.1	71.0	21.5	1534.6	2.2	2693.5	6.7
2007	27.8	72.0	21.5	1444.2	2.6	1888.2	6.5
2008	26.8	72.0	20.8	1263.1	2.0	1813.7	6.2
Average	27.9	70.4	21.3	1302.9	2.5	2207.3	6.5

Source: Champasak Meteorology and Hydrology Division

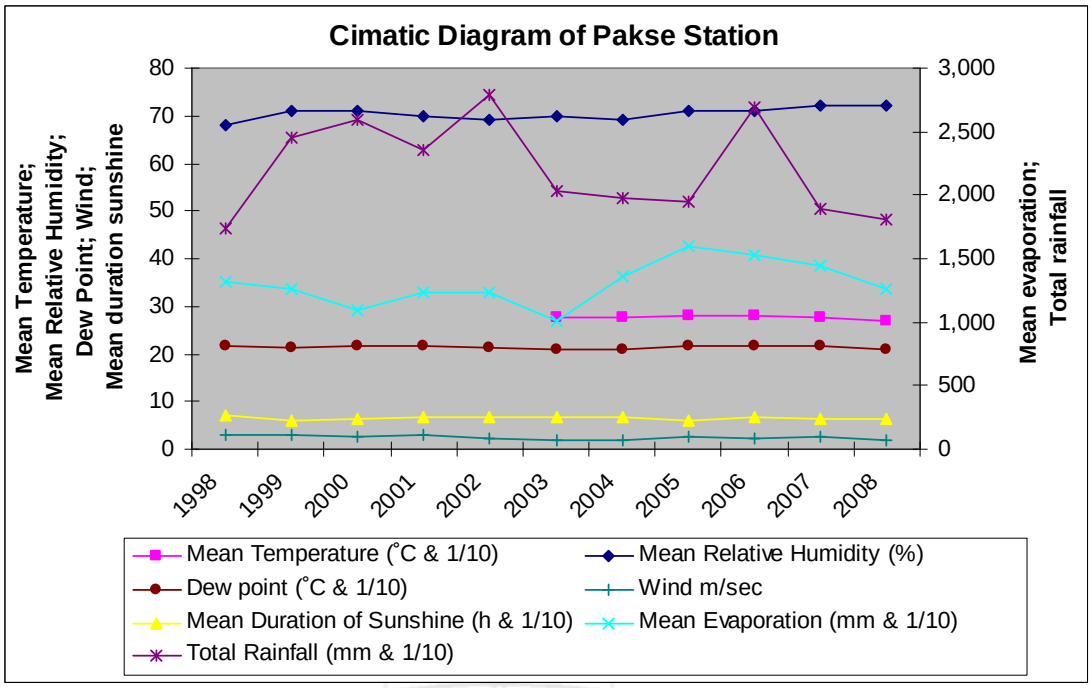

Figure 4.13 Climatic diagram of the Pakse Station

Table 4.21 Climatic information of Sukuma Station (Altitude: 89.94 m, Latitude: 14°38' 40", Longitude: 105°48' 57")

Year	Mean Temperature (°C & 1/10)	Mean Relative Humidity (%)	Dew point (°C & 1/10)	Mean Evaporation (mm & 1/10)	Wind m/sec	Total Rainfall (mm & 1/10)	Mean Duration of Sunshine (h & 1/10)
1998	28.4	70.0	22.5	-	2.0	1733.0	5.8
1999	27.1	71.0	21.9	-	2.0	2060.0	5.5
2000	26.9	75.0	22.8	1042.4	1.3	2827.4	6.0
2001	27.7	71.0	22.3	1444.2	1.0	2098.7	-
2002	27.2	71.0	20.3	-	2.0	2449.8	-
2003	27.8	71.0	22.8	1078.6	2.0	1359.4	-
2004	26.8	69.0	22.4	-	2.2	1942.0	7.0
2005	27.5	70.0	22.3	984.0	2.0	1740.0	6.5
2006	28.3	69.0	22.4	919.7	2.0	2686.4	6.7
2007	28.7	69.0	22.9	1012.8	2.0	1706.3	6.4
2008	28.4	70.0	22.3	910.2	2.0	2904.0	6.2
Average	**27.7**	**70.5**	**22.3**	**1056.0**	**1.9**	**2137.0**	**6.3**

Source: Champasak Meteorology and Hydrology Division

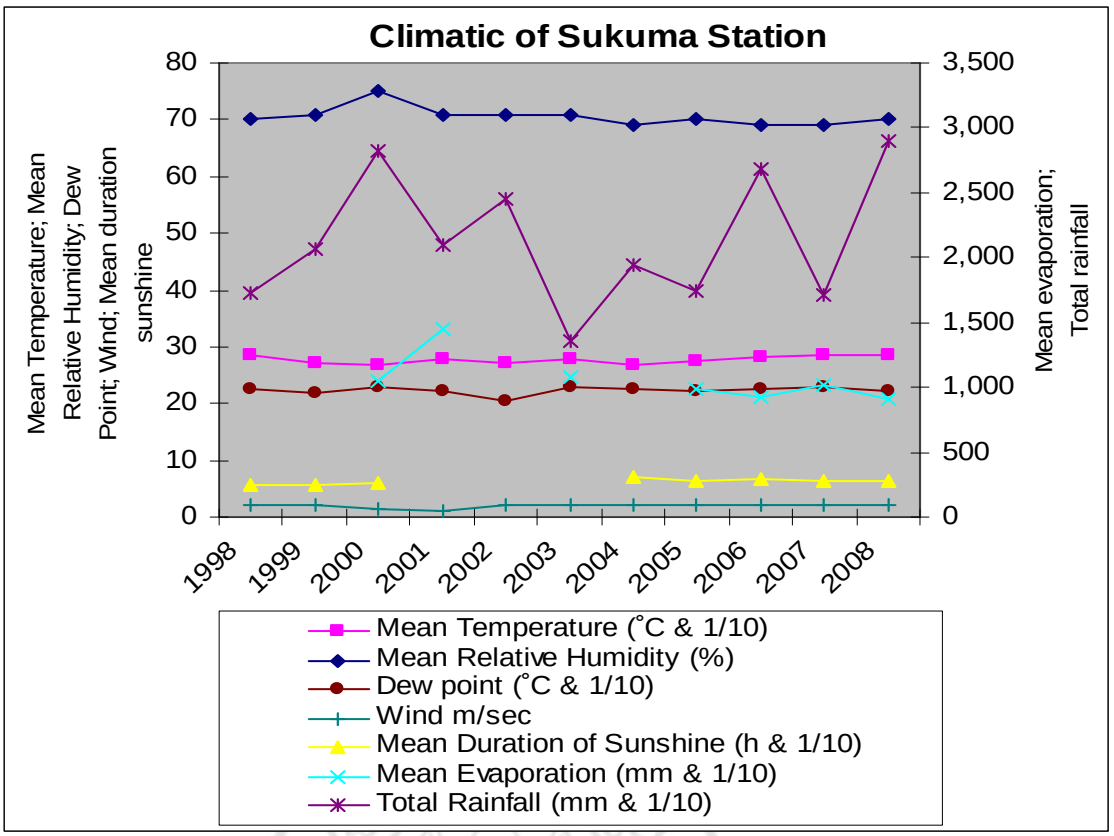

Figure 4.14 Climatic diagram of the Sukuma Station

4.6.3 Water for Consumptions

4.6.3.1 Water quality

Many years ago, the villagers had only one main source of water for drinking, bathing, and cleaning: directly from the stream nearest to the village, Hauy Lao Nya. There were no shallow wells or dug wells at all within the village. Rain water was used only as a supplemental source during the rainy months. Because of those conditions, villagers faced problems of water quality, particularly during the dry season that is the dirtiest period since the water supply is so low.

In order to find out the current status of drinking water quality from the village's main sources of drinking water, water samples from Hauy Lao Nya and Hauy Loh were taken and sent to the laboratory for testing during the driest month (April). This laboratory is under the Sanitation, Environment and Clean Water Section, Department of Heath, Champasak Province. It

is the nearest one because water needed to be tested within only 24 hours of obtaining the sample. The results of this testing are shown in Table 4.22

Table 4.22 Water testing results compared to Lao PDR drinking water standards

No	Sampling element/substance	Result		Unit	Standard Value
		Hauy Lao Nya	Huay Loh		
1	pH	6	6.5	-	6.5-8.5
2	Turbidity	0.5	0.5	NTU	<10
3	Taste and odor	Acceptable	Acceptable	mg/L	Acceptable
4	Conductivity	206	284	µS/cm	1000
5	Iron	0.32	0.03	mg/L	<1
6	Manganese	0.005	0.003	mg/L	<0.5
7	Arsenic	0	0	mg/L	<0.05
8	Fluoride	0	0	mg/L	<1.5
9	Nitrate (NO_3)	35	30	mg/L	50
10	Thermotolerant coliforms	found	found	No/100ml	0
11	Total hardness	80	100	mg/L	<300
12	Nitrite (NO_2)	0.005	0.013	mg/L	3
13	Residual Chlorine in Chlorinated Water Supply	0	0	mg/L	0.2

Note: NTU stands for Nephelolometric Turbidity Unit, S stands for siemens

As can be seen in Table 4.22, generally all testing parameters were within the standard value range due to its location in watershed areas. One exception was pH in Hauy Lao Nya, which was lower than standard values. In addition, Thermotolerant Coliforms were found in both Huay Lao Nya and Hauy Loh. Unfortunately, the capacity of this laboratory cannot separate such parameter into number per 100 milliliters as in the standard unit. However, they can be represented as being in excess of the set standard.

According to the US Environmental Protection Agency (EPA), the descriptions, health effects, and preventive approach are as follows:

Coliforms are naturally present in the environment; as well as feces; fecal coliforms and E. coli only come from human and animal fecal waste. Fecal coliforms are bacteria that are associated with human or animal wastes. They usually live in human or animal intestinal tracts, and their presence in drinking water is a strong indication of recent sewage or animal waste contamination. Fecal coliform and E. coli are bacteria whose presence indicates that the water may be contaminated with human or animal wastes. Disease-causing microbes (pathogens) in these wastes can cause diarrhea, cramps, nausea, headaches, or other symptoms. These pathogens may pose a special health risk for infants, young children, and people with severely compromised immune systems. EPA recommends that if the water tests positive for coliform do not drink the water unless it is boiled.

Water quality can be improved by either preventing contamination from sources, through means such as control of animals, development of sanitation facilities (toilets), and treating water by boiling before consumption.

From April 2009 onward, three water wells with hand pumps were made available in the village. One was given by the Biodiversity Conservation Corridor (BCI), while Sustainable Forest and Rural Development (SUFORD) supported construction of the other two wells. From both group discussions and household interviews during July 2009, villagers reported that water from those three wells has an unfavorable odor and tastes bad; also some small insects are found at times in the water. Some villagers concerned about the water quality due to the absence of any water quality testing after digging those wells; anyway conveniences and low awareness of the danger made most households keep using such water sources.

At the end of the discussion, villagers came up with the idea that the village representative will write a letter to the related project sponsors (BCI and SUFORD) to take water samples from those three wells to test in the laboratory. The villagers feel insecure with respect to consuming water from these wells. In addition, they also stated that two water wells in nearby Kiet Ngong Village (another BCI target village) were closed down because they contained sulfuric acid at levels exceeding the drinking water standard of the Lao Ministry of Health. The

Sanitation, Environment and Clean Water Section, Department of Heath, Champasak Province carried out that particular water testing.

4.6.3.2 Villagers' perspectives on water quality

According to the result of household interviews, villagers also claim that water from their three wells look clean in comparison to the water from the nearby streams which is very dirty during the dry season and causes them diarrhea and skin diseases. However, the ground water has unfavorable odors and when they drink it they can sense the different taste. They also reported that the cleanest sources are rain water, but they have problems because of a lack of containers as well as difficulties in cleaning and changing containers often times. Moreover rainwater is just a supplemented source for a few months only. More results are set out in Table 4.23.

Table 4.23 Villagers' claims about the physical aspects of water quality

No	Water source	Clean	Unclean	Remarks
1	Stream	-	64	Clean only during the wet season, unclean in the dry season
2	Water well	24	64	Unclean because of unfavorable odor and taste
3	Rainwater	24	-	Containers need to be cleaned often

4.6.3.3 Villagers' perspectives on health impacts of water quality

Generally, almost all respondents (100 households) are aware of the impacts of unclean water on their health. During the household interviews some stated that the dirty water causes them to have health problems, especially diarrhea, malaria, skin disease, and stomachache. Eleven respondents reported that unclearn water has no negative impacts to their health. These people see no clear links of such causes and effects, they therefore think that their illnesses are not caused from water. They have become accustomed to it and see the illnesses as somehow caused

by a lack of immunity to fight those diseases. Perceived links between unclean water and the different disease types are presented in Table 4.24.

Table 4.24 The effect of unclear water to health

No	Disease	Number of respondents	Percent
1	Diarrhea	71	71
2	Malaria	13	13
3	Skin disease	12	12
4	Stomachache	4	4
5	**Total**	**100**	**100**

4.6.3.4 Water quality mitigation-water boiling

Most households in this village do not boil water for drinking. The reasons cited are that they have been used to this life style for many generations. The villagers reported that raw water can make them feel fuller than boiled water, and it tastes more delicious. Generally, the well-off households boil water than the other groups, but not all the time. They boil it only during dry season because they see the water during this particular time as dirty. Also when they are sick herbs need to be boiled along with the water. Finally they boil water to serve guests. Media and training also are the reasons that make them want to boil their drinking water.

Some are aware of the negative health impacts of drinking water but just let it be like that, citing many reasons such as no pot, no time, or laziness, etc. Some also claimed that they see no differences between the households that drink raw water and those who drink boiled water; both are still the same in terms of sickness. From household interviews, it can be concluded that 56 respondents claimed drinking raw water has negative effects on their health, while 9 respondents stated that unboiled water has no impacts and the other 6 respondents do not know one way or the other because they cannot see the links clearly.

From household interviews, villagers have different reasons for consuming raw and boiled water. The top reason to boil water is from media information (59.3%); boil with medicinal herbs accounts for 25.4%; the rest are impacts from training and to serve to guests. The reasons

for unboiled water drinking is because they get used to it (23%) while laziness accounts for 21.3% and “it is more delicious is at 19.7%. The full results of villagers’ feedback on water boiling are in Table 4.25

Table 4.25 Feedback on water boiling

Drinking Water	**Sometimes boil (total households= 59)**			
Reasons	Media	Medicine boiling	Training	Serve guests
Number of households	35	15	6	3
Percent (%)	59.3	25.4	10.2	5.1

Drinking Water	**Drink Raw water (total households=53)**					
Reasons	Get used to	Lazy	Delicious	No time	No pot	Full
Number of households	14	13	12	9	8	5
Percent (%)	23.0	21.3	19.7	14.8	13.1	8.2

4.6.3.5 Access to water resources for household use

Both men and women are involved in taking water for home uses; however, most of this responsibility falls most on women. Mothers have this role when the family’s daughter is still young, if not this task will fall to the daughter. However; fathers also have second high contribution to such activity especially when mothers and daughter are not home. Sons also do this, but not so often. Table 4.26 provides statistics from the village research.

Table 4.26 Responsibility for getting water for household use

No	**Family member**	**Number of respondents**	**Percent**
1	Mother	60	35.5
2	Father	46	27.2
3	Daughter	45	26.6
4	Son	18	10.7
5	**Total**	**169**	**100**

4.6.3.6 Household water storage

There are no water storage systems in the village, either within the households or even at village level. All households take just enough water from the stream or from a well to use that same day. They do not have any big containers. Most often, water is drawn in the early morning and again in the evening times; otherwise villagers go get water whenever they need it. They use 15-liter buckets, carrying two buckets at a time. Each household has 2 to 4 buckets, by observation; some use a 20-30 liters pot, and a very few own a big 50-liter jar for rainwater collection during the rainy months.

From household interviews about rainwater storage, only 27 out of the 92 households (29%) collect rainwater for domestic use (drinking, bathing and washing). however, these households can keep their collected rainwater for only 1 to 3 days as the maximum capacity of their containers is very small. During the rainy season, these households use rainwater as their main source, but on days with no rain they draw water from the stream or water well. The majority of households (65, or 71%) do not collect any rainwater, lacking containers to do so.

Nearly everyone in the village (89 households) agrees that rainwater is one of the cleanest water sources available for consumption. A minority (7 households) expressed concern that containers need to be cleaned frequently or problems will emerge from mosquitoes laying eggs in them. Some expressed the feeling that this water needs to be boiled just like stream and well water.

Both types of households -- those who have or do not enough containers for rainwater collection, and those who do not -- expect to have support for getting new containers from an NGO project or the government. All 92 households (100%) expressed an interest in having such aid.

4.6.3.7 Community and household wells

According to the information gathered from focus groups combined with reports from almost all households, in the past many used to try to dig wells for supplemental sources of water for consumption. But that proved impossible to do so successfully since water levels here are quite deep, ranging from 15 to 25 meters deep (refer to the depth of three existing wells in the village, one well is about 15 depth; while the others two are 25 depth). Therefore, digging a well

for household use or as a village well proved beyond their abilities. No one in the village wanted to try this route again.

4.6.4 Water for Production

4.6.4.1 Community-based water resources management in Lao Nya village

As mentioned earlier, the villagers in Lao Nya face problems in terms of secure water supply. They can grow only one crop of paddy land rice per year, during the rainy season, since they have no irrigation systems for the dry season. There are water problems with planting of other crops, too. Facing continual food insecurity, villagers have to rely on NTFPs as a supplement. Almost all of the poor households have problems of rice insufficiency for between 2 months to the entire year. They rely solely on food sources available from nature -- for example, fish they can catch in the nearby streams. These villagers have access to fish from the natural stream, but can not supplement their fish catch by raising fish in ponds, because lack of water. This activity remains the main source for their protein intake, promoting fish raising in both rice field or in the pone, streams after improving the irrigations are positive potentials.

The nearest stream, Huay Lao Nya, has had problems of both quality and quantity particularly during the dry seasons over the past decade or so. In 2001, a check dam was constructed in Huay Loh, 800 meters from the village and from Huay Lao Nya. Construction of this dam reflected support from the government along with villagers' initiatives and labor. This dam is 1.7 meters high, 12.5 meters long and 2.0 meters wide. This particular irrigation system improvement was designed to ship water from that stream to increase the flow in Hauy Lao Nya in order to support paddy land rice growing along this stream. It was also supposed to improve water quality for the villagers' consumptions. Unfortunately, the extent of government support at that time was only enough to cover the dam itself, not the added channel. Villagers proposed to continue it by themselves, but that proved to be beyond their abilities to do so since the land along the channel is rocky and cannot be dug like soil. As a result, this dam was essentially unusable from then until early 2009, when the Biodiversity Corridor Conservation Initiative (BCI) provided added funds for construction of the channel. Now the whole system (dam and channel) is ready to be used for the coming dry season, especially for improved irrigation. More details about local hydrology can be seen in Figure 4.15.

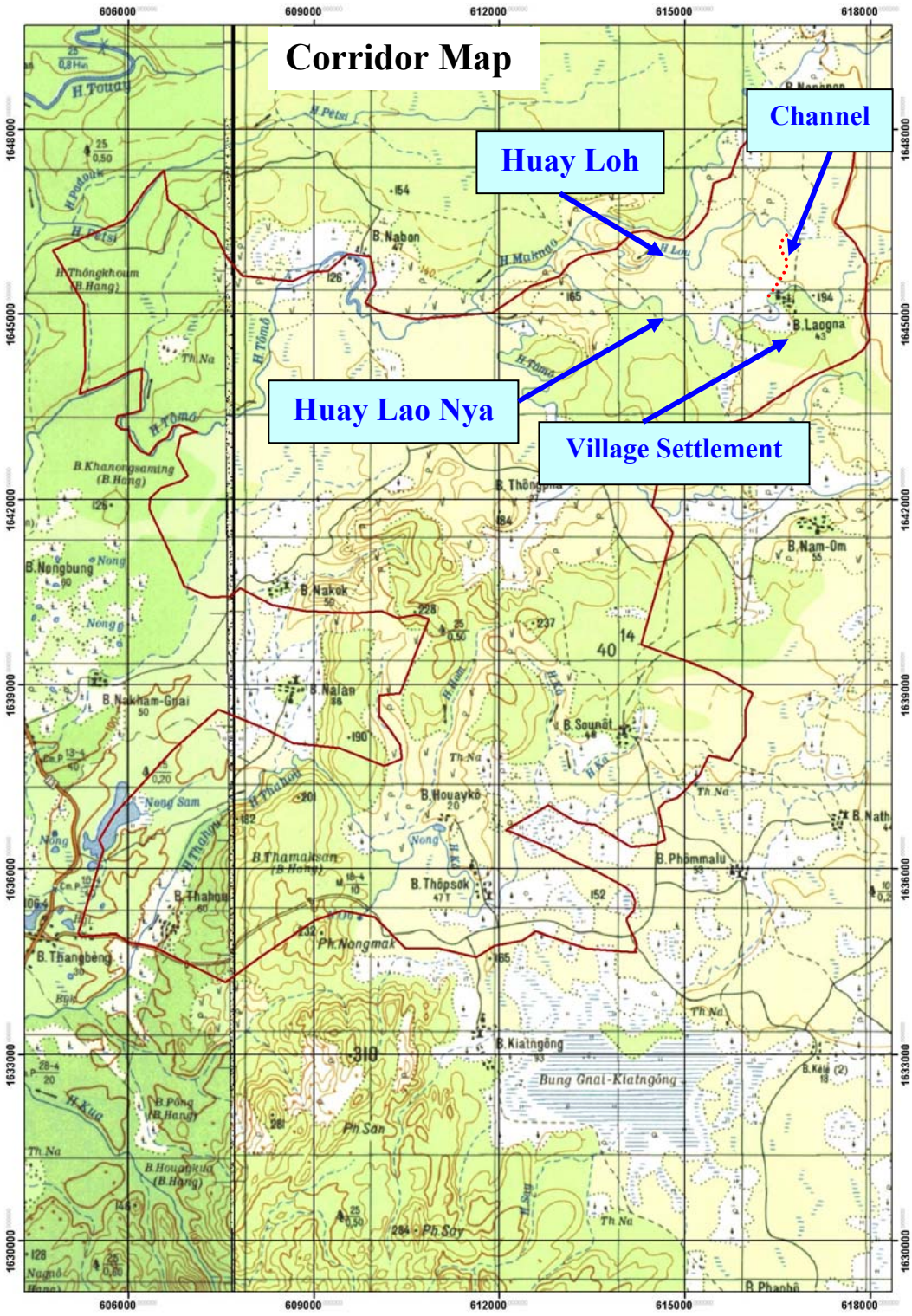

Figure 4.15 The corridor map with related streams in Lao Nya Village

4.6.4.2 Water supply

As mentioned in Chapter three, water availability was estimated by using float measurement. Water supply in related streams within the village such as Huay Lao Nya, Hauy Loh, and Hauy To Mo were assessed in both wet and dry seasons. Wet season flows were measured during September and the dry season during April. These times were chosen because the villagers claimed that these are the wettest and the driest times during the year. All year water flow could not be measured due to limitations of time and budget.

Results of the measurements are shown in Table 4.27. Water flow in both Huay Lao Nya and Huay To Mo differ greatly between dry and wet seasons, whereas flow in Hauy Loh is not so different. That is, Huay Loh's water supply is quite stable all year round. The elders of the village also confirmed that the water of Huay Lao Nya and Huay To Mo can increase very suddenly and also decrease suddenly, but flow in Huay Loh is quite constant. It is not too dry in the dry season or too high during the wet season. When water is diverted from Huay Loh to Huay Lao Nya, water availability of Huay Lao Nya will be increased from 75 m3/capita/year to 4,900 m3/capita/year.

Table 4.27 Dry and wet season water flows of the streams in Lao Nya Village

No	**Name of stream**	**Cross section and water flow in dry season (April)**				
		h(m)	l(m)	A=1/2hl	V(m/s)	Q=A*V(m^3/s)
1	Huay Loh	0.60	8.0	2.40	0.04	0.0960
2	Hauy Lao Nya	0.20	1.5	0.15	0.01	0.0015
3	Huay To Mo	0.40	12.5	2.50	0.07	0.1750
No	**Name of stream**	**Cross section and water flow in wet season (September)**				
		h(m)	l(m)	A=1/2hl	V(m/s)	Q=A*V(m^3/s)
1	Huay Loh	1.0	10.0	5	0.070	0.3500
2	Hauy Lao Nya	1.4	14.5	10.15	0.105	1.0658
3	Huay To Mo	1.5	15	11.25	0.350	3.9375

Note: h = height of the center deepest point, l = length of the stream, A = section area of the stream, V = velocity of the water flow, (V= [Total Distance (10m)]/ average time), Q = quantity of the water or water flow

4.6.4.3 Villagers' perceptions on dam and channel construction

According the household interviews, all 93 households reported that dam and channel construction are good and necessary to them. These improvements are expected to provide enough water to allow them to practice second paddy land rice during dry seasons, while also increasing the flow in Huay Lao Nya which is currently used by the village. At the same time, these new structures will improve water quality as well. Villagers expressed the belief that growing crops along the river would be a lot easier during dry seasons. Landless households in particular will also have more on-farm opportunities; they will not need to go out for other alternative livelihood options.

4.6.4.4 Benefits from community-based water resources initiatives

After channel construction is finished, in the next dry season they will be able to grow paddy rice on 30 hectares (61% of total paddy land, 48.96 hectares). Rice or other agricultural products are the main sources of income for the villagers. This particular irrigation improvement will be a major change for them in terms of income generation and more livelihood options. The village authority had already planned to allocate some paddy lands from land-holding households to poor and landless households, under the condition those receiving the land would share in its benefits. The village committee also confirmed that they would try to help each household to get equal benefits from channel construction through control from the village authority. Besides rice planting, they will be able to do more cash crop diversification, expected to occur on three hectares or more (but there was no detailed survey on that yet). Not only the water quantity will be increased especially during the dry seasons, but water quality also will be better which is good for their daily consumption. Riverbank cropping cultivation will be also benefit to them in terms of better consumptive water access and more food security, respectively (group discussion, July2009).

In addition to looking at the overall benefits from irrigation at the village level, the profits expected from irrigation improvements were assessed in terms of the different household levels. A total of 80 households will gain direct benefit from irrigation system improvement,

while another 35 households will gain indirectly. Within the households gaining directly, 51.4% benefited by being hired for wage labor during dam and channel construction, and 40.2% profited for their agriculture or from water to supply their second paddy land rice practice in dry seasons. The rest (8.4%) saw their benefits in terms of better water quality and more water quantity (two benefits that in fact accrue to all households within the village). For the 35 households who gained indirect advantages from irrigation system improvement, 68.6% of the landless are expected to be able to rent land to grow paddy rice in the dry seasons, while 11.4% will share their lands with their relatives. Full details are shown in Table 4.28.

Generally, benefits seem to be greater among the well-off and moderate poor rather than the marginally poor and the very poor group. However the whole commune is still considered a poor village, therefore the benefits of water diversion will contribute to overall poverty reduction. At the same time, when some households in the village gain greater self - sufficiency, the availability of other natural resources will increase for the poor groups in the village.

Table 4.28 Benefits gained from irrigation improvement, by household

	Benefit	**Other remarks**	**Number of households**	**Percent**
Direct benefits (80 HHs)	Wage Labor	During the construction period	55	51.4
	Agriculture (planting of second paddy land)	Only those owning land	43	40.2
	More water quantity and better water quality	These two things accrue to the whole village	9	8.4

Table 4.28 (continued)

	Benefit	Other remarks	Number of households	Percent
Indirect benefits (35 HHs)	Paddy land renting	Landless HHs and owners of paddy land located far from water sources	24	68.6
	Sharing agricultural plantings with their relatives	The kinship system is still strong in this village	4	11.4
	Have no idea	Just accept it	7	20.0

4.6.4.5 Riverbank cropping practices

All most all households plant vegetables along the river, especially at the nearest water source (Huay Lao Nya). The diverse crop includes vegetables, chilies, egg plant, garlic, onion, and other items that are necessary for their daily consumption; such small-scale planting covers only their household needs. Villagers said this activity contributed to their daily lives because they needed to buy vegetables only for the few months of the dry season. This reduced the expenditures on their food. These vegetables provided a supplemental food source during periods when they could not find other foods from the forest.

Based on the household interviews, the average land size for this cropping system ranges from 3x3 meters to 5x5 meters per household, while their need is about 5x5 to 10x10 meters each to be enough. The land is not only along the river but also some paddy lands near the river. Within the 92 households interviewed 77 (84%) practice this kind of cropping along the river while 15 others (16%) do not do so due to lack of land (6 households), have no time (6 households) or lack sufficient labor (3 households).

4.6.4.6 Crop diversification in dry seasons

After construction of the irrigation channel, villagers were able to plant other crops besides rice during the dry season: beans, corn, cucumbers, onion, garlic, chilies, eggplants, and others. However villagers expressed concerns about water, land, labor and markets for such kind of livelihood options. Villagers had some experiences in the past in terms of second cropping. From one project they received seeds for cucumbers and Chinese cabbage. Almost all households in the village planted those seeds, but the final results were that none of their products could be sold because no markets existed. The production was more than villagers could consume themselves, so the rest decayed; they could not process into any other form. That was one lesson learned about which the villagers remain very concerned about. Crops to diversify during the dry season should be the ones that need less water and are not highly responsive to market demands. These crops should be used to increase household self-sufficiency, rather than for sale or other commercial purposes.

Among 92 households, 66 (72%) have an opportunity to plant cash crops during dry seasons; 26 respondents (28%) think that this would be hard for them due to poor market availability; others cited the inadequate land and labor (10 households); and the other 6 households were concerned with the water supply during this certain period in the case no irrigation system.

4.6.4.7 Communal subsistence freshwater fishery initiatives

In the interviews and discussions 79 households (86%) reported that having a community fishpond would be good for their village. This kind of proposed activity would help them have added food security all year round. At the same time, this is also expected to contribute to the villagers' incomes. In present times the fish population in the area's natural streams has decreased year by year from its previous levels. Combined with population growth, this makes fish availability quite low. Having a new community fishpond is therefore one of the most important livelihood options of the villagers. Conversely, 13 households (14%) do not agree with such a development project. They expressed concerns about management terms and the benefits compared to the work sharing among the villagers (household interviews, July2009).

From group discussions, the villagers also stated that after the channel construction, they would have a secure supply of water for the fishpond. They would plan to extend and repair

the existing wetland area (about 60 * 80 meters), located about 400 meters from the dam, into the new community fishpond. The pond then would be managed by setting up village rules under which villagers take turn security guards. This will be benefit all households equally especially when they have village ceremonies, serving guests, gain income for the village fund and contribute to household food consumption. Fingerlings are needed to invest just only the beginning of the pond; the following years, new fish can be bred from the pond. Besides the existing wetland along the channel, there are some other potential places in the village that can be extended into fishponds. Details about this are in Table 4.29.

Table 4.29 Potential locations for a new community fishpond

No	Potential places	Number of respondents	Percent
1	Along the channel (Nong Aien)	75	78.1
2	Nong Yong, Nong Hou (need irrigated water for dry season)	7	7.3
3	Along the river (Huay Lao Nha)	4	4.2
4	Do not know	10	10.4
5	**Total**	**96**	**100**

4.6.4.8 Combined rice-fish production

Almost all the villagers (82 respondents, 89%) know about combined rice-fish production, but they had never practiced such kind of combination production at all. From the interviews, villagers seem to like this proposed idea very much and they willing to try doing it. Accordingly to the conditions of their paddy rice fields, 31 households (33%) reported that it would be possible to carry out the rice-fish combination within their fields, especially during rainy seasons. However, 62 households (67%) expect that it would not be possible to do so. They reported that their paddy lands are flooded so many times in a year, fish are also flown a way accordingly; they therefore cannot feed fish in their fields especially during dry seasons. Another

reason is their lack of paddy land. Within this subset of households, 42 (68%) have flooded paddy land and 20 (32%) have no paddy land at all.

4.6.4.9 Potential water sources

Besides Huay Lao Nha and Huay Loh, there is another stream called Hauy To Mo that the villagers claimed is another potential source for productive water. This stream is 300 meters away from existing land (approximately 10 ha) which could possibly be shifted to a paddy land rice area or a fishpond if the water from this stream can be brought in. Another existing paddy land nearby will be able to grow crops during the dry season as well.

In the village, there are two waterfalls in Hauy Mak Nao and Hauy Loh. These could potentially become ecotourism places in order to help the villagers have more livelihood options and have more opportunities to earn income from providing services to the tourists.

4.6.4.10 Upstream-downstream water resources governance

Only one village is settled downstream: Na Bon. Villagers stated that no any negative impacts from dam construction to that particular village will be due to Huay Loh because this is the only water source for that downstream village and based on the physical condition of these two villages, it is very fortunate that both Huay Lao Nya and Huay Loh are the tributaries of the same water sources. Water left over from Lao Nya will finally go back to the original water source. That is an advantage to both Na Bon Village and Lao Nya Village in order to reduce possible downstream impacts. However, appropriate mitigation efforts are needed in order to minimize the potential impacts to this downstream village by reducing water demand within Lao Nya bu selecting a sustainable schedule for water utilization. This requires closing and opening the dam to supply water when it is needed for crops' cultivation, increasing water productivity per unit of water by integrating any possible practices such as combined rice-fish production, and shifting to suitable crops that require less water. Furthermore, downstream impacts can be reduced by controlling water quality upstream such as a ban on application of any chemical fertilizers/pesticide in any cropping patterns, proper domestic waste management (not to litter in the streams), bans on use of inappropriate fishing gear (poisonous substances and explosive devices). However, cooperation between the Lao Nya and Na Bon village committees are strongly recommended to keep an eye on the overall situation.

4.6.4.11 Rules and Regulations for Water Resources Management

Currently, there is no any rule and regulation related to water resources management. There are only regulations on Community Forest, Conservation Zone, and NTFPs utilization/management in the Village's Protected Area. Based on some of those relevant rules and regulations combined with feedback from villagers during household interviews, as well as group discussions with key informants, proposed rules and regulations were developed. The proposed regulation on water focus mainly on three relevant 4 parts which are:

Watershed area protection (for all four streams: Huay Lao Nya, Huay Loh, Huay To Mo and Huay Mak Nao).

1. Existing stream protections (for all four streams: Huay Lao Nya, Huay Loh, Huay To Mo and Huay Mak Nao).

2. Operations and maintenance of existing facilities including dam, channels and three water wells.

3. Water shared amongst households within the village and between the Lao Nya Village upstream and the Na Bon Village downstream.

See more detail about rule and regulation on water resources management in the Appendix B

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

Physically, Lao Nya village has rich water resources. Water availability is considered high, but the problem involves accessing those water sources. In the past, agricultural practices, especially rice cultivation, used to be based mainly on rainfall that only occurs seasonally.

Since the village established a new water resources management initiative by developing a small-scale irrigation system, water plays a more critical role in its livelihood improvement and poverty reduction efforts. Improved water supply contributes to greater on-farm opportunities where villagers can now cultivate some of their paddy land twice a year, contributing to increased income. At the same time, they also have more livelihood options in terms of increased cash crop alternatives and river bank cropping systems during the dry season, resulting in improved food security.

Improved water supply from the village initiative allows for stable water consumption during dry months. Proper household water management in terms of water storage, water treatment, and cleaner water will contribute to reduced sickness and health care spending, respectively, maintaining availability of productive labor in the family and improving the villages' overall well–being. In conclusion, community-based water management will ensure food security, rice sufficiency, improvements in overall quality of life, and reduced poverty

Increasing only water quality alone is not enough in contributing to the villagers' well being; it needs to integrate water quality improvement with hygiene awareness raising as well as

the sanitation facilities developments. Those three main factors are the most important things which have to go hand in hand with each others to get the most positive impacts.

Good water governance is also an important and even necessary approach for water management, especially at the community level, in order to ensure that management will be sustainable under present constraints, as well as in the future when population increases. Furthermore, both human capital (knowledge and skills) and social capital (solidarity and community actions) including leadership capacity, and ability of knowledge transfer, are key factors influencing the success of the community-based water resources management.

Multi-purpose water management allows for more successful outcomes. Water supply cannot be based solely on water demand, because water resources are finite. Therefore multi–purpose water management through effective water usage by increasing productivity per unit of water is one effective alternative. Multi–purpose water management can include practicing combined rice-fish production instead of using rice monocultures, or shifting from higher water demand crops to ones requiring less water, which will result in reduced water demand and higher economic value. This approach can also be applied to integration of water for agriculture, aquaculture, domestic use, or recreation.

5.2 Recommendations

Based on the results of the analysis, relevant recommendations with some practical terms are proposed in the following table:

Table 5.1 List of recommendations and practical implementations

No	Recommendations	Location	Possible Implementations
1	Develop community fishponds	Nong Aien (60*80 meters large), 400 meters away from existing dam, along the channel	-Involvement of all households in this initiative, especially by providing labor -Establish village rules that include assignment of responsibilities and benefit sharing -Initial investment for fingerlings is required only for the first year. Ponds can then function thereafter as nurseries for fingerlings and for the rice – fish combination process in following years
2	Improve river bank cropping system	Existing gardens along Huay Lao Nya stream	-Village committee determines appropriate land allocation for each household -Determine suitable varieties of vegetables for household cultivation, consumption, or sale

Table 5.1 (continued)

No	Recommendations	Location	Possible Implementations
3	Promote rice-fish combinations in both dry and wet seasons	Any possible rice fields	-Implement recommended actions for households with appropriate rice fields -Buy fingerlings from markets
4	Set up conservation ponds	Reservoir area of the existing dam	Establish closed season (August to October each year) for catching wild fish (refer to village rules and regulations on water resources management, Appendix B)
5	Develop program of community-based ecotourism	Huay Loh and Hauy Mak Nao	Provide some services and facilities for tourists such as tour guides, and home–stay accommodations
6	Establish sound rules and regulations for water resources management	(1) Watershed area (2) streams: Huay Loh, Huay Lao Nya, Huay To Mo and Huay Mak Na (3)water-related facilities: dams, channels, water wells (4)water shares: within the village and with other villages	-Meetings with villagers to finalize rules and regulations -Approval from both the village committee and the Pathoumphone District Authority -Announcement of approved rules and regulations to all villagers -Effective enforcement and implementation

Table 5.1 (continued)

No	Recommendations	Location	Possible Implementations
7	Raise awareness of effective and safe hygiene practices	For all households	-Set up the hygiene program, including posters, cartoons, role plays or video displays - Provide training for all villagers -Evaluate by comparing their behavior before and after training
8	Set up rainwater storage, some for individual household use and others at community level	Any household with potential to capture and store water, plus other systems at village level	-Train villagers in basic knowledge and skills for rainwater harvesting and storage -Provide or develop additional proper water containers or other necessary materials, based mainly on materials available within the village

5.3 Suggestion for Future Studies

1. Watershed management: Focus on effective techniques for conservation of all relevant watershed areas for all streams in the village: Huay Lao Nya, Huay Loh, Huay Mak Nao, and Huay To Mo. Identify and mark the conservation zones clearly. Then restore such areas or manage them by enforcing appropriate village rules and regulations.

2. Aquatic resources management: Control use of fishing gear or fishing devices. Set and enforce open and closed seasons during the year.

3. Land use management: Since water and land are very closely linked, extensions of water use rules and programs to key aspects of land use are needed. Both land availability and land productivity need to be studied further.

4. Water resources management between Lao Nya Village and the downstream community (Na Bon Village) needs to be examined further to understand its broader implications.

5. Community adaptations to climate change (particularly with reference to water supply) need to be explored more carefully to ensure that villagers have better water utilizations and can access better water sources even in the face of anticipated future constraints.

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APPENDIXS

APPENDIX A

Questionnaire

Household Questionnaire for Community-Based Water Resources Management for Livelihood Improvement and Poverty Reduction: A Case Study at Lao Nya Village, Pathoumphone District, Champasak Province, Lao PDR

No: ....., Interviewer:..... Date:.....

I. <u>Basic Household Information</u>

HH No:..... Name of interviewer:.....

House size:....., Location:.....,

Material use to build the house: Roof material:....., Roof frame:.....

Wall:..... , Floor:....., pole:.....

Well-Ranking: ☐ Well-off ☐ Moderate poor ☐ Very poor

Are you satisfied to reside in the village when comparing the ranking of each household to other households within the village?

No	Name	Gender	Age	Relationship	Occupation	Educational Level	Other Remarks
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							

☐ Satisfied ☐ Unsatisfied ☐ Agree ☐ Disagree ☐ Others .....

II. Family Information

1. How many people live in the house? .....how many people reside outside or working outside the village (where do they reside and what kind of work do they do: Thai/Laos or other)?....., how much money do they spent to support their family?.....
2. How many families live in the house? .....
3. Details about house inhabitants
4. How many productive worker are in your family?.....
5. How many ha of each land type do you own?

   ☐ Settlement land:....., ☐ Paddy land.....

   ☐ Gardening land....., ☐ Other land:.....
6. How many years have you lived here? ☐ 1-10 yrs, ☐ 11-20 yrs, ☐ 21-30 yrs ☐>30yrs. If your family was not originally from here, Where did you move from?.....

   What were the reasons that you moved here? ☐ Cultivated land, ☐ Settlement land

   ☐ Water resource, ☐ Others:.....
7. are there any change in terms of natural resources (water, forest, NTFPs, etc) use compareed between the past and present?

   Water....., Forest .....,

   NTFPs .....

II. Information on Hygiene and Health

1. What are the diseases/common health problems that mostly occur in your family? ☐ Diarrhea, ☐ Malaria, ☐ Fever, ☐ Headache, ☐ Other:.....
2. Are there any problems on infant mortality? How many?.....when?.....

   Why? ☐ Birth complication, ☐ Fever, ☐ Diarrhea, ☐ Malaria, ☐ Other.....
3. How do you normally treat illness in your family?

   ☐ Herb ☐ Medicine ☐ Go to the hospital, ☐ Morya ☐ Others .....
4. What do you think about household toilet? ☐ Agree, ☐ Disagree, ☐ Others.....

   How do you think about public toilet?☐ Agree ☐ Disagree ☐ I do not know ☐ Others....

III. Information on Water Resources

❖ **General Water Information**

1. Did you observe any changes in the village water supply during the past 10 years?

   If yes what kind of change?

   ☐ Rapid changed ☐ Minimal change ☐ I do not know ☐ Others .....

   What do you think are the main causes of changes?

   ☐ Forest degradation ☐ population growth ☐ mitigation ☐ Others.....

2. What do you think about rules and regulations on water management for your village?

   ☐ Agree / good ☐ Disagree ☐ I don't know ☐ Others.....

   What should types of rules and regulations and processes should be established?

   .....

3. What do you think about village participation in water management?

   ☐ Agree ☐ Disagree ☐ I don't know ☐ Others.....

4. In the case that you receive support from some projects or government agency what do you expect from that supports in terms of water?

   ☐ Irrigation System ☐ Water Supply ☐ Water Containers ☐ Others.....

5. What are the sources for the water usage as listed below

Water Usage	Source	Location	Estimated Amount
Domestic			Per day
a. Drinking			
b. Bathing			
c. Washing			
d. Others			
Gardening			Per day
a. Homesteads garden			
b. River bank garden			

6. In the case that some of the water usage above are from many different sources, which sources listed below is used the most: please rank in descending order beginning with the number 1, with 1 indicating that the source is used the most.

☐ River / Stream ☐ Rainfall ☐ Underground water

☐ The irrigated water ☐ Others.....

❖ **Water for Consumption**

7. Do you think the water that you currently consume is clear enough to use?

☐ Clear ☐ Unclear ☐ Normal ☐ Others.....

8. Do you think unclean water has the negative impact to your health?

Yes, how?.....

No, why not?.....

9. Does your family boil water before drinking?

If yes, why so? ☐ From training, ☐boil medicine, ☐ Medias..... ☐Other.....

If no,why not? ☐ To maintain water taste, ☐ To feel fully from drinking unboiled water, ☐ No time to boil, ☐ Other.....

Do you think drinking unboil water poses a negative impact to your health?

☐ Yes ☐ No ☐ I do not know ☐Other.....

10. Who usually collects water for household consumption?

☐ Mother, ☐ Father ☐ Daughter, ☐ Son, ☐ Others.....

11. How long does the water your family collects for consumption usually lasts?

☐ Two weeks, ☐ One week, ☐ Three days, ☐ One day, ☐Others.....

12. Do you store rainwater for use? ☐ Yes ☐ No

If yes, for how long? ☐Two months, ☐One month, ☐A few weeks, ☐Other.....

If no, why not? ☐No container, ☐No techniques, ☐Other.....

13. What do you think about rain water collection?

☐ Agree, ☐ Disagree, ☐ I do not know ☐Other.....

14. Do you agree if government support the container for rain water harvesting?

☐ Agree, ☐ Disagree, ☐ I do not know ☐Other.....

15. What do you think about digging well for household consumptive water?

☐ Agree, ☐ Disagree, ☐ I do not know ☐Other.....

16. What do you think about community well?

☐ Agree, ☐ Disagree, ☐ I do not know ☐Other.....

17. What water resource problems in terms of both quality and quantity did you observe in the past 10 years?.....

At the present time?.....

18. What are your future plans or expectations concerning drinking water?.....

❖ **Water for Production**

19. What do you think about dam and channel construction in your village?

☐Good, ☐Not good, ☐ necessary, ☐ unnecessary, ☐ Other.....

20. Will you receive any profits from channel's construction?

If yes, how?

☐Labor wage, ☐ Agriculture, ☐ Fishery, ☐ Water quality, ☐ Other.....

If no, how do you feel about not receiving benefits? And what do you expect from the channel's constructions? .....

21. Do you practice any river bank cropping system? ☐ Yes ☐ No

☐ Consumption ☐ Sale ☐ Consumption and Sale ☐ Processing ☐ Others

If yes, how large is your sysyem?.....What kind of crops do you plant.....

and how do theses crops help you in terms of food security?.....

If no, why? What is your view towards the riverbank cropping system?

.....

What kind of crops that do you think can be planted along the river?

.....

And what land area do you think is sufficient for your household to implement the riverbank cropping system?

.....

22. Beside of rice do you think you can be planted any other crops in the paddy field or not especially during the dry season?

    If yes, what are they? ☐ Bean ☐Cabbage ☐Cucumber

    ☐Garlic ☐Onion ☐Other.....

    If no, why not? ☐No land, ☐No labors, ☐No seed, ☐No market, ☐Others.....

23. What do you think about the community fish pond? ☐ Good, ☐ Not good, ☐ I do not know, ☐other:.....

    Where are the possible places to implement the community fish pond?

    ☐Along the channel, ☐ Along the river, ☐ Reservoir area, ☐Other.....

24. Have you ever heard about the combined rice-fish production system (raising fish in paddy field during rainy season)? ☐ Yes, ☐ No, ☐ I do not know

    If yes, do you think that the system can be applicable in your village?

    ☐Possible, ☐ Impossible, ,☐Other.....

    The reasons are: ☐ Flooding, ☐ No paddy lands ☐ Other.....

    And what kind of fish do you think can be fed in the rice field? 1.....

    2....., 3....., 4.....

    If No, How do you think about that? ☐Possible, ☐ Impossible, ☐Other.....

25. Do you know where are the location of potential water sources for agriculture (rice, other crops and fish pond)?

    ☐Irrigation, ☐ Groundwater, ☐Rainwater, ☐Other.....

IV. Income and Expenditure

1. Are you satisfied with your current living condition?

    ☐ Yes ☐ No ☐ Others

    If no, how do you think you can overcome your living difficulties?

    .....

    What do you think about the role of related project or government agencies in supporting your village?.....

2. From where do you get the major part of your income?

Income	Amount	Sell price	Total income	Other Remarks
1. Crop Products				
a. Low land rice				
b. Up land rice				
c. Coffee				
d.				
2. Livestock				
a. Cow				
b. Buffalo				
c. Duck				
d. Chicken				
f.				
3. NTFPs				
a. Honey bee				
b. Mak Jong				
c.Cardamom				
d. Kee See				
e. Rattan				
f.				
g.				
h. Others				
4. Trading				
5.Handicraft				
a. Mat				
b. Rice bucket				

6. Labor wage (inside or outside the village)				
a. on-farm work -..... -..... -.....				
b. off-farm work -..... -..... -.....				
7. Fishery				
8. Others				

3. General Expenditure

Expenditure	Amount	Buying price	Total Expenditure
1. Rice			
2. Food			
3. Households Materials			
4. Educational Purpose			
5. Heath Care			
6. Social Contribution			
7. Agricultural Equipment			
8. Transportation Cost			
9. Others			

APPENDIX B

Rules and Regulations on Water Resources Management

Lao Nya Village, Pathoumphone District,

Champasak Province

I. Rules and Regulations

1. Watershed areas protection (Huay Lao Nya and Huay Loh)

a. The village committee with agreement from the villagers will establish this particular area as the village's protected zone, defining its precise boundaries carefully and marking them clearly both on maps and on the ground. This action will be taken within 90 days of these rules and regulations being formally adopted.

b. Cutting of any trees will be banned in this protected zone from that date forward. Villagers of Lao Nya and nearby villages(Nabon, Som Souk, Nong Ake, and Nam Om) agree not to practice slash-and-burn cultivation within the protected watershed area

c. No permit will be issued to burn any tree or any forest materials that can start a fire within the watershed area

d. Plant fast – growing trees and combine with other species based on existing soil conditions in watershed areas. The village committee can request funding or support for seedlings from the Department of Agriculture and / or relevant agencies in order to establish or maintain a village nursery. Transplantation of mature trees from nurseries to watershed areas occurs twice a year during certain periods.

2. Streams (Huay Lao Nya, Huay Loh, and Huay To Mo)

a. The village committee with agreement from the villagers will designate the reservoir in Huay Loh is as a conservation zone

b. No fishing is allowed in this conservation zone from August 1 through October 31 of each year (the "closed season"). This is the period when fish lay their eggs

c. Fishing is allowed from November 1 through July 31 of each year (the "open season") in any stream within the village. However, any use of any kind of

illegal fishing equipment like explosive devices, electrical devices or poisonous substances is explicitly forbidden.

d. It is not allowed to throw or place litter or any kind of rubbish into any stream in the village

e. Application of any chemical fertilizers or pesticides at any croplands less than 200 meters from either banks of the Huay Lao Nya River or Huay Loh River is forbidden.

3. Existing water-related facilities (dams, channels, water wells)

a. The village committee assumes responsibility for leading in operation and maintenance of these water management facilities

b. A representative from each household has to join in clearing weeds along the channel four times each year. Specific dates for such service will be established by the village committee, with each household notified at least seven days prior to the required service day

c. Everyone has to be responsible to protect all the village's water management facilities and help each other to keep an eye out for any bad usage for the benefit of everyone

d. Anyone who damages any of these facilities especially the water well) in any way has to take full responsibility for its repair

4. Sharing of water resources within the village and between Lao Nya and Na Bon

a. Existing paddy lands within the village will be divided and allocated to the landless villagers for use during the dry season based on villagers' agreements. The village committee will lead this process. Benefits will be shared along the lines of a separate agreement, both between villagers and between renters and land owners.

b. Each year at the beginning of the dry season or the second sequence of paddy land utilization, the village committees of both Lao Nya and Na Bon will meet to

discuss water sharing. Residents of both villages will be notified in writing of the results of these annual meetings.

II. Relevant Permissions

a. Villagers are allowed to collect any kind of non-timber forest products (NTFPs) in the designated watershed areas
b. All villagers can fish in any village streams at any time, except in the restricted zone and during the defined closed season
c. All domestic litter or wastes are to be buried underground in a common village site that is managed by villagers. The disposal site can be a large hole dug by villagers that is located far from water sources.
d. Villagers are permitted to apply any kind of organic fertilizers to their crops

III. Penalties

Any person who violates these community water management rules and regulations will be fined or punished according to the steps set out below:

For Violations of Rule and Regulation No.1

- *First time*: Write a report to the village committee and present the report to the committee members in public, as a teaching/learning experience.
- *Second time*: Pay a fine from 100,000 to 500,000 Kip, the specific amount to be determined by the village committee. Those who violate in terms of illegal logging or forest burning will be fined a triple amount
- *Third time*: Send the person to the district administrative office for appropriate punishment

For Violations of Rule and Regulation No.2

- *First time*: Write a report to the village committee and present the report to the committee members in public, as a teaching/learning experience.
- *Second time*: Turn over their fishing equipment to the village committee and pay a fine of 100,000 Kip

- *Third time*: Pay a fine of 300,000 Kip. Anyone using any of the illegal fishing equipment mentioned in Rule2c will be fined 1,000,000 Kip and sent to the district administrative office to proceed to the next step

For Violations of Rule and Regulation No.3

- *First time:* Write a report to the village committee and present the report to the committee members in public, as a teaching/learning experience
- *Second time*: Pay a fine two times the value of the destroyed or damaged items that have to be replaced
- *Third time*: Pay a fine three times the amount of the second one and be sent to the district administrative to proceed to the next step

IV. Other Relevant Points

a. Anyone who identifies a violator and reports this situation to the village committee is eligible to receive a reward of 30% to 50% of the fine charged (the specific amount of this award to be defined by the village committee). The remaining 50% to 70% of the fine will be dedicated to the village fund for operation and maintenance and local public works.

b. These rules and regulations need to be finalized by a village meeting, the foundation committee, and the district administrative office, and will take effect for enforcement as soon as those approvals have all been completed. Each village household will be notified in writing when this takes effect.

c. The village committee will evaluate the performance, effectiveness, and implementation of these rules and regulations twice a year, publishing a report to be distributed to the public at large.

APPENDIX C

Water, Sanitation, and Hygiene (WASH) Awareness Raising Program

I. Training Package

During the training some informative posters, shows, plays, and/or videos related to water, sanitation and hygiene should present the important points below:

1. Water

a) Boil water for consumption in order to destroy all kind of waterborne pathogens

b) Store boiled water in the same container which it has been boiled

c) Safe water handling by closing containers properly with protected openings in order to reduce opportunities for recontamination

d) Boiled water should be consumed within 24 hours

e) Fetching water carefully from any sources, using clean containers

f) Clean rainwater containers frequently and close such containers properly to avoid mosquitoes egg laying

g) Keep water sources clean

2. Sanitation

a. Any kind of proposed latrine must be: within 10 meters from the kitchen or homestead, at least 15 meters downhill from water sources, at the back of a dwelling house for privacy reasons, and at least 1.5 meters above the highest seasonal groundwater table

b. Use dry latrines which are far from water sources (streams and wells) instead of improper defecation in the forest or nearby streams

c. Feces left out in the open (whether from adults, children, babies, animals) must be disposed of properly by burying

3. Hygiene

a. Wash hands properly by ash or any kind of soap after defecation in a field or latrine, after cleaning a baby, or after cleaning wounds

b. Wash hand before cooking or handling food, before eating, before feeding a child or breast feeding, and before cleaning wounds

c. Clean the house and cut the grasses surrounding the house frequently in order to reduce health risks from malaria.

d. Avoid stagnant pools of water in the drainage surrounding a home, which are good habitats for mosquitoes carrying malaria

II. Monitoring and Evaluation

Carry out monitoring after three and six months, then evaluate the results based on comparison of those two periods of time. The seven essential indicators that should always be monitored as a priority include:

a. X% of households boiling/using safe water for drinking

b. X% of households handling water fetching and storage safely before and after training

c. The frequency in cleaning rainwater containers before and after training

d. Any change in terms of defecation habits before and after training

e. X% of the population washing their hands with soap or ash after contact with faecal matter, and before handling food

f. The frequency in housecleaning, and grass - cutting before and after training

g. All sectors of the community, including vulnerable groups, should be capable of practicing targeted hygiene behavior after training

(X% = depends on the situation)

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