A pilot project…to serve collective action

Irrigation Service Center support (GRET-ISC)
Two case studies:
Pram Kumpheak and Teuk Chha irrigation systems
Kompong Cham Province
Cambodia

Presented by

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Agricultural engineer specialization in Social Water Management
At the Agricultural Research Institute for Tropical Regions

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Thanks to my Family, still here in spite of the distance.

[1] « Good morning! How are you? I do not understand! I do not eat insect in the morning ».

ACRONYMS AND ABBREVIATIONS

ADB	-	Asian Development Bank
AFD	-	Agence Française de Développement
ACIAR	-	Australian Centre for International Agricultural Research
Apronuc	-	Autorité Provisoire des Nations Unies pour le Cambodge
ADG	-	Aide au Développement Gembloux
ASIrri	-	Projet d'appui aux irrigants et aux services aux irrigants
AusAID	-	The Australian Government's overseas aid program
AVSF	-	Agronomes et Vétérinaires Sans Frontières
CARDI	-	Cambodian Agricultural Research Development Institute
CAVAC	-	Cambodia Agricultural Value Chain Program, Research component
CDRI	-	Cambodia Development Resource Institute
CEDAC	-	Centre d'Etude et de Développement Agricole Cambodgien
CETC	-	Chambres Extraordinaires au sein des Tribunaux Cambodgiens
CISIS	-	Cambodian Irrigation Schemes Information System
CPP	-	Cambodian People's Party
CSD	-	The Council for Social Development
CUP	-	Communauté des Usagers de Polders (Polder Users' Community : PUC)
DPO	-	Development Policy Operation
DS	-	Dry season
DSGD	-	Development Strategy and Governance Division
EU	-	European Union
EWS	-	Early Wet Season
FAO	-	Food and Agriculture Organization
FUNCIPEC	-	National United Front for an Independent, Neutral, Peaceful, and Cooperative Cambodia
FWUC	-	Farmer Water User Community
FWUG	-	Farmer Water User Group
GRET	-	Groupe de Recherche et d'Echanges Technologiques
IFAD	-	The International Fund for Agricultural Development
IRAM	-	Institut de Recherches et d'Applications des Méthodes de développement
ISC	-	Irrigation Service Center
IMT	-	Irrigation Management Transfer
IRRI	-	International Rice Research Institute
ISF	-	Irrigation Service Fee
IRAM	-	Institut de Recherche et d'Applications des Méthodes de développement
MAFF	-	Ministry of Agriculture, Forestry and Fisheries
MFI	-	Micro Finance Institution
MRC	-	Mekong River Commission
MoU	-	Memorandum of Understanding
MOWRAM	-	Ministry of Water Resources and Meteorology
MREM	-	Ministère des Ressources en Eau et de la Météorologie
NCDD	-	The National Committee for Sub-national Democratic Development
NCSC	-	National Committee for Support to Communes
NGO	-	Non-governmental Organization
NSGDP	-	National Strategic Development Plan
O&M	-	Operation and Maintenance
PDOWRAM	-	Provincial Department of Water Resources and Meteorology
PIMD	-	Participatory Irrigation Management and Development
PRASAC	-	Programme de Réhabilitation et d'Appui au Secteur Agricole du Cambodge
PRDC	-	Provincial Rural Development Committee

RGC	-	Royal Government of Cambodia
SKY	-	Acronym for “Insurance for our Families” in Khmer
SRI	-	System of Rice Intensification
TOR	-	Terms of reference
WS	-	Wet Season
WTO	-	World Trade Organization

INTRODUCTION

The Khmer society is marked, in its social organization, by cycles of violence, essentially of political order. Historical reports speak about this systematic repression starting in 1953, the year that marked the Cambodian independence and the departure of the French, and the change from the Democratic Party to the communist party of the Khmer Rouges; **this violence has a historic value**. This repression came both from the inside and from the outside (American war in Vietnam). Once the American war ended, the Khmer Rouge took over in 1975 imposing an **extreme communist system** which lasted four years; this project, led by **Pol Pot**, leader of the Angkar «the revolutionary Organization ", was to lead the society to a collectivism of all capital goods. There was no more currency and industry, the production was going to fall. The project, which wished to build a new society based on agriculture and irrigation development failed.

Throughout the history of Humanity, never have the **collectivism** and the negation of human dignity been pushed so far as under the democratic Kampuchea. The individual ceased to be; Man was reduced to a work tool, easy to manipulate and replace. The atrocities of this period and the omnipresent fear incited the informing «chèh tam hole dan knie tou vinh tou muk![2]". Then the Khmer Rouge began a hunt of intellectuals and technicians; the country was thus emptied of all skills and the rough egalitarianism **discouraged any initiative** among Cambodians. The country plunged into **famine** and **poverty**.

In 1998, the death of the Khmer Rouges leader marked the end of these years of extreme violence. Having undergone the most radical transformations with an unequalled intensity and without the slightest consideration for human life, it was necessary to think of reconstructing the country by restoring trust among men (and self-confidence among people) to undertake common projects and re-inflate the Cambodian economy essentially based on agriculture.

Thus it is necessary to **develop support programs for agriculture**, essentially by the cultivation of rice which occupies more than 90 per cent of arable land; in order to increase the agricultural productivity and allow the rural families facing lean seasons, the government has to strengthen the irrigation system. But the lack of financial means and skills does not allow the government to manage irrigated systems by itself. A responsibility transfer mechanism from it to local entities has to be planned. The idea to build collective structures able to manage these irrigation systems, at technical, financial, O&M levels, is gaining ground. In 2000, the circular N°1 formalized **the FWUC** (Farmers Water Users Community) creation followed by a **decentralization** process in 2002 from the government to the communes.

These organizations are still weak (lack of capacities, O&M, financing) and numerous hydraulic infrastructures, built under Pol Pot regime, need to be rehabilitated; the **weaknesses at the O&M** level are partly attributable to **low social cohesion** and, consequently to the lack of coordination between farmers. Thus, there is talk, in this study, of the **present state of collective action between social entities and of ways to strengthen it shortly after the end of the civil war and the destruction of social connection.**

It is in this context of social and material reconstruction that the **ASIrri project** "Appui aux irrigants et aux services aux irrigants" was proposed through the consortium "IRAM-GRET-AVSF". In Cambodia, an **irrigation service center** (ISC) was created, still at the project stage and is made up of a local team; their activities are coordinated by GRET.

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[2] « You must spy all the minors' doings of each of you». (Locard, H. 1996. Paroles de l'Angkar)

The study is about two irrigated systems, **Teuk Chha** and **Pram Kumpheak**, both located in Kompong Cham province. It was undertaken for GRET with the ISC team over five months.

The first part of this report sets the study in its general context: the current and former situation of the irrigation sector in Cambodia, as well as the project ASirri and the ISC presentation. The second part describes the conceptual and methodological framework linked to the collective action in irrigation systems. The third part develops the diagnosis of both irrigated systems studied, to end on the intervention ISC process. The discussion will try to understand the collective action weaknesses in the water users' communities through two theories and the ISC work results. Some proposals to strengthen the ISC intervention in the field will be also suggested.

I. TO ENSURE SUSTAINABLE ACCESS TO WATER BY IMPLEMENTING IRRIGATION SERVICES

1 CAMBODIA'S HISTORY LEFT ITS MARK ON IRRIGATION DEVELOPMENT

1.1 Essential water resources management to overcome rural poverty

Cambodia is located in South East Asia and is constituted by a large basin surrounded by mountain range. This small country is bordered by Thailand in the West, Laos and Thailand in the North, Viet Nam in the East and the gulf of Thailand in the south. Mondulkiri plateau is located in the east of Cambodia (cf. figure 1). In the South West, the highest elevation of the country is Phnom Aural at 1,813 meters and creates a barrier between the vast alluvial plains of Tonlé Sap and the gulf of Siam (Feintrenie, 2004).

The total land area is 181,035 km², consisting of 24 provinces, including four municipalities and 182 districts: the rural area is around 54,550 km² and **irrigated land** around 2,700 km² [3](Samphois, 2004).

Figure 1: Map of Cambodia and workplace

Source: *U.S. Central Intelligence Agency*

Cambodia's poor people number almost 4.8 million and 90 per cent of them are in rural areas. Most of them depend on agriculture for their livelihood; thirty-one[4] percent of the population is estimated to live below the poverty line (the Cambodian Government uses its own poverty line of $0.50 per day). The poorest people are mainly subsistence farmers, fishermen, landless people and rural youth, as well as internally old, sick people and mine victims. Health problems, lack of education, poor infrastructures and low productivity lead to deeper poverty.

In Cambodia, at least 12 per cent of poor people are **landless** (IFAD, 2007). In 2004, most landless people (60 per cent) belonged to families who had never been landowners (young couples which did not get a land dowry from their parents or former refugees). The remaining 40 per cent owned land but lost it, either by **expropriation** or by spontaneous sale (De Dianous, 2004). It is one of the consequences of **low productivity**, **decades of war** and **poverty**. It leads to internal **migration** also strengthened by rapid population growth. Due to lack of social insurance or governmental support, many people are obliged to sell their small plots to rich people in order to pay their medical care or to pay off a debt. When poor families do not know how much time they will keep their land, they are tempted to give it up **reducing the investment** in it (**irrigation,** mechanization and devotion of time

[3] FAOSTAT 2007

[4] CIA, 2004

to it). The rural underinvestment, which increases the precariousness of the landed property, grows out of economic uncertainty. Those people are insecure, excluded and vulnerable.

Besides, the country, after decades of civil war, is still full of **anti-personnel mines**. They kill more than 800 people every year, mainly among farmers who are looking for new land to farm (De Dianous, 2004). The goal is **to enable poor rural people** to overcome poverty. One of the solutions to reduce this recurrent poverty may be to propose additional **support** to farmers through **an ease of services access**, making this development easier.

Cambodian farmers have been cultivating rice for at least the last 2,000 years (McKenney & Tola, 2002). Agriculture there is little diversified; 90 per cent of land is dedicated to rice production (about 2.3 million ha)[5]. Recently, this production has become insignificant on a global scale, in terms of production and trade (non-adapted varieties, lack of organization, etc.) (Konishi, 2003). For example, in 2009, Kompong Cham province was the fourth largest rice growing area but, the majority of production was used locally, leaving very little surplus (Escabasse, 2009). In 2008, the rice production was estimated at 6.8 million tons; 2.8 million tons were exported[6].

According to the FAO, there are not sufficient storage sites, transport infrastructures and irrigation systems. Only 16 per cent of rice fields are irrigated while irrigated rice fields generate 40% of the national production.

Rice is a **staple crop** for Khmer families and its production plays a large part in traditions and language; it is also essential to food security of households. In Khmer, to eat is said, "*niam bay*", literally: to eat rice; a farmer is called *neak srê*, literally: the man of rice fields. In rural areas, there is no one family who does not depend on its production; it accounts for as much as 30 per cent of a household's expenditures. Most people practice agriculture at the **subsistence level** and produce rice mainly for home consumption. Considering the low diversity of agriculture and vulnerability of rural families because of offer/demand economics and environmental changes, they are constantly looking for other sources of income from on-farm activities (from selling rice, vegetables, fruits, rice seeds and cashew nuts) and off-farm activities (construction works, groceries, factory works, etc.) (CEDAC, 2010)[7].

Understanding the importance of agriculture and, especially, rice production, the government, supported by international organizations and NGO's, has to improve rural families' incomes increasing the production through the yields and the agricultural diversification (rice, other annual crops and permanent crops (mainly palm trees, coconut and rubber[8])).

In the water sector, the Cambodian government is making some efforts in improving access to public services, sanitation (GRET is working on it), infrastructures and increasing agricultural productivity to face insufficient precipitation throughout the country since the beginning of the wet season in 2010. Food security in Cambodia is generally satisfactory[9]. Some organizations (CEDAC, GRET, AFD, etc.) develop new projects about it (Food Facility project, Irrigation Service Center, etc.).

Since the early 1990s, the **water sector** in Cambodia has reemerged as one of the most **urgent areas for development interventions** (Thuon, 2007) and as an important **public policy** issue. However, the budget of the government seems to be limited to push the irrigation expansion; the sector is **weak** and needs **technical and economic assistance**.

---

[5] IRRI, 2001.

[6] http://www.ccfcambodge.org/ (Chambre de Commerce Franco-Cambodgienne).

[7] CEDAC is an agricultural and rural development organization, set up in August 1997, with initial support from GRET.

[8] Rubber is mainly produced in Kompong Cham and Rattanakiri.

[9] FAO, 2010.

Try Thuon, from CEDAC, cites some reasons to justify the irrigation sector support:

- Many farmers produce rain-fed rice but water resources use is not effective because of the poor functioning irrigation systems,
- The water sector needs human resources management (O&M),
- To achieve stable food supply, poverty alleviation and socio-economic development.

It is said that 75.6 per cent of the total cultivated area is dependent on rainwater and the irrigated area is estimated to be only about 19.5 per cent of the Cambodian cultivated[10] area (CSD, 2002).

In a country marked by a long dry season, it is essential to propose ways to collect and store rainwater in order to extend the irrigation potential throughout the year.

River basin and water balance

Geographically, the country is divided by the **Mekong River** and the **Tonlé Sap River** with the "**Great Lake**". It is located, in the capital, Phnom Penh, in the West of the confluence of both rivers. The inferior parts of the Mekong and Bassac are branches of Mekong River which rises in Tibet and flows to the delta located in Vietnam to flow into the South China Sea (Samphois, 2004). This gives it a **unique hydrological system** (cf. figure 2).

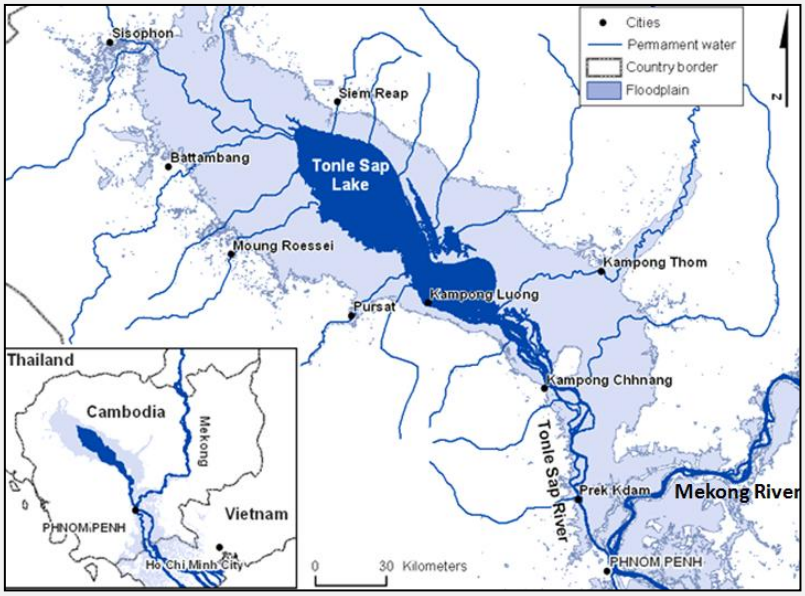

Figure 2: Tonlé Sap and Mekong, a unique hydrological system

Source: ICE Case Studies, 2007

The Tonle Sap is the largest permanent fresh water lake in Southeast Asia; it is said to be one of the most productive inland waters of the world (Varis et. al.2006:395). It is connected to the Tonlé Sap River with the Mekong River and has the characteristic of collecting the surplus of water derived from the Mekong flood when its level is high from July to the end of September; then, in the dry season, between November and June, the River reverses its flow and becomes partially empty. The river Tonlé Sap, coming from Mekong, crosses the country from North to South to join the Mekong River in Phnom Penh. Mekong is also called Tonlé Thom, "the Large River". It draws a long curve in the Eastern central basin. After having joined Tonlé Sap, the Mekong divides into two branches (lower Mekong and Tonlé Bassac): the confluence and the division of Mekong form the "plain of the Four-branches". During the rainy season, the flow of Mekong varies from 15,000 to 40,000 m^3/seconds in Phnom Penh (Delvert, 1994). The excess of water which cannot be evacuated towards the sea is initially rejected into Tonlé Sap, increasing the size of the lake from 2,700 to 9,000 km², at its maximum, to overflow in the plain. Its water storage capacity is estimated at 72 km^3. This overflowing enriches the soils with alluvia and is favorable to fish migration.

[10] The total cultivated area is around 2,700 km².

The country, marked by a **wet monsoon climate,** is said to be **abundant in water resources**, so competition and conflicts rarely occur (Samphois, 2004). The rainy season extends from May to November; then, it is dry season (Muukkonen, 2007). Rainfall fluctuates between 1,250 and 1,750 mm (cf. figure 3) each year, while rainfalls close to the coast are about 4,000 mm.

The maximum precipitation is observed between September and October and the minimum between January and February.
Daily and seasonal variations in temperature are low; the average annual temperature is approximately 27,4°C with annual thermal amplitude of 3, 6°C.
The monthly average evapotranspiration is 90 mm during the WS to 120 mm for the DS.

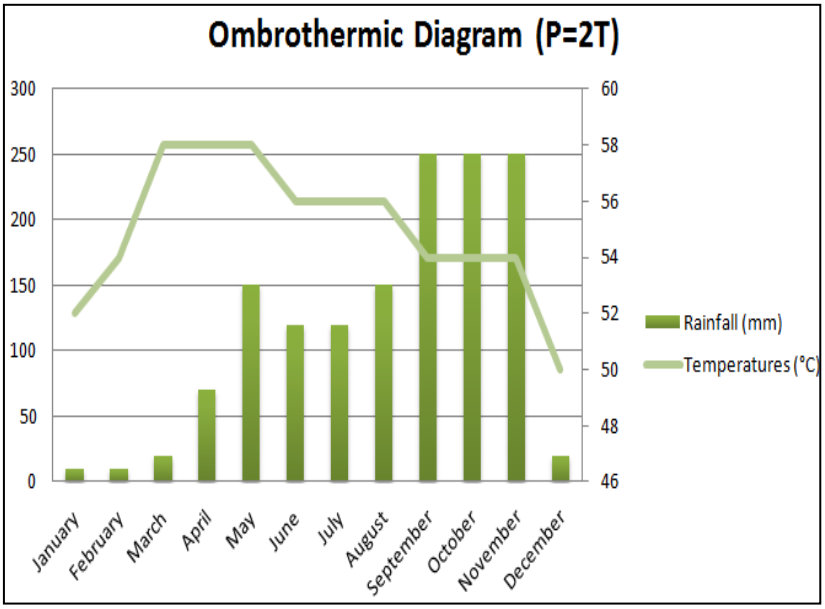

Figure 3: Rainfall diagram and monthly averages for temperatures in Phnom Penh

Source: site Internet Students of the world

In this country, there is an unfortunate combination of an almost total reliance on rice as a basic crop production and a situation of chronically unreliable precipitations (Ovesen, 1996).

1.2 An unaffordable water control

1.2.1 *From Funam kingdom to nowadays*

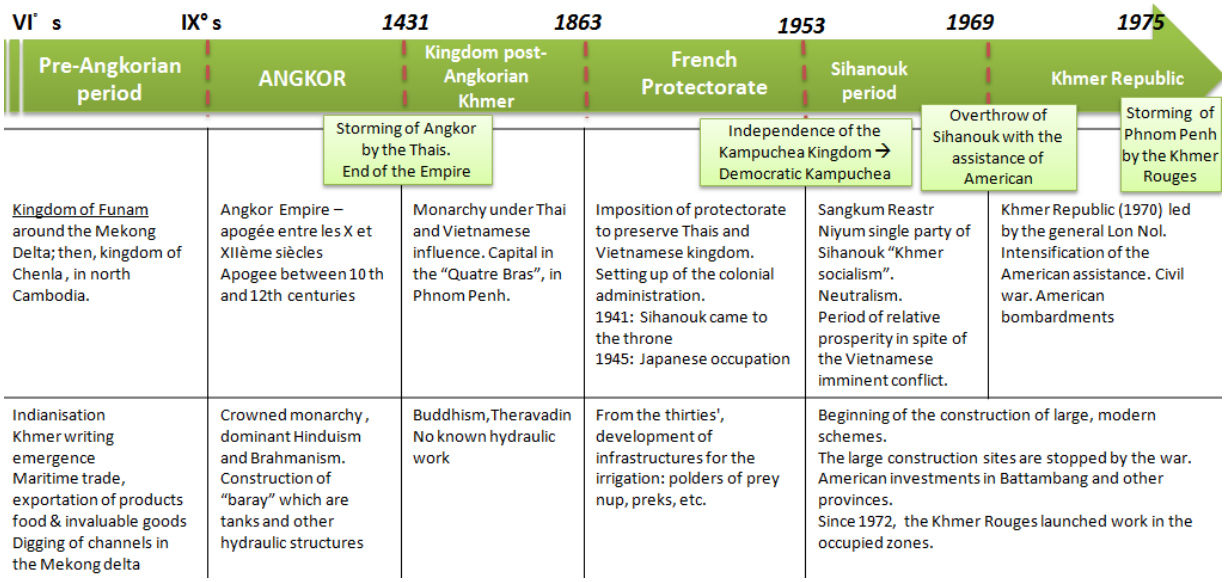

Figure 4: From Pre-Angkorian period to Khmer Republic timeline

Keep in mind that the irrigation sector was developed under the French protectorate but, during the civil war, many projects were stopped and hydraulic infrastructures destroyed (cf. figure 4).

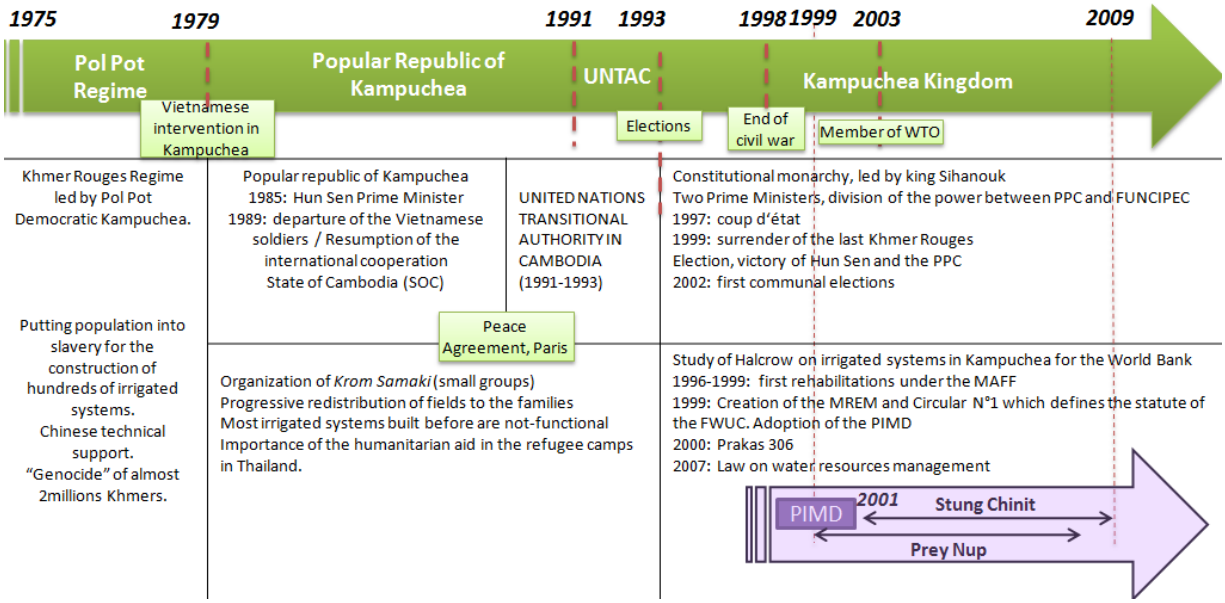

Figure 5: From Khmer Rouge to the present timeline

After years of international isolation, Cambodia, due to its new economic policy and peace Agreements, benefits from the massive arrival of international capital under the register of the Apronuc financing, the international assistance and new investments[11]. The country is gradually rebuilding by relying on the irrigation sector to boost the Cambodian economy.

1.2.2 *The needs for irrigation expansion dependent on bloody History*

The country is emerging from three decades of civil war and instability, which came to an end with the final demise of Pol Pot, the Khmer Rouge leadership in 1999 *(*Samphois, 2004). To reverse the awful effects of decades of social disorder, the Government had to adapt itself to the socio-economic context and to call in international organizations in order to implement new politics supporting socio-economic development of the country. Those new leanings were set up through water resources policy.

[11] Japan, Thailand, China, etc.

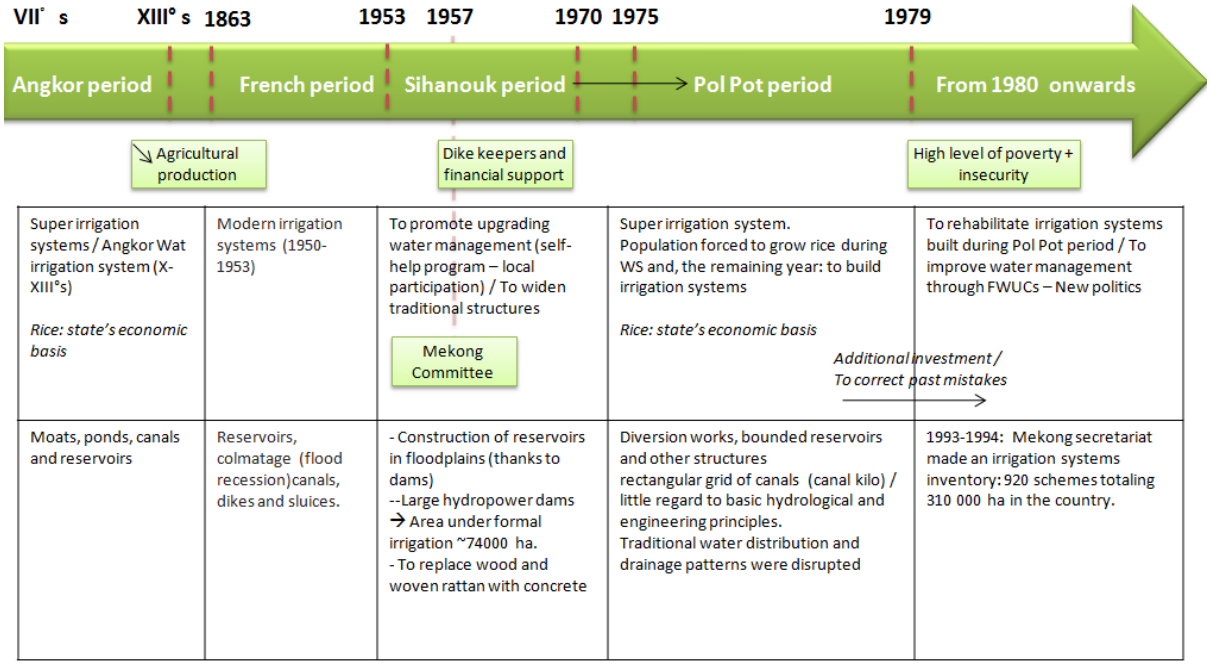

Figure 6: Irrigation timeline

1.1.1.1. Angkor, an "Hydraulic City" or not

The Pre-Angkor period, also called Funan (cf. figure 4), began in the second century when the Cambodian economy relied on agricultural trade and exchange along rivers (Chandler, 1992). At this time, transplanting and rice growing on racks were introduced. First rice varieties, cultivated in highlands, *japonica*[12] were developed. Then, they began cultivating flooding rice fields with another rice variety, *indica*[13] rice.

There are two diametrically opposed schools of thought about water management origin. Some people[14] envisioned Angkor as a "hydraulic city" by considering elaborate hydraulic systems with huge reservoirs (*baray*) used as the source of water to irrigate rice fields and feed the inhabitants of Angkor city. Farmers could have made triple cropping per year. However, this hypothesis can be contradicted. D. Pillot, on the other hand, said that it sounds strange, considering the new agricultural techniques, to produce triple as much during the Funan period compared to the 21st century. For D. Pillot, this hydraulic city is a myth; those reservoirs were built and used for urban purposes and not for rice fields' irrigation (Pillot, 2007). Besides, nobody knows if those *baray* could have held sufficient quantities of water to make any impact upon agriculture in the concerned area (Higham, 2001) and if there were any structures to permit the control of water from the *baray* into a hydraulic network.

A drainage system was also discovered. The objective was to strengthen cultivable land by draining land submerged by the Mekong flood (Pillot, 2007).

From the 11th to 15th century, the use of irrigation for rice production increased (Chandler, 1992). The reservoirs were used to collect and store rainwater and surplus flood water from the Mekong River (Chandler, 1992).

During the Post-Angkor period, from 1431 to 1863 (cf. figure 4), there was a decline in agricultural production; there were no new techniques or infrastructures to diversify crops production and surplus of food was scarce (Chandler, 1992).

---

[12] Oryza sativa var. Japonica, short-grain variety of rice.
[13] Oryza sativa L, a long grain tropical rice.
[14] Bernard-Philippe Groslier, an archaeologist with the French School of Asian Studies (EFEO).

1.1.1.2. Little impact of the French Protectorate on irrigation development

Cambodia was colonized by the French from 1863 to 1953 (cf. figure 5). New hydraulic infrastructures were little-developed. However, they introduced the colmatage[15] system including dikes and sluices in order to control water intake and drainage (Perera, 2006). For example, the Bovel dam (province of Battambang) can irrigate more than 30,000 ha (Pillot, 2007).

Few irrigation schemes with their own reservoirs and dams were built during the French Protectorate (Perera, 2006).

Results are mixed; indeed, French colonists set up these infrastructures without real contact with local people and the development of irrigation was not a priority. Hence, schemes were often in disrepair and inefficiently used (Nguyen, 1999).

1.1.1.3. A quiet independence under Sihanouk reign

The Prince Sihanouk Norodom came to the throne and named this period Sangkum Reastr Niyum which means, literally, Popular Socialist Community. From 1957 to 1960, this government built 7,000 wells, 3,000 reservoirs, 100 dikes and small dams (Delvert, 1963). Those works were realized partially by government officials under Sihanouk's impulsion. Khmer people were also **encouraged to participate in irrigation management** and in the construction of hydraulic infrastructures under the direction of local authorities and monks. Even if few hydraulic infrastructures were developed, two projects of hydroelectric dams were realized in Battambang and Kompong Speu provinces. The irrigation systems planning allowed irrigating 5,000 ha. In the same period, they introduced the system of norias[16].

Irrigation management is considered a success during Sihanouk period. The country showed high rice yields and became a major exporter of rice (ADB and MoWRaM, 2001). Concurrently, the landlessness rate rose among farmers because of the debt; 85 per cent of farmers, in early 1960s, owned less than 5 ha of land (Pillot, 2007). During this time, agriculture can be considered as **family farm**.

1.1.1.4. A destruction process: Khmer Republic and American war (1969-1975)

Sihanouk's period ended in 1970; he was deposed by the lieutenant-general, Lon Nol[17], in a military coup. The Khmer Republic was proclaimed. When the French left Cambodia in 1954, Cambodia's neighbor, Vietnam, was divided into two parts: pro-Western South Vietnam and communist North Vietnam. The USA supported the leader of South Vietnam. The country was plunged into war.

Cambodia had become part of the Vietnam battlefield. During the next four years, American bombers killed up to 750,000 Cambodians in their effort to destroy suspected North Vietnamese supply lines. Cambodia may well be the most heavily bombed country in history. With regard to agriculture, exploitation modes were not brutally collectivized. Until 1972, the production was completely individual (Pillot, 2007).

---

[15] These canals are closed off from the river by a temporary bund until mid - August to allow harvest of the previous season's crop. Then, they are filled on the rising flood and when the flood falls, water is retained at the level of the canal inverted, allowing recession cropping. They also serve an important fishery function permitting passage of brood - stock on to the floodplain (Sinath, 2001).

[16] A noria is a water wheel with buckets attached to the rim. It is used to raise water for transfer to an irrigation channel.

[17] He became the president of the 'Khmer Republic'

The Khmer rouge guerilla movement began in 1970. Their Leader, Saloth Sar, joined the anti-French resistance under Ho Chi Minh in the 1940s and became a member of the Cambodian Communist Party in 1946. He went to France to study civil engineering and joined quickly the foreigners' section of the French Communist Party; there, he began to familiarize himself with Marxist ideology and was an admirer of Maoist communism. He returned to Cambodia in 1953 and few years later, he became known as Pol Pot (CETC, 2009).

In 1975, Lon Nol was defeated by the Khmer Rouge. Pol Pot became the leader of Cambodia. The genocide began (cf. figure 5).

1.1.1.5. Pol Pot period and coercive irrigation without convincing results

The Communists were victorious in 1975; during the next three years, many of the **Cambodian institutions were destroyed** and the urban population was evacuated from their homes to rural areas in order to work as farm labors (Ojendal, 2000). The cities were emptied immediately upon the Khmer Rouge victory. From 1979 to 1984, people were organized into small groups, called ***krom samaki***[18], to work in rice fields building irrigation schemes. They were not the ones who made the decisions and they carried out the work without being paid. In 1979, according to official statistics, there were 54,852 *krom samaki* in Cambodia (nearly 90 per cent of the population) (Pillot, 2007).

The new regime abolished money, markets, formal schooling, Buddhist practices and private property (Chandler, 1996). It is estimated that, during the Khmer period, more than one million Cambodians, or one in seven, died of overwork, illness, starvation or was executed (Ojendal, 2000).

All land, tools and livestock were nationalized. Agriculture became a priority essential to ensure the modernization of the country. Pol pot had an objective to achieve rice yields of more than seven tons per hectare. Food self-sufficiency and economic independence would have been reached. The Khmer Rouge wanted to reach their production objectives through irrigation.

A large number of irrigation systems were built across the country including dams, reservoirs, canals and dikes which were **poorly designed**. Wanting to control water-flood to conserve enough water resources in dry season, Pol Pot forgot to consider technical and farmers' knowledge. The work was done **without technical or quality control** (Chandler, 1992). The hydrology of the system and the natural drainage pattern were disrupted. Overall water requirements were not taken in consideration to build irrigation systems. Besides, the new division of small paddy fields into larger uniform one hectare plots destroyed the paddy cells system necessary to collect and distribute rainfall and runoff. They also decided to build canals within the network one kilometer away (Himel, 2007). However, such a hydraulic system is not adapted to highlands because the pumping cost is too high (Pillot, 2007). As a result, in 1978, the production fell and represented 60 per cent compared to it in 1970.

In 1979, Vietnam invaded the country (cf. figure 5); in few days, the Khmer Rouge regime collapsed and a new government called the Khmer People's Revolutionary Party was formed (Pillot, 2007). At times of war, the agricultural production is almost nil.

"The revival of agriculture is initially the fact of the Khmer farmers themselves. At best, the government tried to follow the movement (…) (Pillot, 2007)".

1.1.1.6. Irrigation Development from 1980 onwards

A large proportion of Khmer people, forced to work as agricultural laborers in paddy fields, began moving back to their home settlements. In 1980s, there was still poverty and insecurity.

[18] Solidarity Groups

The country was under Vietnamese trusteeship and began to rebuild production capacities (Pillot, 2007). However, to avoid Vietnamese expansion, some western countries decided to support Khmer Rouge resistance.

From 1980 to 1985, the land was progressively decollectivized[19]. However, after the fall of Khmer Rouge regime, it was an anarchic land appropriation according to local power struggles. Every family received a plot of land (equivalent areas); the main difference between these plots of land was their localization. Families settled near the canal would have, in the future, more facilities to produce and thus, earn more money compared to those without scheme access.

After 1985, the government was in charge of irrigation management but it also encouraged farmers to participate in irrigation maintenance (cf. figure 6).

Main features about irrigation:

1930-*1953*: Colmatage systems were developed. They may be in deviation of a river or by collecting water from wet season or water-flood in a reservoir.
But, there was no maintenance. Hence, irrigation systems were damaged.

After Cambodia's independence (1953), there was an irrigation program implemented by farmers themselves in order to make durable small hydraulic.

Khmer Rouge regime: many hydraulic infrastructures were built by hand, without technical consideration.

In 1980s: decollectivization, rehabilitation of irrigation systems and implementation of new schemes but lack of technical skills, financial resources and maintenance.

→ **Decollectivization and infrastructures built under Pol Pot period, radically change irrigation management.**

1.3 Towards a new management of irrigation systems

1.3.1 *Irrigation systems inventory*

The inventory completed by Halcrow in 1994 counts 841 irrigation schemes covering a total area 171,727 ha; they were mostly built under Pol Pot regime (69 per cent). Among those 841 schemes, only 21 per cent of the existing systems have been reported as fully operational, 14 per cent not functional and the rest are partly functional. Those schemes can be classified into three types (Thuon, 2007):

- **Small-scale** irrigation systems which serve less than 200 ha
- **Medium-scale** irrigation systems which serve over 200 ha and less than 500 ha
- **Large-scale** schemes which serve over 500 ha
- Sometimes, the category of **very large** schemes, over 5,000 ha, is added.

Those irrigation systems may cover 277,000 ha of rice fields (15 per cent of cultivated land) of which 104,000 ha are fully operational in dry season (Halcrow, 1994).

The MoWRaM developed the Cambodian Irrigation Scheme Information System (CISIS) as a tool to assist the minister in planning of maintenance and development of irrigation schemes. It was financed by AFD and created in 2008. To realize it, they visited nearly 250 schemes managed by FWUC and prepared a diagnosis (functioning, types of problem, etc.). According to the results, they selected some schemes which needed support. Currently, they have listed nearly 530 irrigation schemes.

[19] Land unit/ha range from 15 to 30 Ares (Pillot, 2007).

More than 2,500 hydraulic infrastructures were recorded. A typology of irrigation systems is also available (cf. appendix 1).

1.3.2 Programs to revive irrigation and local participation

A few years after the civil war ended, some institutions (FAO, World Bank and ADB) assisted the government with drafting policies in relation to irrigation management and introduced PIMD in 2000, upon realization that the agricultural productivity was low, irrigation systems were not fully functional and poverty in rural areas was at high levels (Perera, 2006) . The initial idea was to create **collective structures** with farmers to initiate irrigation systems management and development.

The government and donors were limited in their monitoring because of the lack of financial resources. They needed to **progressively transfer responsibilities** from institutions to farmers (MoWRaM, 2008). In 1998, the Ministry of Water Resources and Meteorology (MoWRaM) was established (ADB, 2001). Its main roles were to undertake activities concerning water management, to develop laws, regulations and to provide technical support (Thuon, 2007). In 1999, an application decree No.1 and in 2000, Prakas 306[20] on Farmers Water Users' Communities (FWUCs) were published. These documents served as the basic legal framework. Initially, this organization aimed at taking over the water management of irrigation systems.

The strategy was to improve the performance of these systems increasing yields, improving the water sharing and access to water among farmers in irrigation schemes.

2 FWUC IMPLEMENTATION WITH GOVERNMENT POLICY SUPPORT

2.1 PIMD policy and FWUC creation

Water management is a priority for agriculture development and poverty reduction in Cambodia. The government has already made efforts to improve this management by implementing the PIMD and through decentralization. This policy must be set up for an effective and targeted action. As a result of this policy, FWUCs were created thanks to some NGOs and donors.

Currently, results are mixed and the policy has faced some difficulties. According to a study made by the MoWRaM based on CISIS database, of 223 schemes visited, 180 are still existing (81%), 140 are still active (69%) and 80 are collecting ISF (36%). Besides this, 105 FWUCs (47%) are carrying out routine maintenance and 145 FWUCs (65%) receive training for a few days.

Interviews conducted with focal groups emphasize that (AFD, 2006):

- Farmers do not receive a return on their investment (in terms of time or money)
- FWUC management is weak (no organization, no regulatory system, no members' association)
- Water supply is insufficient or irregular. The main difficulty faced by managers consists in sharing the resource between upstream and downstream demands.
- Infrastructure construction, management and maintenance are not clear.

Theoretically, the MoWRam is in charge of large infrastructure construction[21]and farmers have to build the smaller infrastructures. However, most of the time, they do not have the financial resources

[20] Prakas 306 includes documents relating to policy and guidelines for PIMD implementation (Perera, 2006):

- Circular No. 1 on the Implementation Policy for Sustainable Irrigation Systems.
- Policy for Sustainability of O&M of Irrigation Systems.
- The statute of the FWUCs.
- Steps in the formation of a FWUC.

[21] As an example, in Stung Chinit scheme, the MoWRaM is in charge of primary, secondary and tertiary infrastructure construction whereas in other schemes (Pram Kumpheak, in Kompong Cham), it is responsible only for primary infrastructures construction.

to build them[22]. Generally, the management, for main infrastructures, is done by PDoWRaM and the remaining work is realized by FWUCs. The responsibilities, in terms of maintenance, are not clear; reservoirs, primary canals, protection dikes, external drains and other big infrastructures are maintained by MoWRaM (Stung Chinit, Prey Nup) or FWUCs. In others schemes, there is no maintenance (Pram Kumpheak and Teuk Chha, in Kompong Cham province). FWUCs do not have the financial capacities to undertake large-scale repairs. Sometimes, even routine maintenance is not carried out due to lack of funds.

For some NGOs, the success of FWUCs depends on a large variety of tasks and skills. As quoted by GRET, they need knowledge such as *"engineering, design, preparation of bidding documents, topography, accounting, financial auditing, information management, database and legal advice, amongst many others."* Not all the skills can be learnt by farmers and some additional skills are required from time to time.

These skills are useful to O&M of new rehabilitated schemes required by FWUCs; without it, FWUCs cannot work well. As for GRET, to improve the FWUCs functioning, O&M has to be improved to undertake the following functions:

- System operation
- Water management and sharing (setting up rules)
- Maintenance of infrastructures (small infrastructure rehabilitation)
- ISF collection
- Financial management (budget preparation, reporting, resource identification)
- Institutional management
- External relations with other stakeholders

The policy of the government, through the PIMD, aims towards establishing FWUCs able to manage the irrigation system maintenance. To match the expenditure, they need financial resources which can be mobilized through ISF, paid by all farmers' water users in an irrigation system.

2.2 To give farmers water users' a sense of responsibility

FWUCs are formed for the total irrigated area of the irrigation system[23]. Farmers Water Users' Groups (FWUGs) are formed at the base of the FWUC level. These include farmers who use water in the same identified area at the secondary level (for example, a secondary canal) (Perera, 2006).

According to the statutes defined in Prakas 306, FWUCs' functions are (cf. appendix 2): (Perera, 2006)

DUTIES	RESPONSIBILITIES
-To collect fees in order to cover costs related to service access, irrigation systems organization and maintenance. -To form groups with farmers who own land in the same area in order to facilitate irrigation access. -To supply adequate irrigation water for all members. -To capitalize management, organizational, maintenance and financial skills regarding irrigation systems. -To increase yields and the number of annual crops. -To improve support from the government.	- To collect ISF -To prepare a work plan for each FWUC. -To formulate statutes, contracts, internal regulations of the community. - To maintain irrigation systems in good conditions to supply irrigation water when farmers need it. -To manage and distribute water to all members. -To improve water efficiency, water management of the irrigation system. -To resolve intracommunal problems.

Table 1: duties and responsibilities of a FWUC

[22] In Stung Chinit scheme, quaternary canals were not built because of the lack of financial capacities.

[23] We will see later that the lack of delimitation of the irrigation system can be a problem for the water management.

Among identified schemes, 328 irrigation systems had been organized into FWUCs, 114 of which were registered with MoWRaM (Thun, 2008), (cf. figure 7).

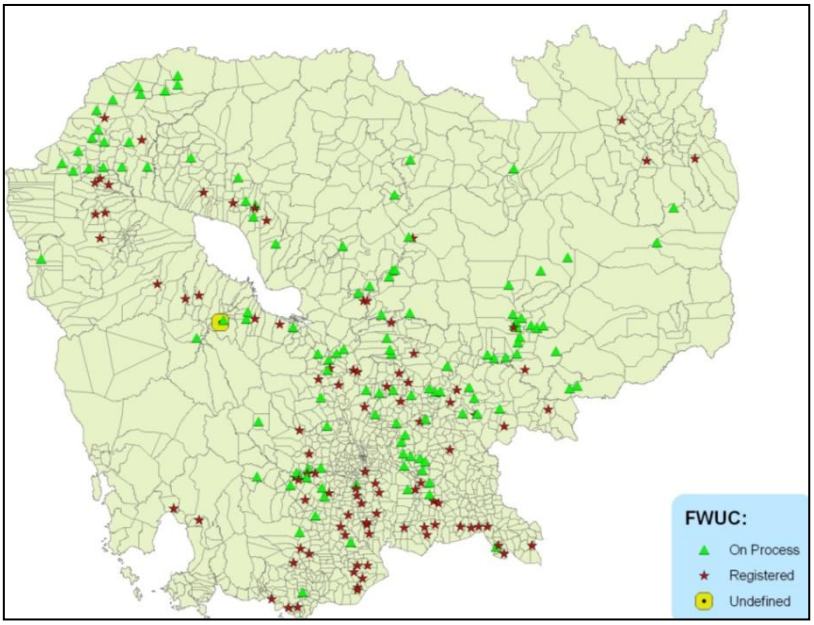

Figure 7: FWUC localization and registration in Cambodia

2.3 Decentralization and local decision-making

Cambodia embarked on its decentralization reform with the enactment of two laws in 2001: Election of the Commune Council and communes' administration and management laws. They gave a new importance to **public decision making**. In 2002, the first commune council elections took place under its decentralization reforms. The same year, they created Provincial Rural Development Committee (PRDC) structures for each province (Ayres, 2001).

Political decentralization has three central official objectives:

- To promote democracy and to improve the governance.
- To give local people greater opportunities to determine their future by becoming decision-makers.
- To ensure sustainable development by reducing poverty, including the delivery of basic services (Ayres, 2001).

This new political orientation gave more power to the communes and, through local decision making processes and facilitated communication, is intended to facilitate implementation of projects.

3 ASIRRI: A SUSTAINABLE IRRIGATION DEVELOPMENT PROJECT

3.1 Affordable services for farmers' water users

The project called Projet d'Appui aux Irrigants et aux Services aux Irrigants (ASIrri) was proposed by IRAM, leader of the consortium IRAM-AVSF-GRET in 2008 (cf. appendix 3). Each ONG is responsible for the implementation of the activities in one country, respectively, Mali, Haiti and Cambodia. The funding agency is the AFD and the budget for Cambodian component is 375,000 €. The project started in 2009 and will end in December 2011.

The vision of the project is to create and sustain a **service center** which can provide "affordable quality services to the FWUC through a pool of professionals with practical experience in irrigation management issues"[24]. Another objective is to identify the particular needs to propose adapted services to FWUCs, with regard to their stage of development.

[24] ASIrri project Summary for MoWRaM, February 2009.

Overall **objectives** of the project are:

- To ensure the management of irrigation schemes for the optimization of agricultural production by sustaining Farmer Water Users' Communities, support systems and services.

Specific **objectives** of the project are:

- To develop, test and sustain follow-up systems and services to water users in order to reach a sustainable operation of irrigated areas, in three different national contexts: Haiti, Cambodia and Mali, taking advantage of their specific experiences to enhance exchanges, co-learning and capitalization.

The expected **results** concern the creation of service centres for farmers' water users in Cambodia and Haiti. In Mali, there was already a service centre which needed to be strengthened. They plan to strengthen these centers and their capacities at institutional level; they need to be recognized at local and national levels.

They have to gather technical and economic references regarding:

- Suitable water management systems according to different types of infrastructures and users' organizations,
- Long term support systems (such as Service Centers) for the development of irrigated areas, are built up and capitalized.

The last expected result is the creation of **national platforms** for irrigation support and/or national coordination between farmers' water users' organizations.

3.2 Prey Nup and Stung Chinit schemes: capitalization feedbacks

Since 1998, GRET has been involved in two large irrigation schemes rehabilitated by the RGC: Prey Nup (10,454 ha) and Stung Chinit (2,400 ha)[25] to support the management transfer to the farmers and water users (cf. appendix 4). CEDAC, Cambodian association, provides support to Stung Chinit FWUC, in partnership with GRET. The French NGO decided to set up and support professional teams in order to create FWUCs.

3.2.1 *Prey Nup, challenge met*

In 1998, the RGC, financially supported by the AFD, undertook a project of rehabilitation of Prey Nup polders, irrigation system located at the south of Cambodia, in the province of Sihanoukville; it is the only deep-water seaport of the country (cf. appendix 5). The first hydraulic infrastructures were built under the impulsion of colonial authorities of French Protectorate through the early years of the 1930s. The last rehabilitation was organized by MoWRaM, AFD and Handicap International between 1999 and 2003.

This project was implemented by GRET and Action Nord-Sud[26] under the supervision of the MREM. The objective was to increase the rice production on 10,454 ha cultivable land by protecting the scheme from the tides.

The project aims at setting up a farmers water users' community with an adapted and sustainable function for water users' groups. This organization, called CUP, was the first FWUC officially registered by MoWRaM in 2000. This structure is made up of 15,000 members and managed on a budget of about 100,000 US$ through ISF collection, since 2007. In 2008, it signed a MoU which defined mainly the responsibilities shared between CUP and MoWRaM as regards polders O&M. However, the CUP can now work autonomously.

This model cannot be easily reproduced on a large scale and for small irrigation systems, it is difficult because of the technical assistance cost involved during 10 years of human investment and

[25] Total developed area (hectares).

[26] Action Nord-Sud was founded by Handicap International, AVSF, ISF, etc. before the year 2000.

external financing (100,000 US$). Moreover, the rehabilitations aim at preventing sea water intrusions and managing freshwater levels within polders. Water comes from rainfall and flows over the hills. They also planned to implement a drainage system to evacuate the surplus of rain water to maintain the proper water level inside the polder.

3.2.2 *The Stung Chinit FWUC was set up, not without problems*

Stung Chinit, located in Kompong Thom Province, is an irrigation system fed by a reservoir on the Chinit river[27], with a gravitational system (cf. appendix 6). The hydraulic infrastructures include a large spillway (700 meters), and a reservoir surrounded by dikes with a water storage capacity of a billion m^3. In 2004, there were 11,250 families and 2,828 farmers water users.

Initially, the rehabilitation of 7,000 ha (for WS production) and 2,000 ha (for DS production) was planned by ADB in 2000 and launched over 6 years (2001-2007).

MoWRaM was the project owner and GRET, under MoWRaM contract, was responsible for project management regarding FWUC implementation, with CEDAC, providing agricultural support. The initial cost of the project is $23.8 billion. The Stung Chinit FWUC was officially recognized by MoWRaM in 2006 and totaled 2,500 members. In 2009, the FWUC budget was limited to its own financial resources (15,000 US$ of fees) with subsidies from AFD (30,000 US$). In 2012, the FWUC will not receive any more subsidies.

A MoU was signed between the Prey Nup and Stung Chinit FWUCs and the MoWRaM to define responsibilities of each stakeholder in terms of water management and maintenance. Since 2009, a budget plan was planned to ensure the maintenance of some FWUCs.

Theoretically, the FWUCs are in charge of schemes maintenance, without other specifications. MoWRaM is responsible for primary hydraulic infrastructures regarding large schemes and has to intervene in case of natural disasters or serious damages. In reality, currently, there is no maintenance policy in effect at MoWRaM.

In the future,

The experience and the success of a professional FWUC through the Prey Nup scheme shows in Stung Chinit some limitations. Below 3,000 ha with poor land, the sustainability of this structure is put into question.

Prey Nup polders rehabilitation is considered a success for AFD and GRET. As for AFD, this project played an important role in supporting its intervention strategy on irrigation fields in Cambodia.

As for ASIrri project, these experiences are considered as capitalization feedbacks: what is the intervention process to follow? What are the mistakes to avoid?

[27] Tonle Sap tributary.

4 TO PROPOSE SERVICES TO FWUCS

4.1 Farmers' access to services in Cambodia

Farmers have access to services to buy fertilizers, equipment at local markets and improved rice seed. Few organizations are in charge of SRI vulgarization. CARDI and a private company manage the seed production upward. Additionally, CARDI and the CAVAC[28] propose agricultural research and irrigation services. As for downstream production, there are rice mills[29] and storage groups[30]. There are no hydraulic services or other sectors linked to management transfer.

The agricultural sector receives financing from microcredit institutions, bank and development bank; the agricultural financing (and/or support and advice) is carried out by CEDAC and other NGOs. Farmer water users have access to health support services through GRET -SKY[31] Health Insurance project of GRET and other agricultural technical services of the district.

According to CEDAC, there are many opportunities to develop irrigation:

- Rice and other agricultural products' prices are increasing.
- Cultivated area and available water resources constitute an important potential for irrigation purposes.
- Government has already developed a legal framework for FWUCs (Prakas 306, Circular No.1, Water law, a draft of FWUC sub-decree).

It is in this context that a new project to support irrigation and FWUCs development and management was launched.

4.2 The ISC project

4.2.1 *To strengthen effectively local capacities*

GRET and CEDAC have been involved in the irrigation sector since 2000; both supported the establishment of FWUCs for two irrigation systems: Prey Nup and Stung Chinit. Concerning Prey Nup polders, we often speak about a successful experience. This is true in terms of material assets (rehabilitation of hydraulic infrastructures, agricultural intensification, rural development (increase in agricultural incomes), users' organization and polders management). However, institutional insertion of the CUP is not completely satisfactory; a project is a success if and only if it is part of a sustainable strategy in the future.

Based on both projects, GRET and CEDAC have recently built a team dedicated to support farmers and their associations to manage irrigation schemes in a service oriented approach (cf. appendix 7 and 8). The Irrigation Service Centre was launched in 2009 in Kompong Thom city[32]. It is considered a tool to include farmers as decisions makers. Thanks to it, they can make decisions about their scheme management and development. The processes of local decision-making and sustainable development are launched.

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[28] CAVAC is an AusAID project. There is an agricultural research component in partnership with CARDI.

[29] It means a workshop or a factory where one treats paddy in order to prepare peeled, milled, glazed rice.

[30] Under the impulsion of AVSF.

[31] Social Health Insurance project implemented by the French NGO GRET.

[32] The ISC was implemented in Kompong Thom because Stung Chinit scheme is located in the same province and it requires further support and because many other schemes of small and middle sized irrigation are here too.

The ISC works in six provinces (cf. figure 8).
In 2010, the ISC signed contracts with 7 FWUCs as below:
Stung Chinit North, Kampong Thom; Stung Chinit East, Kampong Thom; Pram Kumpheak, Kampong Cham; Teuk Chha, Kampong Cham; Sdauv Kaong, Prey Veng; Baray, Siem Reap; Machu Nga, Mondulkiri.

Figure 8: The ISC target area

Source: ISC

The Cambodian irrigation history is based on international and national organizations and government support[33] for hydraulic infrastructure construction and rehabilitation; up to 2000, they put the emphasis on engineering work but **not sufficiently on social aspects** of irrigation management. Recently, the PIMD was implemented after the adoption of circular n°1 in 2000; however, this new policy did not revolutionize the irrigation sector in terms of local decision-making processes. The ISC provides external technical support in the long run, at a reasonable cost. It is a new concept.

As a result, a MoU was signed between GRET and PDoWRaM for the project implementation. Then, a team of experienced professionals was recruited and an office opened in 2009. To start the project, a management and coordination committee was set up, communication tools were designed and a budget was proposed; additionally, the centre has received funding from the EU with the project *"food facility"*[34], the irrigation component of the action named *« Development of food production, farming incomes, nutrition and resilience in rural Cambodia »* run by GRET – AVSF – ADG – CEDAC. The centre is currently functioning and designing services to strengthen local capacities through farmers' organizations; it aims at improving irrigation scheme management.

To ensure the centre's sustainability, the project wants to create a permanent local association and a pool of resources and professionals easily available to farmers.

4.2.2 *Irrigation support in line with government programs*

Due to the mixed results of the MoWRaM and weak government support, the fundraisers launched the project to support FWUCs. The services are developed in accordance with local authorities and under an official agreement signed by the MoWRaM.

The ISC experts will propose an assessment of local irrigation needs and thus, it may bring a new global view and adapted solutions for policy makers in order to improve irrigation development programs.

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[33] Still today, the RGC considers irrigation has a development priority (NSGDP, Rectangular Strategy of the RGC, Strategy for Agriculture and Water 2006-10 established by the Technical Working Group on Agriculture and Water).

[34] This project started in January 2010 and will finish in June 2011. The EU funding is about 266 K€ (including 67 K€ co-funding from AFD) and concerns three provinces Siem Reap, Kompong Thom, Kompong Cham.

The ISC aims at providing **references to a national platform** and then, to exchange experiences and define collectively the main support expected from the government. The idea is to facilitate communication and exchange between farmers and government representatives to raise awareness about the main field issues.

In May 2010, they organized, in Siem Reap, a FWUCs network (with 12 FWUCs) to:

- Promote responsibility, transparency and quality in FWUC management,
- To build capacities and ensure an exchange of experiences,
- To provide technical and financial support for FWUCs,
- To share information (legal, funding, etc.),
- Facilitate and improve relations with MoWRaM,
- Advocate for FWUCs opinions regarding irrigation and water management issues,
- Represent member's interests at national level and in irrigation forum.

The FWUC Network is not created yet. The first meeting, held in May, aimed at exchanging experiences among some Cambodian FWUCs (cf. appendix 9). Field visits were organized to three irrigation systems to observe hydraulic infrastructures and understand problems faced by farmers to manage the scheme. After the field visits, discussions were organized to seek further support, to try to identify problems about schemes development and management, and to seek formal recognition.

The team reflected on member categories and criteria to be a FWUC Network member. A budget was planned for 2010.

4.2.3 *Limited farmers' appropriation*

Since the irrigation development and management have been transferred, farmers have had to be quite autonomous; it is a kind of challenge because they have had to do a work they've never learnt about; Self-organization (meetings with farmers, stakeholders, information broadcasting, etc.), budget preparation and management (collecting money), some infrastructure construction or rehabilitation management, rule system implementation (etc.) are required.

However, they have to run the scheme, respecting at the same time the inflexible model of legal status that farmers' water users try to follow with difficulty; they attend short formal training sessions which do not succeed in helping them to comprehend the complexity of managing the schemes.

Some studies show that most of the irrigation systems rehabilitated from 1996 to 2006 are either not functioning at all or only partially functioning. Indeed, many schemes are not functional technically (not completed, not maintained or destroyed because of conflicts); Once FWUCs are created, most of them are left without support and the farmers do not have the capacities or skills to manage them and to encourage water users' participation. Besides, without collecting ISF every year, the maintenance and the scheme organization are not possible.

This is why many FWUCs are non-existent; they are recorded but are not functioning.

Some problems that affect the FWUC sustainability and autonomy are:

- Economical return from irrigation is often overestimated or not estimated
- Problems of coordination between the stakeholders within the river / stream basin weaken social cohesion
- Upstream flooding due to embankment construction with insufficient drainage
- Insufficient knowledge about water availability inside the scheme (reservoirs, rate of flow, Infiltration rate in soil, etc.)
- Bad or inappropriate hydraulic infrastructures design
- Infrastructure construction quality
- Poor farmer participation
- Delayed infrastructure maintenance (budget, participation)
- Land and water sharing conflicts (water resource competition between schemes with upstream and downstream farmers)
- Weak water management (no rules or rule system unknown)
- Insufficient skills and capacities (water management, maintenance, ISF collection, etc.)

4.2.4 *Project sustainability*

In June 2011, the center should obtain an independent legal statute and will become a private 'non-profit' Cambodian association named ISC. The GRET project is a kind of pilot project to develop with the local team the knowledge and methodologies necessary to design appropriate services and answer the farmers' needs. This three year project is useful to initiate the process, test a range of services and adapt them to local needs (FWUCs and their members) according to financial capacities.

After a few years of development efforts, to make the ISC project a reality, it is necessary to re-activate FWUCs for the long term, thus increasing their financial capacities; then, they have to progressively collect ISF and ensure financial sustainability. This budget will be useful to pay, at least partially, for the requested services. However, at the moment, they need external funding to take effect; currently, O&M of the schemes is not sustainable.

Besides, as it is the beginning of the project, costs have to stay low to be affordable to stakeholders. The ASIrri budget is 375,000€[35] and the budget for Pram Kumpheak service was about 6630,8€. To pay the service, the FWUC counted on ISF collection[36] and commune support. The average amount of money farmers want to pay for water services is about 9,000 riels (1,5€) per ha of rice field (CEDAC, 2010).

In order to improve the staff capacity, training sessions and procedure organization are necessary; a leader and an organizational model have to be chosen.

The FWUC network, established in collaboration with PDoWRaM, must extend the ISC services and model at a national level and make it officially recognized.

35 ASIrri Internal Budget Component 1 (Cambodia)
36 ISF collected from 350 ha

II. CONCEPTUAL AND METHODOLOGICAL FRAMEWORK

1 PROBLEMATIC AND RESEARCH QUESTIONS

In Cambodia, current policy is to transfer irrigation systems management to farmer water users' communities. Starting from the observation of scheme management weakness, the follow up of such transfer actions seems to be important. The stage the internship took place, at the beginning of service implementation, in two schemes located in Kompong Cham province, Teuk Chha and Pram Kumpheak irrigation systems.

An **irrigation system** includes, as for Lavigne Delville, physical structure, water users', organizations in charge of irrigation management and rules used by farmers or other entities to manage the system. This term has to be differentiated from an **irrigated area** which means hydraulic infrastructures of a scheme which allow mobilizing, transporting, distributing water and/or draining off excess water in order to increase agricultural productivity or to satisfy other hypothetic needs. This study will deal with irrigation systems.

The service implementation, in April 2010, has just started; a diagnosis has been already made in both schemes and will be showed in part III of this report. The aim is to complete the existing diagnosis, structure information following a specific methodology.

The ISC services are developed in the fourth part of this report. The objective is to describe and analyze the ISC intervention process on irrigation systems and after that, on Pram Kumpheak and Teuk Chha schemes. The internship began in April 2010; at this juncture, they only just began the first service in Teuk Chha scheme and two contracts had been already signed in Pram Kumpheak (the first one has already been implemented and they had only just started the second one).

According to CEDAC experiences,

- Farmers' participation is very limited for the scheme design and O&M,
- When the support given to the FWUCs ends, FWUC has to start learning by doing.

The main challenge to **ensure sustainable irrigations systems management and development is to enforce farmers' capacity building and collective action designing appropriated services with Irrigation Service Center**.

As for P. Boullet (2009), the **mission of a service center** is to provide services to FWUCs, *"that enable them to successfully and in the long run, handle their mission, reach their targets and show evidence of the benefits to its members"*. It allows providing services to agriculture extension and water management stakeholders in order to expand their impact, capitalize, share and valorize their experiences.

It is in this context that GRET proposed to work on the ASIrri project through the ISC to define a process for re-building the farmer confidence to invest in their scheme management after a history of organizational failures (cf. appendix 10). It is the appropriated moment to wonder: **What are the processes for re-building the collective action in scheme management? What is the service implementation process and methodology? How to support the ISC processes working on social water management?**

The project deals with several irrigation schemes (cf. part I) which are managed, actually or not, by FWUCs. There are large gaps between the present and the requisite status and capacities of FWUCs that are suffering from poor hydraulic infrastructures and lack of O&M. Few FWUCs have already implemented their own rules and institutions to manage properly water resources. Ideally, these structures will become self-reliant agents able to get community prosperity on their own.

At present, the question is to know what are the real impacts of the ISC intervention process and if they improve effectively FWUCs management.

The **internship objectives** are:

- To get a global view about FWUCs implementation and organization,
- To understand weaknesses and advantages for collective action in water management, in Cambodia
- To develop new tools to improve schemes analysis and support ISC projects,
- To implement progressively water sharing principles with the users using a progressive and iterative process.

Indeed, we do not face an area devoid of irrigation management know-how. FWUCs need support from Government and other organizations; the ISC has to be monitored to get the necessary skills to follow-up the FWUC organization. The intervention can be considered a collective action building. As Crozier and Friedberg[37] (1977) said, if collective action is a critical problem faced by our societies, it is first of all because it is not a **natural phenomenon**. It is a **social construction** which existence is problematic, whose emergence and preservation conditions have to be explained. Learn to work together or learn to implement a collective action is really important for the project sustainability.

It is obvious that the long **bloody History** of Cambodia has huge consequences for water management organization and then, it seems essential to wonder the present and previous **social links**; in other words, we must study the **state of the collective action** (How do farmers organize themselves to manage irrigation systems?), the **ways and skills necessary to strengthen it.**

The ISC has to learn how to support FWUC management and development according to their needs.

- What are the different stakeholders expecting from this project?
- Which kind of support do they propose to FWUCs? What will be the services?
- What are the different expected results? What are the changes planned by the project?

The FWUC support is, at the end, a **process**. It seems interesting to wonder what are the **service implementation process** and the **intervention methodology**: how do they select the scheme? How do they build and propose a service? What are the service implementation stages? It may permits to identify their limits and assets (results, impacts) and suggest some improvements to ensure **its sustainability**.

Water: a common-pool resource

The good irrigation system functioning is based on the **collective action** among members; this is essential to manage this **common pool[38]**.

In Cambodia, it is considered that "*everyone has the right to use water resources freely (…) in amount not exceeding that necessary to satisfy the individual and family needs of the user*"[39].

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[37] Crozier, A. Friedberg, E. 1977. L'acteur et le système. Paris, Seuil.
« 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, 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 relations 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 fonction de l'accomplissement d'objectifs communs malgré leurs orientations divergentes » (quoted by Lavigne Delville, 1999)

[38] Irrigation systems are among the most important types of common-pool resources (Ostrom, 1992).

Nevertheless, water resources access cannot be totally free, without regulation system. This article does not take into account the phenomenon of competition for the sharing of resources in the agricultural sector; it must be organized according to the usage made by every farmer (DS, EWS and WS) all year round after consultation process.

Ostrom defines an **institution** as "*a set of rules actually used (working rules or rules-in-uses) by a set of individuals to organize repetitive activities that produce outcomes affecting those individuals and potentially affecting others. Hence, an irrigation institution is a set of working rules for supplying and using irrigation in particular location."* (Ostrom, 1992). Besides, an Institution is n**ot necessarily a formal organization** because the local authorities can change according to the social connections.

Hence, to promote the emergence of the collective action through irrigation systems, it seems important to identify the links between the stakeholders and their common and divergent interests. According to Ostrom (1992), the collective action problem is located in the definition of the **irrigation systems functioning rules**, and in the **structure of the organization in charge of implementing these rules.** As for her, these rules can be divided into three categories:

- The **operationa**l rules
- The **collective-choices** rules
- The **constitutional** rules

It should be reminded that, each society and each social group have their own rules and institutions in charge of implementation and punishment. However, formal rules can be different from the practice and become informal rules. This gap between practices and formal rules can be explained by (Lavigne Delville, 1999):

- Individual needs dependent on social status (village or commune chiefs, FWUC committee members)
- The diversity of individual strategy (depending on farming practices[40], rice growing season, irrigated area, fields location)
- Social dynamics.

There is not one rule system and technical package which can be applied generally. **Each rule system is peculiar to an irrigation system**. It is the reason why rules have to be defined in agreement with the stakeholders for one specific irrigation system. Farmers' needs and problems have to be identified for each scheme in order to define an appropriate rule system.

To set up correctly these rules, in case of divergent interests, it is essential to identify **opportunistic behaviors** to limit them and implement a fair rule system. As for Lavigne-Delville (1999), there are two kinds of behaviors:

- **The free-rider:** it is a person who benefits from the benefit of the collective system without contributing to it.
- **The rent-seeking**: he receives a disproportionate benefit of its activities.

2 METHODOLOGY OF DATA COLLECTION AND ANALYSIS

2.1 Multi-disciplinary approach

To study the water social management through the ISC project, it seems interesting to analyze the different elements which compose this system depending on different fields: history, hydrology, agronomy, sociology, economics, etc. A multi-disciplinary approach is essential to identify and understand the emergence of collective action, the irrigation system functioning and the project implementation and intervention. As for Fontenelle (2004), it means "*a systemic approach, inherited*

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[39] IWRM, Article 8

[40] Broadcasting/transplanting, crops variety, etc.

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".

2.2 Gathering of information and interviews

Along all the field data collection, semi-structured and structured interviews were conducted during five months in 2010; other materials were used such as official documents from MoWRaM or as maps (official or hand-made). The general methodology can be divided in two main activities:

- The activities consist in the implementation of **a continue work** through **meetings** with the **farmers** water users and the **ISC team** (together or not). It allows understanding farmers' practices and needs and ISC intervention process and after that, it seems possible to propose some improvements in water management through ISC services. To collect data about irrigation system diagnosis, 83 farmers were interviewed and 16 village chiefs.
- **Simple observations** of users' practices have been made. It is essential to **work in the field** to understand farmers' practices and to notice the differences between their practices and their statements during the interviews. The ISC team can propose new services in agreement with field reality and hence, sustainable services. **Qualitative data** were collected walking along network and observing farmers; **quantitative data** were obtained talking with them about their cropping systems, their irrigation schedule and water needs. They were used to produce some maps and agricultural statistics (cf. appendix 11).

In qualitative methods, the interviewer is supposed to describe an event, understand a certain action or to be able to give an interpretation of a phenomenon (Muukkonen, 2007). This method makes the understanding easier of a particular situation, at a given moment, of a society or a social group. The interviewer has to situate the study into its social connections (relationships between people such as farmers and stakeholders). Then, the interpretation of the qualitative material is more subjective than with the quantitative material.

In practice,

Technical, historical and organizational data about FWUC and irrigation system management have been collected in Teuk Chha and Pram Kumpheak; it allows collecting primary data and the "feeling" of farmers, involved or not in involved in the social organization of the scheme and getting a better understanding of farmer worker conditions (Ferraton N., Cochet H, Bainville S., 2002). Other information has been collected among resource people in each village: village chiefs, water gate operators, commune chiefs, MoWRaM and PDoWRaM representatives. These people are preferably old and have lived in the community for a long time or are involved in the local development. They are interviewed about the agrarian history because they typify the guardians of family collective or community memory (Lavigne-Delville and Wybrecht, 2006). Other people are chosen for their analytic vision of studied phenomenon (collective action evolution, services implementation, scheme malfunctioning, etc.); it can be local authorities or the ISC team.

Semi-structured interviews realized for the diagnosis (first stage) have been allowed interviewees to express themselves more freely on the subject. A trust relationship is progressively building between the interviewee and the interviewer; this interview is quite flexible, allowing new questions to be brought up during the interview as a result of what the interviewee says while a structured interview has a formalized and limited set questions (it is used for cartography; for instance, it can be asked specific questions about rice growing seasons, yield or rice varieties).

2.3 The weight of History: the first approach

Ruf and Sabatier said that (quoted by Aubriot, 2000) the water management is, before all, **a social construction**, historically produced, but always changing according to unexpected events. Hence, the study of an irrigation system is not limited to technical and organizational characteristics but it has to consider its evolution in the time as a social construction.

The bloody History has an impact on social organization and irrigation system management; this approach allows identifying the community adaptation capacities to face new changes through water management and local development.

The historical aspects have been studied through semi-structured interviews with elder people from different villages and social status of both schemes.

2.4 The territorial approach defines the water access

The analysis of the territory informs us on the **biophysical environment** characteristics of farmers' water users. It allows identifying **water resources available** (water quantity throughout the year, water springs, water storage capacity) and gives information about **watershed area boundaries** which are precious to understand the constraints cropping systems have to face, water distribution and availability throughout the year as regard crop water needs, water springs identification, etc.

As for Ostrom (1992), the first principle (among the 8 major principles characteristics necessary for successful self governing organization) concerns **clearly defined boundaries** that help to identify who should receive benefits, have access to the irrigation system (through hydraulic infrastructures) and maybe pay costs (cf. appendix 12). In other ways, the boundaries define who has **right** to use water, infrastructures and participate in the system management decision-making. In Cambodia, this scheme definition is not obviousness.

The first tool to analyze the territory organization has been the **"reading of the irrigation system"** (Aubriot, 2000). The method was to follow the **water ways**, from reservoirs to downstream fields (until the end of the network) walking along main and secondary canals, crossing rice fields. It has been completed by secondary information as administrative or simplified hydrological maps and official documents (Water Law, MoWRaM, etc.). Then, **interviews** were realized with different stakeholders such as water gate operators, village and commune chiefs and upstream and downstream farmers in order to understand the water ways throughout the year.

2.5 The agronomical approach: farmers' practices and strategy

The agronomical approach of this study allows completing the existing diagnosis of Teuk Chha and Pram kumpheak schemes and proposing a synthetic representation of cropping and irrigation calendar. The aim is to explain the process to the ISC team and think about its hypothetical implementation in order to improve the sharing of water resources along the main and secondary canals.

The concept of **cropping systems** is useful to compare and understand farmers' practices, their constraints to produce and their strategy; according to Jouve (1997), a **system** is "*a synthetic representation of a complex unit whose functioning results from the relations established between these elements*", and he insists on the various organization scales within a system and its links. It is defined by the body of technical modalities implemented on fields cultivated in an identical way.

Hence, a cropping system is defined by:

- Crops nature or associations and succession order
- Crop management sequence including varieties choice
- Products and subproducts, their yields (Sebillotte, 1990).

In the future, it could be interesting, considering the spatial cropping distribution and their production in time, to propose irrigation calendar satisfying the water needs for upstream and downstream fields and hence, reducing water conflicts.

This approach also allows drawing some maps about crop distribution and year-round rice growing season; there are village-scale maps.

2.6 The complexity of water users' connections through the social approach

This approach is fundamental in this **water social management** study. In an irrigation system, people have to come to an agreement to share water starting from **individual strategy**.

It supposes to understand the organization system, former and current rule system in order to propose solutions adapted to farmers' needs. The users have to learn to propose, adapt and understand the regulations. The new regulations proposed during the project implementation will need to be adjusted and changed in the future. Boelens (2000) said: "t*he beginning of the irrigated perimeter should not have too strict rules. In going from fuzzy rules, the system can evolve to some more strong rules".*

The complexity of social organization and connections between stakeholders has to be known. Semi-structured interviews have been made with stakeholders, farmers and the team in both schemes observing what the farmers say and what they do.

3 THE MISSION AND ITS IMPLEMENTATION

3.1 Main activities

We will put the emphasis on water social management following three stages:

- First step: To analyze existing experiences (former and current) and propose a database for the ISC (cf. appendix 13)

A capitalization work will be realized from Prey Nup and Stung Chinit schemes (cf. appendix 5). This study will facilitate the understanding of irrigation systems management and development. Some diagnosis improvements of Pram Kumpheak and Teuk Chha irrigation systems will be proposed (reviewing the existing diagnosis practices of the ISC team). New data collected will complete the ISC work and clarify the understanding by the team of the diagnosis methodology. These data will be available through an Access database and mapping system using ArcMap. Then, new participatory tools will be developed for an easy use for FWUC management and the ISC team.

- Second step: To consider and test new ways to support FWUCs functioning through social water management in Teuk Chha and Pram Kumpheak schemes.

Based on existing services proposed by the ISC and capitalization feedbacks (Stung Chinit and Prey Nup), considering difficulties faced by those FWUCs, the objective is to propose some improvements in terms of water and FWUCs management. It will look at the necessary conditions to build up trust among users to invest in collective action. It will be essential to follow up the implementation by the team of the water sharing principles in Teuk Chha and Pram Kumpheak schemes and understand service issues. Water sharing principles methodology will be proposed and some of these proposals could be tested in the course of the ISC service implementation (such as designing irrigation and cropping calendar with the team).

- Third step: To define and describe the ISC support process

The service proposal will have to be framed with the ISC team taking as example two schemes (Teuk Chha and Pram Kumpheak); the various steps of designing and implementing services process for FWUC will be developed. In the same way, ISC stakes and strategy will be identified and explained (what are the differences with other actors?).

A critical analysis of ISC team experience will be proposed to conclude this work.

3.2 Working calendar

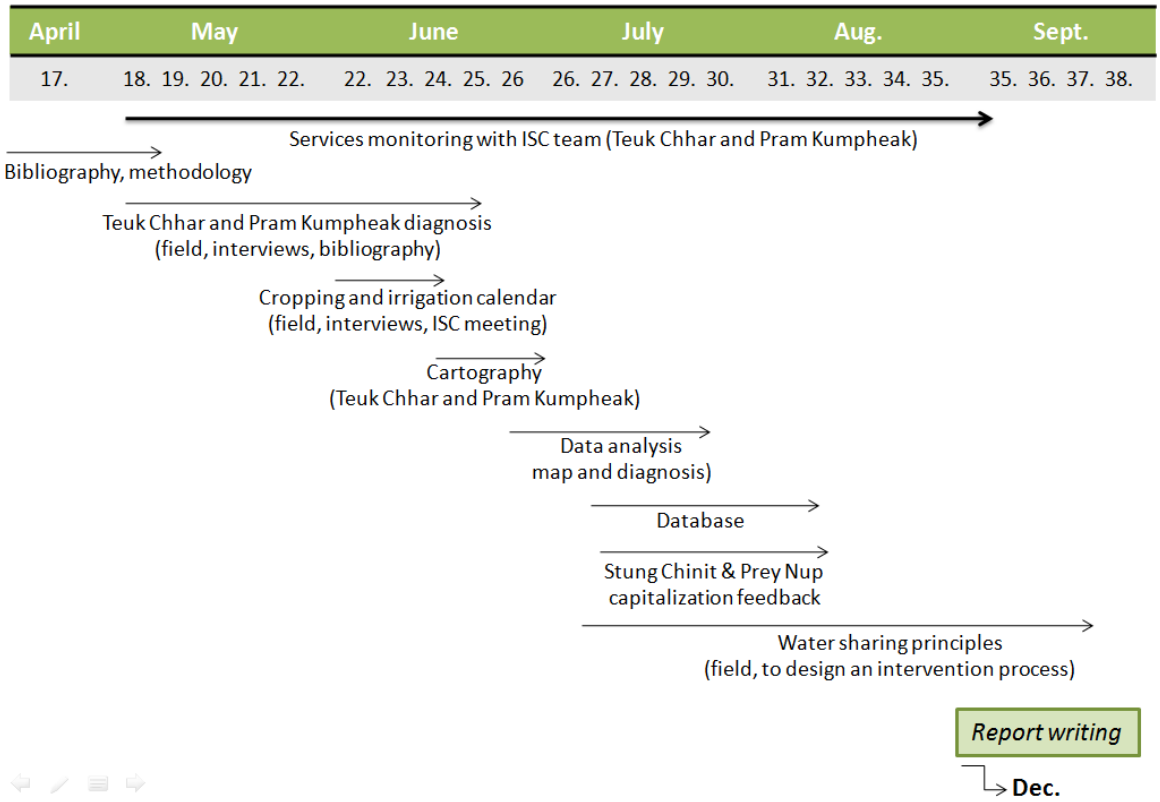

Figure 9: Schedule

3.3 Field work condition and study limits

To conduct interviews, understand, observe farming practices and to be integrated in Teuk Chha and Pram Kumpheak communities, we stayed (for short periods) living in the villages, with the interpreter. It permits also the establishment of a necessary confidence relation between investigators and community. The main difficulty was not to speak the Khmer language.

Then, a translator was required to translate official documents and another from the ISC (service proposal, etc.) and simultaneous translation during the meeting in schemes with farmers. There were two successive Khmer interpreters, students in agriculture (two months each one) during this study realized in 2010, during four months.

We lived in Kompong Thom City 100 kilometers far away from the project area in Kompong Cham. The trips were realized with motorbikes and cars.

What are the limits of the study?

Working with translator includes a bias in the obtained results, especially in the semi-structured interviews where the speech analysis is particularly important and the translation has to be exhaustive. Besides, both translators were not trained in irrigation management, then, it took a long time to explain to them objectives and content of the interviews and project.

In April 2010, both contracts in Teuk Chha and Pram Kumpheak began, then, it was easy to follow-up the service implementation but at the end of the study, the work was still going on. It is difficult not to follow from A to Z a process; considering that, it seems difficult to make realistic proposals to improve intervention process as for water social management. It may be better to follow the entire process.

To work continuously with the ISC team allows understanding many things regarding irrigation policy, farming practices, culture in Cambodia and services implementation. However, working to the rhythm of a team, according to advances made in service implementation on the field, may slow down the study in question.

We interviewed, with the four ISC team members, farmers and village chiefs[41] for the irrigation system diagnosis. The difficulty was to explain to them some agronomical and technical basics about yields calculation, irrigation and cropping calendar interest and implementation (it was explained during a meeting in the office)? Some other terms were explained before realizing the interviews as: peak of water need, % access to water according to the seasons.

What are the limits of the methodology?

The methodology of Ostrom about rules implementation shows some limitations; indeed, she works on the assumption that schemes are functioning well and hence, it would suffice to arrive on irrigation systems and implement directly water sharing principles (cf. appendix 12) without specific methodology. Besides, she does not consider the indispensable contract validation process by the local authorities before implementing the service. As for the ISC, to design an appropriate intervention process needs to make the service approved by local authorities and farmers; if it is not the case, the service cannot be implemented and the contract is stopped. There is no good or bad rule system; it is often unpredictable and depends on local context.

Besides, the first principle to implement a successful institution is not totally realistic. It seems essential to define clear boundaries but how to define them? Once the scheme is delimited, do we need to exclude people from the irrigation system? What could justify some farmers' exclusions? In Cambodia, all water resources belong to the State. It considers that the country has abundant water and then, there is no competition for water resources; as for them, there is no need for conflict resolution mechanisms. Starting from that, how to respect, without creating conflicts, the first principle defined by Ostrom?

She recognizes the scale problems in watershed areas. But, how can we define a watershed area? What are the limits?

To conclude, the methodology of Ostrom allows understanding rule system implementation methodology and collective action basics but the project shows its limits based on its own experience.

[41] Au total, there were 99.

III. CASE STUDIES: TO STRENGTHEN COLLECTIVE ACTION IN BOTH IRRIGATION SYSTEMS

This part aims at presenting the diagnosis which has been done by the ISC team and completed during the internship. The document presents main information about both schemes studied and the ISC diagnosis methodology weaknesses; this allows understanding better the causes of the current low collective action.

It aims at understanding the social, technical and organizational functioning of the scheme. The scheme history is important to determine the failures of the past which are decisive now for the scheme functioning.

1 TO IDENTIFY MISSING DATA FOR AN ISC DIAGNOSIS

1.1 Simple diagnosis methodology

The first step concerns the current functioning of the system; to know that, it is important to:

- To observe the various shapes of water mobilization
- To study the structure of the various networks
- To go up in the history of the structures to understand their current characteristics

Once the technical functioning is clear, it seems important to study the organizational functioning of the scheme. Stakeholders were identified thanks to the ISC team and existing diagnosis; then, they were interviewed. They explained us the principles of management. How does water circulate and which are the management rules? Is there a FWUC? Is it working well?

- Collecting data about formal and informal organizations
- Observing the practical applications
- Understanding the water sharing among farmers.

This first step allows identifying functioning problems, the dysfunction causes, the local capacities by highlighting the confines and blocks. It means understand the strategic points for a modification of the management methods. The second step is to exploit results in order to answer to the question: how does the scheme function? Does it function well? And, how to improve the scheme functioning? What are the pieces of advice you would give to the ISC team? To know that, the good functioning has to be identified: On which criteria it is based?

1.2 Suggestions regarding diagnosis missing data

Services are proposed once the diagnoses are selected by the team thanks to the tool “diagnosis” without methodology planed out in advance. The ISC is interested in data about technique (infrastructures, conditions and construction period), origin of water resources, O&M (stakeholders, organization, budget available), farming practices (rice growing seasons, broadcasting/transplanting, SRI, fertilizers) and their results (yields), economy (budget, incomes and benefits) and social connections (power game, communication, conflicts).

One month later, after had consulting ISC documents, interviewing farmers, stakeholders and the ISC team, it seems interesting to add some data; some suggestions on what else can be done are in the following table.

Approach	Data collection by the ISC	Missing data: some suggestions
Historical	Date of infrastructure construction and rehabilitation, creation of the FWUC and FWUC changes.	Previous farming practices → it seems interesting to understand the evolution of farming systems. *How can we explain the current farming practices? Is there an evolution?*
Territorial	Origin of irrigation water. *Few data*	**Water resources available** (water quantity throughout the year, water springs and water storage capacity) → this gives information about irrigation system delimitation: *where are the boundaries?*
Agronomical	Irrigated area per scheme, farming practices (EWS, WS and DS), uses of water irrigation, yields and rice varieties.	**No irrigated area per canal** (it has to be known at the beginning of the service implementation to propose a fair water sharing). % of rain fed rice fields No irrigation, work and cropping **calendar**
Technical	Hydraulic infrastructures (size, type), kind of rehabilitation, distribution network, main and secondary intakes	Rates of flow into the canal
Social	**Conflicts** (land, water sharing upstream/downstream); previous rule system; **social organization** through FWUC and communes.	How many people are out of the irrigation system because of infrastructures damages or no coordination (upstream/downstream)? Social connections and conflicts because of opportunistic behaviors. *How to limit them?*
Organizational	FWUC functioning and activities, ISF and membership fee collection, participation of local authorities, membership Project, funding	
Economic	Extra-agricultural activities and migration, ISF collection.	**Agricultural incomes** (rice and other crops) → *how much farmers can **invest** in irrigation?* Extra-agricultural incomes.

Table 2: suggestions to complete current irrigation system diagnosis

2 BRIEF IRRIGATION SYSTEMS PRESENTATION: TEUK CHHA AND PRAM KUMPHEAK

The objective of this part is to introduce briefly schemes in order to understand services proposed and the state of collective action, its weakness and the solutions to strengthen it.

Teuk Chha and Pram Kumpheak FWUCs do not function well. On one hand, there is no participation in system maintenance and no funding to operate the FWUC in Teuk Chha; on the other hand, in Pram Kumpheak, as for the team, the lack of confidence from the members regarding the president's leading[42], may be responsible for the low functioning.

The objective is to provide the team new ideas and suggestions through the diagnosis to solve the poor functioning of the FWUC and hence, to strengthen collective action in schemes.

[42] ISF collection fails; there were no regular meeting, etc.

2.1 To define water resources and ways to share it fairly

Pram Kumpheak scheme is located in Lvea Leu commune, Chamkar Leu district. Only one commune and 6 villages are involved in the ISC service.

Teuk Chha scheme belongs to two communes, Kroch and Boeung Nay and is located in Prey Chhor district; 24 villages are involved in the system (cf. figure 10).

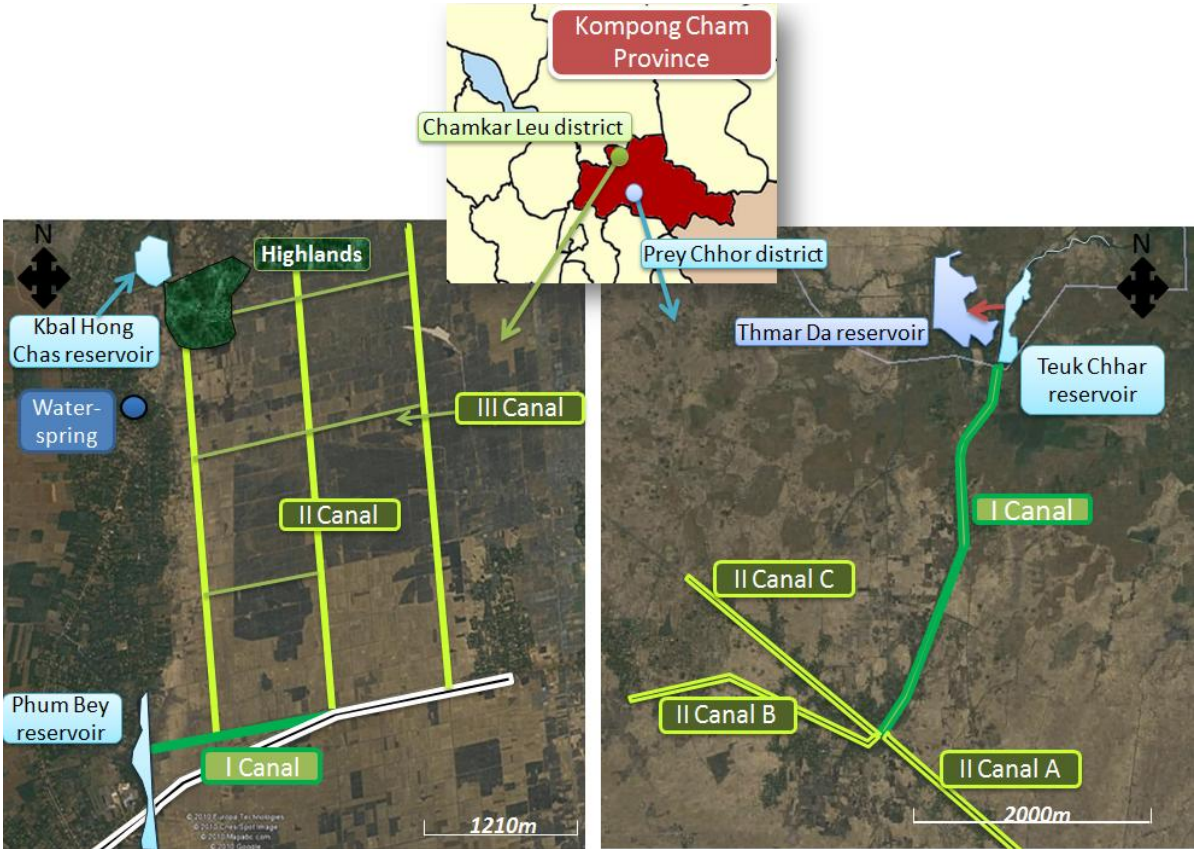

Figure 10: Pram Kumpheak (left) and Teuk Chha (right) maps

Source: Google earth

In both schemes, there is **no major problem of water scarcity**. In Pram kumpheak scheme, there are two reservoirs which are not connected: Kbal hong Chas and Phum Bey[43] . Each reservoir allows irrigating three villages. Besides, a water-spring provides supplementary water.

In Teuk Chha, there are also two reservoirs linked by a spillway. Teuk Chha reservoir is on upper part and Thmar Da in on lower part (used for some villages located at the north of the scheme). The small one, Teuk Chha, is located in three villages' territory (Thmey, Thmar Pon, Chamkar Leur).This is the main intake (cf. figure 10).

Both gravitational distribution networks, whose water resources are surface runoff and groundwater, have access to water all along the year; at present, the PDoWRaM and ISC technicians only know the rough reservoirs storage capacities; no precise measure was realized. Then, the **water availability is unknown**.

It seems difficult to know the area which can be irrigated and number of water users. Indeed, the **global command area**[44] is known for both irrigation systems[45] but it is not accurate and not detailed

[43] Phum Bey reservoir is the main intake (the biggest reservoir).

for each canal[46]. Besides, these reservoirs were **not sized** according to farmers' water requirements and available water resources (still unknown). Hence, farmers have to adapt themselves to available water resources all along the year.

Besides, in Pram Kumpheak scheme, hydraulic **infrastructures** are **not in good condition**[47]: some rehabilitation works, under the ISC contract, were made to repair some gates, build anti-erosion wall to protect earth canals. Until not long ago, there was no gate in Phum Bey reservoir. Since the gate was repaired, water gate operators were recruited, for five months[48] to control the water distribution. At present, they test several ways to share fairly water among farmers according to their water requests. The problem is that, in **WS 2010**, rainfalls are low and there is **not enough water** to irrigate all rice fields. Priorities for irrigation have to be defined.

The technical situation is different in Teuk Chha scheme. Indeed, hydraulic infrastructures are not too much damaged; as for the ISC team, a simple and low cost maintenance of the canals[49] would probably increase the water availability in terms of quantity and reliability.

The main problem is the water sharing at secondary and tertiary levels; there is no coordination between farmers who use water from these infrastructures. As a result, the **downstream part** of the scheme has a low access to water and **the resource is wasted**.

Once the **real water availability** from the reservoir is known and the **detailled command area** realized, the **coordination** between stakeholders can start.

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[44] It means the area of land which is lower to a canal or reservoir water level.

[45] Pram Kumpheak capacity could supply water for 492 ha. FWUC and farmers thought that this scheme capacity could irrigate over than 1000 ha in wet season and approximately 300 ha in dry season.
The wet season supplementary irrigated area (ha) in Teuk Chha is about 4,200 ha with 4,400 landowners.

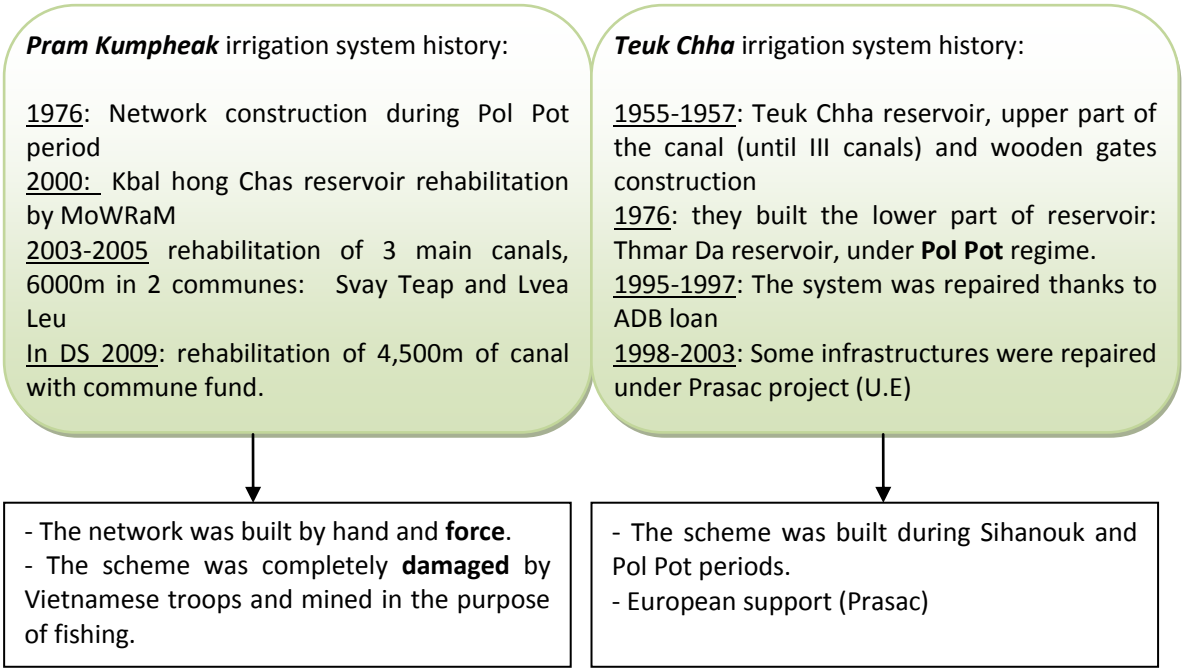
[46] The command area is known for Teuk Chha secondary canals (Canal A : 781 ha / Canal B : 1720,8 ha / Canal C : 897,4 ha)

[47] Secondary and tertiary infrastructures are not rehabilitated.

[48] August 2010.

[49] The idea is to dredge the canals which are too shallow.

2.2 The scheme technical characteristics and their social organization depend on the History



The historical period of scheme construction shows today its consequences on technical performances (in terms of design quality, functioning and adjustment to farmers' needs).

Pram Kumpheak scheme was originally constructed during **Pol Pot** regime in 1976 with the idea of storing water for supplementary irrigation of the wet season rice. It should be pointed out that, given the context of war; it was designed without high technical considerations. Today, there is still much work to be done in order to improve the scheme functioning and efficiency.

Teuk Chha system was established under **Sihanouk** reign. Infrastructures were sized by technicians by respecting contour lines and not built by force; Rehabilitation work is limited.

Hydraulic infrastructure construction depends on topography, geology, hydrology and agronomical scheme characteristics. However, most of those infrastructures were built without preliminary studies. It seems essential, before developing an irrigation system, to identify farmers' and water needs and then adapt the construction to the demand.

Besides, during Pol Pot period, farmers had to work together to produce food for the common good; it was the agricultural collectivization. Landowners gave up their property. This period of collectivization/decollectivization has certainly strong repercussions on social organization. The **social cohesion was affected** and needed to be rebuilt.

2.3 When the rice growing is not sufficient any more to make farmers live

2.3.1 *Coordination processes in a collectively managed rice cropping system*

Three rice growing seasons were identified: DS (from January to April), EWS (from March to July) and WS (from April to September)[50]. DS rice depends exclusively on water irrigation and then, the land localization is decisive to cultivate rice during this season. It is noted that fields close to the scheme (with a better water access), in Teuk Chha, allow farmers cultivating rice three times per year

[50] During WS people who cultivate long-term rice begin in April and harvest in September and those who cultivate middle-term variety begin later, in June and harvest in September too.

including EWS, WS and DS rice while fields far from it are only cultivated during WS. In Pram Kumpheak, farmers do not cultivate rice during DS, only EWS and WS.

Therefore, the economic advantage to own fields close to the network is obvious. This year, the price of rice has increased from about 500 riels to 800 riels[51]per kilo and hence, the principle of supply and demand economics encourages people cultivating, as far as possible, out of the wet season to anticipate lean season.

As for local pedologic characteristics, the soil may be defined as a black soil which is fertile and quite good for rice growing. According to CEDAC study, EWS rice gets highest yields if we compared it with DS and WS rice. However, during the study, 28 farmers in Teuk Chha were interviewed about their yields[52] and results are different: in DS, they produce 2,8t/ha; in EWS, 1,7t/ha and in WS, 2t/ha.

Interviews were made in both schemes to draw **cropping** and **irrigation calendar** in each village, according to the season and the rice variety). It allows identifying the **peak of water needs** for rice cultivators and comparing these calendars: if these calendars are similar, then it is possible to bring farmers who have the same farming practices together.
The idea is to **synchronize farmers' water needs** and **reduce the waste of water** and **conflicts** about the sharing of water (cf. figure 11).

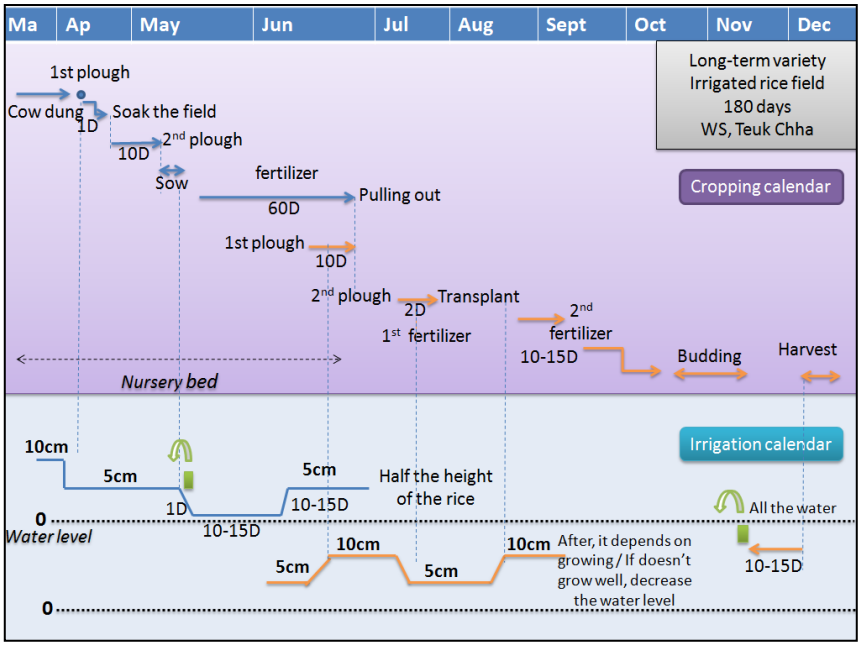


Figure 11: example of cropping and irrigation calendar, WS 2010

2.3.2 *Towards agricultural diversification to ensure the O&M*

In both schemes, most of the farmers are **small farmers** with **little land** and **without financial capacities** to have access to **mechanization**. They use ox to plough their rice fields. Taking into account that they cannot gain adequate benefits from agriculture due to their small sizes of plots, the low irrigation access, the poorly designed hydraulic infrastructures, the poor market integration and expensive credits, how could the farmers invest in the irrigation sector to carry out the O&M of networks?

Farmers' incomes can be increased developing a system based on rice production over the wet season, followed by vegetables, annual or perennial crops over the dry season.

Nowadays, during WS, the main crop is the rice. Out of this season, in Teuk Chha scheme, the more affluent farmers, depending to their canal access, soil quality and rice production, produce vegetables (cucumber and eggplants), watermelon, sesame, soybean and bananas[53] in addition to rice. As for farmers, "these crops are more profitable". The land access and available cash make this

[51] CEDAC, 2010.

[52] The average area of an irrigated farm is about 1,1ha in Pram Kumpheak and 0,9ha in Teuk Chha.

[53] Soybeans and bananas are preferentially cultivated on highlands.

agricultural diversification easier. In this way, they protect themselves against lean season as well as earn some extra income.

Some international and national projects encourage this diversification process as ADG, working with the ISC, and ACIAR.

2.3.3 *To develop economic alternatives for poor people*

In order to face the **landlessness** and **low productivity**, in other words to fight poverty and marginalization, farmers try to diversify their activities (agricultural or not). Many peasants hire-out their labour services locally, to other farmers or far away villages and towns[54].

People, who stay in their village or neighbouring, work in a number of non-farm activities as wood forest product collection and fishing[55]. The latter is responsible for conflicts among farmers in Teuk Chha system; the lack of regulation leads to canals damage, wastes and water thievery in purpose of fishing. There are also complementary activities as raising livestock and sugar palm making[56].

In Pram Kumpheak scheme, the main income-generation activity of interviewed farmers is highland cultivation[57]. Another extra-income comes from sale of labour, taxis, small business and government employment. To give an order of magnitude, 50 people out of 183 families, from Trapeang Bet village, in Teuk Chha scheme, work in construction and textile industries. Generally, the youngest people work in Phnom Penh city and send money to their families.

People most affected by **migration** are the landless and small farmers. To face food shortages, most of the time, able-bodied men and women go to Thailand to look for a job between sowing and harvesting of WS rice. This is a silly season; hence, people migrate abroad for wage work. Migration is considered an important **survival strategy for the poor**. These extra-agricultural activities do not only supplement the farm incomes but also act as a **cushion against crop failure and seasonal food shortages**.

Besides, many people are obliged to migrate because they cannot cultivate out of WS. In O Chrok village[58], 40 to 50 per cent of migration is due to the incapacity to produce during DS.

Both schemes are not modern areas; there are only a few people who have rotary cultivator. In that case, it seems possible to hire out labour within the village or to develop **labour reciprocity** within a village, between farmers.

2.4 Collectives structures that need to be strengthened

2.4.1 *An official FWUC creation which has not tried and true yet*

Before organizing a FWUC in **Pram Kumpheak** scheme, overall system management was managed by the commune chief. Another activity such as O&M was lead by a committee. Each committee member had one specific and proper role.

There is FWUC existing, on two communes, since **2003** by election and recognized by MoWRaM. It is made up of 497 members (one per family); the FWUC board includes:

- One chairman in charge of overall management
- One first-vice chairman, responsible for O&M
- One second-vice chairman who managed water distribution
- And one accountant.

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[54] They go to Phnom Penh, the Capital, to find a job.

[55] Both activities are realized on a seasonal basis and year-round.

[56] The price of palm sugar has only increased from 550–750 riels per kg, over the last five years (CDRI, 2010).

57 Rice cropping is the main or secondary income source generation only for 21% of farmers interviewed (Perera, 2006).

[58] Teuk Chha scheme

As for **Teuk Chha**, its **FWUC** was created, under Prasac project in **1999**; one constitution was signed and approved by provincial governor, Hun Neng, on 20th November. The **committee election** was made the same year. In 2003, two statutes (one for each reservoir) were proposed and approved by MoWRaM. Another FWUC committee election was organized by Kompong Cham PdoWRaM in 2007.

Officially, the FWUC was made up of 36 representatives and 4 committee members[59]. There are 4,438 landowners.

2.4.2 *However, they had not a good track record*

FWUCs, in both schemes, are **not functioning well**. In Pram Kumpheak, once the FWUC was created, statutes and internal regulation were organized by PDoWRaM but still not implemented. This FWUC suffers from **lack of financial capacities** and **members' participation**. To improve it, it seems essential to put special emphasis on farmers' involvement and local decision-making process.

As for **water management**, gates operations are officially controlled by the second chairman of the community committee. In reality, water is used freely by farmers opening and closing the gates.

In Teuk Chha, water management is complex; a water turn was implemented, without good results followed by a water request system. The ISC proposed services to manage it properly and this work implementation and results are developed in the fourth part. Members' responsibilities are **not clear**; representatives have no authority over farmers and are not able to make decisions about scheme management. The **previous FWUC** (1999-2008) **failed.** Indeed, farmers interviewed said that there was no management plan, no maintenance[60] and the water management was not clear (the water turn was curiously flexible according to social connections). Besides, it is said that ISF was collected[61] but not visibly invested in infrastructure rehabilitation or construction. The **lack of transparency** is responsible for this failure. Another FWUC committee election was organized in 2007 by the PDoWRaM and a new FWUC was set up in 2008. They tried to collect laboriously the first year ISF[62] and stopped later, in 2010, the collection. In Pram Kumpheak, there was an ISF collection at the FWUC creation (40,000 riels/ha (about 20% of recovery)); as the results were bad, they stopped the collection in 2003. Through the ISC services, ISF collection is on-going.

Unpaid ISF, low participation, disorganization…**the O&M is still far from ensured** in both schemes. Most of the time, farmers manage to clean the part of the canal they used. In Pram Kumpheak, small works to repair the first main canal were made thanks to the farmers' contribution (about 100,000 riels) through a village ceremony held every year. The second and third main canals were repaired (to repair old culverts or buy another one) thanks to collective work.

This lack of regulation and organization encourages some people to adopt individual practices to the point of cultivating rice into the canal. Even if statutes and internal regulations were written, FWUCs are not actually able to enforce their rules to protect the scheme from illegal actions.

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[59] Kroch commune chief is the head of the community and the commune council member from Boeung Nay is the second deputy head.

[60] Officially, the system maintenance is the responsibility of the first vice-chairman.

[61] In 1999, Prasac project supported the commune for ISF collection. Then, the Community collected 100% of ISF the three first years of support. In 2004, Prasac stopped support the community. The ISF collection decreased by 50% and it stopped totally after until 2009.

[62] In 2009, the ISF fluctuated between 20 and 50 kg of paddy rice / ha and was collected by the village chief for DS cropping.

3 IRRIGATION SYSTEMS WEAKNESSES: A CHALLENGE FOR THE ISC

3.1 Barriers to collective action

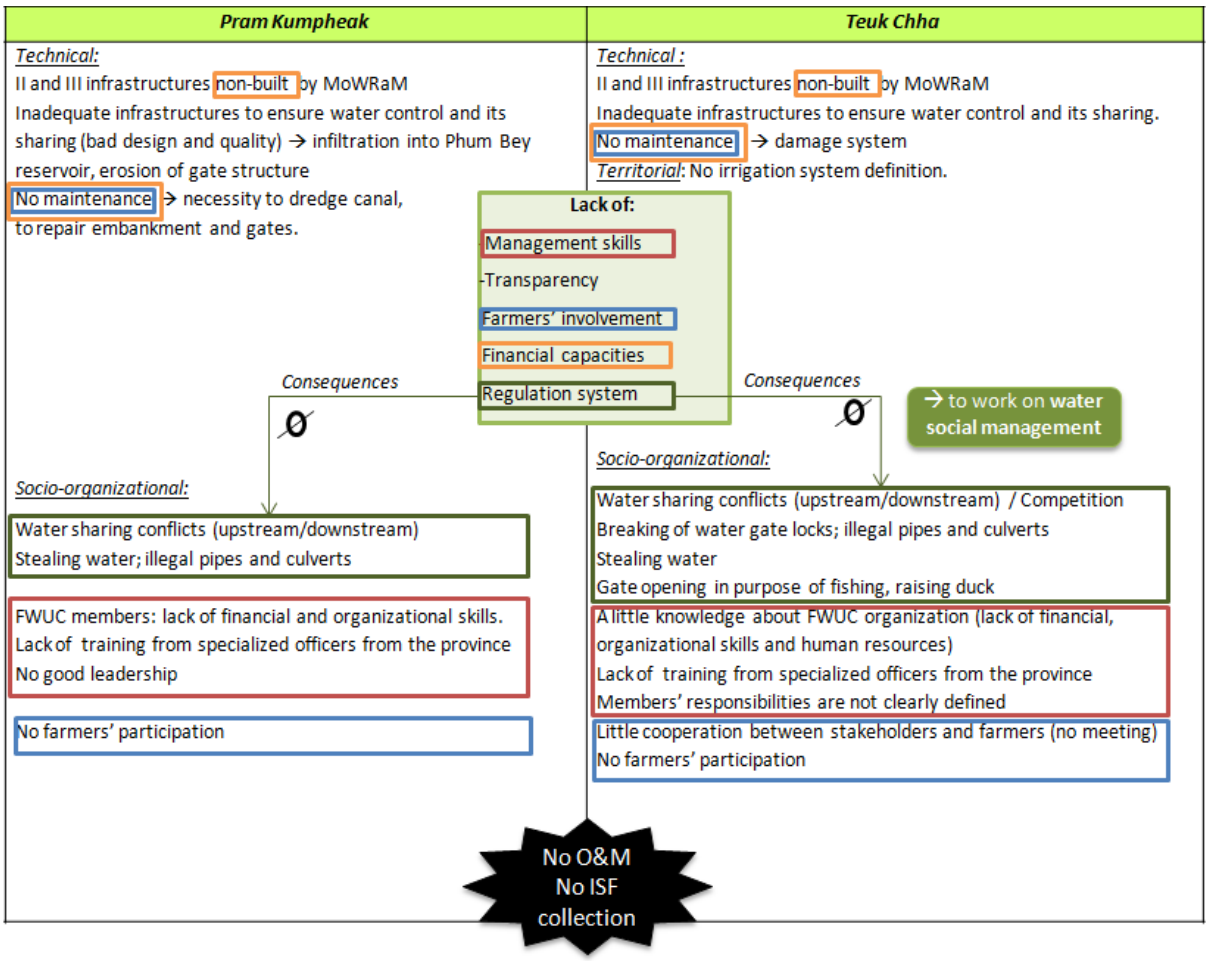

Figure 12: irrigation system weaknesses

The weaknesses of the collective action can result from deeper causes which can be institutional, socio-organizational and financial (cf. figure 12). They have consequences on the confidence which have the farmers in the local authorities (FWUC), on their involvement in the O&M of the scheme as well as on the social connections between water users' and their capacities to use a resource, in a given space by respecting the needs of their neighbors.

3.2 Services formulation and proposal

From the diagnosis realized by the ISC and discussions between the team members and the local authorities, suggestions to improve scheme functioning and development were proposed. These propositions will be discussed in the last part of this report.

When the center began worked with **Pram Kumpheak** scheme, the FWUC was non-functional. Thus, the first service consisted in creating a new FWUC by following these stages:

- FWUGs/FWUC creation
- Record membership
- Create a database of FWUGs/FWUC members.

Once FWUCs/FWUGs were created, according to village chiefs and some farmers' requests, a second service of technical rehabilitation was proposed (cf. appendix 14). The working stages proposed by the ISC were the following ones:

- Build/rehabilitate check structure every 500 meters
- Dredge secondary canal and build the embankment of the canal where it is low
- Install the culverts where it is necessary
- Build the gate with high performance for Phum Bey reservoir in order to control water in the reservoir for EWS and WS.
- Should build one canal (release water canal) to release water when there is flood.

The third service is at present in progress to manage water resources and reduce the conflicts about the sharing of water between farmers.

In Teuk Chha scheme, the objective is to make the water access easier and sufficient for irrigation purpose. Two services were proposed; the first one aims at implementing a good water management in the main canal (between Teuk Chha reservoir to the division in three secondary canals) and the second one at setting up a FWUG for the canal B (after the division in three canals, only on the canal B) (cf. appendices 15 and 16).

To meet the farmers' expectations and needs and organize the working stages for the services implementation, an advisory committee was created at the main canal level (cf. appendix 17). We shall see, in the following part which explains this creation and organization process, that this committee changed its mode of decision-making and its internal organization. At the beginning, decisions regarding water management were made with farmers dependent on primary canal; it was not sufficient and it was finally spread on the whole irrigation system. As regards the FWUG constitution, the service was for its debuts; the participation was sufficient to pursue the process and the membership fee was collected.

IV. TO DESIGN AN INTERVENTION PROCESS FOR SERVICE CENTER

1 DIAGNOSIS, VALIDATION AND CONTRACTUALIZATION METHODOLOGY WITH FARMERS

This methodology aims to clarify the ISC process and the services implementation in two schemes: Teuk Chha and Pram Kumpheak (cf. appendixes 14 and 15). Therefore, this general document can be used as a model for other schemes with similar main features (we will see selection criteria). The objective is to build a methodology starting from practices and field experimentations based on two concrete examples.

The ISC has its own methodology to select schemes; the same goes of drafting, negotiation, validation and implementation of service processes. They are the result of a consultation between the ISC team and the GRET coordinator; they are not rigid because they depend on the local context (farmers' needs and requests), farmers' understanding and acceptance.

If farmers accept the service proposal and then, decide to work with the ISC, they have to be involved in the service implementation paying for it through membership fee and/or ISF. The issues of these payments will be dealt with later. By collecting a membership fee, the FWUC will test the farmers' willingness to support this process.

This first part explains this specific process giving two examples from the field. Some additional proposals were made concerning the diagnosis to improve understanding of the scheme before selecting it.

The second part aims to propose a methodology for the ISC team according to the field work carried out during five months in the internship regarding social management of water resources.

1.1 Diagnosis process

To propose a service, the irrigation scheme has to be well known: water flow, available resources, infrastructures and their condition, water distribution, organization and relationship.

Before the final scheme selection, the main characteristics of the scheme are identified and after that, a detailed identification of the scheme using some cartographic tools can be done.

1.1.1 *Short assessment*

CISIS data base gives an idea of scheme condition and functioning. It is often consulted to make the preselection of the scheme. After visiting twenty irrigation systems, meetings with local authorities and farmers were organized. The main infrastructures were listed (type of infrastructures, size, functioning and condition) during the field visits.

Then the ISC team assesses the economical sustainability of the scheme, the functioning of the organizations and identifies the stakeholders. They notice the hypothetical problems or conflicts within the irrigation system and their causes.

1.1.2 *Pre-selection criteria*

The Irrigation Service Center decides to step in schemes when the main infrastructures have already been built and when scheme rehabilitation is over[63]. Their objective is to improve the management of existing irrigation systems which are partly functioning.

[63] If there is no hydraulic infrastructure or no FWUC, the scheme is not chosen; their objectives are not to build a new irrigation system, it will take too much time and be too expensive.

On top of that, schemes, within targeted provinces, are chosen according to several **criteria** which are:

- the size of irrigated areas (medium and large schemes)[64],
- the status of the infrastructures (partially functional infrastructures),
- the reliability of the water source (in other terms: water is not scarce),
- **the demand from farmers and/or local authorities,**
- a sufficient agricultural and economic potential,
- financial means to pay services,
- the support from local authorities (including financial),
- the good potential for improvement,
- the **absence of conflict**.

As for the ISC, this **absence of conflict** makes the service implementation easier and faster. It allows a better **social cohesion** but limits the questionings of the local stakeholders. The conflict can be a **factor of social change** and encourages farmers to invent new social forms through the consultation to identify the internal problems to irrigation systems management and organization. Once the origins and consequences of the conflict are identified, it will urge farmers to act **from the inside** and to get organized without need of external organization in the hydraulic space. Thus, **the conflict may limit the intervention** of the service center.

As for Simmel (le conflit, 1992), a conflict:

- Reveals social antagonisms.
- Allows reconstructing the societal unity by arousing changes.

The conflicts resolution involves implementing a confrontation process and a search for compromises; thus, a conflict would slow down the service implementation proposed by the ISC. Hence, the criterion of scheme selection "absence of conflict" makes the intervention process of the center easier but it limits communication between local actors.

Given that conflicts reveal the disparities and the real farmers' needs of the farmers, this absence may risk to limit services impacts on scheme management through the FWUC.

At present, considering the current ISC project status, still little known, few FWUCs or communes contact directly the team. It is possible that field visits and the first exchanges between the ISC team and local authorities generate new farmers' needs without being aware of it before. Those new needs' lead them to approve services and sometimes, to cumulate them. In order to strengthen collective action, farmers have to identify, by themselves, their needs and problems and later, contact the center formulating proposals.

∝ Concerning **Pram Kumpheak scheme,** it was chosen for six main reasons:

As for agricultural characteristics, the rice yields are high (about 2 tones/ha)[65] and when the ISC came, they were cultivating **EWS** rice. Indeed, to grow additional rice crop at the beginning of the rainy season allows reducing frequent food shortages, dividing up better their working time and, with higher inputs, can produce better yields (compared with the wet season crop). Besides, the EWS crop requires only a small amount of water to supplement early rains (Chea, 2002)[66].

[64] Cf. page 10.

[65] The average rice yield in Cambodia is 2.3 ton/ha (EWS) vs. 4.6 ton/ha (EWS) in Viet Nam (DSGD, 2008).

[66] EWS rice cultivation requires photoperiod-insensitive rice varieties (Chea, 2002).

Besides, there was a farmer who did SRI and seeds production. The SRI corresponds to "younger and fewer seedlings transplanted with wider spacing and no continuous flooding, and nourished by compost rather than chemical fertilizer". [67]

Many farmers have rubber tree plantations; they are not too dependent on rice production thanks to the diversity of agricultural activities. If new activities are more profitable than growing rice, farmers may reduce their investment in rice production (for example, they would produce once a year only). These additional activities are significant; they allow securing their incomes. It gave a good idea of economical potential in this system. For Perera.L.R[68], "(…) paddy is not the main income-generating activity for most of the farmers" but she did not consider all rice growing seasons.

Main infrastructures (reservoirs, primary canal) are in quite good condition and functional; heavy work has already been made. Few things were lacking after the scheme rehabilitation (some gates, maintenance, etc.).

Commune chief and chairman (previous president of the FWUC) were involved in the scheme functioning (before the ISC intervention, they have already proposed rehabilitation projects for the canal) and showed willingness to improve it.

This scheme, located in the Kompong Cham province, is close to Kompong Thom where the ISC office is based; transports costs are limited.

The main advantage is the abundance of water resources. However, if these resources are poorly managed, some water users risk lacking water as long as they will begin to grow rice at the same time; this weak management is partially due to damage infrastructures. Farmers want to enlarge the irrigated area upon condition that the main infrastructures are rehabilitated. These works would have been done earlier if the farmers participated in the scheme maintenance; the participation in O&M remains a major problem in Pram Kumpheak[69]. When they selected it, farmers did not participate; there was no management once MoWRaM had built the main infrastructures.

The scheme (492 ha for the Lvea commune) is small and there are two independent reservoirs.

In the eyes of these criteria, this scheme had priorities. The ISC wanted to work with it because it showed all the necessary conditions to facilitate the ISC work.

- **Teuk Chha** was selected for similar reasons:

There are three rice growing seasons (DS, EWS and WS), soils are quite fertile and yields are high. Economical potential is also high because of the dependence on rice production (more than Pram Kumpheak). Most people do not have extra-agricultural activities compared with the second scheme.

The quality of infrastructures is fine even if maintenance has to be done.

The water supply potential is high thanks to the variety of water sources (ground water, small rivers).

The involvement of Boeung Nay commune Chief is good. Before the ISC intervention, he wanted to make a data base and collect ISF (in his commune where DS was cultivated).

The scheme is also located in the Kompong Cham province.

1.1.3 *Detailed assessment*

- *Technical system*

The field visits allows observing the **various forms of water mobilization** covering canals, identifying water sources (ground water, small streams, etc.) and their **availability**. To evaluate this

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[67] UPHOFF, N. 2004. System of rice intensification responds to 21st century needs. Rice Today, pp. 42-43. However, there are other definitions of SRI.

[68] PERERA, L. R. Factors affecting the formation of FWUCs in Institution building for PIMD in Cambodia: two case studies. 19p.

[69] Since MoWRaM built main infrastructures, farmers did not manage them.

availability in both schemes, the ISC team will have to measure the water storage capacity of the reservoirs and define the boundaries of the irrigation systems within a command area (see below for delimitation issues); the water control (reliability of sufficient water supply during specific periods) and the efficiency[70] of the distribution system have to be assessed.

In order to analyze and describe the system, it is possible to use a typology of irrigation systems (Deligne, 2010[71]), (cf. appendix 1):

Upstream water management systems	Downstream water management systems
- Stream and runoff (offstream) reservoir: **Teuk Chha** and **Pram Kumpheak** schemes	- Runoff control dam - Polder - Drainage canal - Flood protection dikes
- Lake and river flooding reservoir - diversion river weir canal - Prek, colmatage canal - Pumping station or mobile pumps -Micro-irrigation, borehole irrigation, manual lifting system	

Table 3: Main irrigation systems in Cambodia

The analysis grid below is a proposal to describe and evaluate infrastructures and water supply conditions (cf. table 4). A mapping system can be useful to draw a map locating all the infrastructures specifying their condition. After visiting the irrigation system, the team can propose a draft which will be validated by farmers.

	Good	Medium	Bad
Construction quality			
Construction functionality			
Respect of design requirements			
Control quality during the construction			
Monitoring after the construction			
Secondary infrastructure quality (if there are)			
Secondary infrastructure functionality			
Water distribution system			
Drainage system			

Table 4: infrastructures and water supply condition appreciation

To understand the technical system, let's go back in the **history of the structures**: Who built them? When? For which purpose? This work is based on semi-structured interviews in order to encourage people to explain their own story in the scheme. Some documentation about the scheme history will also be consulted.

A timeline can be drawn and validated later by farmers, during a village meeting for example. The timeline is used to stimulate the discussion on the changes affecting the community and the possible

[70] The definition of irrigation efficiency is, IE= (vol.irrig.water beneficially used)/ (vol.irrig.water applied-variation storage of irrigation water)x100

[71] Deligne, A. A typology of irrigation systems in Cambodia, pp. 9-17

causes. The initial question could be: “What are the most important changes in your agricultural practices (or agricultural practices of your family)?”

The format of this timeline could be the following one (cf. table 5):

Changes	Before French period	1953-1969	Civil war	Pol Pot 1975-1979	RPK UNTAC 1979-1993	MAFF 1993 1999	MoWRaM
Organization							
Agricultural system							
Hydraulic infrastructures							

Table 5: Timeline

In the future, another possibility is to use paper and post-it notes. The ISC has to choose a dynamic and charismatic facilitator to organize this work and encourage people to speak. He has to begin it by drawing a line on a paper and each participant has to write his ideas about changes on a post-it.

- ∝ *Activities systems*

Through this diagnosis, agricultural, non-agricultural activities, practices and performances will be studied thanks to field visits and interviews or meetings with focus groups organized by the ISC team (one focus group with representatives for each canal). It aims at understanding agricultural potentials and the dependence on these activities. Currently, there are few documents about economic analysis.

Main themes which can be addressed:

- Land resources. It seems interesting to identify families without land, those who work on the other plots of land and those who are forced to migrate. The area of every plot of land must be also listed to estimate the potentialities of investment of every landowner in the irrigation field. At present, a GPS study is in progress.
- Soil characteristics (fertility, retention capacity, etc.). Some lands are more fertile than others (variable fertility due to the soil quality and the plot location); the agricultural practices and yields can be appreciably variable from a farmer to another one, from a plot of land to another one.
- Rice growing seasons: the dry season, the early wet season, the wet season, etc.
- Irrigation plan and cropping calendar drawing it.
- Rice variety (advantages and drawbacks). The rice varieties are adapted to rice growing season and to soil characteristics. The choice of the variety can be linked to the fertilizers access (some varieties are more resistant to pests and often more expensive).
- Ecological constraints to rice production growth (presence of pests, weeds, etc.)
- Production results: yield variations. They can be due to the soil, climatic conditions, the scheme access and the agricultural practices.
- Rice price and its variability. If the price is low, farmers will reduce the investment in irrigation field and rice production will be replaced with other activities.
- Competition for labor availability with other economic activities (non-agricultural activities, rubber plantation etc.)

Indeed, concerning the last theme, we have to keep in mind that this diagnosis is not an end in itself. It is an essential precondition to study agricultural practices and understand them but it is limited to agricultural activities only. However, in rural areas, pluriactivity is a structural constant. It is

described itself as the practices of several professional activities done successively or simultaneously all along the year by one social entity (person, family, etc.) (Gasselin, 2008[72]).

It seems interesting to know the global distribution of working time and expenditures of these families: how much time did they devote to agricultural production? Do they do other activities? It would allow assessing their investment capacity in time and money in the agriculture and more precisely in the irrigation sector.

So, the team has to know how many families in the scheme generate additional incomes from off-farm activities and which kind of off-farm activities (garment factory works, construction works, groceries, selling labor on on-farm activities, selling labor on carrying firewood, selling labor in rubber plantation, milling rice, etc.). In order to evaluate their investment capacity, annual average incomes of the household interviewed must be calculated (riels/household/year). A calendar of activities can be drawn as well to observe the distribution of the activities year-round and compare it to the cropping calendar.

An example with the irrigation and cropping calendar:

The idea is to draw a calendar with farmers explaining their agricultural practices throughout the year (according to the rice growing seasons and their access to water) and their water needs. A simplified map of the scheme can be used asking them if they cultivate during early wet season and to locate their fields (cf. figure 13). The first step is to help farmers to locate their plots of land and get a global view (at the end) of agricultural practices in the scheme. This gives the opportunity to the team to make a global map locating rice growing seasons in each village and later, for each plot to identify water access for each part of fields, according to the network location (the field close to main canal, secondary canals, furthest fields, etc.). The objective is to coordinate the agricultural practices within the scheme or at least, along a secondary canal.

N.B: at the beginning of the meeting, facilitators and farmers have to come to an agreement regarding the calendar used (lunar or solar). The lunar calendar does not exactly match our solar calendar.

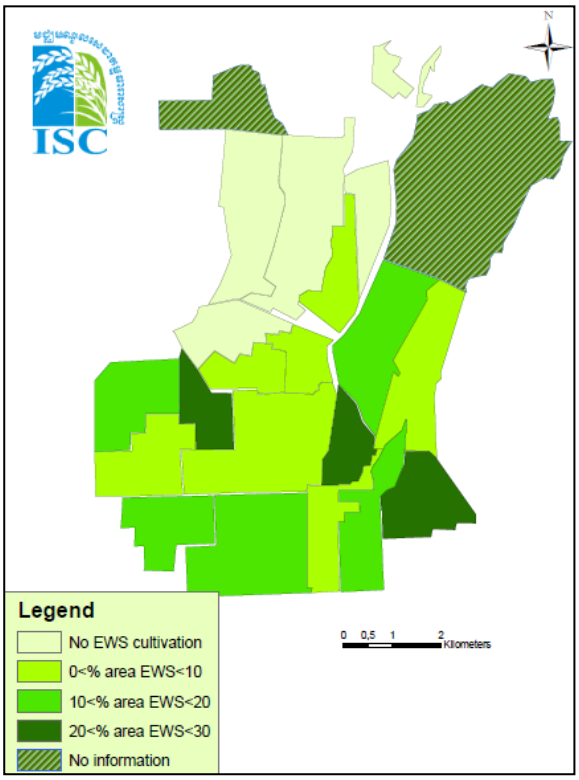

Figure 13: Rice growing during EWS
Teuk Chha Scheme- July 2010

∝ *Stakeholders and organization analysis*

To start the communication and the ISC intervention process, stakeholders who participate in the scheme functioning through the water sharing and management need to be identified. Another part concerns their involvement in the scheme organization through FWUC and other local authorities (village chiefs, commune chiefs, etc.). This work can be facilitated by using CISIS data base (even if

[72] GASSELIN, P. 2008. Diversité des approches systémiques sociales. Master 2R "Innovations et développement des territoires ruraux", INRA-SAD, UMR Innovation, Montpellier.

information is poor on this subject) and the new data base created during the internship describing stakeholders and a more detailed analysis of the **FWUC organization** (cf. appendix 13):
- FWUC details (date of creation, president (mandate), year of registration, any project assistances, FWUC bylaws, official statutes and people in the central office).
- FWUC activities (operational activities, internal rules and enforcement, water management rules, financial management, ISF collection, membership fee collection, maintenance, election, farmers participation, etc.)
- FWUC functionality (representativeness, transparency, autonomy in implementing its tasks, budget, gain the confidence of farmers, leader, etc.). There is no one methodology to assess something so subjective; however, farmers' interviews can be conducted by asking them directly for scheme or FWUC problems and weaknesses.

The service implementation also depends on **commune participation**. So, the team has to learn more about it making interviews with the commune chiefs. The emphasis will be put on coordination with local authorities (village chiefs, PDoWRaM, FWUC), their projects (if they have any) to improve the scheme functioning and if they are ready to participate physically and financially (commune budget available to support O&M or scheme development for example). The commune involvement for ISF collection, rules enforcement and conflict solving also affect the service implementation and the scheme selection.

The last step of this analysis aims at identifying **hypothetical conflicts** in the scheme (problems, causes, consequences, concerned people and location of the conflict).Some conflicts can be directly linked to water resources (lack of water in the dry season) while the others can be attributable to local policy, actors, etc. They may have also consequences on the scheme and FWUC management and affect the access to water.

Meetings in all the villages or individual interviews will be organized. Is it possible to share the water fairly between farmers in a scheme, without generating conflicts? Some examples of conflicts are advanced here (cf. table 6):

Teuk Chha	Pram Kumpheak
Overuse of water upstream (because there are no rules) Illegal opening or damaging of water gates or canal embankments (because there are no rules) Illegal blocking of canals (wood, stones, etc.) Illegal pipes or private pumps (consequences: the water level is lower for downstream fields) Some people steal water at night	
No respect of water gates opening timing	No, because there were no water gate operators
Conflicts with other activities for water level management in the reservoir (hydroelectric station, fishing activities, tourism, etc.)	
Illegal canal invasion by farmers (some people blocked a part of the canal to stretch their fields)	
	Conflict between private rights for fishing and local farmers' fishing free access (the ISC did not work with the second commune because there were private fisheries)

Table 6: Case studies, conflicts in irrigation systems

∝ *Water management and principles*

This last part aims at understanding:

- **Water flow** :
  - Technical viewpoint (water flows from this plot to this plot crossing this place)
  - Social and organizational viewpoint (water turn, water request, upstream priority, water supply from downstream, etc.)
- **Management principles** (rules and practices):
  - To interview farmers, local authorities
  - Are there some existing documents regarding rules implementation?
  - If yes, do they follow these rules?
  - What are their practices?

Once the rules and/or practices systems are identified, the ISC team has to observe their practical applications on the field.

- In theory, people have to follow this rule system but in practice, how do they do (we speak about practices and not rules)? How do they share water? Are there some conflicts because of water sharing? Is it individual or collective?
- To assess efficiency and sustainability of the rule system
- The informal decision-making process in water sharing by farmers, for instance, at household and community level has to be identified. Some decisions can be taken in places out of the meetings (for example, in the pagoda or on the market).

This detailed assessment made with mapping tools and other participative tools gives a global view of the functioning of the scheme and characteristics in relation with irrigation and agriculture. Maps are drawn by the team but need to be validated by farmers. If there are some mistakes, the team corrects them and suggests another validation by going to the field, and so on (cf. appendices 19 and 20). Once this diagnosis is realized, the process of acceptability and legitimacy is started.

1.2 Service building, validation and implementation

1.2.1 *Strategy discussion with the ISC*

Once the scheme is selected, they speak together about the strategy to follow for the service formulation and implementation; it is an analysis step. More than a brainstorming, it is a **pooling of information** from the field. Four **categories of services** can be proposed by the ISC:

- Creating, reactivating new FWUC and/or FWUG (Teuk chha and Pram Kumpheak). This service is almost achieved in Pram Kumpheak.
- Capacity building to FWUC. It means the FWUC exist but they are still weak in some sectors and need ISC knowledge and capacities to strengthen their functioning. This kind of service was proposed to Teuk chha and Pram Kumpheak.
- FWUC support in contract with communes and clients. The FWUC outsources services which are not worth being developed.
  - For example, in Sdau Kong (an irrigation scheme under contract with the ISC), they need financial support but cannot afford to buy an accountant; they resort to the ISC team for few days per month. Services are implemented for the FWUC.
- Project team support.

These services are offered to **two different clients**:

- The commune or the FWUC (if it is functioning). The ISC works directly with the FWUC in three irrigation systems: Prey Nup, Stung Chinit and Sdau Kong. In Pram Kumpeak, once the FWUC is autonomous, they will work with it (currently, they work with the FWUC and the commune); in Teuk Chha scheme, they work with the commune considering the FWUC is weak, without authority. Nevertheless, the implementation of services needs MoWRaM and PDoWRaM approval.
  - Supports are proposed as one goes along FWUC needs.

- A project (NCDD in Stung Chinit East, Japanese project in Mondulkiri province). It corresponds to investment contracts but not a long-term FWUC support.

1.2.2 *Diagnosis presentation*

Once ISC analyzed diagnosis results, they formulate the **proposal**; then, the team goes to the field, organizes meetings with local authorities (commune chiefs, village chiefs, PDoWRaM) to explain to them the analysis and the results of the study and waits for the reactions (validation, refusal, suggestions). This step is **semi-participative**.

For example, the ISC proposes a service to re-activate the FWUC and solve existing problems. They ask the participants if they agree and to formulate their priorities. After that, the ISC details the proposal according to their main priority. This step is used to validate the service need.

If they refuse the proposal, the team has to work again on it and come back to the field to submit the new one. At the end of this process, two service proposals were made, in Teuk Chha and Pram Kumpheak schemes.

1.2.3 *Complete and formal proposal*

When the local authorities validate the proposal, the ISC team works on its **formalization** with the different steps of work implementation. Once service process is clear with the **detail of the costs**, they come back to the scheme to present the results and the complete and formal proposal. It is a step of **negotiation**. If there are some problems or disagreements, the proposal can be worked on and proposed again to the local authorities. Then, they make explicit work logical to farmers.

A tool which can be used to facilitate the **comprehension** of the service logical reasoning is the **problem tree** and **objective tree**[73]. It is not used to find answers but as a participative tool within the team (to understand issues and work processes) and with the farmers to explain to them the work to implement before beginning or as soon as they start it (for example, one idea is to use this tool regarding water management and the implementation of water sharing principles with the advisory committee). These tools can be used to spark off the exchanges on the encountered problems, simplify the analysis of the consequences and try to find solutions and possible actions.

1.2.4 *Participative tools to facilitate the comprehension*

The objectives of the problem tree are to identify a central problem, its effects and its causes (Demante, 2007). The objective tree aims at identifying the solutions to solve this problem and reaching an agreement as regards the necessary actions. Usually, these tools are used during the project implementation to encourage people to participate. It seems interesting to use it at the beginning of the project as a pretext to make the service proposal and implementation clear for the ISC team, for local authorities and farmers during a meeting among professionals or non-professionals. It can be used as a **project clarification tool**.

[73] IRAM. Renforcement des capacités des acteurs du développement locale et de la décentralisation / éléments de méthode pour la planification locale.

∝ *The **problem tree** - To look for the main problems:*

The ISC team can organize an internal meeting, a kind of brainstorming[1], categorizing the causes according to the problems. For example, there are several categories to classify and facilitate the problems analysis in a scheme:

- Agricultural and economic context
- River basin water management and environmental issues
- Water availability inside the scheme
- Design and construction quality
- Land issues
- Farmers' participation / scheme appropriation by farmers
- FWUC institutional building
- FWUC Human Resources
- Financial resources mobilization / ISF collection
- Resource allocation / financial and administrative management
- Maintenance
- Water management and operation within the scheme
- Internal rules enforcement
- Conflict with non agricultural activities
- MoWRaM / PDoWRaM
- Local Authorities

The ISC team tries to analyze the existing problems in each category and evaluate each one (serious problem, minor problem, problem already solved); after, they go to the field, organize a meeting with the FWUC and stakeholders and show them the work results.

In Teuk Chha scheme, one problem is poor water management. There is no clear water sharing and farmers try to adapt to this lack of water sharing principles. That is why, the ISC proposed a service to help them to improve water management. The steps of this work will be detailed in the second part. The main consequences are conflicts, waste of water and the infrastructures being damaged

Work implementation:

Step 1: To constitute a reflection group.
Step 2: To think, within the group, about all the main issues identified during the assets and constraints analysis. The group has to debate and decide which one is the first problem to examine.
Step 3: The facilitator draws a tree and writes the problem on the trunk. If one wishes to examine more than one problem, it will be necessary to draw a tree per problem.
Step 4: To ask the following question: What are the causes of this problem?
Step 5: Starting from the trunk of the problems tree, the facilitator, in charge of the drawing, makes a line and writes the first cause that constitutes the first root of the problems tree. He makes in the same way for all the causes.
Step 6: Once causes chain is realized, the group has to think about the consequences of the problem which constitute the branches of the problems tree.

∝ *The **objective tree** - to think about the objectives to reach in order to solve problems*

Step 7: Considering the problems tree as a model, the group has to reverse all the problems in order to change it in objectives. You get an objective tree. The objective is located at the center of the trunk. The objective at the center is the opposite of the problem identified previously. Roots are the different levels of the "under-objectives" and actions which allow reaching the central objective.
Step 8: After that, the participants have to discuss to know which under-objective can be reached.

Restitutions and debates are parts the last step. Each group has to present their results to other groups. The aim is to compare the groups analyzes, summarize the main problems and the solutions proposed to solve the problems.

N.B: Both trees give an overall view on the links between causes and effects. However, it is necessary to remember that it is a simplified vision.

1.2.5 *PDoWRaM approval*

It is essential to validate the project and then, recognize the ISC legitimacy. If local authorities (district, provincial department) agree, then, the ISC can work on this scheme and the contract with the commune can be signed.

Further to communes' decentralization, a new role was given to local authorities. This service proposal has a cost and even if they do not pay the entire service cost, they have to approve it to start the service implementation.

Services are subsidized by **European** and **DPO funds**. The ISC service costs are **subsidized prices**. Once the project support ends and the ISC is autonomous, it has to take care of those services costs, communes and FWUC members will have to pay the actual price.

At present, participation is possible thanks to the membership fee which involves local authorities, farmers in the service implementation and increases opportunities to succeed. However, according to Ostrom's principles, a person will pay for a service if and only if their profits are proportional to investments. It is too early to know if water users will benefit from these services.

An **assessment** on the first services provided by the ISC was made by the team with Pram Kumpheak village chief; this report is very general ("results were achieved", "we notice the farmers' interest for FWUG implementation", farmers who did not pay membership fee are "poor and behind in membership fee payment") and does not show the effective results of the services. Needless to remind that the specific objective of the ASIrri project is to "develop, test and sustain follow-up systems and services to water users in order to reach a sustainable operation of irrigated areas"; but, if economic results are not satisfactory[74], *how could this service be sustainable*? It seems necessary to develop several **economic assessments** with the farmers at the end of every service and one year later, for example.

This service implementation process is different from other international projects in charge of scheme rehabilitation or construction; in that case, it is often the organism which entirely financed the project including main infrastructure construction. Afterwards, a follow-up limited of a project may be done but the question of financing still remains.

In ASIrri project, the objective is to economically sustain the service center giving up the "project formula": the idea is to give all the skills to the team to become a permanent association and be independent. But, to make it, the ISC **requires payment.** Service prices are calculated according to salaries, the ISC running costs and number of working days sold, all costs included except transportation. FWUCs need external technical support from outside organization in the long run but there are no external organizations able to answer their practical needs at a reasonable cost. The ISC proposes services to **build up knowledge and capacities** and sustain human resources in the long run.

Out of DPO and European funds, the ISC has to be economically independent thanks to:

- **Irrigation Service Fee**
- **Membership**: it is a legal requirement to establish a FWUC. It is paid only once by the members and collected only at the FWUG/FWUC creation or before election. Its amount is fixed according to members' capacity and it is paid according to the farmers own wish to participate.

[74] Profits will be superior to the investment (cf. Ostrom's principles)

According to the **government policies**, "farmers who want to use water for cropping must apply for membership in the FWUC and agree to pay the water fee fixed by the FWUC."(Prakas 306 (2000), Policy for Sustainable Operation and Maintenance of Irrigation System, Article 2.3.5). However, it is never applied (except for Prey Nup and Stung Chinit schemes). Besides, there is no obligation to pay this fee.

- **Financial support from the commune**. The responsibility for repairing major damages remains with the PDoWRaM; the commune is in charge of repairing the rest of the damages.

The main purposes to encourage farmers to pay membership fee and organize a membership registration are:

- To measure **farmers' motivation for participation** in FWUC management. It is a proof of the farmers' commitment to manage their scheme in the long run and then a way to attract outside funding,
- To provide **authority** and **legitimacy** to the FWUC for implementing decisions,
- To ensure that farmers are **ready to collaborate** in the ISC service implementation,
- The ISC own procedures require the **payment of the service**.

The minimum level of participation to go on working with the FWUC is **67** per cent**.** Indeed, this figure comes from legal decision making in FWUC statutes (Prakas 306), defined by the MoWRaM[75]. If there is less than 67 per cent, the ISC team stops working.

The membership principle allows calculating this level of participation; farmers can accept or refuse to be members. The interest to become member is to share its ideas regarding FWUC and scheme management. A nonmember has no option but to accept some changes opposite to its needs and its will. In the FWUC status, article 8, every farmer member can express opinion in a meeting and about the FWUC Committee, vote and be elected in the FWUC. However, their obligations are the same with members: they have to pay ISF (if they get water) and to respect internal rules.

This fee as to be considered a starting fund to cover FWUG functioning costs as, for example:

- Incentives for FWUG representatives and staffs
- Small maintenance and repairs
- Election costs
- Members assembly organization

2 SERVICE IMPLEMENTATION METHODOLOGY

Whatever the scheme considered, there are already practices, individual or collective, that are different from rules. **Practices** mean the daily activities implemented in a scheme, for example, to get water; there are not formalized but needed to be studied in order to understand the social organization and propose an appropriate regulation system.

In the Teuk Chha scheme, under the Prasac project[76] which was a project of European Union that started in 1999 (creation of the first FWUC) and stopped in 2004, **constitution and bylaw** document was written. It represents an **official recognition** of the FWUC by MOWRAM. It defines **constitutional rules** but says nothing regarding operational rules, which correspond to day-to-day activities.

Even if this document is conserved, nobody knows the contents nor refers to it. Therefore, in this scheme, there are no concrete organizational structure and ruling system. Why were these regulations not enforceable? According to some people, the process to obtain these regulations was planned out with the local authorities only. The discussion step with the farmers was skipped

[75] « Every meeting should be attended by at least 2/3 of the members". "The vote can be conducted when the members present at least 2/3 of the total members. If less than 2/3 of the members are present, the vote cannot be conducted (…)."

[76] The Prasac project began in 1995; it delivered about 80 million Euros, in aid to the people of Cambodia and was implemented in 6 southern provinces. Its support concerns irrigation, agricultural extension, community development, business development and credit. Since 2003, the European Commission has continued to support the transition of the PRASAC Credit Association to a fully privatized MFI (http://www.prasac.com.kh).

whereas it is essential to involve the farmers and make them validate the process before implementing it. However, this book must be preserved as it is for the recognition it provides.

These mistakes have to be remembered in order to avoid them next time. For that reason, the ISC team wants to give priority to the farmers' involvement in the process definition and implementation to make it sustainable.

In both studied schemes, two different **decision-making processes** were implemented. They do not start from the same authority level.

- The first one, **upward process**, starts from the lower authority level: the FWUG which includes farmers along a secondary canal. This gives them the opportunity to make decisions regarding a secondary canal (canal B) and submit the proposal to local authorities, the advisory committee composed of influential people (cf. figure 14).
- The second one is the **downward process** (cf. figure 14). It starts from the local authorities (commune, provincial department, FWUC or advisory committee through service proposal); they have to make decisions. After that, the information comes back to the farmers to validate it. It concerns water sharing principles.

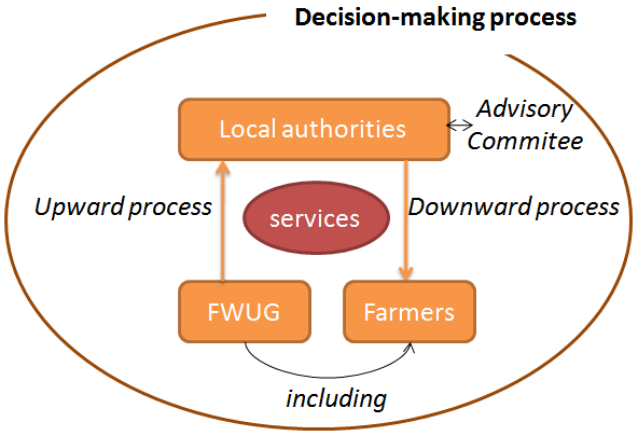

Figure 14: decision making process through ISC services

The **upward process** allows strengthening **collective choice**, **participation** and **legitimacy** and the **downward one** ensures **authority**, **legitimacy**, **credibility** and **decision-making**. Teuk Chha and Pram Kumpheak cases allow clarifying both processes.

In Teuk Chha, one service concerns the creation of an advisory committee to improve water management along the main canal. The second one aims at a FWUG creation for the canal B.

In Pram Kumpheak, one of both services is similar: the FWUG creation for the irrigation system on Lvea commune (there are two communes but contracts were signed for only one). FWUG creation provides legitimacy to a lower authority level (according to the scheme scale) to make decisions and submit it to advisory committee. However, the decision-making process for the FWUG creation is different because it is made between FWUG and FWUC (plus Lvea commune).

Before developing the services implementation in both schemes and rules categorization, we have to clarify the terms linked to water sharing principles. When we speak about ruling system, we define three categories of rules: operational, water management and internal rule enforcement (cf. table 7). The first step of water sharing system concerns the first two categories.

1. Operational rules	2. Water management rules	3. Internal rules enforcement
Practically, how to do to ensure water reach one place? Duration? And reliability? Are they sure to have access to water.	i. To ensure water sharing ii. To adapt agricultural calendar according to farmers' needs.	Rules which concern all the activities realized on the scheme (out of irrigation activities) – fishing, livestock farming, etc.
Opening and closing gates by water gate operators for instance	- Irrigation and cropping calendar - Water turn - Water request	It is forbidden to fish into the canal (example). It is often costly.

Table 7: rules variety in irrigation systems

This document aims at proposing a process to implement rules regarding **water management** and **operational rules**; it is water sharing principles process. The third category "Internal rules enforcement" is not the subject of this report and is not included in the service proposal. In Teuk Chha scheme, there is not internal rules enforcement. But, in the future, in case of conflicts or scheme deterioration, it will be essential to implement these rules, in an autonomous way by farmers and/or local authorities or by a service implementation.

The process starts from a field test, followed by an adaptation process in case of problems. The objective is to facilitate the **adaptation** of the intervention process **by trial and error**. Before beginning, it seems important to differentiate two notions: **equity** and **fairness**. Water sharing refers more to **acceptability** according to the **local norms** than to equitability. It is not possible to work in the scheme and ask the farmers to change their practices in order to yield one part of their access to others farmers who are disadvantaged. In the Pram Kumpheak irrigation system, some farmers own good field location close to the main canal; thanks to it, it allows them to cultivate in EWS; it is an economical advantage for these people who cultivate twice a year while other farmers are no so advantaged and cultivate once a year (WS). However, as for farmers interviewed, this informal right to get first water is not put into question.

In Cambodia, there is no definition of farmers' rights for the water access in an irrigated system; water resources belong to the State. After the capital goods decollectivization, following the Khmer Rouge period, land were distributed, more or less at random, to families; some of them were privileged and acquired land upstream, close to the network.

This service implementation may modify the permanence of water access. If the ruling system is organized and approved, all the farmers will have to respect the new system of water distribution (on demand or rotational system); it means forbidding the individual installation of pumps or pipes and gates closing when the access time is ended in order to preserve water for downstream farmers.

2.1 Rule levels and connection

According to Ostrom's definition, there are three kinds of rules:

2.1.1 *Constitutional rules*

They represent the **framework of the ruling system** and they define who is eligible to take part in rule-making, the decision process and modification process. They refer to rule formulation, governance system, leaders' mandate and election process. It allows defining the **organizational structure**. Once these rules are formulated, they can propose and define collective-choice rules.

2.1.2 *Collective-choice rules*

They define "individuals, affected by the harvesting and protection rules"[77], belong to a group which can modify these rules.

To implement fair water sharing principle system, leaders have to decide with the farmers' agreement to define these collective-choices rules. They are at **the base of daily decisions** implemented by the farmers, their representatives or by the external authorities.

- What will be the **contents of the ruling system**?
- **Who will implement** the rules (FWUC, advisory committee)?
- **Who is in charge to make the rules respected**? (Current staff In Teuk Chha with the possibility to hire somebody (policeman) in case of unsolved conflicts).

For example, they have to decide:

- If they want to collect ISF, who is going to pay, how much, who will collect the ISF, etc.?
- If an irrigation plan is necessary and if they prefer to organize water turn for the entire scheme, for one part (secondary canals) or keep the water requests system.
- What are their priorities in terms of irrigation?

As regards the advisory committee, **there are no making collective-choice** rules because the way to make collective choice has not been defined by constitutional choices. The objective is to test, to see which principle is the most adapted to farmers' request; once the decisions are made by members, it is possible to speak about collective-choice rules. Generally, it is **the last step of implementation rules** (cf. figure 15).

Then, collective-choice can be discussed within each group. However, after taking individual decisions, stakeholders groups have to discuss together and check that decisions do not have pernicious effects on other groups. The ISC team has to follow each meeting.

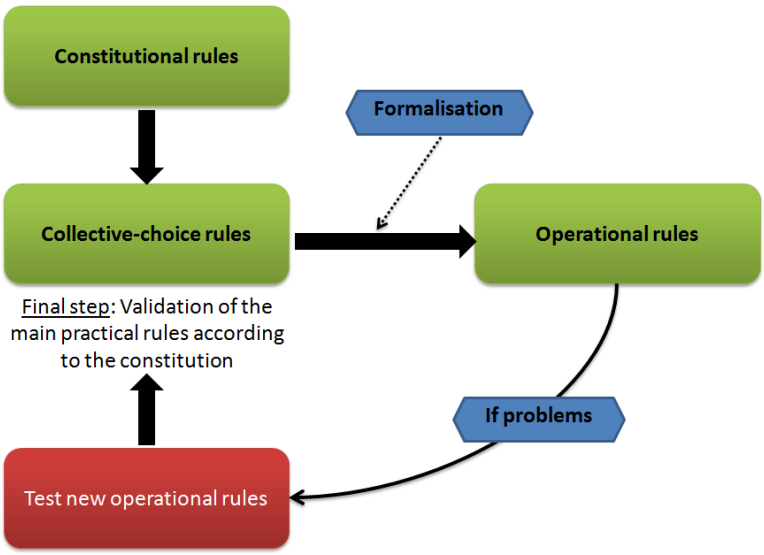

Figure 15: rule connection

[77] OSTROM, E. Understanding Institutional Diversity (New Jersey: Princeton University Press, 2005), 259p.

2.1.3 *Operational rules*

They govern the **daily decisions** of the users and the technicians and have been devised and modified over-time according to a set of collective-choice rules[78]. When, where and how to distribute water? Which information must be exchanged? Which rewards and sanctions correspond to the transgressions?

If the objective is to implement a three day water turn for each secondary canal (it was proposed at the beginning of the service implementation in Teuk Chha scheme), what are the means to encourage people to respect it? How to disseminate the information? Is it approved by all the stakeholders? Is it understood by all the farmers?

According to Ostrom's[79] study, some **incentive structures** have to be considered to ensure compliance:

- Rules are **realistic**. With regard to water turn, it has to be adapted to the water request and to the irrigated area. If it is not the case, farmers could not respect it and rules will automatically be rejected. In time, some alternatives have to be proposed,
- Rules are **legitimate** → they are accepted by the stakeholders even if they can be restrictive,
- Farmers have to be convinced that rules will provide **an interest** in the short and medium-term,
- Rules have to be **clear** and **understood** to avoid the debate and wrong interpretations,
- The process of adjustment is **continuous** (a scheme evolves, changes) and so, answer to requests,
- The rule implementation is **not too costly**,
- And **sanctions** have a sufficient **cost** (to incite people to respect it) and are graduated. It depends on the seriousness and context of the offense[80].

For instance, when some rules are decided, it is essential to test their realism on the field and to notice the practical problems to implement them.

The last step for these rules is to **formalize** them and **disseminate** the information (Cf. table 8) (meetings, new rules on board, newspaper radio, etc.) and write a draft with the rules and corresponding fines will be applied (even if informal rules are still there). The following table shows water turns for each canal. In order to respect it, this table has to be visible to be known by water users.

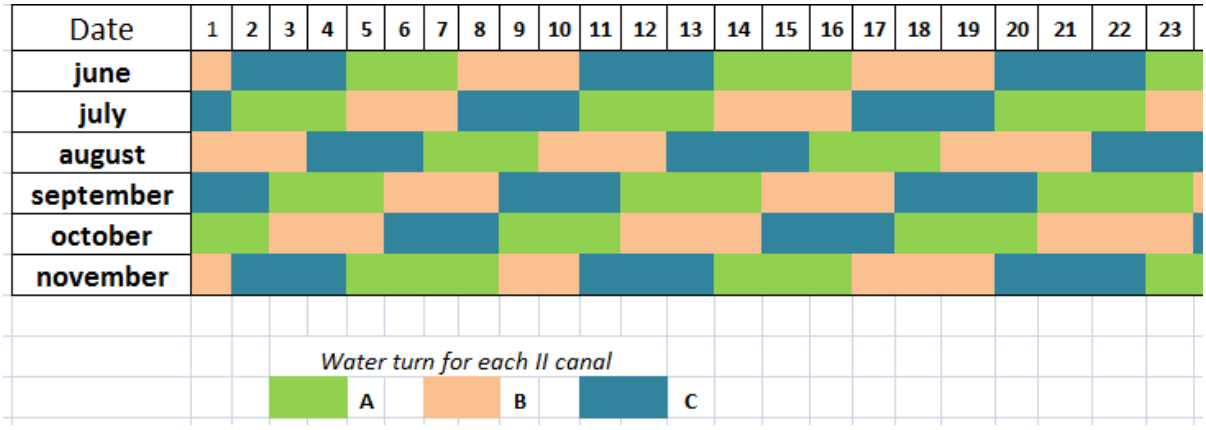

Table 8: Water turn in Teuk Chha scheme for secondary canals

[78] KENNETH, A. SHEPSLE. 1989. "Studying Institutions: Some Lessons from the Rational Choice Approach," Journal of Theoretical Politics 1, no. 2.

[79] OSTROM, E. 1990. Governing the commons. The evolution of Institutions for collective action. Cambridge university press, 280p.

[80] OSTROM, E. Understanding Institutional Diversity (New Jersey: Princeton University Press, 2005), 259p.

The following table shows some **regulations** regarding the **sharing of water** in Teuk Chha scheme; it has been **proposed to the ISC team** as an **example** (cf. table 9). The idea is to explain to them how and where regulations can be created:

- A formalized regulation on paper with an official document; this contract has to be signed between two groups (employees and FWUC or advisory committee for Teuk Chha).
- A formalized regulation approved by local authorities; it is visible by everybody through a book, report, on a board for instance.
- A regulation can be decided during a meeting without real formalization; it can be just approved by the majority.
- An informal regulation can be decided among few people, without official document and without representativeness (for example, a small group of farmers decide to open this gate to get water along canal B tomorrow without consulting other farmers' water users).

The **sanction** has to be decided at the same time the regulation is decided. The formalized sanction is visible and well defined (this fault involves this sanction). Sometimes, it is difficult to quantify a fault, so a meeting has to be organized between local authorities (and leaders of the FWUG, in the future) to judge the fault and find together the corresponding sanction. Generally, for the first three sanctions, it is possible to propose the sanctions in an ascending order (1 → 2 → 3) and for the next ones, it depends on the committee's decision.

The **control system** can be official or unofficial. Even if the control is decided during a meeting, the effectiveness of the control depends on control legitimacy and controller influence (if the water gate operator has no charisma or if he is corrupted, no one will respect him). So, there are several levels of control: the no-control level (nobody checks the rule respect), the water gate operator control, the advisory committee or if there are no strong FWUC and no water gate operator, it can be village chiefs.

It has to be reminded that **practices and operational rules are different**; practices are an adaptation to formal rules; they are informal and have to be studied on a case-by-case basis. Operational rules are defined, formally or informally, by the FWUCs.

Poor water management encourages farmers to develop individual practices to get water. *What to do to transform practices into formal rules in agreement with field reality?*

The rules for WS 2010	Support	Sanctions system	Who is in charge of control system?	Report to?
Don't install pipes without permission	Formalized regulation	2	Water gate operators	FWUG → FWUC→ Commune
Don't open and close the gates, canals and culverts without permission	Formalized regulation	1	Water gate operators	FWUG → FWUC → Commune
Not unauthorized operating of culverts	Formalized regulation	1	Water gate operators	FWUG → FWUC → Commune
Do not damage/obstruct the structure, culvert plate or lock	Formalized regulation	2	Water gate operators	FWUG → FWUC → Commune
Necessity to participate in the maintenance of the embankment	Meeting decision	3	Village chiefs / Commune chiefs	FWUG → FWUC → Commune
Do not fish into the main canal	Formalized regulation	1	Water gate operators	FWUG → FWUC → Commune
Do not block water into the canal (wood, trees, etc.)	Meeting decision	1	Water gate operators	FWUG → FWUC → Commune
Don't destroy check structures	Formalized regulation	2	Water gate operators	FWUG → FWUC → Commune
Respect the water turn (and prevent people from giving backhander)	Meeting decision	1	Water gate operators / village chiefs	FWUG → FWUC → Commune
Etc.				

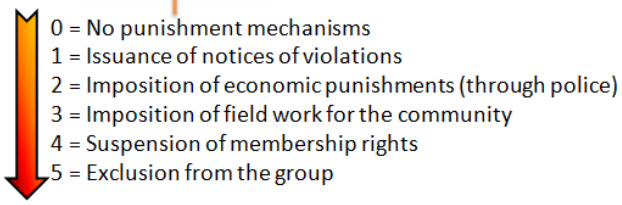

Table 9: examples of rules for WS 2010

2.1.4 *Rules adaptation process*

One single rule cannot be adapted to all the situations. So, for each irrigation system, rules will be defined according to the **specific context.** The eight principles of Ostrom[81] remain probably an interesting guide to implement a **constitutional structure** in an irrigation system. It focuses on finding the conditions to make these organizations independent. The first of Ostrom's principles is about clarity of individual rights to water within the organization. This is similar to the question of membership in a scheme: definition of members' statute, members' rights and responsibilities, financing. When the membership question is clarified, these members must in most cases be helped to draft a constitution and a set of rules.

A farmers group is likely to have its own special objectives, different from another irrigation system; so, unlike Prasac's book, every new ruling document should never be treated as more than a basis, to be modified in discussions through the preparatory phase. Therefore, an adaptation process (cf. figure 15) has to be planned. It allows keeping flexibility to adapt rule frameworks, to meet future changes of objectives and of external context.

[81] OSTROM, E. 1992. "Institutions and Common-Pool Resources: Editor's Introduction." Journal of Theoretical Politics 4, pp: 243-245

2.1.5 *To strengthen the ruling process proposing mechanisms to deal with conflicts*

The conflict-resolution mechanism is one of the criteria developed by Ostrom for robust Institutions. It means that users and local authorities have rapid access to low-cost local arenas to resolve conflicts among farmers or between farmers and local authorities[82].

It seems essential implementing a rule system quite flexible in case of conflicts and giving farmers the opportunity to solve it. Conflicts resolution mechanisms have to be implemented by farmers themselves with the ISC team support, at the beginning. To identify the conflicts between farmers, water gate operators write reports to the advisory committee coming from the field. After getting it, **meetings** with farmers, the advisory committee and the ISC team, as a meeting facilitator to solve the problems, could be organized.

The sustainability of water sharing principles depends on these mechanisms. Seven steps have been identified to solve the conflicts:

- Ways of understanding conflict: definition of a conflict, varieties of conflicts, origins, etc.
    - Some causes of conflicts: competition for the resource when farmers are located far from the canal, unequal power or authority, incompatible objectives, communication breakdown, opportunistic behaviors, organizational problems, etc.

- Typology of conflicts, useful to anticipate them. It also raises awareness regarding the complexity and diversity of conflict. Mechanisms to deal with conflicts: traditional methods (discussion, informal process) / legal process (provincial level for example) / local process with the farmers, try to incite their participation and make decisions together.
- To anticipate latent conflicts and analyze conflicts: to identify previous conflicts about water in the scheme, between groups of farmers or for other purposes. Realize a timeline with previous conflicts in the schemes concerned. Then, identify and analyze roles and responsibilities of stakeholders (to resume former results) and identify the roots of conflicts.
- Developing a strategy for conflict resolution.
- Advantages and opportunities of conflicts: re-enforce the positive aspects of conflicts and encourage participants to face up to conflicts instead of avoiding them.
- Closing Session on Conflict Management (to clarify any unanswered questions, return to discussion points).

2.2 **FWUC reactivation in Pram Kumpheak irrigation system**

2.2.1 *Service proposal*

To improve water management in this scheme, its maintenance, and extending the double cropping area (early wet season and wet season), the ISC proposes to encourage farmers' participation and financial contribution.

The service aims at creating FWUG, one per reservoir (FWUG1 for the Kbal Hong Chas reservoir including three villages and FWUG2 for Phum Bey reservoir including also three villages) under the FWUC organization. FWUG allows reviewing internal rules and organization in this scheme. The existing FWUC will have to:

- validate FWUG management procedures
- solve conflicts between members and/or between FWUG
- Control financial management, ensure transparency.

Each FWUG will be provided with a draft of Internal Rules including statutes (for instance, membership registration rules, committee selection, and general assembly organization).

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[82] OSTROM, E. Understanding Institutional Diversity (New Jersey: Princeton University Press, 2005), 259p.

The team chose to begin the work with this scheme. It is smaller and there were not big problems; the service implementation seemed to be easier. So, they created two FWUG (cf. figure 16). After implementing it, they went on working on the Teuk Chha scheme in order to build also a FWUG but we will see that, according to the scheme size and functioning, the work was quite different.

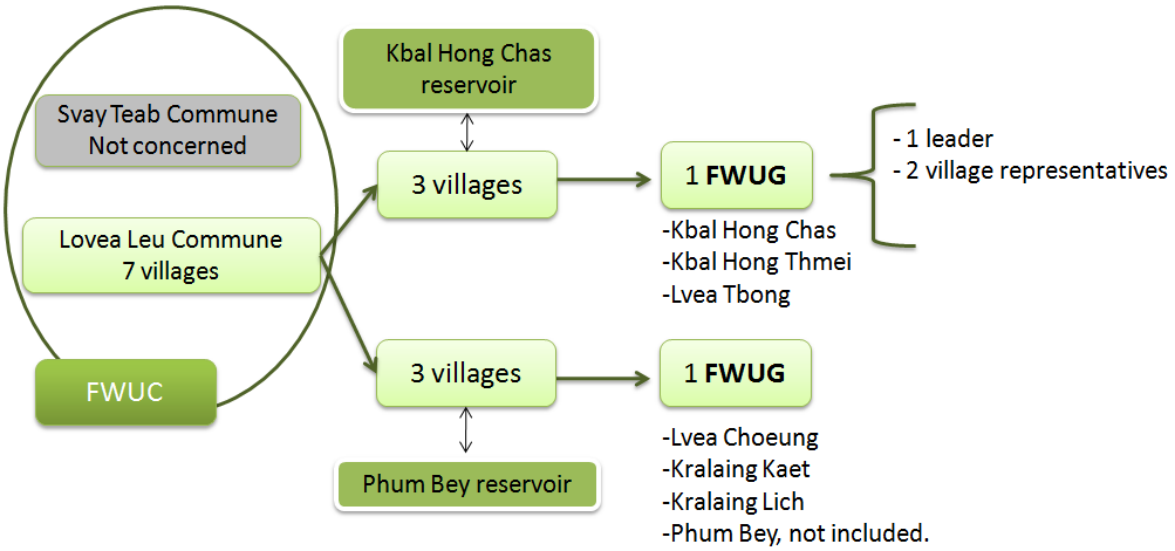

Figure 16: FWUGs in Pram Kumpheak FWUC

2.2.2 *Objectives*

The first service proposal in this irrigation system aims at setting up **constitutional rules**. There are several objectives implementing these rules:

- To define the **irrigated areas**: where are the fields located? When do they irrigate their fields? What do they cultivate? Which part of the canal do they use?
  - The specific objective is to define, in the future, an **irrigation plan** to save water and try to supply water to farmers' groups which have a similar cropping calendar and use water from the same outlet (and from the same canal).

- The team wants to secure the water access. The objective is to collect ISF later and adapt the amount to pay for water access. The more you have access to water throughout the year, the more you have to pay for the ISF.

- To analyze the **farmers' participation**: who is involved in the process? The **membership fee** collection is based on this participation.
  - Issue: the membership fee collection could facilitate the irrigation system **delimitation** thanks to the farmers' census and theirs fields location.

2.2.3 *To act on individual practices to solve current problems*

Water shortages and poor deliveries of water encourage farmers to develop **individual practices** which are difficult to control and limit. However, it is essential to identify them, try to understand them and to study the impacts of these practices on water sharing.

According to the farmers, this small scheme faced this year a decreased rainfall; some farmers developed **new strategies to get water**, to the **detriment** of their neighbors.

Some farmers, often close to the main canal, installed **pumping systems** to irrigate their fields reducing the rate of water flow downstream. They are located on the embankment and easily removable. Others installed private **pipes**, check structures in the main canal or **dug small canals** to "secure" their access to water. Finally, the problem comes from few **infrastructures in bad condition** developing selfish behaviors. Indeed, some parts of the main and secondary canals are too shallow and prevent the water to flow. Besides, some gates are broken or without lock reducing the control

to zero. Therefore, some farmers came to open the gates in case of water need without asking the permission to the FWUC president. Once their fields are irrigated, some people forgot to close it increasing the water shortage. *How to implement water sharing principles if the network does not allow a good access to water while there is water?* In the Phum Bey reservoir, the canal connected to the main gate is higher than the beginning of the reservoir; it makes the water circulation impossible and so, it needs to be dredged. Besides, fields, close to the main canal connected to this reservoir, have no embankment increasing the waste of water. *How to involve the farmers in order to solve these technical problems? Is the water shortage responsible for "**anarchic**" and **unfair practices** to get water? How to implement water sharing principles and a control system in the Pram Kumpheak scheme?*

2.2.4 *To improve access to water and implement water sharing principles*

- To solve technical problems:

Several construction and rehabilitation works were undertaken this year. The PDoWRaM technicians were in charge of the works (cf. figure 17), under contract with the ISC and after consultation with the farmers. They:

- Built one culvert (between the main canal and the secondary canal) and one check-structure within the main canal in order to increase the water level. (cf. figures 18 and 19)
- Rehabilitated Phum Bey water gate (the water control was not carried out) and a tri-face structure (between secondary canals) (cf. appendix 16). This reservoir is covering about 5 ha with permanent water flow from high land area (cf. figure 20).
- Laid stone at the Kbal Hong chas water gate for 15m long, 4.5m in height. The reservoir has one outlet with two gates, still good functioning (cf. figure 21). However, the wall stone is not strong enough; there is a risk of collapse for the structure, weakened by the infiltration.

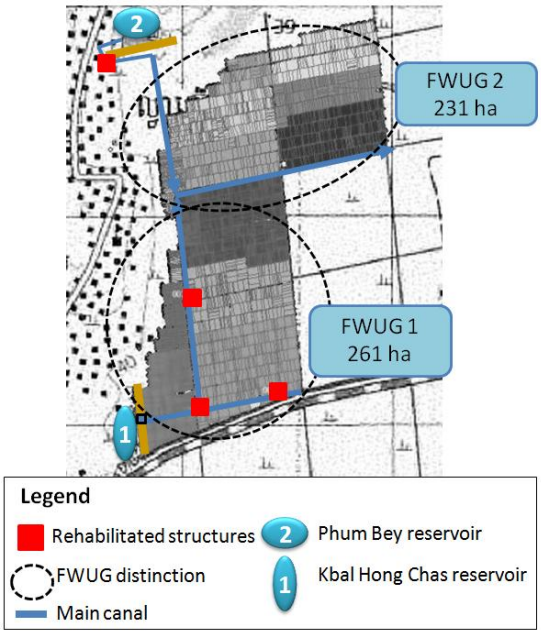

Figure 17: Rehabilitated structures in Pram Kumpheak scheme

The main objective is to make water control easier and then increase rice yields. Currently, DS rice is not developed; with these infrastructures, it could be possible to cultivate thrice (EWS, WS and DS) for those who produce twice a year.

Figure 19: Check-structure in Pram Kumpheak

Figure 18: Culvert (II canal), Pram Kumpheak scheme

Figure 20: Phum Bey water gate

Figure 21: Kbal Hong Chas water gate

The canal, connected from the Phum Bey reservoir to the Trapeang Chrab secondary canal, was shallow, small and blocked by weed. It needed to be dredged for about 1,400 meters and financed the work by collecting money in the three villages concerned. The beginning of the WS 2010 shows low rainfall; Phum Bey reservoir was empty and farmers had to wait for precipitations to start the rice cycle.

The infrastructures were not built or rehabilitated very well: some materials are too permeable to water (Kbal Hong Chas reservoir) or not strong enough (Phum Bey gate). Meetings should be organized before beginning a construction in order to agree together, local team and technicians, on materials to use and their weaknesses (according to the price).

- To implement water sharing principles, the **test period**

The first step of the work was to form **two group leaders**. Both are village representatives at the same time. The ISC team asked them to **control the water level** in reservoirs (they are paid by the FWUC for this task), to clear the canal (check-structure, pipes, trees, weeds, etc.), to close the pipes and gates in order to make the water level higher and wait for the **water requests** implemented through the first service. Indeed, this water supply system was **tested during one month** to know well the water circulation and associated problems.

The group leaders work as **facilitators** answering to water requests. Information they need to collect is: area to be irrigated, irrigation duration, the irrigation-seekers identification, canal used, etc. The **water request process** to follow is:

- Farmers have to request water from their village representative[83]
- The village representative has to submit the proposal to the group leader
- The leader of the group has to organize the meeting with village representatives[84] involved to decide if they have to open or close the gates
- The group leader has to report this activity to the FWUC president
- The group leader and the village representative have to implement the task according to the decision which was made in the meeting
- Check the process of water sharing and water circulation and see if the water supply is effective and necessary according to the number of days they ask for.

They have to solve the current problems to share available water resources fairly. Once technical and organizational problems are solved, it will be possible to implement collective-choice rules regarding water sharing principles.

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[83] Usually, there is one village representative per village.

[84] At the beginning of the water request implementation, meetings were organized for the entire scheme; however, the aim is to organize blocs of farmers which have similar agricultural practices along the same canal and organize the water requests meetings according to this division.

A farmer said:
"We need water at the same time that's why it seems to be complicated to implement a water turn. People do not take care about the water resources availability. To give an example, one farmer opened the gate for 60A without closing it after. There are huge wastes of water in Pram Kumpheak because of the absence of rules."

The following table presents the results obtained after implementing a water requests process:

FWUG 2 (24/07/2010-30/07/2010)					
Date	**Task type**	**Place**	**Result**	**Duration**	**Operator**
27/07/10	Blocked Kilo canal to prevent the water flow to Trapeang Kandal SC.	Border of rice fields located in Lovea Thbong and Lovea Cheurng villages	One village representative and 11 farmers blocked six places of the embankment.	7:00	Yan Ven
28/07/10	Check the possibility of water access for rice fields located in Lovea Cheurng	From rice fields located in Lovea Cheurng to gate of Phum Bei reservoir.	They knew areas where water is lacking and no drainage system.	5:00	Yan Ven
29/07/10	The ISC team & farmers went to the field to check canal situation and repair the canal structure (→ water circulation for rice fields located in Lovea Cheurng).	From Phum Bei reservoir to rice fields located in Lovea Cheurng.	8 people: no access to water →rice fields located far from the water source; they participated in repairing process (canal structure).	12:00	Yan Ven, village chiefs, and farmers.
30/07/10	To control the water circulation in Lovea Cheurng	From Phum Bei reservoir to rice fields located in Lovea Cheurng.	One person checked the water access → 30%	7:00	Yan Ven and Village chiefs.

Table 10: water requests for FWUG2 villages

- To control the water level in both reservoirs:

This measurement aims at knowing the necessary time to irrigate a cultivated area known in advance. After, if they calculate the water storage capacity of each reservoir, it will be possible to propose an irrigation plan adapted to available water resources. But it is too early to speak about that. Once water sharing principles are implemented, an irrigation plan may be proposed and tested according to cropping stages and water storage capacity of the reservoir (and its variations). Currently, the team wants to test and check the water circulation opening Kbal Hong Chas gate. The water gate operators have to check the water level every day in both reservoir (one for each reservoir) and must fill in the following table (cf. table 11) for the next meeting with FWUG representatives, each week.

Date	Time	Water level in the reservoir (dm)	Gate		Level of water in the canal	Land area & hour	Water gate operator
			1th (cm) (Kbal Hong C)	2nd (cm) (Phum Bey)			
16/7/10	7 h 30	6.4	0				
	17h 30	6.4	0				

Table 11: water level measurements

2.3 To improve water management in a larger scheme: Teuk Chha

2.3.1 *Service proposals*

This irrigation system is **very large**. When the ISC began to work on it, the FWUC was not functioning (and it is still not) and was completely abandoned even though it received a lot of support from the PRASAC team (1999-2004). This European project aims at creating a FWUC and monitoring it. At present, this inactive FWUC has no structure to make decisions from the inside. It generates a huge **problem of coordination** between farmers and local authorities. Thus it is necessary to identify the causes and consequences of this inactivity but also to encourage farmers to find alternatives to improve the FWUC.

The first service aims at reestablishing **confidence** in the **cooperation** between farmers and in the **water management**. What are their suggestions?

- To set up **water sharing principles** adapted to field practices.
- This implementation will be based on principles such as flexibility, reliability, equity. It will be guaranteed that farmers who get water now will continue to get it.
- **Enforce authority** creating a committee making decisions for the system.

This service involves getting **authority** from PDoWRaM, the district and the commune; they need to get also authority from farmers by organizing village meetings to explain them the process. Water gate operators will be recruited by the FWUC with funding from the commune and from ASIrri. Besides, an advisory committee able to take decisions on water sharing principles and irrigation plan will be established. Consultation systems with the farmers either according to tertiary and secondary canals or according to village level will be created. Farmer representatives will cooperate with the advisory Committee and the gate operators to relay the information between farmers and the committee.

The second service aims at **improving water management** in one **secondary canal** as a pilot system; it means creating one **FWUG** at secondary canal level. This service includes:

- to mobilize farmers and create membership
- to collect membership fee used for service payment and canal maintenance
- to implement canal dredging and small gates rehabilitation
- to set up water sharing principles at secondary canal level.

Until now, the ISC team allowed forming a working group for the canal B FWUG and registering their members. A data base management system is in process for the list of members.

2.3.2 *Strategy framework*

The objective of setting up **FWUGs** (if there are created for each canal) is to coordinate together for ensuring water sharing and reservoir management according to the results of the first service. This system will be created at secondary canal level with independent financial management and decision making. It is an **upward process**.

They chose the canal B for the FWUG creation because it was considered the one with fewer problems. So, why did they propose another service on the main canal? With regard to the low irrigation system functioning and the scheme scale, it was impossible to propose one service only for the canal B. Indeed, this canal is a secondary canal and it depends on one main canal. The decision-making was linked to the main canal logically.

So, they decided to propose a service concerning **the main canal** in order to create an influential structure with legitimacy to make this work possible and try to organize water management at a larger scale with **the advisory committee**. They set up a **downward process**.

If this pilot system is successful, it will be continued up to ISF collection and it will be extended to other secondary canals (including the main one).

2.3.3 *Adaptation process by trial and error for the first service: to improve the enforcement of water management*

As it is a first year of the ISC work, there is no defined process to implement water sharing principles. Therefore, they will try an **adaptation process by trial and error,** it means to test some processes, note the problems and solve them proposing a new adapted process. It will be detailed for Teuk Chha scheme in the following part. The services implementation on this system is realized at two different scales (secondary canal and main canal). The team noticed that it was impossible to work on both separately. This approach was inadequate. It is essential to facilitate the communication between main and secondary canals in order to make decisions and have them validated.

We are going to develop this test-process, underline the problems and try to adapt the current process to farmers' needs in agreement with the peasants and local authorities.

Step1: the creation of an advisory committee and the recruitment of water gate operators.

Considering that local authorities are weak in the Teuk Chha scheme, who will make decisions and facilitate the communication between farmers and local authorities to implement water sharing principles? The ISC team decided to create an **advisory committee** to facilitate this work. It was initially composed by Krock and Boeung Nay commune chiefs, main canal village chiefs (Trapeang Bet, Toul Kvav, Ta Ok, Neak Ta Sneoung, Thmei, O Chrok, Toul Khpos) and the vice-president of PDoWRAM (Kompong Cham province) and the duration of the mandate is six months (May to October 2010). They will have to organize meetings every week with the ISC team. This creation is based on three **objectives**:

- To organize overall water sharing principles.
- To build the capacity of communities and farmers for water sharing plan implementation.
- To build trust between stakeholders and farmers.

After creating this committee, they chose with the ISC team four **water gate operators** through the commune chief, village chiefs and water resources agency to solve the problems related to water sharing, without defined methodology asking to the committee for some piece of advice. The duration of their work will be 6 months (May to October 2010) and they will be paid 100,000 riels/month. The ISC will support two staff and the communes the other two. Their **responsibilities** will be:

- Close and open the gate along the main canal.
- Close and open the gate with three outlets.
- Close and open the gate at the tertiary canal along the main canal.
- Clean garbage along the main canal.
- Cut weed and plants along the main canal's bank.
- Control water level along the main canal.
- Write a small report about the problems related to water sharing.
- Participate in the meeting organized by the ISC.
- Write report about field observations.
- Prevent cattle, Buffalos and Horses going into the canal and farmers digging the canal to fish.

Step2: Water management along the main canal and secondary canals.

The advisory committee decided to implement a **water sharing process along the main canal** and a **three day water turn for secondary canals** without village[85] representatives in the meeting.

Concerning the main canal, all the pipes or gates along the tertiary canals were closed. They refused to implement a water turn; as for them, some villages are too far to have access to water. They decided to open the gates in case of farmers' **water requests** to village chief for the main canal. After submitting the water request to the community staff, they have to open the gates. The request is valid for five days. If the time is over, they have to request again. Some useless outlets were blocked definitively.

To **disseminate** these water sharing principles, information regarding the water turn will be written on a **board** and farmers along the main canal will receive the information during **meetings** organized by the committee and ISC as a coordinator.

This plan started to be implemented on 02/06/2010 and commune chief had to deliver water turn documents to the village chiefs. The work along the main canal started on 10/06/2010.

Step3: To identify the problems of the distribution system.

After implementing water sharing principles along the main canal and secondary canals, they organized a meeting to speak about water turn implementation. This turn generates **new problems**. Indeed, during Prasac time, a three day water turn was already implemented but it never worked well; the water turn was not fair between the three secondary canals. However, knowing that the previous water turn implemented under the Prasac project would not be accepted once again by water users, the team chose the same three day water turn in order to, deviously:

- Make farmers understand that it is essential to define a water turn according to water requirements, by a secondary canal
- Mobilize farmers about the water distribution between secondary canals

Finally, a **lack of water,** along the canal A, was reported (for transplanting). The advisory committee decided not to modify the water turn because it was not the canal A turn.

This water turn must be considered a **test**. In the future, they will have to define the water turn considering the **real irrigated area** (command area for each secondary canal) and if possible, as regards **irrigation plan**.

Along the main canal, some villages **did not request any water** for two reasons:

- Other farmers benefited from the **natural streaming**. Indeed, because of the bad state of some canals and damaged infrastructures, the irrigation water from the reservoir can flow out of the canals; it allows irrigating some rice fields which can be far from the network.
- Some people did not understand the process of the water request. The management of opening and closing of the gates was **not clear**. If farmers need one more day of water to irrigate their fields, they will open the gates without permission without caring about farmers' water needs. The irrigation system cannot work well without rule system.

Hence, the situation encourages people to adopt **individual practices** creating an **anarchic system** where everybody has to be crafty to get water. The lack of a management team (or a FWUC committee) is responsible for these practices and encourages people to be individualistic. Therefore, the objective is to build new rules to **regulate** this access to water.

Besides, they noticed that many **obstacles** blocked water flow into the main canal (which reduced the water flow in canal A) and so it was necessary to clean the canal and prevent people throwing it in the canal because the water level decreased. They decided to record the name of the person who

[85] Villages concerned by water uses along secondary canals (A, B and C).

put the wood in the canal and inform them to get the wood out. Why do the farmers want to increase the water level? Many parts of the canal are too shallow, they need to be dredged. So, the advisory committee organized **collective work** to dredge it in O Chrok and Trapeang Anhcharnh villages. Farmers had to work but some of them decided to hide in order not to work (two farmers in O Chrok and five farmers in Trapeang Anhcharnh); they are free-riders.

Other **behaviors** slow down a good water management. Indeed, some farmers, to get water one more day for example, pay the water gate operator to let the gate opened one more day; it is **backhander**. Some farmers told us that the Boeung Nay commune chief often asked to the water gate operators to open the gate he used (canal C).

To prevent people from giving money to water gate operators or village chiefs, a meeting was organized to forbid this kind of practices without implementing sanctions. **Without clear decisions** and a **sanction system**, it seems difficult to have the new principles being respected.

These practices are responsible for the **loss of confidence** between farmers and water gate operators, between farmers and local authorities and between farmers themselves. They **weaken the collective action** generating an **unfair water sharing**.

Step4: to enforce the control and improve the water management modifying the organizational and decision-making structure.

Previously, the water gate operators controlled, in the morning, the water flow from the reservoir gate to the end of the main canal without checking that the water flow reached the furthest fields.

The advisory committee and the ISC team proposed to the staff to **follow up water circulation** to the end of the canal and in fields located downstream and write report about water requests (cf. table 12). They have to control the water uses along the fourth canals. It is a **full-time job** for the 4 staffs and the advisory committee has to follow the work.

Village	Date	Duration	Outlet used
O Chrok	01-02, July 01-02, July	2 days 2 days	the fifth outlet along the main canal the sixth outlet along the main canal
Ta Ok	14-19, July	5 days	the fourth outlet along the main canal
Neak Ta Sneung	10-15, July	5 days	the sixth outlet along the main canal
Krock	10-21, July	5 days (but they asked for 10 days)	the third outlet along the main canal

Table 12: Water requests, July 2010.

Thanks to the control made, they noticed that the water turn was not adapted to the water needs; besides, most of downstream fields were not irrigated probably because of the overconsumption and wastes of water along the main canal.

The system of distribution has to be modified. But, do the farmers have the same right for the scheme access? How to implement a fair water management for all system users?

Previously, all the villages involved along the secondary canals A, B, C have never participated in the meeting to discuss water turn organization. The meeting was held only with the seven villages involved along the main canal.

The advisory committee agrees to say that all the farmers must have the same access to water. So, it was decided to restructure this committee and to involve the village chiefs of secondary canals in the process. They will discuss all together about water sharing principles.

Step5: to discuss new water sharing principles with all the villages involved.

The modification of the committee composition means the change in **constitutional rules.** The ISC team will go on working as a coordinator to facilitate the work implemented by the committee and the vice-president of PDoWRaM will go on managing the committee.

In order to ensure fair water sharing management, the advisory committee and the ISC team have to think about the water supply. *Do they want to keep the water turn or try a water request system for all the villages involved? What about the furthest villages? How could they organize the water sharing? How to define it?*

It was decided to give up the water turn and implement water request systems for the villages along the forth canals (A, B, C and main canals). The water requests are allowed according to the cropping stage. The priorities are defined according to the real water need all along the rice growing season and **cropping stage** and they will condition the **priority** to have access to water (cf. table 13).

- Priority 1: seedling or nursery bed almost dying.
- Priority 2: rice growing (nearly dying)
- Priority 3: transplanting or broadcasting
- Priority 4 : rice growing (need additional water)

Village	Date	Canal	Irrigated land	Total land size irrigated	Distribution system
Boeung Nay	1-3/08	B	Broadcasting:5 ha Seedling: 10 ha Transplanting: 293 ha EWS assistance: 43 ha	351 / 405 ha	Gravity
Trapeang* anhcharnh	4-8/08	B	Seedling: 10 ha Transplanting: 125 ha EWS assistance: 20 ha Broadcasting: 5 ha	160 / 180 ha	Farmers' number : Gravity →140/160 Pumping → 20/160
Korma Reach	13-17?/08	B	?	?	?
Krasang Ta Mong	9-12/08	A	Transplanting: 20 ha but no access (no canal connected) – *No farmers participation, weed in the canal.*	?	?
Ta Ok	12-17?/08	MC	1st outlet, transplanting: 20 ha but no access 4th outlet, transplanting: 5 ha (we do not know)	?	?

Table 13: Water requests – August 2010

*Trapeang anhcharnh can provide water to Kbal Damrei irrigating 6 ha if it requests water.

There are only two villages (Boeung Nay and Trapeang Anhcharnh) which gave information about water uses when they requested water (land size irrigated, purpose). The "on demand system" is not well understood; the idea is then to take these villages as **models** for the next meetings and to show to other village chiefs which information they need to know and to provide to the committee. They are the furthest villages along canal B; their localization then justifies their efforts.

Other villages, even though they have no direct access to network, did not request water (Prey Sak, Samsourng, O Chrok, Toul Kpos, Krok); considering their proximity to the canal A and the structures damaged without gate, they take advantage of other water requests (requested by Krasang Ta Mong) getting water from this village.

So, how can we do to share the water fairly and encourage people to express clear water requests? The proposal is to close all the gates (from main canal and secondary canals). The way things are the infrastructures cannot ensure a perfect water distribution according to the water

requests because not all the infrastructures were repaired; hence, there will be still farmers who can benefit from this return flow without requesting water from the village chiefs.

Thus, an **on demand system is not adapted** to the situation and then it will have to be replaced by another system; this kind of formulation can withal **encourage the communication** between the farmers and the village chief as well as between the village chief and the local authorities. It is a way of strengthening the social cohesion even if, in the future, these requests could generate conflicts between farmers.

If they conserve this system on demand without making infrastructure rehabilitation, they will have to put **locks** on every water gate and to insure it **against vandalism** employing water gate operators by day as by night. At present, some farmers break a lock at night for irrigation purpose.

To sum up the main decisions

- Firstly, gates have to be closed if there is no request but they can be slightly opened just to refill the canal.
- Secondly, to formulate request, village chiefs have to provide information about the water uses (location of the fields, purpose of the irrigation, land irrigated).
- Thirdly, we have to make a test to know in how many days you can irrigate all the fields. According to the previous table, we see that in three days, you can irrigate nearly 300 hectares so, in one day, 100 ha. So, this result can be useful in the future to propose some scenario and to know, according to the period of the year, how many hectares you can irrigate with the water available in the reservoir and the rains.

Once infrastructures will have been repaired, this system can be implemented in the long run. An idea is to organize meetings with farmers and suggest they **work collectively** to repair and clear the canal (currently, the water gate operators are in charge of it). Some farmers have the right tools and others, their hands. They have to improve the infrastructures according to their resources (to dig the canal, clear the weed, rubbish, etc.) and develop **mutual aid** to be more efficient.

Step6: To adapt the water requests to the current context.

In August 2010, everybody has almost transplanted and so, the rice growing and water need are almost similar. So, *how to define new criteria to decide between farmers? Do they want to give priority to downstream fields, furthest villages, short-term varieties, highlands?*

It was decided during a meeting with ISC team to define new priorities based on:

- The rice variety (a short-term variety needs more water)
- A clear proposal (including all the information of the table 13)
- Canal condition and farmers' participation.

So, the real situation of rice production has to be well known (cropping stage, varieties used) going to the fields and asking the village chiefs. In like manner, each village chief has to know well the situation in his village regarding the irrigated plots before reporting the water request to the staff and later, to the committee. The last criterion is the most complicated to evaluate: "Canal condition and farmers' participation"; they have to be considered separately. The ISC team and the staff have to make an inventory of all the infrastructures and their condition. Farmers' participation is a pivotal subject and is hard to assess. It will be considered that farmers' participation is good if the infrastructures which need to be improved are really improved. If the farmers do not participate in the scheme improvement and to the common work, they will be the last to receive water.

N.B: if some village chiefs are absent from the meetings, they will be informed by the ISC.

On top of that, the ISC team has to follow up the water level in the reservoir and defines the necessary amount of water for each irrigated area. This amount has to be measured according to the

command area (cf. table 14). It has already been defined. The calculation was made thanks to cartographic tools with the ArcGis software.

Canal	Villages	Command area
Main canal	Ta Ok, Neak Ta Snoueng, Toul Kvav, Tra Peang Bet, Thmei, Toul Khpos, Or Chrok	Not yet known
Canal A	O Chrok, Toul Khpos, Kroch, Kra Sang Tamong, Sam Roung, Koma Reach, Boueng Nay	781 ha
Canal B	Voat Chas, Thmor Koul, Sam Roung, Prey Sak, Koma Reach, Boueng Nay	1720,8 ha
Canal C	Voat Chas, Thmo Koul, Bravas, Koma Reach, Boueng Nay, Trapeang Anchahn, Tra Peang Thom, Chhuk Sor, Kbal Damre	897,4 ha

Table 14: command area for each canal

2.3.4 *The FWUG creation: a service in its early stages*

The ISC team set up a **working group** (the first step of the service implementation). There are 8 members who are two communes' chiefs and six village's chiefs. Its name is "working group to organize FWUG in canal B". The mandate is 4 months according to the project from the 4th of May (contract signature) until the 1st of September. Once the working group was created, **membership fee collection** (15,000 riels/family) was implemented. These first steps are a success: the level of **participation was good** (>67%) and the fee was collected.

Nevertheless, it is too early to discuss water sharing principles at the FWUG level. Now, there is a **decision-making structure** to start the process within the canal B; meetings will be organized with the canal B users to talk about the water management.

It seems easier to adapt the new water sharing principles at **a smaller scale**. Members will have to define an **organizational structure** and decide which rules formulation they want, which governance system they need and think about the ISF collection (amount of the ISF, collection, etc.). ? Besides, they may define an **irrigated plan** to adapt the water quantity which is available throughout the year to the water needs along this secondary canal. This idea will be detailed in the following part.

The creation of this collective structure allows defining the borders of the command area of the canal B. *Who is involved in the water management of the canal B? Who has access to water?* The aim is to share water fairly creating a **negotiation space** thanks to the **constitutional rules**. This space provides **legitimacy** to the FWUG in the eyes of the users and local authorities within the irrigation system necessary to propose water sharing principles.

Three scenarios are proposed below on the FWUG evolution in Teuk Chha irrigation system.

Scenario.1, the FWUG is a success:

1. This FWUG will be autonomous with its own budget (ISF will be collected for the canal B)
2. The ISC team will support the FWUG on water sharing principles. Does it want to organize a water turn within the canal or go on requesting water from village chiefs?
3. The water sharing will work very well and the farmers will be involved in the process
4. This FWUG will be considered as model for others canals.
5. Main canal and secondary canals A and C will want to create a FWUG too.
6. Each new FWUG will be able to collect ISF, to manage the O&M and will get its own budget.
7. Finally, all the irrigation system will be managed through the FWUG

However, there are more pessimistic scenarios about the FWUG evolution: the FWUC does not work well and the level of members' participation decreases (scenario.1); it is no more considered an organizational model for other users of the system. The collective action is not strong enough to go on implementing the FWUG process.

The second scenario is an intermediate scenario: the weaknesses of this collective structure result from the inappropriate sequence of working stages. The water sharing has to be realized as soon as

the process starts between all the system's users (between the main canal and the secondary canals); the users of every canal would have to be organized simultaneously in FWUG in order to discuss and propose together irrigation calendars at the system level, in agreement with their access to water in the time and its access frequency.

Scenario.2, a lack of coordination between users: to the process again

1. ISF is collected and the FWUG is autonomous with its own budget
2. ISC team will support the FWUG about water sharing principles.
3. The water sharing planned seems to be adapted to farmers water needs
4. Farmers along canal B are involved in the process
5. But, the communication and coordination is low between the scheme's stakeholders.
6. Finally, other stakeholders do not approve the water sharing schedule.

→ *Before implementing water sharing principles, FWUG for other canals have to be created.*

The third scenario is a failure. The service proposal was quite good; the service was correctly implemented but the ISC team did not take into account financial skills necessary for FWUG members: the budget is not well managed and the money is wasted. The center stops the work and leaves the irrigation system; it is going to lose in credibility on the next contracts.

Scenario.3, it is a failure:

1. ISF is collected
2. Because of the lack of financial skills, money is wasted. The FWUG will be not financially autonomous.
3. ISC proposed a new service about FWUG financial management.
4. It is the third service proposal and there is a loss of confidence in ISC services.
5. Collective action is not strengthened ….FWUG seems empty.
6. Water management remains the same; there is no coordination between farmers and local authorities on the irrigation system to share water

→ *ISC stops working on Teuk Chha.*

2.4 The irrigation system delimitation: necessary prerequisites to implement a rule system

This delimitation allows the definition of the concerned parties (villages, communes) and the availability and diversity of the resources (river, ground water). According to Ostrom's principles derived from studies of long-enduring Institutions for governing sustainable resources (2005), the boundaries of an irrigation system have to be defined clearly with the individuals or households with rights to cultivate and use water in the scheme[86].

This is one of the criteria for robustness developed by Kenneth Shepsle (1989) that Ostrom used in *Governing the Commons*. These criteria are necessary to create sustainable and robust Institutions[87]; without it, it can create some conflicts between farmers when they request water. In studied schemes, there is no irrigation scheme definition and it starts generating problems.

In the Teuk Chha scheme, services aim at securing the farmers' water allocation. If it is effectively improved and enables people to get water when they want and when they need, people from unknown villages will also request water. However, water quantity from the reservoir does not seem to be enough to irrigate all the fields of the Kroch and Boeung Nay communes. So, to ensure a sustainable allocation, farmers will have to define boundaries with the ISC's help or not: *Who has access to water?*

[86] OSTROM, E. Understanding Institutional Diversity (New Jersey: Princeton University Press, 2005), 259p.
[87] Ibid.

To solve this problem, the question of the authority has to be clarified; a leader must be able to say: "your village is out of the scheme delimitation; you have no priority because of the water shortage"? In these schemes, the absence of authoritarian system makes it tough.

Do they have to limit this access to the irrigation system? Do they have to include these new villages even if it will probably increase the water shortage? If not, can we exclude people from the network?

Ostrom defines the term **common pool resource** as "a natural or man-made resource system that is sufficiently large as to make it costly (but not impossible) to exclude potential beneficiaries from obtaining benefits from its use[88]." In Cambodia, water is a resource **non excludable to potential beneficiaries**.

In both schemes, we cannot consider that water is lacking; throughout the year, reservoirs are more or less filled with water (also in the DS). Then, water resources are relatively abundant; however, internal scheme problems (poor infrastructures, no rule system, organizational weaknesses, etc.) modify the perception farmers have of water resource quantity: abundant for farmers upstream and non-available for farmers downstream or far from the network. Hence, some farmers can cultivate twice a year while others have difficulties to make a cycle of rice a year.

According to Keohane and Ostrom, a common pool resource in abundance does not generate conflicts and could be considered a **public good**.[89] But, water sharing and access disagreements can generate it. For example, in the Teuk Chha scheme, during a meeting with the advisory committee, chiefs from other communes came to request water and so, the right to have access to the network. Currently, they use water from this reservoir thanks to canal extensions and natural streaming. This request could be justified in case of excess water all along the year in the reservoir but it is not the case.

This situation is a problem to ensure sustainable water sharing principles; the sustainability requires the irrigation system delimitation. Besides, in both schemes, there are **many unknown data**: water storage capacity of the reservoir, command area for each part of the canal (work in progress), and then, the water availability throughout the year for each canal and each village. This justifies the ISC intervention process considered a set of tests and **not as a methodology drawn up in advance**.

2.5 Water supply management and participation assessment

The services proposed in the Teuk Chha scheme illustrate the complexity of the decision-making coordination by the local authorities and the FWUG's members; they also emphasize the necessity of the double-approach *top-down* and *bottom-up* to ensure an appropriate water management at the irrigation system level.

2.5.1 *The future prospects of the farmers' organizations*

On one hand, there is the FWUG of the canal B which is in progress. On the other hand, there is **no strong organization** to make decisions and implement a good water management in the irrigation scheme. The ISC team is working on it to **strengthen local authorities** building **an influent go-between** through the advisory committee to discuss and negotiate the water sharing principles.

Let's imagine that the FWUG can be **autonomous** and **recognized i**n the irrigation scheme by local authorities and farmers. After discussing with the village chiefs along the canal B, the FWUG will propose its **own constitutional rules** and **operational rules**. They will be submitted to the advisory

[88] OSTROM, E. Governing the Commons: The Evolution of Institutions for Collective Action (Cambridge: Cambridge University Press, 1990).

[89] KEOHANE, R. and OSTROM, E. "Introduction," in Local Commons and Global Interdependence: Heterogeneity and Cooperation in Two Domains, ed. Robert O. and Elinor Ostrom Keohane (London: Sage Publications, 1995), pp. 13-14.

committee (if the FWUC is still not working well) in order to validate them. If it is the case, water sharing principles within the secondary canal B will be implemented.

And so, with an **adaptation process by trial and error**, how can we get **collective-choice rules**? It can be made through FWUC and FWUG with **upward** and **downward processes**:

- **FWUG level**: Once the constitutional rules decided at the level of FWUG and the FWUG leaders elected by FWUG members, a discussion may be possible between FWUG at canal B level with local authorities; the decision-making process of farmers along the canal B will be facilitated. If they are able to identify problems per area and propose specific and adapted solutions for the canal B, the FWUG will propose operational rules for the canal B: "do they want a three day water turn? When do they want to open the gate?" The collective-choices rules may also be decided at FWUG level; the rule system has to be approved by FWUC. In the following part, hypothetical collective-choice rules will be proposed.
  If this process is working well and if the water sharing principles secure their access to water and facilitate their agricultural practices, then the FWUG may be considered a **model** for other farmers along main and secondary canals. Farmers along other canals will probably request a FWUG through the ISC services. This methodology aims at implementing water sharing principles, making them fair and transparent. So, the idea is to encourage farmers to organize themselves in FWUG making the irrigation system divided into **autonomous structures** (like FWUG).
- The **FWUC** representatives may be considered as middlemen to ensure the **coordination** between FWUG (if there is one for each canal: FWUG of the main canal and one FWUG for each secondary canal) and adapt more easily their proposals at the system level. Hence, the FWUC will be responsible, in that case, for the **global water management** of the irrigation system.

2.5.2 *A good irrigation scheduling depending on farmers' coordination and rule system*

In water supply systems managed from upstream, water resources are often available for water users according to a plan defined in advance before beginning the wet season. This plan is proposed according to the available resources, in time and in quantities, the network, the land areas and the water needs of the crops. The duration of the water turn (time between two water accesses) is often fixed.

On the studied schemes, these water turns were defined in a random way (from Prasac project till now); it is inappropriate, they tested a new one. But, these tests are conceivable if farmers are involved in the decision-making process and can opine about it; otherwise, the practices will be different from water sharing principles and it will be hard to implement a fair rule system.

A poor water management leads to excessive water uses and unfair water accesses between the farmers. That is the case in particular when the period to have access to water (duration, frequency) is inappropriate to farmers practices.

Changes are noticed as regards water accesses, agricultural practices, crop diversity and infrastructure conditions (problems of maintenance). The logic of schemes management has to be studied to propose hypothetic scenario regarding water management future prospects.

As previously stated, there are two types of irrigation supplies: (i) **water turn** and (ii) on **demand** system. There is a third one, not practiced[90] in these schemes, (iii) the **continuous supply** where the supply is adjusted to requirements over the season. The water turn system requires water control, irrigation schedule adapted to water needs along each canal and farmers' coordination.

However, these water supply systems are dependent on rainfall, according to the season. Water is scarce in the dry season when the lack of rainfall makes cropping impossible without irrigation. In the wet season, rainfalls can interrupt the systems based on demand or rotation; thus, the water distribution must be rethought to preserve the water in reservoirs for less rainy periods.

[90] The continuous supply is not possible here because water requirements are unknown and rate of flow uncontrolled.

So, the question is to know *how to optimize water turn or water requests in an irrigation system, within a canal considering the technical constraints of the network as well as the agricultural practices according to agronomic constraints and water uses*?

In both schemes, an **irrigation scheduling** may be useful to optimize water uses by matching the watering schedule to crops needs. Do we need a large or small scale to implement it? This is no one solution; it depends on the scheme itself. The Pram Kumpheak scheme is smaller than the Teuk Chha scheme, so, it is easier to propose an irrigation plan for the entire irrigation scheme. These day-to-day decisions have to answer to the following questions:

- *When do they have to irrigate?*
- *How much water do they need to apply?*

A **good scheduling** means that the water is supplied at **the right time**, **quantity** and **frequency** to **optimize the production** (for example, to increase the yields) and **reduce the waste of water** providing water supply to furthest fields. A bad scheduling means that either too much water is applied (plant water stress, waste of water, pest problems) or too little water and the rice becomes dry and the production low. The same is true of the date of irrigation; if rice fields are irrigated too late or too early, the rice production and quality will decrease and the nutrients use inefficient[91].

In Teuk Chha, the future prospects are to propose an irrigation plan within each secondary canal and to begin, within canal B. The FWUG and ISC team have to reassemble fields with a **similar cropping calendar** throughout the year. Once the **farmers' groups** are constituted, they have to define the water needs according to the **cropping stages**. It allows to optimize the rater of water quantity consumptively used or stored for later uses to the quantity delivered. It is the **irrigation efficiency**[92].

Water requirements for rice vary from nursery to the harvesting. Rice crops are more dependent on irrigation for the **land preparation** (transplanting) where water requirements are higher. Cropping schedules are generally controlled by soil characteristics, rainfall distribution and the availability of irrigation water. "**Crop water requirement** is defined as the depth of water needed to meet the water loss through evapotranspiration of a disease-free crop, growing in large field under non-restricting soil conditions including soil water and fertility and achieving full production potential under given growing environment" (Doorenbos, 1984).

The irrigation plan and water supply system decided within the FWUG, in spaces for consultation and negotiation at local level, refer to **collective-choice rules**. The future prospects concern these water management principles proposed by FWUG and approved by FWUC. Anyway, this decision has also to be taken at the irrigation system scale. For instance, if they choose a water turn system, they will have to think about it together (the hypothetic future FWUG representatives) and to define how many days of water will be granted to each canal according to a specific irrigation scheduling.

Once these collective-choices rules are defined, the water supply can be implemented, **supervised** by water gate operators and likely to be modified according to the water needs and rainfalls.

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[91] HESS, T. 1999. Minimising the environmental impacts of irrigation by good scheduling. Silsoe College, Cranfield University, Silsoe, Bedford, MK45 4DT, pp: 3-4

[92] www.agwaterconservation.colostate.edu, the Agricultural Water Conservation Clearinghouse website.

The success of this process depends on two main conditions:

- **Farmers' coordination and participation**

To propose an irrigation calendar adapted to the water needs of the farmers, they have to be involved in this process to participate in the meetings within the FWUG. The objectives may be to locate their fields (are they far from the main canal or another outlet?) on a map describing their water needs according to the cropping stage (it depends on the variety and the season), their agricultural calendar and the conditions of the infrastructures (Have a good access to water in case of abundance?). Once the FWUG of the canal B is created, some indicators can be proposed to evaluate it (cf. figure 22).

Evaluation of farmers' participation in irrigation management process, based on:					
Natural resources access					
Land access (area)		Access to network (considering the quality of hydraulic infrastructures)			
The farmer water user					
Age	Duties (FWUC or other organizations)	Average income	Education level	Variety of activities (agricultural or not)	Owner or tenant
Environment of the participant					
Influential persons (village or commune chiefs, etc.)?			People involved in the FWUC organization (committee member)		
Nature of the participation					
Financial (ISF, membership fee)	Collective work (O&M)		Water requests	Any other (specify)	
Involvement in the FWUC					
Presence at meetings			Oral participation and exchange of ideas		
Service assessment as for the farmer					
The service answers my needs	The communication is good (before and after the service implementation)		The service is implemented correctly in agreement with peasants (meetings at convenient hours, spaced out in the time)		The results are decisive

Figure 22: indicators proposal to assess farmers' participation

This evaluation can be carried out through individual interviews of farmers of an irrigated system. New evaluations could be done by farmers groups, the assessment criteria being different.

These criteria of evaluation have to consider some factors of changes as the fluctuations in the prices of the rice, the current climatic conditions (for example, low or important rainfall), the land constraints, the evolution of the family agriculture (diversification of cultures, modernization of the agricultural equipment, etc.)

- **Fair water sharing principles**

It is hard to know if water sharing principles are fair or not; it is more a subjective judgment. Indeed, it depends on what the "fairness" is based. Do we consider that a fair principle allows providing water to furthest fields and reducing the access to other farmers? Is it still fair when this access is limited in the time (even if it is not limited in the space)? It means that some people have access to water throughout the year while others have access to water in the wet season. The services aim at improving the water resources access of some farmers and securing the previous access for another one.

The stakeholders are able to choose a similar access for all the farmers or to reduce it; the ISC team can guide the choice of farmers without imposing on them some water sharing principles. This is the collective decision which will allow building fair water supplies at the irrigation system level.

DISCUSSION

More than 80% of Cambodian people (around 14 million persons) depend on income from agriculture. Marked by years of war and atrocities, it is essential to support the most vulnerable populations by developing measures to ensure the durability of natural resources and thus, to protect the means of supporting these populations.

The sustainable management of water resources collides with several difficulties; based on the level of corruption in the country, Transparency International placed Cambodia 154th place of 179 countries[93]. The consequences of this level of corruption are heavy when we deal with fair and sustainable sharing of natural resources and essentially at the level of the land.

Pol Pot had engaged a radical agrarian reform where capital goods had been completely collectivized. Displacements of population, hard labor, tortures…it is certain that the violence of modern history has damaged the society. After years of suffering, it is necessary to reconstruct and to learn again how to work together.

The process of destruction of the Cambodia's society over the last 25 years, which has inevitably increased the vulnerability of the Khmer society, and the decollectivization of capital goods, had led to a complete reorganization of the land and natural resource management.

However, the government has lacked the necessary capacity to expand the regulatory framework for better management of public resources. In 2002, the country began a decentralization process which gave a majority of farmers greater opportunities to determine their future[94]; the government wants the users to manage their common-pool resources. In light of these new responsibilities, the citizens have to learn how to manage these resources and to get organized, but in order to do this, they need financial capacity and specific skills.

Common good management in these irrigation systems, developed in order to improve the water control, involves a coordinated management of the local stakeholders. Do the communities get capacities for self-organization? It seems essential to organize and make operational the collective action needed to supply the required institutions and then, to share natural resources fairly. It is advisable **to determine the state of the collective action within these irrigation systems and the incentive levers to strengthen it.**

Two theories gave rise to debate about **collective action**. The first one respects that its weaknesses are inherent to cultural and religious values. **Buddhism**, the official ideology, had become the dominant religion by the end of the 13th century. It is centered on the individual and on his or her karma; it considers that the Cambodian people show **alleged individualism** and **relative independence**. These intrinsic characteristics to these communities, coupled with self-sufficiency and relative abundance of natural resources, make the village organization unnecessary (Ovesen, on 1996). It is obvious that war atrocities affected the collective action under socialist Pol Pot, weakening cohesion and self-help mechanisms in rural areas. However, it is slowly returning to normal among other things with meetings organized in pagodas[95], centers of religious life in Cambodia, reciprocal labor exchanges[96], weddings and other religious ceremonies.

As for Ovesen, the principle of **nuclear families** is prevailing on that of extended families and hence, every family is seen as an island, one entity which is organized in an individual way without

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[93] Index 2010 de la perception de la corruption de Transparency International, 26 octobre 2010.

[94] NCSC. 2005. Review of decentralization reforms in Cambodia: policy and Practices, Phnom Penh, available at www.ncsc.gov.kh/infomaterials.html

[95] It is a place of worship, education and rituals too.

[96] This principle was fundamental after Pol Pot regime; it was called *krom samaki* and was abolished a few years later by the government.

consultation with other members of the community. Thus, it seems interesting, to strengthen the **social cohesion** and the **collective organization**, to define a way of connecting these islands.

The **second theory** is based on **cultural trauma** caused by the Khmer Rouge period. "It occurs when members of a collectivity feel they have been subjected to a horrendous event that leaves indelible marks upon their group consciousness, marking their memories forever and changing their future identity in fundamental and irrevocable ways" (Alexander, 2004). The war **damaged the social capital**[97], the norms and values. It also **destroyed social relations** that bond groups within the community and the government (Colletta, 2002). These social connections, which are weakened, increase the risk of **social disorganization and division**. However, it seems essential to strengthen them in order to manage natural resources collectively and maximize their utilization **by developing a collective consciousness**.

The **transfer of responsibilities**, through the creation of FWUCs and the decentralization process, involves deep changes at the **level of connections** between the State and the farmers; it also refers to a **dimension of power and financial capacity transfer**, necessary to take on these new duties.

The ISC has an objective to support these organizations at the level of water management, O&M and financial management. The people in charge have to make their own decisions correctly (technical, economic) by using specific tools (financial, participative, organization, etc.) which can be proposed by the ISC team.

The government remains present, in a heterogeneous way, and supports, on certain points, the FWUCs (in particular by the construction of hydraulic infrastructures). It is and it remains an **indispensable partner** of irrigation systems. This new role given to the farmers' water users communities does not mean that they have to manage everything; however, some tasks remain inevitable, such as the water management, the collection of membership fees and ISF, the network maintenance, etc.

Thus, these organizations have to find their place in this new institutional, complex and diversified environment and establish a relation of **confidence** and **exchange** among the members of the communities and institutional actors. This communication is largely facilitated by the ISC's work which allows peasants to gather around a common subject and to connect them to the local stakeholders, people concerned; this approach is described in the study as an "**upward-downward process** ", **giving a voice** to different actors in the same discussion where every decision taken will affect the orientation of the proposed services.

This irrigation systems management raises problems connected to the collective action and those which refer to the **interdependence b**etween actors who can pursue divergent interests. Thus, it seems essential to **define together, rules** of collective action (cf. Ostrom, 2002) for a fair sharing of water resources, so that each, if he wishes it, has better access to water resources, which is more homogenous (throughout the year and quantitatively) and predictable. This definition of rules has to be the object of a **social consensus**.

The **O&M** and the **ISF collection** are getting **slowly** in both irrigation systems. Until now, the FWUCs seemed **empty** (Teuk Chha) or had been recently created and remained without the necessary skills for the management of such a structure (Pram Kumpheak). This lack of organizational and management capacities coupled with a low farmers' participation[98] slowed down the collective

[97] The social capital weakened here refers to hydraulic infrastructures damage, changes in property ownership, population displacement, psychological trauma, etc.

[98] And yet, the participation of water users' in every stage of the collective water management is a basic principle of the social cohesion.

action[99]; thus, the ISC intervened as additional help to these communities to make the systems **more effective** for farmers in terms of access to the network and thus, to water resources. Consequently, the objective is to **improve the agricultural productivity** and then, the **agricultural income**[100].

Agricultural productivity, in Cambodia, is relatively low. It is essential to **intensify the agriculture** and increase rice yields by facilitating access to the network and to water resources. In the short-term, a well managed irrigation system could allow to double even treble the cycles of culture and to guarantee a better control of water levels in rice fields. On the long run, it is essential to ensure the O&M of the irrigation system; without it, it is inconceivable to plan three cycles a year.

Besides, the farmers must be organized **collectively** to **coordinate** their use of water resources (by agreeing, for example, on common agricultural and irrigation calendars). Thus, **rural social cohesion** must be strengthened.

The improvement of **efficiency of water use** involves, in Teuk Chha, a rehabilitation of gates, some check-structures and parts of the canal[101]. In both schemes, the construction and\or rehabilitation of quaternary canals would reduce the individual installations of pumps or culverts along the secondary and tertiary canals; these canals are not maintained by the farmers, mostly due to the lack of financial capacities.

To check the individual installations, it is also advisable to **agree on common rules** for schemes. This approach will begin when the repairs are finished, the network is functional and when the farmers are ready to invest into the FWUC organization and to respect these new rules.

Once this work is implemented and successful, **the scheme access will be secured**[102] and farmers will have the capacity and the will **to invest in the irrigation**[103] through: rehabilitation of infrastructures, payment of the membership fee and ISF.

In a context of transfer of responsibilities and lack of financial capacities of the State, **agricultural development** is possible under the condition of farmers' investment in their networks. It is no longer the State which is at the heart of the **agricultural dynamics** but the farmers themselves. The State is there to back farmers and guarantee them a stable and safe environment which favors the investments of the mass of the farmers (Pillot, 2007).

Considering the recent launch of the project, the ISC members have to gradually design an **intervention process methodology**; their errors or difficulties in the field allow them to improve it and formalize it once the ISC becomes an association in 2011.

Most of the team members come from rural areas and thus, they are conscious of the local problems. Some of them are technicians, other engineers or farmers; then they do not have same career path. This can create internal discord (to give priority to social organizations while others have a technical view) which is reflected on the field and risk discrediting their work within the eyes of the farmers. However, this type of approach is new for both parties and is recognized as a **phase of learning**.

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[99] Refer to assets and weaknesses of both schemes in the part 3 of this report (diagnosis).

[100] The majority of families of both networks depend on agricultural incomes; however, it is important to underline that, in Pram Kumpheak scheme, about 77% of households could get incomes from off-farming activities while about 78% of farmers in Teuk Cha scheme get extra-agricultural incomes.

[101] A portion of the secondary canal A was damaged in Teuk Chha scheme; this is responsible for the regular flood of some rice fields situated near this canal.

[102] First of all, the access will be secured for the farmers already having an access to the network; the purpose is not to reduce their access to allow people improving theirs. It is difficult in that case to speak about equitable water sharing but rather as a fair sharing.

[103] A farmer A will be ready to invest in the irrigation sector if he is sure to benefit from it a year X.

The ISC serves as an **intermediary** between farmers and local authorities; each one has its place in the decision process and hence, needs are clearly identified. The team is not keen to propose prefabricated solutions; they have completed a diagnosis of the irrigation system beforehand thanks to field visits as well as the interviews.

The ISC **gives responsibilities**, indirectly, to the farmers and local authorities in the FWUC organization and management, and through the scheme maintenance. It also necessitates development of new skills for the scheme functioning. This **empowerment** and capacity to interact with other is a consequence of the numerous meetings organized by the team; they allow the communication to improve between the FWUC members and to **establish social ties**. It is the first stage of **strengthening the collective action**.

The center also allows formalizing the weaknesses of the irrigation system at the organizational, social, technical or economic levels.

What is the durability of this project?

First of all, this center has an objective to make the farmers partakers and decision-makers; the services are proposed and implemented by following a specific procedure of validation with the local authorities (definition of services and the launch of the project) and indirect validation of the farmers through the rate of participation; indeed, the participation in the payment of the membership fee must be above 67 % otherwise the service is stopped.

Fund-raising is a condition of centre's sustainability. Indeed, for the moment, the prices of the services proposed, do not represent the real costs but the subsidized costs; the farmers cannot ensure the completeness of the real costs. In the future, the centre will have to look for its own funds (international donors, E.U, NGO, etc.).

In 2011, the team will also have to be able to take on alone, the responsibilities of the implementation of services. It can periodically contact the consultants to improve its methods.

Bibliography

ADB. 2001. Farmer water user communities (FWUCs). Review of past experiences. Project Report No. 19. Manila: Asian Development Bank.

ADB and MOWRAM. 2001. National water sector profile–Kingdom of Cambodia. Kingdom of Cambodia: Ministry of Water Resources and Meteorology.

AFD. 2006. Review of experiences of management, operation and maintenance of rehabilitated irrigation schemes in Cambodia: *Modes of intervention, results and lessons for elaborating a Medium Term Strategy on Agriculture and Water*.

ALEXANDER, J. EYERMAN, R. GIESEN, B. SMELSER, N. SZTOMPKA, P. 2004. Cultural trauma and collective identity. University of California press, 319 p.

APPOLIN F., PEYRACHE X., LAVIGNE DELVILLE, P. 1999. Renégocier les règles collectives en irrigation. Autour de l'intervention de Cicda à Urcuqui (Equateur), Transverses n°6, CICDA, GRET, Groupe Initiative.

ASTHANA, A. 2010. Is participatory water management effective? Evidence from Cambodia, pp. 149–164

AUBRIOT, O. 2000. Comment « lire » un système d'irrigation? Une approche pour l'étude de systèmes irrigués traditionnels, illustrée de cas pris au Nepal, 21p.

AUDIN. 1947. L'hydraulique agricole au Cambodge. 11 p.

AYRES, D. 2001 August. Decentralization. A review of literature. Phnom Penh, Cambodia: Commune Council Support Project.

BALMISSE, S. ROUSSEAU P. and al. 2009. Stung Chinit. Document provisoire, 51 p.

BARKER, R. MOLLE, F. 2004. Evolution of irrigation in South and Southeast Asia. Colombo, Sri Lanka: Comprehensive Assessment Secretariat. (Comprehensive Assessment Research Report 5)

BOELENS, R. 2000. Collective water management and the construction of normative frameworks in irrigation systems. An analysis of some basic working rules, water rights and distribution principles in peasant irrigation. Territoires en Mutation 7:51-74.

BOULLET, P. 2009. Comprehensive Feasibility Study of Business Opportunity of Establishment of Service Center to support farmer water users' community and agriculture development sector in Cambodia. CER France, 32 p.

BRUN, J-M. FONTENELLE, J-P. 2006. Retour sur un pari : Acquis et enjeux du projet de réhabilitation des polders de Prey Nup, au Cambodge, 59 p.

CALAS,J. 2006. Le Cambodge rural face à la pauvreté : contribution à la réflexion sur les dynamiques agraires et le changement social. Document de travail. AFD, 57p.

CEDAC. 2010. In Stung Chinit Khet, Pram Kumphak and Teuk Cha Schemes of Kampong Thom and Kampong Cham Province . Draft Baseline Study Report , 32 p.

CHAMROEUN, S. 2006. Cambodia Water Resources Development. A review of the existing policy and legislation framework, 98 p.

CHANDLER, D.P. 1992. A History of Cambodia, NSW, Australia: Allen and Unwin.

CHEA, S., CRAMB, NESBITTA, FUKAIB and COX. 2002. Assessing the Economic Benefits of an Early Wet Season Rice Crop in Cambodia's Rainfed Lowlands — a Cambodian-IRRI-Australian Project, Phnom Penh, Cambodia; 56 p.

COLLETTA, M. CULLEN, L. 2002. Violent conflict and the transformation of social capital, volume 795, pp. 279-309

DE DIANOUS, S. 2004. Les damnés de la terre du Cambodge. Le Monde Diplomatique, pp. 20-21

DELIGNE, A. A typology of irrigation systems in Cambodia, pp. 9-17

DELVERT, J. 1963. L'économie cambodgienne et son évolution actuelle. In: Tiers-Monde. Tome 4 n°13-14. pp. 193-212.

DELVERT, J. 1994. Le paysan Cambodgien. Editions L'Harmattan, 740 p.

DEMANTE, M.J. 2007. Projet d'appui à l'élaboration, à la programmation et au suivi des politiques de développement rural au Tchad-PAEPS 03- Définir les objectifs et les actions. IRAM. Renforcement des capacités des acteurs du développement local : Définitions et principes - Eléments de méthode pour la planification locale, 16 p.

DOORENBOS, J. Pruitt, W. 1984. Guidelines for predicting Crop water requirement, FAO Irrigation and Drainage paper 24. FAO, Rome, 144 p.

FEINTRENIE, L. 2004. Diagnostic Agraire du district de Mimot, province de Kampong Cham, Royaume du Cambodge, 104 p.

GASSELIN, P. 2008. Diversité des approches systémiques sociales. Master 2R "Innovations et développement des territoires ruraux", INRA-SAD, UMR Innovation, Montpellier.

HIGHAM, C. 2001. The Civilization of Angkor. Weidenfeld & Nicolson, 192 p.

HIMEL, J. 2007. Khmer Rouge Irrigation Development in Cambodia, 12 p.

IFAD. 2007. The rural poverty in Cambodia. 18 p.

IRAM. Renforcement des capacités des acteurs du développement locale et de la décentralisation / éléments de méthode pour la planification locale.

JOLLY, G. 2001. La gestion des périmètres irrigués. Méthodologie de diagnostic. Cas d'un transfert de gestion: les associations d'usagers du périmètre de N'Fis, 21 p.

KENNETH, A. SHEPSLE. 1989. "Studying Institutions: Some Lessons from the Rational Choice Approach," Journal of Theoretical Politics 1, no. 2.

KEOHANE, R. and OSTROM, E. "Introduction," in Local Commons and Global Interdependence: Heterogeneity and Cooperation in Two Domains, ed. Robert O. and Elinor Ostrom Keohane (London: Sage Publications, 1995), pp. 13-14.

KIBLER J-F., PERROUD C. 2006. Towards Co-Management of Hydro-Agricultural Infrastructures: Lessons Learnt from the Prey Nup Project in Cambodia, Coll. Études et Travaux, série en ligne n°7, Éditions du Gret, 71 p.

KONISHI, Y. 2003. Towards A Private Sector -Led Growth Strategy for Cambodia. Volume 1: Value Chain Analysis, GDS LLC, prepared for the World Bank.

MCKENNEY, B. TOLA, P. 2002. Natural Resources and Rural Livelihoods in Cambodia: A Baseline Assessment. CDRI Working Paper 23. Cambodia Development Resource Institute, Phnom Penh.

MIDDLETON, C. PROM T. 2008. Do community organizations exist for managing water resources around Tonle Sap lake? 20 p.

MOLLE, F. 2005. Irrigation and water policies in the Mekong region: Current discourses and Practices. Colombo, Sri Lanka: IWMI. 43p. (Research report 95)

MUUKKONEN, S. 2007. Water management in Cambodia – Resources and relations. Master's thesis Planning Geography, pp. 44-71.

NGUYEN, T.D. 1999. The Mekong River and the struggle for Indochina-water war and peace. London: Praeger.

OJENDAL, J. 2000. Sharing the good: Modes of managing water resources in the lower Mekong River basin. Göteborg University department of Peace and Development Research.

OSTROM, E. 1990. GOVERNING THE COMMONS: the Evolution of Institutions for Collective Action Cambridge University Press, 280 p.

OSTROM, E. 1992. "Institutions and Common-Pool Resources: Editor's Introduction." Journal of Theoretical Politics 4, pp: 243-245

OSTROM, E. 2005. Understanding Institutional Diversity (New Jersey: Princeton University Press), 259p.

OVESEN, J. TRANKELL, I, ÖJENDAL, J. 1996. When Every Household is an Island: Social Organization and Power Structures in Rural Cambodia. Uppsala Research Reports in Cultural Anthropology #15, Department of Cultural Anthropology, Stockholm, 98 p.

PERERA, L.R. 2006. *Factors affecting the formation of FWUCs in institution building for PIMD in Cambodia: Two case studies.* Working Paper 113. Colombo, Sri Lanka: International Water Management Institute, 19p.

RANDEY, S. HUMNATH, B. 2009. Rice production in Cambodia: will exports continue to growth? Manila: International Rice Research Institute (IRRI).

REYNAUD-CRESSENT, B. 2001. « Suivre des règles » dans les organisations. In: Revue d'économie industrielle. Vol. 97. Organisations et institutions : la centralité des règles. pp. 53-68.

Royal Government of Cambodia. 2003. Decree on participatory irrigation management and development in Cambodia. Preliminary Draft. 19 p.

ROUSSEAU, P. BALMISSE, S. 2009. Stung Chinit irrigation and rural infrastructure Project. Main lessons learnt from project implementation. 24 p.

SAMPHOIS, S. BUNNARITH, C. 2004. Country Report: Cambodia. Water resources management in Cambodia.

SINATH,C. 2001. Investment in land and water in Cambodia. Ministry of Water Resources and Meteorology. Phnom Penh. 24 p.

THUN, V. 2008. Irrigation water use in Takeo province: problems, conflicts and solution. *In Annual development review* 2007-08. Phnom Penh: Cambodia Development Resource Institute.

THUON, T. 2007. Localizing Development and Irritation Management System in Cambodia: Case studies in Kamping Pouy, Sdau Kaong and Stung Chinit. A draft paper for RCSD International Conference on "Critical Transitions in the Mekong Regions", Chiang Mai, Thailand, 9 p.

TREBUIL, G. HOSSAIN, M. 2004. LE RIZ - ENJEUX ECOLOGIQUES ET ECONOMIQUES, 265 P.

UPHOFF, N. 2004. System of rice intensification responds to 21st century needs. Rice Today, pp. 42-43.

VARIS, O. KUMMU,M. KESKINEN,M. 2006. 'Editorial'. Water Resources Development, vol. 22 (3), pp. 395-398. Routledge, Oxfordshire.

Equipes IRAM-AVSF-GRET. 2008. Facilité d'innovation sectorielle – ONG. Interventions sur l'utilisation de l'eau en agriculture. Dossier technique, 44 p.

Other sources: DVD

MOUILLOT, R. La gestion de l'eau dans les polders de Prey Nup. GRET, 2007. 1DVD, 20 min.
MOUILLOT, R. La communauté des Usagers des polders de Prey Nup. GRET, 2007. 1DVD, 30 min.

Web:
Escabasse, D. Kompong Cham. Newspaper. http://www.cambodgesoir.info/. September 9, 2009.
CDRI website. Cambodia. http://www.cdri.org.kh/. October 10, 2010.
FAO website. Cambodia. http://www.fao.org/nr/water/aquastat/stm/. October 11, 2010.
CETC, Phnom Penh. Aux sources du Polpotisme. http://www.jennar.fr/index.php/aux-sources-du-polpotisme/. September 14, 2010.
http://www.ruralpovertyportal.org/web/guest/country/home/tags/cambodia/. October 11, 2010.
World Food Program, CSD. Food security Atlas of Cambodia, 2002.
http://www.foodsecurityatlas.org/khm/country, October 27, 2010.

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Appendix 1: A Typology of Irrigation Systems in Cambodia – Synthesis

Draft version # 2
Date: 5 March 2010
Last reviewed by: AD

A. REVIEW OF EXISTING CLASSIFICATIONS AND DESCRIPTIONS

Previous experts working on the irrigation sector have used different criteria or defined specific categories to describe the water management systems in Cambodia.

	1	2	3	4
Source	Irrigation Sector Review for the TWGAW (2006)	Chann Sinath [2001, "Investment in land and water in Cambodia", in FAO proceedings of the Regional Consultation (Bangkok: FAO/RAP)]	CISIS database	Halcrow typology (1993)
Criteria to classify the different water management system	- Type of water control: Reservoir (with dam or dyke), pumping (from a stream, a prek, a lake) or polders - Level of canal network development (0 or I or I+II or I+II+III) and / or drainage (D)	3 criteria: cropping season, water acquisition system and water source (reliability). 6 different system categories: - Gravity irrigation - Pump stations - Mobile pumps - Shallow bunded reservoirs - Colmatage canal - Polders	5 criteria: -Function of infrastructures (Flood protection / Wet season supplementary irrigation / Dry season irrigation / Recession irrigation / Sea protection (polder) / Other) - Origin of irrigation water (Surface / Underground / Mixed / No irrigation) - Main intake and secondary intake (Prek / River weir / Reservoir / Basic river pumping / Borehole / No intake / Other) - Distribution network (Gravity / Pressure / Mixed / None)	4 main categories (A Vol.1 p.11): - Canals offtaking from natural lakes, rivers or stream by gravity - Canals abstracting from rivers via pump stations - Reservoirs storing water from run-off, streams or rivers for supplementary wet season irrigation - Reservoir storing flood waters from the Tonle Sap/Bassac/Mekong system
Some limits?	No variety of systems. Used as a basic tool for description		Difficult to determine the main role played by the system and for somebody consulting the database to understand clearly which type of system it is	

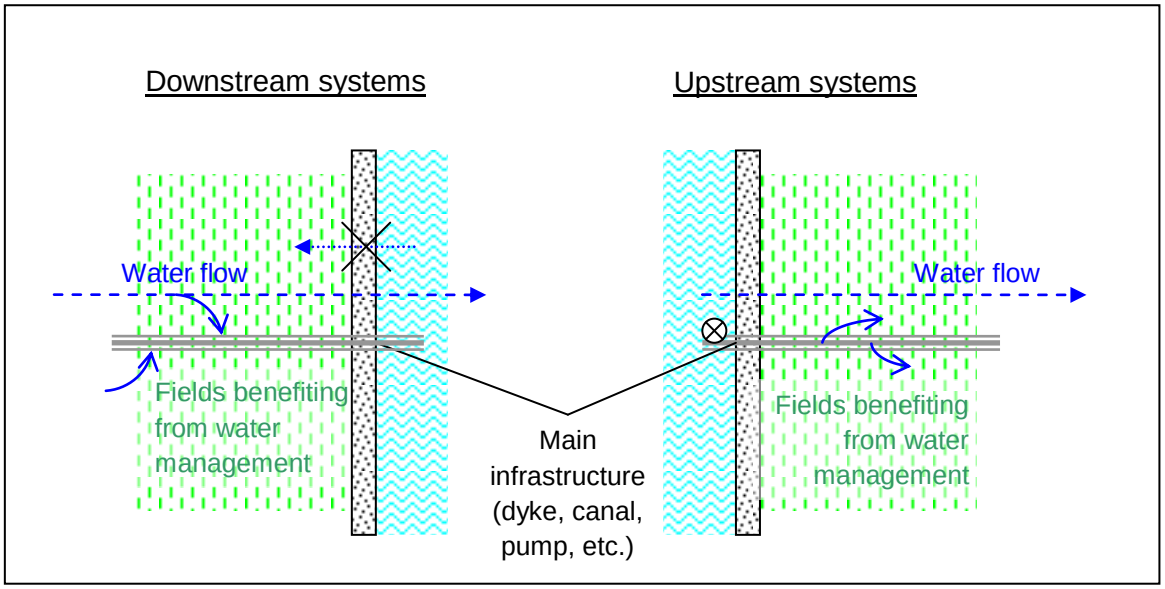
B. PROPOSED TYPOLOGY

Partly based on these 4 models for irrigation system descriptions reviewed above, we propose here to define a new typology of the most frequent systems found in Cambodia and to provide tools to describe each type in more details in order to understand what is the exact system functioning and potential.

The purpose of defining a typology is to recognize important differences between systems that require specific attention from the technicians and in some case specific development strategies.

1. UPSTREAM VERSUS DOWNSTREAM SYSTEMS

To differentiate two groups of water management systems in Cambodia, we propose here a rather tricky criterion: upstream / downstream systems. We call “downstream systems”, those that are more drainage / protection oriented, and “upstream system”, those that are more distribution / irrigation oriented. In “downstream systems” the main infrastructure (a dyke or a drainage canal) is downstream in comparison to the protected fields benefiting from water management. In “upstream system”, the main infrastructure (dam, canal, pump, etc.) is situated upstream to the irrigated area.



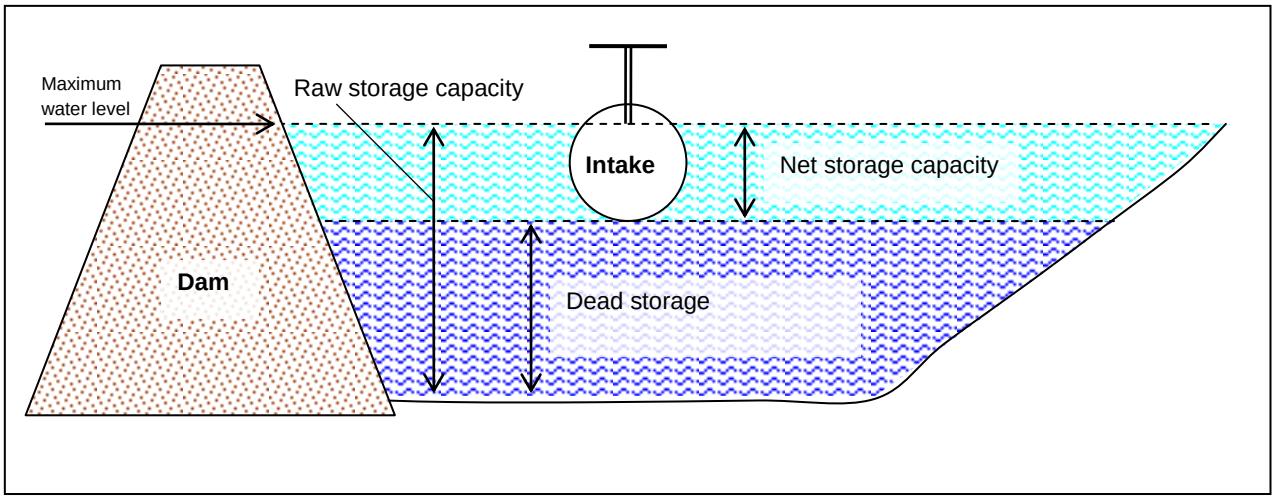
2.6 Upstream water management systems:

2.6.1 *Stream and runoff (offstream) reservoir*

This is the major category. The stream and runoff reservoirs are the most frequent systems for medium and large irrigation schemes designed and build with big investments. These reservoirs are created by constructing a dam that allows the storage of water either within a stream or on land collecting water runoff.

These reservoirs can be distinguished according to:

- The water origin: permanent river / ephemeral stream / surface runoff / ground water, with larger or smaller catchments area
- The level of the net storage capacity (Carry-over storage)



- The regulation system (gate / spillway): only systems with water gate can regulate the reservoir storage capacity
- The distribution network
  - from large area flooding to small block water level control with fixed quantity sharing system or gates that have to be operated at different level
  - canal & drain distinct systems or canal-drain system
  - primary to quaternary distribution canals
- The agricultural seasons and cropping practice (see below)

2.6.2 *Flood recession reservoir*

These reservoirs are mostly built in the flood plains of the Tonle Sap often made of 3-4 dikes which will capture the flood water and allow it to be released for supplementary irrigation of recession rice or other crops during the dry season. Some systems are also in the flood plains along the Mekong, Tonle Sap and Tonle Bassac rivers.

Some stream reservoirs (type 1) are very similar, because they are developed within the Tonle Sap flood plain, but their main water source during the dry season is a permanent stream. Like for Lake Flood Reservoir, these systems are used only for recession cropping and have a very high economical potential.

2.6.3 *River weir / Diversion river weir and canal*

The infrastructures include a river offtake or a canal offtaking from a river with river water level control system provided by a barrage or a diversion weir.

Stung Chinit system, one of the large irrigation systems in Cambodia, is mainly a diversion river weir which has a large dry season irrigation capacity, because Stung Chinit is a major river with a permanent flow during the dry season. The weir creates also a reservoir which can supplement the main canal.

2.6.4 *Prek / colmatage canal*

A Prek is a canal through a river bank which is fed by the river when its water level rises (“Prek” is a Khmer word whose meaning change according to the region: “hand-made canal”, “canal through river bank” or “small stream”). There is no control of the river water level like in river weir systems. As there is no reservoir and settling of the water before entering the Prek, the water is still charged with sediments.

The Prek systems are mainly developed along the Mekong Tonle Sap and Tonle Bassac rivers through their banks to bring the water to the lowland behind it. Many such Prek systems were built or improved during the French colonial period.

These Prek have several purposes:

- colmatage. This system that uses dikes and sluices to provide controlled annual inundation (Perera, 2007).
- natural inundation of low area, pond (boeung) used as reservoirs for receding rice and vegetable crops
- natural drainage of the water back to the river
- irrigation canal if there is a pumping station to supplement water when the river water level is low

These Prek are often associated with pumping during the dry season.

2.6.5 *Station & mobile pumping*

In most of the above system, irrigation is mostly done by gravity and pumping costs are low or limited to individual farmers. Station pumps are large and collective systems mostly organized by the government with funds from donors. The station is fixed on the river bank of a permanent river to feed a canal system distributing the water to a large area (> 50 ha).

The pumps are used mostly in the dry season for intensive cropping with high returns. The pumping systems may allow supplementing irrigation during the rainy season in case of rain shortage.

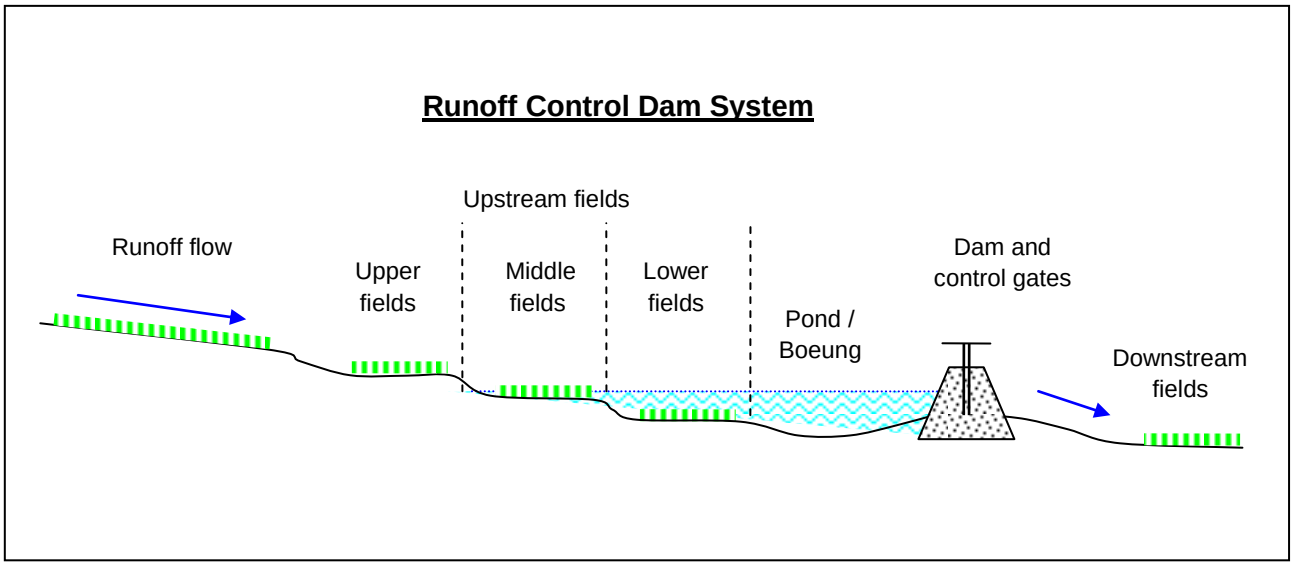
2.6.6 *Micro-irrigation / borehole irrigation / manual lifting systems*

Small irrigation systems such as small electric pumps, treadle pumps to lift water from borehole, neighboring ponds or river are very demanding in terms of labor. They are valuable for very small plots cultivated with high value vegetables for marketing or to supplement the paddy nursery, but are rarely used on the rice fields. Drip irrigation systems are sometime used for intensive gardening systems.

2.7 Downstream water management systems

2.7.1 *Runoff control dam*

These dams are retaining excessive runoff in order to maintain a sufficient level of water in the fields upstream. It is especially important at the end of the rainy season. Sometimes these dams can maintain a small reservoir upstream at the end of the rainy season which can be used for downstream irrigation or upstream irrigation with pumping.



2.7.2 *Flood protection dikes*

These dykes prevent water from streams to inundate the fields. Either they are used as roads or more often they are gated and they can be used as runoff control dam.

2.7.3 *Drainage canal*

These canals increase the drainage from fields and avoid or reduce inundation. Many farmers' made or natural small canals are important in this regard and intersecting such "natural canals" with dikes and gates for managing irrigation can provoke inundation problems upstream, a frequent problem with infrastructures built without consultation with the local farmers.

Sometimes canals have two functions drainage from upstream (to avoid inundation) and irrigation (facilitate water transfer) to downstream fields depending on the season or rainfall abundance.

2.7.4 *Polder*

The polder dikes protect inside fields from saline water intrusion from the sea mainly during high tides and storm period. To be efficient and avoid inundation, the runoff water must be drained within and outside the polders towards the sea during the low tide thanks to inside drainage canals. The polder dyke and gate are used in the same way as a runoff control dam (see above) to control the water level in the fields inside the polders. This control requires that farmers agree to follow a common cropping calendar, which can differ only according to field elevation.

Appendix 2: The Statute of the FWUC

CHAPTER I

NAME AND OBJECTIVE

Article 1 The community is named the Farmer Water User Community, which is represented by the acronym FWUC.

Article 2 The FWUC intends to:

- Bring together the farmers who are farming land in an irrigated area and form a group for facilitating the supply of irrigation water to them;
- Supply adequate water for irrigation to the members;
- Acquire the knowledge of management, maintenance and operation of the irrigation system as well as financial affairs;
- Increase the yields and seasonal cropping;
- Facilitate the support from the government (intervention when they meet obstacles and marketing problems).

Article 3 The FWUC will respect democratic principles under which all decisions concerning the irrigation issues will be decided by the general meeting.

Article 4 The FWUC will have its statute and will be registered with the Ministry of Water Resources and Meteorology.

CHAPTER II

MEMBERSHIP CRITERIA

Article 5 To become a member of the Community, member has to meet the following criteria:

- Be a land owner or tenant whose land is located in the same irrigated area;
- Be at least 18 years old of both sexes;
- In cases where the land owner or tenant is under 18 years old, his/her guardian represent him/her;
- Adhere to internal regulations of the FWUC;
- Apply for membership of the FWUC by printing with the right thumb.

Article 6 Conditions required to cancel membership of the FWUC:

- Dies
- Land owner/tenant sold or transferred his/her land to another owner/tenant.
- The member does not adhere to internal regulations of the FWUC.

Article 7 Every farmer of the FWUC has the following duties:

- To maintain and improve the irrigation system;
- To follow the guidelines and regulations of the Community.

Article 8 Every farmer member shall envoy the following rights:

- To express opinion in a meeting;
- To vote and be elected in the FWUC;
- To resign from membership;
- To propose and put their opinion to the Committee of the FWUC.

CHAPTER III

ORGANIZATIONAL STRUCTURE

Article 9 The FWUC will be led by the Committee of the FWUC, which is elected and has the following members:

- One chairman, in charge of general supervision;
- One first-vice chairman, in charge of maintenance and repairing plan;
- One second-vice chairman, in charge of water supply distribution and record keeping;
- One treasurer, in charge of the finance;
- All chiefs of the FWUGs are members (Article 15).

Article 10 The committee of the FWUC shall have the following duties:

- To prepare the work plan for the Committee;
- To formulate the statutes, contracts and internal regulations of the Community;
- To maintain the irrigation system in good condition to enable the provision of irrigation for whole production season;
- To manage and distribute water to all members;
- To strengthen the use, maintenance and improvement of the irrigation system in an efficient manner;
- To resolve the problems occurring with the Community;
- To collect the water fee as determined by the Community.

Article 11 The role and duty of the Committee of Community's chairman:

- To invite the representatives of the FWUC and members to take part in the meeting;
- To chair the meetings concerning the irrigation;
- To direct and prepare annual irrigation plan including budgeting;
- To implement the work programs which are approved by the general meeting as planned;
- To examine all the activities of each group;
- To coordinate and carry out public relations;
- To control expenditure in accordance with the approved plan;
- To submit the annual budget and work-plan of the Community to the FWUC general meeting;
- In the absence of the chairman, the vice-chairman shall assume the chairman's role as acting chairman;
- In the absence of chairman and both vice-chairman, one of the members shall be appointed as the interim chairman;
- To be a joint signatory along with the transferor in the matters related to finance;
- To serve as an arbitrator for disputes among members;
- To discipline any member who fails to carry out the duties prescribed by the Community, or, to observe the regulations of the Community.

Article 12 The Role and Duty of the First Vice-Chairman:

- To monitor the irrigation system regularly;
- To define the scope of the work of farmers to maintain and repair the network
- To prevent any individual from digging dikes for fishing purpose or letting loose cattle graze on the dike, etc.;
- To plan request for reparation of the irrigation system to submit the Committee;
- To report regularly on the repairs carried out to the irrigation systems;
- And, to serve as the Secretary of the Committee of the FWUC.

Article 15 In the organizational structure of water management, subsidiary to the FWUC is the FWUG.

Article 16 The role and duty of the head of the FWUG:

- To implement the work-plan/timetable of the Community
- Coordination of the work between FWUG and the Community
- Collection of the fees for water use from all members as determined by the Community.

Article 17 The FWUG

The FWUG is made up the farmers who use water in the same irrigated area. The formation of the group will be based on the geographical location of the farmland and the boundary of the irrigation

system in that area. Each group should be led by one head elected by all members or their representatives and may have other office bearers, if needed.

CHAPTER IV

MANDATE AND PROCEDURES OF THE COMMUNITY

Article 18 The mandate of the Committee of the Community is 3 years

Article 20 The procedure for the election for the Committee of the Water Farmer User Community:

The election of the Committee shall be made thought separate votes (the first vote for the chairman, the second vote for the first vice-chairman, the third vote for the second vice-chairman, and the fourth vote for a treasurer). The official final election is made when the vote is the majority of the voted members. The vote can be conducted when the members are present, the vote cannot be conducted and the second vote should be conducted within 3 days. The result of the votes should be confirmed and acknowledged by the Chairman of the meeting and communicated to the institutions concerns.

CHAPTER V

THE REVENUE, EXPENSE AND AUDIT OF THE FWUC

Article 22 Source of revenue

The sources of revenue of the FWUC are:

- Fees collected;
- Assistance or credit from government, IOs, and NGOs;
- Profit from the business operation of the Community;
- Various levies and fines.

Article 23 Expense

- Repair and maintenance of the irrigation system
- Fuel (in case of pumping)
- Support to the Committee of the FWUC
- Administration
- Miscellaneous

CHAPTER VI

RULES AND REGULATIONS

Article 26 All members of the FWUC must attend meetings as schedule and invited by the Committee of the FWUC

Article 27 All members of the FWUC having the rice farmland at the head of the canal shall allow others members who have the next boundaries farmland or far away to dig the canal in order to bring water to their rice field.

Article 28 To irrigate the rice fields, each member should take the responsibility to control the flow rate and the quantity of water in his rice field to avoid wastage.

Article 30 All members have the duty to contribute in the big repair by contribution of labor or payment as determined by the Committee of the FWUC in every season.

Article 32 The Committee of the FWUC shall assure the water distribution to all members to irrigate their crop in a fair manner.

CHAPTER VII

PUNISHMENT

Article 37 Penalty

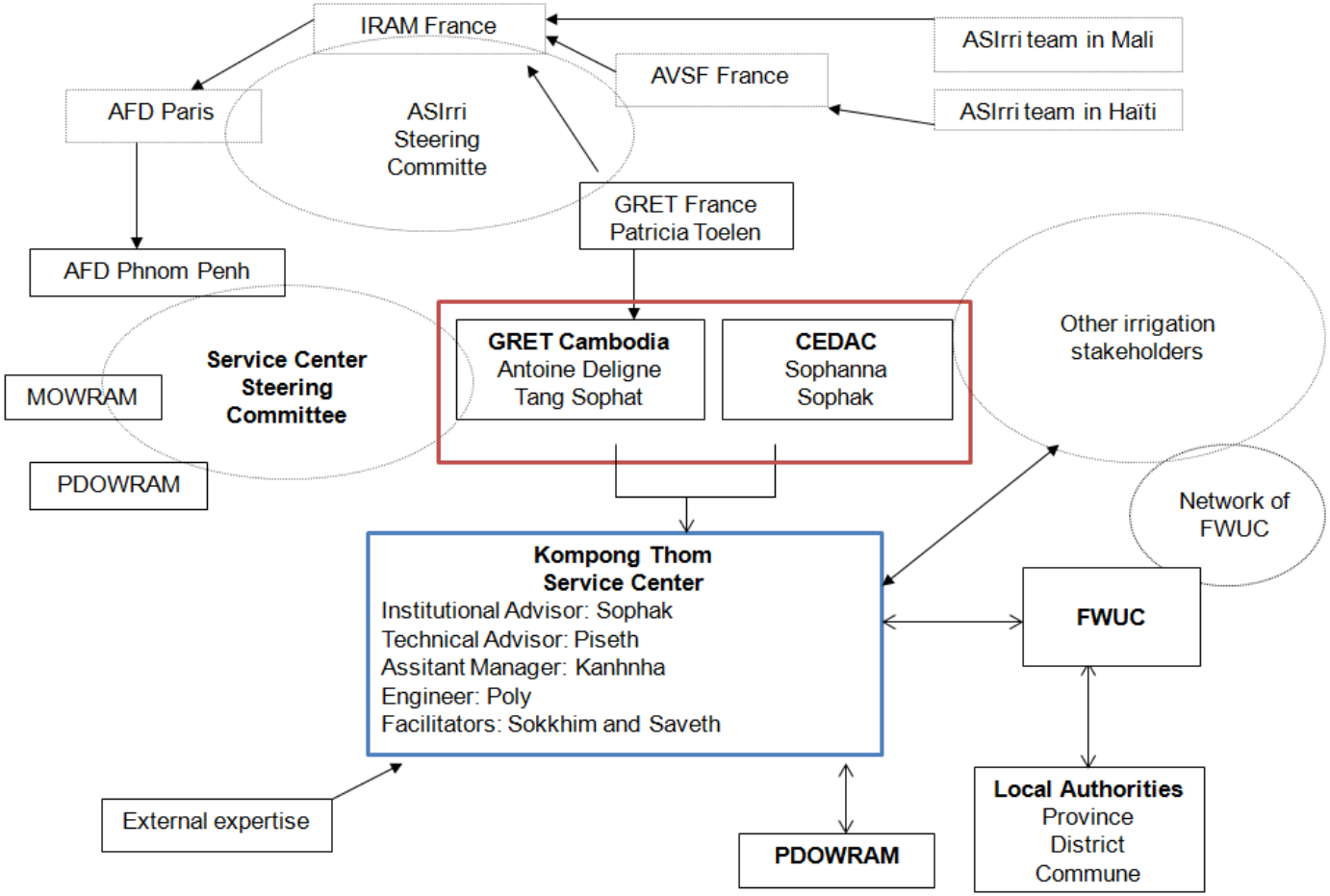
Penalties will be put on any activity considered against the interests of the FWXUC and the levels of fines are determined as follows:

- Absence from the meeting on 3 consecutive times shall be fines…riels or be dismissed from the membership;
- Do not contribute the labor or maintenance proposed by the group's members. The penalties are:
    - Get warning
    - Pay the fine of…riels
    - Get water supply cut off for…days and/or
    - Be sent to the communal authority for legal action.
- Illegal diversion of water from canal shall be fined…riels
- In case that the upper stream/canal operation fails to open sluice-gate as scheduled or open and/or close sluice-gate without permission the guilty part shall be fined…riels. If there is an opening and/or closing sluice-gate done for fishing purpose the fishing gear shall be confiscated in addition to the fine;
- Digging the dike or damaging the canal systems or its structure shall be fine…riels. In addition to the fine, the doer has to do the reparation. If the doer is a child, his/her parents shall do the reparation or pay amount of damages.
- Causing damages by leading the cattle into the canal shall be fined…riels, or confiscate the cattle until the fine is paid.
- Wasteful use of water for irrigation shall be fine…riels
- Blocking the canal and diverting water to irrigate without permission of for other purposes shall be fines…riels.

Any member who refuses to pay the fine or resorts to violence shall be sent to the communal authority. Activity that is considered inappropriate by the Community and subjected to fine is:

- Fail to maintain the canal and use the water wastefully, the association shall use the following measures:
    - Warning
    - Pay the fine…riels
    - Cut off water supply for…days
- Fail to respect the water distributing program determined by the Community, a member shall get:
    - Warning
    - Pay fine…riels
    - Cut off water supply for…days

Appendix 3: The project organizational chart ASIrri



Source : IRAM-GRET-AVSF

Appendix 4: irrigation systems capitalization

Irrigation system name	Stung Chinit (Kompong Thom)	Pram Kumpheak (Kompong Cham)	Teuk Chha (Kompong Cham)	Prey Nup (Sihanouk)
Scheme plan	Dam, spillway, reservoir, I, II, III gravitational canals diversion	Several dams ; reservoirs, I and II gravitational reservoirs	2 linked dams-reservoirs barrages – I, II, III gravitational canals	Polder
Water resources, catchment area, etc.	Stung Chinit river	Superficial flow and ground water	Superficial flow and ground water	Area of polders : lowland of coastal catchment area
Rate of flow	Annual discharge at the location of the reservoir 54.7 m^3/s -Max mean monthly discharge 241.8 m^3/s -Min mean monthly discharge 2.7 m^3/s			
Hydraulic infrastructures	Dam on Stung Chinit river, spillway, reservoir, partiteurs, II and III canals.	Dams	Dam, spillway	Polders, reservoirs, canals, partiteurs, irrigation sluices, thresholds
Protection hydraulic infrastructures de	dikes, spillway, II and III drain			Dikes, vannes, external drains
First rehabilitation date	1975 (Khmers Rouges)	1972 (Khmers Rouges)	1955-1957	Early 1930s (French Protectorate)
Last rehabilitation date	2001-2007 by MOWRAM- ADB	2000 by PDOWRAM	1995-97 by ADB 1998-2003 under Prasac project (UE)	1999 - 2003 by MOWRAM – AFD – Handicap International
Total area rehabilitated (ha)	2,400 ha	492 ha	4,200 ha	10.454 ha
Area out of rehabilitation (ha)	5,000 ha	~ 600 ha		
Farmers water users' number	2,828			~15.000
Coating on the canal walls	No	No	I canal	No
Drainage characteristics	II & III drains (too much drainage, sandy soils)	Drain II	Canals – drains	External canals with dikes hard to maintain

Table: Physical characteristics

Irrigation systems groups	Stung Chinit (Kg Thom)	Pram Kumpheak (Kg Cham)	Teuk Chha (Kg Cham)	Prey Nup (Sihanouk)
Theoretical responsibilities as regards I, II and III infrastructure construction	MOWRAM IV: farmers	I : MOWRAM II, III : farmers	MOWRAM	MOWRAM
Actual actors roles as regards I, II and III infrastructure construction	Id. IV: not built	Id. II, III not rehabilitated	Id.	Id.
Theoretical responsibilities as regards I, II and III infrastructures management	I: PDOWRAM II, III: FWUC IV: farmers	FWUC	I: PDOWRAM Other: FWUC	CUP
Actual actors roles as regards I, II and III infrastructures management	Id.	Id. With commune	Commune chiefs	Id.
Theoretical responsibilities as regards I, II and III infrastructures maintenance	Reservoir – I canal – II drains: MOWRAM Other: FWUC	FWUC? Not defined	FWUC? Not defined	Protection I dikes , hydraulic infrastructures on dikes, external drains: MOWRAM Hydraulic infrastructures within the polders: CUP
Actual actors roles as regards I, II and III infrastructures maintenance	Id. Insufficient FWUC financial capacity	No maintenance	No maintenance	Id., CUP has to intervene urgently
Water irrigation cost / Irrigation cost	ISF 2010 = 30,000 KHR/ ha (7,5 USD) It can increase until 60,000 KHR (expected in 2013)	No fee	No fee	ISF 2010 : 53,000 KHR / ha (13 USD)
ISF collection (%)	~80%			~80%
Existence of management transfer process	FWUC registration (2002) Transfer Recognition letter by DPREM (2009)	FWUC registration (2003)	FWUC registration (1999)	FWUC registration (2000) Framework agreement for the responsibilities transfer with MREM (2008)
Date of the management transfer beginning	Gradual (as regards the end of the project) (2005-2009)		2003, end of Prasac project	Gradual (as regards the end of the project) (2000-2008)

Table: Institutional / organizational characteristics and rehabilitation management

Irrigation systems groups	Stung Chinit (Kg Thom)	Pram Kumpheak (Kg Cham)	Teuk Chha (Kg Cham)	Prey Nup (Sihanouk)
The average of irrigated area / family (ha)	0.85 ha	1.1 ha	0.9 ha	0.7 ha
Wet season crops	Rice	Rice	Rice	Rice
Dry season crops	Rice, vegetables, watermelon	Rice	Rice, vegetables, watermelon	Rice, corn, vegetables
Type of labor force	80% family	80% family	80% family	80% family
Main ITK (for main crop):	Ploughing, direct sowing, harvest	Nursery sowing, ploughing, transplanting (fertilizers), harvest	Nursery sowing, ploughing, transplanting (fertilizers), harvest	Nursery sowing, ploughing, transplanting, fertilizers, insecticides, harvest
Farms differentiation process	Access to rotary cultivator. Access to labor force Access to paid work (seasonal or perennial migration)			

Table: Exploitation and agricultural development

Appendix 5: Prey Nup polders

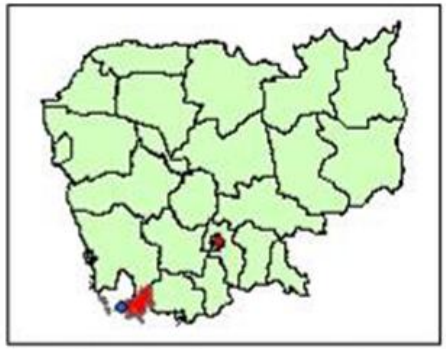


Figure: Sihanoukville province

Source: Lagandré, 1998

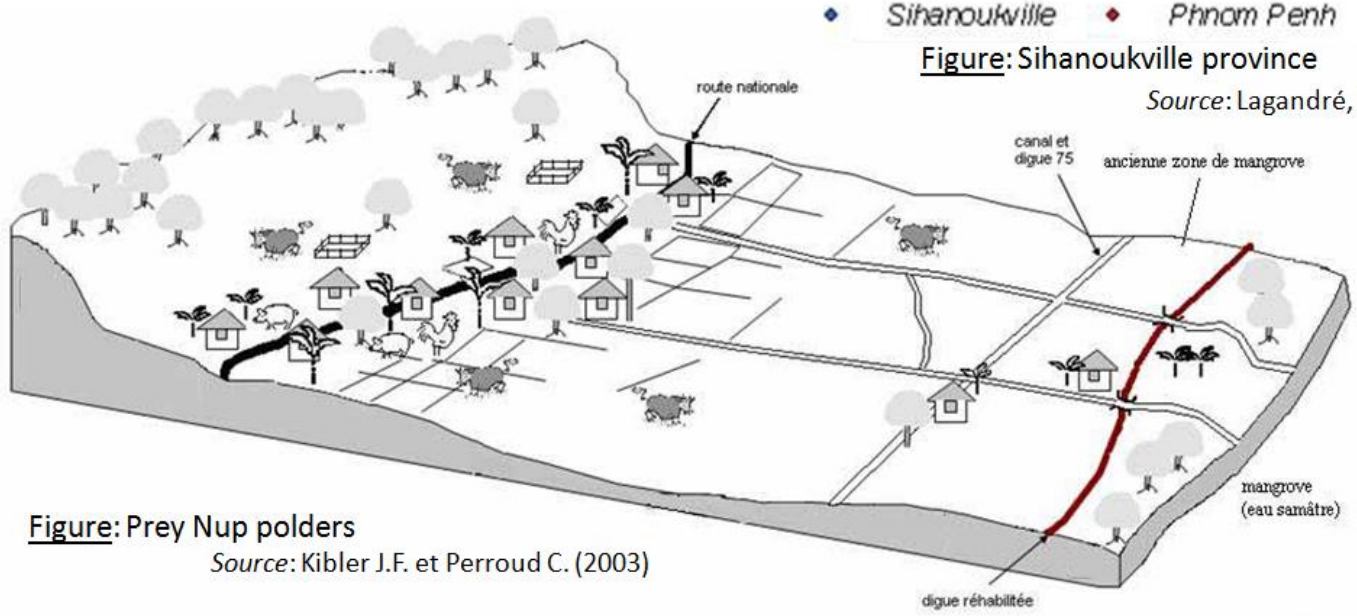


Figure: Prey Nup polders

Source: Kibler J.F. et Perroud C. (2003)

Appendix 6: Stung Chinit irrigation scheme

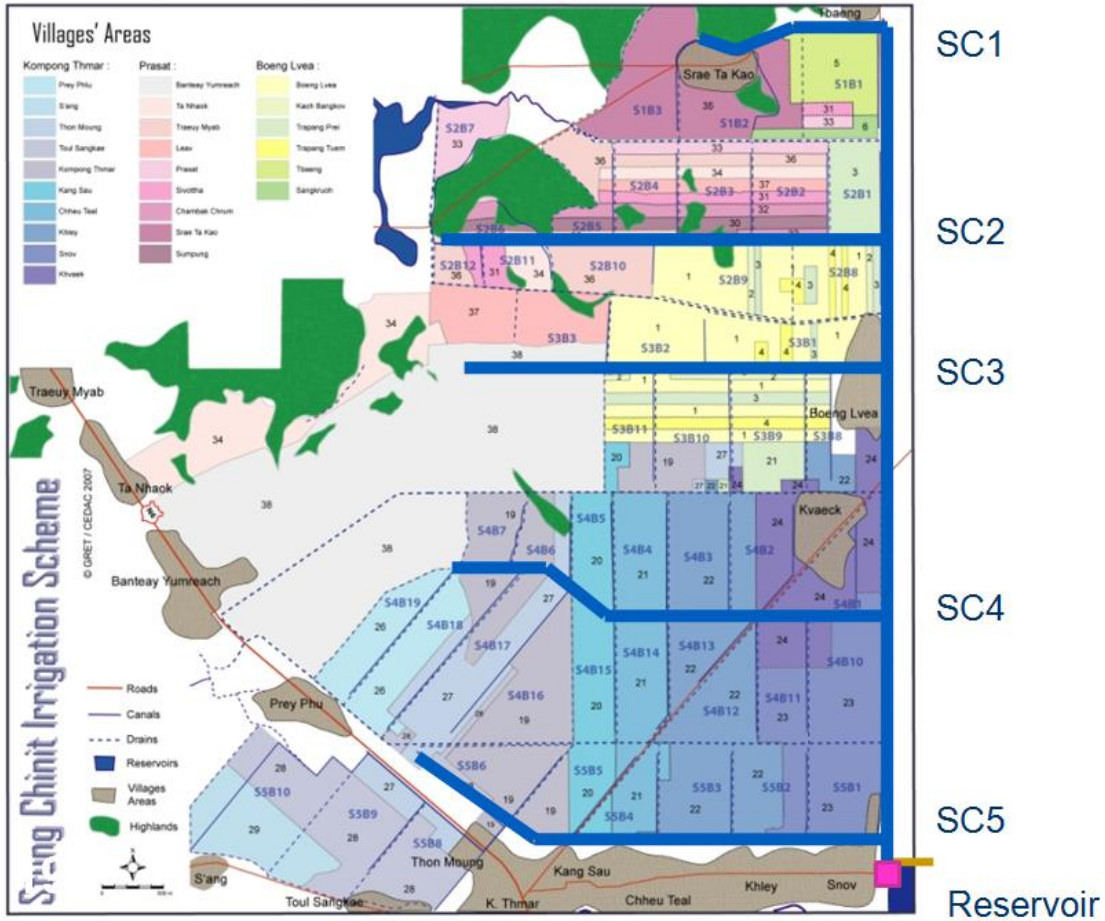
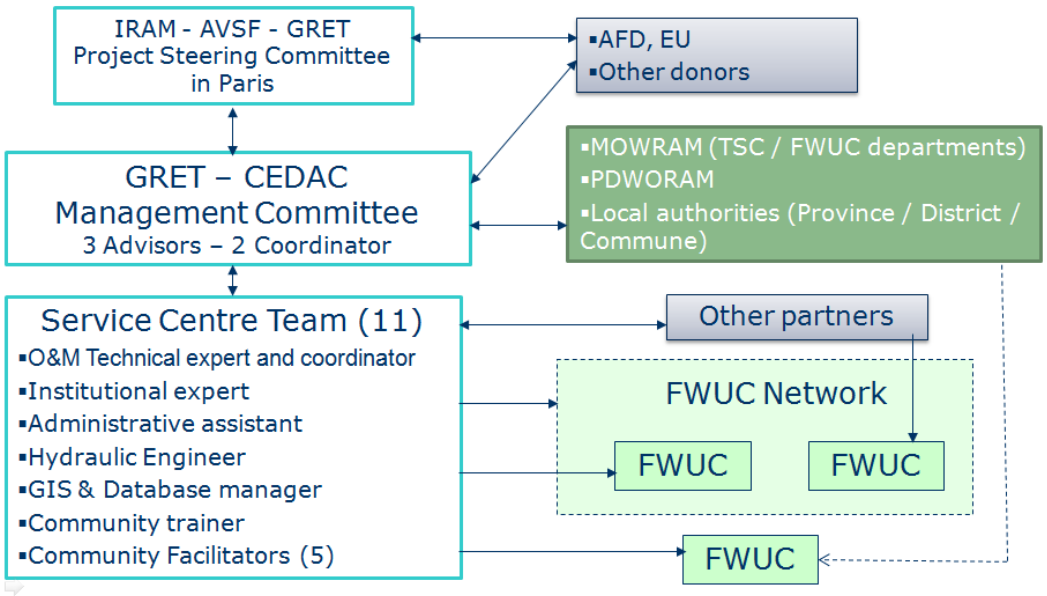


Figure: Stung Chinit scheme, Kompong Thom Province

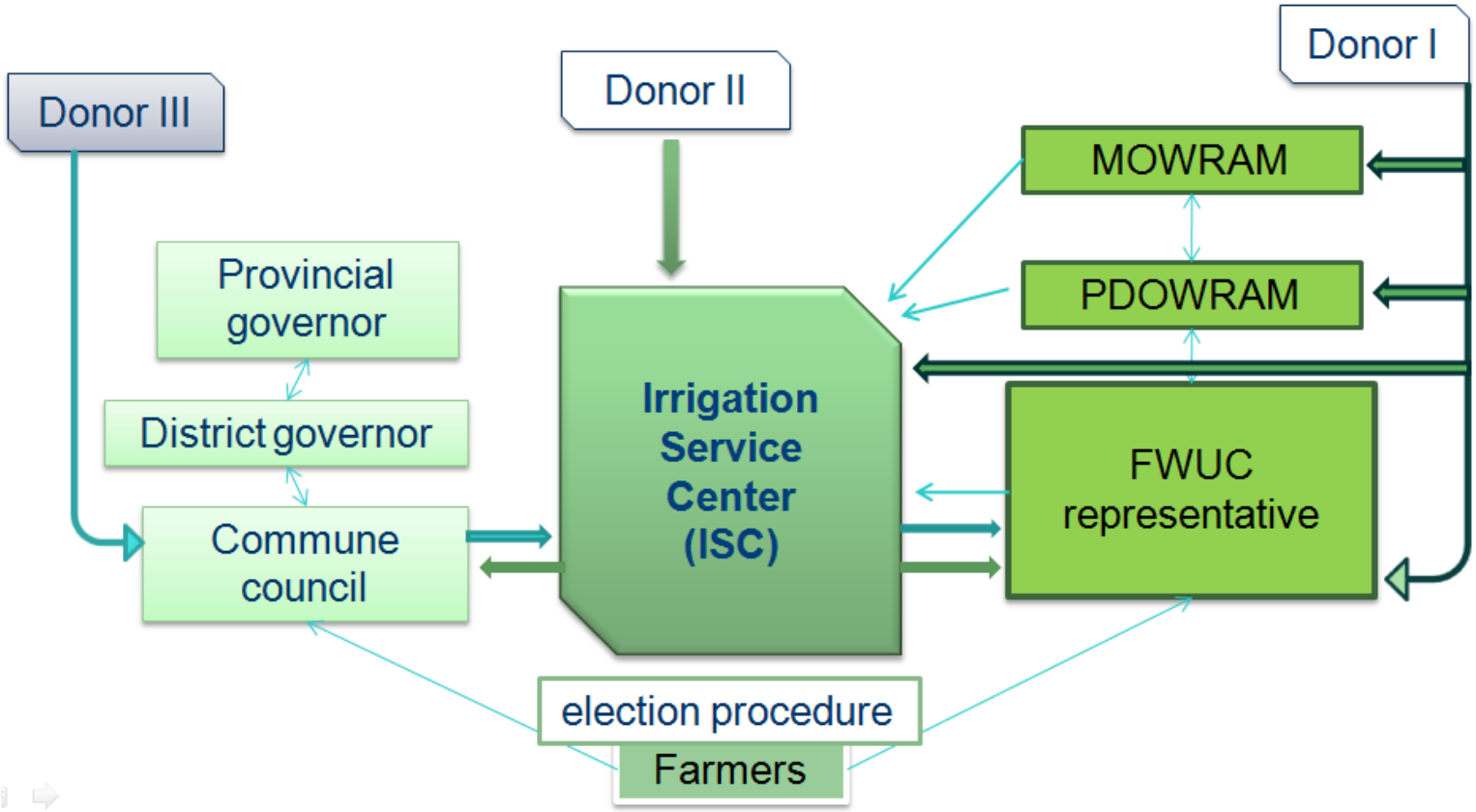
Source: Stung Chinit FWUC

Appendix 7: Project organizational chart of the ISC



Source: GRET-ISC

Appendix 8: The ISC strategy



Source: GRET-ISC

Appendix 9: The FWUC Network proposal

By Antoine Deligne

- **Possible objectives / mission**

1. Train FWUC leaders and exchange experiences between leaders
2. Provide advises and mobilize technical support for FWUC
3. Promote FWUC leader responsibility, transparency and quality in FWUC and water management
4. Exchange information between members (Legal documents, project and funding opportunities, procedures, etc.)
5. Promote the member needs to donors and government
6. Facilitate and improve relations with MoWRaM
7. Advocate (*préconiser, recommander*) for the farmers and FWUC opinions regarding irrigation and water management issues
8. Represent members interests at national level and in irrigation forum
9. Publish policy papers related to members experiences and opinions

- **Issues related to the Statutes of the Network**

1. Who are the members and what are the criteria for membership? (see proposal)
2. Who manage the network and its budget?
3. Who takes decisions and how?
4. What is the role of the promoters CEDAC – M-Power – GRET – ISC?
5. Who will represent the Network?

- **Proposed activities and calendar for 2010**

4 meetings and 1 discussion:

1. First general meeting with potential members on 26 March 2010 in PP
2. Exchange visit to one or two FWUC in one province in June 2010
3. Second general meeting with FWUC who have applied for membership in Stung Chinit in September 2010
4. Exchange visit to one or two FWUC in one province in December 2010
5. Discussions about one first policy paper: June to December 2010

In early 2011: Network official registration

- **Membership**

4 kinds of membership according to the stage of FWUC development

1) Observer
2) Learning member
3) Full member
4) Leading member

The purpose to develop criteria for different kinds of membership is to encourage and promote quality in FWUC management. It is important as well for the network credibility.

Proposed criteria:

1. Scheme size is minimum 50 ha
2. Infrastructure is partially functional and/or there is a clear project for construction with a budget available and an implementing agency

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3. Irrigation is functional over at least 50 ha.
4. FWUC membership has been registered and the members represent at least 67% of all the farmers in the irrigated area (Payment of ISF can be considered has membership.)
5. The FWUC has statutes, internal rules and by-laws approved by the members (General Assembly)
6. One committee has been elected (at least one time)
7. One General Assembly has been organized
8. ISF has been collected at least one time.
9. The FWUC is recognized by the local authorities at commune and district level (official letter).

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10. The FWUC is recognized officially by the PDoWRaM or the MoWRaM.
11. The FWUC has been functioning for at least 3 years.
12. The FWUC committee is re-elected every 3 years (at least one re-election).
13. One General Assembly of the members is organized every year.
14. There is a clear rule for fixing ISF level.
15. ISF collection is organized at least once a year.
16. The FWUC has a bank account.
17. The FWUC produces a financial report and a budget every year which is approved by the GA.
18. There is water management plan approved by the GA.
19. Some yearly maintenance is carried out by the FWUC.

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20. At least 70% of the farmers in the irrigated area pay ISF.
21. ISF level is at least 40,000 riels / ha.
22. There is a coordination committee including local authorities and PDoWRaM in charge of supporting the FWUC.
23. The FWUC has signed an agreement on sharing responsibilities in operation and maintenance with PDoWRaM and/or MoWRaM.

To become an observer the points 1 and 2 at least must be respected.

To become a learning member all points from 1 to 9 must be respected.

To become a full member all points from 1 to 19 must be respected.

To become a leading member all points from 1 to 23 must be respected.

Moreover, FWUC have to submit a request to become a member who should be approved by a majority of full members (and leading members). The FWUC fill the criteria list by itself and submit it to a leading member who control and approve it. The leading member can ask supplementary information (official letter, general assembly minutes, etc.).

A FWUG who respect the same rules as a FWUC can apply to become a member only if the FWUC it belongs to is not yet a member.
The leading members play a specific role in accepting and guiding learning members in the Network. Each learning member should be linked to one leading member for coaching.

- **Decision making:**

Observers cannot participate in any decision making.
Normal decisions are adopted by a majority of 67% (2/3) of the members (learning, full and leading).
Statutes approval and modifications or new members approval are taken by a majority of full and leading members (learning members cannot participate in these decisions).

- **Management board and elections**

The management board will be composed of 3 or 4 people from at least 3 different FWUC:

- the president
- the secretary
- the treasurer
- [one member]

One member is nominated vice-president and must replace the president in case of incapacity. The president and the vice-president must come from a full or leading member.

The president is elected by all members among the candidates. After the election of the president, the members are elected among the other candidates (3 best results). The positions among them are decided by the members of the management board themselves.

Appendix 10: Terms of reference- internship

SUBJECT: DESIGNING SERVICES TO REACTIVATE FARMER COLLECTIVE ACTION IN IRRIGATION MANAGEMENT IN CAMBODIA

The purpose of the study is to define a process for re-building the farmer confidence to invest in their scheme management after a history of organizational failures.

CONTEXT

The FWUC in Cambodia
The ASIrri project

OBJECTIVES OF THE STUDY

1) ANALYSIS OF EXISTING EXPERIENCES AND DATABASE

By looking at three case studies, the research will review the reasons for under performance of irrigation schemes. It will look at technical, economic, organizational and social aspects. Why some FWUC who received support from project and government agencies could not sustain their functioning? Was the problem mainly linked the support mechanism or to the socio-economic context or both?

The student will propose a diagnosis of the existing schemes. He will also review the existing diagnosis practice of the ISC team and propose improvements. Data collected at field level should be made available through database and mapping system. How to design such database and mapping system for an easy use for the FWUC management and the ISC team?

2) CONSIDER AND TEST NEW WAYS TO SUPPORT FWUC FUNCTIONING

After a careful analysis of the difficulties met by those FWUC, the research will propose some improvement in terms of the organizational model both of FWUC and support system for FWUC. It will look at the necessary conditions to build up confidence among users to invest in collective action. To be able to make those proposals, the student will review the existing services proposed by the ISC team and other successful experiences, such as Stung Chinit and Prey Nup. Some of these proposals could be tested in the course of the ISC service implementation.

3) DESIGN SERVICE DESCRIPTION SHEETS

The student will work with the ISC team to frame the service proposal and their implementation process description. It will review the various step of designing and implementing services for FWUC and the questions asked to farmers.
The student will propose a critical analysis of the ISC team experience.

METHODOLOGY

The research will combine field observations, stakeholders' interviews, document reviews and the student will work closely with the team.

Field study
The field study will focus on 3 schemes. The proposed schemes are the following ones:

- Pram Kumpheak (400 ha) in Kompong Cham: under contract with ISC for FWUG organization and scheme improvement of water sharing

- Teuk Chha (3000 ha) in Kompong Cham: the FWUC is managed by local authorities after failure of the first FWUC and different conflicts for water sharing between villages. The ISC is reorganizing the FWUC starting at FWUG level for secondary canal and is also proposing to reorganized water sharing at primary canal level.
- Other according to the student interest and discussion with the project

Prey Nup and Stung Chinit schemes are well documented. They will not be part of this study, but can be used as comparative sources of information. No specific field study should be carried out on those two schemes.

DATA COLLECTION:

In each selected schemes, the student will review:

- the scheme and FWUC creation history, including conflicts and mediations
- the infrastructure condition
- the irrigation efficiency (quantity, reliability and equity)
- the economical analysis of irrigation (costs of O&M + FWUC functioning in comparison to the benefits for farmers)
- the FWUC functioning

Some information will be represented in analytical maps.

INTERVIEWS

For this purpose he will make interviews of all concerned stakeholders either individually or by focus group discussion. Interviews will be recorded for reference and clear quote.

PRACTICAL EXPERIMENTATION

The student will work together with the ISC team in service implementation and will document the negotiation process with the farmers.

REPORT

This research will have two different outputs:

1. According to school obligations
2. A report for ASIrri project

The final version of the report for the project should be finalized on December 2010 latest after reviewing all comments. The project report should be produced in English language.

TIMING AND FINANCIAL ASPECTS

The field research will be carried out during 5 months from mid-April to mid-September 2010.

The student will get 350 Euros/month for this internship. There is a possibility to get access to a computer either in Kompong Thom and Phnom Penh, but this computer will be shared with other staff. For convenience, the student should be equipped.

Appendix 11: cropping and irrigation calendar questionnaire

May-August 2010 - GRET-ISC

Aim: to propose maps as support for villages meeting

Land location

to show the village on the map and the rice fields (and other crops)

1. Where do you live?

- ○ 1. Nek Ta Sneng
- ○ 2. Ta Uk
- ○ 3. Thmey
- ○ 4. Tuol Kvav
- ○ 5. Trapeng Bit
- ○ 6. O Chrok
- ○ 7. Tuol Kpos
- ○ 8. Samrong
- ○ 9. Prey Sak
- ○ 10. Krasang Tamong
- ○ 11. Thmar Kol
- ○ 12. Komar Reach
- ○ 13. Boeng nay
- ○ 14. Trapeng Anhchanh
- ○ 15. Kbal Domrey
- ○ 16. Trapeng thom
- ○ 17. Wat Chas
- ○ 18. Pravas
- ○ 19. Chhuk Qa

2. Where do you cultivate?

- ☐ 1. Nek Ta Sneng
- ☐ 2. Ta Uk
- ☐ 3. Thmey
- ☐ 4. Tuol Kvav
- ☐ 5. Trapeng Bit
- ☐ 6. O Chrok
- ☐ 7. Tuol Kpos
- ☐ 8. Samrong
- ☐ 9. Prey Sak
- ☐ 10. Krasang Tamong
- ☐ 11. Thmar Kol
- ☐ 12. Komar Reach
- ☐ 13. Boeng nay
- ☐ 14. Trapeng Anhchanh
- ☐ 15. Kbal Domrey
- ☐ 16. Trapeng thom
- ☐ 17. Wat Chas
- ☐ 18. Pravas
- ☐ 19. Chhuk Qa

3. which kind of crops?

☐ 1. irrigated rice ☐ 2. rain fed rice ☐ 3. vegetables ☐ 4. fruit-tree

Vous pouvez cocher plusieurs cases.

4. What the size of each plot?

5. Do you have highlands?

○ 1. yes ○ 2. no

6. do you cultivate on your highlands?

○ 1. yes ○ 2. no

Draw cropping and irrigation calendar

See the previous example

water resources

to understand the circulation of water, the availability of water in order to cultivate and according to the season

7. where does the water used come from?

☐ 1. main canal ☐ 2. canalA ☐ 3. canalB ☐ 4. canalC ☐ 5. TD canal ☐ 6. Ô stream

Vous pouvez cocher plusieurs cases.

8. do you have problem of flooded lands?

○ 1. yes ○ 2. no

9. what are the condition of the infrastructures used?

- ☐ 1. main canal good
- ☐ 2. main canal medium
- ☐ 3. main canal bad
- ☐ 4. canalA good
- ☐ 5. canalA medium
- ☐ 6. canalA bad
- ☐ 7. canalB good
- ☐ 8. canalB medium
- ☐ 9. canalB bad
- ☐ 10. canalC good
- ☐ 11. canalC medium
- ☐ 12. canalC bad
- ☐ 13. TD canal good
- ☐ 14. TD canal medium
- ☐ 15. TD canal bad

Vous pouvez cocher plusieurs cases (4 au maximum).

10. When do you cultivate (according to the villages)?

- ☐ 1. dry season (village 1)
- ☐ 2. early wet season(village 1)
- ☐ 3. wet season(village 1
- ☐ 4. dry season (village 2)
- ☐ 5. early wet season(village 2)
- ☐ 6. wet season(village 2)
- ☐ 7. dry season (village 3)
- ☐ 8. early wet season(village 3)
- ☐ 9. wet season(village 3)

Vous pouvez cocher plusieurs cases.

11.When is the peak of water need?

☐ 1. january ☐ 2. feb ☐ 3. mar ☐ 4. apri ☐ 5. may ☐ 6. june ☐ 7. jul,aug ☐ 8. sep ☐ 9. oct ☐ 10. nov ☐ 11. dec

Vous pouvez cocher plusieurs cases (4 au maximum).

12. Do you have access to water when you want?

○ 1. yes ○ 2. no

13. What is your % of security during the 3 seasons?

◯ 1. dry season ◯ 2. wet season ◯ 3. early wet season

14. Is there water until the end of the canal you use?

☐ 1. yes ☐ 2. no

Vous pouvez cocher plusieurs cases.

Main cropping system

The objective is to understand, according to the cropping calendar, where and when do farmers need water all along the year

15. which rice variety do you use?

16. Do you practice direct seeding?

◯ 1. yes ◯ 2. no

17. Could you tell us your yields for each season and each kind of rice?

☐ 1. rain fed rice fields
☐ 2. irrigated rice fields dry season
☐ 3. irrigated rice fields early wet season
☐ 4. rain fed rice fields early wet season
☐ 5. irrigated rice fields wet season
☐ 6. rain fed rice fields wet season

18. Could you explain use the different steps in your cropping system?

19. could you explain us the water level do you need for each step?

Appendix 12: Design Principles Illustrated by Long-Enduring CPR Institutions – Original Version

Principle	Description
Clearly Defined Boundaries	Individuals or household who have rights to withdraw resource units from the CPR must be clearly refined, as must the boundaries of the CPR itself
Congruence between appropriation rules and provision rules and local conditions	Appropriation rules restricting time, place, technology, and/or quantity of resource units are related to local conditions and to provision rules requiring labor, material, and/or money
Collective-choice arrangements	Most individuals affected by the operational rules can participate in modifying the operational rules
Monitoring	Monitors, who actively audit CPR conditions and appropriator behavior, are accountable to the appropriators or are the appropriators
Graduated Sanctions	Appropriators who violate operational rules are likely to be assessed graduated sanctions (Depending on the seriousness and context of the offense) by other appropriators, by officials accountable to these appropriators, or by both
Conflict-resolution mechanisms	Appropriators and their officials have rapid access to low-cost local arenas to resolve conflicts among appropriators or between appropriators and officials
Minimal recognition of rights to organize	The rights of appropriators to devise their own institutions are not challenged by external governmental authorities
Nested enterprises	Appropriation, provision, monitoring, enforcement, conflict resolution, and governance activities are organized in multiple layers of nested enterprises.

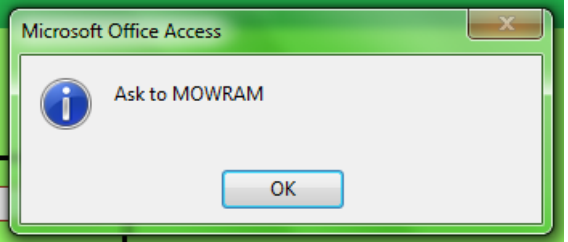
TABLE: DESIGN PRINCIPLES ILLUSTRATED BY LONG-ENDURING CPR INSTITUTIONS (1990)

Source: Ostrom, E. Governing the Commons: The Evolution of Institutions for Collective Action, 90.

Appendix 13: The ISC database

Teuk Chha scheme

First step
Background



A. The project

Map reference	
Halcrow's Basin reference	?
Operators	Irrigation Service Center, GRET and CEDAC
Budget (dollars):	40000
Duration:	6 months
Name of the scheme	Teuk Chhar
Funding	European Union, AFD

B. Interviews

Name of the data collector 1	Saveth, Piseth, Poly and Sophak
Name of the data collector 2	Fanny
Date of the interview	23/08/2010
Who has been interviewed?	village chiefs, farmers, president of the FWUC (previous one too),Commune chiefs

C. Geographical localization

Name(s) of the province(s)	Kompong Cham
District(s)	Prey Chhor
Name of the commune(s):	Boeung Nay and Kroch Communes
Names of the villages	Trapeang Bet, Thma Da, Chonloat Dai, Voat Chas, Korma Reach, Boeung Nay, Thmar Kol, Chhuk Sar, Kbal Damrei, Trapeang Anhcharnh, Bravas, Neak Ta Snoeung, Ta Ok, Traeung, O Chrok, Toul Khpos, Krouch, Thmei, Prey Sak, Krasang Ta Mong, Samsourng
Size of each village	75 ha, 146.68 ha, 400.40 ha, 120.75 ha, 500 ha, 423 ha, 89.7 ha, 250 ha, 240 ha, 220 ha, 117 ha, 157 ha, 138 ha, 78 ha, 250 ha, 100 ha, 60 ha, 145 ha, 130 ha, 182 ha, 40 ha, 72 ha, 146 ha, 125 ha.

D. Land holding

How many families live in the scheme? 4438

Families - landless		Families - Less than 1 ha	
1 < families < 2 ha		Families - More than 2 ha	

E. Activities system

% of households with off-farm activities		% of migration on dry season		% of permanent migration	13

Calculation

Off-farm activities (detail)	About 78% of interviewees have off-farming activities: garment factory works, construction works, groceries, selling labor on on-farming activities, selling labor on carrying firewood, selling labor in rubber plantation, milling rice, repairmen (moto, car, etc.) - cooker - driver, etc.

Second step
Infrastructures and scheme characteristics

Go to the previous step

A. Types of irrigation and/or water control infrastructures

	Upstream water management systems
Stream and runoff (offstream) reservoir: ?	There are two connected reservoirs which are Teuk Chha is on upper part and Thmar Da in on lower part. Water in Teuk Chha reservoir comes from underground (groundwater) the reservoir place is situated n 3 villages territory (Thmey, Thmar Pon, Chamkar Leur).
Lake and river flooding reservoir: Click if there is a reservoir	
Diversion river weir and canal:	
Prek, colmatage canal:	
Station and mobile pumping:	
Micro-irrigation, borehole irrigation, manual lifting systems:	
	Downstream water management systems
Runoff control dam:	
Polder:	
Drainage canal:	
Flood protection dikes:	

B. Water origin

Origin of irrigation water:

River; Upstream runoff and/or spring wa

Main intake: ?

Reservoir

Access to water:

Permanent all year round

Distribution network:

Gravity

Does the main source of water acquisition come from pumping? ☐

Any comments?

C. Irrigated area characteristics

The scheme size: Large

Information about the size scheme

Hectares

Total command area: 3200 ?

Command area for flood or sea protection: 0

Command area for WS irrigation (according to MOWRAM):

Command area for DS irrigation (according to MOWRAM):

Command area for EWS irrigation (according to MOWRAM):

Command area for main canal (ha):

Not yet calculaled, work in progress.

Total real area irrigated: ?

Command area for recessing irrigation (according to MOWRAM): 0

Real area for WS irrigation (according to FWUC):

Real area for DS irrigation (according to FWUC):

Real area for EWS irrigation (according to FWUC):

Command area for II canals (ha):

Canal A : 781 ha / Canal B : 1720,8 ha / Canal C : 897,4 ha

Second step

Go to the previous part

D. Description and measures

Short description 1

Hydraulic infrastructure(s) in question: Stream Reservoir

Size of the infrastructures

Possible storage capacity (m3)

Details of the calculation:

Functioning of the infrastructure (basic principles): Underground water, small stream and rains provide water to Teuk Chha reservoir. The second reservoir (Thmar Da) depends on Teuk Chha reservoir. The link is made thanks to a spillway and gates.

Short description 2

Hydraulic infrastructure (s) in question :

Size of the infrastructures:

Possible storage capacity (m3):

Details of the calculation :

Functioning of the infrastructure (basic principles):

Size and characteristics of the canals

How many canal(s) I ? 1 | How many canals II ? 3 | How many canals III ?

Length of canal(s) I: 5100 m | Length of canal(s) II: A= 4000m, B=5000m and C=3000m

Villages involved along I canal(s): Nek Ta Sneng – Ta Uk – Thmey – Tuol Kvav – Trapeng Bit – O Chrok – Tuol Kpos

Villages involved along II canal(s):
Canal A: O Chrok, Tuol Kpos, Kroch, Samrong, Prey Sak, Krasang Tamong
Canal B: Thmar Kol, Komar Reach, Prey Sak, Boeng nay, Trapeng Anhchanh, Kbal Domrey, trapeng thom
Canal C: Wat Chas, Prayas, Thmar Kol, Trapan Thom, Chhuk Oa

How many culverts along I canal?: | How many outlets along I canal?:

How many culverts along II canal(s)?: A: 6, B: 2, C: 5 | How many outlets along II canal(s)?: A: 10, B: 12, C: 9

Distance between canal(s) III: 500 meters | Are there canals IV? ☑

Material: Earth | But some are in concrete material ☐

Rate of flows (depending on season and place): 1st check structure along the main canal (August): 1,1 m3/s.

If there are gates, are they fitted-out of outlets? ☐

Scheme construction

a. Infrastructures in detail

The scheme is componed of 2 reservoirs (but Teuk Chhar reservoir is the main one, the other one is used for some villages located at the north of the scheme). One main canal comes from Teuk Chha reservoir with one gate (2

b. Construction year for the major infrastructure: 1955-1957 for T.C reservoir and upper part of the canal (and wooden gates)/1976: they had built

Construction year for the canal system: 1955-1957 (canal system until tertiary canals) and extended later

Historic period (name): Sihanouk period and Pol

c. Project(s) (if any)

Total cost (if known) - $

Project progress: Completed

First rehabilitation

a. Infrastructure(s) renovated (some details)

The system was repaired thanks to ADB loan

b.

Rehabilitation year	Implementing agency	Total cost ($)	Quality of the work
1995-1997	ADB		Medium

c. Project progress (1st rehabilitation)

Completed

Second rehabilitation

a. Infrastructure renovated

Some infrastructures repaired by Prasac NGO

b.

Rehabilitation year (2)	Implementing agency (2)	Total cost ($) (2)	Quality of the work (2)
2003	PRASSAC (European Union)		Medium

c. Project progress (2nd rehabilitation)

Completed

Water sharing principles

Go to the previous part

C. Management rules

Explain quickly the water sharing:

Before, there was an anarchical water sharing along the canals. When somebody wanted water, he opened the gate without asking to village chiefs or villagers. During Prasac time, a water turn of 7 days was implemented during one year but it didn't work well (no reflection about the land area to irrigate). ISC tried to implement a 3 days water turn but it

About the water turn

Curently, is there a water turn? ☐ If yes, how many days? Since when?:

Water turn: How many days the first time?: 7

Examples of rules and regulations: Respect the water turn / Don't install pipes without permission, Do not destroy check structures / Cattle grassing Regulation / Fishing Regulation / Don't throw out the rubbish into the canal / Do not block water into the canal (wood, trees, etc.) / Do not open and close the gates without permission / For the water gate operators, do not favor some people (exchange of money) without the permission of external authorities, etc.

Who has implemented the following rules?: ISC team with the Advisory committee

The regulations for WS — Year in question: 2010	Support:	Any punishment?:	Check system
Rule 1: Water requests	Meeting decision	Absence	Weak water gate operatc
Rule 2:	Formalized contract	Proposed punishments	No control / Weak water gate operators / Influential water gate opera / Police / Internal Control (village, co
Rule 3:	Meeting decision	Absence	

Rule 4:	Meeting decision Meeting decision Formalized regulation Formalized contract	Proposed punishments	
Rule 5:			

To develop the sanctions, how does it work?

Currently, there are no sanctions.

Is there a evolution of rules?

Currently, there are no rules.

Third step

Agricultural systems

Go to the second step

A. Farming practices and rice production

i. Rice growing season

- To identify each rice growing season and give the landsize cultivated during this season in the command area

Area cultivated during Early Wet Season (March-August):	289	Area cultivated during Normal Wet Season (June to December):	more than 95%
Area cultivated during Late Wet Season (September to January):	?	Area cultivated during Early Dry Season (November to February):	?
Area cultivated during Normal Dry Season (January to June):	301	% of rain fed rice fields - No access water, Highlands	??
Average area of land cultivated during DS for recession rice:	0		
Average area of floating rice, Wet Season:	0	Paddy % of total crop area cultivated	

Rice production seasons round

Rice yields (DS) - t/ha	1,9	Rice varieties (DS)	IR66
Rice yields (EWS) - t/ha	2,1	Rice varieties (EWS)	Kol Prech, Dam Neup, Chum Neak Pdout, Phka Mlis, 56
Rice yields (WS) - t/ha	2,2	Rice varieties (WS)	Kngauk Pong, Phnom Run, Raing Chey, Kong Kreal, Moha Chornkom, CAR-6, CAR-8

Agricultural practices:

People broadcasting in the scheme (%)		System of Rice Intensification (SRI)		Chemical fertilizers, % of families:	87
		How many families?	0		

Type of soils

Clay soil; Silty soil

B. Other crops production: Non-rice annual and perennial crops

Major non-rice crops and fruit-trees	Sesame, soy bean, bananas trees, cucumber, eggplants	
% of total annual crop cultivated area for non-rice field crops and vegetables		When do they cultivate vegetables?
Mean ha/rural household cultivated for annual non-rice field crops and vegetables		Sesame(Jul-Nov), soy bean (Feb-Jun) during DS
Mean ha/rural household agricultural fruit-trees1 and other perennial crops		

C. Rice cropping and irrigation systems

Peak of water need (DS)	Peak of water need (WS)
Jan-february	May-June-July

Fourth and last step

Farmers water users communities

Go to the 3th step

To begin with the FWUC... Is there a FWUC in the scheme? ☑ **If yes,** Is it currently functioning ☐

A. Association details

Name of the current FWUC:		Duration of mandate for the FWUC:	5 years
Name of the current FWUC president	Kroch Commune Chief	President since?	2008
Other responsibilities of the president	President of Samroung Village too.	How many persons in the central office?:	4
Year of registration	2008	Organizations in charge of assitance	Currently GRET-ISC (2010) and before it was Prasac, european project.
Project assistance to FWUC creation	The Governor of Kompong Cham, in August 1998, requested PRASAC to establish for Teuk Chhar a participatory model of a WUC.		
FWUC bylaws ☑ Official statutes ☑		Period of assistance	1999-2004 (Prasac). When Prassac stopped to support the community --> no support until 2010
How many representatives?	36		

The elections for the current FWUC:

direct suffrage ☑ secret bulletin ☐ how many round of voting? Information diffusion:

And before ?

Is it the first FWUC created? ☐

Year of the 1st FWUC created	1999
Why did the previous FWUC stop?	problems of transparency, no management plan, no maintenance et bad water sharing (about the water turn).

B. Memberships

Number of FWUC members

% of members participation (FWUC)

FWUC members elected ☐ - - - - - - - - - If yes, date of the last election

Members and landsize

Landless labour members

members < 0,5 ha

0,5 ha < members < 1 ha

Members > 1 ha

Number of FWUC members who are:

Fully active members

Little active members

Not active members

C. FWUC financial management and ISF collection

Is there any annual budget planning by FWUC? ☑ Is there any accounting system? ☑ Does the FWUC have a bank account? ☑

If yes — Who is in charge to deposit the money in the bank account? Commune chief

(1) ISF, MOWRAM, other

Main funding source (1): the MoWRAM

Secondary source of income

If ISF is collected, complete the following table; otherwise go directly yo "Activities in the FWUC"

Membership fee

% of families who paid membership fee: 77

Total amount of membership fee (riels): 7285000

ISF

Year of 1st ISF collection

How do they collect ISF?

Amount of ISF collected (since the begining, each year): During Prasac project, ISF was collected but not anymore.

% of ISF recovery (each year)

Defined yearly? ☐

Collection according to:

Collected for how many families?

Collected in how many ha?

When do they collect ISF?

Any comment?

Fourth step - 2nd part

Farmers water users communities

E. Water management

Is there an irrigation plan? ☑ If water gate operators, how many? 4 Are they paid? ☑ How much? (riels): 200,000r/month

Information diffusion: Other By who? Village Chiefs Who is in charge to supervise them? President of A.C

Responsibilities and duties of the WG operators: To open and close the gates (I and II canals)/ To control outlets/inlets along the main and secondary canals) / To clean the canal/ To clear the weed / To check the water circulation / To write a report of their work.

F. In which sector does the FWUC need assistance?

	Yes / No	Detail the answer
Rehabilitation of the scheme	☑	Some gates, outlets are broken. Some parts of the canal are damaged.
Operation planning	☐	
Maintenance planning	☑	No participation in the system maintenance.
ISF collection	☑	Currently, they don't collect ISF (work with ISC)
Water sharing	☑	Currently, it is a test to know which water sharing is the best one (water turn, water requests)
To propose some rules	☑	Because no rules system
To reduce conflicts	☐	

To improve the attendance of members	☑	Low participation - FWUC is not active
To propose a data base	☑	ISC is working on that in order to collect fees.
Other measures (GPS plots, etc)	☑	Under way.
To improve the cropping system (yields, etc)	☑	All these activities have as objective to improve the yields in this scheme.

G. Scheme under ISC contract

Has the ISC has already signed a contract on this scheme? ☑

If yes, fill in the following table

Beginning of the first contract (year)	2010
Duration - 1st contract (months):	6
Objectives of the first contract:	1.Formulate collective prinples for water usage in the scheme 2.Empower and build the capacity of famers and FWUC in terms of the monitoring of the implementation of water sharing along the main canal (and along secondary canals too) 3.Build the trust amongst farmers and stakeholders
Beginning of the second contract (year)	2010
Duration - 2nd contract (months):	6
Objectives of the second contract:	To create a FWUG for canal B

Appendix 14: Pram Kumpheak service proposal

Pram kumpheak Irrigarion scheme

Kompong Cham – Chamkar Leu

Service Proposal

1. OBJECTIVE

In view of improving the water management of 5 Kunmpheak scheme, its maintenance and of extending the double cropping area, the Irrigation Service Centre (ISC) proposes to encourage farmer participation and financial contribution.
The existing infrastructure is supposed to improve through farmers experience and needed with supporting from ISC. The improving work is mainly focus on the following objectives:

- Improve water storage in the reservoir (Phum Bey reservoir)
- Improve water distribution in the main canal
- Improve canal functioning

The service will be provided during 2 months through the following activities:

2. STAGE OF IMPLEMENTATION

There are 5 stages of providing service

STAGE1: SUM UP THE RESULT OF FARMERS PROPOSAL

Objective: To make sure that all proposal of farmers are defined and clear
Activity: In order to achieve this objective ISC will work in the following activities:

- Overview all activities report during detailed study
- Verify with FWUC/FWUG with all requests

ISC team: Poly, Savet and Ek Ren

STAGE2: SITE SURVEY AND DESIGN WORK

Objective: This stage ISC team will visit site and propose design to FWUC/FWUG
Activity: Field visit and discussion meeting with K. Cham engineer
ISC team: Piseth, Poly and one external engineer from PDoWRaM Kompong Cham

STAGE 3: BUDGET CALCULATION AND DEFINE PRIORITY

Objective: This stage we will focus on each cost of structure and develop priority
Activity: Field visit and discuss with engineer and FWUC/FWUG
Team: Piseth, Poly and Saveth

STAGE4: IMPLEMENT THE CONSTRUCTION WORK

Objective: To construct the structures for irrigate in early wet season and supplementary in wet season in case there was a drought.
Activity: find constructor through bidding process and sign contract with constructor for starting the work
ISC team: Piseth and Poly

STAGE 5: CONTROLLING AND EVALUATION THE SERVICES

Objective: To make sure rehabilitation work going smoothly with quality and efficiency.
Activity: Site control and record
Team: Piseth Poly and FWUC/FWUG service e calculation

Description	Unit	Unit price	Quantity	Amount in US$	Amount in riels
Facilitator					
Manager					
Engineer					
Technical expert					
Institutional expert					
Editing and printing costs					
Other costs					
Total					
Subsidy					
Total to be paid					
For one FWUG					

Appendix 15: Teuk Chha service proposal

Kompong Cham

1st Service Proposal

Support FWUC in Water Sharing Management in Teuk Chha Irrigation System

A. Teuk Chha Irrigation System:

- In Prey Chhor district, KP Cham
- 2 communes involved: Kroch and Boeung Nay
- 24 Villages
- Irrigated area: 4,000 Ha
- 4,448 Families
- 3 seasons of rice cultivation: Early Wet Season, Wet Season, and Dry Season

The current FWUC is not functioning:

- no participation in system maintenance
- no funding to operate the FWUC

B. **Objectives**:

1. Formulate collective principle for water usage along the main canal
2. Empower and build the capacity of famers and FWUC in terms of the monitoring of the implementation of water sharing along the main canal
3. Build the trust amongst farmers and stakeholders

C. **Project period** (6 months covering 3 steps):

1. Cooperation with PDOWRAM and district and commune authorities for the management and usage of the main canal

Main activities:

- Meeting with KP Cham PDOWRAM: the management of the water gates along the main canal
- Meeting with the community, relevant communes and villages
- Meeting to elect village representatives (7 villages)
- Meeting to select Watergate operators (4 people)

2. Creation of an advisory committee for water sharing management and conflict resolution

Main activities:

- Meeting with KP Cham PDOWRAM, district, commune and village authorities
- Meeting to elect village representatives
- Meeting to disseminate information
- Meeting to select Watergate operators

3. Support to the action plan and the implementation of water sharing

Main Activities:

- Meeting to discuss with village chiefs and advisory committee to draft water sharing principle
- Discussion meeting with village representatives about water use in each village and along each secondary canal
- Preparing irrigation plan
- Regular monitoring water gate operation

Responsibilities of the project and communes:

- Communes provide incentive/allowance to 2 water gate operators
- The project is responsible for the other 2 operators

Duration of the implementation:

- 132 days (during 6 months)
- Require 84 service days from ISC staff

2st Service Proposal:

Creation of canal B FWUG in FWUC of Teuk Chha Irrigation System

A. Objectives

ISC will create a FWUG for canal B with:

- 6 relevant villages in Kroch and Boeung Nay communes, Prey Chhor district, KP Cham
- 1,088 families
- 1,330 Ha irrigated area

The 2 objectives are:

- Ensure the management of greater irrigation for EWS, WS and DS rice cultivation
- Ensure sustainable use of the canal with 2/3 participation from the farmers, if the farmers are voluntarily willing to become members of the FWUG

B. Project Implementation: 5 months, 6 steps

The created FWUG will receive support in the process of drafting internal rules, membership fee collection and member registration procedure, leader election procedure and how to organize the FWUG's general assembly.

Step 1: Create a working group for the canal B FWUG
Step 2: Register canal B FWUG members
Step 3: Create a data management system for the list of the member
Step 4: Election of village representatives and canal B FWUG leader
Step 5: Prepare action plan and budget for the O&M
Step 6: Organize the 1st General Assembly for the FWUG.

Appendix 20: Hydraulic infrastructures in both schemes (photos)

Figure: tri-face structure in Pram Kumpheak

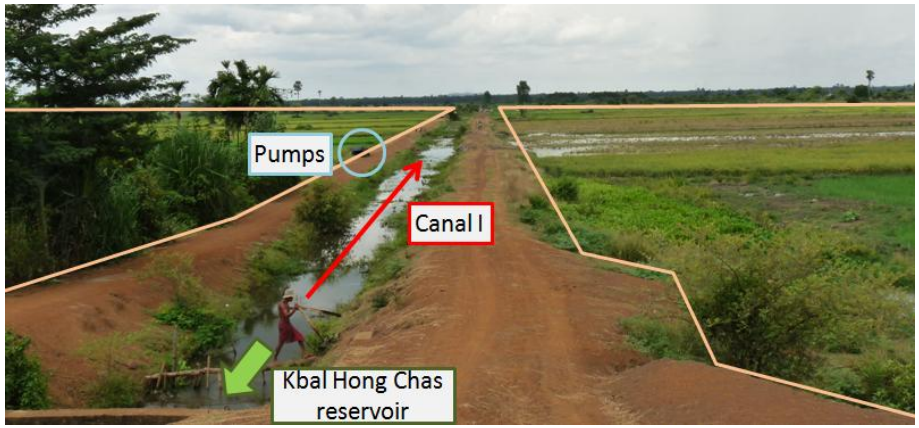


Figure: Main canal in Pram Kumpheak

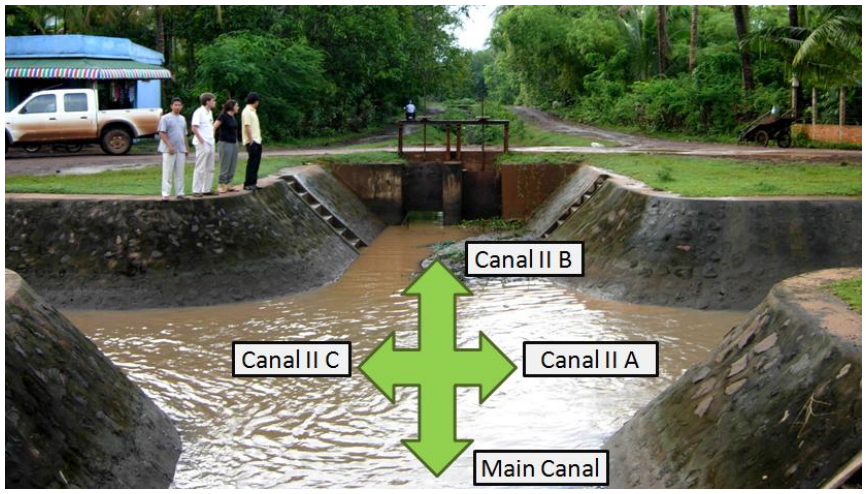


Figure: Three gates division point in Teuk Chha

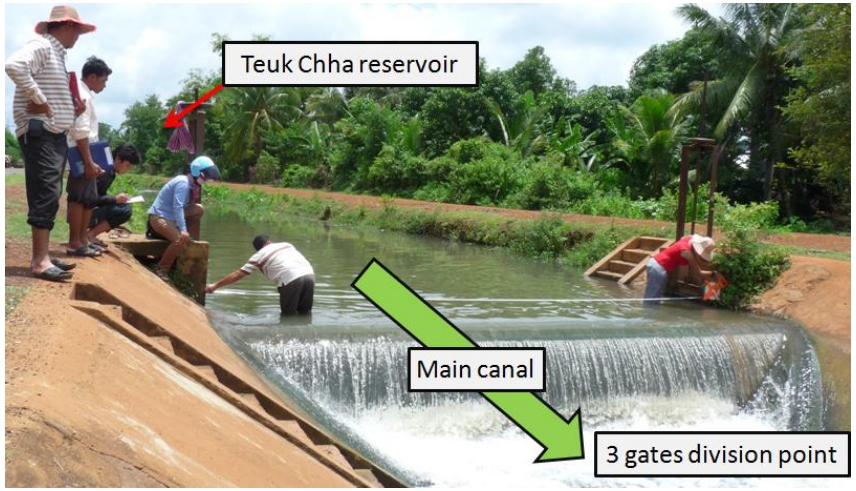


Figure: Main canal and spillway in Teuk Chha

Appendix 17: Meeting with the advisory committee for Supporting FWUC along the main canal in the Teuk Chha scheme through water sharing principles.

Date : 01- June- 2010
Place : Boeung Nay communal office
Started time : 2:00 pm
Finished time : 5: 00 pm
Coordinator : Long Piseth; Oung Saveth
Recorder : Oung Saveth
Number of participants: 19 persons, 2 women and absent 1-Thmei village chief.

1. Objective:
   Mr. Long Piseth presented the objectives of creation of Advisory Committee.
   - To set water sharing principles along the main canal.
   - Support to community staffs
   - To solve the problems according to water sharing.

2. Subsidy for the president of Advisory committee.
   Mr. Long Piseth presented
   - 100,000 Riels /month and duration: 6 months
   - The president of the Advisory Committee has to sign the contract with the community.

3. Discussing about water sharing
   - According to the previous experiences, how could we organize water sharing?
     - Beoung Nay commune chief's idea: to implement water sharing at the gate with three outlets is a good idea. The water turn will be for each II canal three day each one. This policy was set by PRASAC and finally, there was no water turn for the main canal.
     - Mr. Hem Yeoun's idea: We cannot organize water turn and close the gates along the main canal; it means we should keep it open for 10-20 centimeters high for all the pipes connecting to the tertiary canal.
     - Toul Kvav village chief's idea: If we do not irrigate along the tertiary canal, we should close the gate. We will open the gates if there are farmer water requests.
     - Mr. Sorm Theoun's idea: We have to close the gates. The unused pipes will be completely closed.

   Final decision: Water sharing for irrigation:
     - Main canal

All the pipes or gates along the tertiary canals must be closed. We open the gates if there are farmer water requests to village chief. After submitting the water request to community staffs, community staffs will open the gates.

For unused pipes, it must be completely closed. There are 2 places (two pipes) which need to be closed. The first pipe is locating at the fourth water blocking infrastructure and the second pipe is locating at the sixth water blocking infrastructure. There are two tertiary canals which need to be closed. The first

place is located at the ninth water blocking infrastructure and second place (Right side) is located at the tenth water blocking infrastructure.

- ❖ The gate with three outlets, according to previous experiences:
  - Canal A: 3 days
  - Canal B: 3 days
  - Canal C: 3 days

This planning started to be implemented on 02/06/2010 and commune chief has to deliver water turn documents to the village chiefs.

Planning for main canal started to be implemented on 10/06/2010 after the meeting to disseminate information.

4. Sharing Community staffs' responsibilities

Mr. Sorm Theoun: Close and open the gate connected between the main canal and reservoir (gate Mann).
Mr. Kheav Yeoung: Close and open the gate with three outlets (A, B, C) + one gate along the secondary canal.
Mr. Men Hay: Close and open the gates along the main canal from gate Mann until Thnal Yeay Seu bridge.
Mr. Khim Ti: Close and open the gate along the main canal from Thnal Yeay Seu bridge to Neak Ta Sneung Bridge.

5. Meeting to disseminate water sharing principles.
   - ❖ Commune chief's idea: Involved villages must organize meeting with the farmers concerning the main canal. The information will be announced on the board at the division gate for the II canals.
   - ❖ Village chief's idea: They do not need to organize the meeting with involved villages because all the farmers will be busy in their fields. We just will disseminate the information through village chiefs, vice village chiefs, group leaders.
   - ❖ Village chief's idea: Secondary canals A, B, C need to organize the meeting to disseminate information to all involved villages.

   Final decision to disseminate water sharing principles:
   - ❖ Farmers along canals A, B, C need information on the board for water turn date.
   - ❖ Farmers along the main canal need to organize a meeting with all the involved villages.

6. Dissemination meeting plan for involved villages:

No	Name of village	Date	Place	Started time
1	Toul Khpos	07/06/2010	Vice village chief's house- Seth Seath.	8:00 AM
2	O Chrok	07/06/2010	Village chief's house	1: 00 PM
3	Ta Ok	08/06/2010	Vice village chief's house-Phai Phan	8: 00 AM
4	Neak Ta Sneuong	08/06/2010	Mr. Sam Ol Peach's house	1: 00 PM
5	Toul Kvav	09/06/2010	Village chief's house	8: 00 AM
6	Trapeang Bet	09/06/2010	Vice village chief's house-Nou Saveoun	1: 00 PM

- Objectives of the meeting
  - ❖ Guiding the community staffs.
  - ❖ Showing working location for community staffs.
  - ❖ Present about water sharing principles.
- Responsible person:
  - ❖ ISC: Coordinate the meeting.
  - ❖ Village chief
  - ❖ Community staffs: Introduce themselves to the participants.
  - ❖ President of Advisory Committee: Participants (farmers)

7. Discussion about getting a new account bank for Teuk Chha community:
   - ❖ Mr. Long Piseth: ISC will transfer money to community's bank account for the staff's salary and we can get this new bank account at ACLEDA Plc. Bank (Bakhom).
   - ❖ The stakeholders for this account are the president of the community, the first vice president and treasurer.
   - ❖ The president of the community has to prepare documents involving community such as statute for community. The appointment to speak about this new bank account will be set by ISC(2 weeks later).

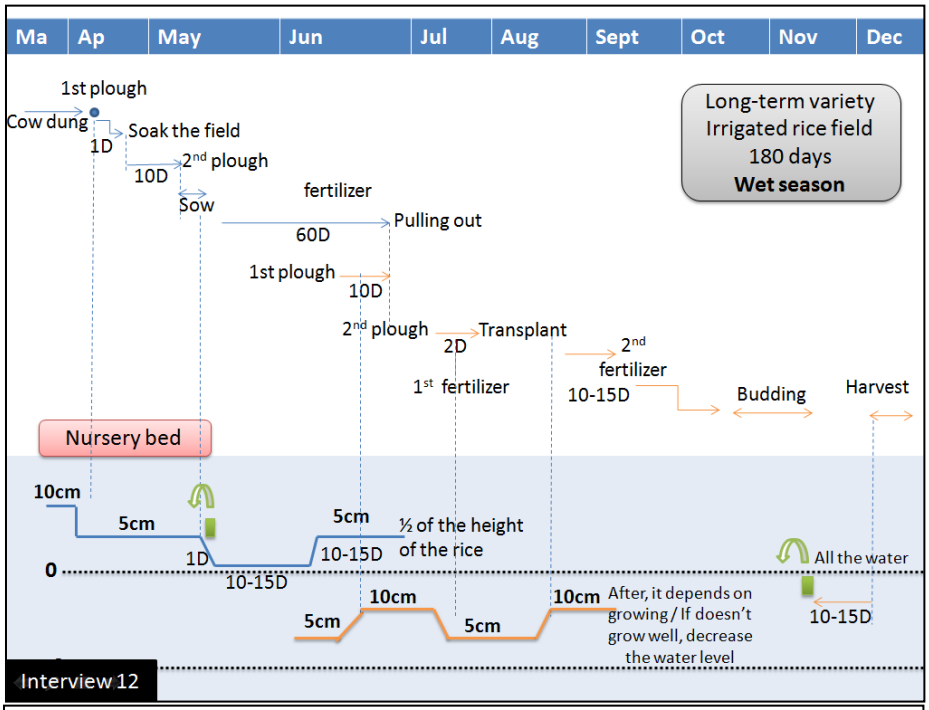
8. ISC's payment principles
   - ❖ They need a budget plan
   - ❖ Organizing for bidding

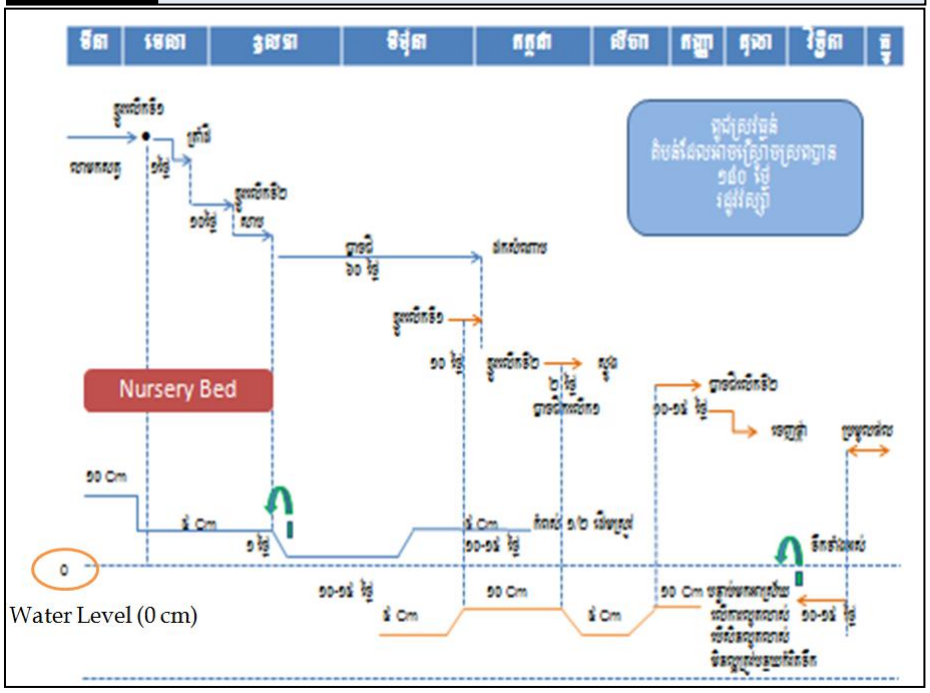
ISC staffs have to collect information about the infrastructures condition (spoiling) in order to make a budget plan for thematic payment (O&M).

9. The staff has to sign the contract with the community.

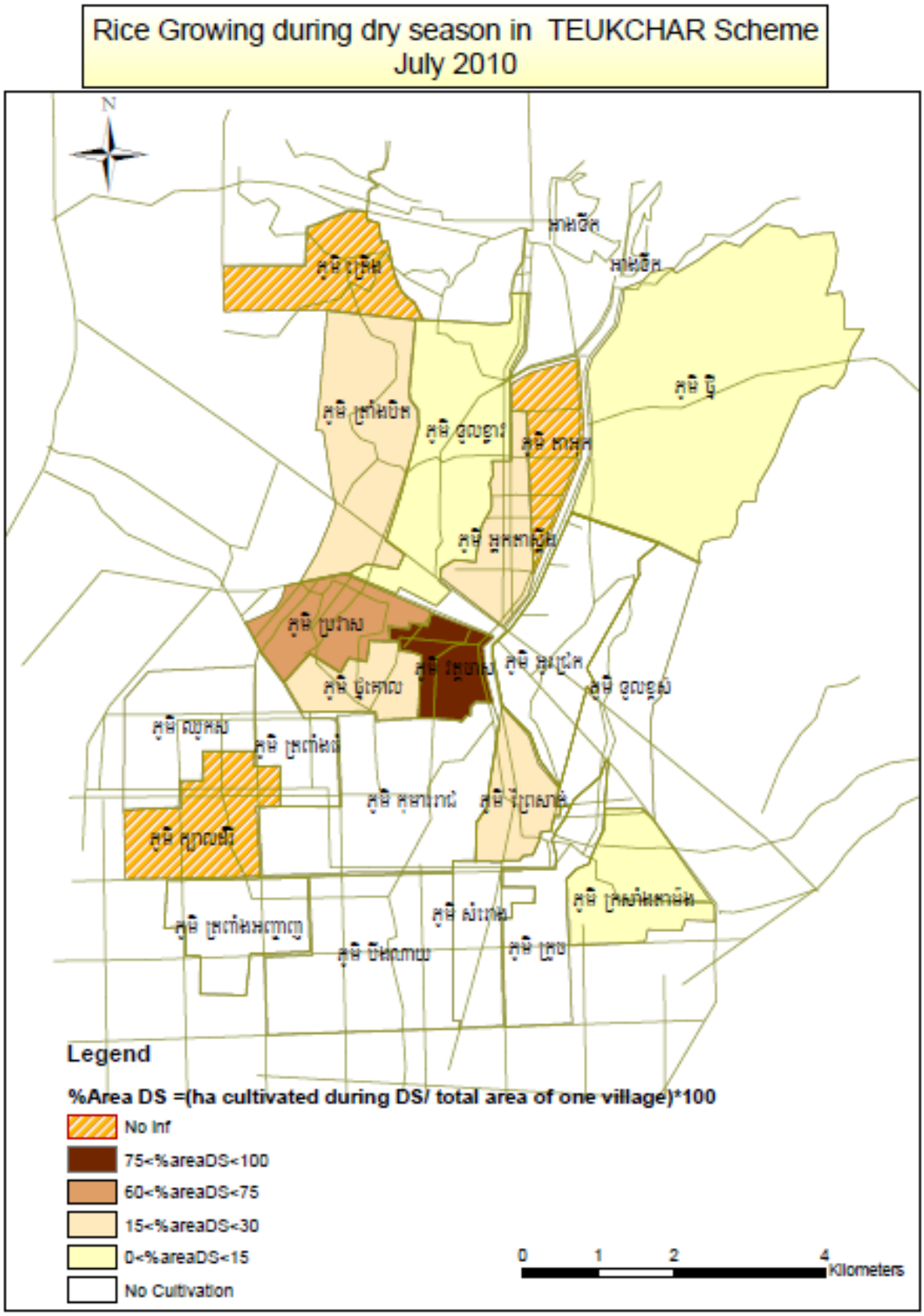
Appendix 18: cropping and irrigation calendar, Tra Peang village

(interviews 9/06/10)

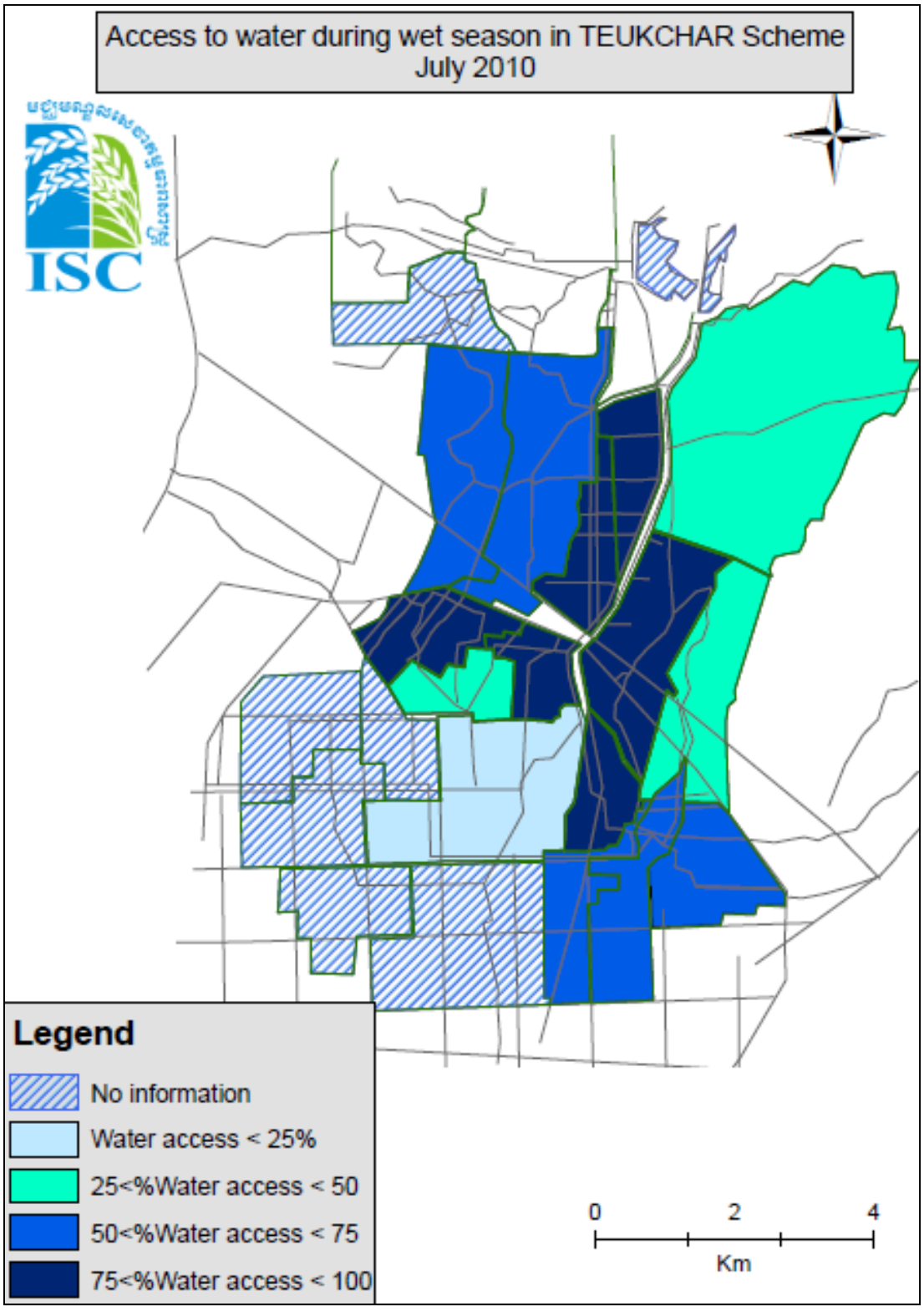




Appendix 19: Dry season rice cultivation in the Teuk Chha scheme



Appendix 20: Access to water during wet season in the Teuk Chha scheme



ABSTRACT

After the recent civil war, Cambodia is currently beginning a reconstruction process. It aims at tackling the poor institutional organization and triggering socio economic development. Rice is the Cambodian staple and thus contributes to the national food security. Agricultural productivity in the country remains low compared to its neighbors because irrigation systems lack O&M. A radical agrarian reform, set up by the Khmer Rouges, aimed at strengthening irrigation and agriculture. However the hard labor, the tortures, the forced migrations (internal), and the lack of technical consideration did not allow reaching the expected results.

On the contrary, the social cohesion among farmer organizations was weakened and schemes are now degraded or non-functional. In view of this assessment and the low financial resources of the Government to carry out infrastructure rehabilitations, these responsibilities were transferred to Farmers Water Users Communities (FWUC), created in 2000. This calls for specific skills that the farmers do not have. The GRET launched an Irrigation Service Center (ISC) in 2009 in the Kompong Thom province, through the project ASIrri "*Appui aux irrigants et aux services aux irrigants*". It is a pilot project which plans the creation of an independent association in 2011, if the local team acquires enough skills. It proposes services to support the Water Users Communities in their management of the irrigation systems. The stake is double: to build the financial, technical and organizational capacities and to strengthen the social cohesion of the farmers' organizations profoundly weakened in the past.

This report deals with the set up of such services in the Pram Kumpheak and Teuk Chha irrigation systems, in the province of Kompong Cham, under the ISC project. The two case studies show the necessity to rebuild collective action before dealing with practical water distribution principles.

Key-words: Service center, collective action, rice, FWUC, irrigation systems, water social management

RESUME

Confronté à des années de guerre civile, des Américains aux Khmers rouges, le Cambodge entame aujourd'hui un processus de reconstruction de l'organisation sociale et institutionnelle et bien évidemment économique.

Le riz est l'alimentation de base au Cambodge et contribue donc à la sécurité alimentaire du pays. Cependant, la productivité agricole reste faible comparée à ses voisins du fait d'un manque d'O&M des systèmes irrigués. Les Khmers Rouges ont mis l'irrigation et l'agriculture au cœur de leur réforme agraire radicale…mais le travail forcé, les déplacements de population, la torture et le manque de considération technique n'ont pas permis d'atteindre les résultats escomptés : la cohésion sociale des organisations d'irrigants a été affaibli et les réseaux sont aujourd'hui dégradés voire non-fonctionnels. Face à ce constat et aux faibles ressources financières de l'Etat pour prendre en charge ces reconstructions, ces responsabilités ont été partiellement transférées aux Farmers Water Users Communities (FWUC) créées en 2000. Ce travail fait appel à des compétences spécifiques que les agriculteurs n'ont pas ; le GRET, au travers du projet ASIrri *« Appui aux irrigants et aux services aux irrigants* » a lancé en 2009 un centre de services pour l'irrigation, au stade de projet pilote jusqu'en 2011. Les services proposés visent à accompagner les communautés d'irrigants dans leur gestion des systèmes irrigués. L'enjeu est double : renforcer les compétences de gestion financière, technique et organisationnelle des systèmes avec une attention particulière portée à la cohésion sociale des organisations paysannes profondément fragilisée. Le CSI a mis en place des services à Pram Kumpheak et Teuk Chha, systèmes irrigués tous deux situés dans la province de Kompong Cham; des règles de gestion de l'eau vont être formulées mais l'action collective doit avant tout être reconstruite.

Mots-clefs: Centre de service, action collective, riz, FWUC, systèmes irrigués, gestion sociale de l'eau.