Ministry of Water Resources

and Meteorology

COLLECTIVE ACTION IN DEFINING RULES FRAMING PRIVATE/PUBLIC PARTNERSHIP IN IRRIGATION SCHEMES DEVELOPMENT AND MANAGEMENT:

Case study of Kbal Por irrigation scheme, Takeo province, Cambodia

Thesis prepared by:

VOGEL AURÉLIE

To obtain a diploma of Engineer in Tropical Agronomy
Co-Supervised by : BALMISSE Sébastien
Thesis Director : FONTENELLE Jean-Philippe

Avril 2006

TABLE OF CONTENTS

INTRODUCTION

This report has been carried out to obtain the Postgraduate Engineering Degree in Tropical Agriculture of the National teaching centre for studies in tropical agronomy (CNEARC), in Montpellier, France.

This study has been carried out in Cambodia, Takeo Province. It takes place in the FSP project "Capacity building on agricultural sector policy making", financed by the French Ministry of Foreign Affairs, which aims at strengthening the institutional capacity of the different ministries involved in the agricultural sector in the definition of agricultural sector national policies. The results of the study will help formulate recommendations to enhance Private-Public-Partnership in national policies and strategies related to irrigation development.

This work takes place during a period of 8 months, two of which were field work (from the 9 June to the 10 December 2005). This work has been supervised by Mr Sebastien Balmisse, technical assistant in MOWRAM, and Mr Jean-Philippe Fontenelle (GRET).

This study concerns a 500 hectares irrigation scheme, rehabilitated in 2003 and currently managed by a private entrepreneur, in Kbal Por, Takeo province. Its objective is to provide a better understanding of the emerging conditions of private initiative and spontaneous organisation in Cambodian irrigation systems.

First we present the objectives, the context, the construction of our research question and the methodology we followed. Then we present an agro-economical diagnosis of the farm-activities carried out by the water users. Afterwards, we will describe the main characteristics of the irrigation system and our analysis of its management and functioning. Last, we take up the whole results of our study by following the three main lines chosen to provide a better understanding of the emerging conditions of private initiative and spontaneous organisation in irrigation schemes. We also formulate several recommendations which may concerns the irrigation systems in Cambodia as a whole.

1 OBJECTIVES, RESEARCH QUESTION CONSTRUCTION, METHODOLOGY AND CONTEXT

1.1 PRESENTATION OF THE PROJECT AND THE TRAINING OBJECTIVES

1.1.1 The FSP « Capacity Building on agricultural sector policy making » Project

Since July 2002, the Project «Appui à la définition de politiques sectorielles agricoles» (Capacity building on agricultural sector policy making), financed by the French Ministry of Foreign Affairs, aims at strengthening the institutional capacity of the different ministries involved in the agricultural sector in the definition of agricultural sector national policies.

This project is focusing on 4 pilot sectors:

Land tenure security;

Participatory Irrigation Management and Development (PIMD);

Reforestation strategy;

Strengthening of farmers' organizations like cooperatives.

The study which is presented in this report takes place in the PIMD component. Within the framework of this component, a workgroup has been created in May 2003, which is led not only by the Ministry Of Water Resources and Meteorology (MOWRAM) and involves the Ministry of Agriculture, Fisheries and Forestry (MAFF) and the Ministry of Rural Development (MRD), but also the Ministry of Economy and Finance (MEF) and the Ministry of Interior. The main goal of this workgroup is to build its own capacity to collect, capitalize and disseminate information related to ongoing irrigation management and development activities in Cambodia and to provide decision makers concrete recommendations to improve the legal framework and the strategy documents.

These recommendations embrace four main topics:

1. Legal Framework of irrigation activities;
2. Institutional framework of irrigation activities;
3. Financial framework of irrigation activities;
4. Support services to the Farmer Water Users Communities (FWUCs).

The main expected output is the capacity building on policy-making. Indeed, one of the key of the success of the process of irrigation systems transfer will result from its appropriation by the Cambodian partners.

This work's results will also nourish the debates recently begun within the framework of a platform involving the Ministry representatives, donors and civil society (Technical Working Group on Agriculture and Water). This Technical Working Group is also supervising one sector review of the nature, evolution and the socio-economic benefits of irrigation activities in the country. The general objective of this study is to produce reliable information on the conditions of viability and sustainability of ongoing irrigation in the country, and evaluate their impact on poverty reduction in rural areas. Building on existing information and ongoing studies, this research will provide

valuable information for further development of a coherent medium term strategy in Agriculture and Water to promote sustainable PIMD in Cambodia

1.1.2 Presentation of the GRET

Through the different steps of the training period, a methodological support has been provided by the GRET, Research and Technological Exchange Group.

This non-profit organization, created in 1976, defines itself as "an international solidarity organization uniting professional activists who work between the research and the development with the local authorities". Two-thirds of its activities involve field projects, systematically undertaken in partnership with local organizations or that lead to the creation of such organizations.

In Cambodia, where Gret is working since 1988, it supported the implementation of several local NGOs, such as CEDAC (Centre for Study and Development in Agriculture), ACAPE ("Association cambodgienne d'approvisionnement en eau") and also a rural microfinance institution (EMT -Ennatien Moulethan Tchonnebat today called AMRET). Gret also plays a role of « interface between the development and the research », through capitalization of experiences and communication for development (publications, animation of information and exchange networks). Last, Gret provides support in public policy building, thanks to the implementation of large scale projects and the contribution to several national sectorial working groups.

1.1.3 The initial proposal

Because of the role of irrigation in food production security, it is seen as a cornerstone in the development of Cambodia. The Government set the development of irrigation as a priority in its 'Social and Economic Development Plan' (SEDP)[1].

However, the development of irrigation in Cambodia is facing several challenges. Currently irrigated areas cover only about 20% of the total agricultural area. First of all, the Government does not have the financial capacity to ensure Operation and Maintenance of all irrigation schemes. Besides, **there is a lack of information on several aspects related to irrigation activities, such as the value of irrigation water or the quality of the service in existing irrigation schemes**.

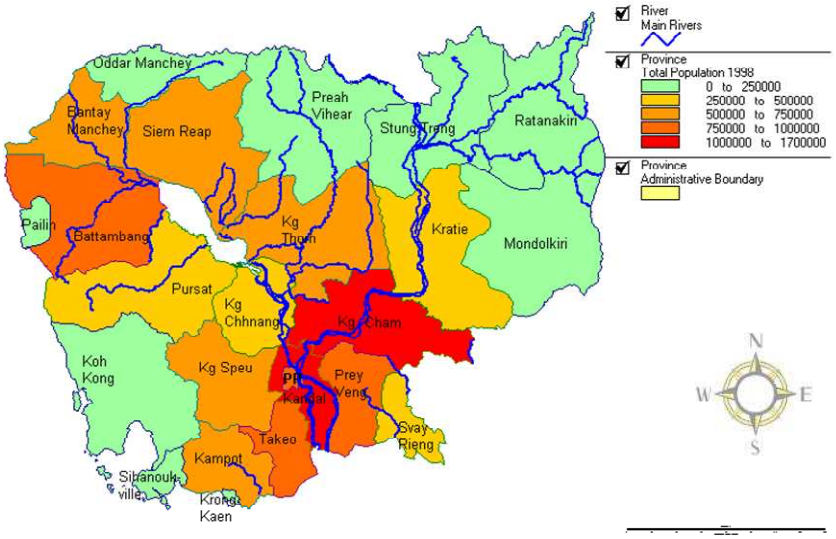
The debate on the development of irrigation in Cambodia is falling under an international scale debate, particularly dealing with the transfer of the management of irrigation schemes (Irrigation Management Transfer). IMT relies on the assumption that farmers are able to manage their irrigation schemes in the most efficient and sustainable way. For about ten years, the Royal Government of Cambodia is promoting an irrigation development policy, oriented towards the transfer of the management of irrigation infrastructures, from State to users associations. One of the main goals of the MOWRAM is the development of Participatory Irrigation Management and Development, particularly by the implementation of Farmers Water Users Communities (FWUCs). The MOWRAM sector policies also define, as a strategic orientation, the participation of the private sector "*into the rehabilitation, reparation, development and management of irrigations systems*". But the current lack of legal framework to

[1] The government policy will be more described in the following part.

organise, control and secure the private investment in irrigation is hampering this kind of private initiative in that sector.

The main goal of the proposed study is to provide a better understanding of the emerging conditions of private initiative and spontaneous organisation in irrigation systems. The study particularly focuses on the modality of establishment of functioning rules governing the relationships between the involved actors. An effort is also done to better understand the adequacy/inadequacy of national legal framework to support Private-Public-Partnership in irrigation development. The results of the study will help formulate recommendations to enhance Private-Public-Partnership in national policies and strategies related to irrigation development.

1.2 PRESENTATION OF THE NATIONAL CONTEXT



Map n°1: Cambodian provinces, administrative boundaries and number of inhabitants per Province (Pillot, forthcoming)

1.2.1 General data[2] on the country

"The Kingdom of Cambodia was founded in 1993 and promoted the development of a multiparty system and a market economy. The country remains one of the poorest countries of the Mekong Region, and suffers from high governance matters." (Roux, 2005)

Official Name :	- Kingdom of Cambodia
Capital :	- Phnom Penh
Surface :	- 181 035 km², borders with Thailand, Laos and Vietnam
Form of Government:	- Constitutional monarchy; King: Norodom Sihamoni ; Prime ministry : Hun Sen (Cambodian People Party).
Population 2004 :	- 13.4 millions people
Density of population :	- 70 people/km²
Population growth rate (2004):	- 1.8%
Life expectancy (2004):	- 58.4 years
Ethnic groups :	- 90-95% Khmers, 5% Vietnamese and Chinese
Religions :	Approximately 95% Theravada Buddhists (state religion), Muslims (400 000), Christians (60 000), some animists.
Population under the poverty line [3]:	- 36% in 2001
Gross domestic product Composition [4]:	- Agriculture: 36% (2003); including rice cropping 38%, with an average of 1.07 ha of arable land per family and about 10% of landless people…

Table N°1: General data on Cambodia

1.2.2 Cambodian agriculture

Cambodia is predominantly an agrarian society, with 84% of the population living in rural areas. Agricultural sector is accounting for 40 % of gross domestic product, and employing more than 70 percent of the national labour force[4].

1.2.2.1 Climate

The Cambodian agriculture is closely linked to the climate and the precipitations. Cambodia has a tropical monsoon climate and receives important annual rainfalls (from 1500 mm per annum in the central lowlands up to 5000 mm in the south-western highlands). Nevertheless, these rainfalls are constraining and difficult to forecast. Indeed, the precipitations are shared out through the year in a really contrasted way, with important inter-annual variations.

The climate of Cambodia is governed by two main seasons:

Dry season, from November to April, with a regime of precipitation quite nil, in January and February, and an intense evapo-transpiration.

[2] http://www.cia.gov/cia/publications/factbook/geos/cb.html

[3] Source : D. Pillot, forthcoming

[4] National Poverty Reduction Strategy 2003-2005, 2002

Wet season, divided into two periods : (1) From May to August, the rainfalls are few and irregular and constitute only 1/3 of the total rainfall amount, with, some years, a decrease of the rainfalls, in July-August, usually called '*the small dry season'*; (2) The period from September to October concentrates the main part of rainfalls, and inundations may occur.

The uncertain arrival of the dry periods and rainfalls strongly conditions the agricultural practices. Indeed, the starting of the rainfalls is really unpredictable and variable between the years. Moreover, even if the rainfalls are abundant in July, they remain irregular. Now, they are really important, as they determine the ploughing and sowing time of the wet season cropping. Furthermore, the 'small dry season' is occurring at a critical moment for the wet season rice cropping and may cause an important water deficit, which may compromise the growth of the plants. The big rainfalls occurring at the end of the season fulfil the natural and artificial reservoir and networks, which constitute an important reserve of water used for human and animal consumption, fish farming, and irrigation of home gardens. These reserves can also be used to fight against the risk of dehydration, as the wet season stops in November, abruptly and irregularly. In some places, the rainfalls cause important floods. This is the case in the Tonle Sap or in Takeo, in our area of study. These floods are particularly useful for the Cambodian farmers: during the flood they can fish and during the flood recession they can crop floating rice or flood recession rice.

Cambodian farmers have to deal with rapid changes of deficit-excess of water in their fields. Nevertheless, the irrigation and drainage possibilities are really limited in the traditional conditions. According to ROMANO (1997) «*Any improvement of the agricultural goes through water management, and without hydraulic infrastructures, the rice-production vocation of Cambodia appears disputable*».

1.2.2.2 Agricultural sector and rice cropping

Rice is the main crop of the country. It accounts for some 84 percent of annual foodcrop production and occupies some 2 millions hectare -or 90 percent of the cropped area- and is the major source of farm income (FAO, 2004). Rice is the main staple of the Cambodian people, who eat it at almost every meal. Rice is the basic food producing crop, the one which is essential for the family food security. **According to the years, this production orients the economical practices of rural peoples** (Pillot, forthcoming).

There are three irrigated and three non irrigated cropping patterns currently practiced in Cambodia, and the irrigated cropping is almost exclusively for rice: the irrigated cropping patterns are (MOWRAM definitions):

- **Wet season lowland rice with supplementary irrigation**: This cropping pattern is where water is abstracted from watercourses or taken from dams to irrigate when rainfall is low.
- **Dry season lowland rice with irrigation**: Generally this land is also used for wet season production with supplementary irrigation, but limited water resources and poor infrastructure mean the area cropped is much less.
- **Flood recession rice**: This cropping pattern exists near the Mekong, Tonle Sap and Mekong system as well as within some reservoirs and relies on natural flooding to water the fields.

The remaining non irrigated cropping patterns are:

- **Lowland rainfed rice**: This is the dominant cropping pattern in Cambodia. Land is prepared and planted in May to early June. The varieties are tolerant to the drier conditions typical from late June into August but there is a significant risk of crop failure in dry years. Also it is not uncommon that there is insufficient rain to plant in May and June.
- **Deep water floating rice**: This pattern is practiced around the Tonlé Sap Lake using varieties able to grow quickly enough to float above rising flood water.
- **Rainfed upland rice**: This is grown in small areas of sloping land in the north and north-east of Cambodia and is not irrigated.

In 2003, rice production was estimated at 4.3 million tons, with yields averaging slightly more than 2 tons/ha. These yields are much inferior to the yields achieved in other south-Asian countries (4.2 ha in Thailand) and most of the farmers are cropping rice only one time per year, during the wet season. In many cases, farmers are practising an extensive agriculture, partly in order to limit the risks inherent to the irregular characteristic of the climate.

1.2.2.3 The high potential of development of irrigated agriculture

The irrigated area amounted in 2000 to 277 000 ha of rice fields. **This represents only 16% of cultivated areas and 40% of rice production**. It is estimated that with the current existing systems, the potential irrigated area related to those systems is more than 606 000ha (Pillot, 2000, quoted by Roux, 2005). The main irrigation method is gravity irrigation. In the wet season, supplementary irrigation may be through direct run-of-river diversion, pumping or by means of release of stored surplus run-off. In the dry season, when in the majority of rivers there is little flow, irrigation is only possible from storage, or by lifting water, either by pumping or by traditional methods, from residual flows, floodwater or on a small-scale, from groundwater. Pumping from the dry season flows from canals and streams connected to the Mekong or Bassac river is becoming a popular and productive dry season farming system in Takeo and Prey Veng provinces (MOWRAM, 2004).

METHOD	IRRIGATED AREA, HA	
	WET SEASON	DRY SEASON
Gravity	87,800	119,700
Pump Station	19,350	23,650
Mobile Pump	73,850	47,850
Traditional Lift	23,000	11,800
Total	**204,000**	**203,000**

Table N°2: the different methods of irrigation in Cambodia [5]

[5] Source: Statistic Data of the Irrigated Agriculture Department, MOWRAM (1999) in MOWRAM (2004). PIMD of Cambodia

In special project areas where water control and agricultural practices are enhanced, rice yields can be 3.0 to 3.5 tons/ha. Conversely rainfed yields may be as low as 0.7 to 0.8 tonnes/ha and crop failures due to inadequate rainfall are frequent. In many case, farmers are practising an extensive agriculture, partly in order to limit the risks inherent to the irregular characteristic of the climate.

Thus, the potential of irrigated agriculture development in Cambodia is high. It may allow to improve the agriculture productivity by increasing yields and developing double-cropping.

1.2.3 History

The following part aims to succinctly present the main elements which may have influenced the technical and organisational characteristics of the Cambodian irrigated agriculture (Kibler, Perroud, 2004). To get more details about the Cambodian history, please see Annex 2.

The Cambodian agriculture may be born from the rice domestication, during the third millennium before Jesus Christ, from the floating rice cropping around the Tonle Sap Lake and the Mekong's banks, but also from the slash and burn rainfed rice, probably handed down by the Yunnan's cultivators. The South Indian sailors, who were navigating on the Mekong to reach China for commercial exchanges, may have transmitted rice cropping techniques (transplantation, drainage), means (plough, harrow, etc.) and new varieties of rice.

During the Angkorian period (IX° to XV° century), Cambodia was living a period of prosperity, thanks to the commercial road between India and China. For several authors, the Angkorian Empire was a 'Hydraulic Empire': according to them, the kings of Angkor built a sophisticated irrigation scheme, with very large reservoirs –*baray*- which allowed to supply enough water to harvest three rice crops per year. This myth is currently criticized by the international scientific community, which estimates that these huge infrastructures were designed to supply water to the cities, and may have been used to allocate a complementary irrigation at the end of the rice cycle, but were not big enough to allow the irrigation of three rice crops per year. (Pillot, Forthcoming).

What is remarkable for our study is that this myth of Cambodian hydraulic power has been widely used by the Khmers Rouges and is still supported by the politicians and the population.

During the French Protectorate (1863-1953), the French Government implemented several reforms (as land property deeds), developed cash crops and export crops and several "big and modern agro-hydraulic infrastructures". These heavy and costly infrastructures were intended for the production of export rice crops on big area (30 000 ha for the Bovel Dam, Battambang Province). But they never achieved the expected results due to failures in the design, high maintenance costs and social instabilities.

In 1970 the General Lon Nol made a putsch and implemented the « Khmer Republic. This started a civil war: the conflicts multiplied, the insecurity increased and the countryside emptied. This social tensions and the support of the exiled King allowed the development of the Khmer Rouge Communist Party.

On April 17th 1975 the Khmers Rouges took power and implemented the Democratic Kampuchea, a system of fear, by killing all the intellectuals and opponents,

abolishing money and emptying cities by force, in order to create a national cooperative. By putting forward the "Angkorian Hydraulic Empire", the Khmer Rouges mobilized manpower into working groups and cooperatives, for agricultural works and the construction of huge hydraulic infrastructures, and this in dreadful conditions. The Khmer rouges leaders wanted to "*rule the countryside in squares with irrigation canals distant of 1 km from each others, intended to irrigate rice fields fully redesigned in homogeneous plots of 100 meters on 100 meters'* (Kliber, Perroud). But despite the quantity of mobilized manpower, these infrastructures gave very bad results, mainly because of lack of competences. Indeed, the overdesigned infrastructures were submitted to fast erosion and did not handle the real fields' conditions. According to a study carried on by HALCROW in 1994 (quoted by Kibler, Perroud), **on the 841 irrigation schemes enumerated, 580 have been constructed by the Khmer Rouge, and only 120 were operational in 1994. But these infrastructures are still structuring the countryside and are conditioning many current irrigation development projects**.

After four years of this system of terror and suffering, the Cambodian population was bloodless, with a number of victims estimated from 1 up to 3 millions, for a population of 8 millions in 1975. Nowadays, the trauma is still strong. **This recent past may impact the local population** (at least the 50 percent who lived this period). '*Particularly, some reluctance may be met in the implementation of collective action and on all kind of forced approach'* (PIERRARD, 2004).

In January 1979, the Vietnamese army liberated Phnom Penh and implemented the People's Republic ok Kampuchea. In order to counter the famine and reconstruct the agriculture, the Government implemented the formation of "*krom samaki*" or "solidarity groups", composed of 10 to 15 families in order to share manpower and means of production. It allowed also to progressively land decollectivization by limiting the land conflicts. But these *krom samaki* have been gradually abandoned by Cambodian people who preferred to reorganize themselves around the family nucleus instead of collective organisations. **This "silent revolution" leads, since 1985, to the pacification of the countryside, to land property stabilization by family take-over, and also to the restart of the economy** (the production reaches the same level than in 1970).

Summary

This brief history shows us that, despite the myth of the Angkorian hydraulic Empire, the infrastructures constructed during the French Protectorate and the Khmer rouge period**, the management of irrigation thanks to collective infrastructures is quite new in Cambodia**. Few hydraulic infrastructures constructed at these times are still functioning nowadays, and most of them are little adapted to the real needs and constraints of local agricultures.

1.2.4 specificities of the social structure of the Khmer society

1.2.4.1 Three main levels of organisation (Pillot, forthcoming):

The household nucleus

The household nucleus (that means the parents and their children) is the basis of the Khmer society. This basis can be extended to the relatives, neighbours and friends into networks build on the trust and dependency. People are inserted into networks of dependency, patronage or vote-catching, where few people are providing economical assistance or physical protection to others who have, in return, to give them their political loyalty or their manpower. Authors often talk about "paternalist relationships", as the chief is considered as the father in charge of his children.

Commune (*khum*) and village (*phum*)

The village chief (*Mephum*), appointed by the district authorities, is playing a role of link between the administration and the rural population. He is often acting as a conciliator in solving conflicts.

The commune, which gathers several villages together, is an institution implemented during the French Protectorate, in 1908. Even if the chief of commune (*mekhum*) is elected, he is not considered as the villagers' representative, but rather as the central authorities' last representatives. The commune is still a blurred concept for the villagers. Nevertheless, because of its judicial power, the *mekhum* inspired fear.

The administrative authorities over the *mekhum* (chief of district and chief of province) are more distant, geographically and relationally and they are less solicited by villagers.

Pagoda

The third level of organisation is the pagoda, which plays both a religious role through the monks, and a social function, with the laic comity and the *achars*. Indeed, the pagoda traditionally plays an important role in education, but also in the redistribution of wealth, through the collect of donation and the mobilization of funds to realize collective projects (such as road construction) and the assistance for old and poor people.

1.2.4.2 Social limits to the collective action?

A lot of authors insist on the low capacity of Khmer people to invest themselves and respect rules of collective action. Individualism, paternalism, hierarchy are often quoted to explain the failure of organisations (such as farmer organisations or farmer water users associations, etc.). These characterizations seem to us too much simplifying. The reality is more complex and we are now going to introduce the main elements which have to be taken into consideration:

The respect of "social harmony" and the settlement of conflict

One of the main characteristic is the importance given to the keeping of social harmony. This feature affects particularly the mode of settlement of conflicts. In a first step, **people will try to avoid the conflict** in order to protect the social consensus, avoid resentment and keep good relationships with neighbours. If the problem is considered to be important, people will try to solve it with the help of a conciliator. The goal of the conciliation is to find a mutual arrangement which satisfy both parties: nobody wins, nobody loses so that nobody loses the face (LUCO, 2002).

In the approach of conflicts, many references are done to the religion. Indeed, the majority of Khmer people practise the Theravada Buddhism. This form of Buddhism

advocates the detachment and the non-violence. This aspect particularly results in a strong reticence to mind other people's business.

This tendency of conflict avoidance is seen as a curb to collective action as it suppresses a way of controlling the respect of rules by the social pressure, defined by Ostrom (1992) as one of the condition for collective action efficiency.

Trauma of Khmers rouges and « collectivism »

The trauma of ten years of communism, and particularly the "collectivist experience" carried by the Khmer rouges, seems to have reinforced the reticence to collective organisation to go back to more individualism.

Hierarchical organisation

Khmer society is also characterized by a partition between the "big" (those who have power or money) and the "small" peoples and a strong relationship of paternalism between these two categories. Because of these relationships, but also because of the problems of corruption and prejudice of the administration, **the contradictory public debates, especially to oppose the authority, seems to be impossible or difficult**. Yet these debates are seen as a cornerstone in the definition of organisations' objectives and rules. The Cambodian farmers also develop one kind of mutual aid called "*provas*" (cf. Box N°1), which consist in exchanges of means of products). But the current process of liberalisation of markets followed by Cambodia induces the "monetarization" of the exchanges and the decrease of *provas*.

Provas

The *provas* is a traditional form of "mutual aid" in Cambodia which consists of exchanges of means of production. There are two major types of *provas*:

- *Provas* for labour force: two farmers exchange their labour force: for example the farmer A helps the farmer B to transplant his field during 3 days. In exchange, the farmers B will have to help the farmer A to transplant his field during 3 days.

- *Provas* for animal husbandry: One breeder may decide to leave another farmer to look after one of his cow (generally because he does not have the time of the fodder to feed it). Most of the time, the keeper gets the first calf of the cow. The following one will be for the owner, etc. It is a good way for the poor people to constitute their own flock.

Box N°1: the traditional practice of *provas*

But despite the fetters of these « social constraints », the Cambodian farmers already showed, in suitable contexts, their abilities for innovations and rapid changes. Thus, the farmers living along the Thai and Vietnamese borders have already demonstrated their dynamism and capacity of change and innovation. Besides, farmers from Takeo have already been called to develop new agricultural area or to intensify the agricultural practices, as in the province of Siem Reap, around the Tonle Sap. Moreover, the recent history also demonstrated that groups of individual with similar

interests are able to take responsibilities in the long run and be actors conscious of social change (Merlet[6], quoted by Bernard, 2006).

1.2.5 National policy objectives

The main objectives of the Cambodian Government are to achieve good governance and poverty alleviation. The Socio Economic Development Plan II (2001-2005) which serves as the Government's principal planning document is a comprehensive development program focusing on growth promotion, regional integration and poverty alleviation. The National Rectangular Strategy is closely based on the SEDP II and elaborates political orientations towards poverty reduction[7].

The rectangular strategy is an integrated structure of interlocking rectangles (cf. Annex 3), defining four "growth sector" strategies[8], whose two concern agriculture and irrigation and one the development of the private sector:

Rectangle 1: Enhancement of Agricultural Sector which covers: (1) **improved productivity and diversification of agriculture;** (2) **land reform and clearing of mines**; (3) fisheries reform; and (4) forestry reform.

Rectangle 2: Further Rehabilitation and Construction of Physical Infrastructure, involving: (1) further restoration and construction transport infrastructure (inland, marine and air transport); (2**) management of water resources and irrigation**; (3) development of energy and power grids, and (4) development of information and communication technology.

Rectangle 3: Private Sector Development and Employment Generation covers: (1) **strengthened private sector and attraction of investments**; etc.

Water is seen by the Government as a priority to achieve its goals of poverty alleviation and economic growth, principally through irrigated agriculture. *"Irrigation contributes to agriculture, and therefore to the achievement of food security, poverty reduction and socio-economic development"*[9].

1.2.6 Cambodian Water policy

In 1998, the Government decided to reinforce its irrigation development policy and upgraded the Directorate General of Irrigation, Meteorology and Hydrology, which was within the Ministry of Agriculture, Forestry and Fisheries (MAFF), into the Ministry of Water Resources and Meteorology (MOWRAM).

The main mandates of this new ministry are: (1) formulation of water policies; (2) to plan and manage the use and conservation of Cambodia's water Resources (3) study and research; (4) technical investigation for multipurpose dams, irrigation, drainage, water supply

6 MERLET M. (2004). Mission d'appui composante Organisation paysanne, Programme FSP "politiques agricoles", rapport de mission. Institut de recherches et d'application des méthodes de développement, 33p.

7 ADB : http://www.adb.org/Documents/CSPs/CAM/2004/csp0200.asp

8 http://www.cnv.org.kh/2004_releases/160704_rectangular_strategy_first_cabinet_meeting.htm

9 MOWRAM (2004). PIMD of Cambodia

and river works; and (5) planning, design and rehabilitation of existing projects and their operation and maintenance. Nevertheless the MOWRM has to share several missions with other ministries, particularly the MAFF, the Ministry of Industry, Mines and Energy (MIME) and the Ministry of Rural Development (MRD), although the mechanisms of consultation between the different ministries are limited.

For a decade, the Cambodian Government, with the international technical support, is working on the formulation of water policy framework. Circulars and Ministerial Decrees ("*Prakas*") are currently used to regulate the sector, and policies, draft Laws and draft strategies have been formulated. In 1999, the Circular N°1 specified the main orientations of the new water management policy. These orientations area greatly influenced by the donors international Community (KIBLER, PERROUD, 2004), who promote the Participatory Irrigation Management Development through the establishment of "Farmer Water User Communities" (FWUCs, to get a more detailed definition of FWUC, please see Annex 4).

The orientations of this new policy fall within the scope of an international scale debate.

1.3 CONCEPTS AND THEORITICAL FRAMEWORK

1.3.1 Evolution of irrigation development policies

Irrigated agriculture is responsible for approximately 70 percent of all the freshwater withdrawn in the world. The challenge of irrigated agriculture is to contribute to the world's food production and to the improvement of food security through a more efficient, cleaner and integrated water usage (FAO, 1993; WB 2004 (b)). All countries face a major challenge in developing and maintaining an appropriate stock of water infrastructures but also in establishing the laws, regulations and institutions required to manage water resources in a more economically productive, socially acceptable and environmentally sustainable fashion (WB, 2004(b)). This interest for the development of irrigation has followed several models through the recent decades (Vermillion, 2001):

The 1950s through 1970s saw an "*era of capital intensive expansion of irrigation worldwide*". The projects of irrigation development were mainly based on the construction or rehabilitation of large hydraulic infrastructures, concentrated on civil engineering. By the 1970s, these construction costs were rising as they started to concern less favourable locations. At the same time, the infrastructures built during the previous period involved rapid deterioration and poor management. This policy of large hydraulic infrastructures also followed the model of central management, which was based on the management of irrigation systems by government agencies, offices or semi-public companies (Ruff, 1998).

The 1970s and 1980s have been called by Vermillion "*The era of irrigation improvement*". Rehabilitation, introduction of new technologies and management techniques were promoted, without solving the problems of infrastructures deterioration and poor management.

At the end of the 1980s, a new current of thoughts started to criticize the State's ability to manage the hydraulic infrastructures in an efficient and sustainable way. Indeed, most of these central agencies responsible for

irrigation systems management are in chronic deficit. They were suffering from the vicious circle of the low rate of water fee collection, increasing their fiscal deficit which resulted in a degradation of the quality of the water service, which in turn resulted in lower water fee collection rates, etc. (Ruf, 2001). To solve this problem, the proponents of this new model advocated Irrigation Management Transfer.

1.3.2 Irrigation Management Transfer (IMT)

Irrigation Management Transfer involves the devolution of part or all rights and responsibilities for irrigation system management from the government to non governmental entities, such as local water users groups or private entrepreneur (Vermillion 2001). The main hypothesis is that these non governmental entities will perform better and have more sustainable results than systems managed by government agencies (organizationally and financially)[10]. This hypothesis ask a question that is: what institutional conditions and principles are most conducive to achieving and sustaining high performance in those gravity irrigation systems currently owned and managed by government agencies (ibid)? This takes us back to another debate: the one of the water statute.

1.3.2.1 Water: a public or private good?

This part is widely based on the paper written by PERRY, ROCK and SECKLER[11] on the account of water as an economic good.

Water is a natural resource not easy to classify. Public good? Common good? Private good? It depends on the way we consider the network and the space in which water is circulating (RUF, 2001). There is currently an important debate between those who want to treat water in the same way as other private goods through competitive market pricing, and those who want to treat water as public good that requires some amount of extra-market management to effectively and efficiently serve social objectives[11].

In order to cover the increasing cost of water infrastructures, some peoples, mainly economists, want to subject water allocation through competitive market pricing. They use the idea, originated in the Dublin Conference (International Conference on Water and Environment, 1992), that water should be treated "as an economic good". According to them, water meets the requirement of an "economic goods": like any other good, water has a value to users, who area willing to pay for it. Like any other good, consumers will use water as long as the benefits from the use of water exceed the costs so incurred[12]. Moreover, water serves a multiplicity of ends, and in many cases, water is scarce in the sense that it cannot fully satisfy all its alternative uses simultaneously. In that sense the market appears to them as the best way to regulate the water sector, by

10 MERREY D.J. (1996) *Institutional Design Principles for Accountability in Large Scale Irrigation Systems.* Research Report 8, IWMI, Colombo, 26p.

11 PERRY C.J., ROCK M., SECKLER D. (1997) *Water as an Economic Good: a Solution or a Problem?*, Research Report 14, IWMI, Colombo, 16p.

12 BRISCOE, 1996, quoted by PERRY, ROCK and SECKLER (1997)

optimizing supply to demand[9]. In this way, The United Nations[13] state that a market oriented approach has to be used to manage the water allocation, and that water has to be considered as a commodity whose price has to be established through supply and demand. Furthermore, according to the World Bank[14], if the government of a developed country chooses to subsidize the water used by its farmers, this has an impact on world prices and thus a direct impact on producers in developing countries. This has a major impact on the prices of agricultural products in developing countries and on the economic returns from farming. These distortions reinforce the demands of farmers in developing countries for subsidies for water, energy and other inputs, usually causing further harm to the economy and the environment.

The proponents of water as a public good object that regulation by free market will exclude the poor from water service: if they cannot pay as much for a unit of water as the rich they will get less water. Indeed, willingness to pay depends largely on the ability to pay. This school contends that, at least up to some minimal level of availability, water availability to certain groups and for certain purposes at well below market prices will serve the greater benefit of society as a whole. In this way, water used for irrigation can be a powerful means to reduce food costs for poor people and, under the proper conditions, should be subsidized[12]. This, according to Ps-Eau[15] (Program of Water solidarity) does not mean that water has to be free for the poor, but rather that, if the need rises, some measures must be taken to ensure them access to water.

Our point of view is that after a basic level of water service is attained, additional supplies could be allocated by market forces. "*Then various kinds and degrees of government intervention or other kinds of collective action, or both, are required to make the market perform effectively to serve the value of consumer's sovereignty*[10]."

Summary

The weakness of irrigation system management by public agencies can be solved by management of these systems by water users' organisation or by private sector. In order to favour the management of irrigation by these entities, commitments of the authorities and the specific obligations of each part have to be clearly defined. Furthermore, definition and enforcement of a clear legal and institutional framework are also necessary.

We are now going to give a succinct presentation of the assets and limits of irrigation systems management transfer to water users organizations and private entities.

13 United Nation (September 2003) Gestion de l'eau dans les payes en développement. Journal officiel de l'Union Européenne

14 World Bank (2004 (b)), Water Resources Sector Strategy: strategic directions for World Bank engagement.

15 http://www.pseau.org/outils/ouvrages/adede_droit_a_l_eau_06_fr.pdf

1.3.2.2 Participatory irrigation management and self governing systems

The participatory irrigation management, which involves the devolution of irrigation systems management to water users organized in associations, is expected to **improve management, accountability, agronomic and economic productivity of irrigation systems** (World Bank, 2004 (b)). The main argument for this type of management is that local users empowered as a group have more incentives to manage their resources more efficiently and in a more sustainable way than does a centrally financed government agency. According to the FAO[16] and the World Bank, the users' involvement in irrigation services improves the access to information, decreases the cost of surveillance, drives a common feeling of shared property and improves transparency and reliability of decisions.

Nevertheless, IMT is often promoted by governments because of budget constraints. In addition, the major development banks and donors support IMT, and include the transfer in their general structural adjustment strategies (Johnson et al. quoted by Vermilion, 2001). As a consequence, government devolves management of irrigation systems to their local users, without setting up a suitable environment to allow the users community to manage properly the irrigation system (World Bank, 1993).

Yet water users' communities are facing several risks. One of the more repetitive problems is the delegation of power: officials oppose the transfer by putting forward users' lack of technical capacities, in order to keep part of their previous responsibilities and associated budgets. **A strong involvement of the central authority and a clear policy is needed to avoid such bureaucracy resistances** (Ruf, 2001).

Another problem frequently observed, concerns the **financial viability** of these users' associations. Indeed, if IMT allows to decrease the global cost of the system and the cost supported by the governments, it usually increases the one supported by the users, especially if the transfer involves the suppression of high subsidies (Vermillion, 2001). In order to reduce the costs and satisfy the users, the association may decide to reduce the expenditures devoted for maintenance, which can in medium run, cause a degradation of the infrastructures. However several studies regarding participatory irrigation management show a global improvement of the rate of water fee payment if some pre-required conditions are respected (ibid). If they get satisfaction from the service and if the way of water fee collection is adapted to their situation, they will accept to pay. There is an additional and essential condition**: the improvement of irrigation management has to improve the productivity of irrigated agriculture**, so that the gain of profits will compensate for the increase of irrigation cost (Ostrom 1992, Vermillion 2001).

In this way, the main objective pursued by Cambodian Government through PIMD process, widely influenced by the donors, is actually to remove the financial burden of O&M form the State, as stressed by the rhetoric used in several water-related policy papers: "*Water management systems cannot be sustained because of limited government resources. MOWRAM is implementing a policy of irrigation management transfer and participatory irrigation management and development. These are applied to new and rehabilitated schemes and progressively introduced to existing systems, with establishment of Farmer Water User Communities*". *(*MOWRAM, roadmap 2003*)*

[16] FAO : Les grands choix en matière d'agriculture irriguée.
http://www.fao.org/documents/show_cdr.asp?url_file=/docrep/003/t0800f/t0800f0d.htm

Nevertheless the MOWRAM is facing several limits in the implementation of this transfer of irrigation systems management to FWUC. "*There is a gap between formal policy making and actual implementation*" (ROUX, 2005)

In the light of these considerations, we can formulate the following hypothesis:

Hypothesis 1: The transfer of the management of irrigation systems to local water users' organisations has been promoted as a good alternative to the management by public institutions. But several experiences met failure because the authorities did not set up suitable conditions (in term of means of organisation, formation, follow up, etc.) to allow the water users to manage irrigation systems properly.

1.3.2.3 Private sector participation

Relying on the example of public-private partnership in electricity and water adduction, the World Bank (2004 (b)) proposed the introduction of a private sector for irrigation management as a potential alternative for the failures in management by public entities and transfer to water users' organizations. In the same way, the ADB[17] recommends the reinforcement of legal framework and physical infrastructures in order to incite the participation of the private sector in the development of irrigation.

According to the international financial institutions, the participation of private sector allows implementation of viable and efficient irrigation systems, because of its abilities in technical aspects and financial management. These assumptions are often too simplistic; the ability of private sector to manage irrigation system is not obvious.

In reality, irrigation systems management by private sector presents its own risks. Indeed, private entrepreneurs usually follow a 'full cost recovery' system, which means they try to gain the money or cost they invest back and to reap benefits quickly. As a consequence of this kind of commercial management, the amount of the water fee may increase, at the risk of excluding from the service and marginalizing the poorest users unable to pay such amounts (United Nation, 2003). Moreover, the characteristics of irrigation management are quite different from the ones of electricity or water adduction. In latter, the quantity of products delivered by the private entrepreneur can be precisely measured, thanks to the use of faucets and meters. In the case of gravity irrigation the quantity of water distributed is not so easily measurable and controllable and the establishment of the water fee amount is problematical. Another eventual mishap may be the risk of corruption, particularly for the attribution of the markets.

The relative importance of these assets and constraints will depend on the form of privatisation chosen, which means **the degree of rights and responsibilities devolved to the private entrepreneur**. There are different forms of privatisations which can be applied, regarding the type and the number of functions which are transferred from the government. According to the World Bank (2004 (a)): "*Financing for water resources infrastructure is not cleanly separable into public and private sectors; increasingly, it requires public-private partnerships, both in investment and operation. While private investment and management are playing, and must play, a growing role, this must take*

17 ADB: Country Strategy and Programme Update, July 2001

place within a publicly established long-term development and legal and regulatory framework and without crowding out community-managed infrastructure and beneficiary participation in design and management of water systems". As the irrigation sector is often considered as a public sector, the government still controls the ownership of the irrigation infrastructures and the privatisation is called Private Sector Participation (PSP), Private Participation in Infrastructures (PPI) or Public Private Partnership (PPP). (cf. Annex 4)

Hypothesis 2: Irrigation systems' management through PPP may represent a simple alternative for both the government and users. The government takes advantage of the private sectors' financial capacities to reduce budgets engaged in irrigation sector and the users, of his technical and management skills

Other high stakes are upstream from the intervention of private sector. The public agencies must be able to create a clear institutional framework. National and local public agencies must be able to control and regulate the private entrepreneurs and companies involved in the management of irrigation sector. They also have to increase the involvement and the coordination of the different actors (water users, private contractor, local administrations…). The private participation in irrigation confronts us to the problem of the collective action in the organisation of the cooperation between the different stakeholders. Indeed, personal interests may be very different, even contradictory, especially between the private contractor and the users.

The private sector participation in irrigation systems management takes an integral part of the current debate occurring in Cambodia regarding the definition and the implementation of the water policy. Indeed, as written in the National Rectangular Strategy, the development of the private sector is one of the strategic priorities of the Cambodian Government. Moreover there are several references to private sector in most of the water-related policy papers:

> *"To assure effective, successful water management, the RGC has the following policies:*
> *To* ***promote and facilitate the participation of private investors****, stakeholders, beneficiaries at all levels, NGOs ans IOs – especially women* ***– in investment in the management, exploitation, protection and development of water resources****" (p.10)*
> (National Water Resources Policy, 2004)

> *"The FWUC and government (and* ***possibly NGO's or private sector entities****) may share the cost of irrigation system repairs and improvements and rehabilitation and upgrading."*
> *"Non-governmental organizations (NGO's) and* ***private sector organizations may also provide support services to FWUC****."*
> (Draft Decree on PIMD in Cambodia, article 3.2; 2003)

If the interest of involving the private sector in the irrigation development in every stage (from the rehabilitation to the development of irrigation systems) is considered, there is no information regarding the modalities in which this kind of participation can be done, except some references to the obligation to apply to the MOWRAM or a licence for whoever intends to exploit, rehabilitate or develop water works.

Moreover there is currently a lack of information regarding several aspects of irrigation activity in Cambodia, and more particularly regarding the private sector ones. **All these assumptions make it particularly relevant to study one case of irrigation system developed and managed by a private entity.**

1.3.3 Collective action

Beyond the question of which entity (public agency, water users' organisation or private entity) is the most capable of managing irrigation system in an efficient and sustainable way, there is another essential question: How to solve collective-action problems in common-pool resources such as water (Tang 1992)? Temporary decentralization and local organizations established as part of construction or rehabilitation projects often do not have a significant long-term impact because the basic institutional framework is not changed (Ostrom, Schroeder, and Wynne 1993, quoted by Merrey 1998).

According to Ostrom (1992), the heart of the problem of collective action is located in the definition of the irrigation systems functioning rules, and in the structure of the organization in charge of implementing these rules. The less legitimate the formal structure responsible for deciding rules is, or the less the interest of the rules is understood by the users, the wider is the gap between normative and pragmatic rules. Then, the main danger is the multiplication of opportunistic behaviours, of 'free riding', 'rent seeking or corruption'. These behaviours may multiply quickly due to the refusal to work for the benefits of other free riders (Ostrom, 1992). Then the main consequence is the quick degradation of the system.

Rules which are well designed increase the advantages for playing the game, decrease the loss of earnings and enlarge the cost of infractions (Lavigne-Delville, 1998). Nevertheless, there is no typical system of rules which can be generalized for all the kind of organizations. One has to take the own characteristics of the local society (relations with power, with collective action, etc.) into account.

Ostrom (1992) defined 8 major principles characteristics necessary for successful self-governing organisation:

1. Both the boundaries of the service area and the individual or households with rights to use water from an irrigation system are clearly defined.

2. Rules specifying the amount of water that an irrigator is allocated are related to local conditions and to rules requiring labour, materials, and/or money.

3. Most individuals affected by operational rules are included in the group who can modify these rules.

4. Monitors, who actively audit physical conditions and irrigator behaviour, are accountable to the users and/or are the users themselves.

5. Users who violate operational rules are likely to receive graduated sanctions (depending on the seriousness and context of the offence) from other users, from officials accountable to these users, or both.

6. Users and their officials have rapid access to the low-cost local arenas to resolve the conflict between users or between users and officials.

7. The rights of users to devise their own institutions are not challenged by external governmental authorities.

8. Appropriation, provision, monitoring, enforcement, conflict resolution, and governance activities are organized in multiple layers of nested enterprises."

Vermillion (2001) completed this list with key enabling factors which are hypothesized to be conducive to the emergence and development of desired collective action in water users associations. The list is distilled from literature on the subject and interactions with numerous practitioners in international meetings and fieldwork.

- Irrigation makes a significant improvement in productivity and profitability of irrigated agriculture, compared with rainfed agriculture.

- Irrigated agriculture is an important component of farm family livelihoods.

- A generally-accepted system of land and water rights exists or can be expected to exist by the time irrigation management transfer, or devolution, is implemented.

- Social divisions are not serious enough to prevent communication and joint decision-making among farmers.

- Social traditions support group organization for irrigated agriculture, existence of producer cooperatives and other rural organizations.

- It is technically feasible to implement the water service with existing infrastructure or after pending improvements are made.

All these criterions can be used to determine if an irrigation scheme (managed by users' organisation or private entity) meets the minimal requirements so that collective action does not dysfunction.

Nevertheless, these criterions, if they are necessary, are not enough. In fact as stressed by Crozier and Friedberg (1977), collective action must be considered as a problem, not as a natural phenomenon.

The following part is mainly inspired by the works of Crozier and Friedberg.

> *« Si l'action collective constitue un problème si décisif pour nos sociétés, c'est d'abord et avant tout parce que ce n'est pas un phénomène naturel. C'est un construit social dont l'existence pose problème, et dont il reste à expliquer les conditions d'émergence et de maintien. (...) Nos modes d'action collective ne sont pas le résultat automatique du développement des interactions humaines, d'une sorte de dynamique spontanée qui porterait les hommes en tant qu'« êtres sociaux », à s'unir, à se grouper, à « s'organiser ». Ils ne sont pas davantage la conséquence logique déterminée d'avance de la « structure objective » des problèmes à résoudre. (...) Ils ne constituent rien d'autre que des solutions toujours spécifiques, que des acteurs relativement autonomes, avec leurs ressources et capacités propres, ont créées, inventées et instituées pour résoudre les problèmes posés par l'action collective, et notamment le plus fondamental de ceux-ci, celui de leur coopération en vue de l'accomplissement d'objectifs communs malgré leurs orientations divergentes ».*
> (Crozier and Friedberg)

Collective action is a decisive problem for our societies because it is not a natural phenomenon. Its existence confronts us with a problem and its emerging condition and preservation still have to be explained. The different types of collective action are always specific solutions, chosen by actors relatively autonomous, with their own capacities and resources, in order to solve the problems of collective action. The more fundamental problem is the one of cooperation. Indeed, even if the different actors get organized to carry out shared objectives, they still may have opposite personal orientations.

The organized groups try to regulate the sequence of power relationships and to limit actors' room of leeway by building means (laws, rules, organisation chart, etc…) which structure the field of action (by imposing some constraints to the actors) and make it possible. By defining sectors where the action is more foreseeable and process more or less easy to bring under control, these charts and rules delimit area of organisational uncertainties. Individuals and groups will try to control these areas of uncertainties to engage power relationships with other actors in order to reach their own interest. Because of actors' "active nature" there is no social system completely regulated or controlled, and there still will be a gap between the formal rules defined by the organisation and the one applied by the actors in their collective action.

Bailey[18] proposed the following definitions (quoted by Lavigne Delville):

Normative rules ("*règles normatives*"): the official rules, the one which govern the theoretical behaviours by defining what is good and bad, fair and unfair. These rules are publicly used by the local actors, either in their relationships with the environment, or in the internal conflicts.

Pragmatic rules ("*règles pragmatiques*"): these rules do not define what is fair or not, but what is recognized as efficient. With these informal rules actors

18 BAILEY F.G., 1971, *Les règles du jeu politique*, Paris, PUF, 249p.

allow individual behaviours, even if they are forbidden by the official rules.

The pragmatic (or informal) rules do not have to be considered as exceptions or simple structural dysfunctions. On the contrary, they must be analyzed to understand the difficulties the system has to deal with (Crozier and Friedberg).

Hypothesis 3: **Collective action is not a natural phenomenon**. The actors involved in organisations have always room for leeway they use to follow their personal objectives, which are not necessarily compatible with the ones of the organisation. They are implementing power relationships with the other actors to follow their personal interest. **Analysis of collective action must focus on the power relationships and the rules of the games implemented by actors to regulate these relationships. Furthermore, analysis of the gap existing between formal and informal rules allows to stress out the difficulties that the system has to deal with**.

1.4 FROM THE CONSTRUCTION OF THE PROBLEMATIC TO THE ELABORATION OF THE METHODOLOGY

1.4.1 Primary definitions

Irrigation Scheme

This expression concerns the physical infrastructures of the irrigation network, allowing to mobilize, transport, and deliver water and/or evacuate the excess water in the fields, in order to increase the agricultural productivity or to satisfy any others eventual needs.

Irrigation System

According to the definition provided by Molle and Ruf[19], an irrigated system includes an irrigation scheme, the land which can get water from this irrigation scheme, and the people who depend on it (users, staff, managers, etc.), with its institutions and means of production. According to the two authors, the study of an irrigated system implies a system approach to understand the different elements making up the system and their interactions. Indeed, an irrigated system, contrary to non-irrigated systems (including rainfed agriculture) is strongly conditioned by the existence of infrastructures. These infrastructures compel societies or human groups, different and specific, to get organized to harness, drive and distribute the water, but also to buy and maintain the infrastructures.

19 Molle F., Ruf T., 1994, « Eléments pour une approche systémique du fonctionnement des périmètres irrigués ». Symposium international Recherches-système en agriculture et développement rural, Atelier 1, Dans quelles directions le champ et la méthodologie des recherches systèmes doivent être redéfinis ?, 21-25 nov.1994, Montpellier, AFSR/E, CIRAD, INRA, ORSTOM, pp. 114-118

1.4.2 Research questions construction

The bibliographic researches and reflexions presented in the previous parts allow us to pose the following hypothesis:

1) The transfer of the management of irrigation systems to local water users' organisations has been promoted as a good alternative to the management by public institutions. But several PIM experiences met failure because the process of transfer did not take into account the particular characteristics of the collective action engaged in any organization.

2) Irrigation systems' management through PPI may represent a simple alternative for both government and users. The government takes advantage of the private sectors' financial capacities to reduce budgets engaged in irrigation sector and the users, and of his technical and management skills.

3) Moreover, collective action is not a natural phenomenon. The actors involved in organisations have always room for leeway they use to follow their personal objectives, which are not necessarily compatible with the ones of the organisation. They are implementing power relationships with the other actors to follow their personal interest. Analysis of collective action must focus on the power relationships and the rules of the games implemented by actors to regulate these relationships. Furthermore, analysis of the gap existing between formal and informal rules allows to stress out the difficulties that the system has to deal with.

Assuming these hypotheses, we can formulate the following research questions:

1) In which conditions can actors, who have different or contradictory interests, cooperate together? How are the rules structuring the collective action defined and adapted to face new stakes? **Is it possible, in the current Cambodian context, to think about the collective action of users** (and eventually private contractor**) in the management of irrigation systems**? If yes, in which conditions?

2) **Does the management of irrigation systems through a PPI represent an acceptable solution for the users?**

   → How have the rules been elaborated? By whom? Do they have legitimacy for the users? For this rules to be enforced and respected which means can the entrepreneur use? Are the users able to pressurize the entrepreneur if he does not fulfil his own undertaking?
   → Are the water fee amounts asked by the entrepreneur reasonable for the users? Are the users able to pay the water fee if the irrigation water is used for rice cropping? Is there any risk of marginalization of the producers who are not able to pay the water fee?
   → Is this example viable and reproducible?

3) **Does the current legal and institutional Cambodian framework provide favourable conditions for a PPI in irrigation sector?**

   → What are the limits of this framework for PPI in irrigation sector? The assets? Who is responsible for controlling that the rules of this framework are respected? Are they respected? Which proposals can we formulate to improve the Cambodian institutional and legal framework?

1.4.3 Methodology of data collection and analysis

To answer these research questions, two irrigation systems have been studied.

The first and main study, carried out during almost three months, deals with the issues of the private participation in irrigation infrastructures. Indeed, this irrigation scheme located in Kbal Por, Takeo Province, has been rehabilitated in 2003 by a private contractor who is currently providing irrigation service to the farmers. The study of this irrigation system allows us to better understand the functioning modalities of a private participation in irrigation infrastructures rehabilitation and management, and particularly, the establishment of agreements and rules between the local community and the investor.

The second study carried out during two months in Battambang Province, concerned an irrigation system rehabilitated and managed thanks to the endogenous (without external support) initiative of a farmers' community. This second study has been realised in collaboration with another student from CNEARC, Cedric Bernard, who has studied the same community, by focusing on 'the farmers' organisations in Cambodia: conditions of emerging, internal functioning and efficiency. The goal of our study was to get some comparative elements between management of irrigation schemes by private contractor and by users' community. It also allowed us to place the Kbal Por irrigation system in the Cambodian context (by providing us some elements regarding agricultures practices, collective action, etc. in two different provinces). These elements are used to structure our reflexion and this case study will not be fully developed in this report. To see a detailed presentation and analysis, please see the first case study presented by BERNARD (2006).

An irrigation system is a complex system, involving several fields of action, such as the agricultural practices, the water allocation, the users' organisation, the creation and implementation of rules, the national policies, etc. In this light, we used in both studies a 'Social Water Management' method, based on a multi-disciplinary approach, which '*combines a systemic approach, inherited from the agrarian systems analysis developed by the agronomists, with a spatial approach, borrowed from geography, and with a cultural approach, borrowed from the social anthropology*' (Fontenelle, 2004).

1.4.3.1 Study of the physical infrastructures of the Irrigation System

In a first stage, we studied the physical infrastructures of the irrigation schemes. As a matter of fact, the physical infrastructures are an important element in the understanding of the functioning of the irrigation system: it conditions the possibilities and limits of water supply (volume and time and duration of distribution), the cost of the irrigation system, the means which have to be mobilized for the maintenance. Its study allows us to identify some nub of power and decision, such as sluices, on which the water management organisation is relying.

To get these data, we collected the plans and sketches available from the contractor and the local authorities. These data have been corrected and complemented by direct observations in the field. We drew a new sketch which has been used as a visual support in several surveys to discuss with different group of actors.

1.4.3.2 The historical approaches

The objective of the historical approaches is to know the historical context in which the irrigation system is fitting. Indeed, the choices which have been made during one period are reflected in the infrastructures and the rules of management may persist even if the circumstances surrounding these choices have evolved. The infrastructures and the rules of an irrigation system crystallize the characteristics of a social history. The history of the irrigation scheme, allows us to reveal the basis of many of their current characteristics, but also to gauge the nature of the mutation they may have suffered from, giving us an idea of their adaptation capacity to face new changes (JOLLY, 2003).

This aspect has been studied through surveys carried with the chiefs of villages and communes, individual and collective meetings with older people.

1.4.3.3 The social approaches

We already have demonstrated the importance of the rules, and particularly the way these rules are adapted and used in practice by the different actors, to understand the functioning and difficulties of an organisation. The process of elaboration of these rules and the possibility to change them in order to adapt them to the current situation are also important. In this sense, we have analysed the gap existing in the studied irrigation systems, between the "normative" and "pragmatic" rules. First, we studied the formal rules and the way they have been defined, through surveys with several involved actors (particularly the contractors and the local authorities) and the collection of different "official" documents (cf. Annex 5). Observation of the actors' practices in the field allowed us to identify the gap between the formal rules, and the real practices. At the same time, several interviews have been carried out with different stakeholders (private contractor, local authorities, staff from provincial departments, downstream and upstream users, etc.) in order to understand their own point of view regarding the gap existing between the formal rules and the observed practices. We took care of analysis of the "speech" material and the conditions in which it has been produced.

A particular attention has been given to analyse the understanding that the actors have regarding the different formal rules. We also focused on a "political" analysis of the individual constraints, assets and interests of the different actors, to understand their point of view and threw light on the different "actors' games". Indeed, the study of organisation functioning has to be done through the observation and the measurement of attitudes, behaviours and strategies of actors, but also by the appraisal of their specific resources and the constraints limiting their room of leeway and weigh on their strategies. Such an analysis will allow us to understand the rationality of these behaviours, attitudes and strategies by rebuilding the structures and the nature of the "game" they are playing (Crozier and Friedberg).

1.4.3.4 Agro-economic diagnosis

One of the main question surrounding the participation of the private sector in irrigation development and management, is the economical interest of that kind of arrangement for water users: Are the water fee amounts asked by the entrepreneur reasonable for the users? Are the users able to pay the water fee when the irrigation water is used for rice cropping? Is there any risk of marginalization of the producers

who are not able to pay the water fee? Moreover according to one of the pre-requisite for a good management and functioning of an irrigated system, defined by Vermillion, irrigated activities have to represent "*an important component of farm family livelihoods*".

To answer these questions, an agro-economic diagnosis has been carried out. **The objective was not to realize a diagnosis of the systems of production, but rather a comparative diagnosis of the different cropping systems**.

First, we organised interviews with *mekhums* of each village and **collective interviews** with several farmers (water users or not) in each of the six villages located in the command area of the irrigation scheme. The qualitative data collected from these interviews allowed us **to identify the different cropping and animal husbandry systems practiced in the area**. It also allowed us to determine the number of households in each village who crop fields on the irrigation scheme and the number of those who have an off-farm activity. Without doing a detailed analysis, we expected **to determine the importance of activities linked to the irrigation scheme in the households' strategies**. Moreover, these first collective interviews, associated with other interviews carried out regarding the management and the functioning of the irrigation system stressed on differences in the access to irrigation water between upstream and downstream users. As a result we decided to realize individual interviews with all pre-identified categories of households' strategies both in upstream and downstream villages to be able to compare the eventual impact of the location on the irrigation scheme for the different categories of households.

Then, we conducted several **individual interviews** with farmers who carried out the different pre-identified household strategies. This allowed us to establish their working calendars and approximate family income. The main objective was to determine the logic (intensification or not, food production or sale) of the different activities and the rank of the irrigated crops in the family income (in order to determine the users' propensity for paying the water fee). Another series of individual interviews were devoted to collect quantitative and detailed data regarding the technical practices, work calendar, and economical results of the irrigated crops. The main goal was to determinate the operational sequence and to calculate the gross income and the added value for each cropping system. The number of individual interviews conducted was limited to 20 in downstream villages and 13 in upstream villages, so that the data processing was not too long and complex.

1.4.3.5 The territorial approaches

The methodological approach developed through this study is also focusing on a multi-scale institutional analysis. The organisation is not an exclusive system: it is in relationship with its environment which will partly determine the constraints that the actors of the system will have to deal with (Crozier and Friedberg). There are several levels of decisions concerning the organisation (in and upstream the organisation), several actors, several conflicts, choices or compromises. The territorial approaches aims at reflecting the different types of conception of the IS, from the different local groups, to the local and national administrations.

First, a bibliographic study has been carried on to analyse the Cambodian government policies regarding the management of irrigation systems. We focused particularly on the study of the legal and institutional framework surrounding the private participation in the management of irrigation systems. Then several surveys were

conducted with some authorities, especially at local (chiefs of communes and villages) and provincial levels (representatives from the PDAFF, PROWRM and PRDC) to understand their personal interest, point of view and engagement regarding irrigation systems management.

1.4.4 The training period development

1.4.4.1 Working calendar

Please see in Annex 6 the detailed working calendar of the training.

1.4.4.2 Conditions of training period

The first three months, study has been conducted in collaboration with a young Cambodian student, who recently graduated from the Royal University of Agriculture of Phnom Penh. After his departure for his studies, we worked with several translators.

The study of the 'Ballat Manchey Rural Development Community' has been carried out during the months of July and August, in order to work with the other student from CNEARC studying the same community. This collaboration allowed us to cross and complete our observations and points of view.

The Kbal Por irrigation scheme has been studied in two stages. Two weeks have been dedicated to field work in Kbal Por in June. It allowed us to observe the irrigation scheme in period of functioning. The second period (September to November) occurred during the rainfall season, when the pumping station of the irrigation scheme was not used.

During the field work periods in Kbal Por we were lodged by two families living in the irrigation scheme area. The first one was a water chief's family. It allowed us to question him more deeply and informally about his work, his constraints and points of view. The second family was a user's family, who provided us a better understanding of the users' points of view. Thanks to the patience of the family and the translators' curiosity, staying in the villages allowed us to build good relationships with the people and to observe many village activities. It increased the volume of information gathered but also enhanced the quality.

At the end of the study, several meetings have been organised to present our results to different type of actors concerned by this study at different level.

- Presentation of the results regarding the case study of 'Ballat Manchey agricultural development community', with Cedric Bernard, for the users' representatives, local NGOs, PDAFF representatives.
- Presentation of the results of the study of the Kbal Por irrigation Scheme in the Takeo Provincial Rural Development Comity (PRDEC), under the chairmanship of the deputy governor, in presence of representatives of PDAFF and PDOWRAM, the contractor, Sambou Commune chief, Village chiefs and users
- Presentation of the results of the study during the taskforce meeting of the Technical Working Group on Agriculture and Water

1.4.4.3 Limits of the study

First, all the surveys have been conducted with translators. The usual bias inherent in any work of translation has been amplified by the difficulties we met to find translators speaking fluently French or English and ready to work during several weeks in the villages. We had to change frequently (4 times at least). These changes slowed down our study progress because of the time spent to explain the subject and the methodology to the new translator.

Moreover, only two weeks of our field work in Kbal Por allowed us to observe the functioning of the irrigation scheme. Indeed, we came back to Kbal Por, after our two months study in Battambang, in September, during the wet season and the pumping station was not functioning. As a consequence, we were not able to compare some information provided by the different actors with their real practices. Even if the different points of view of the stakeholders have been crosschecked as much as possible, it can not replace field observations…

2 PRESENTATION OF THE KBAL POR IRRIGATION SCHEME

This case study has been carried out in the irrigation system named "the Kbal Por Pumping Station", Takeo Province. We are now going to present several elements of the local context which seemed to us interesting for us to lay out before presenting the irrigation system.

2.1 LOCATION (CF. MAP N°1, P 4)

The Takeo Province is located in the South of Cambodia and is surrounded by Vietnam in the South, Kandal Province in the East-North, Kompong Spoe Province in the West-North and Kampot Province in the West-South. The surface of the Takeo Province is 3 563 km². The provincial town of Takeo is located at about 90 km south of Phnom Penh. The road between the province city and Phnom Penh is asphalted and passable all the year around.

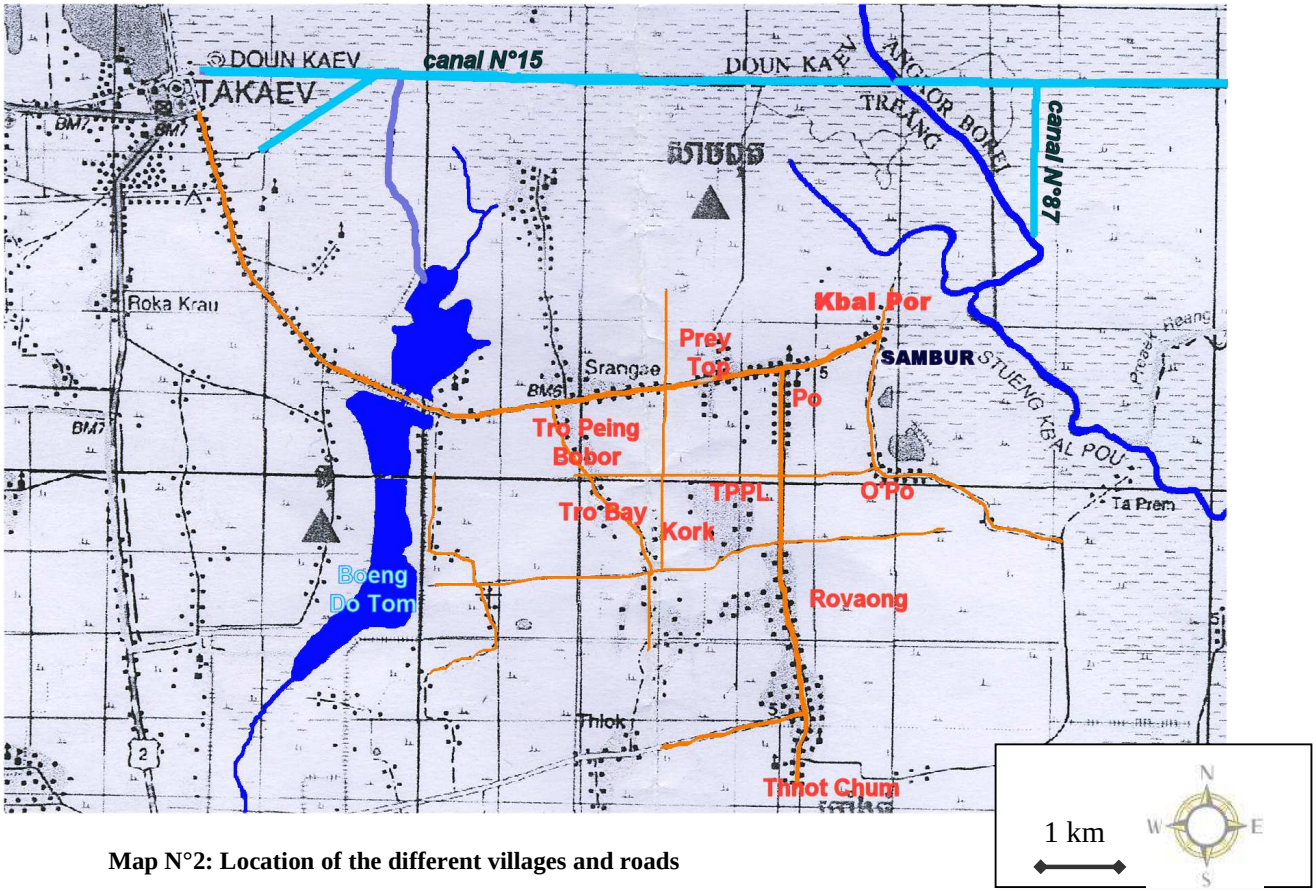
The irrigation scheme we studied is located at above 15 km from Takeo city, in the commune of Sambour, in Traeng district. There are only lateritic roads between the Takeo city and the villages of the commune of Sambour, which are difficult to use during the rainy season. Due to the proximity of the Cambodian capital, many young people from the area leave periodically for Phnom Penh to find some off-farm activities. Most of them are taken in by some relatives and work for one of the numerous textile industries installed in the south of Phnom Penh. The proximity of Phnom Penh also provides markets to sell products such as fish or poultry.

Moreover, this area is close to the Vietnamese border, which can be reached both by road and waterway. As a result there is a close network exchange between the two borders. On one hand, there is an exchange of agricultural practices: the Takeo farmers are using Vietnamese rice varieties (N*am không bôn…*), fertilizers and equipments, but also some agricultural techniques (the Vietnamese model has been quoted by the majority of the farmers practising broadcasting). On the other hand, Vietnamese merchants are coming directly in the Sambour commune to purchase Cambodian products (rice crops but also cattle and poultries). In addition to these legal exchanges, smugglers bring fuel from Vietnam up to Cambodia. There seems to be an important network of contraband of fuel in Takeo, allowing inhabitants to purchase, illegally, fuel at a lower price[20].

The irrigation scheme studied here, concerns the two communes of Sambour and Srangkae. People have been surveyed in 6 villages of the *Khum* Sambour (Kbal Por, Po, O'Por, Rovaong, Thnot Chum and Tro Peing Pon Lou) and in 4 villages of the *khum* Srangkae (Kork, Tro Bay, Tro Peing Bobor and Prey Top).

20 According to the local villagers, the contraband fuel from Vietnam is sold between 1500 and 2500 riel per litre, that is to say 2000 riel less than the legal price of fuel in Cambodia.

2.2 LAND AND WATER RESOURCES



Map N°2: Location of the different villages and roads

The study area is divided in three main zones:

1) The flooded area

This lowland area is flooded every year during the wet season by the channel N°15, a warping channel dug to drain the Mekong floods up to the lowlands. During the wet season the flood area stretches out several kilometres.

The flood area fills up from August to November-December. During this period, this area is occupied by fishermen. Indeed, fishery is a traditional activity for several farmers, mostly small size-land owners or from families with an important labour force. This activity was used to provide a significant source of income for those who fished almost dayly and sold part of their catch to other villagers or at the market. But currently, the fishes become scarce. According to several villagers, this scarcity is mainly due to the “electricity fishery”: the fishermen put some electric power into the water, which stuns all the fishes in the vicinity. It only remains to the fishermen to catch the stunned fish. This practice has a really negative impact on the aquatic ecosystem, as all the small fishes can be killed by the electric power. As a consequence, the fisheries stop to be a lucrative activity, and most of the villagers only go fishing occasionally for their own consumption.

The flood recession starts in December-January. All the farmers who own land in the flood area (the majority of the farmers living on the study area) start the flood recession rice cultivation. The flood area will be covered by the rice fields from

December-January to March-April. After the rice harvest, the area is used as grazing land for cattle and buffaloes up to July, when the farmers plough their fields before the arrival of floods.

Out of this flood area, the landscape is occupied by the rainfed lowlands, of which the main components during the wet season are the rice fields. These rice fields are only punctuated with the villages and the palm trees.

2) The rainfed lowlands located in the command area of the irrigation scheme

The fields located in the command area of the irrigation scheme (less than 500 meters away from one rehabilitated channel) are cropped from May to January for the wet season rice cropping. After the January harvests, the area can be used as grazing land for cattle and buffaloes, but the fodders run out quickly because of the arrival of the dry season.

3) The rainfed lowlands out of the irrigation scheme

The fields located out of the command area are cropped during a shorter time, from July to December-January. Out of this cropping period, this area is also used as grazing land, especially after the first rainfalls which induce weeds regrowth.

4) Moreover, the area has several kinds of water resources:

- The rain water

Usually, the rainfalls occurring during the wet season cover the water needs of the rainfed rice crops. They are also drained into the family ponds and the irrigation channels. These reservoirs can be used for the family "garden" and as complementary irrigation for rainfed rice. On no accountant these reservoirs can ensure the irrigation during the dry season.

- The flood water

The flood water constitutes an important resource for the villagers, as it provides water to irrigate the flood recession rice during the dry season. Thanks to the use of individual moto-pumps, this water resource is well managed by the farmers and there is no problem of water scarcity for this crop. The flood water represents also an important resource for the villagers as it constitute an important fish reservoir, however in decline.

- The irrigation schemes

There are several irrigation schemes around our study area. Several are using the rehabilitated channels from the same big-scale irrigation scheme constructed during the Khmer Rouge period. But they are currently managed by different kind of entities in different ways:

- The "Kbal Por pumping station community", despite its name, is the irrigation system rehabilitated and currently managed by a private contractor, which we are going to present in the following pages;

- The "Sampot irrigation scheme" belongs to the same old irrigation scheme constructed by the Khmer Rouge than the irrigation scheme from Kbal Por. These two systems are currently contiguous and several farmers from *Phum* Po are water users form both irrigation systems. This irrigation scheme has been rehabilitated thanks to the help of the NGO Australian Catholic Relief (ACR) in the nineties. The NGO also supported the creation of a water users community (*sahakum pra prang teuk*);

- The Kantharith (pronounced "*kontout"*) irrigation scheme: this irrigation system is taking water from the Boeng Do Tom reservoir. From 1990 to 1995 it received financial and technical support from an Australian NGO. This support contributed to the creation of "*sahakum pra prang teuk"*. After the departure of the Australian NGO, the irrigation system has been managed by a water users' community. According to the former chairman of the community, who is the current *Mekhum* of Srangkae, the water fee collection was high at that time. But currently, the users do not have to pay any water fee, as the community receives another "*humanitarian help"*(according to the *mekhum*) from His Excellency Searng Chuntry, the director general of tax department, who was born in the Commune and belongs to the Cambodian People's Party. He is currently financing the purchase of fuel and the building of a concrete main channel.

- The Meon Tamrong irrigation scheme: this irrigation scheme, which is also taking water from the Boeng Do Tom reservoir, has been rehabilitated thanks to a program financed by the FAO (according to the deputy chief of the PDWRM of Takeo). At the same time, a Farmer Water Users Community has been created to manage the irrigation scheme. But currently, the FAO involvement has ended and the irrigation system is not financed by the FWUC, but by His Excellency Searng Chuntry.

The first three irrigation schemes quoted here (Kbal Por, Sampot and Kantharith) are not under the responsibility of the MOWRAM, as all the Cambodian irrigation schemes are supposed to be, but under the MAFF. According to Mr Koy Sokhunthea, chief officer of Agriculture in Takeo PDAFF, this particularity is explained by the fact that these three irrigation schemes have benefited from a common development program financed by ACR "The Kbal Por community Development Project", which involves the MAFF. When the MOWRAM has been created, the MAFF was still carrying out this project and kept his authority on these three irrigation schemes.

2.3 LOCAL AGRARIAN HISTORY

To collect these data, about fifteen interviews have been done with the *Mekhum* of Sambou, *Mephums* and several old people from the six villages of the study area. We asked them to tell us the story of their villages during the different periods which have marked the country, by stressing on the farmers' practices (crops, breeding, means of production, etc…), the population movements and the different examples of collective action.

2.3.1 Local Agriculture during the Sangkum period (1960-1970)

By interviewing old people, we managed to collect information back to the middle of the sixties, during the regime of Sihanouk. The population density was lower than today (30 to 50 % below). The predominant crops were the flooded rice and the upland rice growing.

- The upland rice was grown on the lower (*srey kraom*) and middle (*srey kandal*) banks around the villages, on surfaces of around 2 ha per family.

- The flood recession rice was grown in the flood area. Only the lower lands, closer to the flooding river, were cultivated. To transport the water from flooded areas to fields, they used manual means.

Except for the use of lake water during water recession, there was no irrigation system in the area at that time. The farmers used only traditional varieties of rice with long cycle (*red rice*). Farmers did not use any chemicals (fertilizers and others plant protection products) and the fertilization was only done with organic manure provided by family cows and oxen breeding. The soil cultivation was animal powered. Not all the families owned draught-animals and ploughs. As a consequence, systems of mutual aid ("*provas*", cf. Box N°1) were often used: manpower exchange (mostly for transplanting and harvesting), loan of oxen or ploughs, etc. The yields were a little bit better for the flooded rice (2.5 to 3 T/ha) than for the upland rice (around 2T/ha). The main part of the production was used for the on-farm consumption and the eventual excess was sold to middlemen who resold it, partly in Takeo city and, mainly, to Vietnamese merchants.

Most families owned between 2 and 3 hectares of arable land, but there were already some landless families (around ten per village), whereas some other families owned up to 10 hectares. Most of the farmers breaded bovines (from 2 up to 15 animals) for soil cultivation, organic manure, and sale. Bovines were fed by grazing in the fallow lands of the "lake area" during the rainy season, and on the rice fields harvested of the upland area during the dry season. Farmers also fed their bovines with the rice straws from their fields. Each family also breaded some chicken and ducks for the on-farm consumption. Pigs' husbandries were limited to a few families which reared one or two pigs.

The farmers also grew some fruit trees around their houses for their own consumption. There was no real forest, only some shrubby trees and bushes (mainly used for firewood) in the fallow lands of the "lake area". Fishing was also an important activity for many families, especially in the villages bordering the "lake area". A lot of families (half of the village in O'Po) used to fish in the lake from September up to January, in order to sell one part of their production in Takeo or to middlemen. Most of the other families were also used to fish, but only for their own consumption, even in the villages like Tro Peing Pon Lou (5 km away from the flood area). During the dry season (after the drop in level of the lake) some families went fishing in the river. Children of the villages were also used to catch frogs, crabs, etc. in the rice fields for the family consumption.

Besides fishing and a wine factory located in Kbal Po (which provided a daily payment around 2500 and 3500 riel), there was no off-farm activity. People interviewed told us that, even if they had less goods, the way of life was the same, or even better than today. Indeed, fishing and catching crabs were easier and improved the daily life of the farmers, especially for the families who had less or no arable land.

2.3.2 First period of disturbances: the regime of Lon Nol (1970-1975)

The taking of power by Lon Nol and the war against the Vietnamese and the Khmer rouges deeply disrupted the life of the villages closest to the Vietnamese border. In 1972, attacks on villages increased strongly and villagers often had to leave for short periods. To stop running away, many villagers joined Lon Nol's supporters based in Takeo city. Life in the city, despite the food provided by Americans, was hard too. Many villagers had to rent small land to grow rice for their families, or work as drivers

of moto-taxis, or to fish. But life was more difficult for those who stayed in the villages. Many houses were destroyed. Attacks and escapes reduced the possibility of breeding animals and growing crops, and many people suffered from hunger. One villager from Rovaong told us: "*During that time, we lived like animals, without food for our family*".

2.3.3 The regime of the Khmers Rouges

If the way of life was difficult under the regime of Lon Nol, it deteriorated seriously after the Khmers Rouges' overthrow.. This period was marked by a complete break of the social fabric. The population was forced to leave their lands, villages and families and were relocated to other areas (close to Takeo or in the south, close to Kampot), where they were assigned to different specialised works. Some had to work as manpower in the construction of hydraulic schemes, cutting trees (in Kampot Province), growing rice (ploughing, transplanting or harvesting, etc), maize, beans, etc. The people located in our study area had to work as manpower for the construction of a big irrigation scheme (more than 1500 ha). A big pumping station was been built at this time, and 4 Korean motors (250 horsepower each) were been installed to pump water from the river to supply the channel. The statements of the people surveyed concerning the efficiency of the irrigation scheme at this time are discordant: some of them told us that the irrigation scheme was working properly and that an important area was irrigated, the others told us the opposite. Besides the use of chemical fertilizers and irrigation, the agricultural practices were the same than during the Sangkum.

The people were often moved from one place to another to do different jobs. The work was exhausting and people were not receiving enough food. One old farmer compared his life during these two periods: "*During the Regime of Lon Nol, it was difficult, but we worked normally, we could find some food. With the Khmers Rouges, we had to work the all day long, we did not receive food and we were beat or killed at the first mistake*."

When the regime of the Khmers Rouge ended in 1979, the population was bloodless, the houses and villages were destroyed. Each one tried to return to his village and find the survivors of his family. The first people arriving in the villages settled down in the house of their choice. There was no major conflict about the house properties: "*there were a lot of places and we were not numerous, each one settled down where he could*".

2.3.4 The Krom samaki (1979-1982)

In January 1979, the Vietnamese army liberated Phnom Penh and put in place a new government that they controlled strongly: the Popular Democracy of Kampuchea. To eradicate famine and rebuilt the national agriculture, the government encouraged the formation of groups of solidarity, the *krom samaki*. During this period, farmers grew flood recession and rainfed rice using the same agricultural practices than during the *Sangkum*. One part of the harvest was given to the government, and the rest was distributed between the families of the group, in step with their participation in the group's work.

As soon as they had enough means of production, and because they considered this kind of organisation too restrictive (one lazy farmer may slow down the work of the

entire group), farmers asked the local authorities to stop work in fixed group and to crop their own land.

2.3.5 From the land distribution to the current period

In 1982, the government allowed to stop the *krom samaki*. The *Mekhum* of Sambou was in charge to reallocate lands between the different *Mephums*, who divided the land between the different chiefs of *krom samaki*. **In each village of the area, each one (adults and children) received 20 are in the lowland around the village (plots were measured). In addition, each family received a plot in the down flooded land**. The size of the plot was not measured precisely but according to the size of the family (small plot for small family …). Moreover each one was allowed to clear land in the wasteland of the flooded area and to appropriate this plot.

The people surveyed told us there was no major conflict concerning this land distribution, which seemed to have been fair, except for the local authorities (commune's employees), who were allotted bigger surfaces of land. Indeed, currently these people have more surface than the average. However, some people complained to us about the fact that their children were born just after the distribution and did not receive any land.

In 1989-1990, the government provided temporary title deeds to the farmers who did not have to pay more than 1000 riel for one form (one form for one plot). Although they still do not have the real title deeds, they do not seem to worry about the validity of their temporary titles , In fact, they told us that in case of a conflict about land property, *Mekhum* and neighbours can testify who the owner of the land is.

The cropping practices did not change at the beginning. But soon (between 1983 and 1987), the Takeo Provincial Department of Agriculture, Fishing and Forestry (PDAFF) provided the farmers with small quantities of chemical fertilizers and new rice varieties (short cycle rice, as IR 66). The NGO Australian Catholic Relief (ACR), present in the area during the nineties (we did not manage to determinate the exact dates of their action in the area, because the information collected at this point were very contradictory), also helped to develop the use of more intensive practices. Indeed, they built one center on the road between O'Po and Rovaong, where they distributed fertilizers and short cycle rice (IR 66 also). They also provided technical formations, demonstrations of some cropping methods, and lent materials to farmers (pumping motor, *koyoun* and threshing machine). After that, the use of chemicals and new rice variety increased progressively. When the NGO left the area, they let the center under the responsibility of the PDAFF. But they encountered many problems (material broken and not repaired, lack of payment for the maintenance of the material…) and after two years, the PDAFF sold the material and closed the center.

In the late eighties, motorized pumps of 1.6 to 10 horsepower, appeared in the area, mostly used for flood recession rice cropping. The use of these pumps increased since 1995 and currently almost all farmers own and use one. The only farmers who do not have pumps are those who do not cultivate fields in the lake area. The use of motorized pumps allowed the farmers to extend the arable surface in the flooded area for rice growing up to the higher border of the flooded basin.

The mutual aid ("*provas*") was a usual practice for a while after the end of the "*krom samaki*". Then it decreased as the families reconstituted their means of production and the use of paid manpower and ploughing service spread. Currently, the

farmers who are using the mutual aid for manpower or plough are whose who do not have enough family labour force and no financial resources to pay for it.

Currently, the average surface of arable land owned by family is about 1 to 1.5(ha?) per household. There is only a small amount of landless people (less than 10 households per village) but many households own less than 0.5 hectare,barely enough to ensure the family food self-sufficiency. There is no phenomenon of real estate concentration. No farmer owns more than 5 hectares in this area

2.4 THE FARM ACTIVITIES

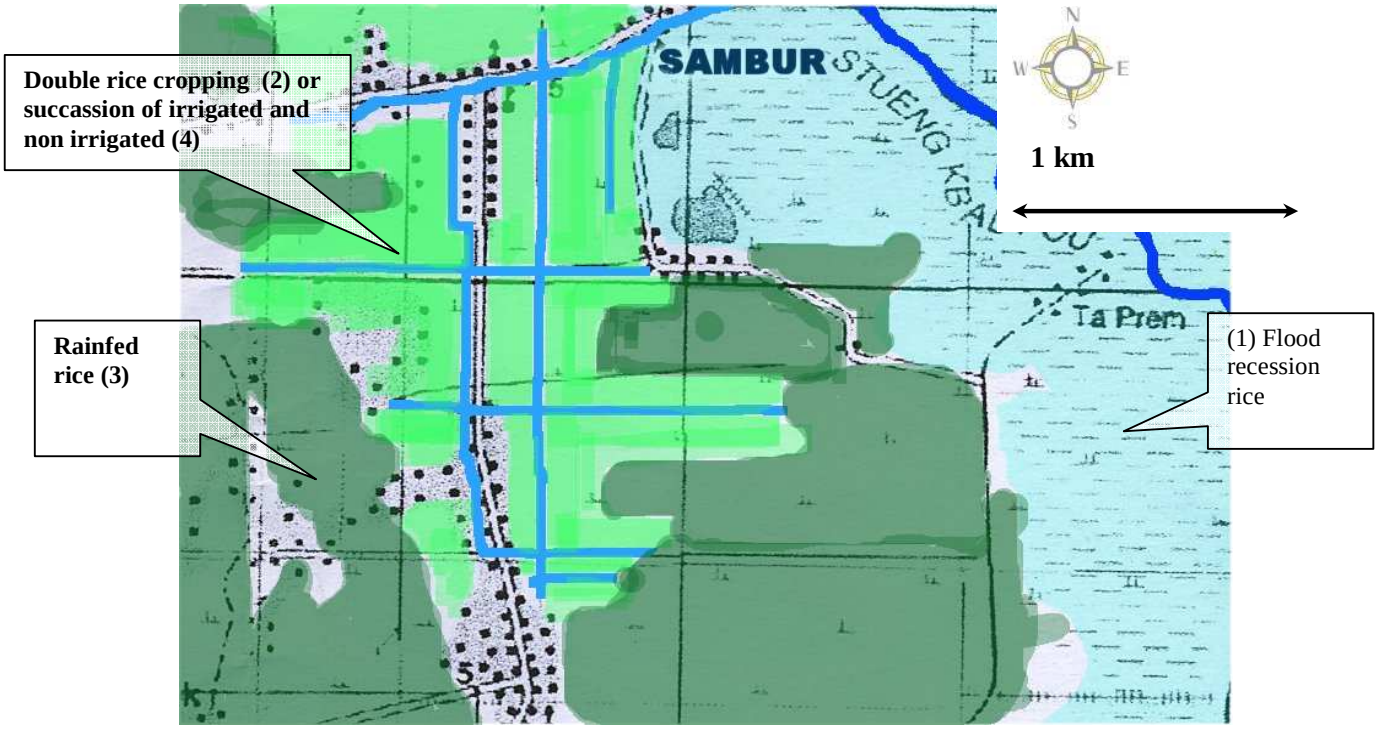
The results presented in this part rely on the six collective meetings (one in each village located in the irrigation scheme) and the 33 individual surveys carried out with farmers, users or not of the irrigation scheme, but all located in the irrigation scheme area, from September to November 2005. (cf. methodology p.25-26)

In a first part, we will present the management sequences of the rice cropping systems. Then we will present the livestock management systems, their management sequence and economical results when the data collected allowed it. Moreover, farmers also practise some complementary activities such as animal husbandry and off-farm activities. All these activities will be presented, in a more or less detailed way, according to their representativeness, their impact on the households' income, but also the reliability of the data collected. Last, we will present our analysis of the economical impact of the irrigation scheme on the water users and the place that the irrigated crops take in the household income.

2.4.1 Rice: management system

The rice fields occupy the major part of the arable land. **.** Most of the farmers surveyed described themselves as "rice growers". **Rice cultivation is the main activity of the majority of the farmers of the area and governs the rhythm of the villages' life.**

There are two different field locations where four different rice cropping systems are carried out (cf. Map N°3):

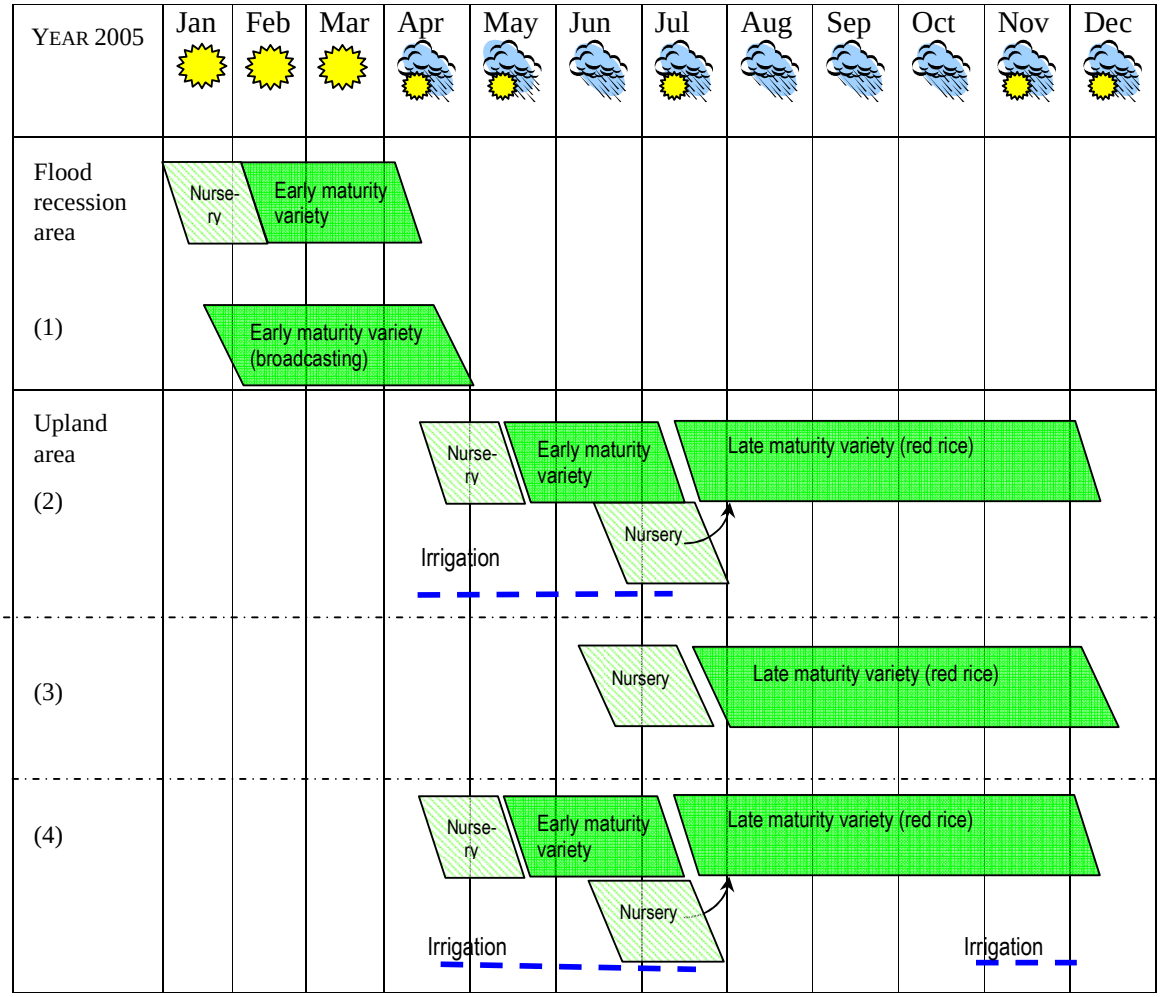


Map N°3: Location of the different system of rice cropping

- The flooded area, where almost all farmers (except those who have sold their land) are cropping **flood recession rice** (1);

- The lowland area where farmers are cropping:

→ **Double rice** cropping (2) [*early wet season rice/late wet season rice*];
→ **Rainfed rice** cultivation (3);
→ Succession **of irrigated early wet season rice** and **non irrigated late wet season rice** cropping (4)



Graph N°1: rice cultivation calendar

We will describe the main characteristics of the different rice cropping systems. The goal here is not to give a detailed presentation of the crop management sequences, but rather to stress on **some relevant elements regarding, on one hand the agricultural local context in which the irrigation scheme is fitting into, on the other hand the impact of the irrigation on these rice cropping systems**. We chose to present the results of the year 2005. Indeed, in 2005 the first irrigation started one month later because of the delay of the first rainfalls. It seemed interesting to us to analyse the impact of that kind of delay on the irrigation scheme functioning and economical results. Moreover, farmers spoke more easily about what they were doing currently.

2.4.1.1 Flood recession rice

According to the old people interviewed, the flood recession rice was already cropped in this area before the Khmers Rouges regime. Since the end of this regime, this crop has benefited from several innovations (new varieties, moto-pumps, harvester, thresher, broadcasting, etc.), mostly introduced by Vietnamese.

Working calendar

The varieties of rice currently used in the flood recession area are early maturity varieties, mostly IR66, IR "Unnal" and "Nam không Bôn" (504 in Vietnamese). These early maturity varieties avoid risks of water shortage at the end of the cropping cycle, in case the flood recession ends early. The cropping conditions are particularly favourable during this period (luminosity, water management, soil fertility) and allowe the use of varieties more demanding but with high potential of production. Nevertheless, without the constraints of risk of water shortage, farmers would probably crop late maturity rice. Indeed, even if these varieties have a lower potential of production, farmers prefer to crop late maturity varieties, as they consider it as the "heaviest and tastiest" rice, which get higher sale prices.

NAME	TYPE OF VARIETY	CROPPING CYCLE	ORIGIN	CHARACTERISTICS
"red rice"	Late maturity variety	Nursery: 30 to 45 days Total cycle: 180 days	Traditional variety	"heavy rice"[21], tasty
IR 66, IR Unnal	Early maturity variety, Photoperiodic Incentive Variety	Nursery: 28 days Total cycle: 110 days	IRRI	"light rice", less tasty
"*nam cong bong*"= IR 504	Early maturity variety, Photoperiodic Incentive Variety	Nursery: 28 days Total cycle: 110 days	IRRI	"light rice", Less tasty

Table N°3: the different rice varieties used in the study area

Two flood recession rice cropping systems are practiced in our study area: one with nursery and transplanting, the other one with broadcasting. The choice of one of these two practices is above all determined by the location of the plot in the flood area: Only those who have their plots in the upper part can broadcast their rice. Indeed, there are two constraints which forbid broadcasting in the low part of the flood area:

- Farmer would have to wait the end of the flood recession to sow his rice. All the cropping cycle would be delayed (the flood recession may last 2 months) and would suffer from drought (no rain and no more water in the flood area).

21 The two appellations « heavy » and « light » rice are referring to the finale volume of rice remaining after cooking: for an equivalent volume of dry rice, the "heavy" cooked rice will take a bigger volume than the "light" one

- There is a risk of “return of flood”: after the water level in the lowlands decreases and the farmers sow their rice, a “return of flood” can occur and destroy the young seedlings.

Furthermore, many farmers still practice the transplanting in the upper area, because they do not know how to manage broadcasting. The main explanation given by these farmers is the pressure of weeds, which is stronger during this season, while broadcasted fields are more sensitive to this pressure than transplanted fields (as the seedlings are denser). Nevertheless, broadcasting is interesting for farmers who have little family labour force, as it suppresses the expenditures for pulling out and transplanting young seedlings. Farmers have to assess what is the more costly for them: the manpower for transplanting or the use of supplementary weed killer for broadcasted fields.

In both systems, fields are ploughed a first time in July or August, before the start of the flood. The start of the next operation is very variable, between December and February, according to the years and the rainfalls. As stressed by several farmers, they have to watch carefully the water level in the flood area to start their rice crop at the suitable time. The nurseries which will be transplanted in the upper lands and the broadcasted fields are sowed in the upper border of the flood area, as soon as flood recession start, while there is still a few centimeters of water on the soil. The majority of the farmers harrow the nursery manually before they sow it. The quantity of seeds sowed varies from 50 to 300 kg per hectare with transplanting. We noted that the farmers who own small land increase the quantity of seeds sown (for example, one woman owning 0.15 ha sowed 50 kg, which means 333 kg/ha). Farmers who broadcast their fields sowed between 80 and 200 kg of seeds per hectare. Most of the farmers interviewed told us that they use seeds from the previous harvest (from early wet season rice for many) every year. Nevertheless, some of them (about 30%, but there may be more) told us that they change their variety every 3 or 4 years. They purchase new seeds (generally from new variety) every 3 years, from Takeo merchants or other farmers. The main explanation they gave us is that they want to try new varieties, after they have seen other farmers get good results with it. Indeed, if IR 66 is currently the most widespread variety, several farmers told us that they want to try IR *Unnal* or IR 504 for the following early maturity rice cropping cycle.

The nurseries intended for the lower area are sowed in the upper part according to the rhythm of the flood recession: “*I sow my nursery when the water in the transplanting field is higher than my thigh*” (Han Progn, Farmer from phum O’Po). Farmers may have several plots in the flood area at different levels and they have to sow several nurseries at different times.

The young seedlings are pulled out from the nursery as soon as the level of water in the field allows to transplant it. The field is not ploughed again (it has been ploughed one time before the flooding) but may be harrowed one day before transplanting. For the early maturity variety, the ideal time in nursery is between 20 to 28 days. The farmers try to respect this period but their practices are conditioned by the speed of the flood recession, which is very variable according to years. They may have to transplant sooner or, more often, later than the recommended data, which may have a negative impact on the final yield by reducing tillage capacity.

Several treatments, mostly against insects and weeds, fertilisation and irrigation are realized between the transplanting (or broadcasting) and the harvest. This one takes place three months to three months and half after the sowing, between the end of February and April.

Irrigation and water management

Apart from the risk of delay of transplanting, the water is well overcome for the flood recession rice, as the risk of water shortage is low. This control is particularly allowed by the use of individual motorized pumps and flexible tubings. As detailed in the local history, these moto-pumps are used in the area since the middle of the nineties, and currently almost all the families who own land in the flood area own at least one moto-pump. The farmers who do not have one are the widows, divorcees, young or poor peoples (around 8% of the farmers in our study area). The use of individual moto-pump is currently growing in Cambodia, but is far away to become as widespread as in our study area.

The management of water is here largely individual. There is little *provah* system for the loan of moto-pump as almost everyone has his own. The fields are irrigated almost once a week from the sowing up to two weeks before the harvest. The number of irrigations is about 8 after the transplanting, and the quantity of fuel required may be important (up to 100 L per hectare per cropping cycle when the field is far away from the recession limit).

Inputs and intensification

The quantity of weed killer and insecticide is higher than for the rainfed rice, as the pressure of weeds and insects may be very high during dry season. The farmers are using mostly Vietnamese products and they often do not know the composition and the quantity applied.

The farmers do not spread any organic manure on these fields as the soil is already fertile thanks to the alluvium brought by the flood. The fertilisation is exclusively chemical, with the supply of urea, DAP or "*philipine*" (NPK: 16-16-8-13S). The quantities spread are variable (from 0 to 200 kg per hectare), according to the product destination and the financial capacities of the farmers. Indeed there is a strong tendency to reduce (and even stop) the supply of fertilizers and other chemicals when the rice production is intended for the on-farm consumption.

Moreover, even if the rice is used for their own consumption, the majority of the surveyed farmers hire a lot of manpower to pull out and transplant the seedlings in one day only. All the fields of the flood area have to be harvested at the same time. Indeed, a rice field harvested several days after the others may be damaged by the cattle driven for grazing on the stubble fields (Pillot, forthcoming).

Yields and Production purpose

There is an important variability in the yields obtained in the flood area, **from 3.2 to 7 tons per hectare**. The causes of this variability are multifactorial and combine natural factors (such as soil quality, location of the field in the flood area, etc.) with technical factors (quantity of fertilizers applied, practice or not of transplanting, etc.). **But it is important to mention that even the lower yields are higher than the Cambodian average yield**. Indeed, farmers from our study area have high technical skills. Thanks to the proximity and the numerous exchanges with Vietnamese and Phnom Penh, they have a good access to the new techniques (as early maturity varieties, chemicals, moto-pumps, broadcasting etc.) and overcome them, which allow to improve the yields. Moreover they have the financial capacities to intensify their cropping management systems, particularly because they have several cropping cycle through the year and they get incomes from other activities (such as animal husbandry, renting of

agricultural equipment, etc.). Besides the flood recession rice cropping benefits from suitable cropping conditions (water management, soil fertility and luminosity).

An increasing number of farmers are harvesting their flood recession fields with harvesters, instead of hiring manpower. Indeed, harvesters can be used since the soil is almost dry at the harvest time (which is not the case for the rainfed rice). Moreover, the area cropped by one farmer may be high (the average area in the flood area is 1.5 hectare) and the pressure on manpower is important as all the fields are harvested almost at the same time. These harvesters have been introduced in the area by the Vietnamese. Indeed, many Vietnamese merchants are come to purchase early maturity varieties and at the same time they introduce new techniques and materials.

Several farmers told us that for the flood recession rice, Vietnamese merchants purchase their production directly in the fields. Those who do not sell their production to Vietnamese merchants sell it to the local rice millers. The production can be sold in its entirety or progressively, according to the farmers needs. Most of the farmers are selling at least half of their production. Those who keep it for their own consumption are those who do not have enough land to get surpluses.

Furthermore, about thirty farmers from Kbal Por and Por are working with the Company AQUIP (Agriculture Quality Improvement). This Company, based in Takeo city since 2001, works with about three hundreds farmers from Traeng District. This cooperation is established by a contract between the Company and each farmer. The Company supplies the farmers with seeds (early maturity rice) and chemical products. In return, the farmers commit themselves to follow the detailed field management sequence imposed by the Company (quantity of seeds and chemicals per hectare, transplanting in lines, transplanting and harvesting with company's authorization, etc.). Then, the Company purchases the harvest at a fixed price (usually higher than the market price) and deducts the price of inputs.

2.4.1.2 The irrigated rice cropping systems

On the irrigation scheme, the availability of water and of early maturity rice allow to practice two crops during the rainy season instead of the one traditionally cropped on the lowland rainfed areas. The first crop (early wet season crop) starts with the first rainfalls. Without supplementary irrigation, rainfed rice cannot be sowed before July. The rainfalls are too poor and irregular to allow cropping without the security of complementary irrigation. The use of early maturity variety for the first crop allows to reduce the irrigation costs. Indeed, if farmers used late maturity variety, they would have to start two months earlier, when there is no rainfall

Two different systems of early wet season rice are practised by the irrigation scheme users: on the one hand the early wet season rice with transplanting practiced by all the upstream users and part of the downstream fields, and the early wet season rice with broadcasting mostly on the downstream fields.

2.4.1.2.1 Early wet season rice with transplanting

Cambodian farmers traditionally sow their rice in nurseries before transplanting the seedlings in the entire field. The nurseries are installed on small plot (around one tenth of the area which will be transplanted) where farmers can provide the best care to the young seedlings (fertile soil, water easily available).

Usually, the farmers prepare their land at the end of April or in early May. This year, they started this work one month earlier. We will describe here the settlement followed in 2005.

Working calendar

At the End of May 2005, farmers ploughed the nursery area a first time. About fifteen days later, after the first rain or the first irrigation, the nursery is ploughed a second time and harrowed. The nursery is fertilized with organic manure (2 to 10 ox carts, according to the on-farm availability) and 3 to 10 kg of urea. Then the farmer sow the rice on the basis of 30 to 175 kg per hectare transplanted. Farmers use only early maturity varieties for this crop. Currently, the varieties used are the same than in the flood recession area, and the favourite one is IR66 (around 85% of the people surveyed are using it for the early wet season rice).

When the installation of the nursery is finished, farmers plough the transplanting area. Here again, the land is ploughed twice and harrowed once. At the second plough, farmers put some organic manure (10 to 20 ox carts per hectare) and chemical fertilizer. About one month after sowing (according to the rice variety and the water availability), the seedlings are pulled out and transplanted in the new area. These two activities are very costly in manpower (around 20 men a day for one hectare transplanted). It is important to notice that, contrarily to other Cambodian farmers, farmers from this area focus their attention on respecting the advocated period in the nursery. Most of the farmers surveyed told us that they transplant the seedlings around "*28 days after sowing for IR66*". Nevertheless several downstream farmers added that they often exceed this date because of the lack of water (no rainfalls and not enough water in the downstream channels).

Three months and a half after the sowing time, the rice is harvested, mostly by hand with a sickle. Only two farmers surveyed told us they use a motorized harvester, rented to someone from another village, because they do not find enough manpower at the harvest time. We have to point out that the use of a motorized harvester does not exclude the use of manpower to collect the rice straws scattered by the harvester.

The traditional threshing technique is still used by several farmers: they transport the rice straws up to their house and separate the paddy from the straws by threshing it manually, mostly by foot. But another technique is developing and currently used by an important part of the farmers: the threshing machine. This machine has been introduced in the area by Vietnamese who have used it for a decade. At first, farmers rented it to Vietnamese or people from other villages. But currently, several farmers purchased a small threshing machine in order to thresh their fields and rent their services to other villagers. About five to ten farmers, in each village, own this kind of machine and work for others farmers in exchange for one part of the rice production, on the rate of 1 bag for 20 bags of paddy threshed. The early development of the use and owning of threshing machine by farmers is another specificity of our study area. In most of the other parts of Cambodia, it is rare to see more than 1 or 2 threshing machines per village.

After being threshed, the paddy has to be dried, which may be difficult, as the early wet season rice is harvested in September, during the period of heavy rainfalls. The bags of rice have to be emptied onto mats several times a day for a period of one or two weeks. Then the rice is winnowed directly in the wind or by using a fan, before it is stored in the house or sold.

Irrigation and water management

The nursery is irrigated 2 or 3 times and the transplanted field 3 to 5 times, depending on the rainfalls and the water availability in the channel. Most of the water users have to pump water from the channel up to their field. The quantity of fuel used to irrigate one hectare during one cropping cycle varies from 10 to 70 litres with an average of 36 litres. The quantity of fuel used depends mostly on the distance that separates the fields from the channel and the number of intermediate pumping necessary to reach the field.

Inputs and intensification

Globally, the early wet season rice is the most intensified rice crop of the wet season regarding the use of organic manure and fertilizers and the hired manpower.

Most of the farmers put organic manure both in nurseries (about 4 ox carts per hectare-one ox cart contains about 250 kg of organic manure) and main fields (from 2 to 50 ox cart per hectare). They also spread chemical fertilizers, mostly a mixture of urea and DAP, but also "*Philippines*". The quantities spread per hectare vary considerably, from 20 to 250 kg per hectare, with a small part (2 to 5 kg per hectare) on the nursery. The size of the plot seems to influence the fertilization: globally, those who spread the bigger amount of fertilizers own a small plot. Nevertheless, the size of the plot is not the only explanation: quantities of chemical fertilizers applied depend also on the cash availability at the time of fertilizing. Indeed farmers who own small land but do not have cash availability apply few fertilizers.

Most of the farmers hire labour force for transplanting and harvesting. Nevertheless, a lot of them use family labour force for pulling out the young seedlings. Those who own small land or enough manpower, or those who do not have financial capacities for hiring manpower will use family manpower for transplanting and harvesting. Some of them also practice *povas*. The climate may also influence the farmers' choices: if they have little time to transplant or harvest, they will more easily hire manpower.

Yields and Production purpose

The average yields are between 4 and 5 tonnes of paddy per hectare. The farmers who did not manage to reach these yields are either those who had some problem of water shortage or diseases, or the households in "decapitalization" who do not have the financial capacities or means of production necessary to intensify their production. **We did not observe any significant difference between the agronomical results of the upstream and downstream users surveyed**. We did not have enough time to make a precise analysis allowing to explain the differences observed between the yields obtained, but these differences may be due to the different levels of intensification of the crop (which may itself be influenced by the risk of water shortage but also by the level of capital, equipments and manpower of the farm).

Most of the early wet season rice production is intended for sale. Indeed, several (25%) farmers interviewed sell the totality of their production, the majority of them (58%) sell more than half and a small fraction (17%) keep it for own consumption. These strategies are oriented by the arable land area owned by each farmer: those who owned enough land to produce rice surpluses will sell the early maturity rice in priority. If they crop two early maturity varieties in a year (one in the irrigation scheme and one in the flood area) they will sell one part (or the totality, if they produce enough red rice) of each production in order to cover the expenditures. Indeed they often have to pay

chemicals and manpower on credit and have to pay it after the harvest. The sale money can also be used to cover the expenditures of crops (late wet season rice and flood recession rice), and avoid to ask credit.

These high rates of farmers selling their rice production are another characteristic of our study area. In most of the other part of Cambodia, most of the farmers keep the major part of their production for own consumption. Indeed, farmers from our study area are able to produce more rice than farmers in other places of Cambodia, and obtain and sell rice surplus:

- Thanks to the flood recession area and the irrigation scheme, the farmers can crop from 2 up to 3 rice cycles per year.

- The farmers from our study area are "rice croppers", with higher technical skills than in other parts of Cambodia, allowing them to get higher yields.

- As explained for the flood recession rice, they also have the financial capacity to invest in and intensify their cropping systems, resulting in improvement of yields.

The production is brought and sold to one of the three local rice millers (two in Kbal Por and one in TPPL) or to the trucks owned by local rice millers or to middlemen from Vietnam and other parts of Cambodia. The price is slightly higher (around 20 riel per kg) for those who bring their production to the rice processing-factory. Moreover, there is an important price variation in the course of the three months following the harvest. In 2005, the sales price of the paddy was 480 riel/kg at the harvest time and 530 riel/kg in mid-November and was supposed to increase up to December (date of harvest of the red rice). Obviously, those who have to pay off their chemicals and manpower have to sell part or totality of their production at the harvest time. But several farmers in the area were still waiting to sell their production when we left the area at the end of November.

Furthermore, the Company AQUIP started to work with farmers for the early wet season rice. They decided to work with farmers from our study area as they notice the good yield results and the quality of the irrigation water distribution, at least for the upstream users. Currently, only 8 farmers from *Phum* Kbal Por and one *Phum* O'Po work with the Company. The Company agrees to work with more farmers for this crop, but the joining has to be voluntary. Several farmers told us they were interested in working with AQUIP but they were a little afraid because the in-line transplanting requires an important manpower. Nevertheless, this partnership can represent a positive impact for the valorisation of the irrigation system's product (as AQUIP represents a safe market with high price levels and provides advances of seeds and chemicals).

2.4.1.2.2 Early wet season rice with broadcasting

The sample of farmers surveyed for this system is quite low (only four people), and reduces the representativeness of these results.

An increasing number of water users apply this practice for their early wet season rice cropping. This practice is quite recent for this cropping and has been used for only one or two years now. Nevertheless it seems to be really successful in the downstream villages: about 30 to 50 percent of the water users from the villages of *Phum* Thnot Chum and Rovaong and from *khum* Srangkae are broadcasting their irrigated fields. Several overlapped explanations have been given to explain this choice:

- The broadcasting suppresses the important expenditures in manpower necessary for the pulling out and the transplanting. In view of this, it decreases the losses in case of water shortage. Indeed, all the farmers practising broadcasting for this crop were complaining that the irrigation scheme did not provide them enough water for their fields;
- Farmers need an important quantity of water at the transplanting time. If they do not receive this water on time, they have to delete the transplanting, which can have a negative impact on the final yields. To avoid that risk, farmers can chose the broadcasting: even if they are still dependant on the irrigation water availability, broadcasted fields don't require as many water volumes at one precise time than transplanting. Broadcasting provides more flexibility in irrigation than transplanting and good reactivity to face the problems of a bad securing of water allocation.

Working calendar

The working calendar is quite the same, except the absence of pulling out and transplanting. Most of the farmers surveyed told us that this year, they waited the first rainfalls to plough the second time, harrow and sow. As the farmers were not able to give us the precise date of sowing (they only said "start" or "mid-" or "end of" May and June) it is difficult to say if the downstream farmers broadcasted after the other farmers sowed their nurseries. The harvest is done after 110 days for the variety IR66.

Irrigation and water management

As we explained before, broadcasting provides more flexibility in irrigation than transplanting and good reactivity to face the problems of a bad securing of water allocation. In a global way, broadcasted fields require less water than transplanted ones. The quantity of fuel used for the irrigation of one hectare varies from 10 to 80 litres. The young seedlings have to be irrigated every 7 days if there is no rainfall. According to farmers, small rainfalls meet the need of seedlings. In case of no rainfalls, the broadcasted field has to be irrigated every ten days. But several downstream farmers told us that they irrigated their broadcasted fields only three times this year (because they got enough rainfalls).

Inputs and intensification

Broadcasting avoids the use of manpower for transplanting and also reduces the consumption of fuel. Moreover, the farmers do not increase the quantities of weed killers and insecticides, as the pressure of weeds and insect is not important during the early wet season, but they seem to use more fertilizers (on average 260 kg of chemical fertilizers per hectare and 10 to 60 ox cart of organic manure per hectare).

Yields and Production purpose

We did not notice significant differences between the yields obtained with this two systems. The average yield with broadcasting is still around 4T per hectare, with a minimum of 2.2 tons per hectare. The destination of the rice production is the same than transplanting system.

Nevertheless, only one or two people are using this practice in the upstream villages, as they consider they do not manage this cropping method enough. Our point of view is that since the upstream water users don't feel a particular risk of irrigation water shortage, they do not want to incur a new practice. The risk linked to the

implementation of a new practice seemed higher than the one linked to the water shortage. Nevertheless, as a consequence of the good results obtained by the downstream « broadcasters », the use of this technique in the irrigation scheme can develop in the upstream area. Indeed several farmers from the upstream villages told us "*Perhaps next year I will try to broadcast my early wet season rice, because the people in Thnot Chum and Rovaong who tried it got good yields and spent less money for manpower*." (Farmer in *Phum* Po).

2.4.1.2.3 Lowland late wet season rice

The field management system of this crop is close to the traditional lowland rainfed system. All the farmers are cropping the traditional late maturity variety called "*red rice*".

Working calendar

All farmers are practising transplanting for their crop. Indeed, it allows them to sow on small land before the harvest of early wet season rice, and to transplant in the main plot just after the harvest. The nursery area is ploughed twice, harrowed once and sowed in July, with the first heavy rainfalls. A small quantity of organic manure (about 2 ox carts) and urea (around 5 kg per hectare transplanted) can be spread on the nursery during the second plough. The time of sowing is decided according to the date foreseen for the harvest of the early wet rice. Indeed, straight after the harvest, the field is ploughed (once or twice according to the time available) and harrowed and the farmers transplant the red rice seedlings. Thus the seedlings are pulled out from the nursery and transplanted 1 month and a half to 2 months after sowing, in August-September.

About 4 months after the transplanting, the red rice is harvested, in December-January. According to the farmers interviewed, the delay of one month undergone this year during the early wet season rice will not have any negative impact on the late wet season rice production, as "*the rainfalls can last up to January, and if they stop too early, we will try to get water from the pumping station*".

Irrigation and water management

Usually, farmers do not use water from the irrigation scheme for the late wet season rice. Besides, when we asked them about the functioning and the water distribution of the irrigation scheme, they did not say anything about irrigation during late wet season rice.

Nevertheless one part of the late wet season rice fields have been irrigated in 2004. This year, the rainfall stopped during a long period (3 or 4 weeks) in October-November. So the water users asked the entrepreneur to start the pumping machine. We will come back to this point later, as it is the cause of one conflict between the users and the entrepreneur. Furthermore, when we leaved the area in November 2005, it did not rain for two weeks and the water users started to discuss among themselves and with the entrepreneur when to start pumping if the rainfalls don't come soon.

As a consequence, there is a possibility of complementary irrigation which secure the crop, even if this late wet season irrigation seems to be a cause of tension.

Inputs and intensification

Farmers do not spread organic manure for this crop because:

- The field has already been manured for the early wet season rice;

- It is too difficult to drive the ox cart in the fields at this time, as the soil is soaked;
- Farmers do not have enough organic manure to fertilize all the cropping cycles. They prefer to use it for the early wet season rice.

Concerning the chemical fertilizers, the quantities applied depend on the destination of the production. Indeed, we observed that the quantities of chemical fertilizers are generally higher when the rice is for sale than when it is for own consumption. Moreover, only a few farmers are using other chemicals such as weed killers or insecticides.

Lastly, we observed a strong tendency to reduce the hired manpower for this crop, especially when this rice is used for own consumption.

Yields and Production purpose

The average yield for this crop, around 3 tons per hectare, is still higher than the Cambodian average. Nevertheless, we registered an important variation in these yields: from 0.8 to 4.3 tons per hectare. These variations are here again linked to the level of intensification of the crop, itself influenced by the structural characteristics of the production unit and the destination of the production, but also the access to water or the soil quality.

2.4.1.3 Lowland rainfed rice cropping system

The field management system of this crop is quite the same than for the late wet season rice: same rice variety (red rice), same work calendar, same level of intensification, etc.

Nevertheless small differences are noticeable:

- The late wet season rice seems to have more or less priority on the rainfed rice, which means that the quantities of fertilizers (chemical as organic) can be conditioned by the cash flow available after the late wet season rice fertilization.

- The fields used for rainfed rice are too far away from the irrigation scheme: in case of rainfall shortage, they can not be irrigated. This can explain the fact that rainfed rice is the last one to be intensified: as it is less secure than irrigated crops, farmers will use inputs for irrigated crops first and then intensify rainfed crops according to the resources (cash flow, fertilizers, etc…) available.

YEAR 2005	FLOOD RECESSION RICE WITH TRANSPLANTING	FLOOD RECESSION RICE WITH BROADCASTING	EARLY WET SEASON RICE WITH TRANSPLANTING	EARLY WET SEASON RICE WITH BROADCASTING	RAINFED RICE
Quantity of seeds (kg/ha)	50 to 300	80 to 200	32 to 300 (average =100)	117 to 500 (average=300)	15 to 150 (average = 80)
Weed killer	Yes	Yes	Rarely (3 farmers)	No	No
Average quantity of organic manure	0	0	20 ox carts (~5 tonnes)	28 ox carts (~7 tonnes)	0 to 29 ox carts
Average quantity of chemical fertilizers (kg/ha)	75 to 200 (average= 160)	160 to 300 (average=200)	67 to 250 (average = 170)	190 to 416 (average =260)	70 to 200 (average= 109)
Average quantity of fuel (L/ha)	20 to 100 (average=60)	60 to 130 (average =100)	11 to 180 (average = 36)	10 to 83 (average = 43)	0
Labour force for transplanting (man a day of work per ha)	15 to 61 (average = 38)	0	13 to 40 (average = 29)	0	16 to 40 (average = 24)
Labour for harvesting (man a day of work per ha)	12 to 46 (average = 32)	Mechanical harvester	14 to 66 (average= 34)	12,5 to 17	19 to 40 (average = 25)
Yields (T/ha)	3,2 to 5,8 (average = 4,4)	4 to 7 (average = 5)	1,8 to 5 (average = 3,9)	2,25 to 6,2 (average = 4,4)	1,9 to 4 (average = 2,8)

Table N°4: Comparison of the inputs and yields used for the different rice cropping systems

2.4.2 Other crops

The rice is the main crop which occupies the main part of the arable land. We did not observe any other crop in the lowland area (and the other area was under the flood), but the farmers are cropping several other cultivations on small areas, around their houses or at the village borders, mostly vegetables (gourds and beans), bindweed, manioc and banana tree. All these cultivations are for own consumption or occasional sales to neighbours. One of the villagers interviewed told us that in this area, people were rice croppers first, and they do not have the time to take care of a garden or orchards.

2.4.3 Animal husbandry

"*The Cambodian animal husbandry could be defined in few words and at the risk of a simplistic generalization as a "small scale" family husbandry, tightly overlapped with the vegetal crops, especially with rice cropping. The animal productions are more in farmers' hands than in breeders' hands*" (Pillot, forthcoming).

Animal husbandry takes up a secondary place for most of the households from the study area (regarding the inputs and the family income). There is an important diversity of husbandry systems: cattle or buffalo's husbandry, pigs and ducks rearing, poultry holding and fish breeding:

1) Cattle husbandry

In our study area the number of households who owned more than 3 oxen and cows is noticeably higher than in others areas of Cambodia. It may be due to the important production of rice straws (as most of the farmers crop at least two rice crops per year) and the sale of rice surpluses which allow to reconstruct their flock. The main breeds used in this area are the "*Haryana*" and the "*Cambodian ox*" breeds or crossbreeding between these two breeds.

Cattle husbandry has three main functions: field work, organic manure and savings.

- **The supply of oxen traction is one of the main functions of cattle husbandry**. Most of the families are breeding one or two oxen for field work (ploughing, harrowing) and transportation. Indeed, the majority of the farmers are still ploughing with draft-oxen, at least for the sowing area. The people who do not have oxen are, on the one hand people who are in a "decapitalisation" process (who had to sell part of their land and have generally small arable land); on the other hand people in a capitalization process, who have sold their oxen and purchased a *koyoun* (motor cultivator). Some families have three to four oxen and rent them to other people to plough (60 000 riel/ha) and harrow (20 000 riel/ha) their fields and even for transportation. But owners of draft-oxen rarely rent them more than 2 or 3 times per year, because they have to do the work themselves and it takes too much time.

- **The organic manure produced by cattle is very important for the farmers**, as it makes up an important part of the fertilisation of rainfed lands, particularly for the sowing area. Farmers collect dung in the shelter and on the daily stalling place and put in on a dung heap. Some farmers also place it into a hole dug behind their house.

- **Cattle husbandry also constitutes important savings** which can easily be mobilized in case of needs (mostly in case of disease, to pay hospital fees).

Moreover, most of the families breeding oxen also have some cows. **The cows are firstly bred for the renewal of the draft oxen team**. Indeed the Cambodian peoples do not consume the fresh milk. We did not meet any breeders who milked his cows. All the milk is left to the calves. The average number of cows per household is one to three, but some families (about 10 per villages) have more than 7 cows. These families have more manpower than the others to take care of the cattle. Most of the farmers interviewed told us that with more than 5 cows and oxen, it starts to be difficult to watch and feed them.

Cambodian cattle husbandry system is low intensive with little inputs, apart from manpower. When the flooding area is dry, from May to July-August, the animals graze all day long in this area. Most of the time, the herders consist of one or two children from family. Out of this period, the animals stay next to the house because all the fields are occupied (by water in the flooded area and rice crops in the lowland plots). At this period, they receive dry rice straws from the family rice production, and green grass daily cut along the road, the plot bounders and in the fields, by one member of the family. This last point is the most restrictive, as quoted by almost all the herders, as it is very difficult to find enough grass every day, particularly at the end of the wet season.

Some herders are leading their flock in the lowland area after the wet season harvest, but there is not much to graze, since all the farmers cut the rice straws for their own consumption (for their own flock feeding or to burn in their field). During the night, the cattle are put into their shelter, most of the time situated under the houses built on piles. The shelter is usually closed with a mosquito net to protect animals from diseases passed on by mosquitoes.

The oxen are usually castrated. The cows can be covered naturally in the grazing area, by young bulls, or by hiring a breeding bull from another villager. The price of one covering is between 2 and 8 $ according to the bull breeds. The cows are calving for the first time at the age of 3 to 4 years. The interval between two calvings is one year and a half. The young calves are either sailed to merchants (middlemen from Phnom Penh or Vietnam) or local farmers (from 170 to 240 $ for one 3 years old bullocks, from 190 to 360$ for one three years old heifer) or kept for the renewal of the flock. **(**Cf. diagram of demographic functioning annex 7**)**.

The cows are scrapped at the age of 10, after having calved 5 to 6 times. The old cows and oxen are sold at the age of ten to slaughterhouses (middlemen come in the villages). The prices vary from 140$ for one reformed cow to 280$ for one ox.

The owning of one or more cows can also provide a secondary income thanks to the sale of heifers or bull calves:

To illustrate the added value of this activity, we are going to present the example of economical results of one farmer holding two draft oxen and one cow. To see the sketch of demographic functioning of the flock, please see in Annex.

Calculation of the gross income:

-Number of heifer sold at the age of 2 years: 0.11 per year
-price of sale = 1 000 000 riel
- Number of bull calves sold at the age of 3 years: 0.07 per year
- Price of sale = 800 000 riel
- Number of old cows sold to the slaughterhouse at the age of 11 years: 0.14 per year
- Price of sale = 600 000 riel
- Number of old oxen sold to the slaughterhouse at the age of 3 years: 0.28 per year
- Price of sale = 600 000 riel

In addition to these incomes, we have to notice the importance of the additional benefits of the field work of the draft oxen and the production of organic manure.
The cost for renting draft oxen for ploughing (1 time) and harrowing (2 times) one hectare is 150 000 riel. The farmer have to plough and harrow his field (4 hectares in one year), so his draft oxen allow him to save up 600 000 riel.
We manage to asses neither the quantity of organic manure produced by this flock nor the economic value of this organic manure.

→ Total gross income = 1 018 000 riel = 245 US$

The cattle is feed only by grazing, with green grass cut from the fields and rice straws which are not used for other activity and are not sold. Feeding activity is costly in manpower so we should count the opportunity cost of manpower:
- 1 person every full day during 3 months and a half for grazing (often a child or old people)
- 1 hour every morning the rest of the year to cut grass.
Nevertheless, as the labour is most of the time done by children or old people we are not able to do other paid activity we did not count it in our calculation.

→ Added value = 245 US$

Box N° 2: Example of added value obtained with cattle husbandry system

2) Buffaloes husbandry

Several families living in the villages along the flooded area (O'Po and Kbal Por) are breeding buffaloes instead of cattle. The use and the flock management are quite the same, except that the buffalo's females can be used as draft animal just as well as males are. But it is difficult to breed them far from the flooded area as they request to stay in water part of the day, particularly during the dry season. The sales price is also a little bit different (240 $ for a 3 years old female and around 200$ for a 3 years old male). The interval between two calvings is also different. It is not often that buffalo females calve more than 1 time in three year**. (**Cf. diagram of demographic functioning, Annex N°7**)**

3) Pig farming

The pig farming allows a good development of the rice sub-products. The pig farming is particularly dynamic in Cambodia and the national livestock has exceeded 2.5 millions in 1998, that is to say 1.6 pigs per household. (Pillot, forthcoming)

More and more families are rearing pigs in our study area. Most of the families start by purchasing one or two piglets from their neighbours for fattening. If they get good results, they will try again and increase the number of pigs. Nevertheless, several farmers told us that they tried once or twice but the pigs got sick or died and they stopped this production. Some families (around 20 per village) are rearing big pig herds (more than 10 animals). They are mostly families with enough manpower to take care of the animals, and sufficient financial resources, as the food requests important expenditures.

In fact, there are two pigs' management systems which can be combined into a same unit of production:

Borning system

One household can keep one to three sows for the reproduction. Sows are purchased at the age of 6 months and reach the maturity at the age of 7 to 8 months. At it first drop, one sow gives 5 to 6 piglets. This number will increase with the age of the sow, up to 10 or 12 piglets per drop. One sow can give birth two times a year. The piglets are sold at the age of 1 month and a half, barely weaned, to other villagers or to middleman who will sell them in Takeo or Phnom Penh. The sales price varies from 12 to 30 $ per piglet, according to the breed and the weight.

The feeding practices are variable. The majority of the farmers interviewed feed their sows with rice soup (around 1.5 to 2 kg of milled rice per sow per day), bran (around 2 kg per day) and water bindweed. Rice and bran come from the surpluses, if any, of the on-farm production, or are purchased from the rice miller or at markets The water bindweed grows in almost any pond, river or channel during the wet season. Several farmers are "cropping" it in their family pond, behind their house, or even in the irrigation channels during the late wet season. Some breeders prefer to purchase it from other villagers (about 100 riel per armful).

Sows are usually sold at the age of 3 years (with an average weight of 100 kg), for their meat, at the price of 70 to 100 US$ riel per hundred kg alive.

Several farmers are also keeping one boar in order to hire out its services. One covering has to be paid from 2.5 to 3 $, according to the breed of the boar. The feeding practices are the same than for the sow (same aliments, same quantities). Just like the sow, the boar reaches its sexual maturity at the age of 7 months and is usually sold at the age of 3 with a weight of about 100 kg.

Fattening system

Pig breeders purchase 1 month old piglets from other villagers who breed sows (15$ to 30$ per piglet), mostly just after selling other 5 month old pigs or his rice harvest. The average number of piglets per family is two. But this number is likely to increase as the technical performances of the breeders improve.

The piglets can roam free around the houses, or be attached close to the house or be installed in small shelter constructed by the farmer. The feed intake is composed of rice soup (about 0,5 kg per piglet per day), bran (about 0,5 kg) and water bindweed. Several farmers interviewed told us they never have to purchase rice for their pigs: they only use the on-farm rice production. Some farmers start to use special fattening food they purchase in Takeo or in the small shops installed in the villages. One to three bags of 50 kg (about 20$ per bag) are used for one fattening cycle of 5 piglets, by being mixed with the usual feed intake.

Usually the fattening cycle is stopped when the pigs reached the weight of 100 kg. Then the pigs are sold to other villagers or merchants coming in the village or directly in the Takeo market. The performances of these fattening systems are variable, according to the feed intake and the health care provided. Some piglets can reach 90 kg at the age of 6 months, although other will reach only 50 kg at the same age. In several cases, farmers will not finish the fattening cycle and will sell their piglets at the weight of 40 or 50 kg, because they need cash.

The profitability of this activity can be questioned. Indeed, the gross income does not always allow to cover the intermediate expenses, as the expenditures for the food are particularly high:

To illustrate the added value of this activity, we are going to present the economical results of one farmer fattening two piglets:

Calculation of the gross income:

- Age and weight at the sale time: 5 months, 50kg per piglet
- Price of sale = 4000 riel/ kg

→ Gross Income = 400 000 riel = 96 $

Calculation of the intermediate expenses:

- Price of purchase = 22$ per 1 month year old piglet
→ Expenditures for piglets purchase = 44$
- Q of food = 0.5 kg milled rice (IR66) + 2 kg barn + water bindweed every day for the two piglets
Price of rice = 1000 riel/kg; price of barn = 600 riel/kg; water bindweed from family pond → Expenditures for food= 204 000 riel = 50$
- Expenditures for medicine = 10 000 riel = 2.5$

→ Intermediate expenses for fattening two piglets during 4 months = 96.5$

→ Added value = -0,5 $!!!

Box N°3: Example of calculation of a piglet fattening system

In the absolute, the added value of this fattening system is negative. But most of the time, the farmers do not purchase the rice: they are using the on-farm production. In

that sense, **the fattening of pigs may be seen as a method of valorisation of the rice product**: instead of sailing his rice at the price of 450 riel per kg, that is to say less than half the price of the milled rice at the market, they prefer to feed pigs with this rice. This way, the expenditures for food go down to 43$ and the added value becomes positive.

Furthermore, **even it is not necessarily profitable in terms of benefits, the fattening of pigs constitutes a way to save money which can be mobilized easily** in case someone from the family falls sick or to pay one part of the rice cropping expenses. Pigs' dung may also be used as organic manure by farmers. Pigs dung is usually put on the cattle dung heap. We did not manage to evaluate the quantity of organic manure produced by pigs.

Last, several farmers who fatten or bread pigs also carry out a rice distillery activity (see section 2.4.4.7)). The rice must be used to feed pigs. This practice has a double interest for the farmer: it allows to increase the value of the milled rice (used a first time for distilling and a second time to feed pigs) and to provide better food for pigs.

4) Poultry holding

The majority of the rural households are holding some poultries. This is generally small scale extensive systems: villagers own five to ten chickens and ducks which are roaming free around the house and do not get any special care, except some seeds. As the economic impact of this activity did not seem to have a significant impact on the household, we did not interview farmers on this point.

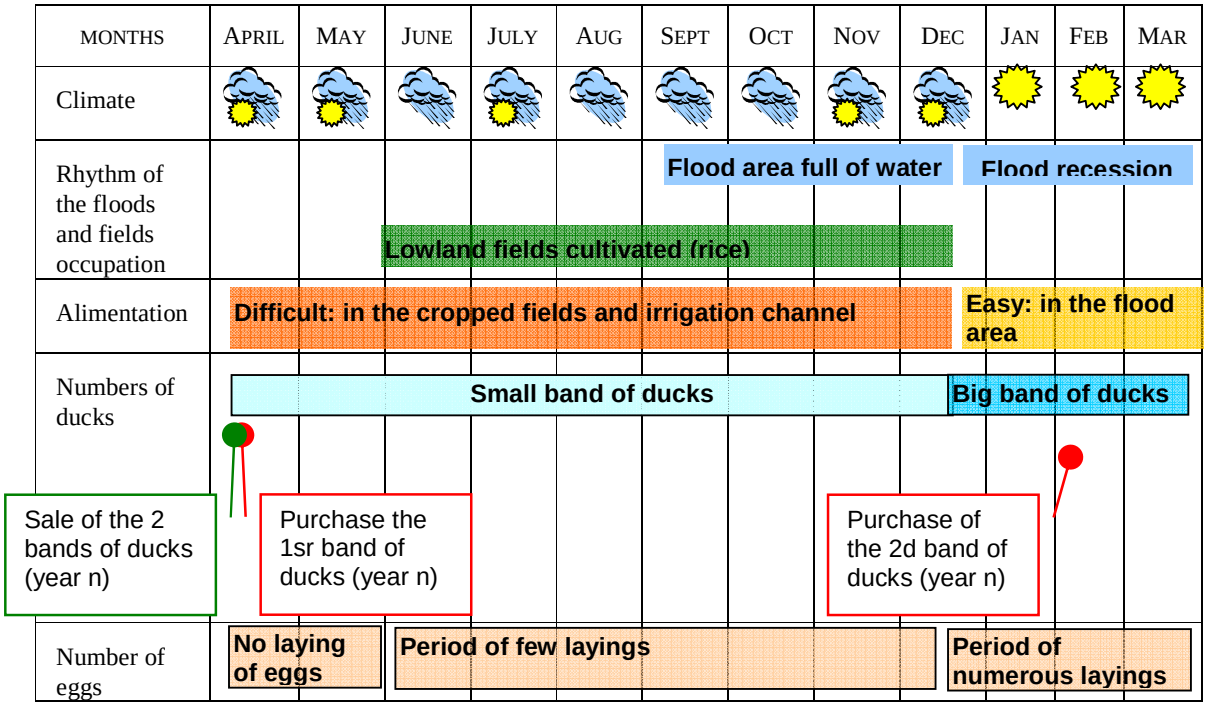
Nevertheless, some farmers from the area have implemented bigger and more specialized poultry rearing, mostly with ducks. We did not meet any farmers rearing more than 10 chickens, as it seems that chickens are suffering and dying from too many diseases.

5) Ducks rearing

The ducks are essentially reared for the production of duck eggs. These eggs are particularly popular in Cambodia, more than hens' eggs. Cambodian people are very fond of "embryonic eggs" produced with duck eggs. We have to add that Takeo is one of the Cambodian Province where rearing of ducks is the most developed.

Five to ten families per village are rearing ducks, with bands of 200 to 600 ducks. This activity mobilizes a lot of manpower, as one person has to drive and take care of the animals all day long, the whole year around.

This activity is governed by the rhythm of the floods and the rice cropping (cf. graph N° 2).



Graph N°2: Work calendar of a ducks rearing system

Indeed, the ducks do not find enough food in the cropped fields (they do not have access to the rice fields after rice earring) and in the lake while the water is deep. The best period is the flood recession. As a consequence, the breeder purchases a first small band (from 100 to 300 heads) of 2 to 4 months old ducklings in April. The ducklings are purchased from merchants from Takeo city, at the price of 1.2 $ per 4 months old duckling.

The ducklings are driven by the breeders in the irrigation channels and the fields during the day. They can “graze” in the rice fields, where they find insects, weeds and molluscs, until the earring. Every night they receive rice cooked by the breeder (around 50 kg of milled rice has to be cooked for a band of 300 ducklings). When the water level in the flood area starts to drop (in December-January), the breeder purchases a new band of ducks and double the size of his flock. The new ducks are usually purchased at the age of 6 to 8 months, at the price of 1.5 to 2 $ per duck. The total cooked rice intake is also doubled. From this time up to the end of the flood recession (April-May) the ducks are also fed in the lack. During this period the diet of the ducks is particularly rich.

The ducks start to lay eggs at the age of 6 months, if they get enough food. According to the breeders, with a band of 300 6 months old ducks , they get about 80 eggs per day. This number increase progressively up to 250 eggs per day. When breeders purchase an additional band of 300 ducks over 6 months old, the number of eggs laid each day increases to up to 350 eggs per day, thanks to the rise of the number of ducks, but also the improvement of their diet.

These eggs are collected by the breeders and sold to merchants coming regularly, every 3 or 4 days, from Takeo. Small amount of eggs are also sold to other villagers.

Prices of purchase vary from 6.5$ to 8.4$ a hundred. The higher prices are kept until November and decrease quickly after the start of the flood recession. At the end of a rearing cycle, in April, all the ducks are sold to merchants from Takeo, at the price of 6000 riel per head.

The ducklings are vaccinate at the time of purchase (2$ for 100 heads), but the breeders don't know for which disease they have been inoculated. They also provide them with some treatments, mostly against diarrhoea, that they incorporate into the food. Globally, we noticed that the breeders did not know clearly which medicine they were giving their animals. One of them told us that he was giving some treatment against intestinal parasites. When asked to show us the medicine he brought us a powder used for rehydration in case of diarrhoea. It proves the gap existing in the animals' health undertaking. Nevertheless, according to the breeders, the death rate is less than 5 %.

We did not manage to determine the added value of this rearing system. Indeed, the economical data provided by the 2 breeders surveyed did not allowed to obtain a reliable economic analysis. However, this kind of activity provides a regular income throughout the year. Nevertheless, this breeding system implies an important initial investment to purchase the first band of ducks (about 215$ for a band of 200 heads). Moreover, there is an important risk due to the numerous diseases which may affect the ducks. The breeders surveyed also complained about the risk of low rate of eggs laying. Indeed, because of diseases or diet problems, it may happen that the ducks do not lay enough eggs to cover the initial investment.

6) Fish breeding

Many households own one pond which has been dug behind their house. These ponds are traditionally used as drinking water for their animals, to crop water bindweeds and to breed fishes. In the majority of households, fishes are bred for the family's own consumption: they purchase small amounts of small fish at the start of the rainy season, feed them with the left-over rice and bran and eat them according to their needs.

Some villagers started more important and intensified fish breeding. These new fish breeders are essentially rice millers or "big" land owners (more than 3 ha) which can feed their fishes with big amounts of bran.

We did not carry out detailed interviews on these systems and are unable to be more specific regarding their economical performance. But their numbers seem to increase, most probably to face the decline in fishing in the flooded area.

2.4.4 The off-farm activities

The villagers from our study area can also practice several off-farm activities:

1) Factory workers

Many people are leaving the area occasionally to look for a job in the factories, mainly textile factories, located in the south of Phnom Penh. These are mostly young people from families owning small land or in need of cash (to purchase chemicals, pay hired manpower, etc.). According to the local authorities, it concerns about 30 people per village. This kind of "migration" is well organized as cars or trucks are driving regularly back and forth between the village and the factory area. Factory workers can

earn up to 70 $ per month. They are often staying with a relative or a friend living in Phnom Penh. Nevertheless, this kind of job is risky, in the sense that it is difficult to get monthly contracts. Workers often get only weekly contracts and are never sure they will keep the job and earn 70 $ per month. Moreover, they have more expenses than those who stay in villages (at least for transportation: 10$ for around-trip journey).

2) Daily Farm workers

Several villagers are working as farm workers for other villagers, mostly for pulling out, transplanting and harvesting. The farm work is paid daily. The price for one day of work depends on the activity and the farmers. Farmers who need labour force ask their relatives and friends first in the early morning and, if they need more people, go around the village to offer work to other villagers.

Some farmers are providing some food to the workers and pay 1000 riel less than without food. Some jobs (particularly pulling out) are paid by the piece. The prices for the year 2005 were:

Pulling out	2000 riel/40 bundles of seedlings
Transplanting	5000 riel/day with food 6000 riel/day without food
Harvesting	5000 riel/day with food 6000 riel/day without food
Transportation	7000 riel/day
Threshing	9000 riel/day

Table N° 5: payment for the different farm work in 2005

The payment asked for this kind of work increases every year (in 2004 the payment for harvesting and transplanting was 5000 riel per day without food).

Many farmers (about 60% of the people interviewed) are working as daily agricultural labourer in order to increase the family income or to finance inputs for rice cropping. They are hiring their labour force when work in their fields is done. But this activity seems to be occasional: one farmer told us "*I do not work more than 10 days for each cropping cycle*". Some other people (about 10% of the people interviewed) who do not own land or not enough land to ensure food-security, have to work as often as possible in order to finance their agricultural inputs and even to purchase rice to feed their family Even by working every day, farm work hardly allows to earn more than 30$ a month.

3) Horse transportation

Some farmers (about 4 per village) are working as horse-cart drivers. They have to purchase one cart with pneumatic tires (60 000 riel) and one small horse (about 1 000 000 riel). One horse may work 3 to 5 years but most of the drivers prefer to

change every year (he loses 10 000 to 20 000 riel each time). Indeed, horses are suffering from this hard work. They are fed with rice soup, bran and banana trees.

Horse drivers are transporting goods and people between villages and Takeo city. They are doing the trip twice a day. Some of them stop their activities to do the main field work (ploughing, transplanting, harvesting, etc.). This work is only practiced by men. We did not get enough reliable information to asses the economical results of this activity.

4) Fishery

This activity, which was widespread and constituted part of the family's income for several villagers a decade ago, suffers currently from a strong decline. Fishing in the flood area hardly allows to feed a family. Few fishers are still selling their catch to other villagers. According to them, fishing is often risky in the sense that they are never sure to get a good catch to cover the fuel expenses. Even the ones qualified as the "best fishermen in the area" were not able to earn more than 100$ per year.

5) Small shopkeepers

There are numerous small shopkeepers in each village (about 10 to 20 per village). They sell bare necessities, fuel, and sometimes chemicals products and medicines.

There are also many villagers who sell some products (fish, water lily, vegetables, bindweed, etc) more or less regularly. These products can come from their own production (for example a small plot of gourd behind the house, duck or hen eggs, home made cakes), their picking (water lily, bind weed) or their catch (fish). These kind of products may be sold daily, by those who are in need of cash (particularly landless people or people who do not own enough land) to ensure rice for the family's consumption. Other people sell it in case of punctual need of cash (for example to pay manpower or inputs for rice). The economical impact on these small business activities has not been assessed.

6) Rice factories

There are three rice factories in the irrigation scheme area. They started their activity during the nineties. Currently they are working with regular customers from Provinces of Kompong Speu, Kampot and from Phnom Penh. They also sell part of their production to Vietnamese middlemen.

It was difficult to collect data from rice millers concerning the prices and quantity of rice they are dealing with every year. Nevertheless the one qualified by villagers as the "bigger rice miller of the commune" told us that he sells from 800 to 1500 tons of milled rice per year. As much as possible, they collect paddy from farmers of the district, but they sometimes purchase rice from other provinces'middlemen. Farmers from the Traeng district can deliver their production themselves directly to the rice miller, if they have access to means of transport. They can also sell it to the rice millers' trucks which go around the villages purchase their production. When a farmer sells his production to the trucks, he receives 20 riel less per kg than those who deliver it themselves to rice millers.

Rice millers purchase paddy rice and sell mostly milled rice to their customers. Vietnamese customers also purchase rice, bran and husk.

The products obtained by milling one ton of rice are:

PRODUCTS OBTAINED	*RED RICE*	SALE PRICE (OCTOBER 2005)	IR 66	SALE PRICE (OCTOBER 2005)
Milled rice ("white" rice)	640 kg	1 100 riel/kg	600 kg	980 riel/kg
Bran	100 kg	600 riel/kg	150 kg	600 riel/kg
Husk	200 kg	~50 riel/kg	200 kg	~50 riel/kg
Broken rice	60 kg	800 riel/kg	50 kg	800 riel/kg

Table N° 6: products obtained by milling one ton of paddy sales price of these products on market

As shown by this table, bran represents an important by-product of rice milling, which has a high economic value. In the past, rice millers were used to sell bran to farmers: when they sold their production, they had to pay 400 riel per kg bran to get it back. Currently, rice millers told us that they do not sell bran to farmers: those who sell paddy to them do not ask for the bran. When they want to use the bran of their production farmers hire the service of villagers who own a small "rice-mill".

Moreover, the three rice millers from our study started to diversify their activity. All of them are fattening pigs or breeding fish. They feed their animals with a high quantity of their bran production. Two of them have also a small business in their village where they sell bare necessities, fuel, chemicals products and medicines.

One of them told us that many people borrow small amounts of cash (about 100 000 riel) from him. These small loans have to be pay off after 4 months, most of the time by rice: the 100 000 riel are paid off by rice at the market sale price (for example 450 riel per kg of paddy) and 100 kg have to be given for interest (that represents an amount of 45 000 riel for a loan of 100 000 riel). But he told us that he reduced this activity and currently borrows only to faithful farmers (those who sell their production to him every year).

7) Small distillery of rice alcohol

Some farmers (we did not get the number of farmers distilling) distil rice into alcohol. This practice constitutes a good way to increase the value of rice milling by-products. 25 kg of milled rice (mixture of red rice and IR) mixed with one kg of yeast allow to produce 30 L of alcohol. For heating the rice, they use rice husk (about 3 bags for 25 kg of rice; one bag cost about 300 riel). The rice wort ("moût de riz") obtained (3 buckets) can be used to feed pigs (according to the farmer interviewed, the rice wort obtained with 25 kg or milled rice allows him to feed 6 piglets during 3 days). The rice alcohol produced is sold to other villagers or to middlemen from Takeo or other cities.

To illustrate the added value of this activity, we are going to present the economical results of one farmer distilling 25 kg of milled rice every two days:

Calculation of the gross income:

- Number of litres of alcohol produced: 30 L/day; 5475L/year
- Price of sale = 900 riel/L

Moreover, the rice wort is used to feed the pigs and replace the milled rice traditionally given to pigs. As the three buckets obtained allow to feed 6 piglets during 3 days and as the traditional milled rice intake is 0,5 kg/day/ 2 piglets we can add:

- Equivalent in milled rice per year = 365 kg/year
- Price for one kg of milled rice = 1000 riel

→ Gross Income = 1275 $/year

Calculation of the intermediate expenses:

- Quantity of milled rice = 25 kg/day = 4562 kg/year
- Price of milled rice = 1000 riel/kg
→ Expenditures for milled rice purchase = 1099$
- Quantity of rice husk = 3 bags/day = 550/year
- Price of rice husk = 300 riel/bag
→ Expenditures for rice husk = 40$
- Quantity of yeast = 1 kg/day = 182 kg/year
- Price of yeast = 2 500 riel/kg
→ Expenditures for yeast = 109$

→ Intermediate expenses = 1248$

→ Added value = 27$/year

Box N° 4: Example of added value obtained by a small distillery of rice alcohol

The economical added value obtained is small. Nevertheless this activity is interesting for the household as it provides a good way of valorisation of the milled rice produced on the farm. It also allows to get small amount of cash through the year and provides a better feeding for pigs than traditional milled rice.

8) Hire of agricultural equipment

Some farmers have invested in the purchase of agricultural equipment such as *koyoun,* husking machine or threshing machine, which they rent to other farmers from the area.

The "husking engine" has been present in the area for at least a decade. About 10% of the households own one. The purchase price for a new one is about 800 $. One farmer explain to us his milling business: "*I mill rice particularly for my relatives and neighbours. By milling 50 kg of paddy, one gets 4 buckets of milled rice and 10 kg of bran. If people want to take bran, they have to pay 300 riel per bucket. But if they(let) (leave?) it to me, they do not have to pay. Most of the people prefer to(let) me the bran instead of paying."* These small-scale rice millers often keep bran and husk and can use it for fattening pigs or producing rice alcohol.

In the last few years, new agricultural equipment has been purchased by farmers to hire it to other farmers: the thresher. Currently, 5 or 6 farmers per village own a thresher. The purchase cost for a small new one is about 1700 $.

We did not collect enough data regarding these businesses to assess the income they can provide to households practicing them. Nevertheless you want to stress on the importance of these off-farm activities. **Almost all the farmers from our study area practice one or several activities in addition to rice cultivation**, whatever their land or manpower. These activities have several goals, **but for most of the farmers surveyed they are practiced, at least partly, to finance inputs for rice cropping**.

2.5 ECONOMICAL ANALYSIS

This part aims at determining the economical interest of the studied irrigation system for the water users. First, we will compare the economical results of the irrigated crops with the other rice copping systems carried out in the study area. Then we will assess the place of the irrigated crops in the household incomes of the water users.

2.5.1 Economical results of the different rice cropping systems

We did not observe any significant correlation between the farmers' means of production We did not observe any significant correlation between the farmers' means of production, the level of intensification of the cropping systems and their agro-economical results. Indeed, agro-economical results are influenced by many parameters which may interact with each other. We did not get enough data and time to carry out that kind of analysis. Nevertheless, we observed significant differences between the level of intensification and the economical results of the different rice cropping systems carried out in our study area. The analysis of these differences appeared to us as a good tool to assess the economical interest of the irrigation for the water users: is the level of intensification higher than for the other crops? What about the added value?

In order to answer these questions, we are now going to present the economical results obtained for one hectare of each rice cropping system.

2.5.1.1 rice prices

The prices of rice vary according to the variety and the period of sale.

On one hand the different varieties cropped in the study area did not get the same price. Indeed, the late maturity varieties (red rice) get most of the time, higher prices than early maturity varieties. Indeed in 2005, the price for red rice varied from 550 riel/kg in January up to 650 in October. For early maturity varieties prices vary from 450 riel/ha up to 600 riel/ha

On the other hand the price increases before the harvest, as the rice miller and middlemen start to ask for rice although there is no offer. Moreover many farmers do not have enough rice in reserve to feed their family up to the harvest and have to purchase milled rice. On the contrary, prices decrease suddenly after the harvest. Indeed, this year the price paid to farmers for their *red rice* paddy was expected to vary from 500 riel per hectare from July (price decreased after the harvest of IR66) to October up to 700 riel per hectare in November and December, before the harvest. The ability for farmers to wait a few months after harvest to sell their production allows them to increase the added value of their production.

It seems to us important to point out that there is no farmers' organisation for selling rice. Indeed each farmer trades his production individually, directly with rice millers or with middlemen. However, a farmers' organisation would allow to have a stronger position to discuss the prices with rice millers and middlemen.

2.5.1.2 Work opportunity cost

In the following part, we are going to present the economical results of the rice systems. In that sense we will have to calculate the expenses, including the payment of manpower. We counted the daily payment of the family manpower in the same way than for the hired manpower. Indeed, we assessed the work opportunity cost at about **5500 riel/day**, the same amount than the usual daily payment for farm work.

We counted that factory work hardly allowed to earn more than 40$/per month, that means 5 500 riel/day. Nevertheless, this assessment has to be used carefully as the added value of several on-farm and off-farm activities have not been determined.

2.5.1.3 Comparison of the economical results of the different rice cultivation systems

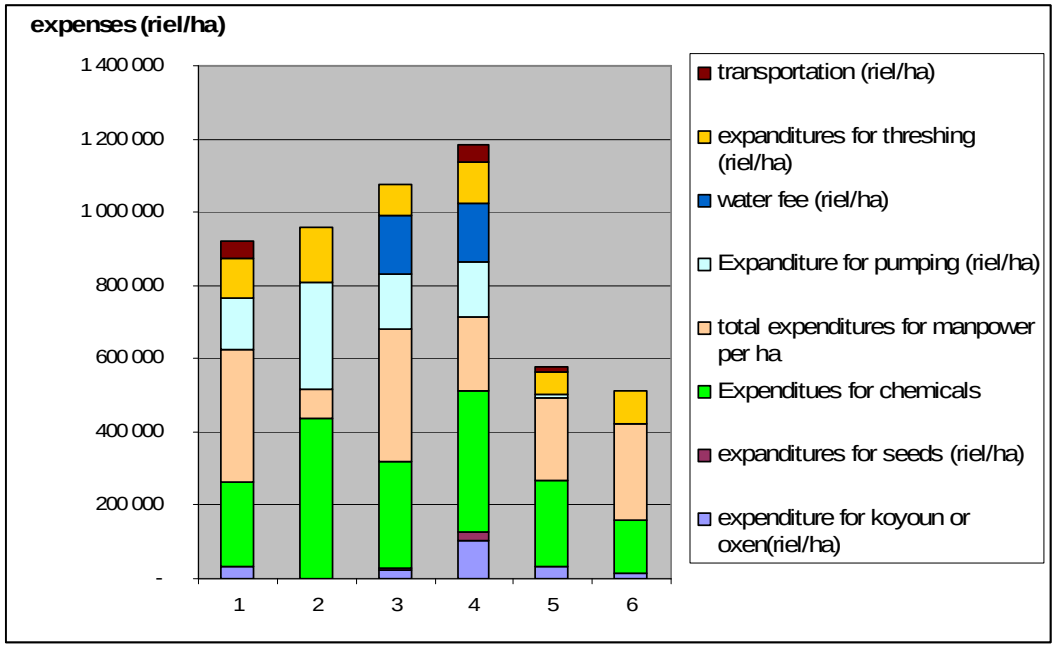
This table has been realized from the data collected during our individual interviews. We used 10 interviews for flood recession rice with transplanting, 4 for flood recession rice with broadcasting, 17 for early wet season rice with transplanting, 4 for early wet season rice with broadcasting, 14 for late wet season rice and 9 for rainfed rice.

These data have to be used carefully. Indeed, the average amounts are presented here to **illustrate the strong tendencies which characterize the systems in order to compare each other**. Nevertheless, we have to keep in mind that they are only averages and that the real practices and results for each cropping system presented here vary a lot. Moreover, we did not have time to survey more than 4 people for broadcasted fields. This small number reduces the relevance of the data concerning this system.

AVERAGE (STANDARD DEVIATION)	FLOOD RECESSION RICE (2005)		EARLY WET SEASON RICE (2005)		LATE WET SEASON RICE (2004)	RAINFED RICE (2005)
	TRANSPLANTING (1)	BROADCASTING (2)	TRANSPLANTING (3)	BROADCASTING (4)	TRANSPLANTING (5)	TRANSPLANTING (6)
rice varieties	IR66	IR66	IR66	IR66	red rice	red rice
INTERMEDIATE EXPENDITURES						
total expenditure for *koyoun* or oxen(riel/ha)	33 750	-	23 375 *(65 286)*	105 588 *(99 643)*	30 615	13 333,33 *(40 000)*
expenditures for seeds (riel/ha)	-	-	5 496 *(9520)*	22 916 *(9520)*	-	-
Expenditures for chemical fertilizer (riel/ha)	204 433	323 229 *(82 176)*	262 295 *(94 471)*	364 056 *(163 230)*	220 448	145 042 *(79 900)*
expenditures for weed killer (riels/ha)	9 722	71 500 *(88 218)*	5 155 *(13 641)*	8 750 *(8196)*	11 551	-
Expenditures other chemicals (riels/ha)	15 071	43 167 *(51165)*	22 245 *(20 646)*	10 000	5 667	-
Expenditure for pulling seedling out manpower (riel/ha)	18 452	-	84 444 *(36 755)*	-	-	-
total expenditures for transplanting(riel/ha)	199 429	-	159 528 *(48 529)*		92 231	135 943 *(44 630)*
total expenditures for harvest(riel/ha)	145 460	78 889 *(11 706)*	120 209 *(72 456)*	201 372 *(71 327)*	130 634	126 165 *(52 526)*
Expenditure for pumping (riel/ha)	**140 845**	**290 000 *(88 057)***	**148 597 *(150 712)***	**151 952 *(130 599)***	**13 200**	**-**
water fee (riel/ha)	**-**	**-**	**160 000**	**160 000**	**-**	**-**
Expenditures for threshing (riel/ha)	108 185	151 375	83 789 *(47 353)*	110 340 *(46 329)*	59 405	90 096 *(32 900)*
transportation (riel/ha)	45 048			49 722	14 000	
INTERMADIATE EXPENSES (riel/ha)	920 395	958 160 *(144 595)*	1 075 134 *(258 516)*	1 184 699	577 752	510 580
INTERMADIATE EXPENSES ($/ha)	**222**	**231**	**259**	**285**	**139**	**123**
GROSS INCOME						
Paddy yield (kg/ha)	4 462	5 167 *(2 323)*	4 155 *(1094)*	4 413 *(1853)*	3 091	2 890 *(580)*
sale price (riel/kg)	479	458 *(15)*	528 *(27)*	522 *(15)*	600	600
Gross income (riel/ha)	2 135 067	2 363 750	2 193 840	2 303 586	1 854 600	1 734 000
Added value (riel)	1 214 672	1 405 590 *(608 225)*	1 118 706	1 118 887	1 276 848	1 223 419
Added value ($)	**325**	**339 *(147)***	**270 *(149)***	**270 *(196)***	**308**	**295 *(62)***

Table N° 7: comparison of the economical results of the different rice cropping systems (to get the individual results of the water users interviewed, please see in Annex 8 to 13)

2.5.1.3.1 Intermediate expenses and level of intensification



Graph N°3: Comparison of the expenses for the different rice cropping systems (cf. annex 14 to get the detail)

The analysis of this graph provides us interesting information regarding the level of intensification of the different rice cultivation systems. First, we can see that the early wet season rice crops are the more intensive ones: the total expenses are double than the expenditures for late wet season and rainfed rice, but they stay close to those done for flood recession rice. Moreover, we can observe the same tendency for early wet season and flood recession rice: the expenses for labour force are two times less with broadcasting than with transplanting. On the contrary, the expenses for chemicals are higher for broadcasted fields.

Interesting information provided by this graph concerns the expenses for water that we are going to resume in the following table:

	FLOOD RECESSION RICE (RANSPLANTING (1)	FLOOD RECESSION RICE BROADCASTING (2)	EARLY WET SEASON RICE TRANSPLANTING (3)	EARLY WET SEASON RICE BROADCASTING (4)	LATE WET SEASON RICE (5)	RAINFED RICE TRANSPLANTING (6)
% of total expenditures allocated to the purchase of fuel	15%	30%	14%	13%	2%	0
% of total expenditures allocated to the water fee	0	0	15%	14%	?	0
% of total expenditures allocated to irrigation	15%	30%	29%	17%	?	0

Table N° 8: Percentage of expenses allocated to irrigation in the different rice cropping system

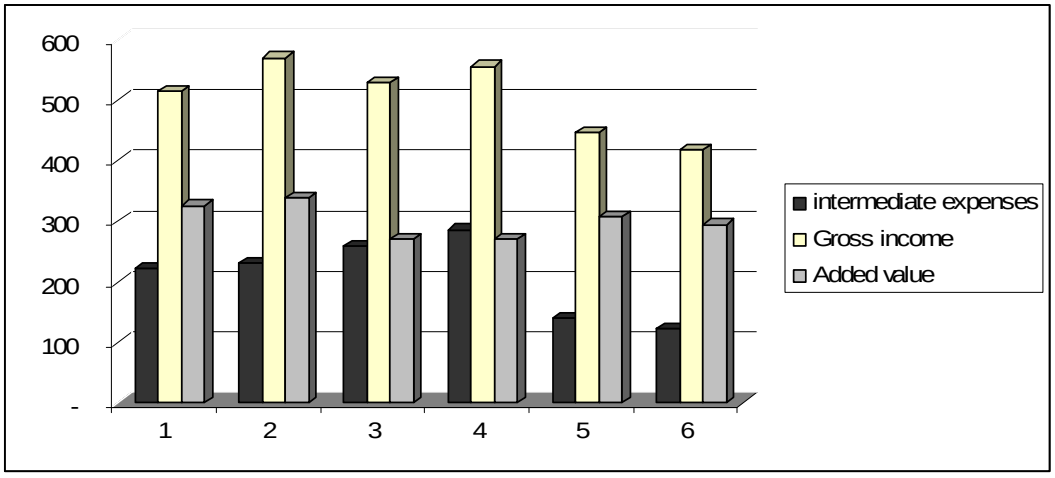
Farmers from our study area spend money for water in two cropping systems: flood recession rice and early wet season rice. For flood recession rice, the expenditures

for the fuel represent (around 50$ per hectare) a quarter to a third of the total expenditures for this cropping system with transplanting. For early wet season, the water expenses are divided between the water fee and the fuel for individual pumping. The cost in fuel is about 100 000 riel (36$) for one hectare, which is close to double the price of irrigation, as the water fee is 160 000 riel (33$). The expenditures for irrigation (water fee + fuel) represent a little bit more than a quarter of the total expenses for this crop. These irrigation expenses represent between a third and a half of the total expenses realized for the traditional rainfed rice cropping. **Farmers spend as much money for irrigation in flood recession rice as in early wet season rice**. This may be a positive point for the payment of the irrigation scheme water fee. Indeed farmers are already used to spend money to purchase fuel for flood recession rice. **This "habit" may allow them to understand and agree with the payment of the water fee**.

According to the data presented here, the broadcasted fields consume as much water as the transplanted ones during the early wet season. Nevertheless, several farmers told us that they used less water since they broadcasted. Indeed farmers consume high quantities of water at the transplanting time. These assumptions are confirmed by the observations and studies done in many irrigation systems: broadcasted fields usually request less irrigation water than transplanted ones. These contradictions may be explained by the small number of interviews carried out for broadcasted fields. The farmers interviewed may have underestimated their expenses or their fields may be distant from the channels which increase the pumping cost.

As explained before, some farmers received water from the pumping station to irrigate their fields during the late wet season 2004. It would have been interesting to analyse the impact of this supplementary irrigation on the agro-economical results of water users. Nevertheless, the allocation of water and the water fee payment for this late wet season irrigation are causes of tension between the users and the contractor As a consequence we did not manage to get reliable information concerning the economical impact of this irrigation.

2.5.1.3.2 Economical results

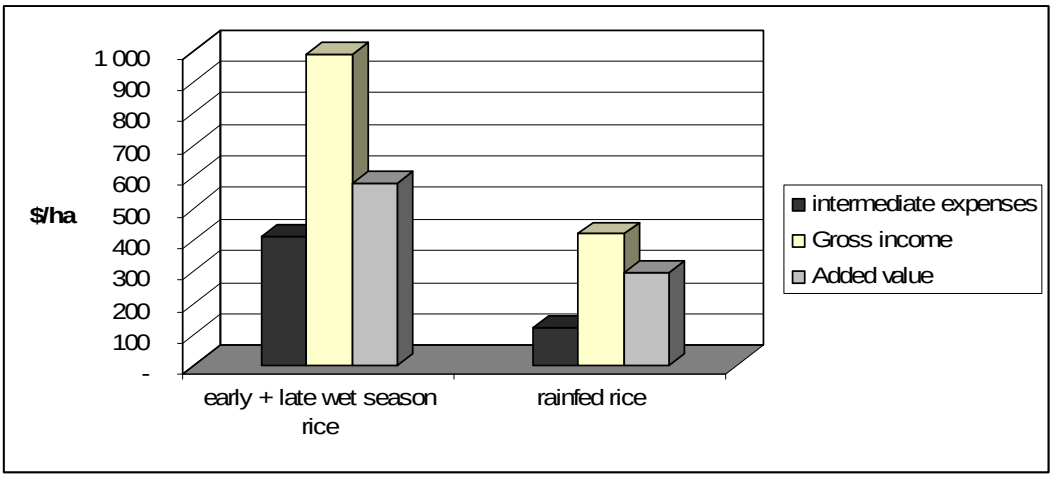


Graph N° 4: comparison of the economical results of the different rice cropping systems

First we can notice that added values of flood recession systems are the highest ones, and those of early wet season the smallest ones. Nevertheless there are no strong

differences between the added values obtained for the different cropping systems which go from 270 to 339 $/ha.

Moreover, the irrigation allows to produce two rice crops during the wet season rice. Nevertheless, the implementation of this new cropping system is subject to conditions. Indeed, to go from one (rainfed rice) to two rice crops (early and late wet season rice) implies that the farmers are able to spend enough time and inputs. The two rice crops imply to spend three times more money than for traditional rainfed rice. It may be difficult for those who have to practice off-farm activities (particularly for the daily worker) and those who have debts.



Graph N°5: Comparison between the economical results of the succession of "irrigated"[22] crops and the rainfed rice

The average addition of early and late wet season added values represents more than double the ones of rainfed rice (about 580 $ instead of 295). In sum, the practice of of two crops on the irrigation scheme is expensive, but it allows to significantly increase the family incomes.

Moreover, the possibility to get irrigation water or not for the late wet season rice does not seem to influence the choice of doing two crops instead of one. As several farmers told us "*late wet season rice is cropped almost at the same time than traditional rice, it does not increase the risk of rain water shortage at the end of the cycle*". As explained before, we did not get further information, regarding the impact of the possibility of irrigating or not late wet season rice on the farmers' practices and results.

Last, we want to stress out that almost all the farmers who own plots in the irrigation scheme command area are cropping rice two times during the wet season. Those who are cropping only rainfed rice told us that it was only because their plots were "*too far away from the channels, more than 200 meters"*. Only two people told us that it was both because their plots were too far away and because it was too expensive.

[22] By "irrigated" crops we mean the succession of early and late wet season rice which is carried out by the irrigation scheme users

Summary

This part allowed us to demonstrate the economical interest of irrigated crops, which allows to double the added value obtained with rice cropping during the wet season. Now we are going to evaluate the impact of these crops on the household's incomes.

2.5.2 Place of Irrigated crops in the households income

First, it seems important to mention **that the family income of the farmers from our study area is higher than in other parts of Cambodia**. This higher level of income is allowed by the association of the several assets the farmers have at their disposal:

- Farmers owned globally more than one hectare divided between the flood and the rainfed areas. They can crop at least two crops per year and get higher yield than the country average. For the same land area they can produce more rice than other farmers and can produce surpluses easier;
- Farmers have high technical skills ;
- Farmers carry out animal husbandry and off-farm activities. In addition to the sale of the eventual rice surplus, these activities allow them to have financial capacities to purchase inputs;
- Thanks to theses assets, farmers get a high level of intensification which allows them to benefit from natural increase against the yields ;
- Farmers also benefit from the proximity and the dynamism of Vietnamese markets. This proximity provides them a market to sale their production, but also to purchase inputs, often earlier and at lower price than Cambodian products.

All these assets allow farmers from the study area to produce more rice and to get easier surpluses they can sell. Indeed, according to Pillot (forthcoming), *"One family of five people consumes about 800 kg of milled rice[23] every year. As a consequence, they have to get, on 0.5 hectare of rice field, a yield of 1.7 T/ha to get enough rice for the family consumption."* Farmers from the study area, who get more than 2T/ ha for rainfed rice and about 4 T/ha for other systems can get surplus as soon as they have more then 30 are in the flood recession area.

The economical impact of the irrigated crops on the family income depends particularly on the other activities carried out by the family, its means of production and the level of intensification of the crops. As a consequence, in order to give a better representation of this economical impact we choose to base our analyses on the presentation of the different categories of household we identified. Our collective and individual interviews/meetings, but also our daily observations in the villages, allowed us to define a typology, based on the land resources and the activities (on- and off-farm) carried out in the study area as follow:

- Landless people
- Small-sized land owner

[23] We consider that 1 tonne of paddy provides 60 kg of milled rice : 800 kh of milled rice means 1280 kg of paddy

- Medium-sized land owners
- Large-sized land owners

We did not collect enough data to carry out a statistic analysis of the economical results of these households. As a consequence, for each category, we are going to base our reflexion on one example to evaluate the place of irrigated crops in the income of the households. Furthermore for calculating added value, we counted all the rice production obtained, without differentiate the part used for on-farm consumption and the one which is sold. Yet the late wet season rice and the rainfed rice are mostly kept for family own-consumption, while flood recession rice and early wet season rice are sold as soon as the household get surpluses. The following analysis will also aim at defining the orientation of the different crops (own-consumption or sale). In each case we choose one example we judged the more representative as possible of that category, according to the information collected during the interviews and daily field observation.

2.5.2.1 Landless people (4% of the villagers)[24]

About 5 to 10 families per village are landless or own very small-sized land (5 to 10 are). We surveyed 4 people from this category. According to the information collected, there are three explanations for this situation:

- Some people came back in the area after the period of land redistribution (1982) and did not get any arable land.

This is the case of one of the landless family we interviewed. To get money the husband works as a policeman in Takeo (the salary of a Cambodian policeman is about 30$ per month), one girl tried to find work in Phnom Penh but came back because she couldn't find a job. Their other children work as farm workers for other villagers, as often as possible. For the first time this year they purchased two piglets for fattening

- Some people coming from large families get very small land from inheritance when their parents' land has been divided.

Two of the "landless" surveyed were in this situation. We choose to call them "landless" as their arable land is far from allowing to ensure the family consumption in rice. One of them, an old widow leaves her 10 are as *provas* to another villager. He has to pay 250 kg of rice per rice cropping cycle. As her land is on the irrigation scheme, she can do two *provas* per year and get 500 kg of rice.

Another family, who owns 5 ares of arable land crops its field. They have to rent a *koyoun* to plough and harrow it. The rice produced does not cover half of family needs in rice. The husband repairs cycles in the village and works as a farm worker regularly. They also get one cow in *provas* from one of their friend.

- Half of the current landless that owned small-sized land before had to sell it to pay hospital fees for one family member.

It is the case of one family we interviewed. The two parents and their 8 young children do not own any land; they had to sell their 20 ares 10 years ago to pay hospital fees. Currently, the husband is working almost everyday as a farm worker (for transportation, transplanting, harvesting, threshing, etc.). Many times he had to ask for

[24] These percentages are given for information only, they come from our rough estimations, based on our field observations and the villagers' evidences.

an advance and earns only half of his salary (2500 riel instead 5000 riel for being paid in advance). His wife is doing small business, by cooking cakes or meats and selling them to other villagers.

For all these families, off-farm activities represent the main part of the family income. Irrigation may have an important impact for them by allowing to cover family needs in rice. Nevertheless, it may be difficult for them to finance the necessary inputs. One farmer owning 0,25 ha on the irrigation told us that he did not use irrigation water because its plot was too far and it was too costly for him.

Several members of this category would like to rent or purchase arable land, but according to them: "*there is no land for sale and there are very few people who rent their fields: only widows and old people. And they do not want to rent us their land because we do not have enough means of production so they find it too risky."* As a consequence, they try to diversify their activity thanks to animal husbandry and off-farm activities.

2.5.2.2 "Small-sized land owners" (about 40 percent of the villagers)

About 10 people from this category have been surveyed, through collective and individual interviews. They own about 0.5 hectares of arable land, in the flood area or the upland area or both. Their rice production often does not cover the family need in rice. Some of them sell part of their rice production to finance inputs, but it does not mean that they obtain rice surpluses: most of the time they have to sell rice because they are in need of cash, but they will have to purchase milled rice (at the market price) later for their own-consumption. Members of the family have to do off-farm activities to purchase rice for family-consumption but also to finance the inputs for rice cropping (manpower, fertilizers and other chemicals). The main off-farm activities are daily farm work or small business. Several families send one or two of their children to work in Phnom Penh factories. Some of them also may have an activity of animal husbandry. Two of the people surveyed bread a cow "given" in *provas* to them by relatives of friends. Several people purchased young piglets in order to fatten them. Most of the people from this category told us that it was often difficult for them to get food all the year.

To illustrate the place of irrigation in this category of household's income we are going to present the example of one family (Mom Sokiar[25]), composed of 4 people (one man, one woman and their 2 young children) who own:

- 0.5 ha in the flood recession area
- 0.23 ha in the irrigation scheme command area
- 1 cow
- 2 piglets
The husband works as a farm-labourer as often as possible (about 30 days per year)

[25] To get the detail of the expenses and results, please see annex N°

They do not own oxen but they borrow the koyoun from their father. We will only present here the total intermediate expenses and the added value of the different activities:

	INTERMEDIATE EXPENSES ($)	ADDED VALUE ($)	% OF THE FAMILY INCOME
Flood recession rice	*28*	*180 (1925 kg of paddy)*	*39,5%*
Early wet season rice	*86*	*66 (1265 kg of paddy)*	*14,5%*
Late wet season rice	*53*	*72 (950 kg of paddy)*	*16%*
Cow breading	*?*	*100*	*22%*
Daily farm work	*0*	*30 * 1.2=36*	*8%*
Total income		*454*	*100 %*

The added values of early and late wet season rice cover a third of the family income. *Moreover the double cropping allows to double the quantity of rice surpluses (about 2000 kg of paddy instead of 1000 kg if they were cropping only rainfed rice).*

2.5.2.3 "medium-sized land owners" (about 40 percent of the villagers)

Farmers from this category own about 1 to 2 hectares of arable land divided between the flood area, the irrigation scheme and the land out of the command area. Most of them obtain surpluses and are able to sell part of their rice production. Most of them carry out one or more animal husbandry activities. They own 2 draft oxen or buffaloes or one *koyoun*, 1 to 3 cows for the renewal of the draft oxen team or in order to sell calves. Many of them are also fattening several piglets every year and may distil rice. They may also work occasionally as daily workers for other farmers when they are in need of cash. Some of them own a "husking engine" or a Thresher.

To illustrate the place of irrigation in this category of household's income we are going to present the example of one family (Mr Tcheyn, Phum O'Po), composed of 5 people (3 adults and 2 young children) who owns:

- 1 ha in the flood recession area
- 0.5 ha in the irrigation scheme command area
- 0.5 ha which are not irrigated because they are "too far away"
- 2 cows and 2 draft oxen
2 adults work as farm-labourer as often as possible (about 60 days per year)

We will only present here the total intermediate expenses and the added value of the different activities:

	INTERMEDIATE EXPENSES ($)	ADDED VALUE ($)	% OF THE FAMILY INCOME
Flood recession rice (1ha)	*158*	*269 (3500 kg of paddy)*	*24%*
Early wet season rice (0.5ha)	*115*	*229 (2150 kg of paddy)*	*19.5%*
Late wet season rice (0.5ha)	*62*	*191 (1750 kg of paddy)*	*16.5%*
Rainfed rice (0.5ha)	*65*	*85 (1250 kg of paddy)*	*7%*
Cow breading (2 cows)	*?*	*317*	*27%*
Daily farm work	*0*	*60*1.2=72*	*6%*
Total income		*1163*	*100%*

***The double cropping represents 36% of the household income**. It allows to triple the quantity of rice produced during the wet season rice. These families keeps all the red rice production for their own consumption and sell all the early maturity rice.*

2.5.2.4 "big-sized land owners" (about 6 percent of the villagers)

Farmers from this category are in a process of capitalisation. Thanks to previous (or current) off-farm activity (such as policeman) or by selling animals, they managed to purchase new lands and own currently between 3 and 7 hectares of arable land. They also diversified their activities: they are all breading animals (cows or pigs or both) and purchased agricultural equipments (mostly *koyoun* and thresher) that they hire to other farmers. They have to hire a lot of labour force but never work as agricultural labour force for other farmers.

To illustrate the place of irrigation in this category of household income we are going to present the example of one family (Niep Piep, Phum O'Po), composed of 4 people (2 old people, 3 adults and 2 young children) who owns:

- 3 ha in the flood recession area (2 ha transplanted and 1 ha broadcasted)
- 0.7 ha in the irrigation scheme command area
- 1.3 ha which are not irrigated because they are "too far away"
- 5 buffaloes (3 female, one 'heifer' and one male)
- 2 piglets for fattening
2 adults work sometimes as farm-labourer (about 30 days per year; 1 aduls fishes 30 days a year

We will only present here the total intermediate expenses and the added value of the different activities:

	INTERMEDIATE EXPENSES ($)	ADDED VALUE ($)	% OF THE FAMILY INCOME
Flood recession rice(transplanted)	*321*	*383 (6500kg of paddy)*	*22%*
Flood recession rice(broadcasted)	*177*	*311 (4500 kg of paddy)*	*18%*
Early wet season rice	*160*	*140 (2500 kg of paddy)*	*8%*
Late wet season rice	*110*	*142 (1750 kg of paddy)*	*8%*
Rainfed rice	*120*	*361 (4000 kg of paddy)*	*21%*
buffaloes breading		*238$*	*14%*
Pigs fattening		*0*	
Daily farm work		*36*	*2%*
Fishing	*?*	*100*	*7%*
Total income		*1711*	*100%*

In this case, double cropping represents 26 % of the household income*. The impact of the total wet season production is lower than in the other categories, as the farmer owns a large field which is not irrigated ("too far away from the channel" according to Niep Piep). This family sells all the early maturity varieties production (a small amount is kept for sowing in the next cropping season). Most of the time, they can wait that the prices increase to sell their production. The red rice production is used for family consumption. They get surpluses for this red rice and sell it to finance part of the inputs for the following crop.*

It is interesting to add that several people owning large-sized land prefer to breed buffaloes instead of cows and oxen. Indeed, in a flock of 5 buffaloes, all adult animals can be used for work in the field, males as well as females. The farmer can plough all his fields, ensure the renewal of his flock and sell some animals with a flock of 5 animals. On the contrary, with a flock of 2 oxen and 3 cows, the farmer is able to ensure the renewal of his flock and to sell some animals, but he will have to rent additional oxen to plough all his fields.

2.5.3 Conclusion on the economical impact of the irrigation system

First this analysis demonstrates that double cropping allows good agro-economical results, comparable to the flood recession and rainfed rice. In spite of heavy expenditures for chemicals, water and labour force, double cropping allows to double the added value obtained for one hectare cropped during the wet season. In all the categories of household we defined, the double cropping represents about a third of the household income. **These characteristics (good agro-economical results and an important place in the household income) correspond to two assets defined by**

Vermillion as essential pre-requisites to ensure a good functioning of the irrigation system: these two characteristics may motivate water users for paying water fees.

In addition to these characteristics, there is one more predisposing factor for the water fee payment. The farmers from the study area are already used to spend money for water, as they have to pump water for flood recession rice cropping.

Moreover, we did not notice any significant differences between the agro-economical results of downstream and upstream water users for the irrigated crops. Even if the downstream users complained about the bad quality of the water security (we will go into this question later), they managed to adapt their practices by broadcasting instead of transplanting and manage to face the problem of the irrigation water distribution. This ability of water users to adapt their practice is one more particularity of the study area. All Cambodian are not able to practice broadcasting in their fields in the irrigation systems which dysfunction. Moreover, to change their practices they took some risks: even if they were already used to broadcast their fields in the flood recession area, they never tried to do that in the upland area. As these farmers took more risks and consume less water, they may request to pay less water fee than people who still transplant their fields (we will go into this question later).

At the end of this analysis, agro-economical aspects seem to be favourable to an efficient functioning of the irrigation systems. Nevertheless agro-economical factors are not the only ones who influence and characterize the functioning of an irrigation system. The following part allows us to enrich our reflexion by analysing other factors.

2.6 PRESENTATION OF THE IRRIGATION SYSTEM (IS)

The following parts aim at describing the main characteristics of the irrigation system necessary to understand and analyse its current management and functioning. First we will briefly depict the history of the irrigation system by insisting on its successive management methods. Then we will portray the different stakeholders and their role in the irrigation system management and functioning. After that we will describe the infrastructures of the IS in order to stress on their main assets and constraints. Last we will present different elements of the irrigation functioning.

2.6.1 History of the Irrigation System

We encountered difficulties in understanding the history behind management of this Irrigation System, as the views of the people interviewed are contradictory on the identity of the different actors, the order of the events and the irrigated areas at the different periods.

2.6.1.1 Construction and management of the irrigation scheme during the Vietnamese period

The irrigation scheme has been constructed during Pol Pot time: four fuel pumps with Korean motors with an average flow of 300 m^3 per minute. The irrigation scheme has been constructed by the Khmer Rouge. According to the people interviewed, the command area was 1500 ha, squared with 1 km distance channels. The views of people surveyed are contradictory regarding the efficiency of the IS at this period. According to some of them, the IS never worked except for supplementary irrigation for rainfed rice cropping. According to others, they managed to produce dry season lowland rice.

During the period of *Krom samaki* the commune was in charge of the irrigation system. The *Mephums* had to collect money from the users to buy the petrol every time the village required water. They brought the money to Mr Mar Oum, the mechanic, who started the pumps. In case of a breakdown, the *Mekhum* was responsible for seeking for money. It seems that the PDAFF was giving some financial support to purchase fuel or to repair the pumps. The pumps were only used to secure the wet season lowland rice growing. There was no early wet season rice growing because the short cycle varieties and the practice of this kind of crop were not well known by the farmers.

2.6.1.2 The "Kbal Por Rural Development Project"

According to our information, the NGO ACR arrived in the area in the late eighties. Its role in the irrigation system is not clear at all. According to the people of PDAFF in charge of the three communes of Sambou, Srangkae and Tlot at that time, there were two main irrigation schemes in the area: Kbal Po IS and Samput IS, and ACR worked on the rehabilitation of Samput IS only. However, several farmers told us that ACR provided them with some fuel for the Kbal Po pumping station and organized the water distribution by introducing an irrigation schedule (2 or 3 days per villages from the downstream to the upstream).

According to one MOWRAM's report (Mac Donald, 2001), ACR worked on the Sampot IS from 1991 to 1994. The main goals of its project were (1) to secure a wet

season crop, (2) to introduce a double cropping wherever possible, and (3) to establish and train a Farmer Water Users Community (FWUC) being able to take over the management of the scheme. ACR installed the centre of "Kbal Po Rural Development Project" close to Rovaong, in the Kbal Por Irrigation Scheme command area. If ACR didn't provide any help to repair the pumping station or to buy fuel in Kbal Po (this is not reported in the document but may have happened), they may have provided to the water users advises on the management of the IS.

Last, the pumping station has been flooded several times and the Korean motors were destroyed.

2.6.1.3 Management of the IS by users' community

In the middle of the nineties, the PDAFF repaired two of the four pumping motors. According to the people surveyed in the PDAFF, the money came from a loan taken from the water users' community of Samput. They created a "*Sahakum khum Sambou"*(Community of Commune of Sambou) in charge of the management of the IS. At this time, irrigation started to be used to grow early wet season rice.

Information given by the people supposed to be in charge of the management at that time[26] is very confusing. It seems that the users had to pay a water fee (around 100 000 riel/ha) at the harvest time, which was collected by *Mephums*. The money for fuel and reparation was lent by about ten people from the area. According to the farmers surveyed, only a small area could be irrigated (around 10 to 20 ha per village), in the plots close to the canal. The community experienced difficulties for the costs covering. After two years, the pumping station was flooded once again, and no one was able to repair the pumping motors.

The irrigation scheme stayed out of order during several years, up to the year 2002.

2.6.1.4 The rehabilitation by a private contractor: an initiative of the Mekhum

In 2002, during the campaign for the *Mekhum* election, Mr Som Trin, who was already assuming this function before the election, promised to the villagers that he would rehabilitate the irrigation scheme. After his election as *Mekhum*, he asked for some assistance from the PDAFF and PDWORAM. However the provincial departments did not have the financial ability to support this project. The *Mekhum* asked them to allow him to look for a private contractor able to rehabilitate the Irrigation Scheme.

According to him, Mr Som Trin received an authorisation from the ministry to contact a private entrepreneur[27]. We did not manage to get the official paper. As he indicates, he contacted three entrepreneurs, but only one, Mr Sok Touch, entrepreneur in Takeo, was really interested and had the technical and financial means necessary to

[26] And even their identity is not so clear. Several people have been quoted by villagers as chief or deputy chief of the users' community but deny to have assumed that kind of responsibility…

[27] We did not manage to get the official paper

realize this rehabilitation and management project. Mr Sok Touch, accepted the proposal, after a preliminary study (he checked that the topography of the area will allow the water to flow by gravity down to the downstream villages): he thought he could repair the Irrigation Scheme at low cost, thanks to his civil engineering equipment.

In 2003, he rehabilitated part of the irrigation scheme and a 15 years contract was signed between the contractor, the *Mekhum* from Sambour, and the six *Mephums* of Kbal Por, Po, Tro Peing Pon Lou, O'Po, Thnot Chum and Rovaong. The Irrigation system was named "the Kbal Por pumping station community".

2.6.1.5 Evolution of the irrigated area

Since the irrigation scheme was rehabilitated by the entrepreneur, the irrigated area during the early wet season has changed every year. We have to add that the data presented here has been provided by the contractor and as such there is no guarantee over the reliability of these data. There is particularly a doubt over the reliability of this information related to year 2005. Indeed during our first period of field work, *meteuks* of the different villages told us that the irrigated area was smaller than for the previous. However the data provided by the contractor show appreciatively the same irrigated area.

YEAR	KBAL PO	PO	TPPL	ROVAONG	THNOT CHUM	O'PO	KHUM SRANGKAE	TOTAL
2003	64.4	71	50.6	21	22.5	60	-	289.5
2004	80	64	55	50	55	103	20	427
2005	80	63	59.3	48	55	103	38	446.3

Table N° 9: irrigated areas per village during the first the early wet season crop (data collected from the contractor).

According to these data, in 2003, 289 ha have been irrigated during the early wet season in six villages of Sambou Commune (around 60 ha per village in 4 upstream villages but only 20 ha in downstream villages). 407 ha in 2004 and 408 in 2005 have been irrigated during the early wet season in the six villages of Sambou commune. All the villages increased their irrigated area between 2003 and 2005.

Moreover, some farmers from Srangkae Commune requested water from the Kbal Por community pumping station in 2004. These farmers are used to crop early wet season rice by using water from another irrigation scheme: the Kantharith irrigation scheme, which is using water from a reservoir (the Boeng Do Tom, cf. map n°2). But for the early wet season rice cropping 2004, because of low rainfalls, the reservoirs did not contain enough water to provide water to all the usual water users, and 20 additional hectares[28] in the two villages of Kork and Pray Top have been irrigated by the Kbal Por pumping station. In 2005 the same problem occurred again. People did not get enough

28 number provided by the *Mephum* of Kork, Srangkae district

water from the Boeng Do Trom and two more villages from the Srangkae Commune asked water from Kbal Por pumping station. At least 38 hectares[26] in these four villages have been irrigated during the early wet season rice cropping 2005.

The water users also received water for the late wet season rice cropping. Indeed the rainfalls stopped during more than two weeks and the users requested water from the contractor. We did not manage to know how many hectares have been irrigated at this time. Indeed, the contractor did not provide us any list with recorder information for the late wet season irrigation. Moreover, the number of hectares irrigated during this season is at the centre of a conflict between the users and the contractor.

Moreover the entrepreneur plans to increase the irrigated area by rehabilitating new channels, mostly in Srangkae Commune. Nevertheless he does not want engage more investment in the irrigation scheme before that he gets legal recognition for this work.

Summary:

This historical perspective on the irrigation system shows its evolution, in particular regarding the different kind of managements implemented throughout the years.

This irrigation system has experienced several management methods:

1) **It has been managed by one government's authority**: during the Vietnamese period, **the Commune was in charge of its management**.

2) During the nineties **the PDAFF was also involved in the financial and organisational management** of the irrigation system.

3) Then, the Irrigation System benefited from the organisational and probably financial support form an Australian NGO.

4) Last**, two experiences of community management of the IS** have been carried out, **one under the impetus of the NGO, the other one under those of PDAFF**. Both these experiences did not last more than two years and provided only a complementary irrigation for the traditional rainfed rice. The irrigation did not allow to produce two rice crops per wet season. We can add that in all these management systems**, the *mephums* played an important role, as they were in charge of the water fee collection and the regulation of conflicts**.

But **all these experiences have ended in failures. The causes of these failures are numerous, but mostly of financial order**. The collection of the water fee seemed to be difficult, but above all the people responsible for the IS management did not get the financial resources to repair the regular and important damages caused by the floods.

As a result, we can conclude that, **before the arrival of the contractor, this irrigation system did not have any sustainable experience of management** neither under the commune authority nor with a community management. Nevertheless, if the farmers did not get any positive experience of irrigation with the irrigation scheme, **they all overcame the management of irrigation based on their experience in the flood recession area**. But since the water resource is not limited in this area, the farmers do not have to manage this resource in a collective way.

2.6.2 the different actors involved

Several actors are involved at different levels, in the functioning of irrigation:

1) The Ministry level

This irrigation system is still under the authority of the MAFF. Nevertheless, MAFF refused to give its approval to the first entrepreneur's request for a contract or any legal recognition from the MAFF. According to the chief officer of the PDAFF, the MAFF criticizes Sok Touch for installing old pumping engines instead of new ones. According to the contractor and Mr Sokhunthea, the MAFF asked the contractor to draw up a master plan for the ten next years to obtain a legal recognition.

The MOWRAM is not involved in the management of this irrigation system.

2) The provincial authorities

The PDAFF is involved in the management of this irrigation scheme since the Vietnamese period. Indeed, Koy Sokhunthea, the chief officer of the agriculture department of the PDAFF was already involved in Kbal Po pumping station from 1988 to 1995 and owned one office in *Phum* Kbal Por. He also worked with ACR in Sampot irrigation community capacity building. He was also responsible for the reparation of the Kbal Po's pumps and for the creation of the *Sahakum khum sambou.*

Since the rehabilitation of the IS, he is still engaged in its management. Indeed he took part to the meetings organized to discuss the engagement of the contractor and the users in 2002. He provided advisory services to the contractor regarding the writing of the contract, the water fee, etc. This year, he took part in several meetings with the contractor, the local authorities and the users' representatives in order to discuss the water fee. Indeed, the users' representatives and the contractor disagreed on this point. According to him, his current duty is to help the users and the contractor to find a compromise on the main conflicting points, which are the water fee amount and the way of payment. In addition to that, when we left the area, he was helping the contractor to draw up the master plan for the ten next years to obtain legal recognition.

The PDOWRAM of Takeo is not involved in the management of the Kbal Por irrigation system. According to its deputy director, "*PDWORAM does not want to interrupt what PDAFF is doing: when you start something, you have to finish it yourself. I know nothing regarding this irrigation system, except that it is managed by a private contractor*".

3) Local authorities

- The *Mekhum* of Sambour

He is the one who asked Mr Touch to the rehabilitate the IS. He signed the first contract as witness, and resigns a new contract every year. He is in charge of the organisation of meetings between Mr Touch and the *Mephums.* He is also responsible for the control of Mr Touch's employees (for example, he told us that he has to check if they are giving enough water to all the villages …): every 3 to 4 days he is going around the IS to check the fields (according to him).

Currently, he has to give his approval before that Mr Touch's request for a legal contrast with the MAFF can be transferred to the district and provincial department. According to our information he did not have signed the document when we leave the area.

- The *Mekhum* of Srangkae

He signed a contract with the *Mekhum* of Sambour and the contractor so that four villages from his commune can be supplied in irrigation water by Mr Sok Touch. He does not have any function in this irrigation scheme.

- The *Mephum* of each village:

Every year they have to sign the contract with Mr Touch and the *Mekhum*. The villagers who want to use the irrigation scheme have to contact them and sign their users' book (finger marks) with their name and the surface they want to irrigate. They also have to choose the users' representatives for their village (they choose the number of representatives and their names), but they have to ask the approval from Mr Touch. The *Mephum* is responsible for the organisation of meetings with the villagers and has to give his village's fee to Mr Touch. When a user from his village doesn't pay his fee, he has to try to convince him to pay it (for the interest of the village…).

4) The contractor, Mr Sok Touch

- His other activities

Mr Touch is 45 years old and lives in Takeo since 1982. From 1979 to 1982, he worked for an ironworks company. In 1982, he started his own ironworks company, in Takeo city. In 2000, he purchased 5 trucks, mechanical shovel and bulldozer, and started to rent it to drill holes (for fish farming, house building …). In 2002 he started to rehabilitate the Kbal Por IS. In 2003, he started a new project of drinking water adduction for the villages of Kbal Por and Po, supported by the GRET-KOSAN through the MIREP project.

According to that he told us, the irrigation system raised his higher expenses:

- Since he started his ironworks factory he has already invested 100 000 US$. Nevertheless we do not know if this amount corresponds to the fixed capital or to the counted functioning costs;
- He invested 40 000 US$ in the purchase of earth moving equipment (two trucks and one excavator). We did not get any information concerning the recovering of these costs;
- He also invested about 20 000 US$ for the installations of a water supply network (cost for digging a reservoir, building a water tower and install pipe and other equipment for water adduction up to the villages);
- The amount he provided as the total expenses for the rehabilitation of the irrigation system is 113 100 US$ (cf. table N°10)

The contractor does have any training or previous experiences in the management of water distribution. Nevertheless, he is resourceful (he repaired old motors for the pumping station and built himself the water tower for the water supply network) and has financial capacities. He also knows how to take opportunities for developing his network of relationships (cf. letter addressed to Mr Fontenelle, Annex 15), particularly with NGO's like the JICA and CEDAC.

Moreover, the fact that the irrigation system constitutes the main contractor's investment is a positive element for the management of the IS. Indeed it may motivate him to put a lot of time in this activity in order to ensure the recovering of his investment. Indeed, the problem with some private entrepreneurs who carry out several

activities is that may be occupied by their others activities and as a consequence, not available to manage the IS in efficient way.

- A family business

Mr Sok Touch lives with his family in Takeo city, where his ironworks and trucks companies are installed. As Takeo city is not far away from the irrigation scheme (about 15 km) and since he owns a pick-up, he goes easily and quite often to the irrigation scheme, at least during the irrigation period. His wife is in charge of the book-keeping of the family business. She puts a lot of effort into this work, and she often goes with her husband in the irrigation scheme area to talk with the *Meteuks* and water users. Their son is also involved in the family business. Thanks to his knowledge in computer science and in English, he is typing some documents in English, particularly some documents used to present the IS or to communicate with NGOs, etc.

5) The Irrigation system's employees

- The users' representatives (*meteuk*):

The *meteuks* responsible for one village are chosen by the *Mephum* of this village. A chief of *meteuk* is also chosen in each village. In many villages, the *mephum* himself carries out the functions of chief of *meteuks*. The *meteuks* are responsible for:

→ Observing the fields conditions (too dry or not) and requesting water from the contractor's representatives when needed;
→ Receiving requests from users regarding the lack of water in canals and fields if any and trying to resolve them;
→ Representing the water users from his village during the meetings regarding the functioning of the Irrigation System;
→ Informing the users about the water schedule and the water fee amount and way of payment;
→ Collecting water fees from users.

Their status, roles and level of responsibility are ambiguous on several points. Indeed, **on one hand they are considered as the users' representatives, but on the other hand they are paid by the contractor** and have to control the users' irrigation activities and their water fee payment. We will come back to this point later.

Their number and repartition of work varies with the villages and *Mephums*' choices:

→ In Kbal Por: 5 representatives, who are dividing the work according to the canals (2 representatives for the part in the north of the primary canal, 2 for the north)
→ In Po: 3 representatives (2 for the south part of the primary canal, one, who is the *Mephum* himself, for the north)
→ O'Po: 2 representatives with no specific division of work
→ Thnot Chum: 8 representatives, each one is responsible for the fields around his owns.
→ Rovaong : 5 representatives, one is the *Mephum* himself
→ Tro Peing Pon Lou: 3 representatives (one is the *Mephum*)

Currently they are complaining about the difficulty of their work: when there is not enough water they receive complains of the users, and when they have to collect the

money for the water fee, they endure complains (and anger) from both the users (who don't want to pay) and the contractor (who wants his money). This work seems particularly difficult in the downstream villages. If users from one village do not pay the water fee, the money missing is taken by the contractor from the village's representatives' salaries. Two *Mephums* (from Kbal Por and Thnot Chum) do not want to ensure *Meteuk*'s functions as they found this work too hard and time-consuming.

The allowance of the different representatives is calculated in each village in the following way:

(Number of ha irrigated in the village) (10 000 riel)/ (Number of users' representatives in the village + 1 employee of Mr Touch)*

VILLAGE	AREA IRRIGATED (HA)	NUMBER OF *METEUKS*	ALLOWANCE ($/*METEUKS*)	ALLOWANCE ($/VILLAGE)
Thnot Chum	55	8	14.7	132
Rovaong	50	5	20	120
Kbal Por	80	5	32	192
Tro Peing Pon Lou	55	3	33	132
Po	64	3	38.5	154
O'Po	103	2	82	248

Table n°10: Example of calculation of *meteuks*' allowance for the year 2004

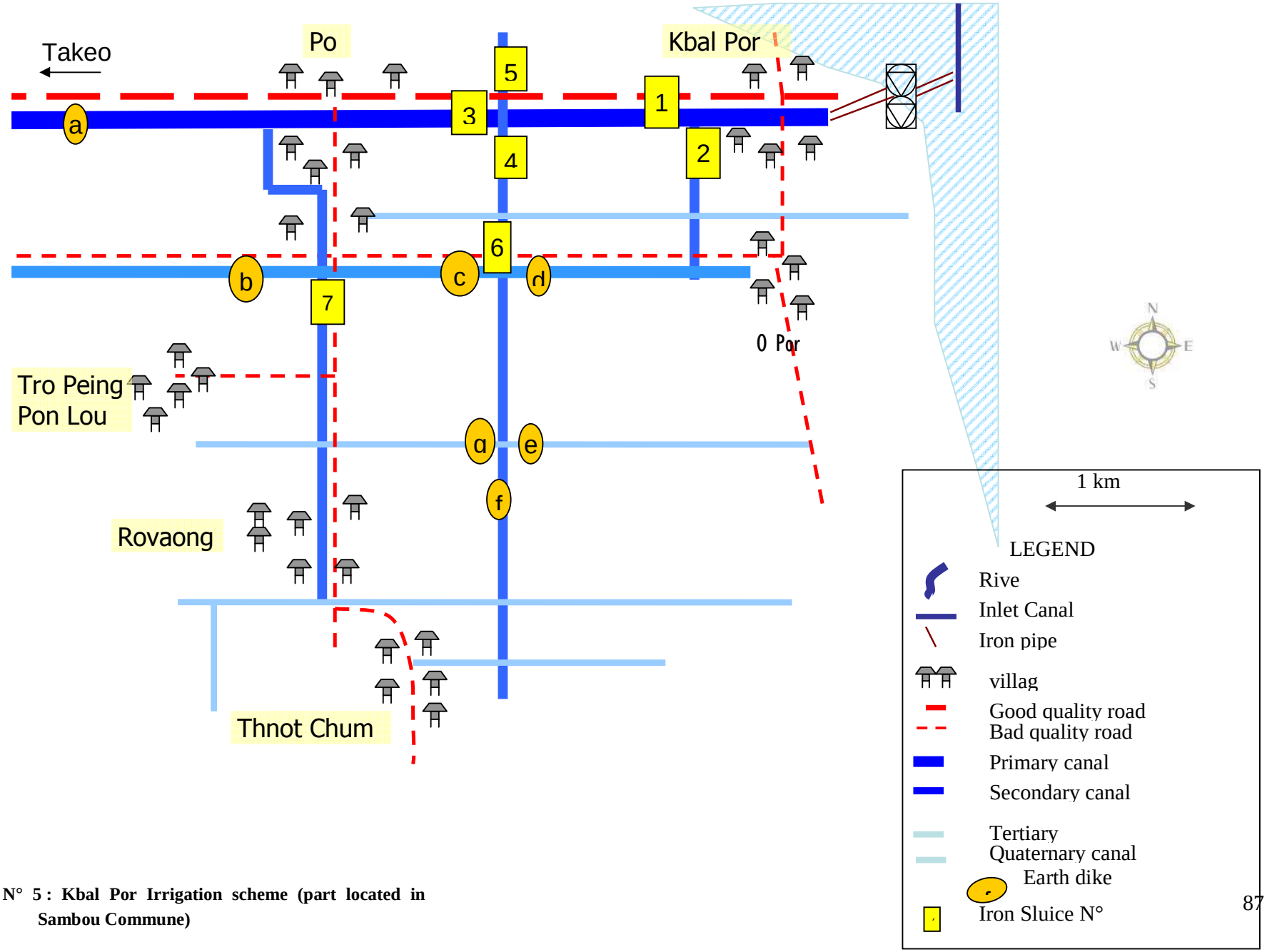
- Mr Touch's employees:

Four people are working for Mr Touch, two are working in the pumping station, two on the canals (to operate the doors and to control the level of water in canals and fields). In 2005 these two employees were working on the secondary canals for the first time. When they have any conflicts with farmers and representatives about the water allocation, they have to inform Mr Touch. The two people working on the canals are also employees of Mr Touch for the drinking water station (they receive one salary for each job).For example, for the year 2004 they calculation of their salary has been done by the following way:

(14.2+20+32+33+38.5+82)/4 = 55$/employee

6) The water users

They have to be registered by the *meteuk* before every irrigated crop cycle. Farmers who want to irrigate have to give the location and the area of the plot(s) they want to irrigate and the type of irrigation they have to do (direct irrigation or with subsidiary pumping). The *meteuk* write down this information on two identical registration forms (cf. Annex N°). The user has to sign these forms (finger mark) and can keep one copy with him. Most of the users choose to let two forms to the *meteuks*. The sized and the type of irrigation will be checked later by the *meteuks* and the user together.



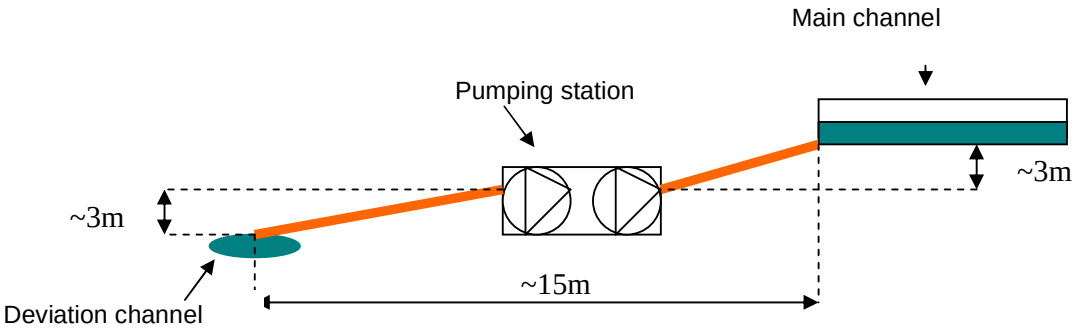
Map N° 5 : Kbal Por Irrigation scheme (part located in Sambou Commune)

2.6.3 physical infrastructures

2.6.3.1 Description

The sketch (cf. map N° 5) has been realized according to the one done by Mr Touch himself and some corrections have been made, based on our field observations and discussions with farmers.

The water is taken from a deviation channel, linked to the Kbal Por River (*stueng Kpal Pou* on the map). This river is connected to the canal N°15 by the canal N°87. The pumping station is at around 15 meters from the river.



Sketch N°1: difference in height between the deviation channel and the main channel

The pumping station has been constructed by the Khmer rouge in 1977. But they disregarded which area was flooded after the wet season. As a result the pumping station is flooded almost every year and is currently in very bad condition.

In 2003, the contractor replaced the four broken Korean motors by two motors of Russian trucks. These second hand motors have a horsepower of 200 and 250. The maximum aspiration height is 9 meters and the maximum pumping distance is 400 meters (data from the contractor). According to the contractor, the flow provided by the two pumps working together is around 150 m^3/ min. Since the field work took mostly place during the wet season, when the pumping station was not working, we were not able to check these data empirically. Due to the floods, the contractor has to raise the two pumping engines every year during the wet season. The two Russian motors are in bad condition. Farmers are complaining that the motors break down too often (one time in 2005, at transplanting time) and are using too much fuel (from 12 to 30 L/hour, according to the water level in the river).

Since 2003, the contractor has rehabilitated more than 23 km of channels with his excavator:

- In 2003, he cleaned out the concrete supply channel (around 1 km long, 1.2 m depth, ~0.5 m width). Nevertheless, he did not repair it and the end of this supply channel is still broken.
- In 2003, he rehabilitated also the primary channel, which is not lined, (length : 3 km, depth: 1.2 m, width: ~0.5m), three secondary channels and three quaternary channels, also not lined, (above 18 km long), all located in the *khum* Sambou

- In 2004, he rehabilitated about 5 km of earth tertiary channels, in order to reach four villages from Srangkae Commune. According to the contractor himself, it was no really rehabilitation, as they only removed the soil and other material which would have blocked water flood.

According to the size and the location of the channel, the command area stretches out between 50 and 200 meters along on each side of the channel.

2.6.3.2 Assets and constraints of these infrastructures:

The physical infrastructures condition the possibilities and limits of water supply (volume, time and duration of distribution), the cost of the irrigation system and the means which have to be mobilized for the maintenance. We are now going to present these possibilities and limits but also some nubs of power and decision, on which the water management organisation is relying on.

1) Assets and Possibilities

Two iron gates have been installed at the intersections of the main and secondary channels and can be locked (cf. map N°5). These gates may facilitate the control of water allocation between the secondary channels.

The good filling up of the primary and secondary channels allows the upstream users who own fields along these channels to irrigate directly: they can make an opening in the embankments to irrigate their fields. They can also place a pipe across the embankments: the extremities of the pipe are blocked (with cloths, plastic, etc) and the users open it to irrigate their field. Moreover, on the upstream part, along the primary and secondary channels, fields are irrigated up to a distance of 200 meters distance from the channel.

2) Constraints

There are several constraints on the water distribution due to the infrastructures:

- Direct irrigation practices are limited to a small amount of water users. The others, who do not own fields along the channels or in the downstream part, have to use a small moto-pump to irrigate their fields:

  → Some of them are pumping directly from the channel to their fields, and may have to use flexible pipes to reach their fields;

  → Some others have to pump from one channel to another channel which will drain the water up to their fields. Indeed, a part of the tertiary and quaternary channels is not dug as deep as the secondary and tertiary channel;

  → Several users have to pump twice: from the secondary/tertiary channels to the tertiary/quaternary channels and from the tertiary/quaternary channels to the fields. As a consequence the expenditures for fuel and so the irrigation costs, may vary from user to user;

- The command area is limited and only the fields close to the channels (less than 100 meters) can be irrigated. Moreover, the physical infrastructures are partly damaged and not always fully rehabilitated and maintained, particularly in

the downstream part, and the downstream users may receive a service not as good as the upstream ones;

- Except one part of the main channel, the channels are made of earth. They are more easily damaged and have to be maintained every year. All the more because the villagers have a strong tendency to dug theses channels at the end of the wet season in order to fish. The damages can be important and decrease the water flow to the downstream villages. In addition to that, the width and the depth of the secondary channels, particularly the third one, are subject to numerous variations. These variations are caused in particular by the villagers who installed culverts to cross the channel and reach their house, but with a too small diameter. As a consequence, the water floods decrease;

- As explained before, the engines used in the pumping station are old and their pumping capacity is limited. Thus the cost for pumping, but also for repairing the engine, is higher than with new material. The pumping station is still flooded every year, and even if the pumping engines are raised each time, the foundations weaken every time.

- The level of water in the channel N°15 and in the deviation channel is influenced by the climate. This year these channels were almost empty because of the delay of the first rainfalls. As a consequence the first irrigation started one month later than usually and all the cropping cycle has been delayed.

3) Nubs of power and decisions

As in most of the gravity irrigation systems and in as much as some problems of water floods may occur from upstream to downstream and as the power of the pumping engine is limited, **there may be some conflicts between the downstream and upstream users and the intersections may represent important nubs of power and conflicts**:

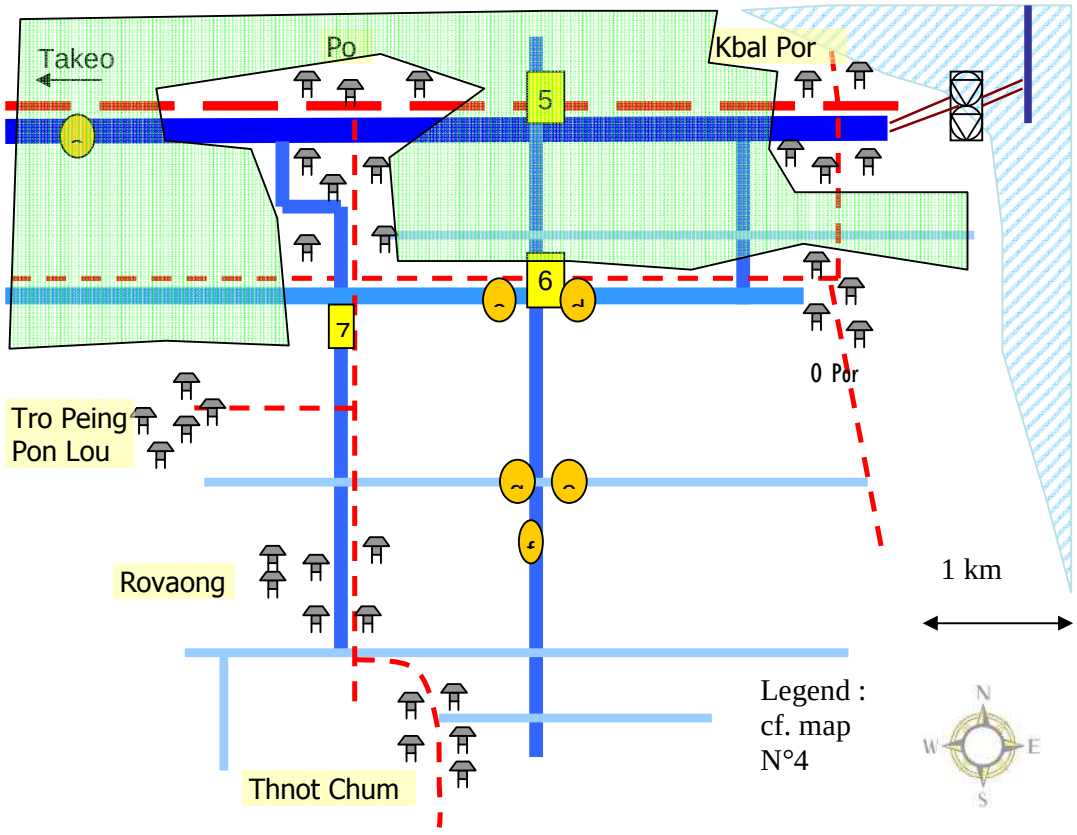
- Several gates are locked. They are located at the most strategic places. (gates N° 1, 3 and 7, cf. Map N° 5)

- On the contrary, several strategic intersections do not have any iron gates. When it is their turn to irrigate, water users have to block some intersections with small dikes. These dikes are difficult to build and easy to destroy, which may complicate the management and the control of water allocation.

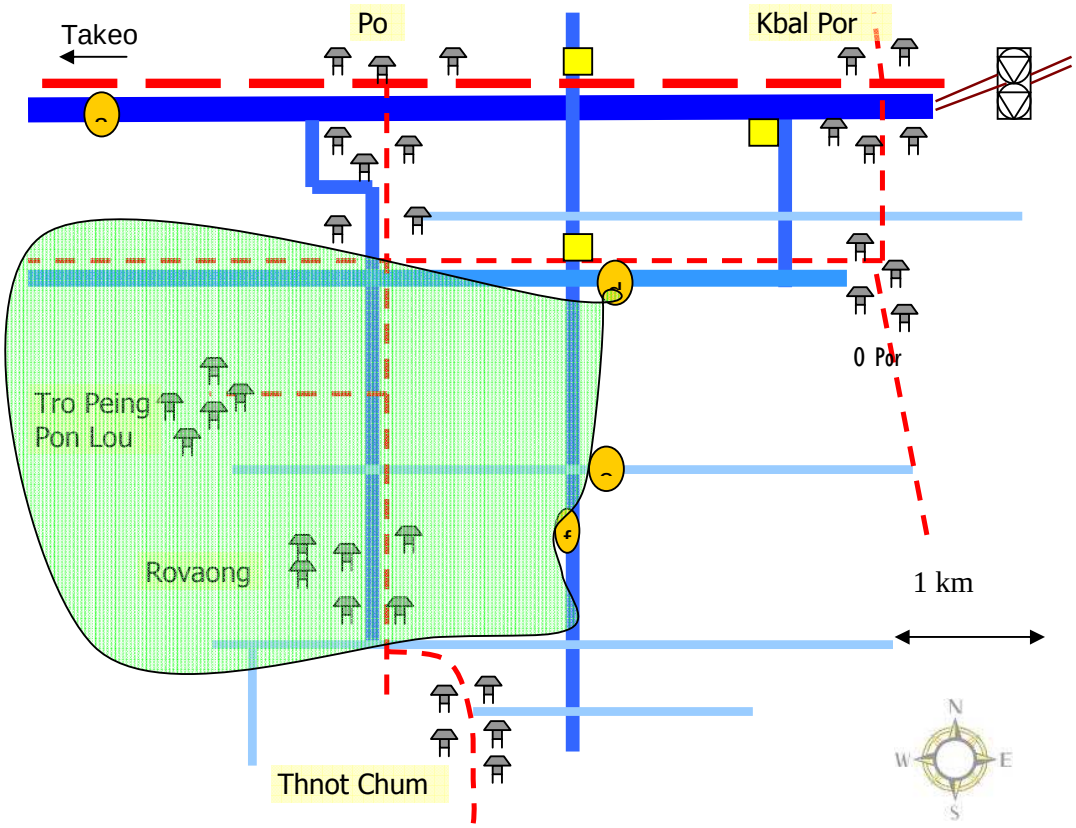
Last, we can add that several local authorities (*Mekhum, Mephums* and *meteuks* from Kbal Por and Por) own fields in the upstream area, along the first section of the main channel. It may influence their choices and give advantage to the upstream users.

2.6.4 water distribution

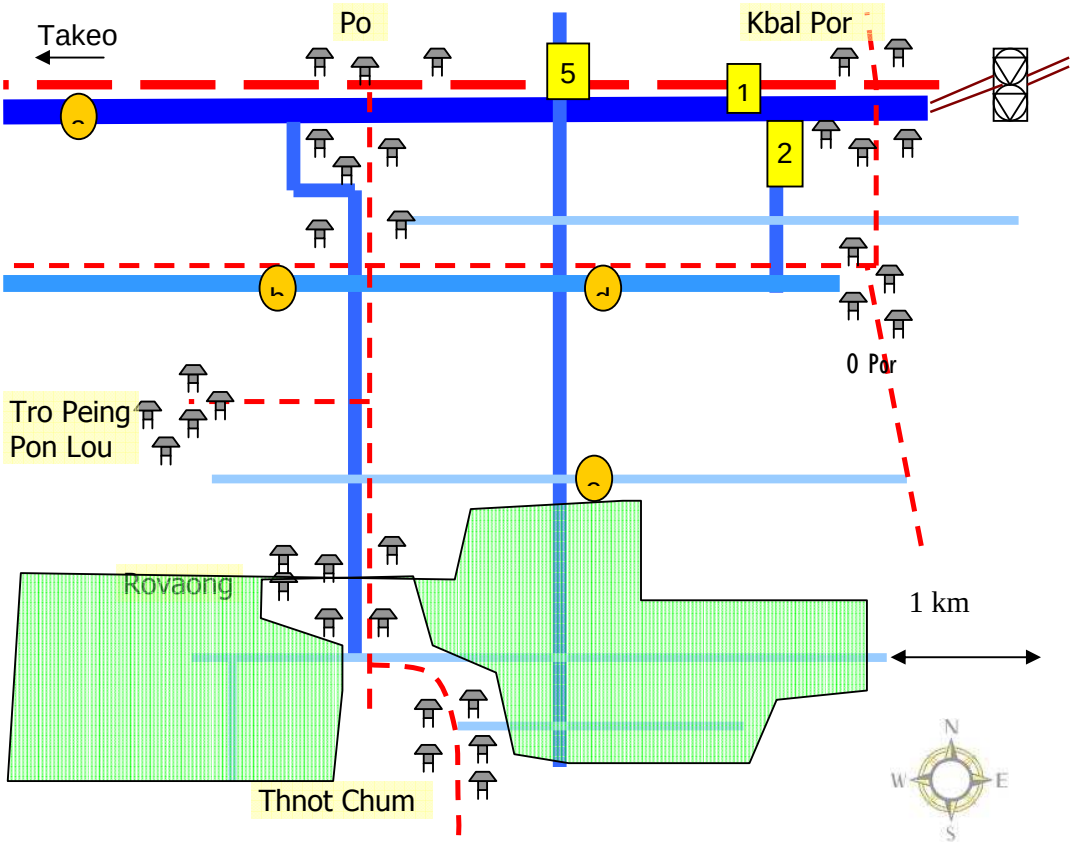
In the contract, there is no element regarding the water distribution and allocation between the users. Nevertheless, in the years 2003 and 2004, *Mekhum, Mephums*, Mr Touch and the responsible from PDAFF have done one meeting before the start of the irrigation season to fix the water schedule. The water turn was allocated per village and was supposed to start from upstream to downstream villages. During one village's turn, all the canals rounded by fields of users from this village were supposed to be open.



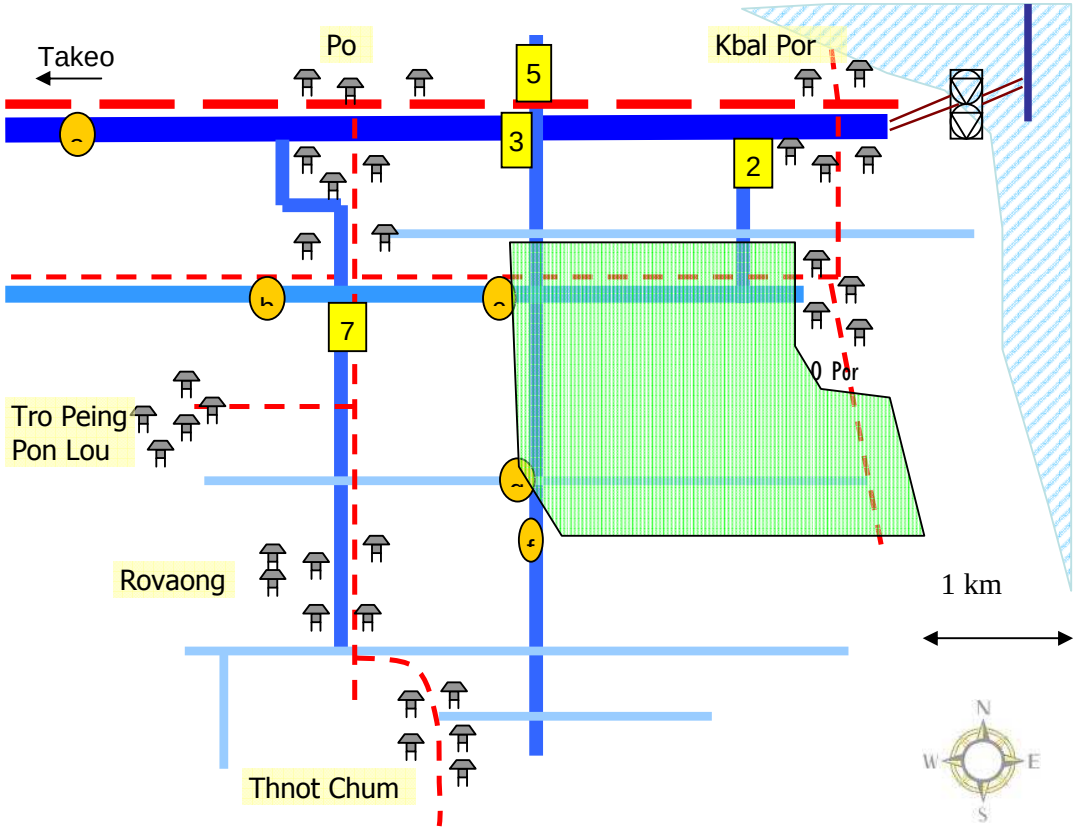
Map N°6: Theoretical water turn of Kbal Por and Po



Map N°7: Theoretical Water turn of Tro Peing Pon Lou and Rovaong



Map N°8: Theoretical water turn of Thnot Chum



Map N°9: Theoretical water turn of O'Po

2.6.4.1 The theoretical fixed water schedule

In 2004, the water scheduling defined during the meeting was the following one, which was displayed in the pumping station:

1) Kbal Por and Po: 2 or 3 days (cf. map N°6)

Doors 1, 2, 3 and 4 are fully open; doors 6 and 7 are closed. Door 5 is partially open. Most of the time, 2 days are enough to irrigate the fields of the users, so they inform the following villagers that they can start their turn. It must be added that the door 1 is not closing completely, and water is flowing in the secondary canal S1 all the time.

Moreover, the tertiary canal located after the dike (b) fits with the administrative boundaries between the two villages Po and TPPL. When it is the turn of *phum* Po, the users from Tro Peing Pon Lou are allowed to use the water from the canal (and reciprocally).

2) Tro Peing Pon Lou and Rovaong: 2 or 3 days (cf. map N°7)

Door 2 is partially open and doors 1, 3, 4 and 7 are fully open (because the 2 villages have fields around the secondary canals 2 and 3). They can build dikes in positions (d) and (e). According to some people door 2 is partially open because it is broken and can not be closed fully. For others, it is in order to avoid that the main channel overflows.

3) Thnot Chum : 3 days (cf. map N°8)

Doors 1 and 5 are partially closed and doors 2, 4, 6 and 7 are open. This village received a turn of 3 days because the flow arriving to this downstream village is lower than for upstream ones. They can build dikes in positions (b), (d) and (e).

4) O'Po: 3 days (cf. map N°9)

Doors 2, 3 and 5 are closed and doors 1, 4 and 6 are fully open. Users can build a dike in positions (c), (f) and (g). According to Mr Touy and his employees, the secondary canal S1 is not reaching the tertiary because farmers destroyed it partly to do rice fields (so they have to use the secondary 2 to irrigate the village).

2.6.4.2 The water turn in practice

These elements have been given to us by contractor, its employees and some *meteuks.* Nevertheless we did not manage to observe the implementation of water turn in practice. Indeed this year, at least until the seedlings transplanting, there was no fixed water schedule. The first irrigation has been delayed. Usually Mr Touch waits that the river level starts to increase to start pumping. When he started this year, rainfall had not yet begun and the water level was still low. Indeed rainfall started one month later than usually (June instead of May). As a consequence the growing cycle has been delayed and all the farmers were in need of water for their fields at the same time. Mr Touch told us that he decided to wait until seedlings have been transplanted to fix the water schedule in order to avoid conflict and try to satisfy all the users (because at this time, users need less water). As we left the area after the end of the transplanting and came back after the harvest, we did not observe if the water turn has been established afterwards.

During our first period of field work in Kbal Por (when there was no water turn) we have seen several *meteuks* and farmers asking the contractor to give water to their

village. We also have seen the contractor asking his employees and *meteuks* to operate some doors to give water to such and such village. Moreover the downstream users and village authorities we met at this time complained strongly about the lack of water. They were worried about their plots and were concerned that they will not get water for transplanting. On the contrary, the upstream users were only complaining they did not get enough water but were not as concerned as downstream people. When we came back in September, most of the users were satisfied of their crops but they told us that it was thanks to rainfalls which started in early July, not thanks to the irrigation. Thus we had to base our study on the different stakeholder descriptions.

On a whole, except some users from Kbal Por and Po, the majority of the stakeholders agree to say that there is a real problem of water distribution and that the water schedule is rarely respected. Most of the downstream users and *meteuks* (particularly those from Thnot Chum and Rovaong) are strongly complaining about the water service. They told us that they never get enough water for their crops. The *meteuk* from Rovaong told us that his village gets water more than two weeks after the start of the pumping station. Several downstream users told us that this year, they decided to broadcast their fields because their village got water too late and in too small quantity. Nevertheless, as we did not observe the functioning the irrigation system, we had to base our study on the different stakeholders' descriptions. Nevertheless, as we will see further, the points of view of the different actors are very contradictory regarding the water turn and its implementation.

2.6.4.3 Water theft

The downstream users complained widely that upstream users take water outside their water schedule. The users' displeasure was particularly strong during our period of surveys at the end of June. The downstream villages did not receive enough water for transplanting. Even when their village was supposed to receive water, the canals stayed empty or almost empty. They said it was because the upstream villages were taking all the water. Indeed, it is at the transplanting time that the users need the most water in a small period conditioned by the age of the young seedlings. There are several kinds of water thefts:

- The most common one is the pumping into the channel outside of one's turn. This kind of offence does not seem to be a source of direct conflict between the users;

- Another kind of water theft, which is mostly done at night, is the opening or the closing of gates in order to divert the water. This kind of offence can be done to different degrees and has already been the cause of conflicts between users:

  → According to the *meteuks* from Rovaong, some people partly block the gates: "*before I come to close the gate N°2, people from Kbal Por put some material at the bottom of gate, so that I cannot close the gate properly and the water continues to flow into their secondary channel*".

  → According to the contractor, three or four locks have been broken this year to steal water.

  → Several *meteuks* told us that they sometimes sleep near the gates to watch it and be sure that their users will get water: "*If I am close to the gate, no one*

will try to close or open it if it is my village's turn." Nevertheless, conflicts already took place regarding this kind of offence.

2.6.4.4 Conflicts and resolution of conflicts

Water users criticise, sometimes vigorously, the quality of the water service and downstream users complain that the upstream users are taking water outside of their village turn. Nevertheless there are few direct conflicts between the stakeholders. The only conflicts described to us by users concerned water thefts by opening or closing gates and dikes.

Two examples of conflicts:

1) One occurred between *meteuks* from Thnot Chum and O'Po. The chief of meteuks from O'Po told us the sequence of this conflict: "*One day I asked water to Sok Touch. When the water arrived, the people from Thnot Chum wanted it also. We blocked the secondary channel in (f). Around 8 o'clock in the evening, the meteuks from Thnot Chum came to break the small dike. I managed to convince them to leave. At 11 o'clock, they came back and again. I managed to stop them. But after I left the place and let the two other meteuks from O'Po. At 3 o'clock in the morning, the meteuks from Thnot Chum came again and broken the dikes. The meteuks from O'Po dropped the surveillance".* This conflict has not been solved. The *Meteuks* from O'Po finally gave up and did not complain to the contractor.

2) Another conflict occurred on gate number 7, in July 2005, just before we left the area. At this time, all the farmers were in need of water to transplant their fields at the same time and competition for water was at its peak. This conflict opposed water users from Rovaong to those from Srangkae Commune. Some users from Rovaong removed the sluice N°7 (cf. Map N°5) during the night. When we interviewed the *mephum* from Rovaong the following day, the sluice was in his garden. According to him, water users removed the sluice because water users from Kork or Tro Peing Pon Lou closed it while Rovaong needed water. By closing this gate, they stopped the water flowing up to Rovaong and diverted it up to their own fields. According to the *meteuk* Sok Touch granted water turn to Rovaong at this time. Nevertheless, the users from Kork or Tro Peing Pon Lou closed the door. Despite of the Rovaongs' complaints, the contractor and the *mekhum* did not intervene. As a consequence, users from Rovaong removed the gate in order to get water and to avoid the los of their crops. According to the *meteuks,* users from the two villages were about to fight each other. Finally, the *Mekhum* from Sambou came to the conflict place but did not take any coercive measures. He allocated water turn to Rovaong but did not decide of punishment. The following day, the users from Kork (or Tro Peing Pon Lou, we did not manage to identify them) placed a concrete block instead of the sluice. According to *Meteuks* and users, the conflict stopped thanks to the arrival of the rainfalls which provided them enough water so they were not so much in need for irrigation.

Box N°5: examples of conflicts occurred because of water distribution.

2.6.4.5 Plot irrigation

According to the different stakeholders we interviewed, there is no organisation of water between the users of one village. Water users told us that there is no conflict regarding water between users from the same village. According to most users, the first arrived is the first served. Nevertheless, some water users described us one kind of organisation between users for irrigation of their field. Indeed, some users, instead of using pipes, decided to dig small channels to reach their field. These small channels

have to go through the fields separating users' plots from the irrigation channel. As a consequence, the water users who want to dig a small channel have to pay every year the equivalent of 120 kg of paddy for each 100 meters of field crossed, at every cropping cycle. When two users dig a channel together and cross another user's field they can divide this "crossing fee". It seems that several water users using the same small channel to reach their fields organized some kind of water schedule to use the small channel: "*I am using a small channel to irrigate my plot. I share this small channel with 6 other people from my village. We try to organize ourselves so that the one whose field is the most in need of water can irrigate it first"*. We did not manage to get further information regarding this kind of water users' organisation.

2.6.4.6 Users' compensation

According to the contract and the entrepreneur, if one user gets bad yields because of dysfunctions of the water service, the entrepreneur has to reimburse him for the water fee (if the user already paid one part of the water fee) but also all the cropping expenditures (chemicals, labour force, fuel, etc…). This clause can be applied only for the users whose fields are located at less than a hundred metres from one channel. The yield must be 30% lower than the average yield of other users from the same village. Moreover, the user has to inform the contractor before the harvest, so that he can check if the water service is the real cause of the damages. In three years, he never got any complaint **before** the harvest until this year. Some users from Srangkae Commune complained that they get bad yields (70% less than other villagers). These losses are not only due to dysfunction of irrigation but the crop had one serious disease caused by an insect (the Brown Plant Hoper) which ate and damaged the seeds. Nevertheless, the users refuse to pay the water fee as they did not get profit. The contractor told us that he would like to exempt them from the water fee payment but he was afraid that this king of complaints would increase after that. We do not know how this problem has been solved.

2.6.5 Water fee

2.6.5.1 Negotiation of the water fee

Every year, a first water fee is proposed by Mr Touch before starting the irrigation period. Then he has to submit and discuss this price and the way of payment with the users. Every year, Mr Touch increases the fee because of the price of fuel. The price of fuel is the only explanation he gives to justify the water fee amount: he doesn't explain to the users the part of the fee used to pay maintenance, manpower, financial expenses….

Negotiation of the water fee in the year 2005

This year there was a long process of discussion (5 or 6 meetings between the contractor, the *Mekhum* and *Mephums* and Mr Koy Sohunthea from PDAFF):

1) Firstly, Mr Touch proposed a new way of payment: he asked farmers to pay the fee after the harvest with a part of their rice production: 380 kg/ha for users who need a subsidiary pumping, 430 kg/ha for the others. According to the current price of rice (around 550 riel/kg) it corresponds to water fees of 209 000 and 236 500 riel per hectare.

2) The users agreed to pay after the harvest, but refused to pay with a part of their rice production (they found the price in rice was too high and they do not want Mr Touch to stock their rice and sell it later at a higher price…)

3) Mr Touch agreed to let them pay cash, but only if they pay half of the fee before the transplanting (like the years before) and half at the harvest time, and added a new point: each village will have to pay him 1 million riel before receiving the first irrigation.

This last solution has been chosen with the following prices:

- 220 000 riel / ha for farmers who don't need to use subsidiary pumping

- 160 000 riel / ha for those who need to use subsidiary pumping one time

- 120 000 riel / ha for those who need to use subsidiary pumping two times (one time from main primary or second canal to second or tertiary canal, one time from canal to field)

Box N° 6: Example of water fee negotiation: the case of the year 2005

2.6.5.2 Water fee collection

The problem of late payments

Meteuks have to collect water fees from the users and to give it to the contractor. They have to convince water users to pay the water fee on time. For that, they must do the rounds of their village regularly (every day or every two days) to ask for the missing amounts. Indeed, many users are paying late for both payments. Those who do not make the first payment on time (3 days after the first irrigation) gave us two different explanations:

- Some people told us that they are not able to make the first payment because they do not have the financial capacity at this time: they have to wait the harvest before they pay the totality of the water fee

- Some downstream users told us that they do not want to pay the water fee at the time of the first irrigation because they are not sure to get enough water. So they prefer to avoid to take financial risk and pay after they are sure they got enough water (generally after the transplanting) or even after the harvest.

Many users are also paying late their last payment (supposed to be done just at the harvest time). They explained us that they wait that the sales price of rice increases before they sell their rice and get the money to pay the water fee. Indeed as explained in a previous paragraph, the price of rice can increase by 100 riel in two months. At the end of our period of field work, in November, money was still missing (25 % in Kbal Por, 40% in Po, 44% in Rovaong, 70% in Thnot Chum), but meteuks told us that they

were only waiting to sell their rice at higher prices. According to meteuks and the contractor, downstream users are paying later.

There are no reprisals in case of delay in the water payment, even for those who pay the first payment after the harvest. **Nevertheless, to face the low collection rate of the first payment, the contractor added a new clause**: each village has to pay 1 million of riel (about 240$) before getting irrigation instead of the 50% of the water fee. We do not know if this clause has been decided during a meeting or by the contactor alone. The users refused to give money to the contractor before they get water. The *meteuks* from Po and Tro Peing Pon Lou told us that they borrowed 1 million of riel so that their village gets water quickly. The *Mephum* from Po told us "*I borrowed one million riel for paying the contractor because I was afraid that he will not give water to my village. I have to pay 35 000 riel of interest for this loan. But the users do not want to pay for that. Next year, I will not borrow this money!"* The *meteuk* from Kbal Por told us that he did an arrangement with the contractor: he did not pay the 1 million to get water but he has to tell to other people that he paid. In his opinion, Sok Touch had no choice: water users from Kbal Por would have taken water in the channel as soon as the pumping station would have started. The *meteuks* from Thnot Chum told us that he paid 200 000 riel to Sok Touch on June 10th 2005 and 800 000 riel 5 days later. According to the pumping list of Sok Touch, the pumping station was turned on in May 29th, that is to say 10 days before. According to the *meteuks* his village gets water after he finished paying but he was not able to say how many days after.

A high rate of water fee collection

Moreover, according to the contractor, the water fee collection rate is really high: only 2% of water users did not pay their water fee for early wet season rice in 2003 and 5 % in 2004. The water users from Tro Peing pon Lou and Po are better debtors than Kbal Por and Rovaong. The water users from O'Por and Thnot Chum are the worse debtors. Nevertheless, it was not possible to check these data provided by the contractor: he did not agree to show us his detailed accounts. Moreover, the number of hectares irrigated he gave us corresponds to the number of hectares irrigated paid by users after "reduction". Indeed, many water users do not pay the full amount of their water fee: small amounts are lacking, from 100 to 1000 riel per hectare. **The contractor tolerates these small amounts, particularly for those who pay on time**. He tolerates losses of 50 000 riel per village. **The irrigated surfaces he gave us do not take in account the surfaces corresponding to these small lacking amounts**. He only takes into account the outstanding payment of users who do not pay an important part of their water fee.

When we asked the users if they paid their water fee, two major answers have been given to us:

- **Some users told us that they paid their water fee because they are satisfied with the service** and wanted to get water the following year. Nevertheless they admitted that they deducted small amounts from their water fee (from 100 up to 1000 riel). One user told us that it was because the contractor wanted to count the nursery area as an irrigated area but he refused, so he did not pay the corresponding amount. They added that *meteuks* do not ask for these small amounts.

- **Others, which were not fully satisfied or even dissatisfied with the water service, paid their water fee to avoid problems**. Several users told us "*I pay my water fee because if I don't, meteuks will come in my house every day and I will feel ashamed*

of that". Others told us that it was because they were afraid to be summoned by the *Mekhum*.

- We met two families who did not pay their water fee. These families were poor and owned very small land. They did not get good yields and did not have the financial capacity to recover their expenditures. So **Mr Touch exempted them from water fee.**

When a user refuses to pay his water fee, *meteuks* come almost every day to ask for it. Then, if the user still refuses to pay, the *Mephum* tries to convince him "*by speaking"*. If he still refuses, the *Mephum* can threaten him to inform the *Mekhum*. According to the *mekhum*, when he summons someone he asks him to explain why he refuses to pay. If he is not convinced by this explanation he convinces him to pay. We did not manage to get the number of users summoned by the *Mekhum* regarding the outstanding water fee payments. According to the different stakeholders, most of water fee problems are solved at the village level. The contractor considers that it is the duty of the *meteuks* to make sure that the users pay their water fee. If they do not pay, the lacking amounts are subtracted from *meteuks'* allowances. The contractor can also exclude the bad debtors from irrigation service the following year, but it never happened.

2.6.5.3 The case of the late wet season rice 2004

When we questioned Mr Sok Touch about the water fee collection rate he did not tell us that he already had problems for collecting water fees. It is only after one month and a half of field work that one *meteuk* talked about a conflict between the users and the contractor regarding the late wet season 2004.

At the end of the late wet season 2004, the rainfalls stopped earlier than expected and the rice crops were suffering from drought. The users asked water to the contractor. After discussion, the contractor agreed to start the pumping station and the water fee was fixed at 80 000 riel/ha/pumping. As the crops needed water immediately to avoid losses, Sok Touch started to pump before the users signed any contract. The information collected regarding the irrigated surface and the rate of water fee payment are very contradictory between the stakeholders, and some stakeholder interviewed twice gave us two different answers to the same question. The people interviewed were not able to give the exact number of hectares irrigated during this season. And several times, they seemed to confuse the data of early and late wet season rice.

Most of the users told us that the contractor pumped only one time, although he committed himself to pump as much as users needed up to the harvest. According to the contractor, users from upstream villages paid their water fee. On the contrary many users from O'Po and Rovaong did not pay. According to *meteuks* and the contractor, 49 ha have been irrigated in O'Po at this time but only 1 790 000 riel have been paid (about 2 000 000 riel are lacking). In Rovaong about 1 500 000 riel are still lacking. *Meteuks* from Rovaong and O'Po told us that it was difficult to collect money for late wet season rice since the users from their villages did not get enough water. As they got losses, they refused to pay the water fee. Moreover, since they did not sign any contract and it was difficult to prove that they really used water from the pumping station, they cannot pressure them. Indeed, some farmers admitted they pumped water from the irrigation scheme one or twice in July 2005, for their nursery. They did not pay any water fee for this pumping. Moreover, some of them also pumped water into the channel at the end of

the crop, because of rainfall shortage. But according to them, "*we pumped before that when the pumping station did not work; the channels were full of rain water*".

In Sok Touch's opinion, several villagers took water from the pumping station although they did not ask for water during the meeting. As a consequence he was afraid they would refuse to pay the water fee and stopped pumping.

3 ANALYSIS OF MANAGEMENT AND FUNCTIONING OF THE IRRIGATION SYSTEM

As stressed out in the first part of this report, conditions of elaboration of rules will influence the way they will be understood, accepted by the stakeholders and so respected in practice. We are now going to present the condition of elaboration of the rules supposed to organize the management and functioning of the Kbal Por pumping station community. Then we will describe their content. Afterwards we will analyse how the users understand these rules and how it influences their practices. Last we will analyse the internal organisation of the irrigation system and its relationships with its environment.

3.1 ELABORATION OF THE RULES

In a first time, two meetings have been organised to discuss the conditions of the private entrepreneur's participation in the rehabilitation and the management of the irrigation system (cf report of the two meetings in Annex 16).

The first meeting has been organised in the Pneat pagoda, in *Phum* Kbal Por the August 26th 2002, in the presence of Mr Koy Sokhunthea from PDAFF, the commune council, the contractor and several villagers (66 people). First, the *Mekhum* presented the contractor. Then, with the agreement of the commune council, the entrepreneur committed himself to:

-"Remove"[29] the old engines and install three new pumping engines with 350 horsepower, at the price of 150 000US$

- Rehabilitate the main channel;

- According to the price of the fuel, the water fee amount will be (1) 140 000 riel for the direct irrigation, (2) 110 000 riel for those who have to do subsidiary pumping;

- Rebuilt the pumping station;

- Sign a contract for duration of 15 years;

- If, at the end of this period, he does not win the invitation to bid, he will neither ask for any compensation regarding his expenditures of the rehabilitation of the channels and pumping station nor take back the pumping engines.

After the presentation of these choices, Mr Koy Sokhunthea asked the villagers if they agreed with these elements. They agreed with all of them, except with the water fee amount. After a three hours discussion, the water fee amount was fixed as follows: (1) 150 000 riel for the direct irrigation, (2) 110 000 riel for those who have to do subsidiary pumping. It is still unclear whether this report mentioned that water fee was supposed to follow the evolution of fuel or not.

A second meeting has been organised on October 22nd 2002, in Por Ampel Pagoda, in *phum* Po, with the participation of the contractor, Mr Koy Sokhunthea, the *Mephums* and the villagers. At the end of this meeting, the following agreements have been chosen:

[29] According to the translator who translated the meeting report, "remove" means "leave it to one side"

- The water fee amount for the early wet season rice is fixed as follows: (1) 150 000 riel for the direct irrigation, (2) 110 000 riel for those who have to do subsidiary pumping;

- The water fee amount is the same whatever the duration of the irrigation cycle (the water fee amount will not be reduced if the irrigation is stopped before the harvest);

- The contractor commits himself to provide a "constant level of water in the channel from sowing to harvest".

Summary

This part stresses on three main points.

- First, meetings have been organized between the different stakeholders before drafting the contracts. Nevertheless, except for the water fee amount, the water users did not take part into the rules formulation.

- Secondly, **the water fee amount was already an element of discussion between the users and the contractor before the start of the irrigation system**.

- Last, **several essential points not have not even been mentioned, such as the level of service which should be provided by the contractor or the authority in charge of the water allocation between the users.**

3.2 THE CURRENT CONTRACTS AND THEORETICAL RULES

According to several actors, a first contract has been signed between the *mekhum*, the *meteuks* and the contractor in 2003. **This contract was supposed to last 15 years with a fixed water fee amount, but because of the fuel price evolution, it is rewritten every year.** Nevertheless, because of problems of translation and as the dates were not written on all the contracts, we did not manage to follow the evolution of the elements broached in the successive contracts. We will only detail here the 2005 contracts, which have been written by the contractor, with the advices of Mr Koy Sokhunthea and the approval of the commune council:

The first one is the contract regulating the water distribution. There is one contract per village, signed by the contractor, the Mekhum (as witness) and the chief of the *meteuks*:

"Water distribution Contract":

- Contractor has to supply **enough water** into the main channel;

- Contractor does not guaranty the direct irrigation;

- Contractor will not be responsible for any properties damaged which are located on the main canal or dams;

- Water users have to organize groups or communities which have land area at least 20 ha to get water from the station

- Water users have to pump water from the main channel by themselves and do not have to block canals without permission from *meteuks*;

- Water Users have to provide information immediately in case of water shortage;

- Water users have **to maintain secondary channel, dams, and dikes**.

If farmers refuse to use water from the station, and if, by going to paddy field to measure, and the station see them transplanting, if the station has enough evidence that these farmers are using water from the pumping station, they will be fined double price.

Special case: If any paddy is damaged more than 30% the station will pay for seeds and labour cost, but the station will not pay for paddy damaged less than 30%.

This contract will not be done by any force from any party and will be acknowledged after signing it.

Note: This contract contains 3 copies:
- Party "A": the original
- Party "B": one copy
- The station office: One copy

Box N°7: "Water distribution Contract":

A second contract is done to regulate the *meteuks*' functions. One contract is done in each village. It is signed by the contractor, the *mekhum* as a witness and the chief of *meteuks*:

Contract of water chiefs:

"I am ….., sex, age, living in ….village, Sambour Commune, Traeng District, Takeo Province, takes position as a chief of water or customer[30] who uses water from the pumping station.

- Our station will give money 10 000 riel/ha

- Co-Conditions between *meteuk* and entrepreneur:

1. Chief of water has to cooperate with the station and farmers in order to control water delivery system, dikes, and dams and to limit the time for pumping.

2. Chief of water has to be responsible for maintenance at the place where excavator can not access.

3. *Meteuk* has to be responsible for the payment of 50% of the amount of water fee 3 days after pumping which have water in each village (problem of translation?).

According to the principles and conditions stated above, I am the chief of water or customer using water from the station, I will be fully responsible for every loss of advantage to the community.

Note: I am …., chief of water, if I am not respecting these conditions, I will be fully responsible to the authority".

Box N°8: contract of water chiefs

Our interviews with the different actors concerned by the irrigation system stressed on **several divergences regarding the content, the signification and the application of these contracts and rules** supposed to run the functioning of irrigation system.

3.3 DIVERGENCES IN THE UNDERSTANDING OF THE IRRIGATION SYSTEM RULES

There are three main explanations for these divergences of points of view.

1) Lack of transparency

First, very few people really know the content of this contract. Only the entrepreneur and the *mekhum* own one original copy of the "water distribution contract". The entrepreneur told us that he gave one copy of this contract to all *mephums* and chiefs of *meteuks*. Nevertheless, only the chief of *meteuks* from Thnot Chum told us (and showed us) that he had one copy in his possession. The contractor also placed one copy in the drinking water station (where his staff is located). Our surveys stressed on that, **apart from the commune council and Mr Sok Touch, the other actors have a poor knowledge of the terms of the contract** ("*I do not know it well*").

2) Lack of clarity

Secondly**, the terms of the contract are far from being precise and exhaustive**: many points stay vague regarding undertakings of each one. For example, the clause regarding the level of service that the contractor has to provide is too vague: the terms "enough water" is not explicit enough, as users and contractor may have very different views of what "enough water" means. The interpretation that is done by the different

[30] According to our translator, this part is not clear in the Cambodian version

actors varies a lot, according to their functions (in and out of the irrigation system), their knowledge about the contract, and their location on the irrigation scheme (upstream or downstream).

3) Lack of interest from users

We want to underline that **the contradictions existing between the interpretations of the contract which are done by the different actors can admittedly be explained by the lack of preciseness of the contract, but also by their own interest regarding the irrigation scheme.** As we already explained each actor involved in a collective action follows his own individual interest: each one tried to give us a picture of the Irrigation System which could be profitable for himself. Thus **the water users may have tried to blacken the quality of the water service in order to get some financial help from NGO or government to purchase fuel[31], although the contractor may have embellish it to get some support for legal recognition**. It is not always easy to establish the stance of the actor interviewed and his own interests regarding the irrigation system, in order to make allowance for falsehood (or exaggerations) in the speech of each one and settle the different points of view.

Illustration of the bias which could exist in the stakeholders' speeches:

According to the meetings and the people who were present, the speech regarding the quality of the water service may vary a lot for a same actor. For example, the village authorities from Thnot Chum, during a meeting organised for the visit of Mr Fontenelle (GRET), Mr Balmisse (French technical assistant in MOWRAM) and five national consultants, drew a very black picture of the service of water distribution (and of the irrigation system as a whole): "*Thnot Chum never get water, in 2005 we get 1T/ha,…*" On the contrary during interviews I carried out with my translator only, the results stated by these same authorities and other water users were fare from being so disastrous. The chief of *meteuks* admitted that he blackened the picture of the situation in the hope of receiving external support (for example to purchase fuel). According to what he said to us, only people who have plots far away from channels seems to get such bad yields. The water users interviewed in this village told us that they obtained yield of the order of 3T per hectare. This example illustrates how much it may be difficult to discern the level of exaggeration in the actors' speech and how much it may be useful to cross the points of view of different stakeholders on a same question.

Box N°9: Illustration of the bias which could exist in the stakeholders' speeches

Crossing the different interpretations of the contract appeared to us as a good way to crystallize the different nubs of power and conflicts which may oppose the different actors of the system. Indeed as stressed out by Crozier and Friedberg (1977), an organisational "construct" corresponds to some kind of power structuring between the opposing parties. By revealing this power structuring and the assets and constraints it imposes to the different categories of stakeholders, one can understand the rationality and the strategies of each of these categories.

« Ce construit correspond donc à une certaine structuration du pouvoir entre les parties en présence. La mise en évidence de cette structuration du pouvoir, et des opportunités ou

[31] We have to remain that they already get this kind of help in the past, from ACR and PDAFF. Moreover, several neighbouring irrigation systems get financial help.

contraintes qu'elle impose ou fournit respectivement aux différentes catégories de personnel, permet de comprendre la rationalité des stratégies que l'on peut déceler dans chacune d'elles. » (Crozier and Friedber)

In the following part we are going to present the different interpretations of the contracts given to us by the different stakeholder, the way they apply theses rules in practice and the eventual conflicts may follow. For each stakeholder, we will endeavour to analyse these points of view in the light of the personal interests of the different stakeholders.

3.4 INTERPRETATION OF THE CONTRACTS, CONFLICTS AND NUBS OF POWER

We area now going to present the different interpretations of contracts in the five main issues we identified: the water distribution, the water fee, the maintenance, the extension of the irrigation system and the particular case of the late wet season rice 2004.

3.4.1 Water distribution

The water distribution is a central issue. It is quoted as a problem by most of the actors surveyed and is the subject of the most opposite points of view.

1) A level of service not defined

As we stated in a previous paragraph, the clause of the contract regarding the water distribution is too vague: "the contractor has to provide *enough water* in the main channel". But the contract does not precise what "*enough water*" means: How much litres of water? How much hours of pumping? Who can decide what enough is? How?

Indeed, what is "enough" from the contractor's point of view is not necessarily enough from the users' one. Thus, according to the entrepreneur, this clause means that "*There must be a little water in the main channel all the time*". On the contrary, according to *meteuks* and users it means that "*all the channels, from the main channel up to the water course, have to be full of water*". All users and *meteuks* agree to say that the entrepreneur does not fulfil this clause. The downstream users (particularly the users from Rovaong and Thnot Chum) are complaining that they never get enough water. The arguments used to support this point of view vary with the actors.

First **the number and duration of pumping** is often questioned, particularly by the downstream users and *meteuks*. The *meteuk* of Thnot Chum told us that his village never gets enough water mostly because "*Mr Sok Touch never pumps enough, he always finds some excuse for not pumping.*" Even the upstream users, who globally say they are satisfied with the water service, consider that the contractor does not provide all the users with enough water. According to the *Mekhum* and one of his assistant, the contractor does not supply enough water. Nevertheless, they consider that he makes a great effort to satisfy the users' needs, but he has to face several difficulties, such as the lack of water in the river (due to the delay of the rainfalls) and most of all, the increase of the fuel price. Moreover, they consider that the pumping engines are too small: "*if a saucepan is just bigenough to cook rice for 3 peoples and then 5 peoples come to eat, there will not be enough rice for everybody"*. They also argue that people are always complaining: "*They all get benefits thanks to irrigation, but they keep on complaining because they want to get more by paying less."*

Moreover, beyond the quantity of water which has to be supplied by the contractor, the current problem lies also in the fact that **the responsibilities of the different actors are not defined clearly: who has to organize the allocation of water between the users?** This question amounts to define the level of service which has to be provided by the contractor: **is he responsible for the water distribution up to main channel, secondary or tertiary ones**?

According to the current contract, "*the contractor has to provide enough water in **the main channel***". On one hand the contractor seems to have fixed the theoretical water turn we already described. He also seems to have a real authority on the question of the water allocation: we have seen several *meteuks* and farmers asking the contractor to give water to their village and Mr Touch giving orders to *meteuks* to open or close such and such gates. On the other hand, after he has allocated water to a village, he considers that he is not responsible for the control of this allocation: "*It is the meteuks' duty to prevent, stop or solve the problems of water theft during their village's turn"*. This statement amounts to say that the contractor is in charge of the water distribution in the main channel only and that *meteuks* are responsible for the allocation between the different villages. According to the *Mekhum*, it is the duty of the *meteuks* to make sure that users get enough water and to ask for water to the contractor if users need more water. In fact the *meteuks* have to pick up the keys of the gate from the entrepreneur's staff, in the pumping station or the "pure water" station when it is their villages' turn to get water. Moreover the contractor's staff is also involved as they have to watch the opening of the gates.

Thus beyond the problem of the allocation of water, **the problem of the control of the respect of this allocation** is coming up. Indeed, the lack of pumping is not the only reason to explain that downstream users do not receive enough water: the problem of water thefts at the upstream level is also implicated.

2) The problem of water thefts

There are two kinds of water thefts, which are not perceived in the same way: the water theft by pumping in the channel outside of its turn, and water theft by opening or closing gates.

- Pumping outside of one's turn

Most of the upstream users and *meteuks* and part of the downstream ones **do not talk about "*water theft*" when upstream users are pumping water from the channel outside their turn**. It appeared to us that **the notion of water theft is strongly linked to the one of water turn**. According to these speeches, the water turn is not recognized or even known by many users. As a consequence, the fact to take water at any time is not necessarily seen as an offence.

The different views voiced regarding the "water theft"

- The *meteuks* from Kbal Por and Po do not consider that the users steal water: "*Sometimes farmers are not available during the water turn of their village. So they have to take water during the other villages turn. They have the right to do that as they also pay the water fee."*

- The *meteuks* from downstream villages (Thnot Chum, Rovaong and O'Po) deem that in fact, the water turn is never respected after the first week of irrigation: the upstream users are taking water from the channel at any time they need it.

- The majority of the upstream users interviewed told us that "*I do not know the water turn, I take water when I need it* or *when there is water in the channel*" and even that "*there is no water turn*".

Moreover, even if the downstream users criticize the fact that upstream users are taking water at any time, they consider that this problem is directly due to the fact that Mr Sok Touch does not provide enough water "*The upstream users are taking water outside their turn because they do not get enough water during their turn, as Mr Touch never pumps enough*".

Furthermore, the *meteuks* from Rovaong and Thnot Chum do not want water turn: according to them their villages receive less water with water turn "*when there is no water turn, we can receive at least a small volume of water all the time. Although with the water turn, we do no receive water during the turn of the other villages, but we do not receive more water during our turn, as the other users do not stop to pump."*

Box N°10: Different views voiced regarding the "water theft"

In fact, there is an ambiguity in the speech of many users: according to the upstream users, there is no water turn, so they can pump water at any time. According to the downstream users, there is a water schedule, which should be stopped because the upstream users are pumping at any time. According to them, it is not possible to ask the upstream users to stop pumping water during their turn (they also need water, and there is no way of control). Going by what they said to us, the solution seems to be simple: the contractor has to put more water in the canal…

On one hand it is probable that the contractor does not always pump as much water as requested by users. Indeed, he invested more that 100 000 US$ in the rehabilitation of the irrigation system but this investment is not secured as he did not get any legal recognition. As a consequence he may try to limit his fuel expenses in order to increase his profits.

On the other hand, it is also probable that users exaggerate the responsibility of the contractor and lighten the part of water thefts in the water distribution problem. Indeed our field observations in June allowed us to observe the real impact of the water theft: although the third main channel was full and the gates N° 2 and 4 were closed, the water did not flow up to Thnot Chum which was asking for water since several days. About 10 users were pumping in the third secondary channels, before the village of Rovaong and the channel was already quite empty at the end of *Phum* Rovaong. This example shows us that the impact of the water theft should not be neglected. Indeed, 10 pumping engines of 5 horsepower pump about 300 L/s, which is far to be inconsiderable.

- Opening or closing gates outside of one's turn

There is another form of water theft which may be the cause of conflicts between the users themselves: the opening or closing of gate or dikes by users outside of their turn. This problem concerns just as well downstream than upstream users. If upstream users do not consider the fact of pumping outside of their turn as an offence, they admit that it is not allowed to touch the gates and dikes during other villages' turn and this kind of offence is seen and called "water theft". As detailed in the previous paragraph dedicated to the description of water distribution, several problems and conflicts between users already occurred because of this kind of water theft.

These troubles make us question the problem of the control of the water turn respect. **Who has the responsibility and the authority to control the users and to intervene?**

Different views voiced regarding the authority responsible for controlling that users respect water turn:

According to the users and the contractor, it is the duty of the *meteuks*. However the contractor told us that in case of tension (as this year at the transplanting time) he is on his round on the irrigation scheme at night with his staff. He never needs to intervene during his round, as his presence has a deterrent effect on the users. The *meteuks* try to watch the users and the gates during the water turn. They say that their presence may be deterrent, but most of the time**, when they catch someone taking water outside of his turn, they can only talk to him:** "*I tell them that they do not have to take water. But most of the time they reply that they missed their turn and they ask me to let them pump."* And "*if I refuse, they implore me or they say that they also pay their water fee so they can use water when they need it".* Beyond the discussion, there is nothing else they can do: "*I can not confiscate the pump and I can not call the police. I do not want to get in the middle of the conflict. The only thing I can do is to talk with them".*

The conflict may occur, particularly in the case of opening or closing of gates or when there is competition for the water resource (as this year at the transplanting time). In this case the *meteuks* can ask the help of the *Mekhum* or the contractor. Indeed, according to some *meteuks*, it is the duty of the contractor to solve the conflicts regarding the water distribution. According to others, it is the duty of the *Mekhum*. But most of the *meteuks* surveyed agreed to say that they rarely intervene: "*They do not come immediately, and then they say that it is in the past now, it is not useful to talk about it".* Moreover, even the *Mekhum* told us that he can not do more: "*I do not want to call the police for that: they are not criminals, they all pay a water fee. All users are member of my commune; I can not favour one part of them."* On the contrary, the contractor told us that *meteuks* never complain to him at the moment of the offence. They always come later "*and tell me the problem, by laughing*".

Box N°11: Different views voiced regarding the authority responsible for controlling that users respect water turn

The contract does not define any authority responsible for the control of the respect of the water allocation. As a consequence, water theft practices increase and no-one has neither the intention nor the authority to intervene efficiently. There are numerous cases of water theft in the upstream part of the irrigation scheme. If most of the time there is no conflict between users, these water thefts may have a real impact on the water availability in the downstream part. The multiplication of these offences may have a real negative impact on the irrigation system functioning.

3) Lack of external control

Furthermore it is difficult for us to assess in which extent the users' complaints are ju12stified. Indeed, we did not observe the entire irrigation period **and there is no external control of functioning of the irrigation system.** The contractor lists the number of hours of pumping, but his list is not controlled and does not notify which village gets the water. As a consequence, it is difficult to assess the quality of the service provided by the contractor.

According to the *Mekhum* there is a self-regulation of the irrigation system: if the contractor does not provide sufficient water to the users said, they would not pay the water fee and they would stop to ask for irrigation the following year. On the contrary, most of the water users pay their water fee and the irrigated surfaces increase every year. In his opinion, that means that water users get satisfactory results thanks to irrigation but "*they try to get more water by paying less money, that's why they criticize Mr Sok Touch so widely.*" In his mind, due to this self-regulation, there is no need of external control.

Summary

The points of view of the different actors regarding the water distribution are very opposite. **The numerous inaccuracies and the lack of control in the contracts allow to each one to defend his own opinion which reflects his individual interest. The problem of the water distribution crystallizes the power struggles existing between the users and the contractor.** At this stage of our analysis, we can suggest the following assumption: the water distribution is an area of uncertainty that both users and contractor try to dominate.

On one hand, the contractor tries to overcome this area of uncertainty in order to satisfy his individual interest which is to increase his profits. But the pursuit of his own interest is limited by the necessity to satisfy a minimal level of service to the users so that they pay their water fee.

On the other hand the users try to limit their own investment (in term of money and time). They lighten the responsibilities of the upstream water theft in the problem of water distribution of the downstream users and focus on the responsibilities of the entrepreneur: t**hey prefer to blame him for his service, rather than invest themselves in collective organisation**. Their contradictions and behaviour regarding the implementation of water turn confirm this hypothesis. We have to underline that this hypothesis does not mean that the quality of the service provided by Mr Sok Touch does not have to be questioned. It only means that the quality of the service is not the only responsible for the problem of water distribution to downstream users and that the organisation of water allocation and its respect by users are also involved.

Currently, **the system is in equilibrium between the individual interests of the different stakeholders. Nevertheless, this kind of equilibrium is precarious**. If one of the party goes too far (for example the contractor does not give enough water, or the downstream users take too much water) this balance can be upset and all the functioning of the water system can be cast doubt over.

3.4.2 The water fee

1) Another source of conflict between users and contractor

The water fee is another key element of the conflicts between the users and the contractor. This point illustrates once again the opposition of the individual interests of these two parties:

- On the one hand the users and their representatives complain that the water fee amount is too high. Indeed, they want to decrease the expenses for water fee (without decreasing the quality of the water service) in order to decrease their intermediate expenses and increase their profits. Most of the users insisted on the fact that the contractor promised, in the first contract, that the water fee amount will be the same every year.

- On the other hand, the contractor tries to increase the water fee amount in order to recover his investment. As we will see in a following part, the contractor does not have any legal recognition for the rehabilitation and the management of the irrigation system. As a consequence he has to recover his costs as soon as possible. Indeed the water fee amount (between 160 000 and 240 000 riel per hectare) is higher than those of many other irrigation systems (managed by FWUCs, with or without external support) which varies from 8 000 up to 200 000 riel/ha[32].

Even if the users criticize the water fee amount, the rate of water fee payment is high (at least for the early wet season rice). There are two main explanations for this high rate:

- T**he users get good economical results for irrigated crops which represent an important part of the family income** (30%), which is defined as an essential prerequisite so that users are motivated for paying water fee;

- **The users are already used to spend money for irrigation** as they have to purchase fuel for individual pumping during the flood recession rice;

- Moreover **there is some kind of social pressure at the village level**: several users pay because they would feel ashamed if the *meteuks* came every day or they are afraid of being summoned by the *Mekhum.* They are afraid that their neighbours know that they did not pay their water fee. This behaviour may be explained by one characteristic of the Khmer society which is the respect of social harmony: users may be afraid of distinguishing themselves from other users who pay the water fee. Nevertheless, in many Cambodian irrigation schemes, this traditional respect for social harmony does not prevent several irrigation systems in Cambodia to get very low water fee collection rates. The two other assets of Kbal Por irrigation system may favour the respect of this social tradition.

2) The problem of free riding

Furthermore, despite this high rate of water fee collection, the contractor has some problems for collecting it: **many users are paying late and small amounts are lacking for each user**. **There is no coercive measure to stop this kind of offence**. The contractor partly offloads the impact of these offences onto the *meteuks* as he deducts the lacking amounts from their allowances. As demonstrated by E. Ostrom (1992) this

32 According to the summary of results obtained from field surveys of the team responsible for water sectorial review

kind of "free riding", when it is not repressed, may increase rapidly. Free riders, who do not pay the total amount of their water fee *"will receive a disproportionate share of benefits"* and the people who pay the entire water fee will feel like "*sucker*". If there is no punishment, other people will stop to pay the entire amount to avoid being "*suckers*". *"If free riding becomes the dominant mode of behaviour (…) all users are ultimately hurt."* Indeed the additional lacking amounts may have a negative impact on the contractor's profits and on the viability of the system.

3) Different levels of water fees?

Currently there are three different levels of water fees according to the way the water is driven from the channels of the irrigation scheme up to the users' plot. This measure appears to us as necessary as some users have to do two subsidiaries pumping to irrigate their field although others have only to open a dike. Nevertheless this differentiation of the water fee amounts may not be enough to satisfy users. Indeed as we explained before, **the water service provided to downstream users is worse than the one for upstream users. As a consequence they have to invest more time in their crop** (to watch if water is flooding in the channel) **and to innovate which implies to take more risks**. Indeed most of the upstream users told us that they did not try to broadcast early wet season rice because it was too risky as they never tried to do it for this crop before. Downstream users get good results and since their innovation (broadcasting) allowed such good results, many upstream users are thinking about broadcasting also. Nevertheless, the question of different levels of water fee for downstream and upstream users has to be questioned, as long as upstream users will not respect water schedule. If the quality of the water service is not improved, the downstream users should have to pay smaller water fee. Another solution may be to improve the water service by fining water theft and ascertaining that contractor provides enough water to satisfy users' needs. Both solutions have to be discussed with the users, the contractor and the local authorities.

Summary

The water fee is another source of conflict between the contractor and users. The personal interests of these opposing parties are more opposite than for any other elements. Indeed the contractor wants to increase the water fee amount although the users want to decrease it. As a consequence, several users do not pay the total amount of the water fee. As there is no sanction against this offence, this behaviour may increase. Last, as long as the downstream users get less water than upstream ones, they should have to pay less money for this service.

3.4.3 The Maintenance

As stressed in our presentation of the assets and constraints of the physical infrastructures, the channels have to be maintained regularly. **According to our observations the maintenance of the channels is too limited to repair the numerous damages sustained**. Indeed, during the rainy season, the villagers damage the channels for fishing. At harvest time in December, trucks and oxen-carts are coming into the fields to transport the harvest, damaging the dikes of the canals.

Once more, this problem is largely explained by the vagueness of the contract which only states that "*users have to maintain secondary channel, dams, and dikes*". The modalities of this maintenance are not defined (when? How?). Furthermore**, the notion of "maintenance" is not understood by the different actors**: according to users, *meteuks*, but also the commune council and the contractor, maintenance is a matter of repairing the channels when they are damaged, that means to warp the bounders (to avoid water losses from their field) or remove the small soil dams (to allow water to flow up to their fields). **No one mentioned a regular clearing out of the channels**. Last, **there is no element in the contract regarding the damage made by villagers on the channels**: villagers can damage it without being afraid of eventual sanctions. Nevertheless, since the irrigation scheme has been rehabilitated only three years ago, it is difficult to assess if the current level of maintenance is not sufficient to guarantee the water distribution. Indeed, the "optimal" level of maintenance is not necessarily the "maximal" one, but rather the one optimizing the cost-profits ratio. To answer this question, we would have to be able to study the impact of this level of maintenance on the water distribution during a longer period.

There is also a contradiction on the entity responsible for this maintenance. The majority of the local authorities and *meteuks* agree to say that the entrepreneur is responsible for the clearing out of the main channel. On the contrary, they disagree regarding the entity responsible for the other channels. For most people, the entrepreneur is also responsible for the secondary channels, and the users have to "maintain" the inferior levels. For some others (particularly the *mekhum* and one of his deputies) the contractor has to "maintain" all the channels, except the water course dug by the users to reach their plots. According to the contractor, it is the duty of the *meteuks* to organise the reparation of the channel by the users, in all the places where the embankments are too small to go with the excavator (the end of the secondary channels and all the inferior levels).

In practice, Mr Sok Touch clears up every year, in April, the concrete part of the main channel and repairs the principal damages of the primary channel and the upstream part of the secondary ones. He also has to clear up the supply channel upstream to the pumping engines every year, as this supply channel is partly destroyed because of the annual floods. He does not plan any other maintenance: machines and other materials are repaired when they have failures.

Another problem concerns the installation of culverts ("*lou*") by villagers to cross the channel and reach their house. Most of the villagers use culverts with small diameter which slow down the water flood. According to several stakeholders and our observation, these small "*lou*" may have a negative impact on the water delivery to the downstream villages. This problem is particularly strong in Rovaong. Nevertheless, there is nothing on the contract regarding the installation of culverts and nobody wants to spend money to purchase bigger *lou*: according to the contractor, it is the duty of the villagers or the *Mephum*, according to the *Mephum* it is the duty of the contractor…

Summary

The level of maintenance is very low although the damages are numerous and regular. Here again each party tries to invest itself as less as possible and put the blame on the other party. And here again, **the vagueness of the contract favours this kind of passive behaviour**. Nevertheless, **the lack of maintenance may have a strong negative impac**t on the irrigation system functioning in the short or medium run.

3.4.4 Extension

There is no element regarding the extension of the irrigation scheme in contracts. Nevertheless, the contractor has extended the irrigated area every year since the beginning of the Kbal Por pumping station community. According to the different stakeholders' views, we can distinguish two kinds of extensions: the one done within the commune of Sambou, and the one done outside of the commune.

Extension within the administrative limits of the commune of Sambou

Several channels have been rehabilitated by the contractor between 2003 and 2005 within the administrative limits of the commune. Two channels have been rehabilitated on user's request: one in Thnot Chum and one in Tro Peing Pon Lou. In both cases, the views differ on the way these channels have been rehabilitated.

Different views on the way irrigation scheme can be extend:

In Thnot Chum the users told us they have rehabilitated manually 600 meters long of tertiary channel. The contractor advances his participation in this work and showed us a photo of him pick-axing into the channel. According to the village authorities, they did not get any help from the contractor (neither financial, nor material aid) he only came to take the picture…

The users from Tro peing Pon Lou also dug a 150 meters long tertiary channel. Here again the contractor's involvement is source of contradiction. The contractor claims that he paid the water users who dug the channel, although the village authorities told us that they did not get any support from him. Moreover, in May water users from Tro Peing Pon Lou asked Mr Touch to rehabilitate another channel (1 km long). Even if villagers promised to finance part of the work up to 500$, Mr Touch, who gave his approval during a previous meeting, finally refused to do this work. According to him, the work would be too expensive (much more than 500$) because the channel has been filled again and across one village. To avoid conflict with these villagers he does not want to dig the channel.

Box N°12: Different views on the way irrigation scheme can be extend

In both cases, the project of extension was discussed between the contractor, the *Mekhum* and villagers who owned plots along the channel supposed to be rehabilitated. The other water users of the irrigation systems were not consulted. All stakeholders interviewed on that point consider that **only the water users who can use this part of the channel are concerned by the rehabilitation decision**. The others do not have to give their point of view. **This point demonstrates the "individualist" nature of the water users' behaviour**. But most of all, this point stress out **the lack of collective**

action in the decision-making process. This involves the contractor and people directly concerned only. It is just like if the infrastructures belong to the entrepreneur who can decide alone what to do with them.

Thus the *Mephum* from Tro Peing Pon Lou admits that the rehabilitation of one channel in his village may induce problems for the water distribution in downstream villages (by reducing the quantity of water available), but he considers that his duty is "*to improve the conditions in his own villages before he looks after the ones of other villages*". Even the downstream water users share this point of view "*Upstream villages do not have to consult us if they want to dug new channels, it is their right to do so*".

Extension out of the administrative limits of the commune of Sambou

In 2004 and 2005, the contractor provided water to four villages of the commune of Srangkae. The downstream (especially those from Rovaong and Thnot Chum) water users from Sambou did not appreciate this contractor's decision. Nevertheless, some users from Kbal Por told us that they ignored that Mr Touch gave water to people outside the commune of Sambou.

The *Mekhum* of Sambou is the only *Mekhum* who signed the first contract with Mr Sok Touch in 2003. According to the water users from Sambou, that means that they have priority: "*Sok Touch signed a contract with our commune. In this contract he commits himself to provide us with enough water. He can not provide water to other as he does not give us enough water*". Nevertheless, even if they consider that the contractor has no right to extend the irrigation system to other communes, they admit that they have no duty to take decision on that point. Indeed only the *mekhum of sambou* can take this kind of decision and he already signed a contract with the contractor and the *Mekhum* of Srangkae. If the users criticize the fact that the contractor decided to distribute water to people out of the commune, they do not call into question the right of the *Mekhum* to take that kind of decision alone. It may be consider as a kind of recognition of the authority of the *Mekhum* regarding the irrigation systems. Nevertheless this extension has already turned into conflicts between users from Sambou and users from Srangkae (cf. the conflict regarding the door N°7).

These different reactions between extension within and outside of the limits of the commune show that there is a notion of water right linked to the commune.

Moreover **the contractor told us that he does not care about displeasure of users from Thnot Chum and Rovaong**. According to him, "*They are always complaining. I have always problem to collect water fee in these villages. It is not my fault if they do not get enough water: the water is not flooding properly up to their villages. On the contrary, the water flood properly up to Phum Kork and I have no problem to collect water fee"*.

Summary:

To sum up, **the extension of the irrigation system is another source of tension between the contractor and users and even between users themselves**. The contractor seems to have the upper hand on this point: he is planning to extend again the irrigated area in the Srangkae Commune but, according to what he told us, he is waiting to get a legal recognition before he invests more in this irrigation system. Moreover, the extension of the irrigation system outside of the Sambou commune starts to arouse some users' anger and induced the most important conflict between users. As a consequence, we can suppose that this point may have negative incentive on the relationships between some users (mostly those from rovaong and Thnot Chum) and the contractor and on the irrigation system in the medium or long run.

3.5 DIAGNOSIS OF THE IRRIGATION SYSTEM MANAGEMENT

3.5.1 A precarious balance?

Our agro-economical analysis stressed on that water users from Kbal Por pumping station get good agro-economical results for their irrigated crops, higher than in other Cambodian areas. Moreover, the rate of water fees collection seems to be high and the irrigated areas have increased every year.

Nevertheless the previous parts stressed out how much the numerous inaccuracies in the rules feed power struggles between the different stakeholders. These inaccuracies encourage the multiplication of behaviours (such as stealing water, not fulfilling his duties, etc.) which may have strong negative incentives on the functioning and the viability of the system:

1) Inaccuracies in the service definition

The contract does not define precisely the boundaries of the service area and the individual or households with rights to use water from the Kbal Por irrigation system. As a consequence, the contractor can extend the irrigation system as he wants, without taking into account the opinion of the other water users. For the moment he never excluded any users from the service but it may happen, as shown by his speech regarding the village of Thnot Chum: "*if water users from Thnot Chum continue to pay late and to criticize my service, I will provide water to users from Srangkae commune instead of them*".

Moreover, the level of service that the contractor as to provide is not clearly defined. **The identity responsible for the water allocation between the users is also not clear** (is it under the responsibility of users? *Meteuks*? Contractor?). In the same way, the amount of water that an irrigator is allocated is also not specified. As a consequence, it is difficult to assess the quality of the service provided by the contractor, the veracity of the users' complaints and to solve the problems regarding this point.

2) Inaccuracies in the maintenance definition

The level of maintenance which has to be ensured and the entity(ies) responsible for it are not defined. As a result the different stakeholders invest themselves as less as possible in this activity and the infrastructures may become too much damaged to allow a good water distribution service.

3) Inaccuracies in the sanctions definition and in the appointment of the authorities in charge of applying these sanction

The entity(-ies) responsible for controlling and maintaining the rules is (are) not clearly defined (is it the role of *meteuks*? Of contractor? Of *Mekhum*?) In the same way, the sanctions which have to punish the eventual rules transgressors are not contractually defined. As a result there is an important risk of seeing the transgressor behaviours increase.

Our opinion is that the irrigation system is currently balanced: there is a problem in the water distribution particularly for the downstream users who get less water than the upstream ones. Even if the agro-economical analysis does not show any significant difference between the results of the upstream and the downstream users, it does not mean that there is no problem in the water distribution. The good agro-economical results of water users may be explained by their high technical skills regarding rice cropping and their good adaptability which allows them to soften the impact of eventual dysfunctions of the irrigation system. Nevertheless if this problem is currently limited and the system is balanced, this balance can be upset if the unruliness and the power struggles between the users and the contractor increase.

The case of the late wet season rice in 2004 is particularly enlightening on the risks caused by the contract inaccuracies.

3.5.2 The particular case of late wet season rice

There is nothing in the contract regarding the organization of the late wet season irrigation. The contractor does not consider that he has the duty to provide water for the late wet season: the users have to organise meetings to convince him. In 2004, at the end of the late wet season, most of the upstream users paid the fee for this irrigation (according to the contractor about 30$ were missing). On the contrary about 800 $ were missing in two downstream villages (Rovaong and O'Po, no data for Thnot Chum) as many users were dissatisfied with the service.

In our opinion this conflict illustrates how the balance of the irrigation system can be upset. Indeed the decision to irrigate has been taken in a hurry and users did not sign any contract. Moreover, it is more difficult to control who takes water from the irrigation scheme than for early wet season. At this time, only those who get water from the irrigation system can crop rice, others have to wait the rainfalls. On the contrary, for late wet season rice all users sow their crop almost at the same time. Furthermore, the contractor did not have time to ask users to sign contracts before to start the pumping station. As a consequence, even if several farmers commit themselves to take water, he did not get any assurance on the number of hectares irrigated. In fact many users, who did not commit themselves during meeting, took water when the

contractor started pumping. **Worrying at not being paid by all users, the contractor limited his expenditures for fuel and did not pump enough to satisfy all needs**.

According to the *meteuks* from Rovaong and O'Po the contractor stopped to ask for the lacking water fee. Indeed he provided water for early wet season 2005 to those who did not paid for late wet season even so. Nevertheless when we left the area at the beginning of December, there was no rainfall since more than 2 weeks and the users were thinking about asking water from the pumping station. The contractor told us that he will agree only on one condition: all users would pay the water fee for the late wet season rice…Unfortunately, as we left the area, we do not know how this power struggle between users and contractor has been solved.

3.5.3 Collective action: the main issues

As we explained in the first part of this report, collective action is not a natural phenomenon but rather a problem that the organisations have to deal with for functioning. Numerous studies insist on the fact that collective action is particularly difficult to implement in Cambodia.

As written by Crozier and Friedberg (1977) « *Quels que soient en effet les objectifs manifestes des organisations, celles-ci ne peuvent faire abstraction des valeurs charriées par une certaine structure sociale à laquelle ses membres sont plus particulièrement attachés* »: Whatever objectives of organizations, they can not disregard the values carried by some social structure at which one its members are particularly attached. We have to take into consideration the fact that the notion of collective action is not "obvious" for most of the Khmer farmers. The traditional forms of organisations and their way of functioning do not go in that sense. They are rather promoting to stay in the background, to avoid conflict (particularly with the authorities) and to maintain the social harmony. This characteristic of the Khmer society influences several aspect of the management and functioning of the irrigation system, such as the involvement of the different stakeholders and the processes of rules elaboration and conflicts resolution.

3.5.3.1 The different stakeholders' involvement

At different levels, the stakeholders try to limit their personal involvement in the irrigation system, in term of money, time, risk and organisation.

Water users

We observed a real withdrawal of most water users from the irrigation system management and functioning. Even if they consider that Sok Touch is not the owner of the channel ("*it is the property of the State*") they think that he has to solve all problems. As a consequence they did not put effort into elaboration of rules, maintenance, respect of rules and resolution of conflicts. They try to limit their own investment. They lighten the responsibilities of the upstream water theft in the problem of water distribution of the downstream users and focus on the responsibilities of the entrepreneur: t**hey prefer to blame him for his service, rather than invest themselves in collective organisation**. The most eloquent example is the one of water theft: even if the water thefts of upstream villages have a real negative impact on the water availability for downstream users, these one mostly accuse the contractor. This kind of behaviour can be explained by both:

- The traditional precept of the Khmer society which advice to stay in the background to avoid conflicts;

- The hierarchical relationships which traditionally structure the Khmer society: the contractor is seen as a kind of chief or powerful people that users pay in exchange of his service.

Contractor

The contractor appears to us as a dynamic person, who involves himself a lot in the management of the water system. Nevertheless this involvement concerns above all the elements which allow him to increase his profits. Indeed he is particularly ingenious and spends a lot of time to organize the water fee collection. He organizes several meetings to discuss this point with users and goes regularly in the area to meet *meteuks* and check the water fee collection. He also spent a lot of time with NGO's and other organisations likely to help him to get a legal recognition. On the contrary his involvement his low regarding the maintenance and the water distribution: he does not try to stop the water thefts, except if the situation gets worth and if he feels that the dissatisfaction of users becomes too high. **No meetings have been organized to discuss the problem of water schedule and water theft.**

3.5.3.2 Process of rules elaboration and decision taking

According to Ostrom (1992) "*Most individuals affected by operational rules has to be included in the group who can modify these rules*". The process of elaboration of rules strongly conditions its legitimacy and its respect by users.

At first sight the process of rules elaboration and water fee fixing seems to fulfil this principle: users were present at the meeting organised to introduce the contractor and define the rules of functioning of the irrigation system. Moreover, their representatives, the *meteuks* and *mephums* are supposed to take part in the meetings organised for discussing the water fee. When they do not manage to get a common agreement, they can receive help from *Mekhum* and from Mr Koy Sokunthea, who can act as mediators.

Nevertheless, in the facts, **the participation of the users in the decision process is low**. Even if they were present at the first meetings they did not participate in the rules definition, except those regarding the water fee. In the same way, all the *meteuks* did not takes part to the annual meetings regarding water fee and there is no meeting between *meteuks* and their users in order to discuss about their needs or the results of the meetings with the contractor. It does not means that the contractor refuses or tries to limit the users' participation. Most of the users told us that they do not need to take part to the meetings or even to know the debates and results of these meetings as their *Mephum* are doing it and represent their interest. In the same way, the contractor can decide almost alone to extend the irrigation scheme: if he extends it within the Sambou commune boundaries he does not meet any opposition. The users do not participate to the decision taking process. **This lack of personal commitment belongs to traditional Khmer rules of social stability such as the standing back in front of the authority and the conflict avoidance**. Thus the involvement and personal commitment stays difficult for most of Khmer people.

Nevertheless, **in some cases users and their representatives seem to be motivated and to commit themselves to defend their interest**: this is the case of the fixing of the water fee: users try to reduce the water fee amount since the first meeting.

Nevertheless it seems to be difficult for them to lay down their point of view. According to the water users, the final decision is always close to the one suggested by the contractor than to theirs. During the meetings, the *Mekhum* tries to reduce the price, but he told us that he can not « *too much insist and pressurize the contractor* ».The commune considers that even if the price augmentation is partly justified due to the increase of the fuel price, the amount asked by the contractor is too high. As a consequence we can suppose that the contractor has the upper hand on the water users and even on the commune in the decisional process. **This "weakness" of water users regarding the negotiation of the water fee may also be explained by the social Khmer characteristic we just defined but also by the fact that the contractor does not present the different expenses necessary for the irrigation system functioning**. The only explanation he gives to the water users is the fuel consumption. Moreover, the water users have no way to check the real annual fuel consumption. As a result, it may be difficult to negotiate about something they do not know well.

As a consequence, these rules partly imposed by the contractor are not recognised and so not respected by users. Thus water users are paying late and do not pay the total amount of the water fee. **Even if they do not take part into the decisional process, they express they needs and point of views through their unruliness**.

We can add that there is also a real problem of information spread between the different stakeholders. Thus most of the users and even their representative do not known the content of the contracts supposed to regulate their relationships within the irrigation system. Moreover, users do not know the day of pumping of the station and the water schedule. As a consequence, they have to watch the channel (which cost time) or they take water at any time (which may penalize the downstream users). Last the contractor did not provide them reliable information regarding the financial management of the irrigation system.

3.5.3.3 Negotiation and conflict resolution

According to Ostrom (1992) any collective organisation has to be able to solve conflicts and to implement graduate sanctions to those who violate operational rules. On the contrary, **the Kbal Por irrigation system has a low capacity for solving conflicts and penalizing those who violate rules.**

In most cases, the different stakeholders try to avoid the conflict, at the risk of letting the situation get worse and becoming more difficult or even impossible to solve. Thus the *meteuks* are seen by the other stakeholders as responsible for controlling the water allocation between the users. Nevertheless, apart from discussion, they do not have any power to intervene, stop and punish the water thefts. As a consequence this kind of offence increases. Furthermore most of the time no-one intervenes in case of water theft until some violent conflict (gate broken, users close to fight each other) happens. Even in case of violent conflict there are no coercive measures against the water thief. In the case of the gate N°7, the *Mekhum* intervenes but only to quieten down the users.

3.5.3.4 The village as an organisation unit

The Khmer society has also some assets which could be used to solve a part of the difficulties linked to the collective action.

The irrigation system is partly based on the village as a unit of organisation of the users. The water allocation is organised according to the administrative boundaries of the villages. The organisation is also based on the traditional village authority: the *Mephum*. Indeed in 4 of the 6 villages, the chief of *meteuks* is the *Mephum* and the others *meteuks* already had responsibilities in the village (previous *mephum*, soldier, etc.) or they are people whose reliability is recognized by other villagers. This observation is not inconsiderable as the *meteuks* play a central role in the irrigation system. Indeed they are the link between the users and the contractor. He is responsible to spread the information from users to contractor (mostly because they want more water) and vice versa.

Meteuk is also the first one involved in the resolution of all problems, those regarding the water fee payment as those regarding the water theft or the lack of water in the channels. He is seen as responsible for the majority of the points which are not clearly defined by the contracts. **To solve the problems, they use traditional mean which is the private discussion:** when a user does not respect the rules, the *meteuk* talks with him and tries to convince him that he has to respect rules because it is not good to create conflict. More than the traditional authority, it is a traditional foundation of the Khmer society which is used: the respect of social harmony and the avoidance of conflict. This system is working to face and limit the problem of water fee payment. On the contrary it dos not work to avoid the problem of water theft. Our hypothesis on that difference is the notion of "water theft" does not traditionally exist in the Khmer society. Except in case of gates operation, villagers do not consider the fact to take water outside of schedule as an offence. The traditional authority represented by the *Mephum* may have power only on the element commonly consider as an offence by the majority of the villagers.

3.5.3.5 Power struggles

As explained in the first part of this report, power struggle are inherent in collective action. Nevertheless, the relationships between users and contractor are particularly strained. Even if no direct clash ever happens between users and contractor up to now, they have opposite personal interests. These power struggles concern all the aspects of the irrigation system management and functioning: the water distribution, the water fee, the maintenance and the irrigation system extension. Even if users and contractor have a collective interest in the functioning and the sustainability of the irrigation system, they have personal interests widely opposite. They both want to increase their personal profits, which imply to decrease the profits of the opposed party. They do not want to share the profits. As we explained previously, the numerous areas of uncertainty of the contracts but also the lack of spread of the information creates numerous areas of uncertainty that each stakeholder try to overcome to follow his personal interest.

To illustrate our intention, it is like if users were pulling one tip of an elastic, and the contractor was pulling the other tip. Currently there is an equilibrium which allows the irrigation to function. But this balance may be upset: the elastic may break if the opposing parties are pulling too hard. This power struggle exacerbates the usual limits of any collective action.

3.5.4 Financial management

Lack of openness

All the information we got regarding the financial management of the irrigation system comes from our interviews with the contractor or from the background papers he wrote for *Mekhum*, MAFF and NGO's. We did not manage to access to his personal papers. Each time we asked him or his wife to see their documents regarding his expenses and receipts they told us that they did not maintain detailed books and even that they did not keep the documents regarding the previous years. We believe that they did not want to show us these documents. Indeed, as we are going to see it in the following section, a part of information they gave us does not seems reliable (they tend to increase the amount of their expenses and decrease the one of receipts).

MATERIAL	SIZE	UNIT PRICE	NUMBER	TOTAL
Fuel pumps	250 horsepower 200 horsepower	3000 USD 2000 USD	2 2	10 000 USD
Water turbines	0.5 meter in diameter	4 500 USD	3	13 500 USD
Iron pipe (pump station to primary canal)	0.5 m	50 USD/0.5m	100	5000 USD
Concrete pipe	0.5 m	25 USD/0.5m	60	1 500 USD
Pumping station (platform)	12 m*16m	25 USD/m²	72 m²	1800 USD
Canal rehabilitation	Length : 200 m	*1 USD/m^3*	*12 800 m3*	*12 800 USD*
Canals rehabilitation	6 channels* 2000 m	1 USD/m	12 000 m	12 000 USD
Sluice gates		200 USD/gate	20	4000 USD
Canals bending (by hand)		1 USD/m^3	3000 m3	3000 USD
Concrete and small concrete pipes (under bridges)		50 USD	20units	2000 USD
Repairing of pump Concreting the pumping station				18 000 USD
Canals rehabilitation		1 USD	18 000 m3	18 000 USD
Concreting canals crossing		300 USD	15	4 500 USD
TOTAL				**106 100 USD**
Technicians salary		100 USD	5 people * 7 months	3 500 USD
Man Power		100 USD	5 people * 7 months	3 500 US$
TOTAL				**113 100 US$**

Table N° 11: Contractor's expenses for the rehabilitation of the irrigation scheme

According to their information:

- The contractor invested 113 100 US$ in the rehabilitation of the irrigation scheme and the pumping station;
- In 2003 he made 1 823 US$ profit and 648 US$ for early wet season 2004. We do not have the data for the late wet season rice 2004 and the early wet season 2005.

According to these data, with this kind of annual profits, the contractor would need about 90 years to cover his costs. Nevertheless, several elements allow us to say that this data are not reliable and do not correspond to real amounts. Indeed, the contractor wrote that he consumed 600 L of fuel in 2003 and 2004. However the irrigated area was not the same (412 ha in 2004 and 290 in 2003) and he told us that he assessed the water fee according to the quantity of fuel consumed the previous year. We did not manage to ascertain the quantity of fuel really used by the contractor. The contractor writes down the quantity of fuel used every day in the pumping station. He showed us the statement for 2005 (cf. Annex 18) but told us that it was incomplete. According to this document the total amount of fuel used is 375L between May 29th and June 27th. Nevertheless, according to the users, the pumping station did not work in July and August as they got enough water from rainfalls. An overvaluation of the fuel consummation of 100 L allows the contractor to earn 50 US$ (with a price of 2000 riel/L). Furthermore, the contractor does not take into account the surfaces irrigated from Srangkae Commune (and the water fee corresponding) in his receipts. However the expenses for these surfaces are mixed with those of Sambou Commune. This kind of "oversight" for an irrigated area of 30 ha allows the contractor to earn about 1230 US$. All these observations allow us to assume that **the contractor overvalues the quantity of fuel consumed every year and undervalues its profit**. Nevertheless, we are not able to assess the measure of this undervaluation. There is a lack of accuracy in the financial management of the irrigation system.

Moreover even if the contractor declares that he gets a high rate of water fee collection (more than 95%), we have no way to check this information. Moreover we know that the contractor reassesses the amount of irrigated surface according to the small sum of money that the users do not pay. Moreover, he does not take into account the bad results obtained for the late wet season rice 2004. Here again **there is a lack of accuracy and openness of the data provided by the contractor regarding the financial management of the irrigation system**.

A lack of sustainability

The contractor does not do any provision for depreciation of the equipment. As a consequence, in case of engine failure or important damage on the irrigation system there is no guarantee that he will have the financial capacities to change or repair the dysfunctioning parts. As a consequence the functioning and the sustainability of the irrigation system may be cast doubt over at any time.

Moreover, the problem of the payment of the water fee has to be questioned. If the problem of the late wet season rice 2004 happens again a real conflict may occur between the contractor and the users: what would happen if users refused to pay the water fee again? Would the contractor manage to cover his costs? In the same way, what would happen if the free riders' behaviours worsen?

These elements show us that the financial management of the irrigation system is not necessarily sustainable. If a problem occurs the contractor would not always be able to solve it (in a financial mean).

3.5.5 "Relationships" between the irrigation system and its environment

The organisation is not an exclusive system: it is in relationship with its environment which will partly determine the constraints that the actors of the system will have to deal with (Crozier and Friedberg, 1977). Indeed an irrigation system fits into a legal and institutional framework which may partly structure its organisation, but which may also be restrictive for its functioning. In the case of the Kbal Por irrigation System, the Cambodian institutional and legal framework, or rather the lack of institutional and legal framework put pressures on its functioning.

3.5.5.1 Lack of legal recognition

The contractor did not get any legal recognition for the rehabilitation and the management of the Kbal Por Pumping Station Community. He gets the *mekhum*'s recognition in writing since he signed the contract as witness. Nevertheless this local authority does not have the legal ability to authorize one private entrepreneur to manage an irrigation system.

As a consequence, the contractor does not have any guarantee that he will be allowed to continue this activity and to cover its costs. Anyone can claim the right to manage this irrigation system. Indeed, two of the neighbouring irrigation systems are currently managed by Mr Searng Chuntry, the director general of Tax Department. He is not asking users for water fee and he finances costly and obvious rehabilitation works. Both irrigation systems were previously rehabilitated by foreign NGOs which created water users communities in charge of the irrigation system management. When Mr Chuntry proposed his help, the water users' communities stopped to manage the irrigation system. Mr Sok Touch would probably not be able to face this kind of competition: even if the service proposed by Mr Chuntry is highly politicized, farmers would probably support this free system.

This absence of legal recognition has a negative impact on the irrigation system. Indeed, on the one hand the contractors tries to increase his annual profits, by decreasing the quantity of fuel used in the pumping station (and so the quality of the service) and by increasing the water fee amount (which decreases the users' profits). On the other hand he tries to reduce his expenses for the maintenance of the irrigation scheme (which is limited to the bare minimum) and the provisions for depreciation. **The legal recognition appears to us as a necessary condition to ensure the viability of the management of the irrigation system by the contractor**. This legal recognition would be useful for the contractor (who will get the right to manage the irrigation system during a fix number of years) but also for the users (if contractor get the guarantee he will have time to cover his costs, he may ensure a better service for a better price).

Nevertheless the legal recognition of the entrepreneur implies the support of several actors. Indeed before to be presented to the ministry, the request for legal recognition has to go all the steps of the administrative hierarchy. The irrigation system may represent an important issue for the different actors involved in this process:

- First the contractor has to receive the support of the *Mekhum* who is the central authorities' last representative at the local level. But this irrigation system represents a major issue for *Mekhum*. Indeed he already used it as central election promise. Even if the actual *Mekhum* is the one who contacted Mr Sok Touch to rehabilitate and manage the irrigation system, there is no guarantee that he wants to support Sok Touch's legal recognition. Indeed a legal recognition will probably imply a long run (about 10 years) contract which will 'block' the irrigation system: the *Mekhum* would not be able to use it during the next communal election by promising a "better" system, with lower water fee…Thus when we leaved the study area, according to the contractor and Mr Sokunthea, the *Mekhum* did not have signed the legal recognition request to pass on to the district level. According to the contractor the *Mekhum* blocked deliberately his request and was asking him for "baksheesh". Nevertheless he refused to tell us the amount asked by the *Mekhum*. This one denied and told us that he already passed it on to the district level.

- As we explained previously, the Kbal Por irrigation system is under the MAFF's responsibility. The contractor already sends a request to the MAFF. According to the contractor, he gave 500 $ of commission to the MAFF. Unfortunately, the MAFF employee who was in charge of Takeo PDAFF's files died last year and, in Sok Touch's opinion, this event stopped the process of legal recognition. Nevertheless Mr Sokhunthea, the current chief officer of agriculture in PDAFF told us that the MAFF refused to give a legal recognition because the contractor did not provide enough information to evaluate his proposal. According to him, **Mr Sok Touch has to write a more detailed request and to describe his plan regarding the irrigation system management for the 15 next years**. **The MAFF also criticized Mr Touch's project for installing old pumping engines instead of purchasing new ones**. Nevertheless, Mr Sokhunthea is currently helping Mr Sok Touch to write a better file. He told us that he will use his own experience in the field of irrigation system management. Nevertheless, several points he explained us regarding his plans for the irrigation system seemed confused.

- Currently the PDWORAM and MOWRAM do not intervene in this matter, as this irrigation system is under the MAFF responsibility.

In our opinion, **the main brake on Mr Touch's legal recognition is the institutional and legal Cambodian framework**. Indeed, as we will detail further, there is no framework defining the process of devolution of irrigation system management to private entrepreneur. There is nothing regarding the authority empowered to implement this kind of devolution.

3.5.5.2 Lack of external control

A direct consequence of this lack of legal recognition is the lack of external control of the irrigation system management. **This lack of external control has a negative impact on the irrigation system viability**.

- Indeed there is no control of the quality of the water service distribution. As a consequence there is no way to check if the contractor fulfils these obligations and provide "enough water" to the users. Moreover, as the water allocation is supposed to be under the responsibility of the *meteuks*, the external control authority would be able to control the real impact of water thefts on the water distribution quality, and if necessary, to solve this problem, possibly by implementing coercive measures against water theft.

The work of this external authority would allow to settle and solve the conflict opposing users and contractor on that point.

- There is no control of the level of maintenance. As a consequence, the level of maintenance is currently very low and the infrastructures will be damaged quickly which will decrease the quality of the water service. The problem of water distribution for the downstream users will increase if the damaged infrastructures slow down the water flood;

- **There is no control of the level of water fee asked by the contractor. Consequently there is a lack of openness and reliability of the financial management**. The users do not know what they are paying. Moreover there is no guarantee that the contractor does the necessary provision on depreciation which may endanger the viability of the irrigation system.

Our analysis stressed on that an external control is necessary to ensure the respect of both parties' commitments. This control would also ascertain that the management of the irrigation system is able to ensure its viability on the long run.

During our field work we also tried to determine which entity would be able to ensure this kind of external control. The follow-up and the control of the contractor imply a proximity that only the local level can guarantee[33]. Nevertheless the local authorities do not have necessary the capacities (in term of finances, time, competences and motivation) to ensure that role:

- The *Mekhum* is the central authorities' last representative at the local level. **He is already implied in the management of the irrigation system as a witness of the contract**. Moreover he has already a role of "control" and mediation but this one is not defined by contract. On one hand he tries to reduce the water fee amount to guarantee the users interest. On the other hand he can summon the water users who refuse to pay his water fee amount. Nevertheless he considers that he only have to intervene in the irrigation system in case of serious conflict. Moreover most of the time his influence on both parties is limited. He does not have the ability and the will of pressurizing the contractor regarding the water fee and the water distribution. He also does not have the means and the will to apply coercive measure against the users. He only uses the traditional way of discussion and social pressure. Indeed the users are potential electors so he avoids loosing their votes by using coercive measures. Moreover, the *Mekhum*. Last **the commune is already engaged by contract in the control of Mr Sok Touch in framework of the water supply station**, in the frame of the project MIREP (Small Scale Piped Water Systems). Thus the commune council is contractually involved as "*project designer, partner of the private investor and interface with users and administrative authorities. It also shares the role of contractor authority with the PRDC*"[34]. Nevertheless the responsibilities of the commune council are not well understood or accepted by the different stakeholders and the commune does not currently fulfil all its duties.

[33] MAHE J. P., CHANTAN K. (2005), *rehabilitation of a rural electricity system: general report.*

[34] MAHE J.P., CONAN H., DALIMIER T., GAY B., MONVOIS J. (2005) *Programme Mini-Réseau d'Eau Potable (MIREP) au Cambodge : une approche novatrice de partenariat public-privé pour le développement de réseaux d'eau en milieu rural.* Lettre PS-EAU N°43, http://www.gret.org/ressource/pdf/lettre_pS-Eau_43_article_Mirep.pdf

"Globally, families do not have understood the roles and responsibilities of the commune and the private investor in the water supply network implementation and management. Families do not know that the commune has to control the functioning of the operating of the water supply system by Mr Touch. The commune is not recognized as relevant in the water delivery system. Moreover several families are complaining about its incompetence and abuses, particularly regarding the construction and reparations of roads. When we interviewed families on the role that the commune will be able to play in the water supply network management, they answered that the commune may act as a mediator, able to pressurize the contractor in case of conflict. Nevertheless, if they understand the issue in the role of the commune, currently they do not have confidence in it for legitimating his role in the system. "
(Caroline BILLARD and Janie BOURSIN, personal communication)

Box N°13: Information collected in the families from the Commune of Sambou regarding the management of the water delivery network by trainees working for the project MIREP, GRET

- We did not get any information regarding the district step. Nevertheless none of the stakeholders interviewed mentioned involvement of this step or even any relationship with it. If this step is close to the local level in a territorial sense, it does not seem to be close to it in practice;

- The irrigation system and the contractor have already relationships with provincial level:

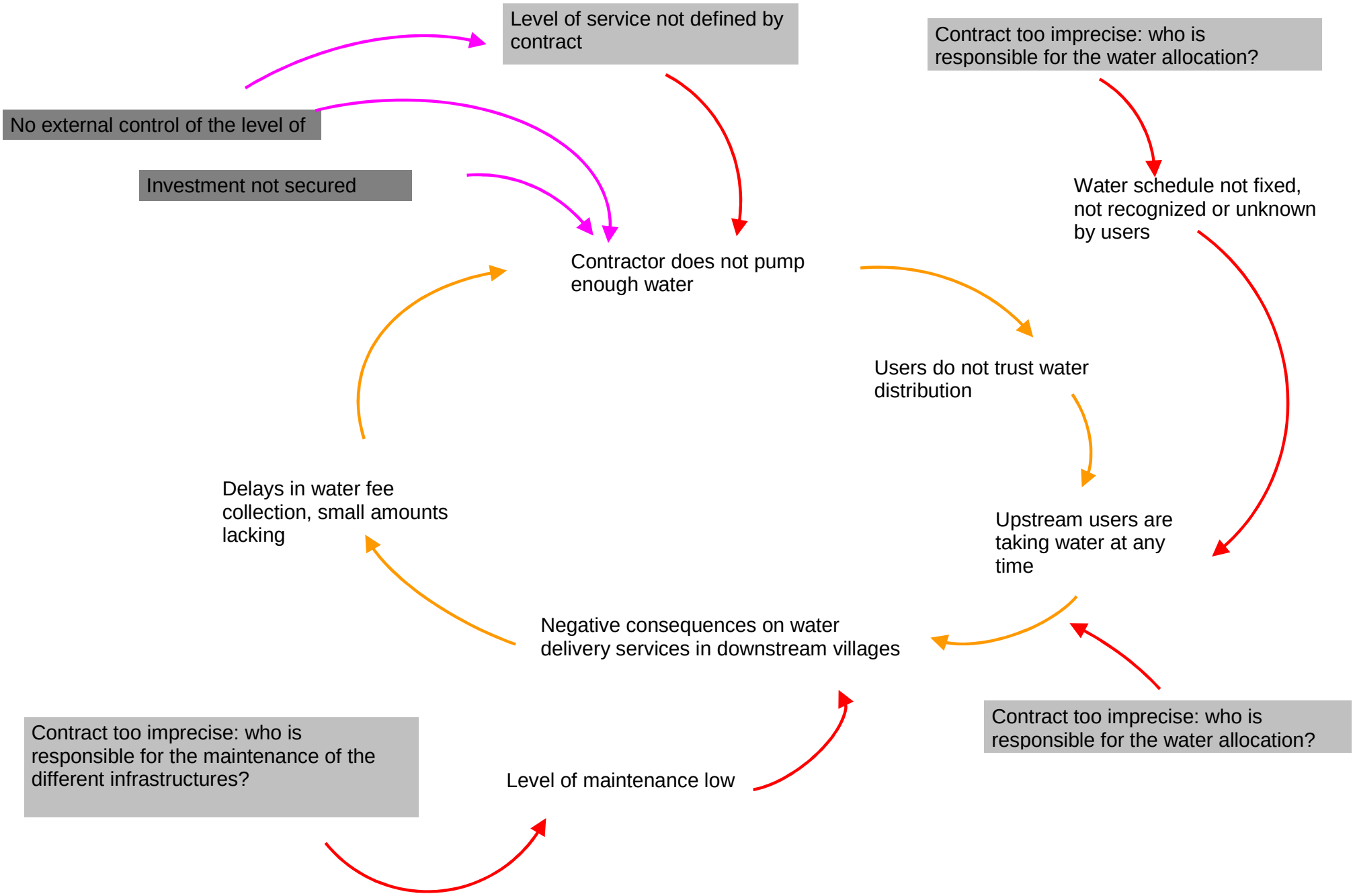
→ Indeed the PDAFF and particularly Mr Sokhunthea are involved in the Kbal Por irrigation system management since several years. He has currently a role of "*mediator*" between the users and the contractor regarding the water fee amount and way of payment. He is also helping the contractor for the elaboration of the master plan and the organisation statutes to get some recognition from MAFF. Nevertheless, even if he qualifies himself as a "*mediator*", he does not have the financial means and the wish of act as a "contracting authority". We can add that there is a lack of understanding of the goal and the principle of this kind of external control. Indeed, in his opinion, if Mr Touch get legal recognition, there will be no need of external control as there will be some kind of self-controlling of opposing parties: "*everything will be written on the statutes and Mr Touch will have ensure its respect. He will have the power to control the users, and if he does not respect his agreements, the water users will do conflicts"*. Furthermore the staff of PDAFF does not have the time and the financial means to operate the follows up and the control of the irrigation system: "*If my staff moves to Sambou to control the irrigation system, the contractor will have to pay them and it will increase the water fee. It is not in the users' interest to do that*".

→In the frame of the MIREP project, the PRDC shares the role of contracting authority with the commune. "*The provincial authorities ensure among others a role of selection of the communes, allocation and control of subsidies and supervision of the works. The PDRC plays a role of technical supervisions and of advice"*. According to the team form MIREP involved in the implementation of this project, the authorities of PRDC of Takeo are really motivate and engaged in this project and try to ensure their responsibilities. When we interviewed them regarding the possibility of playing the role of contracting authority for the Kbal Por Pumping Station Community, they showed a real interest. They also have been available for answering our questions and helped us in the organisation of a meeting between the different stakeholders organised to present our results and to open the debate regarding the future of the irrigation system.

3.5.6 Conclusion on the irrigation system functioning and management

Our analysis stresses out the numerous problems existing in the organisation and the management of the Kbal Por Pumping Station Community. Indeed the combination of negative aspects such as the vagueness of the rules, the lack of spread of the information between the different stakeholders, the absence of effective sanction against those who do not respect the rules drive the system in a vicious circle which can upset the current balance of the system (cf. graph N°6).

We want to insist on the fact that this irrigation system is not perfect but it works. Indeed the users get good agro-economical results and the contractor seems to obtain a high rate collection of water fees. Most of the Cambodian irrigation systems, independently of the entity responsible for their management, do not obtain such good results. If we pointed all these problems, it was to stress out the risk there is in allowing private participation in infrastructures management without defining clear rules and without external framework and control.



Graph N°6: the vicious circle

4 CONTRIBUTION OF THIS STUDY FOR THE FSP PROJECT

This last part aims at taking up the whole results of our study by following the three main lines chosen to provide a better understanding of the emerging conditions of private initiative and spontaneous organisation in irrigation schemes. The results presented here are based on the detailed study of one irrigation system enriched with our observation of another irrigation system (not presented here). This study has no statistical pretensions. It does not allow us to generalize the results obtained to all the Cambodian irrigation systems. Nevertheless our global reflexion on the question of the private irrigation in Cambodia allows us to formulate several recommendations which may concerns the irrigation systems in Cambodia as a whole.

4.1 ANSWERS TO THE THREE MAIN LINE OF REFLEXION:

First we will take up the whole results of our study which allow us to answer to the research questions defined above our field work.

4.1.1 Collective action in the management of irrigation system

In which conditions actors who have different or contradictory interests can cooperate together? How the rules structuring the collective action are defined and adapted to face new stakes? Is it possible, in the current Cambodian context, to think about the collective action of users (and eventually private contractor) in the management of irrigation systems? If yes, in which conditions?

Our study clearly demonstrates that collective action of water users and private entrepreneur in the management of an irrigation system is not a natural phenomenon. It is a real problem. Indeed even if users and contractor have a collective interest in the functioning and the sustainability of the irrigation system, they have personal interests widely opposite. These opposite interests bring about a power struggle. One of the main elements stressed on by our analysis is the role of imprecision in the contracts in this power struggle. Indeed these imprecision are as much areas of uncertainties that users can use to follow their personal interest at the risk of jeopardizing the sustainability of the irrigation system. It brings to light the importance of defining clear and precise rules, understood and accepted by all stakeholders. **These rules have to be unambiguous, particularly regarding duties and rights of each party**. They also have to establish graduate sanctions to those who violate operational rules. Rules must also appoint the authority(ies) which will be responsible for applying these sanctions and which will have the means to make these sanctions be applied.

In order to ensure the legitimacy of these rules, their process of elaboration as to involve all stakeholders or at least their legitimate representatives. Due to some particularities of the Khmer society, the joint elaboration of the rules by the members as a whole appears to us as difficult to obtain. However it is defined by Vermillion (2001) as one of the pre-requisites for collective action *"Social traditions support group*

organization for irrigated agriculture, existence of producer cooperatives and other rural organizations".

Nevertheless, we have to avoid the total exclusion of the members from this elaboration process. One solution would be to organize preliminary meetings in small groups (for example at the village scale) where users would be able to speak and discuss the rules each other and with their representatives. These representatives should receive some formation to **encourage users to discuss together and to give their point of view, but also to explain them the interest of the different rules** (particularly those regarding water theft…).

Moreover the Khmer society has also some assets on which the rules have to rely. In particular, rules should rely on the traditional local authorities such as *Mephums*. As stressed on during our study local authorities may have a strong influence on users regarding some elements such as the water fee payment. The social pressure may also compel users to follow some rules. This social pressure has to be strengthened on the elements it already influences such as the water fee payment.

Last, an effort has to be done to improve the spread of the information between the different stakeholders. It could be done by the organisations of meetings at the village scale or by the intermediary of the water representatives.

4.1.2 Private participation in irrigation system management

Does the management of irrigation systems through a PPI represent an acceptable solution for the users? → How the rules have been elaborated? By whom? Do they have legitimacy for the users? Which means can the entrepreneur use to enforce these rules be respected? Are the users able to pressurize the entrepreneur if he does not fulfil his own undertaking?
→ Are the water fee amount asked by the entrepreneur reasonable for the users? Are the users able to pay the water fee in the case the irrigation water is used for rice cropping? Is there any risk of marginalization of the producers who are not able to pay the water fee?
→ Is this example viable and reproducible?

Our analysis of the Kbal Por pumping station community stressed on that the rehabilitation and the management of an irrigation system can represent an acceptable solution for users.

In this case water users get good agro-economical results. Nevertheless these good results are subjected to conditions. First we have to remind that this analysis is based on one case study. **The farmers from the study area have some specific characteristics which have to be taken into account**: among other things, they have high technical skills and good financial capacities which allow them to get high yields, and they have easily access to market to purchase inputs and sell their production. As a consequence, they are able to pay water fee and get profits. This situation is far from being common in Cambodia. Other studies should be done to assess if farmers with lower yields and other cropping strategies would be able to pay water fee asked by contractor and to get profits.

On the other hand we also stressed on that this situation is not necessary viable. The rules, which have been mostly defined by the contractor are not clear and leave out numerous essential elements, such as the definition of the level of service which has to be

provided and the responsibilities of the different stakeholders. **The process of elaboration of the rules is open to criticism** on the one hand because of the numerous shortcomings and imprecision but also because the users are not enough involved in this process. However **this problem is not specific to management by a private entrepreneur**. Indeed it is the case of systems managed by users' communities where the rules are elaborated by the people in charge of its management or by external supporting organisation.

Moreover, most of the rules are not respected by the contractor and the users mostly because these rules are imprecise or not legitimate from the stakeholders' points of view. Their offences are not sanctioned, partly because of the imprecision of the rules and partly because there is no entities which have the abilities and the wish to apply coercive measures. Because of this impunity, these offences may increase and upset the current precarious balance of the system. Here again, these problems are not specific to the management by a private contractor and have been observed in irrigation systems managed by water user's community. Indeed the problems of abuses in the water consumption of upstream users have been observed in numerous gravity irrigation systems, independently of the type of management of the system.

Yet the repetitive offences of the different stakeholders and the irresolution of conflicts can lead to the decline of the infrastructures, of the relationships between stakeholders and so to the decay of the management, functioning and financial viability of the irrigation system.

To avoid these problems, there is an essential need of rules clearly defined to frame the relationships between the different stakeholders and their personal responsibilities.

4.1.3 The weakness of the Cambodian legal and institutional framework

Does the current legal and institutional Cambodian framework provide favourable conditions for a PPI in irrigation sector?

The current legal and institutional Cambodian framework does not provide favourable conditions for the participation of private investors in the management of infrastructures in general and of irrigation systems in particular.

We met difficulties in understanding which laws, Decrees and sub-decrees are currently established and used to frame PPI in Cambodia. There are several laws, particularly those regarding concessions which are only drafts. Moreover, in many of these documents **the key authorities responsible for the decision and implementation of PPI process is not defined, as the procedures themselves**.

	DATE
Prakas # 418 (MEF) on delegation to provincial-Municipal Departments of Economy and Finance	August 2005
Sub-Decree on the Implementation of the Amendment to the Law on Investment	2005
Sub-Decree on State Land Management	2005
Land Law	2001
Investment Law	1994

Table N°12: Main Cambodian laws referring to PPI

Even if the Rectangular strategy presents the development of the Private Sector as one of the Government's priorities, and if there are "*various laws and regulations in place in Cambodia that make some provision for private sector participation in infrastructure*"[35], there is no clear framework for the delegation of management of infrastructures, particularly for hydraulic ones. The Land Law, the Investment Law and its Sub – Decree do not frame the investment of private entities in public infrastructures.

The main findings of the *Inception Report* can be grouped into the three categories set out above, namely **legal framework**, **institutions** and project cycle **processes**.

1) **An effective cross-sectoral legal framework for infrastructure is lacking**: over-arching sector laws for telecommunications, water supply, and transport (inland and water as well as civil aviation) still in draft form leaves significant gaps.

2) **There is a lack of clarity over responsibility for key activities and decisions within institutions**. For example, with respect to concession approvals; there is 'competition' between government institutions for projects due to uncertain concession granting authority, leading to differing points of entry for investors on projects that should be handled consistently and inefficiencies resulting from 'unofficial' fees and payments.

3) **The processes for which government is responsible throughout the project cycle suffer due to the lack of sector strategies or master-plans** and persistent by-passing by politicians or non-application of existing laws; leading to a reactive (as distinct from a proactive) response by line ministries, most projects being unsolicited and a lack of proper competition between **investors**.

Box N°14: The main constraints to the PPI stressed on by the Economic Consulting Associates and Cambridge Economic consulting Associates regarding the PPI in Cambodia[36]

The direct consequences are that there is no external authority established for the implementation, the follows up and the control of the private participation in

[35] ECONOMIC CONSULTING ASSOCIATES (ECA), CAMBRIDGE ACONOMIC POLICY ASSOCIATES (July 2004). *Cambodia-Framework for improving Governance in PPI transaction: PPI Policy Paper* (Draft, rev 3), 21p.

[36] ECONOMIC CONSULTING ASSOCIATES (ECA), CAMBRIDGE ACONOMIC POLICY ASSOCIATES (December 2003). *Cambodia -Framework for Improving Governance in PPI Transactions.* Draft Proposals Report, 59 p.

irrigation system. There is also no guarantee to protect the private investments necessary for the rehabilitation or the construction of hydraulic infrastructures.

4.2 PROPOSALS

This work takes place in the project FSP "Capacity building on agricultural sector policy making" which aims at strengthening the institutional capacity of the different ministries involved in the agricultural sector in the definition of agricultural sector national policies (cf. part 1.1.1). Cambodian legal and institutional framework currently evolves rapidly, particularly in the field of PPI in electricity and water supply. Nevertheless this framework has to be done on solid bases to secure the investment and attract private investor, by ascertaining that public interest is respected.

We are going to do several proposals and recommendations regarding the definition of policies framing the PPI in irrigation systems.

4.2.1 Establishment of contracts and rules

The main point stressed out by our study is **the importance to define clear rules framing the responsibilities of the stakeholders and their relationships**. In fact these rules, since they involve several types of stakeholders (private entrepreneur, users, local, provincial and national public entities) may be subject of **several contracts and agreement framing the relationships between these different types**.

1) Concession agreement (cf. Annex 4)

First a public authority (called the contracting authority) **should establish an agreement with the private entrepreneur which fix their respective obligations**. This agreement should frame and guarantee that:

- The contractor respects the public interest by:

→ Defining precisely which level of service the contractor has to provide in terms of water distribution and maintenance of the infrastructures;

→ Establishing procedures of control and regulation of the level of service provided by the contractor for the water distribution (by introducing a follow up of the numbers of hours of pumping, of the level of water in the main channel, etc.);

→ Establishing a procedure of control and regulation of the level of water fee amount (by introducing a limit threshold, a calculation table, etc.) and guaranteeing the transparency and accountability of the financial management;

→ Establishing procedure to control the level of maintenance (regular visits);

→ Establishing a procedure to decide if the network can be extended (control of the technical feasibility of the extension project, public inquiry);

- The contracting authority gives some security to the contractor to make is investment profitable (concession period)

- The contracting authority could provides some technical and organisational support (intervention in case of

Remarks: The procedures of control and regulation should take into account the financial capacities and the technical skills of the contracting authority. For example a regular follows up of the number of hours of pumping provided by the contractor would take more time (so more staff) than the regular checking of the water level in the main channel. If the part of the water distribution service (for example the allocation of water between users) or part of the maintenance is not under the responsibility of the entrepreneur, the external authority should also control the entity responsible.

2) Contract

Secondly, **a contract should be signed between the different stakeholders** (private entrepreneur, water users and public authorities) **in order to rule their respective duties and commitments**. This contract has to respect and complement the rules established in the Concession agreement. This contract should:

- Define what the irrigation scheme is (different levels/categories of infrastructures, command area, etc.)
- Precise the level of water which has to be provided by the contractor;
- Define the rules of water distribution between the users or users' groups if any (water schedule for example);
- Establish the procedures of water fee fixing, of payment and collect of the water fee;
- Precise which entity is responsible for the maintenance of the different levels/categories of infrastructures and the level of maintenance requested for each level;
- Define the sanctions which have to be applied when the rules are not respected. Several levels of sanctions should be defined according to the gravity of the offence. The contract should also defines the authority(ies) responsible to control the respect of the different rules;
- Precise the procedure of decision of the irrigation system extension.

Remarks: This contract should be updated every year to fix the water fee but above all to enforce the rules and the IS management and functioning. These updates will allow to adapt the rules according to the evolution of context and to solve the eventual problems identified in the contract.

3) Internal policies and procedures

Last policies and procedure can be defined between the users and their local authorities in order to precise the functioning of the IS, the rights and duties of the users. For example these rules can precise the procedures of water allocation between the users, or their participation in manual works for the maintenance of the channels under users responsibility if any.

4.2.2 Which public entities could be the contracting authority?

After defining the different type of rules and contract necessary to frame the management of an irrigation system by a private entrepreneur, we have to identify which public entities would be the more able to ensure the elaboration and the control of these rules and contract.

The follow up, the control and the regulation of an irrigation system implies proximity of the responsible authority. As a result, this role could be acted by local authorities. The involvement of local public authorities such as *Mekhum* could lie within the scope of the decentralisation and deconcentration policies currently defined by the Cambodian government. For example the *Prakas* # 418, issued by the MEF in August 2005, delegates "*to provincial-Municipal Departments of Economy and Finance in making decision relating to provincial-municipal investment project with capital size less than US $ 2 millions*".

Nevertheless, **before to confide this responsibility, one has to check if the chosen local authority has enough power and means to ensure this role properly**. Our study already allows to point some assets and constraints of the local and provincial authorities:

- The commune chief doesn't have the power to control private investor's activities and to resolve conflicts between users and contractor. As a result it will not be able to play the role of contracting authority in the concession agreement. Nevertheless the commune could control the respect of the internal rules and regulations framing the relationships between the water users.

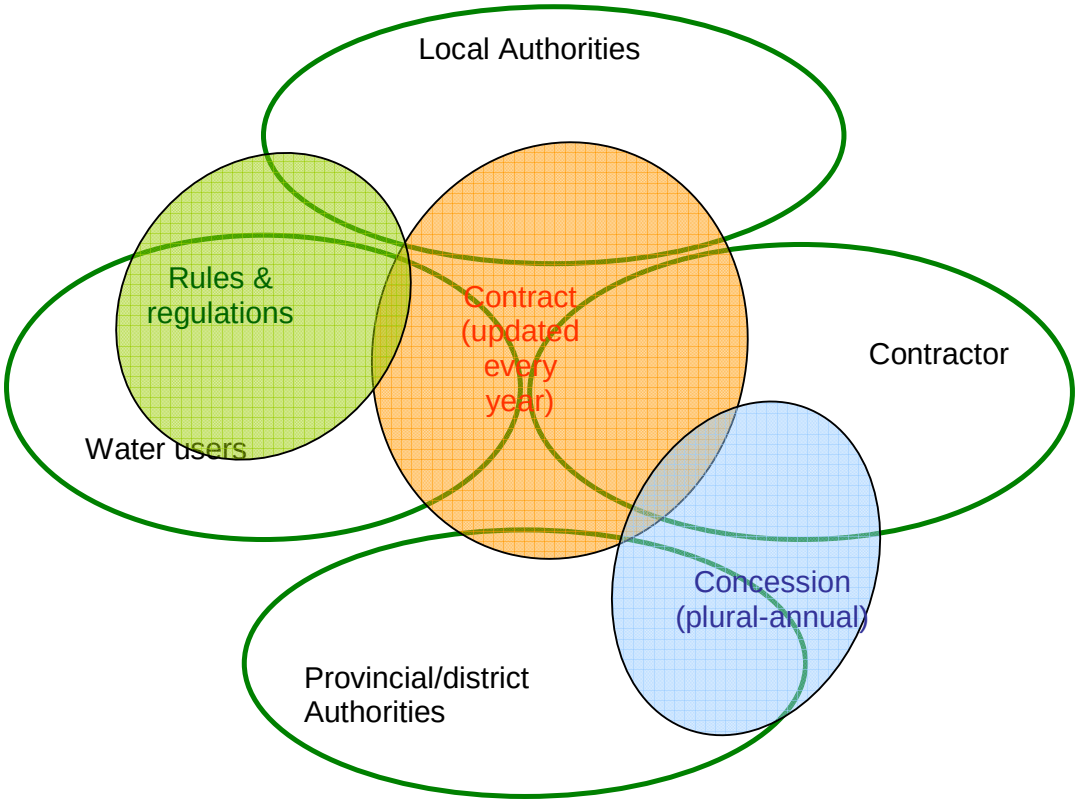
- The duties of contracting authorities for both concessions agreement and contract could be endorsed at the provincial level. The PDAFF could play this role since he already framed the role of mediators for the water fee fixing. Nevertheless it does not seem to have the financial capacities and the wish to endorse this role. We also ca suppose that the PDOWRAM, as it already frame the management of irrigation system by FWUC's could be able to endorse this function but their financial capacities is also limited. Moreover, as the authority on the PPI in irrigation is currently not clearly established, there is a risk of competition between these two departments.

- **The PRDC appears to us as the most able to endorse the role of contracting authority in the PPI concession agreement**. Indeed it already assumes this role in the frame of water supply[37] and the results are quite encouraging. Moreover in the frame of deconcentration process, the PRDC gather under its responsibility the technical provincial departments as a whole. With the PRDC as contracting authority the irrigation system managed by a PPI could benefit from technical support of both PDAFF and PRDC.

The final meeting we organized at the end of our study with the support Mr Tor Sèn (deputy director of the PRDC) under the chairmanship of the vice-governor of the Takeo Province, allowed us to gather the different stakeholders and reinforced our position on that point. The PRDC as the contractor showed a real interest in the establishment of an agreement contract. Moreover, the authorities from the PRDC showed a real understanding of the issues surrounding the PPI in irrigation systems management.

37 In the frame of the MIREP project

Nevertheless**, since these propositions are based on one case study of irrigation system managed by a private entrepreneur**, and since this irrigation system benefits from particular assets (such as the high technical skills of the water users), **they have to be used cautiously**.



Graph N°7: potential configuration of the contract and rules framing a PPI in a SI

CONCLUSION

The water command represents a major issue for the Cambodian Government which defined the irrigated agriculture development as a priority. For a decade Cambodia works on the elaboration of an irrigation development policy. The orientations of this new policy fall within the scope of an international scale debate regarding the private participation in the development and management of irrigation systems.

Our study allows to stress out that the rehabilitation and the management of an irrigation system by a private entrepreneur can allow users to have good agro-economical results and a high rate of water fees collection. Our study also points the difficulties inherent to collective action and the eventual negative incentives caused by power strugglers. These difficulties are particularly high in the case of a Cambodian irrigation system managed by a private contractor, because of the natural opposite interests of the contractor and the water users regarding water fee, but mostly because of the notion of collective action is not “obvious” for most of the Khmer farmers. The traditional forms of organisations and their ways of functioning do not go in that sense. They are rather promoting to stay in the background, to avoid conflict (particularly with the authorities) and to maintain the social harmony. This characteristic of the Khmer society influences several aspects of the management and functioning of the irrigation system, such as the involvement of the different stakeholders and the processes of rules elaboration and conflicts resolution.

Nevertheless, Khmer society has also some assets which could be used to solve a part of the difficulties linked to the collective action, such as the natural power of traditional authorities on the water fee payment.

Last it demonstrates the importance to define precisely the level of service which as to be provided by the private entrepreneur, as the rules framing the functioning and the management of the irrigation system. The lack of precise legal framework and the weakness of Cambodian public institutions weaken the system. The gap in the law regarding the responsibilities of the public authorities in the frame of private participation in irrigation system causes a lack of control of the quality of the service and limits the possibilities to control the conflicts occurring between water users and private entrepreneur and so, the sustainability of the system in the long run. The legal and institutional Cambodian framework has to define and empower a contracting authority able to monitor, control and regulate the Private Participation in development and management of irrigation system. According to our results, the Provincial Rural Development Committee could endorse this role. Nevertheless our assumptions are based on the case study of one irrigation system. Further studies have to be done on that point. Further experiences of Private Participation in infrastructures have already been done in Cambodia in the electricity and water supply sectors. The analysis of their results can provide interesting information.

BIBLIOGRAPHY

BERNARD C. (2006). ***Les organisations Paysannes au Cambodge : Conditions d'émergence, fonctionnement interne et efficience (Etudes de cas dans la province de Battambang, districts de Tmor Kol et Sangker).*** CNEARC, Montpellier, France, 151p.

CALAS J. (2004). **Contribution à la réflexion sur la dynamique de crise des agricultures cambodgiennes** (version provisoire).

CROZIER C., FRIEDBERG E. (1977). *L'acteur et le système.* Paris : Editions du seuil, 500p.

DELVERT J. (1957). ***Le paysan cambodgien.*** Paris: L'Harmattan. 740p.

ECONOMIC CONSULTING ASSOCIATES (ECA), CAMBRIDGE ACONOMIC POLICY ASSOCIATES (December 2003). *Cambodia -Framework for Improving Governance in PPI Transactions*. Draft Proposals Report, 59 p.

ECONOMIC CONSULTING ASSOCIATES (ECA), CAMBRIDGE ACONOMIC POLICY ASSOCIATES (July 2004). *Cambodia-Framework for improving Governance in PPI transaction: PPI Policy Paper* (Draft, rev 3), 21p.

EFFANTIN R. (1999). **Les systèmes irrigués paysans au Cambodge : Etude prospective des enjeux liés au contexte local et à l'intervention d'un projet , à travers trois études de cas dans les provinces de Kandal, Prey Veng et Takéo.** *Mémoire de fin d'étude : ISTOM.* 200p.

FONTENELLE J.P. (2004). **Dynamiques agraires, irrigation et institutions dans le delta du Fleuve rouge (Viêt-nam) :** Une analyse multi-scalaire de la gestion agricole de l'eau. *Thèse de doctorat : Université Catholique de Louvain*, 305p.

GUMUCHIAN H., GRASSET E., LAJARGE R., ROUX E. (2003). *Les acteurs, ces oubliés du territoire.* Paris : Edition Economica, 186p. (Anthropos)

Institut du Développement Durable et des Relations Internationales, IDDRI. (2003). **Eau : encadrer les partenariats public-privé**. *Les notes de l'Iddri*, 43p.

JOLLY G. **La gestion des périmètres irrigués : méthodologie de diagnostic. Cas d'un transfert de gestion : les associations d'usagers du périmètre de N'Fis** (office du Haouz, Maroc). In : Actes de l'atelier du Pcsi, Montpellier, 22-23 janvier 2001. *La gestion des périmètres irrigués collectifs* : Cemagref, Cirad, Ird, p. 25-45

KIBLER J.F., PERROUD C. (2004). ***Vers une cogestion des infrastructures hydro-agricoles : Construction associative et réhabilitation de polders : l'expérience du projet Prey Nup au Cambodge.*** Paris : Les Editions du Gret (collection Etudes et travaux). 319p. ISBN : 2-86844-148-3

KRISHNAMURTY V. (1999) The impact of armed conflict on social capital : a study of two villages in Cambodia. Phnom Penh, 67p.

LAVIGNE DELVILLE Philippe (1997). ***Pour des systèmes irrigués autogérés et durables : façonner les institutions*** (Traduction et synthèse de E. Ostrom, 1992, « Crafting institutions for sef-governing irrigation systems », ICS Press, Institute for contemporary studies, San Francisco, 111p.) Paris : Inter-Réseaux, 44p.

LAVIGNE DELVILLE P. (1998) **Les négociations des règles d'action collective, quelques repères.** In *Traverse N°6* . GRET, p. 14-37.

LUCO F. (2002), ***Entre le Tigre et le Crocodile, approche anthropologique sur les pratiques traditionnelles et nouvelles de traitement des conflits au Cambodge***. Phnom Penh : UNESCO, 191p.

MANSFIELD C., MACLEOD K. (2004), ***Commune councils & Civil Society: Promoting decentralization through Partnerships***. Phnom Penh : Malin van der Meer, 46p.

MERREY D.J. (1996) *Institutional Design Principles for Accountability in Large Scale Irrigation Systems.* Research Report 8, IWMI, Colombo, 26p.

MOLLE F., RUF T., 1994, ***« Eléments pour une approche systémique du fonctionnement des périmètres irrigués ».*** Symposium international Recherches-système en agriculture et développement rural, Atelier 1, Dans quelles directions le champ et la méthodologie des recherches systèmes doivent être redéfinis ?, 21-25 nov.1994, Montpellier, AFSR/E, CIRAD, INRA, ORSTOM, pp. 114-118

MOWRAM (1999). **Circular n°1 and Appendix on the status of FWUC.**

MOWRAM (2003). **Sub decree on Farmer Water Users Communities:** Preliminary draft.

MOWRAM (2003)**. Decree on Participatory Irrigation Management Development:** Preliminary draft**.**

MOWRAM (2003). **Sub-Decree on Irrigation Management Transfer and Certification of Management Authority:** Preliminary draft.

MOWRAM/APIP (2001) **Draft law on water resources management of the kingdom of Cambodia.**

ONIMUS François (2003). ***Rapport de fin de mission juin 2001-mai 2003***, Assistance technique au Ministères des Ressources en Eau et de la Météorologie, 65p.

OSTROM E. (1992). ***Crafting Institutions for Self-Governing Irrigation Systems***. San Francisco: Institute for Contemporary Studies, 111p.

PERRY C.J., ROCK M., SECKLER D. (1997) ***Water as an Economic Good: a Solution or a Problem?***, Research Report 14, IWMI, Colombo, 16p.

PIERRARD Joris. (2004). **Rules of water management and sharing: Definition of rules for the management and the share of water by users and their representatives of the Stung Chinit irrigated perimeter-Cambodia.** *Mémoire de fin d'étude : ENGES, CNEARC*, 110p.

PILLOT D. (forthcoming), ***L'agriculture du Cambodge*** **(temporary title).** GRET/ Karthala.

RGC (2002), ***National rectangular Strategy 2003-2005***

ROMANO J.P. (1997), *Présentation des caractéristiques de la Province de Battambang,* Cambodia, 45p.

ROUX Julienne (February 2005). ***Water Governance in Cambodia, policy in the making and links to implementation***, IWMI, 123p.

RUF T. (1998). Du passage d'une gestion par l'offre en eau à une gestion par la demande sociale : Ordre et désordre dans les questions d'irrigation et de conflits d'usage de l'eau. In : Actes de l'atelier du Pcsi, Montpellier, 22-23 janvier 2001. *La gestion des périmètres irrigués collectifs* : Cemagref, Cirad, Ird, p. 11-24.

RUF T. (2001). **L'irrigation abordée sous l'angle de la gestion communautaire de biens commun.** Actes de l'atelier « La gestion des périmètres irrigués collectifs à l'aube du XXI°siècle, enjeux problèmes démarches »,22-23 janvier 2001, Montpellier. p. 11-24.

RUF T. (2003). **Les institutions de l'irrigation paysannes : des cycles d'organisation et de réorganisation**. Agridoc.

SINATH C. (2004). **Participatory Irrigation Management Development of Cambodia**. MOWRAM.

TANG S. Y. (1992). *Institutions and collective action: Self-governance in irrigation.* San Francisco, California, USA: Institute for Contemporary Studies Press.

UNATED NATION (September 2003) Gestion de l'eau dans les payes en développement. Journal officiel de l'Union Européenne.

VERMILLON D.L. (1997). **Le transfert de gestion de l'irrigation : conditions de succès, options de changement**, in « Les conditions de l'autogestion des organisations de producteurs dans les ménagements hydro-agricoles », Actes du séminaire de Niamey Inter-réseaux/IIMI, 24-28 septembre 1996.

VERMILLON D.L. (1997). **Impacts of Irrigation Management Transfer: A Review of the Evidence.** *IIMI research reports N°11*. 35p. ISBN: 92-9090-340-5.

VERMILLION, D.L., SAGARDOY J.A. (2001). Transfert des services de gestion de l'irrigation : directives. *Bulletin FAO d'irrigation et de drainage, n°58,* 102 p.

WORLD BANK (1993). *Water resources management. A World Bank Policy Paper*. Washington, D.C.: World Bank.

WORLD BANK. (2004 (a)). **Private partnership in Irrigation and Drainage: Need for a professional "third party" between farmers and government**. (Draft)

WB (2004 (b)), Water Resources Sector Strategy: strategic directions for World Bank engagement.

Websites :

FAO (1993) : **Les grands choix en matière d'agriculture irriguée**. http://www.fao.org/documents/show_cdr.asp?url_file=/docrep/003/t0800f/t0800f0d.htm [25/04/05]

http://www.fao.org/ag/agl/aglw/aquastat/countries/cambodia/index.stm [25/04/05]

http://www.cia.gov/cia/publications/factbook/geos/cb.html

MAHE J.P., CHANTAN K. (2005), *Rehabilitation of a rural electricity system, Smau Kney village, Trapeang Sab Commune, Bati District, Takeo Province: final report*. 64p. http://www.gret.org/ase_uk/resume.asp?cle=232

MAHE, MONVOIS, MALAFOSSE (2003), Programme mini-réseau d'eau potable (MIREP) au Cambodge : Une approche novatrice de partenariat public-privé pour

le développement de réseaux d'eau en milieu rural. *Lettre Pseau N°43, juillet 2003.* http://www.pseau.org/outils/lettre/article.php?lett_article_lettre_id=518

http://www.pseau.org/outils/ouvrages/adede_droit_a_l_eau_06_fr.pdf [15/01/06]

ADB (2001). **Country Strategy and Programme Update 2002-2004 (CSP) : Cambodia.** http://www.adb.org/Documents/CSPs/CAM/2001/CSP_CAM_2001.pdf [25/04/05]

VERMILLON D.L (2001). **Property rights and collective action in the devolution of irrigation system management**.
http://www.capri.cgiar.org/pdf/devolution_vermillion.pdf [27/04/05]

TABLE OF ILLUSTRATIONS

MAPS

TABLES

BOXES

GRAPHS

SKETCHES

TABLE OF CONTENTS

ANNEXS

Annex 1: Vocabulary

KHMER	ENGLISH
Baray	*Reservoir*
Khum	*Commune*
Koyoun	*Motorized cultivator*
Krom Samaki	*Solidarity group*
Mephum	*Village chief*
Mekhum	*Commune chief*
Meteuk	*“water chief”*
Phum	*Village*
Prakas	*Ministerial decrees*
Provas	*Traditional form of mutual aid*

Annexe 2: Cambodian history

The restless history of Cambodia is divided into several periods which marked the population. The following part aims to succinctly present the main elements which may have influence the technical and organisational characteristics of the Cambodian irrigated agriculture (Kibler, Perroud, 2004).

The pre-Angkorian period (I-XV century)

The Cambodian agriculture may be born from the rice domestication, during the third millennium before Jesus Christ, from the floating rice cropping around the Tonle Sap Lake and the Mekong's banks, but also from the slash and burn rainfed rice, probably handed down by the Yunnan's cultivators. The South Indian sailors, who were navigating on the Mekong to reach China for commercial exchanges, may have transmitted rice cropping techniques (transplantation, drainage), means (plough, harrow, etc.) and new varieties of rice.

The Angkorian period : myth of an hydraulic Empire (IX°-XV° century)

Cambodia was living a period of prosperity, thanks to the commercial road between India and China. The management of the water recession of the Big Lake allowed cultivation of floating rice and receding rice, producing surpluses used constructing temples and financing the army. For several authors, the Angkorian Empire was a 'Hydraulic Empire': according to them, the kings of Angkor built a sophisticated irrigation scheme, with very large reservoirs *–baray-* which allowed to supply enough water to harvest three rice crops per year. This myth is currently criticized by the international scientific community, which estimates that these huge infrastructures were designed to supply water to the cities, and may have been used to allocate a complementary irrigation at the end of the rice cycle, but were not big enough to allow the irrigation of three rice crops per year. (D. Pillot, à paraître).

What is remarkable for our study is that this myth of Cambodian hydraulic power has been widely used by the Khmers Rouges and is still supported by the politics and the population.

Starting from the XV° century, the Angkorian Empire declined, due to the repetitive attacks carried on by Vietnamese and Annamese, but also because of the restart of the use of roads for the commercial exchanges between India and China.

French Protectorat (1863-1953)

In 1863, the King of Cambodia signed a protectorate agreement with the French Government, in order to defend the country from his neighbours' attacks. The French Government implemented several reforms (as land property deeds) and developed cash crops and export crops.

From 1930 the French engineers developed several "big and modern agro-hydraulic infrastructures". This heavy and costly infrastructures were intended for the production of export rice crops on big area (30 000 ha for the Bovel Dam, Battambang Province). But

they never achieved the expected results, because of failures in the design, but also because of the high cost necessary to ensure the maintenance and the social instabilities.

From the Kingdom of Cambodia (1953-1970) to the Khmer Republic (1970-1975)

In 1953, the King Sihanouk proclaims the Independence of his country. The following period witness the development of cash crops, the starting of hevea private plantations and the increase of the rice production, mainly because of the increase of cultivated area. The king implemented several works which aimed at developing the infrastructures of the country (roads, ports, railways) and encouraged the development of industrial crops by family farms. He planned the construction of hydraulic infrastructures following the French model, but few are really constructed.

In 1970, while the king was out of the country, the General Lon Nol made a putsch and implemented the « Khmer Republic", apparently with the tacit agreement of the Americans. This is the start of a civil war, the conflicts multiplied, the insecurity increased and the countryside emptied. This social tensions and the support of the exiled King allowed the development of the Khmer Rouge Communist Party.

The trauma of Khmer Rouge period (1975-1979)

The 17th April 1975 the Khmers Rouges took the power and « Angkar », the supreme organisation, implemented the Democratic Kampuchea, a system of fear, by killing all the intellectuals and opponents, abolishing money and emptying cities by force, in order to create a national cooperative.

By putting forward the "Angkorian Hydraulic Empire", the Khmer Rouges mobilized manpower into working groups and cooperatives, for agricultural works and the construction of huge hydraulic infrastructures, and this in dreadful conditions. The Khmer rouges leaders wanted to "*rule the countryside in squares with irrigation canals distant of 1 km from each others, intended for irrigate rice fields fully redesigned in homogeneous plots of 100 meters on 100 meters'* (Kliber, Perroud).

But despite the quantity of mobilized manpower, these infrastructures gave very bad results, mainly because of a lack of competences. Indeed, the infrastructures, overdesigned, were submitted to fast erosion and did not handle the real fields' conditions. According to a study carried on by HALCROW in 1994, on the 841 irrigation schemes enumerated, 580 have been constructed by the Khmer Rouge, and only 120 of these one were operational in 1994. But these infrastructures are still structuring the countryside and are conditioning many current irrigation development projects.

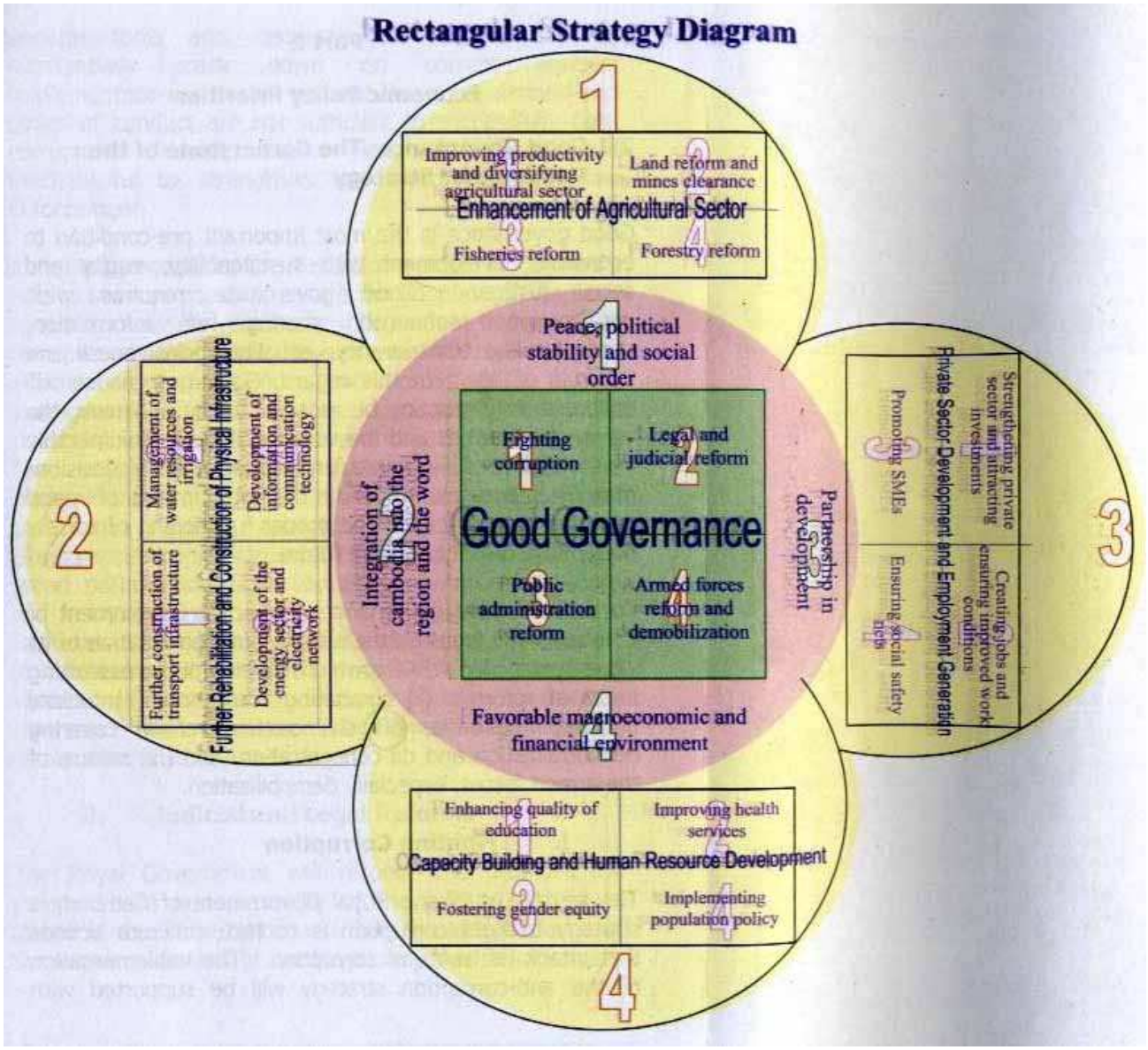
After four years of this system of terror and suffering, the Cambodian population was bloodless, with a number of victims estimated from 1 up to 3 millions, for a population of 8 millions in 1975. Nowadays, the trauma is still strong. This recent past may impact the local population (at least the 50 percent who lived this period). '*Particularly, some reluctance may be met in the implementation of collective action and on all kind of forced approach'* (PIERRARD, 2004).

From the People's Republic of Kampuchea (1979-1991) to the Kingdom of Cambodia

In January 1979, the Vietnamese army liberated Phnom Penh and implemented the People's Republic of Kampuchea. This is a period of reconstruction of the country: "*Within a decade, Cambodia is rebuilding its production capacities at the same level than before the war, but it is also following remarkable changes into its economy and society*" (PILLOT, 2004)

In order to counter the famine and to reconstruct the agriculture, the Government implemented the formation of "*krom samaki*" or "solidarity groups", composed of 10 to 15 families in order to share manpower and means of production. It allowed also to progressively landing decollectivization by limiting the land conflicts. But these *krom samaki* have been gradually abandoned by Cambodian peoples which preferred reorganize themselves around the family nucleus instead of collective organisations. This "silent revolution" leads, since 1985, to the pacification of the countryside, to land property stabilization by family take-over, and also to the restart of Economy (the production reaches the same level than in 1970).

Annex 3: The National Rectangular Strategy



Annex 4: Some concepts and technical vocabulary used in this report

- **Participatory Irrigation Management (PIM)**

Devolution of irrigation system involves the transfer of part or all rights and responsibilities for irrigation system management from the government to non governmental entities, such as local water users groups or private entrepreneur (Vermillion, 2001).

- **Farmer Water Users Community (FWUC)**

"The Farmer Water Users' Community (FWUC) is to be a legal corporate body of farmer water users who share the use of water and take responsibility for drainage of water within a single irrigation system. The FWUC will be responsible to operate, maintain, rehabilitate and finance the overall management of the irrigation system. Before a new irrigation system is developed, an FWUC will be established to guide the process of development." (MOWRAM, 2003)

Currently, the MOWRAM has established 79 FWUCs. But the establishment of one FWUC does not necessary mean the functioning of this FWUC. Indeed the MOWRAM is facing several limits in the implementation of this devolution of irrigation systems management. "*There is a gap between formal policy making and actual implementation*" (ROUX)

Indeed the MOWRAM's budget is limited and its personnel is low paid (around 30$ per month), is little trained and do not have enough means to implement properly IMT policy. This problem is most strongly felt at provincial and lower level. The personnel we met in the PDOWRM of Battambang did not even know the content of Circular N°1. As a consequence, in many cases, there is no support and no follow-up of the FWUCs established.

- Private Participation in Infrastructures (PPI)

The following definitions are mostly based on those used in the Final Draft of the Cambodia PPI policy paper[38].

- **Private Participation in Infrastructure** = the transfer of a significant degree of investment, management and/or operating risk from the public to the private sector. The forms that PPI may take include, but are not limited to, concessions, leases, management contracts, operating contracts, sales of existing assets and new build 'greenfield' developments, including joint ventures between public and private organisations. All PPI projects represent a partnership between the private and public sectors in the delivery of infrastructure services, although the degree and nature of public sector involvement will vary from project to project.

- **The Contracting Authority** is the entity defined in Cambodian Law as being responsible for the delivery of the infrastructure services in question. It is responsible for developing and awarding a PPI project, signing the contract with the selected private sector developer and monitoring compliance with the contract terms. The Contracting

38 ECONOMIC CONSULTING ASSOCIATES (ECA), CAMBRIDGE ACONOMIC POLICY ASSOCIATES (July 2004). *Cambodia-Framework for improving Governance in PPI transaction: PPI Policy Paper* (Draft, rev 3), 21p.

Authority for a particular PPI project can be the responsible Line Ministry, a parastatal entity such as a state-owned corporation or a Provincial or Municipal Authority.

- "BLT" means build, lease and transfer
- "BOT" means build Own/operate and transfer
- "BTO" means build transfer and operate
- "EOT" means expand, own/operate and transfer
- "MOT" means modernize, own/operate and transfer
- "BOO" means build, own and operate
- "Lease management" means lease and operate/manage
- "management" means manage and operate
- "MOO" means modernize, own and operate
- "concession" means any act attributable to the state whereby a public authority entrusts to a private third party the total or partial implementation of an Infrastructure Project for which the authority would normally be responsible and for which the third party assumes a major part of construction and/or operating risks or receive a benefit by way of compensation from government revenue or from fees and charges collected from users or customers.
- "Concessionaire" means the person that carries out an Infrastructure Project under a Concession Contract entered into with a Contracting Authority

Concepts used for the agro-economical calculations :

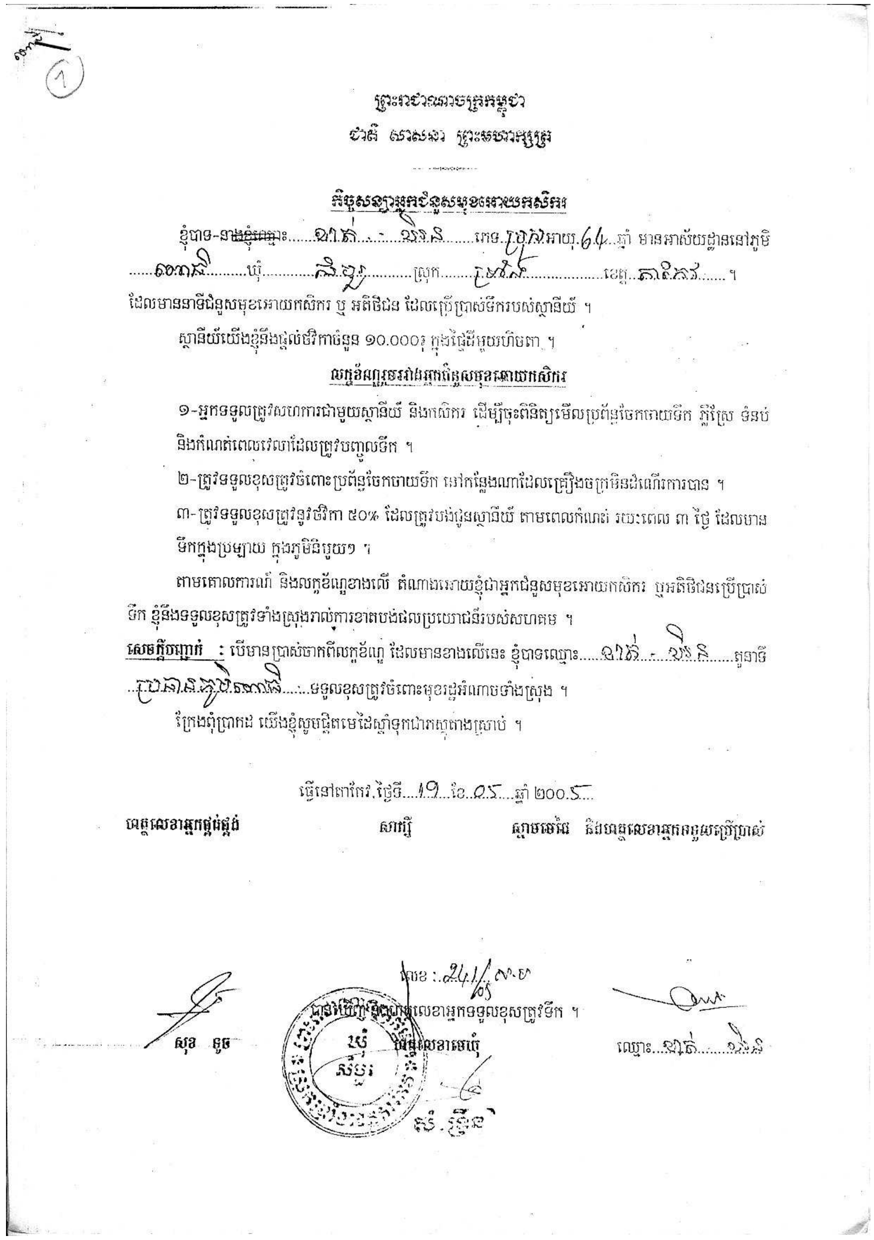
On-farm consumption = own-consumption = Farm products (rice, milk…) consumed by the farmer's family (or to produce other crops or animals in the farm);

Gross Income (GI): monetary value of the final products, whatever their use (sale, axn-consumption);

Intermediate expenses (IE) = monetary value of the inputs (seeds, chemicals, etc.) or service (labor force, threshing engine, etc.) used during one production cycle.

Added Value (AV) = It is the richness produced during one production cycle. This element allows to compare several cropping systems. AV=GI+IE

Annex 5: Irrigation system Documents


ព្រះរាជាណាចក្រកម្ពុជា

ជាតិ សាសនា ព្រះមហាក្សត្រ

កិច្ចសន្យាអ្នកជំនួសមុខអោយកសិករ

ខ្ញុំបាទ-នាងខ្ញុំឈ្មោះ...... ......ភេទ...... អាយុ 64 ឆ្នាំ មានអាសយដ្ឋាននៅភូមិ ...... ឃុំ...... ស្រុក...... ខេត្ត...... ។

ដែលមានភារកិច្ចជំនួសមុខអោយកសិករ ឬ អតិថិជន ដែលប្រើប្រាស់ទឹករបស់ស្ថានីយ៍ ។

ស្ថានីយ៍យើងខ្ញុំនឹងផ្តល់ថវិកាចំនួន ១០.០០០៛ ក្នុងផ្ទៃដីមួយហិចតា ។

លក្ខខណ្ឌនៃអ្នកជំនួសមុខអោយកសិករ

១-អ្នកទទួលត្រូវសហការជាមួយស្ថានីយ៍ និងកសិករ ដើម្បីចុះពិនិត្យមើលប្រព័ន្ធចែកចាយទឹក ភ្លឺស្រែ ទំនប់ និងកំណត់ពេលវេលាដែលត្រូវបញ្ចូលទឹក ។

២-ត្រូវទទួលខុសត្រូវចំពោះប្រព័ន្ធចែកចាយទឹក នៅកន្លែងណាដែលគ្រឿងចក្រមិនដំណើរការបាន ។

៣-ត្រូវទទួលខុសត្រូវនូវថវិកា ៥០% ដែលត្រូវបង់ជូនស្ថានីយ៍ តាមពេលកំណត់ រយៈពេល ៣ ថ្ងៃ ដែលបានទឹកក្នុងប្រម្យាយ ក្នុងភូមិនិមួយៗ ។

តាមគោលការណ៍ និងលក្ខខណ្ឌខាងលើ តំណាងអោយខ្ញុំជាអ្នកជំនួសមុខអោយកសិករ ឬអតិថិជនប្រើប្រាស់ទឹក ខ្ញុំនឹងទទួលខុសត្រូវទាំងស្រុងរាល់ការខាតបង់ផលប្រយោជន៍របស់សហគម ។

សេចក្តីបញ្ជាក់ : បើមានប្រាសចាកពីលក្ខខណ្ឌ ដែលមានខាងលើនេះ ខ្ញុំបាទឈ្មោះ...... ......តួនាទី ...... ទទួលខុសត្រូវចំពោះមុខរដ្ឋអំណាចទាំងស្រុង ។

ក្រែងពុំប្រាកដ យើងខ្ញុំសូមផ្តិតមេដៃស្នាមទុកជាភស្តុតាងស្រាប់ ។

ធ្វើនៅតាកែវ ថ្ងៃទី 19 ខែ 05 ឆ្នាំ ២០០5

ហត្ថលេខាអ្នកផ្តល់ផ្គត់   សាក្សី   ស្នាមមេដៃ និងហត្ថលេខាអ្នកទទួលប្រើប្រាស់

ឈ្មោះ...... ......

CONTRACT OF WATER DISTRIBUTION

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ
*****

ស្ថានីយ៍ប្រមូលទឹកក្បាលពោធិ៍
ភូមិ.....លេខ:.....

Tel : 011 870 334
: 032 931 304
Icom: 14.531 (ឃៅ 17)

បំណុលទទួលប្រើប្រាស់ទឹក

កសិករឈ្មោះ.....ភូមិ.....ឃុំ.....
ស្រុកទ្រាំង ខេត្តតាកែវ ។
បានយល់ព្រមប្រើប្រាស់ទឹករបស់ស្ថានីយ៍ ក្បាលពោធិ៍.....
លើដែ្ន.....អារ ប្រភេទដី.....
ទីតាំងស្រែ ឬ ឈ្មោះស្រែ .....
ឯកភាពទូទាត់ជាប្រាក់តាមតំលៃ : ទូលស្ងួយប្រវត្តិ ១ អារ.....ប្រាំល
បូមបន្ត ១ អារ.....ប្រាំល
.....
.....
ក្នុងករណីមានភ្លៀងឬមិនមានភ្លៀង
ទឹកប្រាក់ត្រូវទូទាត់.....ប្រាំល

ថ្ងៃទី.....ខែ.....ឆ្នាំ ២០០.....

ប្រធានស្ថានីយ៍ក្បាលពោធិ៍	គណនេយ្យទូទាត់	កសិករទទួលទឹក
ហត្ថលេខា	ហត្ថលេខា	ស្នាមមេដៃស្តាំ

សុខ ឌុច

(A)

ព្រះរាជាណាចក្រកម្ពុជា

ជាតិ សាសនា ព្រះមហាក្សត្រ

បំណុលដាក់ពាក្យប្រើប្រាស់ទឹក

ខ្ញុំបាទ -នាងខ្ញុំឈ្មោះ ..... ភេទ ..... អាយុ ..... ឆ្នាំ មានទីលំនៅ បច្ចុប្បន្នភូមិ ..... ឃុំ ..... ស្រុក ..... ខេត្ត ..... ។

តំណាងដោយសហគមន៍ នៃគ្រួសារប្រើប្រាស់ទឹកចំនួន .....267..... គ្រួសារ ដែលបានប្រើប្រាស់ទឹកស្រោចស្រពលើផ្ទៃដីចំនួន .....103..... ហិចតា ។

អាស្រ័យហេតុនេះ សូមលោកប្រធានស្ថានីយ៍ មេត្តាជួយផ្តត់ផ្តង់ទឹកអោយបានគ្រប់គ្រាន់ជូនយើងខ្ញុំផង ។

អ្នកទទួលខុសត្រូវស្ថានីយ៍បូមទឹក	សាក្សី	អ្នកទទួលប្រើប្រាស់
	លេខ :.....	
	បានឃើញ ហត្ថលេខាអ្នកទទួលខុសត្រូវទឹក ។	
	តាកែវ ថ្ងៃទី.....ខែ.....ឆ្នាំ ២០០.....	
	ហត្ថលេខាមេឃុំ	ឈ្មោះ.....

C

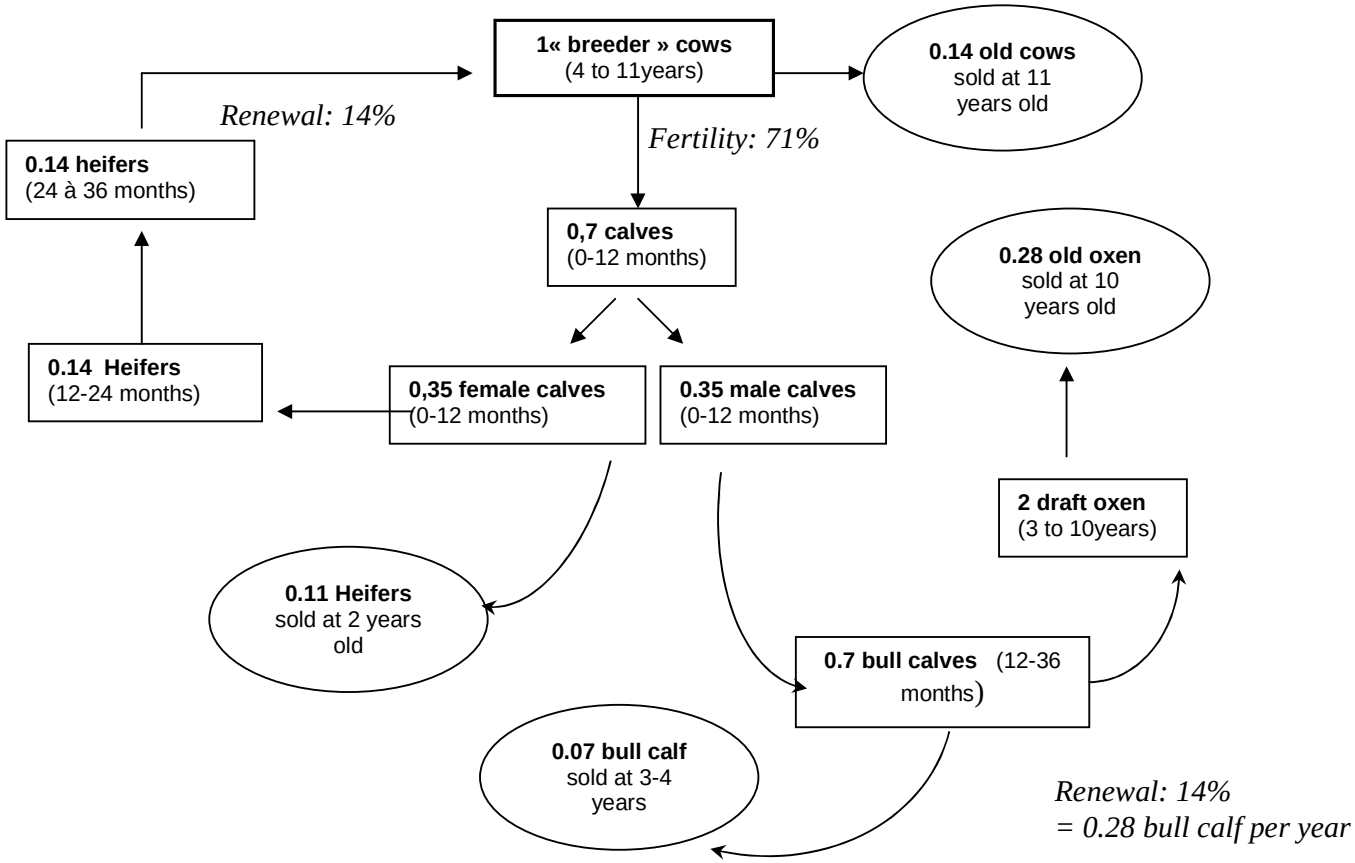
CONTRACT OF METEUK

Annexe 6: working calendar

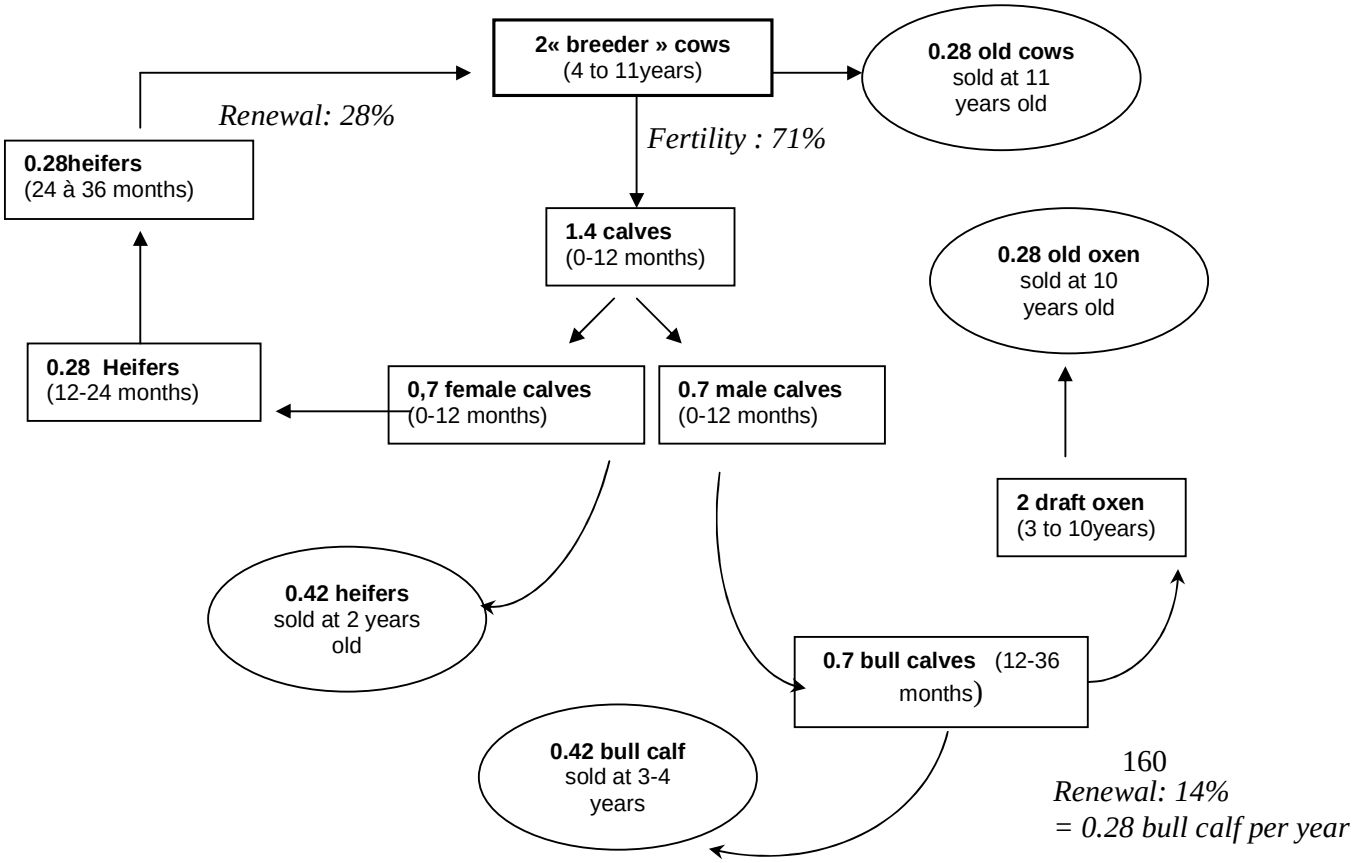
10th June 2005	*Arrival in Phnom Penh*
13th to 18th June 2005	*Bibliographic work in Phnom Penh*
20th June to 1st July	*Field work in Kbal Por*
4th July to 31st August	*Case study of the irrigation systems of the 'Ballat Manchey agricultural development community', in collaboration with Cedric Bernard, a CNEARC student focusing on 'the farmers organisations in Cambodia, condition for emerging, internal functioning and efficiency'*
1st to 4th September	*Research of a new translator in Phnom Penh*
5th to 9th September	*Field work in Kbal Por*
10th to 25th September	*Holidays*
25th September to 4th October	*Bibliographic works in Phnom Penh*
4th to 14th October	*Field work in Takeo*
20th To 28th October	*Work this the "sectorial study"*
28th October to 4th November	*Field work in Takeo*
5th to 9th November	*Research of a new translator in Phnom Penh*
10th to 6th November	*Field work in Takeo*
21st November	*Presentation of the results regarding the case study of 'Ballat Manchey agricultural development community', with Cedric Bernard, for the users' representatives, local NGOs, PDAFF representatives.*
22nd to 24th November	*Research of a new translator*
25th to 27th November	*Field work in Takeo*
28th November to 9th December	*Bibliographic works, analyses of the study results in order to present it*
7th December	*Presentation of the results of the study of the Kbal Por irrigation Scheme in the Takeo Provincial Rural development Comity (PRDEC), under the presidency of the deputy governor, in presence of representatives of PDAFF and PDOWRAM, the contractor, Sambou Commune chief, Village chiefs and users*
9th December	*Presentation of the results of my study during the taskforce meeting of the Working Group on Agriculture and Water*

ANNEXE 7: Diagram of Demographic functioning

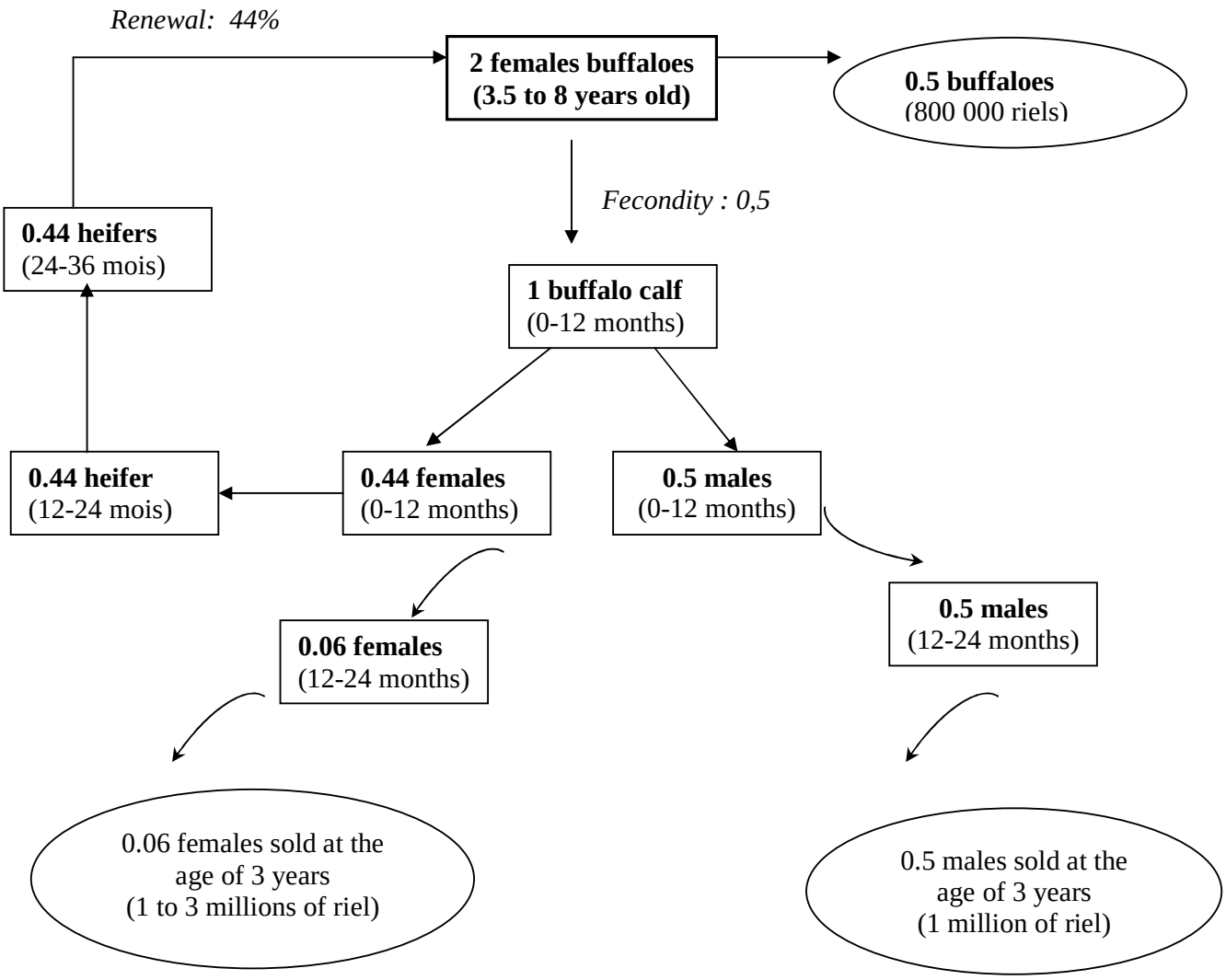
- With 1 “breeders” cow



- With 2 “breeders” cows



- With 2 “breeders” buffaloes



ANNEX 8: FLOOD RECESSION RICE CROPPING (with transplanting)

Name	Niep piep (p. 109)	Han Progn	Soun	Me Sok	Tcheyn	Sok Tègn	Mao Tchienda	Tchi Tcheing	Yan Sey	Mom Sokia
Village	O'Po	O'Po	O'Po	O'Po	O'Po	O'Po	Po	Po	Po	Po
Family labour force available	2,00	5,00	2,00	2,00	2,00	7,00	3,00	1,00	2,00	2,00
flood recession plot (ha)	2,00	0,25	3,00	0,15	1,00	2,00	0,70	1,00	0,25	0,50
			Lower land	?	Upper land	Middle land	Upper land			
AGRO6ECONOMIC RESULTS										
rice variety	*unnal*	IR66	IR66	IR 66	IR66	IR66	*IR Unnah*		*IR66*	*IR66*
Yield in paddy (kg/ha)	3 250	4 000	5 000	6 667	3 500	5 500	3 571	5 800	4 000	3 850
total paddy production (kg)	6 500	1 000	15 000	1 000	3 500	11 000	2 500	5 800	1 000	1 925
ECONOMIC RESULTS										
INTERMEDIATE EXPENDITURES										
cost for *koyoun* renting *(riel/ha)*			0			90 000			1 500	
expenditure for *koyoun* renting (riel)			0			126 000			1 125	
quantity of fuel for *koyoun* (L)		0	0			0				
fuel price (riel/L)			0			90 000				
total expenditure for koyoun (riel)			**0**			**126 000**			**1 125**	
total expenditure for koyoun or oxen(riel/ha)	**0**	**0**	**0**	**0**	**0**	**63 000**			**4 500**	**0**
seeds quantity (kg)	130	?	500	50	?	60	65	50	30	
seeds quantity (kg/ha)	65		167	333		30	93	50	120	
Q of chemical fertilizers for nursery(kg)		2	0		10			10		
Q total of chemical fertilizers(kg)	150	50	0	30	150	400	**100**	200	30	0
Q of chemical fertilizers (kg/ha)	75	200	0	200	150	200	143	200	120	
price of chemical fertilizers (riel/kg)	1 450	1 450	1 450	1 400	1 400	1 400	**1 450**	**1 450**	**1 450**	
Expenditures for chemical fertilizer (riel)	**217 500**	**72 500**	**0**	**42 000**	**210 000**	**560 000**	**145 000**	**290 000**	**43 500**	**0**

Expenditures for chemical fertilizer (riel/ha)	**108 750**	**290 000**	**0**	**280 000**	**210 000**	**280 000**	207 143	290 000	174 000	0
Q weed killer (cl)							0			
price of weed killer (riel/cl)	?									
expenditures for weed killer (riel)	**20 000**				**25 000**	**25 000**			**10 000**	
expenditures for weed killer (riel/ha)	**10 000**	**0**	**0**	**0**	**25 000**	**12 500**	**0**	**0**	**40 000**	**0**
Q other chemicals (cL)								50		
price other chemicals	?					mélange				
Expenditures other chemicals (riel)	**20 000**				**25 000**	**25 000**	40 000	**7 000**	**6 000**	**6 000**
Expenditures other chemicals (riel/ha)	**10 000**	**0**	**0**	**0**	**25 000**	**12 500**	**57 143**	**7 000**	**24 000**	**0**
price for MP for pulling out seedlings										
number of family "manday" of labour force							**0**	2		
number of *provas* " labour force "										
number of hired labour force							10	1		
expenditure for pulling seedling out manpower (riel)							30 000	**12 500**		
expenditure for pulling seedling out manpower (riel/ha)							42 857	12 500	**0**	
family labour force for transplanting	2	5	2	2	2	4		1	2	2
provas labour force for transplanting						6			6	5
hired labour force for transplanting	80	5	170	5	40	40	17	14		5
Total manpower/ha	41	40	57	47	42	25	24	15	32	24
daily price for hired labour force	5 000	6 000	4 500	6 000	6 000	6 000	**6 500**	4 000	6 000	4 000

total expenditures for transplanting (riel)	**410 000**	**30 000**	**765 000**	**30 000**	**252 000**	**300 000**	**110 500**	**56 000**	**0**	**48 000**	
total expenditures for transplanting(riel/ha)	**205 000**	**240 000**	**258 000**	**280 000**	**252 000**	**150 000**	**157 857**	**60 000**	**192 000**	**96 000**	
price for harvester (riel/ha)	80 000		80 000								
expenses for harvester (riel)	160 000	0	240 000						0		
family labour force for harvest		5		2	2	4		2	2	2	
provas labour force for harvest						6		10	5	2	
hired labour force for harvest		5		5	30	40	**15**		1	4	
		40	0	47	32	25	21	12	32	16	
daily price for hired manpower		5 000		6 000	6 000	6 000	**5 000**	**5 000**	**5 000**	**5 000**	
total expenditures for harvest(riel)	160 000	25 000	0	30 000	960	300 000	75 000				
total expenditures for harvest(riel/ha)	80 000	100 000	0	200 000	960	150 000	107 143	60 000	40 000	40 000	
total expenditures for harvest(riel/ha)	80 000	200 000	80 000	280 000	192 000	150 000	107 143	60 000	160 000	80 000	
Number of irrigation	1à 4	3			7	7	8	10	8	6	
Q fuel (L)	100	6		0	90	100	40	45	20	18	
Expenditure for pumping (riel)	360 000	21 600		0	135 000	300 000	128 000	112 500	70 000		46 800
Expenditure for pumping (riel/ha)	180 000	86 400	0	0	135 000	150 000	182 857	112 500	280 000	93 600	
mechanic Threshing price (riel/kg)	23	23	23	23	27	23	25	26	23		23
expenditures for threshing (riel)	146 250	22 500	337 500	22 500	92 750	247 500	62 500	152 250	22 500	44 275	
expenditures for threshing (riel/ha)	73 125	90 000	112 500	150 000	92 750	123 750	89 286	152 250	90 000	88 550	
transportation (riel)		0		0			64 500	3 000	10 000		17 500
transportation (riel/ha)	0	0		0			92 143	3 000	40 000	35 000	
TOTAL INTERMADIATE EXPENSES (riel)	1 333 750	171 600	1 102 500	124 500	740 710	1 883 500	655 500	633 250	162 000	162 575	
INTERMADIATE EXPENSES (riel/ha)	666 875	686 400	367 500	830 000	740 710	941 750	936 429	633 250	648 000	325 150	
	161	165	89	200	178	227	226	153	156	78	
GROSS INCOME											
Qpaddy for on-farm-consumption (kg)	0	1 000	0	500	0	0	750	0	1 000		770
Q paddy for sale (kg)	6 500	0	15 000	500	3 500	11 000	1 750	5 800	0	1 155	
sale price (riel/kg)	450	450	500	450	530	530	500	525	450	450	
Gross income (riel)	2 925 000	450 000	7 500 000	450 000	1 855 000	5 830 000	1 250 000	3 045 000	450 000	866 250	
Gross income (riel/ha)	1 462 500	1 800 000	2 500 000	3 000 000	1 855 000	2 915 000	1 785 714	3 045 000	1 800 000	1 732 500	
Added value (riel)	1 591 250	278 400	6 397 500	325 500	1 114 290	3 946 500	594 500	2 411 750	288 000	703 675	
Added value ($)	383	67	1 542	78	269	951	143	581	69	170	

Added value/ ha (riel/ha)	**795 625**	**1 113 600**	**2 132 500**	**2 170 000**	**1 114 290**	**1 973 250**	**849 286**	**2 411 750**	**1 152 000**	**1 407 350**
Added value/ ha ($l/ha)	**192**	**268**	**514**	**523**	**269**	**475**	**205**	**581**	**278**	**339**

ANNEX 9: FLOOD RECESSION RICE CROPPING (with broadcasting)

Name of the farmer	Niep piep (p. 109)	**Mr Sit**	**Key Bair**	**Aur Seth**
Village	O'Po	Thnot Chum	Rovaong	Thnot Chum
Family manpower available	2,00	4,00	2,00	5,00
flood recession area (ha)	1,00	0,30	0,20	0,50
			middle	up
AGRO-ECONOMIC RESULTS				
rice variety	*namanbong*	*Unnal*	*IR66*	*IR66*
Yield in paddy (kg/ha)	4 500	4 000	9 000	7 000
total paddy production (kg)	4 500	1 200	1 800	3 500
ECONOMIC RESULTS				
INTERMEDIATE EXPENDITURES				
seeds quantity (kg)	150		30	40
seeds quantity (kg/ha)	214		150	80
seeds price (riel/kg)	-			
expenditures for seeds (riel)	**-**			
expenditures for seeds (riel/ha)				
Q of chemical fertilizers(kg)	200	50	45	150
price of chemical fertilizers (riel/kg)	1 450	**1 450**	**1 450**	**1 450**
Expenditures for chemical fertilizer (riel)	**290 000**	**72 500**	**65 250**	**217 500**
Expenditures for chemical fertilizer (riel/ha)	290 000	241 667	326 250	435 000
Q weed killer (cl)	?	**30**		
price of weed killer (riel/cl)				
expenditures for weed killer (riel)		15 000	40 000	18 000
expenditures for weed killer (riel/ha)	-	50 000	200 000	36 000
Q other chemicals (cl)		70		
price other chemicals				
Expenditures other chemicals (riel)		**35 000**	**4 000**	**18 000**
Expenditures other chemicals (riel/ha)	**-**	**116 667**	**20 000**	**36 000**
expenses for harvester (riel)	**80 000**	**20 000**		**45 000**
expenses for harvester (riel/ha)	**80 000**	**66 667**		**90 000**
family labour force for harvest				
provas labour force for harvest				
hired labour force for harvest				
Daily price for hired manpower				-
total expenditures for harvest(riel)	**80 000**	**20 000**		**45 000**
total expenditures for harvest(riel/ha)	**80 000**	**66 667**		**90 000**
mechanic Threshing price (riel/kg)	25	25	25	24
expenditures for threshing (riel)	**112 500**	**30 000**	**45 000**	**84 000**
expenditures for threshing (riel/ha)	**112 500**	**100 000**	**225 000**	**168 000**
Number of irrigation			10	8
Q fuel (L)	**100**	**40**	**20**	**30**
price for fuel (riel/ha)	2 500	3 000	3 000	3 500
Expenditure for pumping (riel)	**250 000**	**120 000**	**60 000**	**105 000**
Expenditure for pumping (riel/ha)	**250 000**	**400 000**	**300 000**	**210 000**
TOTAL INTERMADIATE EXPENSES (riel)	732 500	292 500	214 250	487 500
INTERMADIATE EXPENSES (riel/ha)	732 500	975 000	1 071 250	975 000
	177	235	258	235
GROSS INCOME				
Q paddy for on-farm-consumption (kg)	-	600	-	-
Q paddy for sale (kg)	4 500	600	1 800	3 500
sale price (riel/kg)	450	450	450	480
Gross income (riel)	2 025 000	270 000	810 000	1 680 000
Gross income (riel/ha)	2 025 000	900 000	4 050 000	3 360 000
Added value (riel)	1 292 500	- 22 500	595 750	1 192 500
Added value ($)	311	- 5	144	287

Added value/ ha (riel/ha)	1 292 500	-	75 000	2 978 750	2 385 000
Added value/ ha ($l/ha)	311	-	18	718	575

ANNEX 10: EARLY WET SEASON RICE (with transplanting)

Name	Niep piep (p. 109)	Soun	Me Sok	Tcheyn	Sok Tègn	Key Beir	Me Nuing Yeat	Mr Yun	Njor	Me Kim Kunti	Tci Tcheing	Eyng Som	Sièn Teng	Han Hong	Gnim Louy	SO Yay	Mom sokia
Village	**O'Po**	**O'Po**	**O'Po**	**O'Po**	**O'Po**	**Rovaong**	**Thnot Chum**	**Tro Peing Pon Lou**	**Po**	**Po**	**Po**		**O'Po**	**O'PO**	**Rovaong**	**Kbal Por**	**Po**
Family manpower available	2	2	1	2	7	2			4	1	2	3	2	3	2	5	2
Early wet season area (ha)	0,70	0,70	0,10	0,50	1,90	0,57	0,75	0,50	0,50	0,15	0,50	0,60	0,80	0,80	0,90	0,45	0,23
AGRO6ECONOMIC RESULTS																	
rice variety	*Namanbong*	IR 66	IR 66	IR 66	IR66	*IR66*	*Unnal*	*IR66*	*IR66*	*IR66*	*IR66*	*Namanbang*	*IR Unnal*	*IR66*	*IR66*	*IR66*	*IR66*
Yield in paddy (kg/ha)	3 571	4 286	5 000	4 300	4 211	4 386	2 667	5 000	5 000	2 000	4 524	5 000	4 125	1 875	5 194	5 333	5 500
total paddy production (kg)	2 500	3 000	500	2 150	8 000	2 500	2 000	2 500	2 500	300	2 262	3 000	3 300	1 500	4 675	2 400	1 265
ECONOMIC RESULTS																	
INTERMEDIATE EXPENDITURES																	
cost for *koyoun* renting *(riel/ha)*					bœufs				oxen	150 000			provah ox	provah ox			
expenditures for *koyoun* renting (riel)			**0**							**22 500**							
quantity of fuel for *koyoun* (L)																	
fuel price (riel/L)																	

total expenditures for koyoun (riel)										22 500							
total expenditures for koyoun or oxen(riel/ha)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**224 000**	**150 000**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
seeds quantity (kg)	50	60	30	80	60	100	75		12	10	50	40			84	50	30
seeds quantity (kg/ha)	71	86	300	160	32	175	100	0	24	67	100	67	0	0	93	111	
seeds price (riel/kg)	year y-1	year y-1	year y-1	year y-1		year y-1	year y-1					exchange			177	exchange	
expenditures for seeds (riel)	**0**	**0**										**0**			**14 840**		
Expenditures for seeds (riel/ha)											**0**	**0**			**16 489**		**0**
Q of chemical fertilizers for nursery(kg)	7	5	10			3	8	3			10	3	20	10	12	2	
Q total of chemical fertilizers(kg)	150	100	20	100	400	75	150	100	125	10	100	75	120	60	100	100	50
	214	143	200	200	211	132	200	200	250	67	200	125	150	75	111	222	217
price of chemical fertilizers (riel/kg)	1 450	1 600	1 500	1 500	1 500	1 500	1 500	1 500	1 900	1 500	1 450	1 450	1 540	1 750	1 500	1 661	1 750
Expenditures for chemical fertilizer (riel)	**217 500**	**160 000**	**30 000**	**150 000**	**600 000**	**112 500**	**225 000**	**150 000**	**237 500**	**15 000**	**145 000**	**108 750**	**184 800**	**105 000**	**150 000**	**166 100**	**87 500**
Expenditures for chemical fertilizer (riel/ha)	**310 714**	**228 571**	**300 000**	**300 000**	**315 789**	**197 368**	**300 000**	**300 000**	**475 000**	**100 000**	**290 000**	**181 250**	**231 000**	**131 250**	**166 667**	**369 111**	**380 435**
Q organic manure for nursery	**3 ox carts**	**3 ox carts**	**2 ox carts**	**5 ox carts**		**2 ox carts**	**2 ox carts**	**2 ox carts**		**0**	**4 ox carts**	**4 ox carts**	**5 ox carts**	**3 ox carts**	**10 ox carts**	**2 ox carts**	
Q total organic manure	23 ox carts	23 ox carts	**5 ox carts**	**30 ox carts**	**15 ox carts**	**15 ox carts**	**2 ox carts**		**20 ox carts**	**0**	**12 ox carts**	**14 ox carts**	**7 ox carts**	**11 ox carts**	**10 ox carts**	**12 ox carts**	**10 ox carts**

	29	29	30	50	8	23	3	4	40		16	17	3	11	11	22	
cost of organic manure																	
Q weed killer (cl)	30	0	0	0		50	0	0	0	0	0	0	0	0	0		
price of weed killer (riel/cl)	333					600			0								
Expenditures for weed killer (riel)	**10 000**	**0**	**0**	**0**	**0**	**30 000**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**7 000**	
Expenditures for weed killer (riel/ha)	**14 286**	**0**	**0**	**0**	**0**	**52 632**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**15 556**	
Q other chemicals (cl)	50	0				100	0	100	0		0						
price other chemicals					mélange (+MO)	300		300	0								
Expenditures other chemicals (riel)	4 000	**0**		**20 000**	**40 000**	**30 000**		**30 000**	**0**	**6 000**	**0**	**20 000**	**25 000**	**30 000**	**7 000**	**12 000**	**7 000**
Expenditures other chemicals (riel/ha)	5 714	0	0	40 000	21 053	52 632	0	60 000	0	40 000	0	33 333	31 250	37 500	7 778	26 667	30 435
price for MP for pulling out seedlings							MOF		MOF	MOF	2 MOF	8 MOF	2000 riel/40 bundles	2000 riel/40 bundles			
number of family labour force										3				1		6	
number of *provas* labour force																	
number of hired manpower														**10**			
expenditures for pulling seedling out manpower												**0**	**100 000**	**60 000**	**48 000**	**0**	

(riel)

expenditures for pulling seedling out manpower (riel/ha)													**125 000**	**75 000**	**53 333**		
family labour force for transplanting	3	2	1	3	10	2	?	2	2	1	2	2	1	1	1	1	2
provas labour force for transplanting										2	15					5	3
hired labour force for transplanting	15	17	3	10	40	15	10	15	15			17	21	25	28	10	2
manpower for transplanting (MD/ha)	26	27	40	26	26	30	13	34	34	20	34	32	28	33	32	36	30
daily price for hired manpower	5 000	6 000	6 000	6 000	6 000	6 000	5 000	6 000	6 500		4 000	6 000	5 000	3 000	5 000	6 000	6 000
total labour force for transplanting (riel)	**90 000**	**102 000**	**18 000**	**78 000**	**240 000**	**90 000**	**50 000**	**90 000**	**97 500**	**0**	**75 000**	**102 000**	**105 000**	**75 000**	**140 000**	**60 000**	**42 000**
total expenditures for transplanting(riel/ha)	**128 571**	**145 714**	**180 000**	**156 000**	**126 316**	**157 895**	**66 667**	**180 000**	**195 000**	**0**	**150 000**	**170 000**	**131 250**	**93 750**	**155 556**	**133 333**	**182 609**
price for harvester (riel/ha)																0	
expenses for harvester (riel)											60 000	0				0	
family labour force for harvest	3	2	1	3	10	2	MOF	2		MOF	2	3	1	1	1	1	2
provas labour force for harvest											5					5	5

hired labour force for harvest	17	20	3	30	40	15		18				8	30	25	28	10	2
manpower for harvesting (MD/ha)	29	31	40	66	26	30		40			14	18	39	33	32	33	34
daily price for hired manpower	5 000	3 000	6 000	3 000	6 000	6 000		6 000				3 000	5 000	3 000	5 000	6 000	6 000
total expenditures for harvest(riel)	**100 000**	**60 000**	**18 000**	**99 000**	**240 000**	**90 000**	**0**	**108 000**		**0**	**0**	**24 000**	**150 000**	**75 000**	**140 000**	**60 000**	**54 000**
total expenditures for harvest(riel/ha)	**142 857**	**85 714**	**180 000**	**198 000**	**126 316**	**157 895**	**0**	**216 000**		**0**	**60 000**	**40 000**	**187 500**	**93 750**	**155 556**	**198 973**	**201 268**
Number of irrigation	1à 4	3	6	?	7	8	5	3		5	5	7	3	3	2	5	6
Q fuel (L)	10	15	18	1	70	24	20	11		10	15	17	22	30	10	15	15
Q fuel (L/ha)	14	21	180	1	37	42	27	22	0	67	30	28	28	38	11	33	65
Expenditures for pumping (riel)	**72 000**	**54 000**	**64 800**		**224 000**	**76 800**	**64 000**	**35 200**	**0**	**36 000**	**54 000**	**61 200**	**79 200**	**108 000**	**36 000**	**54 000**	**55 500**
Expenditures for pumping (riel/ha)	102 857	77 143	648 000		117 895	134 737	85 333	70 400		240 000	108 000	102 000	99 000	135 000	40 000	120 000	241 304
mechanic Threshing price (riel/kg)	25	25	25	25	25	manuel	provah	25		30	**25**	25	25	25	manual	25	25
expenditures for threshing (riel)	**62 500**	**75 000**	**12 500**	**53 750**	**200 000**	**0**	**0**	**62 500**		**9 000**	**56 550**	**75 000**	**82 500**	**37 500**	**90 000**	**60 000**	**31 625**
expenditures for threshing (riel/ha)	**89 286**	**107 143**	**125 000**	**107 500**	**105 263**	**0**	**0**	**125 000**	**0**	**60 000**	**113 100**	**125 000**	**103 125**	**46 875**	**100 000**	**133 333**	**137 500**
transportation (riel)		0										provah				15 000	
transportation (riel/ha)		**0**							**60 000**			**0**			**0**	**33 333**	
water fee (riel)	112 000	112 000	16 000	80 000	304 000	91 200	120 000	80 000	**110 000**	**24 000**	**80 000**	**80 000**		**128 000**	**144 000**	**72 000**	**80 000**

water fee (riel/ha)	160 000	160 000	160 000	160 000	160 000	160 000	160 000	160 000	220 000	160 000	160 000	133 333		160 000	160 000	160 000	160 000
TOTAL INTERMADIATE EXPENSES (riel)	668 000	563 000	159 300	480 750	1 848 000	520 500	459 000	555 700	445 000	112 500	410 550	470 950	726 500	618 500	769 840	491 100	357 625
INTERMADIATE EXPENSES (riel/ha)	954 286	804 286	1 593 000	961 500	972 632	913 158	612 000	1 111 400	890 000	750 000	821 100	784 917	908 125	773 125	855 378	1 091 333	1 554 891
	230	194	384	232	234	220	147	268	214	181	198	189	219	186	206	263	375
GROSS INCOME																	
Q paddy for on-farm-consumption (kg)	500	700	350	0	0	1 750	1 000	1 250	1 250	300	1 131	1 000	1 650	1 500	0	1 800	759
Q paddy for sale (kg)	2 000	2 300	150	2 700	8 000	1 750	1 000	1 250	1 250	0	1 131	2 000	1 650	0	4 675	600	506
sale price (riel/kg)	500	500	500	530	570	530	530	600	530	530	530	530	530	500	540	500	500
Gross income (riel)	1 250 000	1 500 000	250 000	1 431 000	4 560 000	1 855 000	1 060 000	1 500 000	1 325 000	159 000	1 198 860	1 590 000	1 749 000	750 000	2 524 500	1 200 000	632 500
Gross income (riel/ha)	1 785 714	2 142 857	2 500 000	2 862 000	2 400 000	3 254 386	1 413 333	3 000 000	2 650 000	1 060 000	2 397 720	2 650 000	2 186 250	937 500	2 805 000	2 666 667	2 750 000
Added value (riel)	582 000	937 000	90 700	950 250	2 712 000	1 334 500	601 000	944 300	880 000	46 500	788 310	1 119 050	1 022 500	131 500	1 754 660	708 900	274 875
Added value ($)	140	226	22	229	653	322	145	228	212	11	190	270	246	32	423	171	66
Added value/ ha (riel/ha)	831 429	1 338 571	907 000	1 900 500	1 427 368	2 341 228	801 333	1 888 600	1 760 000	310 000	1 576 620	1 865 083	1 278 125	164 375	1 949 622	1 575 333	1 195 109
Added value/ ha ($l/ha)	200	323	219	458	344	564	193	455	424	75	380	449	308	40	470	380	288

ANNEX 11: EARLY WET SEASON RICE (with broadcasting)

Name of the farmer	Chauy ear	Samreth Un	Yon	Pan Houn
Village	**Rovaong**	**Kork**	**Tro Bay**	**Rovaong**
Family manpower available	7,00	5,00	2,00	
Early wet season area (ha)	0,24	0,80	0,40	0,85
	500m du canal-broadcats since 2004		!water shortage!	water shortage!
AGRO6ECONOMIC RESULTS				
rice variety	*IR66*	*Nam Cong Bong*	*Nam Cong Bong*	*IR66*
Yield in paddy (kg/ha)	6 250,00	5 625,00	2 250,00	3 529,41
total paddy production (kg)	1 500,00	4 500,00	900,00	3 000,00
ECONOMIC RESULTS				
INTERMEDIATE EXPENDITURES				
cost for *koyoun* renting *(riel/ha)*	2 400,00	himself	rented oxen	rented oxen
expenditures for *koyoun* renting (riel)	57 600,00	oxen	40 000,00	70 000,00
quantity of fuel for *koyoun* (L)	included			
fuel price (riel/L)				
total expenditures for koyoun (riel)	57 600,00	0,00	40 000,00	70 000,00
total expenditures for koyoun or oxen(riel/ha)	**240 000,00**	**0,00**	**100 000,00**	**82 352,94**
seeds quantity (kg)	60,00	180,00	200,00	100,00
seeds quantity (kg/ha)	250,00	225,00	500,00	117,65
seeds price (riel/kg)	exchange	exchange	550,00	
expenditures for seeds (riel)			110 000,00	
expenditures for seeds (riel/ha)	**0,00**	**0,00**	**91 666,67**	**0,00**
Q of chemical fertilizers(kg)	100,00	150,00	100,00	150,00
price of chemical fertilizers (riels/kg)	1 450,00	1 493,33	1 300,00	1 400,00
Expenditures for chemical fertilizer (riel)	**145 000,00**	**224 000,00**	**130 000,00**	**210 000,00**
Expenditures for chemical fertilizer (riel/ha)	**604 166,67**	**280 000,00**	**325 000,00**	**247 058,82**
Q organic manure	5 oxen carts	8 ox carts	**10 ox carts**	**50 ox carts (5cattle)**
cost of organic manure				
Q weed killer (cl)	0,00			?
price of weed killer (riel/cl)	0,00			
expenditures for weed killer (riel)	0,00	13 000,00	4 000,00	
expenditures for weed killer (riel/ha)	**0,00**	**16 250,00**	**10 000,00**	
Q other chemicals (cL)	?			
price other chemicals				
Expenditures other chemicals (riel)	23 000,00	24 000,00	8 000,00	50 000,00
Expenditures other chemicals (riel/ha)	**10 000,00**	**10 000,00**	**10 000,00**	**10 000,00**
Number of irrigation	3to 4 times	3 times	1,00	4,00
Q fuel (L)	20,00	30,00	?	8,00
Expenditures for pumping (riel)	70 000,00	105 000,00		28 000,00
Expenditures for pumping (riel/ha)	**291 666,67**	**131 250,00**		**32 941,18**
price for harvester (riel/ha)		90 000,00		0,00
expenses for harvester (riel)		**112 500,00**		0,00
family labour force for harvest		4,00	1,00	2,00
provas labour force for harvest			3,00	0,00
hired labour force for harvest		6,00	2,00	13,00
total hired manpower for harvest (per ha)		12,50	15,00	17,65
daily price for hired manpower		7 500,00	10 000,00	6 000,00

total expenditures for harvest(riel)		**157 500,00**	**20 000,00**	**78 000,00**
total expenditures for harvest(riel/ha)	**291 666,67**	**225 000,00**	**150 000,00**	**138 823,53**
mechanic Threshing price (riel/kg)	25,00	25,00	25,00	25,00
expenditures for threshing (riel)	37 500,00	112 500,00	22 500,00	75 000,00
Expenditures for threshing (riel/ha)	**156 250,00**	**140 625,00**	**56 250,00**	**88 235,29**
transportation (riel)	25 000,00	0,00	18 000,00	
Transportation (riel/ha)	**104 166,67**	**0,00**	**45 000,00**	
water fee (riel)	**38 400,00**	**136 000,00**	**68 000,00**	**130 000,00**
water fee (riel/ha)	**160 000,00**	**170 000,00**	**170 000,00**	**152 941,18**
TOTAL INTERMADIATE EXPENSES (riel)	**396 500,00**	**772 000,00**	**420 500,00**	**641 000,00**
INTERMADIATE EXPENSES (riel/ha)	**1 652 083,33**	**965 000,00**	**1 051 250,00**	**754 117,65**

GROSS INCOME				
Qpaddy for on-farm-consumption (kg)	**1 500,00**	**2 500,00**	**450,00**	**0,00**
Q paddy for sale (kg)	0,00	2 000,00	**450,00**	3 000,00
sale price (riel/kg)	530,00	530,00	530,00	500,00
Gross income (riel)	**795 000,00**	**2 385 000,00**	**477 000,00**	**1 500 000,00**
Gross income (riel/ha)	**3 312 500,00**	**2 981 250,00**	**1 192 500,00**	**1 764 705,88**
Added value (riel)	**398 500,00**	**1 613 000,00**	**56 500,00**	**859 000,00**
Added value ($)	94,88	384,05	13,45	204,52
Added value/ ha (riel/ha)	1 660 416,67	2 016 250,00	141 250,00	1 010 588,24
Added value/ ha ($l/ha)	395,34	480,06	33,63	240,62

ANNEX 12: LATE WET SEASON RICE

Name	Niep piep (p. 109)	Soun	Me Sok	Tcheyn	Sok Tègn	Key Beir	Me Nuing Yeat	Mr Yun	Njor	Me Kim Kunti	Tci Tcheing	Sièn Teng	Han Hong	Mom Sokia
Village	**O'Po**	**O'Po**	**O'Po**	**O'Po**	**O'Po**	**Rovaong**	**Thnot Chum**	**Tro Peing Pon Lou**	**Po**	**Po**	**Po**	**O'Po**	**O'PO**	**Po**
Surface RFSP (ha)	**0,70**	**0,70**	**0,10**	**0,50**	**1,90**	**0,57**	**0,75**	**0,50**	**0,50**	**0,15**	**0,50**	**0,80**	**0,80**	**0,23**
					golden seed								water shortage!	
AGRO-ECONOMIC RESULTS														
rice variety	*Red rice*	*"Pka Ktum"*	Red Rice	Red Rice	Red Rice	*Red Rice*	*red rice*	*red rice*	*red rice*	*red rice*	*red rice*	*red rice*	*red rice*	*red rice*
Yield in paddy (kg/ha)	2 500	3 571	4 000	3 500	3 158	4 386	2 667	4 000	4 000	2 333	2 552	2 636	875	4 130
total paddy production (kg)	1 750	2 500	400	1 750	6 000	2 500	2 000	2 000	2 000	350	1 276	2 109	700	950
ECONOMIC RESULTS														
INTERMEDIATE EXPENDITURES														
cost for *koyoun* renting *(riel/ha)*				0	loue kouyoun pour 80% surface					170 000		provah 4 ox carts		
Expenditures for *koyoun* renting (riel)		**0**		**0**						**25 500**				
quantity of fuel for *koyoun* (L)				0										
fuel price (riel/L)				0										
total expenditures for koyoun (riel)	**0**	**0**		**0**						**25 500**				
total expenditures for koyoun (riel/ha)	**0**	**0**	**0**	**0**	**228 000**	**0**	**0**	**0**	**0**	**170 000**	**0**	**0**	**0**	**0**
seeds quantity (kg)	40	40	40	50	40	40	40	30	30	10	40	100	50	
seeds quantity (kg/ha)	57	57	400	100	21	70	53	60	60	67	80	125	63	
seeds price (riel/kg)	0	0	0											
expenditures for seeds (riel)	**0**	**0**	**0**								**0**	**0**		
Expenditures for seeds (riel/ha)			0	0	0			0	0	0	0			

Q of chemical fertilizers for nursery(kg)	7		0		5	4	2	3			3	10	5	
Q of chemical fertilizers(kg)	150	50	0	50	200	100	150	100	150	10	50	100	100	50
price of chemical fertilizers (riels/kg)	1 450	1 700	0	1 450	1 450	1 450	1 500	1 600	1 900	1 900	1 600	1 540	1 700	1 750
Expenditures for chemical fertilizer (riel)	**217 500**	**85 000**	**0**	**72 500**	**290 000**	**145 000**	**225 000**	**160 000**	**285 000**	**19 000**	**80 000**	**154 000**	**170 000**	**87 500**
Expenditures for chemical fertilizer (riel/ha)	**310 714**	**121 429**	**0**	**145 000**	**152 632**	**254 386**	**300 000**	**320 000**	**570 000**	**126 667**	**160 000**	**192 500**	**212 500**	**380 435**
Q organic manure for nursery	8 ox carts		0			2 ox carts	2 ox carts	0	0	0	0	3 ox carts	3 ox carts	
Q total organic manure	23 ox carts		0		**ca depend**		2 ox carts	0	0	0	0	3 ox carts	3	
cost of organic manure			0										0	0
Q weed killer (cL)	0	**0**	**0**		**0**	**0**	**0**		**0**		**0**	**0**	**0**	
price of weed killer (riel/cl)														
Expenditures for weed killer (riel)	**0**													
Expenditures for weed killer (riels/ha)	0	**0**	**0**		**0**		**0**	**0**			**0**			
Q other chemicals (cL)	0	0	0	0	0	0	0		0		0	0		
price other chemicals		0	0	0	0									
Expenditures other chemicals (riels)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**		**16 000**	**0**		**30 000**	
Expenditures other chemicals (riel/ha)	**0**	**0**	**0**	**0**	**6 000**	**0**	**0**	**0**	**0**	**106 667**	**0**	**0**	**37 500**	
price for MP for pulling seedlings		0	0	0	0		MOF			MOF	MOF	MOF		5 000
number of family labour force		0	0	0	0	0					**4**			**5**
number of *provas* labour force		0		0	0									
number of hired manpower		0	0		0								5	
expenditures for pulling seedling out manpower (riel)		0	0	0	0	0					**0**		**75 000**	**25 000**

expenditures for pulling seedling out manpower (riel/ha)		0	0	0	0				0	**48 000**				93 750
price for transplanting manpower (riel/day)	5 000	6 000	6 000	6 000	6 000	6 000	5 000	6 000	5 000	5 000	5 000	7 000	5 000	
number of family labour force	3	2	1	3	10	2			1	2			4	
number of *provas* labour force		0			0				3	12			4	
number of hired labour force	16	15	3	8	40	15	10	15			21	25		
labour force for transplanting 1 ha	27	24	40	22	26	30	13	30	0	27	28	26	31	35
Expenditures for transplanting labour force **(riel)**	**95 000**	**90 000**	**18 000**	**66 000**	**240 000**	**90 000**	**50 000**	**90 000**		**0**	**0**	**105 000**	**175 000**	**40 000**
expenditures for transplanting labour force **(riel/ha)**	**135 714**	**145 714**	**240 000**	**132 000**	**157 895**	**178 947**	**66 667**	**180 000**	**0**	**133 333**	**140 000**	**131 250**	**218 750**	**173 913**
price for harvest labour force (riel/day)	5 000	3 000	6 000	6 000	6 000	6 000	MOF	6 000		MOF		5 000	MOF	4 500
number of family labour force	3	2	1	3	10	2					2			3
number of rented labour force	16	20	3	8	40	15		15			12²provah	30		3
labour force for harvesting 1 ha	27	31	40	22	26	30	0	30	0	0	4	38	0	26
Expenditures for harvest labour force **(riel)**	**95 000**	**60 000**	**18 000**	**66 000**	**240 000**	**90 000**	**0**	**90 000**	**0**	**0**	**0**	**150 000**		**27 000**
Expenditures for harvest labour force **(riel/ha)**	**135 714**	**94 286**	**240 000**	**132 000**	**157 895**	**178 947**		**180 000**	**0**		**0**	**187 500**	**#VALEUR!**	**117 391**
mechanic Threshing price (riel/kg)	30	30	*provah*	30	30	30	provah	manuel		30		provah		provah
Expenditures for threshing (riel)	**52 500**	**75 000**	**0**	**52 500**	**180 000**	**75 000**	**0**	**0**	**35 000**	**10 500**				**42 000**

Expenditures for threshing (riel/ha)	**75 000**	**107 143**	**0**	**105 000**	**94 737**	**131 579**	**0**	**0**	**70 000**	**70 000**	**0**	**0**	**0**	**182 609**
transportation (riel)		**0**								**2 100**		**0**		
transportation (riel/ha)		**0**								**14 000**				
Number of pumping										**3**		**0**	**1**	
Q of fuel (L)													**10**	
Expenditures for pumping	**0**	**0**				**0**				**30 000**			**36 000**	**0**
water fee (riel)	0	0		0			0	0				0	80 000	0
water fee (riel/ha)	0	0					0	0					100 000	
TOTAL INTERMADIATE EXPENSES (riel)	**460 000**	**310 000**	**36 000**	**257 000**	**950 000**	**400 000**	**275 000**	**340 000**	**320 000**	**103 100**	**80 000**	**409 000**	**566 000**	**221 500**
INTERMADIATE EXPENSES (riel/ha)	**657 143**	**442 857**	**360 000**	**514 000**	**500 000**	**701 754**	**366 667**	**680 000**	**640 000**	**687 333**	**160 000**	**511 250**	**707 500**	**963 043**
	158	**107**	**87**	**124**	**120**	**169**	**88**	**164**	**154**	**166**	**39**	**123**	**170**	**232**
GROSS INCOME														
Q paddy for on-farm-consumption (kg)	**1 750**	**2 500**	**300**	**1 750**	**3 000**	**1 750**	**2 000**	**1 500**	2 000	**350**	**1 276**	**0**	**450**	**950**
Q paddy for sale (kg)	0	0	100	0	3 000	1 750	0	500		0	0	**2 109**	250	0
sale price (riel/kg)	600	600	600	600	650	600	600	600	600	600	600	530	600	550
Gross income (riel)	**1 050 000**	**1 500 000**	**240 000**	**1 050 000**	**3 900 000**	**2 100 000**	**1 200 000**	**1 200 000**	**1 200 000**	**210 000**	**765 600**	**1 117 770**	**420 000**	**522 500**
Gross income (riel/ha)	**1 500 000**	**2 142 857**	**2 400 000**	**2 100 000**	**2 052 632**	**3 684 211**	**1 600 000**	**2 400 000**	**2 400 000**	**1 400 000**	**1 531 200**	**1 397 213**	**525 000**	**2 271 739**
Added value (riel)	**590 000**	**1 190 000**	**204 000**	**793 000**	**2 950 000**	**1 700 000**	**925 000**	**860 000**	**880 000**	**106 900**	**685 600**	**708 770**	**-146 000**	**301 000**

Added value ($)	142	287	49	191	711	405	220	205	210	25	163	169	-35	72
Added value/ ha (riel/ha)	842 857	1 700 000	2 040 000	1 586 000	1 552 632	2 982 456	1 233 333	1 720 000	1 760 000	712 667	1 371 200	885 963	-182 500	1 308 696
Added value/ ha ($l/ha)	203	410	492	382	374	710	294	410	419	170	326	211	-43	

ANNEX 13: RAINFED RICE

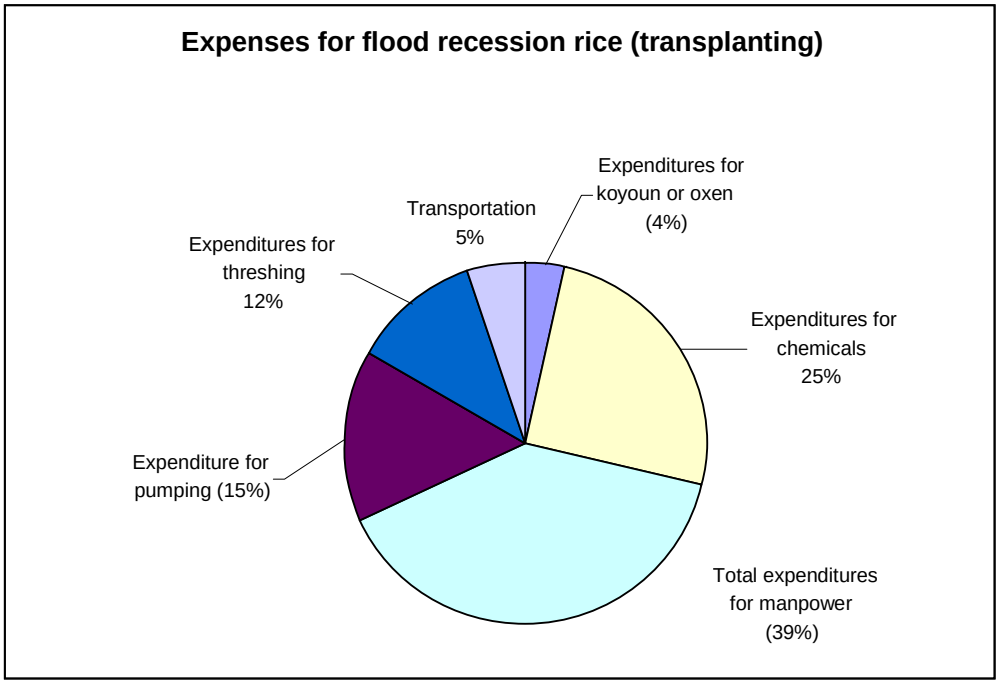
Name	Niep piep (p. 109)	Han PROGN	**Soun**	**Thi**	**Tcheyn**	**Mr Sit**	**Chein Thien**	**Ayur Soret**	**Tchi Tcheing**
Village	O'Po	0'Po	O'Po	O'Po	O'Po	Thnot Chum	Thnot Chum	Thnot Chum	Po
Family manpower available	2,00	5,00	2,00	3,00	2,00	4,00		5,00	2,00
lowland rainfed rice(ha)	1,30	0,25	0,30	1,50	0,50	1,20	1,00	1,50	0,50
AGRO-ECONOMIC RESULTS									
trive variety	*red rice*	*red rice*	*red rice*	*red rice*	*red rice*	*red rice*	*red rice*	*red rice*	*red rice*
yield (kg of paddy/ha)	3 076,92	4 000,00	3 333,33	2 666,67	2 500,00	2 916,67	1 925,00	3 000,00	2 600,00
rice production (kg of paddy)	4 000,00	1 000,00	1 000,00	4 000,00	1 250,00	3 500,00	1 925,00	4 500,00	1 300,00
economical performance									
Inpout expenditures									
renting price for *kouyoun* or draught oxen (riel/ha)	MOF	120 000,00	MOF	MOF	MOF	MOF	MOF	MOF	MOF
expenditures for renting *koyoun* or draught oxen		**60 000,00**							
Fuel for *koyoun* (L)		bœuf							
fuel price (riel/L)									
expenditures for *koyoun* fuel (riel)		**0,00**							
expenditures for *koyoun* fuel (riel/ha)	**0,00**	**120 000,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
seeds quantity (kg)		30,00	15,00	60,00	80,00	60,00	60,00	150,00	30,00
seeds quantity (kg/ha)		120,00	50,00	40,00	160,00	50,00	60,00	100,00	60,00
seeds cost (riel/kg)		0,00							
Expenditures for seeds (riel)	**0,00**	**0,00**	**0,00**						
Expenditures for seeds (riel/ha)	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**		
Q fertilizer for nursery (kg)		**2,00**		**6,00**		**5,00**	**10,00**		**4,00**
fertilizer quantity (kg)	100,00	25,00		150,00	100,00	80,00	100,00	200,00	50,00
fertilizer price (riel/kg)	1 500,00	1 400,00		1 500,00	1 500,00	1 500,00	1 500,00	1 500,00	1 500,00
Expenditures for fertilizer (riel)	**150 000,00**	**35 000,00**	**0,00**	**225 000,00**	**150 000,00**	**120 000,00**	**150 000,00**	**300 000,00**	**75 000,00**
expenditures for fertilizer (riel/ha)	**115 384,62**	**140 000,00**	**0,00**	**150 000,00**	**300 000,00**	**100 000,00**	**150 000,00**	**200 000,00**	**150 000,00**

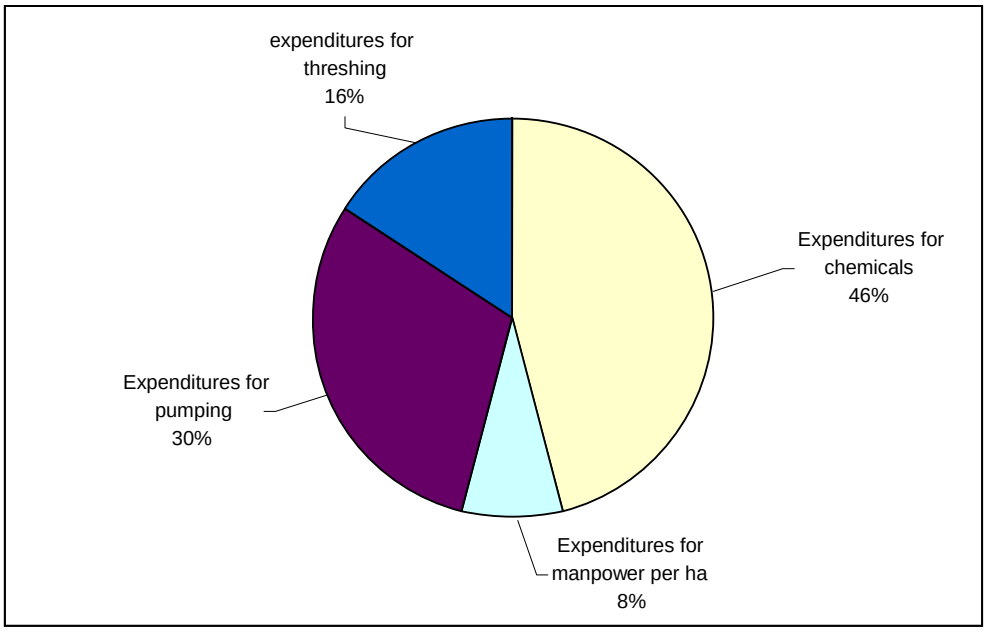
Q organic manure for nursery		**2 ox carts**	**1 ox cart**	**4 ox carts**		**5 ox carts**	**2 ox carts**		**3 ox carts**
organic manuer quantity	the remains part	6 ix carts		**15 ox carts**	**30 ox carts?**	**30 ox carts**	**2 ox carts**		**4 x carts**
expenditures for organic manure (riel)	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**		
Q weed killer (cL)	0,00								
price of weed killer (riel/cl)									
expenditures for weed killer (riel)	**0,00**	**0,00**	**0,00**	**0,00**					
expenditures for weed killer (riel/ha)	**0,00**								
Q other chemicals (cl)									
price other chemicals									
Expenditures for other chemicals (riel)	**0,00**		**0,00**	**0,00**					
Expenditures for other chemicals (riel/ha)	**0,00**	**0,00**							
price for MP for pulling out seedlings									
number of family labour force									
number of provas labour force "									
number of hired manpower									
expenditures for pulling seedling out labour force **(riel)**									
expenditures for pulling seedling out labour force **(riel/ha)**									
family labour force for transplanting		**5,00**	**2,00**	**6,00**	**3,00**	**4,00**	**5,00**		**2,00**
provas labour force for transplanting						**2,00**			**12,00**
hired labour force for transplanting	25,00	5,00	5,00	30,00	7,00	20,00	11,00	**40,00**	
total labour force for transplanting per ha	19,23	40,00	23,33	24,00	20,00	21,67	16,00	26,67	28,00
daily price for hired labour force	5 000,00	6 000,00	6 000,00	6 000,00	6 000,00	6 000,00	**5 000,00**	**5 000,00**	**5 000,00**

total expenditures for transplanting (riel)	**125 000,00**	**30 000,00**	**30 000,00**	**180 000,00**	**60 000,00**	**120 000,00**	**55 000,00**	**200 000,00**	**0,00**
total expenditures for transplanting(riel/ha)	96 153,85	240 000,00	140 000,00	144 000,00	120 000,00	130 000,00	80 000,00	133 333,33	140 000,00
expenses for harvester (riel)			2,00	2,00	3,00		20,00		
expenses for harvester (riel/ha)									
family labour force for harvest		5,00				4,00			2,00
provas labour force for harvest									12,00
hired labour force for harvest	25,00	5,00	7,00	30,00	7,00	20,00		40,00	
total manpower for harvesting per ha	19,23	40,00	30,00	21,33	20,00	20,00	20,00	26,67	28,00
daily price for hired manpower	5 000,00	6 000,00	3 000,00	6 000,00	3 000,00	6 000,00	5 000,00	5 000,00	6 000,00
total expenditures for harvest(riel)	**125 000,00**	**30 000,00**	**21 000,00**	**180 000,00**	**30 000,00**	**120 000,00**	**0,00**	**200 000,00**	0,00
total expenditures for harvest(riel/ha)	**96 153,85**	**240 000,00**	**90 000,00**	**128 000,00**	**60 000,00**	**120 000,00**	**100 000,00**	**133 333,33**	**168 000,00**
number of irrigation	0,00	0,00	0,00	1 (july for ferti nursery)		0,00			1(nursery)
fuel quantity (L)				2,00					0,50
price for fuel (riel/ha)				3500					3500
Expenditures for pumping	**0,00**	**0,00**	**0,00**	**7 000,00**	**0,00**				**1 750,00**
Expenditures for pumping (riel/ha)				**4 666,67**					**3 500,00**
threshing price (riel/kg)	25,00	25,00	25,00	MO	25,00	25,00	MOF	25,00	**MOF**
Expenditure for threshing (riel)	**100 000,00**	**25 000,00**	**25 000,00**	**240 000,00**	**31 250,00**	**87 500,00**		**112 500,00**	
expenditures for threshing (riel/ha)	**76 923,08**	**100 000,00**	**83 333,33**	**160 000,00**	**62 500,00**	**72 916,67**		**75 000,00**	
transportation (riel)									
transportation (riel/ha)									
TOTAL EXPENDITURES (riel)	**500 000,00**	**180 000,00**	**76 002,00**	**832 002,00**	**271 253,00**	**447 500,00**	**205 020,00**	**812 500,00**	**76 750,00**
TOTAL EXPENDITURES (riel/ha)	**384 615,38**	**720 000,00**	**253 340,00**	**554 668,00**	**542 506,00**	**372 916,67**	**205 020,00**	**541 666,67**	**153 500,00**
TOTAL EXPENDITURES ($/ha)	**92,68**	**173,49**	**61,05**	**133,65**	**130,72**	**89,86**	**49,40**	**130,52**	**36,99**
Marge brute									

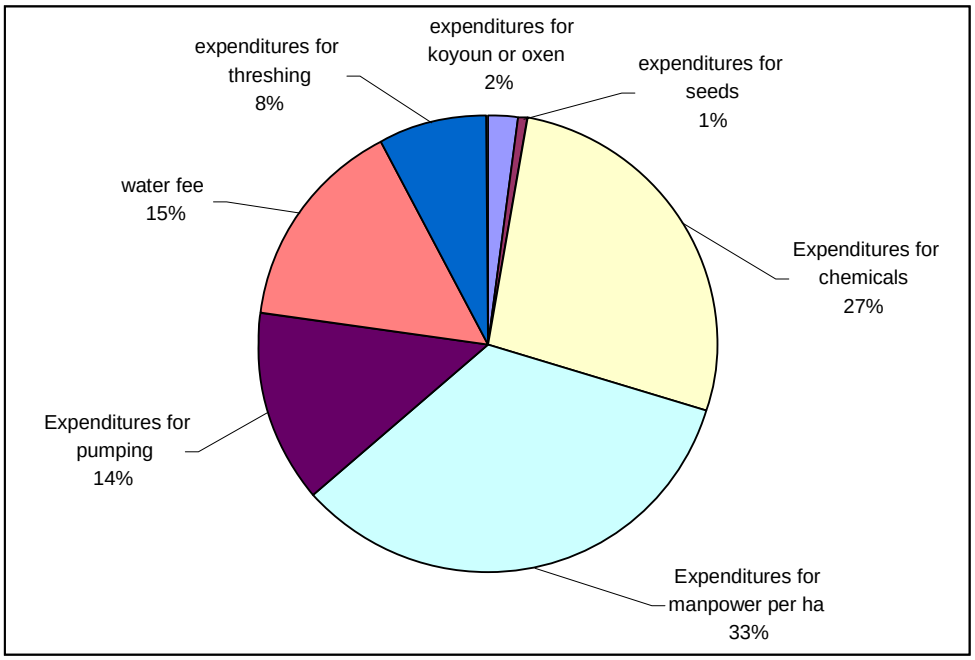
paddy for on-farm consumption (kg)	**1 500,00**	**1 000,00**	**1 000,00**	**2 500,00**	**1 250,00**	**3 500,00**	**962,50**	**4 500,00**	**1 300,00**
paddy for sale (kg)	2 500,00	0,00	0,00	1 500,00	0,00	0,00	962,50		0,00
sale price (riel/kg)(2004)	500,00	500,00	500,00	500,00	500,00	500,00	500,00	500,00	500,00
Marge brute	**2 000 000,00**	**500 000,00**	**500 000,00**	**2 000 000,00**	**625 000,00**	**1 750 000,00**	**962 500,00**	**2 250 000,00**	**650 000,00**
Added Value (riel)	**1 500 000,00**	**320 000,00**	**423 998,00**	**1 167 998,00**	**353 747,00**	**1 302 500,00**	**757 480,00**	**1 437 500,00**	**573 250,00**
Added Value ($)	361,45	77,11	102,17	281,45	85,24	313,86	182,53	342,26	136,49
VA /ha (riel/ha)	1 153 846,15	1 280 000,00	1 413 326,67	778 665,33	707 494,00	1 085 416,67	757 480,00	958 333,33	1 146 500,00
VA/ha ($/ha)	278,04	308,43	340,56	187,63	170,48	261,55	182,53	228,17	

ANNEX 14:

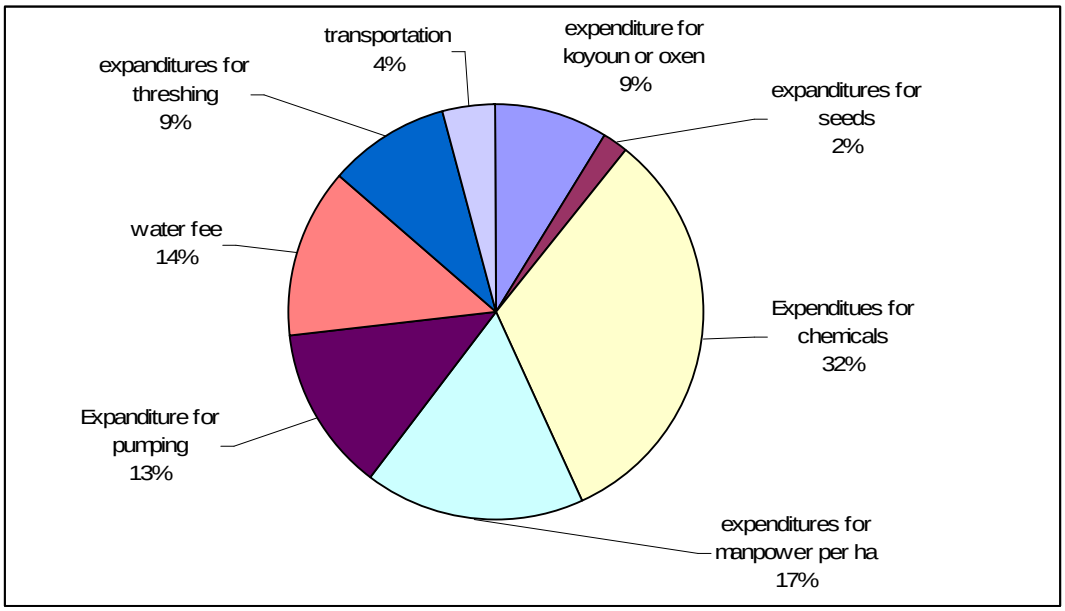




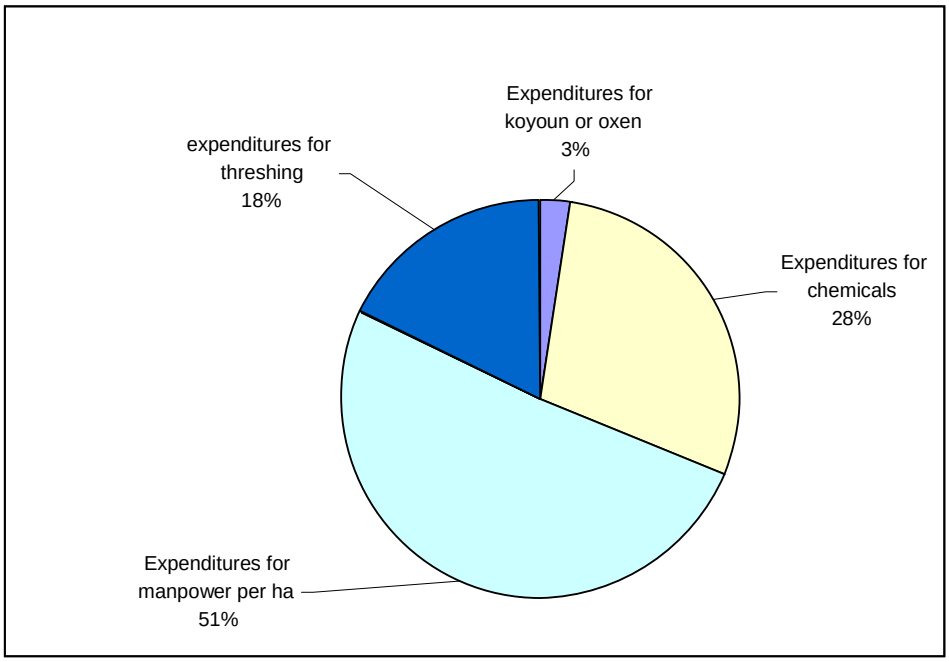
Expenses for Flood recession with broadcasting



Early wet season rice with transplanting



Expenses for Early Wet season Rice with broadcasting



Expenses for Rainfed rice

Annex n°15 : Letter addressed to Mr Fontenelle

Kbal Por Community Pump Station
Sambour commune, Trang District, Takeo Provinces
Tel: 855-12-479 269

Dr.Jean-Philipp Fontenelle
Social Water Management Specialist
Sustainable Food and Agriculture Cluster Coordinator
Tel:33 (0)14005 6145
E-mail: fontenelle@gret.org

Dear Dr. Jean-Philipp Fotenelle

On behalf of the representative of Kbal Por community Pump Station in Sumbour commune, I would like to thank for your present in our community. We are glad to see you at anytime, and we expects that you will cooperate with us as a good partnership of Kbal Por community.

With the supporting from authorities and the people in Sambour commune, Kbal Por community Pump Station was re-established to supply the need of the people in growing rice and other agriculture fields, but we have imbalance between water supply and water demand, because we have deficiency in fund to satisfy the tremendous demand of the people.

We have try on our best to operate water supply to the people through what we have, as the result , we have achievement as below:

-Increase living standard of the people, reducing poverty in Sambour commune.
-People was employed with agriculture field for a full year.
-Reducing migration to the city, that is the cause of spreading AIDS.
-The agriculture was develop from the low standard to higher standard.
-Increase agriculture's productivity. ...etc.

We plan to improve our operation to other nearby commune, such as Phum Chen, Phum Tomlob,Phum Pok, Phum Trohbek, Phum Troh paing Ambos, Phum Prey Tapoh, Phum Tlok, with approximately 9000 populations. We estimate to spend $100,000.00 to extend our operation to serve the people.

Now, we would like to appeal to NGO, government and the generosity to cooperate with us as partnership to strengthen our ability especially Financial , management , and technology support to prove our operation to reach the goal.

We expects that you will give us the good feedback to us soon!

Yours [illegible]

SOK TOUCH, Kbal Por community pump station

ANNEX 16: report on the meetings regarding the rules of the irrigation system

(translation realised by Tonkin)

Le 16 août 2002, à 9h00, à la Pagode de Pneat, dans le village de Kbal Por, dans la commune de Sambour, district de Treang, province de takéo, s'est tenue une réunion sur *l'investissement/commerce* de la station de pompage de Kbal Por, avec la *participation/présidence* de Mr Koy Sohunthea, *chef de la riziculture/irrigation* de la province et représentant du département provincial de l'agriculture, sous la présidence du chef de village ;
Avec la participation de :

- le chef, les assistants et les membres de la commune
- les chefs des villages
- les citoyens

Total : 66 personnes dont 19 femmes

Tout d'abord, Mr Sam Trin (chef de la commune) a *présenté* la station de pompage de Kbal Por. Il a déjà sollicité de l'aide auprès de différentes organisations pour réparer les canaux et changer les pompes, mais n'a pas obtenu de réponse positive (*irréalisable*). Il y a près d'un mois, des personnes *ont proposé de/ont voulu* réparer la station avant de dire que ce projet était irréalisable. Récemment, un entrepreneur privé, Mr Sok Touch, domicilié dans la ville de Takéo, a proposé d'investir dans la station de pompage.

Avec l'accord du conseil communal, la *réunion* a fixé les points suivants : l'entrepreneur s'engage à :

- Installer 3 nouvelles pompes, d'une puissance de 350 chevaux, pour un coût de US $150 000 ,
- Les anciennes machines seront *changées (mises de côté)*
- Restaurer le *canal principal*
- Le prix de la redevance sera proportionnel à celui du pétrole
  - Pour l'irrigation directe, le montant est fixé à 140 000 riel/ha
  - Pour l'irrigation indirecte (utilisation d'une moto-pompe) le montant de la redevance sera de 110 000 riel
  - *Distribution au moment de la saison des pluies*
- La durée du contrat est de 15 ans
- *Reconstruire* la station de pompage

Si, à la fin de ce contrat, l'entrepreneur ne remportait pas l'appel d'offre, il ne pourra pas réclamer d'indemnités concernant les dépenses pour la réparation et la restauration des canaux et de la station de pompage, ni même reprendre les pompes.

Après la présentation de Mr Sam Trin, c'est au tour de Mr Koy Sokunthea de discuter avec les citoyens. Mr Koy Sokunthea a demandé aux citoyens s'ils *s'étaient mis d'accord sur/étaient d'accord avec* la présentation du chef de commune. Les citoyens ont ensuite discuté le prix de la redevance. Tous les points ont été acceptés, sauf le montant de la redevance qui pose un problème aux citoyens. Selon eux, la plupart des

rizières sont loin du canal principal. Or l'entrepreneur a fixé un prix unique de 140 000 riel/ha, quelque soit *la longueur de l'irrigation directe ou de l'irrigation indirecte (?).*
La discussion a duré 3 heures. Les citoyens ont encore eut des problèmes pour le prix. L'investisseur a décidé encore une fois que :

- Le montant de la redevance est de 150 000 riel/ha pour une irrigation directe
- Le montant de la redevance est de 110 000 riel/ha pour une irrigation indirecte
- Ce montant est valable pour une durée de 15 ans *selon que le prix du pétrole soit plus ou moins élevé (????fixe ou variable selon le prix de l'essence ???)*
- *Le remboursement des dommages causé par le disfonctionnement de la machine porte sur les dépenses pour la main d'œuvre et les semences*
- *Il n'y a pas de remboursement des charges en cas de dommage causé par des insectes.*

La réunion s'est terminée à 12h30 *avec l'accord/sous la décision* de l'entrepreneur, dans un moment favorable

COMPTE RENDU DE REUNION (traduction réalisée par Tonkin)

Le 22 octobre 2002, à 8h00, à la Pagode de por Ampel, dans le village de Por, dans la commune de Sambour, s'est tenue une réunion sur *l'investissement/commerce* de la station de pompage de Kbal Por, sous la *direction/présidence* de Mr Koy Sohunthea, *chef de la riziculture* à Takéo.
Les participants :

- *L'investisseur (ou les investisseurs ?)*
- le chef du village
- les citoyens

Avant tout, Mr koy Sokunthea, l' (ou les) investisseur(s) et les citoyens ont discuté de la station de pompage de Kbal Por et ont pris les engagements suivants :

1) Les entrepreneur prennent l'engagement suivant: le montant de la redevance pour l'irrigation du riz en début de saison des pluies sera fixé à 150 000 riel par hectare, *avec un niveau d'eau permanent du semis à la récolte*.
2) Le montant de la redevance est le même quelque soit la durée d'utilisation de l'eau d'irrigation (même prix que l'on s'arrête d'irriguer à la récolte ou avant).
3) Si l'usager doit pomper l'eau du canal vers sa parcelle, le montant de la redevance est de 110 000 riel par hectare.

La réunion s'est achevée à 11h00, dans une situation favorable et de fraternité.
Vu et approuvé :

L'entrepreneur: Mr Sok touch	Sam Trin (chef de commune)	Koy Sokunthea

Annex 18: functioning costs and receipts[39]

FUNCTIONING COSTS FOR YEAR 2003						
	DURATION (MONTH)	QUANTITY	UNIT	PRICE PER UNIT($)	TOTAL COST ($)	
Fuel	3	600	kans (30L/kan)	12	7 200,00	(18000L/3mois)
Oil	3	6		30	180,00	
oxen grease	3				50,00	
Manpower	3	9 (3 people during 3 months)		300	900,00	(100$/mois/people)
TOTAL					**8 330,00**	

RECEIPTS FOR THE YEAR 2003						
VILLAGE	WET SEASON	DRY SEASON	IRRIGATED AREA	WATER FEE/HA	TOTAL (RIEL)	TOTAL (US$)
Kbal Po	265	264	64,4	110000/150000	8 372 000	2 017
O Po	273	305	71,0	150 000	10 650 000	2 566
Tro peing Pon Lou	249	301	50,6	150 000	7 590 000	1 829
Po	269	254	60,0	110000/150000	9 000 000	2 169
Rovaong	254	267	21,0	150 000	3 150 000	759
Thnot Chum	329	195	22,5	150 000	3 375 000	813
TOTAL	**1 639**		**289,5**		**42 137 000**	**10 153**

[39] Information provided by the contractor

	FUNCTIONING COSTS FOR YEAR 2004					
	DURATION (MONTH)	QUANTITY	UNIT	PRICE PER UNIT($)	TOTAL COST ($)	
Fuel	3	600	Kans (30L/kan)	14	8 400	(18000L/3mois)
Oil	3	6		33	198	
Oxen grease	3				60	
rehabilitation 2 canals	3	2	canals		2 000	
concreting canal for bridge	3	5	bridges		1 000	
manpower	3	2	people	300	600	(100$/mois/people)
TOTAL					**12 258**	

RECEIPTS FOR THE YEAR 2004						
VILLAGE	WET SEASON	DRY SEASON	IRRIGATED AREA	WATER FEE/HA	TOTAL (RIEL)	TOTAL (US$)
Kbal Po	265	264	80	130000/170000	10 400 000	2 506
O Po	273	305	103	130000/170000	13 390 000	3 227
Tro peing Pon Lou	249	301	63	130000/170000	8 190 000	1 973
Po	269	254	63	130000/170000	8 190 000	1 973
Rovaong	254	267	48	130000/170000	6 240 000	1 504
Thnot Chum	329	195	55	130000/170000	7 150 000	1 723
TOTAL			**412**		**53 560 000**	**12 906**

1830 RIEL/L OF FUEL	DATE	PUMPING SCHEDULE	NUMBER OF KANS (30L/KAN)	PRICE (RIEL)	PRICE (US$)
1st irrigation	29/05/2005	7H00 - 15H00	10	550 000	133
	30/05/2005	10H15-15H55	6	330 000	80
	31/05/2005	6H40-12H00	5	275 000	66
	01/06/2005	8H30-11H50		0	0
	02/06/2005	6H30-11H50	13	715 000	172
	03/06/2005	7H00 - 9H00	10	550 000	133
	04/06/2005	7h30 -16H30	3	165 000	40
	05/06/2005	7H00-11H00	1	55 000	13
	06/06/2005	7H00- 22H05	14	770 000	186
	07/06/2005	7H00- 22H06	22	1 210 000	292
	du 08 au 15 juin	24/24	116	6 380 000	1 537
	22/06/2005		31	1 705 000	411
	23/06/2005		7	385 000	93
	23/06/2005		10	550 000	133
	23/06/2005		13	715 000	172
	24/06/2005		7	385 000	93
	24/06/2005		5	275 000	66
	24/06/2005		10	550 000	133
	25/06/2005		7	385 000	93
	25/06/2005		7	385 000	93
	25/06/2005		7	385 000	93
	25/06/2005		10	550 000	133
	26/06/2005		10	550 000	133
	26/06/2005		23	1 265 000	305
	26/06/2005		4	220 000	53
	27/06/2005		9	495 000	119
	27/06/2005		4	220 000	53
	27/06/2005		11	605 000	146
TOTAL			**375**	**20 625 000**	**4 970**

Table: pumping statement (done by the contractor)

Annex 19: some photo of the IS

Supply channel

Pumping station

« tête morte »

primaryCanal

Sluices (N°4 and 5) on primary Canal

Irrigation with pump (from tertiary canal to quaternary)

Secondary Canal

Irrigation by dike opening