Final Report

Public versus private provision of irrigated water management on rural economic development: the Case Study of Trapaing Trabek irrigation, Kampong Chhnang province, Cambodia

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By Chea Phallika

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Executive Summary

The study was conducted, on one hand, to analyze the impacts of irrigated water management on agricultural productivity and household poverty with the provision of both public and private sector, and on the other hand to examine the famers' satisfaction and perspectives on public private partnership toward sustainable irrigated water management at the Trapaing Trabak irrigation scheme located in Kompong Chhnang Province.

It can be seen that not only the rich but also the medium and the poor can access to either FWUC or private irrigation. The choice of irrigation type is not dependent of household status (rich, medium or poor) but mainly on the close accessibility to the scheme. The result of the study illustrated that through the provision of both public and private irrigation, agricultural productivity has significantly improved due to the expansion of dry rice season farmland and a large increase of rice yield, which have contributed to the household poverty reduction in the study area.

The analysis of which sector could bring more socio-economic benefits remains challenging. But, FWUC is considered as a better management than a private sector. This is due to the activities of O&M of FWUC and the lower ISF compared with a private sector. In short, people are satisfied with FWUC in terms of irrigated water management in this area, mainly also due to much lower water fee. The level of farmer contribution to O&M was revealed moderate acknowledgment while it is difficult to address if farmers have adequate knowledge to participate in the decision making level toward sustainable irrigation management in this area. This could be a limited capacity of farmers in terms of contributing at a high level of participation and/or the unclear structure of either FWUC or private sector in order to inform to the communities for gaining their participation.

Although these both sectors have different functions and ways of management, still they have the same vision of irrigation system development. Thus, public private partnership with the participation from the farmer water user group under the method payment of ISF based on farm size is a useful combination strategy to apply in this area in order to better farmers' livelihood as well as socio-economic development.

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List of Abbreviations

ADB	: Asian Development Bank
AFD	: Agence Française pour le développement
ASFC	: American Friend Service Committee
AusAID	: Australian Aid
BOO	: Build-Own-Operate
BOOT	: Build-Own-Operate-Transfer
BOT	: Build Transfer Operate
BT	: Build-Transfer
CDRI	: Cambodian Development Resource Institute
DB	: Design-Build
DBM	: Design-Build-Maintain
DBO	: Design-Build-Operate
DBOM	: Design-Build-Operate-Maintain
EU	: European Union
FWUC	: Farmer Water User Community
ISF	: Irrigated Service Fee
ITC	: Institute of Technology of Cambodia
IWRM	: Integrated Water Resource Management
JICA	: Japanese International Cooperation Agency
MAFF	: Ministry of Agriculture, Forestry and Fishery
MOWRAM	: Ministry of Water Resources and Meteorology
MoP	: Ministry of Planning
NIS	: National Institute of Statistics
O&M	: Operation and Management
PDA	: Provincial department of Agriculture
PDLMUPC	: Provincial Department of Land Management, Uban Planning and Construction
PDOWRAM	: Provincial Department of Water Resource and Meteorology
PPP	: Public Private Partnership
RGC	: Royal Government of Cambodia
RUPP	: Royal University of Phnom Penh
SME	: Small and Medium Enterprise
TWGAW	: Technical Working Group on Agriculture and Water

ToR	: Term of Reference
UNDP	: United Nation Development Programme
USDA	: United States Department of Agriculture
USAID	: United States Aid
WHO	: World Health Organization

1. Introduction

1.1. State of the art

Water sector plays an important role on agricultural enhancement and rural poverty reduction in Cambodia. As a result, the Royal Government of Cambodia (RGC) has committed their policy on supporting the irrigation projects, as well as the establishment of the Farmer Water User Community, known as FWUC, to serve as the basic development framework which deducting the RGC's activities and responsibilities at the grassroots level means decentralization approach mainstreaming.

According to Water Law, FWUC is a group of farmers using water in the same irrigation scheme and shall be registered formally with the provincial or municipal directorate of the Ministry of Water Resource and Meteorology (MOWRAM) as determined by the government Sub-Decree (MOWRAM, 2007). The FWUC is led by the FWUC Committee (which is selected by voting among those farmers using water at the same scheme) under the Board of FWUC who acts as a facilitator. They are encouraged to plan and develop irrigation system by their own financial and human resources with the technical support from the Government (PIMD, 2009). With this, the water users of this public system have to pay water fee as the contribution fund for Operation and Maintenance (O&M).

Investment on Private Water Supply in the agriculture sector is a part of Small and Medium Enterprise (SME) which is promoting in the Private Sector Development and Employment Generation recognized as one angle of RGC's rectangular strategy toward economic growth of Cambodia as well as increasing agricultural productivity. Private sectors refer to business agencies which seek to gain benefit and are not under control of the state (Wikipedia, 2010). In the irrigated water supply by private sectors, water is used as the economic goods; the users have to pay for the water supplied services. Those private enterprises have adequate capital including financial and human resources in the O&M of the irrigation scheme in order to fulfill farmers' need to avoid crop losses due to inadequate water for doing farming.

Both public (FWUC) and private sector on irrigation system management are the vital mechanisms of irrigated water management in agricultural production enhancement, and poverty reduction in Cambodia. However, these two actors might bring difficulties to RGC to achieve sustainable irrigated water management in agricultural field since there are unclear

of task sharing or responsibilities between these two actors and the understanding of farmers on public and private sector is generally lacking.

1.2. Research Rationale

Traditionally, water is a common pool resource which is viewed as “nature’s gift”. Cambodians tend to use this resource for free while it is under the state/public (FWUC) sector. However, with the high demand of water consumption, water has become more finite even though its volume is massive in the nature (Anon, 1992). This tendency brings water to become economic goods globally. This is difficult for Cambodians, especially farmers to be aware of this new concept as water is containing abundant around the geographical feature of Cambodia and historically water use in the agricultural sector is free of charge.

Moreover, most FWUCs are weak due to many problems occurring either in the central state level or at the grassroots level such as poor capacity of state administration, new political fractionalizing, political legitimacy at the communal level, and local-level conflicts, etc. (Try, 2006). In this case, water allocation has become more fragmented between the poor (do not meet the human basic need) and the rich or better-off users in terms of equitability and efficiency. Lack of water distribution to the poor’s farmlands demonstrates the downturn of crop productivity, and also reflects on the inefficiency of irrigated water management within a scheme level.

There are difficulties for public/FWUC in achieving successful irrigated water management at a scheme level particularly in a case that there is an implication on public and private sector sharing the same water resources. Some clear problems are ambiguous definitions of roles and responsibilities of FWUC among different groups and sectors resulting in FWUC’s failures on water resource management. The discussions on common property (water) have always been more intensified, for instance, two sectors (public and private) use the same resource at the same location, but the scheme operations and maintenances have been performed by these two different actors. Thus, this is a crucial interaction between public and private sector. Solving existing problems is possible in case of the cooperation of these two actors and influential stakeholders such as local authorities, technical agencies, and the water users to ensure water use equity and sustainability.

Hence, the research on the public versus private provision on irrigated water management and rural economic development has to be raised in order to answer the key questions on how these two actors play an important role like a case study in Trapaing Trabek irrigation

and what has worked, what hasn't, and why; and what are the solutions to deal with these challenges toward rural economic development as the country as a whole.

1.3. Research Objectives

This research will be conducted on the small scale irrigation system of Trapeng Trabak scheme located at the Chrey Bak catchment in Kantuot Commune, Kampong Chhnang Province, Cambodia. Two main objectives are:

i) To analyze the impacts of irrigated water management on agricultural productivity and household poverty with the provision of both public and private sector.
ii) To examine the famers'satisfaction and perspectives on public private partnership toward sustainable irrigated water management.

Several inquiries are raised to deal with the two above objectives:

Objective 1: To analyze the impacts of irrigated water management on agricultural productivity and household poverty with the provision of both public and private sector.

i) To find out the agricultural productivity (crop yields, expansion of irrigated farmland, cropping pattern, labour forces, household income, etc.) after the implication of both public and private sector.
ii) To evaluate the household status of the people who access to irrigated water between public and private sector

Objective 2: To examine the famers'satisfaction and perspectives on public private partnership toward sustainable irrigated water management.

i) To understand how the farmers define public and private sector on irrigated water management and how they participate and contribute within these both sectors.
ii) To compare between the past and present on water management with and without public and private sector whether which actor could bring more socio-economic development in the study area.
iii) To find out which methods of payment the farmers are willing to choose (e.g: paid by land size, by water quantity, by crop yield, etc.)

2. Literature review

2.1. Study on the impact evaluation of irrigation development

2.1.1. The impacts of irrigation on rural economic development

As a vital resource in agriculture, irrigation generates a variety of benefits contributing to many productive and livelihood opportunities in rural settings (Hussain, 2007). Numerous studies provide evidence of the direct productivity-related benefits of irrigation (see Hasnip et al., 2001; Hussain and Hanjra, 2003 and 2004 for a detailed review of related studies).

The impact of irrigation on poverty is a controversial issue. While there is empirical evidence that irrigation development has, in some cases, a substantial impact on poverty reduction, it becomes increasingly clear that such impact is determined by the type of irrigated agriculture. The scheme size, the type of operation and maintenance, the system of water allocation, etc. can play an important role in determining the eventual impact on beneficiaries (Lipton & Litchfield, 2003). Irrigation boosts total farm output and hence, with unchanged prices, raises farm incomes. Increased output levels may arise for any of at least three reasons (Lipton & Litchfield, 2003). Firstly irrigation improves yields through reduced crop loss due to irregular, unreliable or insufficient rainwater supply. Secondly, irrigation allows for the possibility of multiple-cropping and so annual crop yield increases. Thirdly, irrigation allows increasing more land to be used for crops in areas where rainwater is impossible. As a result, irrigation is likely to boost output and income levels.

The irrigation can have direct effect on poverty reduction through employment opportunities. Irrigation projects need labor for construction and regular maintenance of the canal system, wells, and pumps etc. The construction and maintenance of irrigation systems provide direct employment benefits, mainly to those living in or near the irrigation systems. Therefore, landless people with excess labor or seasonal excess labor can find the jobs offered locally in the village where they live. In addition, there may be effects that extend to other areas if irrigation projects reduce migration to urban areas, and so reduce the pool of job-seekers and relieve the downward pressure on urban wages and the upward pressure on prices of housing and other urban infrastructure. Food prices are also impacted by irrigation development. Many agricultural products will be locally increased through irrigation improvement; consequently, this may result in lower food prices. The effect of irrigation on prices and therefore on poverty may be particularly strong in i) remote areas or countries with high transport costs where, prior to irrigation project, food deficit had to be compensated by purchase from other regions; ii) areas with a comparative advantage in food production

which can respond more strongly to the availability of irrigated land (having a surplus of land or labor) and iii) areas with high surplus output levels which can be traded in wider markets (Lipton & Litchfield, 2003).

Hence, examining the direct first-round effects, irrigation is likely to reduce poverty via increased food output, higher demand for employment and higher farm real incomes among a) net food purchasers in irrigated areas, b) net food purchasers in non-remote non irrigated areas and c) the urban poor. Positive effects may be experienced by net food producers and waged laborers if effects of, respectively increases in output and employment outweigh effects of price falls. This is increasingly likely with liberalization of food trade, with falls in growth rate of irrigated area and with better transport and falling transport-cost/production-cost ratios. The availability of irrigation also has *second round effects* via output, employment and prices on poverty. In the longer run, and in a dynamic, general equilibrium scenario with multiple farm outputs, irrigated land usually encourage farmers to adopt or increase their use of fertilizers, pesticides, improved seeds and other agricultural inputs, and provide the stimulus for further research into improved plants and technology that lead to increased output, and so employment and incomes, with possible further price reductions (Lipton & Litchfield, 2003). This 'Green Revolution' style virtuous circle is likely to lead to further poverty reduction.

Nevertheless, irrigation projects do not only affect positive economic outcomes, but may have wider socio-economic effects. A very visible effect of irrigation projects are the negative health effects associated with increases in incidence of water-related diseases (Lipton & Litchfield, 2003). When irrigation is associated with the construction of large dams, additional impacts include the displacement of large numbers of people and negative environmental effects of dam construction. According to the World Bank, forced population displacement cause by dam construction is its single most serious counter-development consequence (Horowitz, 1991).

2.1.2. The impact of irrigation on the environment

The benefits of irrigation have resulted in lower food prices, higher employment and more rapid agricultural and economic development. However, irrigation and water resource development can also cause social and environmental problems. Irrigation represents an alteration of the natural conditions of the landscape by extracting water from an available source, adding water to fields where there was none or little before, and introducing man-made structures and features to extract, transfer and dispose of water. According to Lipton & Litchfield (2003), irrigation projects and irrigated agriculture practices can impact the

environment in a variety of ways following sources of environmental impact: construction of irrigation projects, water supply and operation of irrigation projects, and irrigated agriculture management practices such as soil erosion, fertilizers and pesticide use which are detrimental to surface water quality when agricultural runoff transport those contaminants to the stream networks. The construction of some schemes –large dams and canal systems– is associated with particular environmental problems such as loss of natural habitat. Generally, irrigation projects have also further detrimental impacts on the environment beyond the construction phase. Water loss through unproductive evaporation, seepage and percolation, possibly inducing problems of water logging and salinization have been found to be important potentially negative consequences of irrigation. The question to know if the poor are more likely to suffer from these effects than the non-poor depends very much from one case to the other. Furthermore, withdrawing ground-water may cause the land to subside, aquifers to become saline, or may accelerate other types of ground-water pollution. Withdrawing surface water implies changes to the natural hydrology of rivers and water streams, changes to water temperature, and other alterations to the natural conditions, sometimes deeply affecting the aquatic ecosystems associated with these water bodies (Stockle, n.d). In addition, new diseases would probably exist in the new irrigation areas such as parasitic disease, malaria and others following reservoir construction for irrigation.

2.2. Irrigation development in Cambodia

Cambodia's population is currently estimated by the Ministry of Planning's National Institute of Statistics (NIS) in the 2008 Population Census and by the World Bank at roughly 14.0 million, and is growing rapidly (1.7% per annum). Approximately 80 percent of the population resides in rural areas and 60 to 70 percent are estimated to be solely dependent on agriculture (largely rice cultivation) for their livelihoods. The average farm size in the country varies by region and population density, with the largest in the northwest provinces at 2-4 hectares and smallest in the southeast at 1-2 hectares (USDA, 2010). Cambodia's rural areas are home to most of the country's poor, who face underdeveloped infrastructure and limited access to services. Their livelihoods are mainly dependent on agriculture, forest resources and aquatic resources. According to FAO (2007), 25% (4.626 million hectares) of the total land area in Cambodia is cultivable and 85% of this cultivable area is now being cultivated. This means that the cultivated land area in Cambodia has almost been doubled compared to that of the 1993. According to the study conducted by Ojendal (2000), the total cultivated area in 1993 was about 2.1 million ha, 88% of which was rice field, 6% field of other annual crops, and the other 6% field of permanent crops such as palm trees, coconut and rubber. Cambodian agriculture has been traditionally characterized by, rain-fed farming; the yield of which is mainly dependent of precipitation and traditional farming techniques.

According to the recent report (Chea, 2010; Halcrow, 1994) estimates the yield from rain-fed cultivation to be the lowest compared both to that of the wet season supplementary irrigation cultivation (73% higher) and to that of dry season irrigation cultivation (231% higher). As indicated by Ojendal (2000), it means that Cambodian agriculture is very responsive to irrigation given the right circumstances (Chea, 2010). For instance, in the Doun Kaev Commune, the rice yield has increased from 1.3 tons in 1994 to 2.5 tons per hectare in 2000 and each farmer gives 10–15 kilograms of rice as payment to the lead farmer for maintaining the irrigation canals (ADB, 2001). The increase in yield is attributed not only to irrigation but also to improved varieties, more fertilizer, land improvement, and integrated pest management.

Although Cambodia has abundance of water resources for its irrigation development, water resources management is still limited by technical knowledge, governance and management. The technical improvement is essentially required to better increase irrigation efficiency and sustainable management. The irrigation management in Cambodia has been traditionally practiced rather than scientifically adopted. As it can be seen, most of irrigation systems constructed during the Pol Pot regime have ineffectively functioned due to lack of technical design and maintenance.

Obviously, many of the existing irrigation canals have long been dysfunctional, making farmland vulnerable not only to drought but also to frequent flooding. Therefore, the increase in agricultural production through irrigated land expansion is still challenging. Currently, plenty of irrigation systems for both small and large scale are under construction and rehabilitation by the government and other international development programs. Irrigation schemes in Cambodia are classified according to the scale: small (up to 200 ha), medium (200 to 5,000 ha) and large (higher than 5,000 ha) (Thun and Chem, 2007). The most common irrigation techniques used in Cambodia include traditional lifting, mobile pumping stations, gravity or a combination of these methods. Some small scale irrigation systems, and most medium and large scale irrigation systems, have reservoirs to store water and irrigation distribution canal systems. Currently, MOWRAM estimates that there are more than 2,000 irrigation schemes (1,415 small, 955 medium and 33 large), which can potentially irrigate more than one million hectares in case that all irrigation schemes are well functioning, approximately 40 percent of the total paddy land area (Thun and Chem, 2007). Most irrigation development focused on small scale schemes during the 1980s and early 1990s. After the establishment of MOWRAM in 1999, the focus moved to medium and large scale projects due to availability of funds from both the government and international development partners (ADB, World Bank, EU commission, JICA, AFD, USAID, etc.).

According to the ADB (2005), in the Tonle Sap area, irrigation schemes are largely designed to manage floodwater to supplement rainfall for wet season rice production at the start and/or the end of the wet season from May to November. Only a few schemes are designed to divert water from the Mekong or Tonle Sap catchment for dry-season crops during the main part of the dry season or for flood-recession irrigation early in the dry season. With support from Technical Working Group on Agriculture and Water (TWGAW), MOWRAM and MAFF, are working to enhance investment in irrigation and research to promote agricultural production for poverty reduction. MOWRAM has shown a strong commitment to increase the size of irrigated area in Cambodia by 20,000 hectares per year (CDRI, 2008). Increasing investment in irrigation to enhance rice production and encourage agricultural diversification for food security and higher value added crops is essential, but these are not the only goals of water resources management. Water resources management also provides for agriculture, fish production, biodiversity, water supply and sanitation, and transport and hydropower; thus it is crucial that basin wide management issues are taken into consideration when planning irrigation development (CDRI, 2008).

2.3. Water governance on irrigation water resource management

When mentioning on water resource management, it is considering on the water governance context. According to UNDP (UNDESA/UNDP/UNECE, 2003) and Global Water Partnership (Rogers and Hall, 2003) define water governance as “range of political, social, economic, and administrative systems that are in place to develop and manage water resources and the delivery of water services, at different level of society”. It requires the participation among different actors not only the public but also the private sector, non-governmental organizations, and all civil society related groups with voices, responsibilities, transparency and accountability to both formal and informal management have been raised up. UNDP notes that once the good governance occurs, political and social risks, institutional failures and rigidity will decrease and the capacity improvement to deal with the shared problem will taken place (UNDP, 2004). Integrated Water Resource Management (IWRM) is the main concept of good governance on water issue toward sustainability of the environment. It needs the involvement and participation of the relevant stakeholders with the comprehensive understanding on process occurring in the water resources systems (by K.S. Rama Sastry cited in K.S. Raju at el., 2004). The technical and financial association, obvious responsibilities division among stakeholders, transparency, accountability, and information sharing are the main elements to achieve water resource management either running with structural or non-structural methods. The fulfillment on the implementation of each actor is important due to the relevant and the linkage of each component toward sustainable irrigated water resource management.

Due to the multi-stakeholders involvement to deal with the water governance, the trend on water perceptions should be addressed in order to find the balance on managing water resources towards sustainability.

2.4. Water as public and economic goods

Water perceptions have been changing and debating among different groups due to the global population growth and the basic need on this finite commodity – the total fresh water amount to 0.8% of the total water on the Earth (Kotwicki, 2009) is being used for the global consumption of human and all lives on the earth in different geographical feature. According to United Nation Committee on Economic, Cultural and Social Rights (WHO, 2002), Kofi Annan, United Nations Secretary-General (http://www.righttowater.org.uk/), and The Law on Water Resources Management of the Kingdom of Cambodia (MOWRAM, 2007) mentions that water is vital for life, human can access to it for the basic consumption as the basic human right, no one can or should be excluded from using it or no one can have a monopoly over the use of water. This obviously illustrates that water is treated as the public good – state institutions have responsibilities and obligation to distribute this scare resource to citizens; however, treating it as the public good results in the wasteful use as everyone has no need to pay while using it (CDRI, 2008). Naturally, state performs slowly on water division to the urgent need of citizens and comparatively long time and sloping downward as well as remarkably less paying attention to manage or delivery water service if for free as an instance in Cambodia (Perry et al., 1997; Savenije & Zaag, 2001; and Wade, 1982).

Water as economic good has been taken into account due to the controversial issue on treating it as the public good (Perry et al., 1997; Savenije & Zaag, 2001; ADB, 2004; ICWE, 1992). Historically, public sector has had played an important role in irrigated water management while in this decade the private sector has become the main role to provide service on water supply. The two main reasons on this transaction are public service is subjected to market failure while private could booth economic growth. Public supply was censured as “chronic disequilibrium, imperfect competition, asymmetric information in supply or in consumption, externalities, discrimination, cost on technical ability to satisfy user requirement, uncertainty, or user ignorance of his or her own interest” (Tony & Elke, 2003) and/or “low level equilibrium which implying in low operational efficiency leads to low quality service”, according to Anwander and Ozuna, 2002 (cited in Prasad, 2006). Private sector, on the other hand can generate more benefit due to lower costs, productiveness, innovation, private capital mobilization, high quality of goods and services, market fit and market expansion, and greater the economic sector as a whole (Svendsen, at el. 2003). Therefore,

the current trend from public to private control of water resources has been presented wisely in the society as it is recognized as an important and effective element of water resource management and economic development in each nation.

2.5. Public Private Partnership (PPP)

According to European Commission in 2003, a partnership is an arrangement and agreement between two or more parties to work cooperatively toward sharing compatible objectives, share authorities and responsibilities, join resources for investment, share liability or risk-taking, and share mutual benefit if the plan ideally implemented. Public-Private Partnership (PPP) is the relationship involving the power sharing, work, support and/or information between the public and the private enterprise for the achievement of joint goals and/or mutual benefit (Kernaghan, 1993). It has been used since 1970s in the United State which initially focused on economic infrastructure development, and then on building, health center, energy, water, and waste treatment (New South Wale Treasury, 2009) as well as has applied successfully in European countries. It refers to change of government management system – turning from state own only to the combination joint venture between the public and private in order to faster the economic growth in the countries. The former Prime Minister of Czech Republic, Jiri Paroublek addressed that *"just like any other market economy, we are trying to multiply our economic potential and implement projects for which the public sector alone has neither the strength nor the resources*" (Eggers, 2006). Therefore, the PPP has been optimistically defined as the good concept to apply in each nation in order to achieve the economic development and reduce responsibilities of the governments.

There are numbers of types of Public-Private Partnerships, according to Deloitte Research (2006). The agreement between the private sector and the government has to be made including service contract and/or management contract. Service contract refers to the private partner takes the task of providing service which government used to perform previously. Management contract is the private has to responsible for operation and maintenance. Below are the types of PPP:

- Design-Build (DB) or Build-Transfer (BT): Private designs and builds while government then take responsibilities to operate and maintain the facility.
- Design-Build-Maintain (DBM): Private designs, builds, and maintains while the public responds on operation.

- Design-Build-Operate (DBO) or Build Transfer Operate (BTO): Private designs, builds, and then transfer to government (title as the public facility) while private partner operates for a specific period.
- Lease-Operate-Maintain: private operates and maintains the asset under the term of reference of the lease.
- Design-Build-Operate-Maintain (DBOM) or Build-Operate-Transfer (BOT): A private designs, builds, operates, and maintains for a specific period. Then transfer to the public.
- Build-Own-Operate-Transfer (BOOT): government grants and authorize to private sector to finance, design, build, and operate for a specific period time. Ownership will be transferred to public at the end of the project.
- Concession: private sector has exclusive right to operate and maintain the asset in the long period time base on the requirement set forth by the government. "*The public sector retains ownership of the original asset, while the private operator retains ownership over any improvements made during the concession period*" (Deloitte, 2006).
- Build-Own-Operate (BOO): Private sector designs, builds, operates, and maintains which retains ownership. And there is no requirement to transfer to government.
- Divestiture: government transfer an asset (part or full) to the private with the certain conditions that the sale of asset have to ensure the citizens continue to be served with the improvement of the private activities. It is the full privatization.

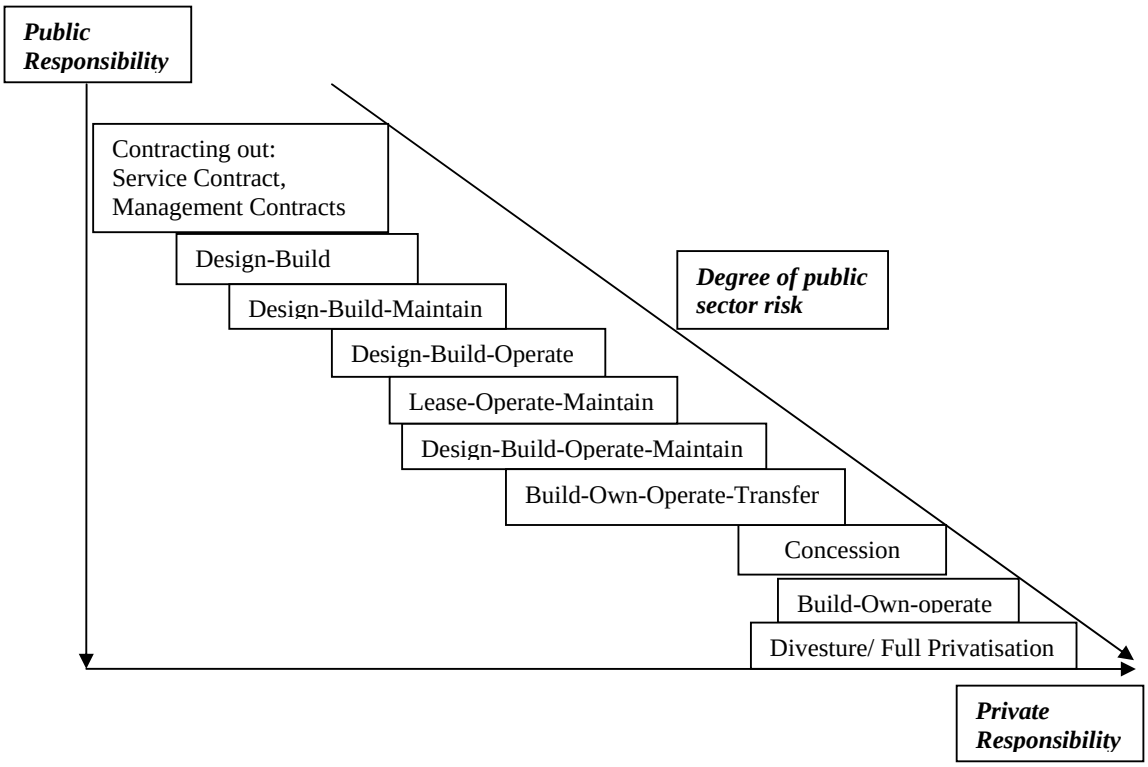


Figure 1: Scale of Public-Private Partnerships

Sources: Canadian Council for Public-private partnerships; Deloitte, 2006

Although PPP has been recognized as a good model to be applied, there are many risks in implementing PPP. Those include technical risk, construction risk, operating risk, revenue risk, financial risk, environmental risk, regulatory and political risk, force majeure or natural disaster risk (Grimsey & M.Lewis, 2007). The factors that lead PPP to be failure are the indicators to measure and mitigate the risks. According to Deloitte Research (2006), weak organizational structure of the government, lack of clarity of the expected outcome, poor communication and cooperation (between government and private sector), inappropriate risk modelling, lack of internal capacity (both government and private), inadequate planning and poor setup, lack of operational focus, failure to realise value for money are the factors lead to the failure of PPP. Therefore, to avoid these challenges, Palmer (2009) has highlighted some tips as following:

- Organisational and structural arrangement: clear roles and responsibilities, and risk sharing.
- Regulation and law framework: appropriate corporate and commercial law, deregulation, and tax reductions to support the private investment.

- Establishing Dedicated PPP unit in government sector: centre to build knowledge for government to be able to drive service innovation. But have to avoid the confusing where the unit is seeking for encouraging PPPs (Vinning and Boardman, 2008).
- "Value for money": auditing should be carried out by external auditors to check the project.
- Promoting ongoing benchmark to ensure the continuing money value from the existing project.
- Ensuring the bidding process is competitive with proper procurement procedures and publicly announce.
- Considering on accountability and transparency all time.
- Contract should be flexible and develop over the lifetime of the project, and not only focus on the most attractive projects especially in the rural area.
- Clearly state the timeline for completion.
- Getting feedback and evaluation of the projects from the local citizen's voice.
- Detail Impact assessments of each project which will affect to other sectors have to be taken into account.

2.6. Public irrigated water supply in Cambodia (FWUC)

Redistribution of resources by the state to the individual or private sector to take responsibility to make use the existing resources to achieve economic development in the country is the most political consensus in recent decades. The private is the benefit oriented which could lead to the destruction of the resources while the community who has direct interest and depends directly on those resources tends to be ownership, well manage and better control on their own commodities in the sustainable manner; thus the recognition on the ownership maybe better than devolution of the private owned (Dalal-Clayton et al., 2003). This aspect also has been considered by the RGC, in 2007, the Law of water in Cambodia was established by Ministry Of Water Resource And Meteorology (MOWRAM) in 2007; one part mentioned about the duties and powers of farmers to manage water in their area.

In article 19, chapter IV of Law of water mentioned that Farmers' Water User Communities (FWUCs) have role and responsibility "to ensure effective and sustainable management and operation of the irrigation system, the MOWRAM shall initiate the creation of FWUCs. And all farmers using water from the same irrigation system or part thereof may form a Farmers' Water User Community". The statutes of the FWUC shall be registered with the provincial or municipal directorate of the MOWRAM. After its registration, the FWUC is fully entitled to carry out its

Statutes and formally recognized. The procedures for the establishment and dissolution of FWUCs shall be determined by the government sub-decree.

The mains objective of FWUC is to facilitate and organize farmers to carry out feasibility studies and construct irrigation systems including diversions, intakes, outlets and canal systems to supply irrigation water to farmers' fields in an efficient and sustainable manner and to cooperate with the concerned ministries to create the FWUC. The duty is to manage water use in any irrigation system by obtaining due recognition from the RGC. FWUC structure (Secondary Committee, Tertiary Committee, and Watercourse Committee) is leaded by the FWUC committee under the Board of FWUC who mostly is facilitated by the Provincial Department of Water Resource and Meteorology.

In concept of financial management in FWUC level, the one third of FWUC bank account fund is for emergency repair on farm water management improvement. In the first stage of year 1 implementation, government contributes 80%, but the contribution is less and less in the year after once the FWUC is strengthened and has enough budgets on Operation and Maintenance (MOWRAM, 2007).

Although the structural system management of FWUC in Cambodia was set up and it terms traditionally and/or locally practical which may not be interpreted as scientific and/or technical for the FWUC to manage; the rules of water distribution can in fact be very sophisticated. It need both software including the strong management system such as the sufficient capacity of Farmer Water User Communities, advisory extension services and hardware which refers to infrastructure such as ponds, main canal, tertiary canal or more efficient field layouts to fulfill the O&M (Veng, 2007).

2.7. Decentralization and FWUC in Cambodia

Decentralization system was set out in the national policy and has brought to the local level, nevertheless it is still hardly to implement successfully, according to International Water Management Institute (IWMI) in 2006. For the water resource management in the irrigation system, Cambodia is still young and in the initial stage of infrastructure construction. Participation of farmers in the water resources management is vital important element to take into the government consideration in Cambodia. Participatory Irrigation Management (PIM) in practically: "farmers often don't gain real empowerment, new roles, or better control over their water supply" (IWMI, 2006). FWUC forms by RGC is still very much top-down initiative as the government still play a role to tell FWUC what to do while the state policy intends to strengthen, expand, and enable FWUC to participate in water resource management

including water allocation, irrigation infrastructure operation and maintenance in an effectiveness and sustainability (Veng, 2007).

The two main factors which lead to the failure of irrigation schemes are the financial problems and lack of farmers' interest. Providing both technical and management training; as well as more intensive to follow up during the first month after authorizing them to manage and control the scheme might help the farmers to make the system running, according to Woong and Waddod in 1997 (Cited in Hussain, 2004). Until now, there are …. FWUC was established. Some communities still get technical and financial support from the government and especially organizations play role as the donor. Once the NGOs move out, the group starts to confront with the difficulties of self-management on the O&M and the administration activities.

2.8. Trapaing Trabek Irrigation: history, water sources, management and rural economic development

The Trabek reservoir is located in Kantuot village, Kantout commune, in Kompong Chhang Province, 91 km from Phnom Penh capital. The Trabek Reservoir, located not far from the town about 5 km southeast, has 5 meters in depth in Bak River, one of the main rivers in the Province (Figure 2).

After the collapse of Pol Pot (Khmer Rouge) Regime (1975-1979) in 1979, formal irrigation scheme in the community did not exist. However since then, the local idea has been shaped by irrigation works set by the Khmer Rouge policy and by the effects of forced collectivization on local productive expertise and resources (Chea, 2010). A dam wall was dug manually near Boeung Thom Lake, covering an area of 750 hectares, in order to allow the pumping of the water to the fields nearby in dry seasons, but this project had not been completed by the time the Pol Pot period came to an end. What was left of the station was kept unattended, and the two floating rice varieties were lost by the end of the Pol Pot regime. The farmers in the community had still practiced only floating-rice farming because more than 90% of the community's farmland is submerged under the flood water for most of wet season, generally from late August to mid December.

In early 1990s, the construction of the *Trabek* scheme took shaped then farmers started to adopt rice cultivation during the dry season with water sources from the scheme. The reservoir consists of a concrete dam of 20 meters in length, connecting with its six main canals, which can store water of about 200,000 cubic meters at the maximum, and which, at present, is providing water to approximately 550 hectares of the farmland in dry season

(Chea, 2010). Large-scale irrigation system has not yet existed within the commune. The Trabek scheme is small-scale but the biggest irrigation system within the commune as there are a lot of water sources in the land. The two large water sources in the commune are Bak River with the water flow throughout all seasons and Big Lake (Boeung Thom), a very big lake which is the source of water and fish. There are also a few other small and medium ponds in the commune. The dry-rice season land in the commune is 1219 hectares (approximately 20% of the total communal land area). Floating rice has not been grown since late 1980s because of the natural condition (i.e., big water every year) and the loss of the right kind of rice variety after the Pol Pot Regime. Villagers haven't raised animals for business yet; they just raise them for family use and consumption.

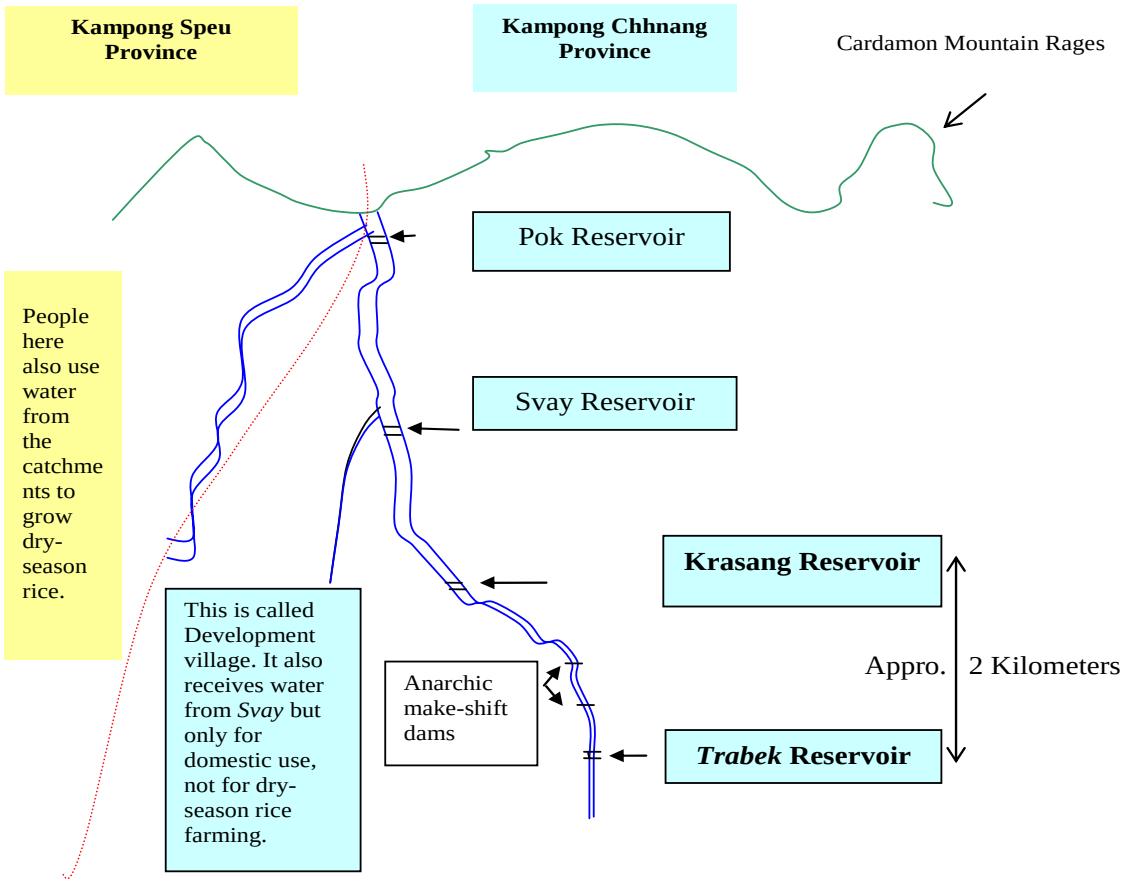


Figure 2: Location of the Trabek reservoir (source: Chea, 2010)

The Trabek reservoir is under the use and the management of Farmer Water User Community (FWUC) called the Trabek community. The community is currently comprised of more than 600 farmer households from six villages of three adjacent communes in the province: Kantuot, Chey, Pok, and Pich in Kantuot Commune; Snay in Snay Commune; and Ksach in Bak Commune (Chea, 2010). Following the last several years, the Trabek scheme

has turned the people in the community into a future promising one. The average rice yield in this area ranges from 3.5 to 7 tons per hectare through the sufficient water, the use of the fertilizers, and the care given to the rice plants. Due to the increase in the agricultural sector within the community, villagers are getting higher rice yields (on average 6 tons/hectare for when there is water and when they use fertilizer on the land), which enable them to sell and get some cash as their capital. It used to be one of the poorest among all the 13 communes within Kantuot District, but presently villagers in the Kantuot Commune have now been among the richest in the district (Chea, 2010). At the same time, there has seen the flow of some families from the provincial town into this community.

3. Materials and methods

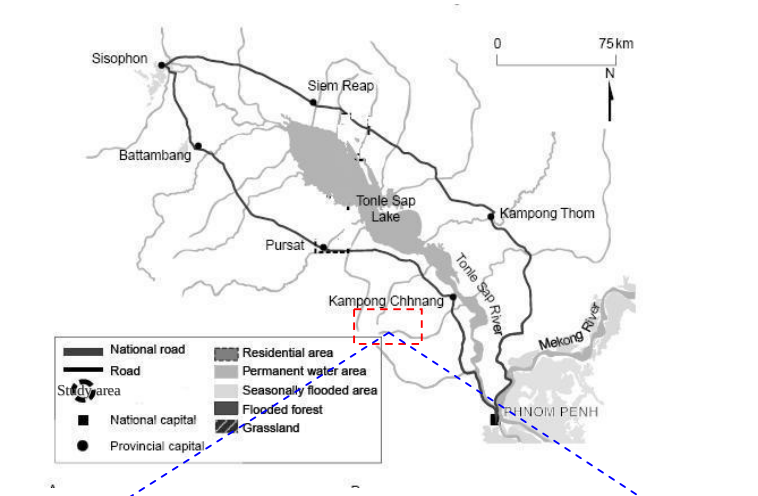
3.1. Site Selection

The Chrey Bak catchment is located in Kampong Chhnang province, 91 km from Phnom Penh (Figure 3A), covering an area of about 791 km^2 (ITC, 2010). The catchment elevation ranges from the downstream flat area of the Tonle Sap Great Lake, to the upstream area of the Cardamom Mountain. Water source mainly originates from the mountains and flows to the Lake particularly during the rainy season (May to October). During the wet period, the flat area at the downstream of the catchment is often flooded.

There are a few main types of landuse within the catchment: agricultural land, forest land, grassland, shrub land and very little urban land (Figure 3B). Among those landuse, forest land is mainly found at the end upstream along the mountain, agricultural land is seen from the upstream to the downstream and the grassland is spread through out the catchment. Very little urban areas are seen in the landuse map since the village towns is small. This study is conducted at the Trapaing Trabak irrigation scheme located at the downstream of Chrey Bak catchment (Figure 3C). The two target areas of this scheme are: (a) the farmland using water from the FWUC and (b) the farmland using water from the private sector. Non irrigators will be also included within this study.

There are several reasons that I, researcher, decided to choose this area as a research site. Firstly, I used to be familiar with this irrigation area when I used to work for water resources management project funded by AusAID as a research assistant from RUPP. Through this experience, I have some key contact persons such as village and communal chief, chief of Farmer Water User Association and staff from Provincial Department of Water resources. This will help to get more helpful information in doing the research in this area. Secondly, irrigation scheme is a medium scale less than 500 hectares; thus, it will not be difficult and time-consuming to collect data from the farmers. Thirdly, there are two groups of farmers who use irrigated water from the irrigation scheme; therefore, it is very interesting to examine the reasons and benefits from exploiting these two services. Lastly, the study area is not far from the capital and easily accessible; thus, it will enable the researcher to visit the place quite often so that the researcher will get more data and information.

(A)



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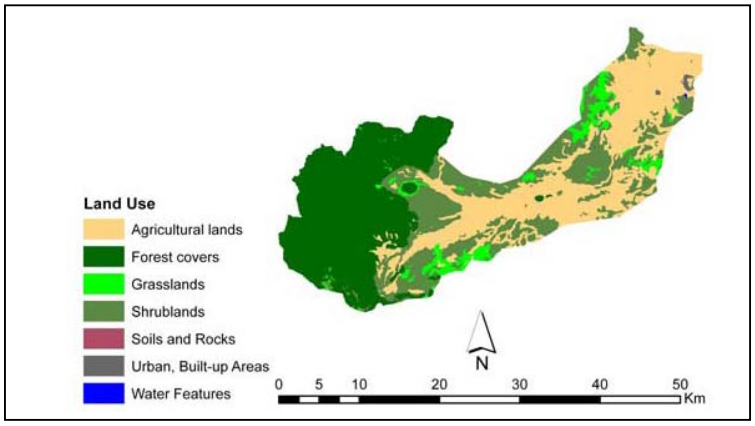

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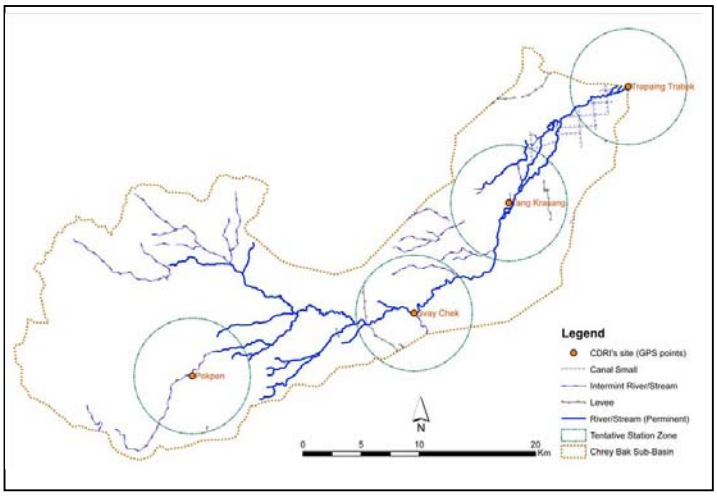


Figure 3: (A) Location of the study area, (B) landuse in the catchment area, (C) four irrigation locations (Trapaing Trabek (1), Tang Krasang (2), Svay Chek (3) and Pokpen scheme (4)) (source: ITC, 2010)

3.2. Method of data collection and information acquisition

This research involves the collection of both qualitative and quantitative data. The statistical analyse will be conducted using data collection from questionnaire survey with SPSS or STATA Package. The following description will outline the picture of how the study will be conducted.

Data collection method: Both secondary and primary data will be collected.

Secondary data will cover the following information:

- Official Statistics/ Data Based report from Ministry of Planning (MoP).
- Document of Water law and other relevant documents of MOWRAM.
- Articles and journals related to Private and Public sector on irrigated water management.
- The history and management structure of Trapeng Traback FWUC establishment from Provincial Department of Water Resources and Meteorology (PDOWRAM).
- The history of private water-pumping enterprise from the local authorities such as PDOWRAM, Provincial Department of Land Management, Urban Planning and Construction (PDLMUPC), and commune council.
- The scheme plan of FWUC and the private enterprise: objectives, scope, and expectation.
- The rice yield collection before and after the irrigation construction, from Provincial Department Agriculture (PDA) or other related NGOs.
- The irrigated farmland before and after the irrigation construction among the public and private sector, from Provincial Department of Land Management, Urban Planning and Construction (PDLMUPC) and commune council.

Primary data will be obtained from:

- In-depth interviews with the key stakeholders of government and private including PDOWRAM officers, provincial/district governor, commune council committees, FWUC committees and farmers / water users, and private owner
- Group discussions will be held which focus on constrain of O&M of the scheme (the discussion will focus on eliciting what the farmers think are causes of problems and what will be good solutions for their problems)
    i. Public water users (the farmers using water from FWUC) whose farms are near to water canal
    ii. Public water users (the farmers using water from FWUC) whose farms are far from water canal

iii. Private water users (the farmers using water from private irrigation)

- Personal observations in the area: The investigator will spend time in the community to learn more about Trapeng Trabak irrigation scheme, people perception and willingness to participate between public and private sector or both
- Quantitative questionnaire survey will be conducted with farmers using public (FWUC) and farmers using private option to elicit the basic information about family size, farm size, irrigated land, crop yields, income, expenses on the farming affairs (pesticides, water fees, fertilizers, labor fees, etc.).

3.3. Questionnaire development

The questions are seriously developed to meet the objectives which were set at the beginning. The required information was collected through a comprehensive, well designed and pre-tested questionnaire. The questionnaire contains some basic and essential information related to socio-economic information, household wealth, irrigation status, household income, household expenditure, and status of irrigation participation as following:

- General information of the households: age of household head, number of family members and economic activities
- Wealth status: household habitation, family processions
- Resources endowment and productivity : farm size, cropping times, rice yields and other crop yields
- Access and non-access to irrigation: reasons, propositions, irrigation services, type of irrigation, and payment method
- Household income: farming and off farm income
- Household expenditure: farming labour, fertiliser, water fees, food, children education, health and transport
- Status of irrigation participation: public/private, irrigation maintenance and contribution

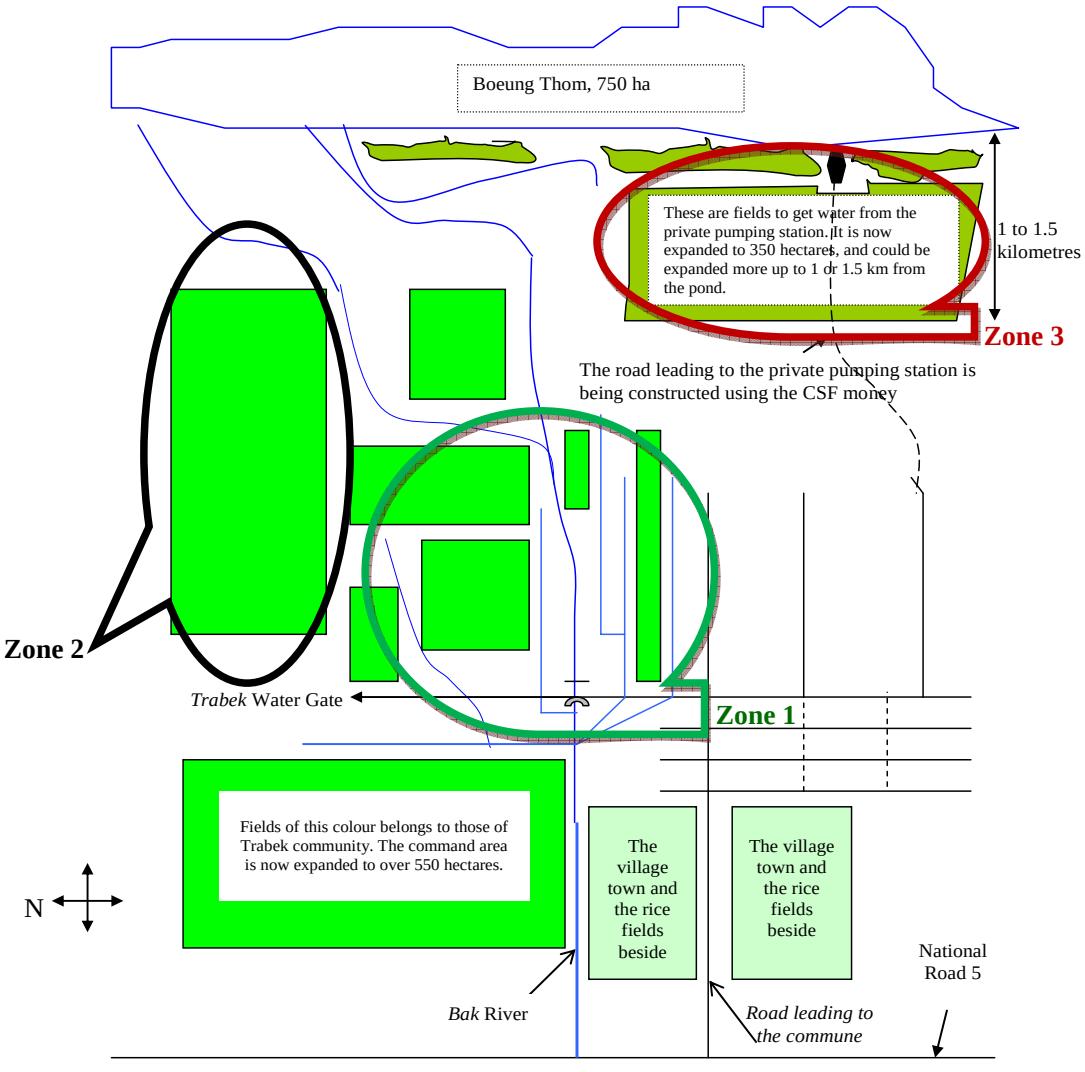
The sample questionnaire is attached as Annexe 1.

3.4. Sample size and its distribution

150 samples have been collected during the field survey within the research site. To have a good representative distribution in the whole study area, three zones from five villages were divided: zone 1 (area close to Trabeak irrigation scheme), zone 2 (area far from Traback irrigation scheme), zone 3 (area using irrigated water from private sector) (Figure 4). The Table 1 shows the total number of households from eight villages within the two communes and the number of interviewed households.

Table 1: Numbers of interviewed households

Commune	Village name	Household	People	Interviewed Household	%interviewed
Kork Banteay	Kork Banteay	208	1022	60	29
	Popeal Pork	185	797	36	19
	Meanchey	106	533	17	16
	Troneam Pech	88	381	19	22
Chreybak	Thmey	150	NA	5	12
	Thnal Thmey		NA	5	
	Prey Pouch		NA	7	
	Prey Koh		NA	1	



Note: This figure shows the present situation of the area.

Figure 4: Map of zone division for conducting questionnaire survey (Map source: Chea, 2010)

3.5. Pre-test questionnaire

The test aims at checking the quality of the individual questions and the questionnaire as a whole. Regarding the individual questions, the test will focus on the variation of the answer, meanings, redundancy, scalability, non-response, and acquiescent response set. The household head will be interviewed but if he is absent, his wife will be a key person to be interviewed. This method will be adopted during the whole field survey.

3.6. Management of bias

Bias is the key problem that can affect the quality of data collected for the analysis. The following are the potentials biases that can occur in PRA and questionnaire survey and the proposed solutions for dealing with them.

Power relation bias: the potential challenge of a diverse group meeting for PRA is the unequal voices raised by the participants. The dominant groups (the well respected elders and rich people) tend to have more voices than powerless people (women and the poor). To mitigate this problem, the facilitator needs to ensure equal chances for all people to talk and particular attention should be paid to the powerless group if they decline to participate. Various tools of active participation, for example each person needs to talk, need to be used.

Sample bias: it is possible that a large number of women will decline to be interviewed because of cultural barriers as mentioned above. Minimising the issue, the Quota Sampling will be applied so that the number of male and female being interviewed is under controlled. However, within this study, the household head will be the key person to be interviewed. If he is absent, his wife will be questioned.

Interviewer bias: it is possible that some respondents tend to provide answers that they think the interviewer wants. Mitigating the issue, the interviewer needs to provide a clear and convincing introduction of the aim of the research as well as the importance of the respondents' real answers for the research. It may also be minimized through focus group meeting.

Strategic bias: the respondents provide the answers that they think may benefit them or they think the results of the research will not make any change for their communities. The solution for this issue is similar to interviewer bias. The interviewer needs to mention clearly the aim of the research and confirm the respondents that real answers would be of benefits for the

individuals and communities as a whole. Again, the focus group meeting may provide useful insights for dealing with this problem.

Response bias: this type of bias occurs when respondents are forced to answer the questions that do not reflect their views. To minimize the problem, the open-ended questions are used so that people can express their views. Also, the insertion of the options “doesn’t know” or “not sure” for the close question will ensure that all options are provided.

At the onset of the interview, the interviewer starts with the introduction himself then moves into the purpose of the interview. This is an important step for the interview to draw confidence and interests of the respondents with the survey. The recorder may be used if the respondents are comfortable. Gender will be noted on the list of the questionnaire.

4. Results and Analysis

4.1. Impacts of irrigated water to the agricultural productivity

4.1.1. Socio-Economic of the study area

The interviewed age of the 150 respondents ranges from 18 to 67 years old with mean age of 42 years old (Table 2). Among the interviewed, 24% are men and 76% are women because women generally look after the children and do household works at home and men mainly work at the rice fields during the interview period. The family member varies from 1 to 10 people with mean number of 5 and 65% are adult.

Table 2: Household information

	Interviewed Age	Adult	Family member
Minimun	18	1	1
Mean	42	3	5
Maximun	67	7	10

- Occupation

Through the survey, all the interviewed villagers (100%) do the farming. However, besides farming, they have their own extra occupation. The majority of 59% in particular women do their handicraft work (Chak Kontrong) at home while 31% do fishing. 14% are sellers at the local market in the central of the village and only 5% are civil servant such as commune staff and teachers (Figure 5). Beside these, some of their family members especially the youth are the factory workers and construction workers. Based on the interview with FWUC leader and elderly in Kok banteay commune, the young ladies have worked as the factory workers in the textile area, leaving home in the early morning and back in the evening. Only small amount of people have migrated to live permanently in the city.

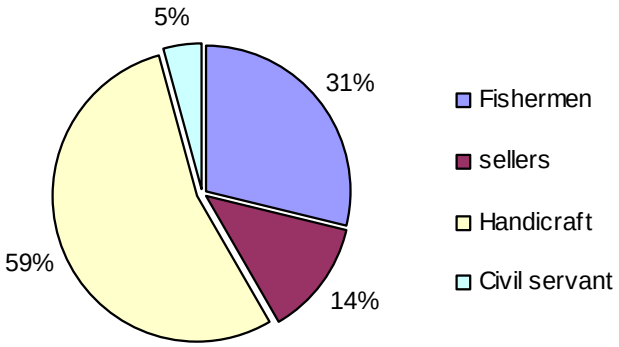


Figure 5: Extra occupation besides farming

- Household status

House condition has been used as principal criteria to classify the social status since Cambodians primarily pay attention to their habitat. The brick house with tile roof is considered 'rich', the wooden house with iron roof is 'medium' and the palm house with palm roof is 'poor'. Based on the criterion, 19% are rich, 27% are medium and the majority of 54% are poor (Figure 6).

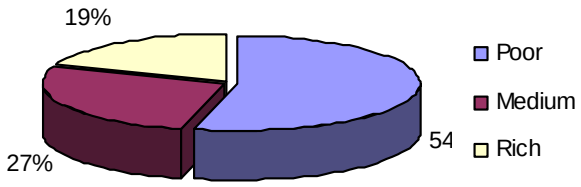


Figure 6: Household status

- Household asset and resources endowment

Regarding the land for rice cultivation, it can be found from the survey that the villagers own a plot of farmland ranging from 10 a to 10.5 ha with mean plot of 1 ha. 43% own farmland less than 1 ha, 41% from 1 ha to 2 ha and 16% higher than 2 ha. All most of interviewees (91%) have their bike as a common transport for mobility in the village. Only 38% have motorbike while nobody has a car. Even though all people in the study area do the farming, only 14% have a truck/tractor as their transport facility for agricultural works. The majority of 69% have cow/buffalo and only 17% have ox-cart. More than 50% of them have a TV set mainly a black-white set. 45% own a pumping machine for irrigating the rice fields. The Table 3 summarised those information.

Table 3: Household asset and resource endowment

Bike	Motobike	Car	Truck/tractor
91%	38%	0%	14%
TV set	**Pumping Machine**	**Cow/buffallo**	**Ox-cart**
57%	45%	69%	17%

- Household income and expenditure

According to the survey result, it showed that the interviewed households had their annual income ranging from 600,000 Riel (150 $) to 23,530,000 Riel (5,882 $) with mean income of 5,300,000 Riel (1,320 $). The Table 4 summarized the income range of the interviewed household.

Table 4: Income range of interviewed households

Annual Income (in million Riel)	<1	1 to 3	3 to 5	5 to 10	>10
% household	4%	26%	32%	27%	11%

Very few families have earned higher than 15,000,000 Riel (3,750 $). Rice selling has been found to be one of the main sources of their income generation.

Comparing between the income and expenditure of the 150 interviewed households, we can look at the graph showing the comparative fluctuations (Figure 7). The family income is not significantly correlated with the expenditure. It can be seen that the income generally is higher than the expenditure; however, in some cases, the expenditure of some families is higher. This could be attributed to particular case in which the families have spent much money on medical treatment and attend often the traditional ceremonies. Through the interview, they told that the exceeding expenses were mainly taken from the money borrowed from the community saving budget or rural development banks such as Acleda Bank, Prasak Bank etc, and/or outsider businessman with the high interest rate - borrowing 1 million Riel (250 $), villagers are required to pay 25,000 Riel (6.25 $) every day within 50 days, counting from the beginning to the end of the loan (according to unofficial interview with some key informants in the village). In accordance with this, some households are being in dept.

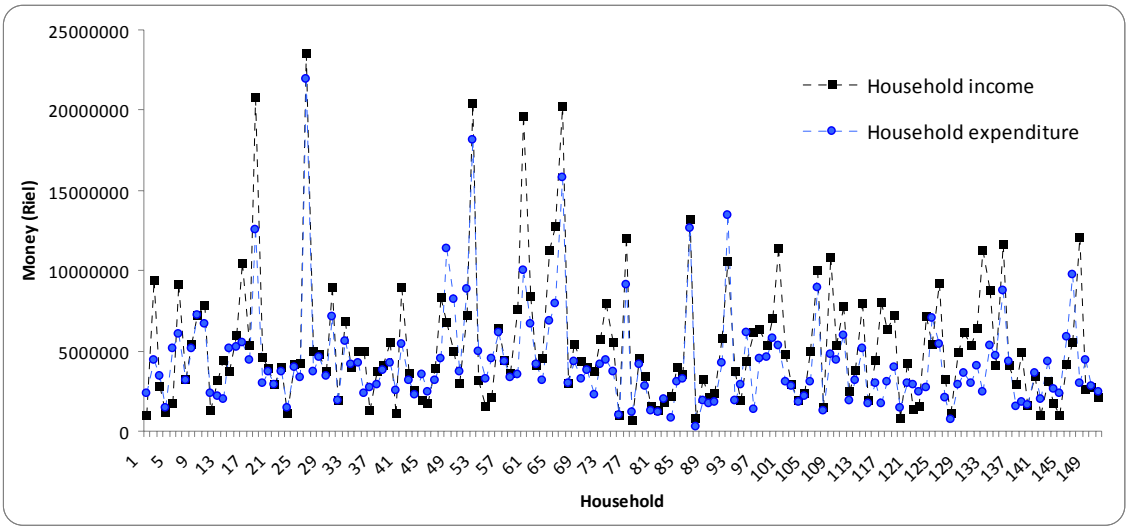


Figure 7: Comparative graph between household income and expenditure of the 150 interviewed families.

According to the data collected from the survey, it was showed that 47% in average of the total income was spent on food, 14% on agricultural labour, 8% on fertiliser, 4% on water fee, 4% on transport, and 22% on others such as wedding, traditional ceremonies, health, school fees of their children. By the way, the villagers spent nothing on rice seed because they always keep their own seed for yearly consecutive cultivation. The Table 5 summarized the expense information in their families.

Table 5: Household expenses on different sectors

Food	Labor	Fertilizer	water fee
47%	14%	8%	4%
Seed	**Hired land**	**Transport**	**Others (health, ceremonies, education etc.)**
0%	1%	4%	22%

4.1.2. Agricultural productivity with irrigation

- Irrigation system expansion and rice yield increase

According to the survey, it showed that the agricultural productivity has been increasing after receiving the irrigated water supply into the rice fields. The average rice yield per hectare of farmland using irrigated water is 3 tons and the highest is 7 tons (the dry season rice within 3-4 month-period) while without irrigation, the average rice yield is 2 tons and the highest is 6 tons (mostly the rainy season rice with adequate rain and spending 6 months for crowing from sowing/transplanting to harvesting). With the additional water distribution from the Trapaing Trabek scheme to the rainy season rice, the rice which is expected to die due to the drought in rainy season could be rescued and the dry season rice cropping has been adopted since then. Moreover, the result from the questionnaire interview revealed that the expansion of farmland of individual household has been increased up to 10.5 ha as the largest dry rice farmland which can produce rice yield of approximately 31 tons per year in average; whereas, the minimum farmland is 0.01 ha with rice yield of only 0.14 tons per year. Noticeably, before 1991, there were no farmers adopting the cultivation of dry season rice since there had no irrigation system. Only some farmers used to do floating rice as the amount of farmland in this area are flooded during the rainy season (geographically, this area is the Tonle Sap floodplain). In 1991, the first time of Trapaing Trabak scheme rehabilitation had taken place after the Pol Pot regime, the bamboo hydraulic structure was being re-constructed into a concrete structure under financial support from the American Friend Service Committee (AFSC), and then the technical support from provincial department of

agriculture with the labor providing from local people. Since then, the dry season rice has been applied. At that time the irrigated farmland area was only about 20ha within 50-60 households. Then in 2000, the number of farmland has been increased to more than 100 ha belonging about 120 households using the water from this irrigation scheme. Currently approximately 450 ha of 470 households are consuming this water source, according to the interview with FWUC committee chief. Also, there has been a considerable increase of farmland from 13 hectares in 2006, 70 hectares in 2007, 100 hectares in 2008, 130 hectares in 2009, to 150 hectares in 2010 respectively for the private irrigated water supply with the water source from Big Lake (Beung Thom), located close to the outlet of the Chrey back catchment (information sourced from an investor of irrigated water pumping). Therefore, comparing between the past and the present, agricultural productivity in this area has considerably improved due to the large increase of rice yield and the expansion of irrigated water allocation and dry rice season farmland.

By dividing between the irrigated water provision between FWUC and Private sector, we still can see that the level of rice yield was shown increasing after these both sector implementations in this area. The percentage of the rice yield increase was significantly observed for both public and private sector. Based on the interview with the farmers, an average and high increase were in between 34% and 40% while a small increase from 14% to 17% and the same from 9% to 13%. However, rice decrease was also seen slightly ranging from 1% to 2% of the total respondents, mainly due to the distant rice fields from irrigation access (their farmland is far from the scheme particularly at the end tale). Using the Trapaing Trabek scheme under the management of FWUC, it can be seen that the amount of yield increase was 6% higher than the yield using pumping water from private sector (FWUC: 40% and Private: 34% respectively). Hence, with the promotion of irrigation implication through either public or private in this area, the proportion of agricultural productivity has been ameliorated.

Table 6: Level of rice yield increase between FWUC and Private irrigation

	High increase	Average increase	Small increase	The same	Decrease
FWUC Irrigation	40%	35%	14%	9%	2%
Private Irrigation	34%	35%	17%	13%	1%

- Cropping pattern changing and the impact on labour force

Cropping pattern refers to the ways that farmers organized their farmland into plot to be fitted with the irrigation system and the numbers of cropping time annually. Via the result from the survey, we can see that farmers arranged their farmland based on the water distribution from the FWUC committee and private water pumping system – water which flow directly from the Trapaing Trabek main canal to the secondary canal and then to their farmland through tertiary canal (Figure 8). Similarity to the private structure, the water is pumped from Big Lake into the reservoir which locally called “Hong Tek” and then flow to the main canal then through secondary and tertiary canal before reaching to the rice fields. On the other hand, as the geographical feature in this area is fluctuated, farmers often flatten their land before delivering water into their rice fields. It is thus one of the problems that make some farmers who do not taking care of their farmland can get low rice yield at the end of the harvesting season. Regarding the cropping time, farmers can only do farming one time per year and the method of cropping is seeding but transplanting because they cultivate dry rice seed which only requires short duration from the first stage to the final stage of rice development (3 to 4 months – from mid-December to mid-April). In contrast, they cannot adopt long-term rice cultivation (Srov Thngounn) which is time consuming and this kind of seed usually can be well grown with large water requirement, in particular in the rainy season. Noticeably, some farmers have either rainy rice or dry rice farmland, so they can farm in a whole year both in the rainy and dry season with the additional gravity irrigation and/or pumping water from Trapaing Trabek irrigation scheme and private station.

Figure 8: Rice field irrigated by FWUCand Rice field irrigated by private sector

Moreover, according to the interview, farmers in general have hired labour during rice harvesting season. Some of them borrow money from the saving community and/or micro credit bank as well as the other rich people outside the village. Specifically, the poor only hired some for the additional labour to complement with their family labour. We can see that as the farmland are expanded each year, the labour force has been also increased; most of

them are the outsiders from other villages in the commune or different communes such as the farmers from Tang Krasaing commune and other nearby areas. Either villagers or outsiders come to settle temporarily in Trapaing Trabek area from the beginning to the end of harvesting period by bringing food along with or some relatives back and forth to bringing food from homes. Generally, they spend about a few weeks for this harvest – some back home early while some still stay there until the final stage of rice collection period (Figure 9). With these activities, not only the villagers in the Trapaing Trabek itself but also the communities from the other villages or communes can generate more income due to the implementation of dry rice cropping in this area.

Figure 9: Activities of farmers in the harvesting season in Trapaing Trabek area

- Market information and challenging to farmers

According to the observation and interview, we can see that there is one market located along the road which is connected to the national road No. 5 – its name "Prey Khmer Market". Within this market availability, people can get access to market information better than in the previous time and they can bring agricultural products to sell there or wait for the traders or middlemen to come directly to their villages. Although people can produce more rice yield and have access to market information through Prey Khmer market which is close to their area, they still confront with the low price selling during the peak period – harvesting season with large amount of rice yield. This is because people have no their own stock or machine to dry the rice in order to avoid from fermentation or to protect from insect or mice, and especially they have to pay back loan as they borrowed for their investment on buying fertilizer, labour hiring, and family health issues, etc. Generally in 2010, the lowest rice price is 700 Riel (1.75$) per Kilogram and the highest price is 1,200 Riel (3$), depending on the rice variety and seasonal price variability. Some interviewees exclaimed that "the middlemen usually low down the price when they see people intend to sell rice to them. They told that

they were very difficult to negotiate with them as they needed to exchange cash to refund a loan or interest and/or to get money to support their family". Differently, a few better off in the village could keep their rice in a suitable warehouse and waited until the price started to increase, and then they decided to sell to the traders. Based on this way, it was clearly explained that the poor still have confronted with the challenge of uncertain market information even though they could yield up their rice production and access to the free-market – the benefit given to the poor still shows the limitation.

4.1.3. Comparison on household status and the use of irrigation system

- Access to irrigation

Based on the survey, there were 47% using irrigated water from FWUC and another 47% using both – FWUC and Private sector, while only 6% accessed to only private sector which demonstrated that about less than 8 times compared to the households using water from Trapaing Trabek scheme (Figure 10).

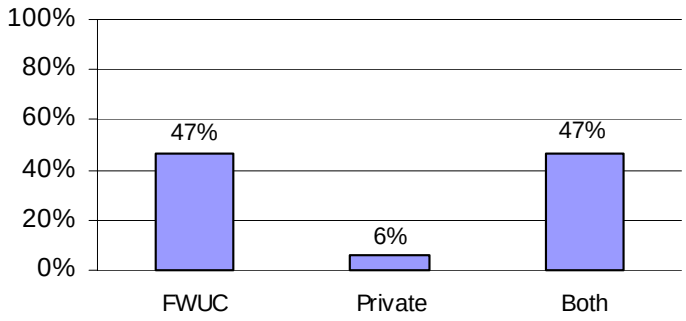


Figure 10: Access to irrigation

The reason of choosing these kinds of irrigation is that the people have farmlands at both sites: the one near the Trapaing Trabek irrigation and the another near the private sector station. For some who access to only one type of irrigation (FWUC or Private), they only have rice field at one of these two sites. According to the survey, the proportion was significantly illustrated that 91% of the 150 respondents access to these irrigation types because their farmlands are nearby the scheme (either FWUC or Private) (Table 7).

Table 7: Reasons of choosing irrigation system

Reasons	Near to farmland	Fair Price	Cheap Price	Good O&M
Respondents	**91%**	**53%**	**17%**	**47%**

- Household status and type of irrigation access

Using irrigated water from public or private sector doesn't show the significant correlation to the difference household status in the study area; it depends on the accessibility to the water source rather than the level of rich, medium, and/or poor status to decide whether to use those types of irrigation system. According to the survey, for the poor households, there were 40 who access to irrigated water from FWUC, 5 to private and 35 to both. For medium households, 16 access to irrigated water from FWUC, 2 to private and 22 to both. For rich households, 14 access to irrigated water from FWUC, 2 to private and 13 to both. The Table 8 presented that information.

Table 8: Households using irrigated water classified by the household status

	FWUC	Private	Both	Total
Poor	40 (27%)	5 (3%)	35 (23%)	**80** (54%)
Medium	16 (11%)	2 (1%)	22 (15%)	**40** (27%)
Rich	14 (9%)	2 (1%)	13 (9%)	**29** (19%)
Total	**70 (47%)**	**9 (6%)**	**70 (47%)**	**149 (100%)**

In regard to the number of respondents, it seemed like the majority of the poor intend to use FWUC service. However, if comparing the percentage; we can see the small different proportions among the poor, medium, and rich households who have accessed to irrigated water from FWUC, Private, and both. The poor, medium, and rich have accessed to FWUC in the proportion of 50%, 40%, and 48%, respectively, to Private 6%, 5%, and 7% respectively; whereas, to both 44%, 55%, and 45%, respectively (Figure 11). Moreover, the price of water fee between FWUC and private sector doesn't show the discouragement of farmers including the poor, medium, and rich for not involving in using these types of irrigation system. Accessibility to the irrigated water is the most necessary point. Through the result from the survey, the private water fee is about 17-20 folds higher than FWUC, 87.5-100 $ (private) and 5-7.5 $ (FWUC), respectively; but, the level of household status still didn't represent the correlation of accessing to either FWUC or private sector. The most important reason is the location where their farmland is – if it is near by the FWUC scheme, the accessibility to the FWUC will be addressed, but the people will access to private sector in case their farmland is located close to the private water station because they have no other options to select which type of irrigation system should be adopted in order to generate more income from rice cultivation. Therefore, the rank of the family status in this study area is not the main indicator to measure the amount of farmer using irrigated water from either private

or public. It is more likely dependent of the location of farmland and the accessibility to the irrigated water for both public and private sector.

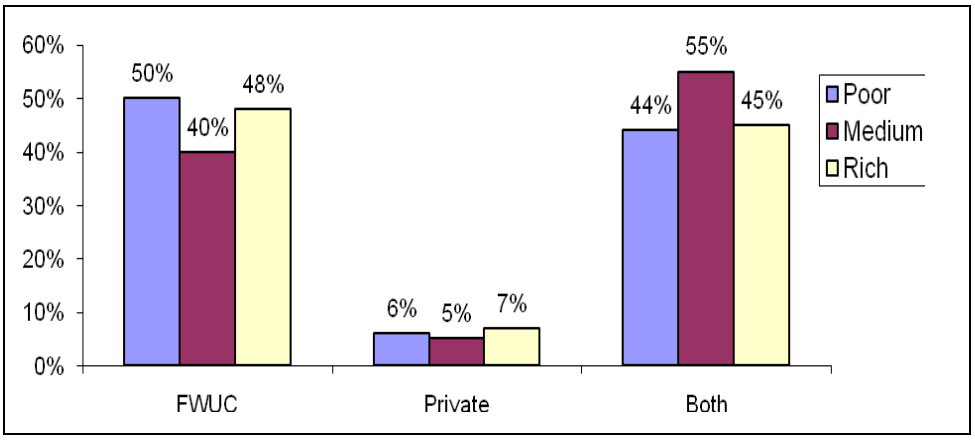


Figure 11: Comparison of household status following access to irrigation

4.2. Management system of FWUC and Private sector

4.2.1. FWUC

Historically, due to the problem of doing floating rice farming – no suitable seed for cropping in this area and low level of crop yield, in 1991 AFSC and POWRAM had cooperated with each other in order to repair and rehabilitate the Trapaing Trabek scheme for the community to use the water for agriculture sector. Unfortunately, between 1991 and 1994, FWUC committee had not yet been formulated. Only one person was selected by a commune chief, responsible for the irrigated water distribution. However, without incentives, he decided to quit his duty. By seeing this problem, the commune chief had taken action with the technical support from the AFSC to establish Trapaing Trabek FWUC committee unofficially and two people were assigned and took responsibilities on water distribution and maintenance of the scheme. Soon after, in 1995, there was an unofficial voting for FWUC Committees under the administrative support from the commune council. Yet, there had no clear structure of the FWUC to manage this irrigation system. The village chief and other 2 farmers were voluntary to respond for operation and maintenance (O&M) of the scheme. Then, in 2000, by seeing the potentials of dry rice farm land in this area, PDOWRAM cooperated with the commune chief to formulate FWUC committee. Since then, the FWUC was formulated and have clear structure (Figure 12)– chair man was in charge of general supervision and the other three vice chair man, the first vice chair man responsible for system maintenance and repair, and the second vice chair man was in charge of water distribution and the third accountable for financial management - cashier. However, this FWUC has not yet been registered formally until now.

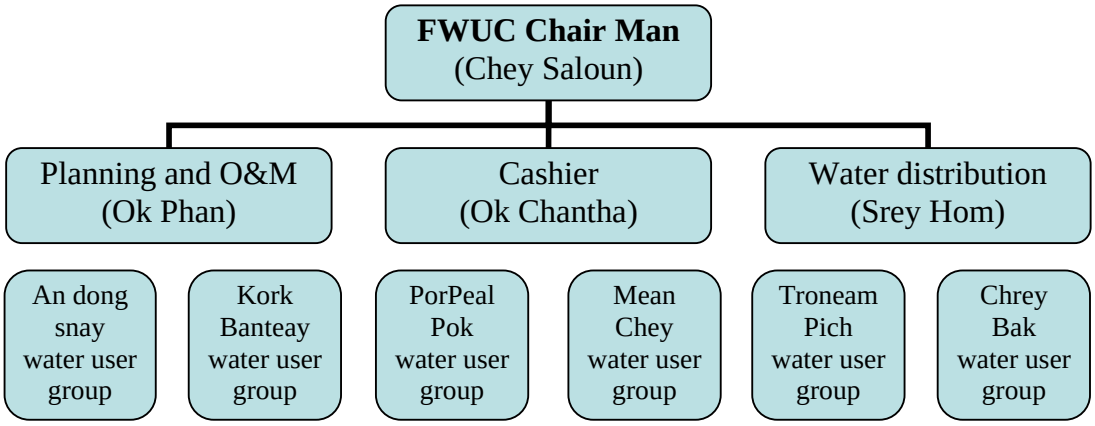


Figure 12: Structure of Trapaing Trabek FWUC committee

Geographically, Trapaing Trabek scheme can supply irrigated water to 5 villages in Kork Banteay commune, such as Kork Banteay, Porpeal Pork, Mean Cheay, Tror Near Peak, and Chrey Bak commune (the farmlands are far from the scheme which results in the difficulty for farmers to cultivate within this village). Some farmlands at Andoung Snay village in Andoung Snay commune are also the potential area for cropping, using this irrigation system, according to the interview with FWUC. In 1991, the first time of rehabilitation after Pol Pot regime; there was about 20 ha irrigated farmland within 50-60 households. Then in 2000, the number of farmlands were increased to more than 100 ha with approximately 120 households, and currently about 450 ha within 470 households are using this water source.

For the O&M, the FWUC committee plays a role as the open water gate, and takes care of the main scheme while farmers operate their own tertiary canal. The water fee is 20,000-30,000 Riel (50 – 75$) per hectare. Occasionally, farmers have faced a shortage of water during a drought period when the water supply from canal cannot reach the field. Meanwhile, the pumping machine of the government (PDOWRAM) will be requested in order to help the farmers, called “SangKros Srov” – helping rice to be survived. The machine to be used for this case is under the recommendation from the P.M. Hun Sen, according to the interview with FWUC committee.

This irrigated management system doesn’t work well as the FWUC committees are volunteers and the water fee collected from the farmers each year doesn’t fit to the real expense on the maintenance and the communication expense with the upstream scheme – Tang Krasaing scheme, which is the source of water supply to Trapaing Trabek reservoir. Also, some better off farmers only pay ISF for FWUC committee less than their actual farmland even though the committee has known their accurate farmland. This is due to the

powerlessness of the FWUC as it has not yet been registered officially. Moreover, the proposal of the FWUC committee on the irrigation system extension (excavating Trapaing Veng reservoir) was not approved by the commune chief to integrate into the communal planning.

In accordance with this, based on the group discussion with farmer water user group, they mentioned that the election on FWUC committee should be organized again in order to show the transparency and accountability on the voting and soon after FWUC committee structure being authorized and recognized by either the state or farmers publicly. Also, building relationship among the FWUC and commune chief in this area is very important as they are the leaders to boost the socio-economic growth in the area.

4.2.2. Private sector

The irrigated water pumping supply by private sector to the farmers' farmland in this area was initiated in the early 2005. This private system was taken place due to the initiative idea between commune chief and the better off in Kok Banteay village. Initially, by seeing the seed use for floating rice farming lost with the consequences in difficulty of growing in the this area, the commune chief has intended to change the traditional floating rice cropping to dry rice farming in order to ameliorate villager livelihoods. He has known one villager who has high knowledge, capital resource and power, and thought that he could be a right person to do the investment on the irrigated water provision to the dry rice farmland. With this relationship, at the end of 2004, he asked that person to invest on this sector. Finally, this man decided to run a pilot project on farming dry rice season. In early 2005, he started with only 10 ha nearby the private scheme. After 3 months at this pilot area, farmers who applied the method of pumping water through the private sector can gain benefit with the notable quantity of crop yield. Regarding to this, a number of farmlands in this area have increased from year to year – 13 ha, 70 ha, 100 ha, 130 ha, and 150 ha farmland increasing each year from 2006 to 2010, respectively. There were 20 households within 10 ha, who have implemented the pilot project of the private sector in the early of 2005. Noticeably, the potential farm areas which could get water supply from the private sector are approximately 300 ha and which could receive water supply from the Big Lake (about 10Km x 4Km with the depth of 2 m) covering an area of 750 ha. This lake is primarily the main water source for private sector to pump and distribute to the rice fields, according to the private owner's stattement.

There has no clear structure and official implementation of this private water pumping in this area. Generally, if mentioning the private business to be undertaken, the company has to be

registered, obtain a license from the government and pay tariff based on how large the company or private enterprise is. Yet, this water company has not been registered and permitted from the government – just only the agreement with the commune chief and recognized by a provincial governor. Moreover, the administrative sector hasn't yet been formulated – there has no headquarter for communication and information sharing related to the service of this company. The water fee is based on the petroleum bidding among the other private companies in Kampong Chhnang based on the petroleum cost in the market. Generally, the farmland owner has to pay about 350,000 (87.5 $) - 400,000 Riel (100 $) per hectare, which means that 1 ha of farmland using pumped water from private sector was estimated to consume the petroleum of about 4 Kan (1 Kan = 30 liters) for the dry rice until harvesting. Moreover, there are only a few workers responsible for the Operation and Maintenance (O&M) – they pump water for storage (Hong Tek) and then release to the secondary canal while the farmers themselves have to regulate and adjust water as their need. The son of the private owner is the water fee collector – collecting water fee is started during the process of pumping water from the beginning to the end of dry rice, which refers to the harvesting period. The peak period of pumping begins from early December to January. To invest on this business, the private water supply owner has to reserve their own budget about $3,000 - $4,000 in advance for paying petroleum before the water fee is collected finally at the end of the harvesting period. On the other hand, with the unstructured management system especially the water fee collection, some farmers ignored to pay due to insufficient water released to their rice field; therefore, at the end of harvesting season, they could obtain much yield. This is the challenge for the private sector as there has no any Term of Reference (ToR) to be the legal agreement between the private owner and the water users.

Noticeably, the private water supply owner has plenty of ideas for improvement of the O&M as well as the upgrade of this irrigated water pumping system. According to the interview with him, he addressed that "improving the water pumping system in this area is not too difficult to apply like a complex technical model from the developed countries. The farmers themselves could spend their own money to buy the plastic to cover around the dike in order to control the water flow out and into a lowland area. With this method, they can keep water in their farmland and do not need to spend much on getting water from pumping. Moreover, the farmers should take care of their land by ensuring that the height of the dike is suitable enough to store water for rice growth. However, by applying this system, it needs the participation from the farmers themselves to take care and spend their own capital resource to buy the plastic. And this is very difficult as the farmers in this area seem so lazy and maybe need him to spoon them, according to the statement from the private owner. Although

he claimed like this, but if looking back to farmer side, there is a constraint for them as the geographical feature in this area is not flat so that it is difficult to store water in each rice field and if they use plastic with the dike, they will spend a lot of money while some of them are in dept and some are borrowing money for their rice investment. This is a reflection why people tend not to do so, according to the private owner's point of view.

4.3. Farmer participation and perception on public vs. private sector

4.3.1. Participation and contribution to irrigated water management

Participation has been explained differently and variously based on each nation and/or culture of each community as well as language. In this case study, accessing irrigated water, contributing money such as ISF to FWUC committee and water fee to Private Sector, providing labor and material to operate or maintain the scheme of Trapaing Trabek with secondary or tertiary canal are defined as participation while the ideas of contribution in the decision making toward the irrigation management and improvement were not seriously taken into account in the farmers' perception.

4.3.2. Participation in Operation and Maintenance (O&M)

According to the survey, 149 respondents addressed that they support having irrigation system in this area and intend to participate with the FWUC as they have contributed through paying ISF (76%), labor (91%), and material (43%) for O&M (Table 9). Although they intend to participate, the proportion of labor (91%) was higher than paying water fee (76%) and and/or material (43%). This is due to 65% of family members of the household respondents are adults; they have adequate labor for contribution in the farming activities.

Table 9: Type of contribution to irrigation participation

	Money	Labor	Material
Household	114	136	65
Percentage	76%	91%	43%

Specifically, according to the interview with farmer water user from either FWUC or private sector, majority of them mentioned that there is no sense to provide labor and material for improvement of the private irrigation system as commonly they have thought that private owner is the service provider and private water user group are the clients. Only some farmers explained that the private sector was only responsible for pumping water and farmers themselves had to regulate and ensured that water was maintaining properly in the rice field from the beginning to the end of harvesting period in order to avoid the problem of too much or less water which could be the difficulties for rice growing. Thus, in terms of

participation on O&M with private sector, it still remains limited. Based on the interview with the private owner; the majority of farmers using private system do not take care of their tertiary canal and dike. This could result in having not enough water for cultivation and thus providing low rice yield. To regulate the water quantity in the rice field, and to keep protect the dike from crab destruction are very important; consequently, water in the field can flow forward to the downstream – Big Lake if no good maintenance from the farmer side. In addition to this, one recommendation from the private owner was ignored – using plastic to circle around the dike in order to keep water stay in the rice field and to avoid the dike destruction from crabbing. He added that "without participation, those farmers could not produce much yield and would still be in dept due to the investment in the early stage and especially the private owner cannot get water fee payment at the second or the final stage as the farmer blamed that they could not obtain much yield due to the inadequate water supply." The reason why people don't participate both in the operation and maintenance because the water fee was calculated based on farm size (1ha = 4 Kan of petroleum) but not based on the water quantity which the private owner pump for them – so when there is less water in the rice field, the farmers will alert the water controller to pump into their farmland. However, they never go to check their fields whether the rice grows properly, according to the information from the private owner.

On the other hand, briefly talking about the famers using water under the FWUC provision; the level of participation in O&M is still marginal, according to the FWUC leader s' statement. FWUC committees are difficult to collect the ISF as people s' commonsense is "*water is for free*" and traditionally they have never paid irrigated water since they were born and just have undertaken agricultural activities like their great grandparents. This can be explained that the level of conceptual understanding on the water as economic good of the people in this area is still rather low.

Table 10: Trapaing Trabek ISF record (in USD)

Year	Kork BanTeay	PorPeal Pok	Mean Chey	Troneam Pich	Chrey Bak	Thnous Rorng	Total ($)
2004	243	178	60	103	130	50	764
2005	77	25	8	22	80	0	212
2006	87	45	19	55	80	0	286
2007	162	70	32	26	40	0	330
2008	287	110	99	64	42	0	602
2009	292	177	82	143	48	0	742

As a result, despite the number of agricultural land has been increased from year to year, the ISF collection was annually fluctuated. Via the the Trapaing Trabek ISF record from 2004 to 2009, we can see that fee collection in 2004 was higher than 2009 even there were farmland expansion every year (Table 10). Therefore, it can be concluded that farmers seem not fully contribute and/or participate with the either FWUC or private sector in terms of O&M as well as water fee contribution.

4.3.3. Participation in decision making

A majority of farmers are the members of FWUC, but they cannot contribute their idea to the irrigation improvement through the meeting. They only attend to listen and follow the ideas of FWUC committee, in particular the chief. The initiative idea generally has been set up by FWUC chief while the other committee and FWUC members kept quiet and then the final decision was made based on the FWUC chief's idea. According to the observation while asking more detail about farmer participation in decision making, a majority of them could not provide suitable answer – they only responded that they intended to participate as they would like to attend the meeting and to get more information and/or to see the progress of the FWUC which has been made so far on the O&M scheme management since these factors are very important to ensure whether they can get adequate water for their rice fields as a result of livelihood improvement (88% of respondents) (Figure 13). They often attend to see how the FWUC committee set the plan for the irrigation development in the future. Nevertheless, they rarely share their idea in the meeting. This revealed that they still had low knowledge on the understanding of the participatory concept in the decision making level.

Moreover, about half of the respondents (52%) demonstrated that they would try to adjust their time in order to attend the meeting for catching up the updated information from FWUC committee and share their problem related to the irrigation issues to the FWUC committee and to ask the committee to deal with it as well as to contribute their time for maintenance or operation activities which were suggested by FWUC committee. Remarkably, a majority of the respondents are females; thus, they can spend more time with FWUC for the meeting while the males who are the important persons in the irrigation scheme management frequently missed the meeting organized by FWUC. On the other hand, 27% responded that they or their family members could contribute their skill referring to the labor contribution such as canal or scheme reconstruction, reservoir restoration, and or checking the water flow into the rice fields while the other 12% mentioned that they would like to know the new program initiated by the FWUC leaders, or to claim for adequate water for their rice field, and to select a good leader. The above description is shown that the level of farmer participation is still in the beginning level of attending rather than advocating to voice out their ideas to be

integrated into the decision making level. Consequently, the level of participation in decision making still remains poor – only few of the respondents can provide proper answer while the others never tended to take the term “Decision making” into consideration since their assumption is that making decision is not the farmers’ responsibility.

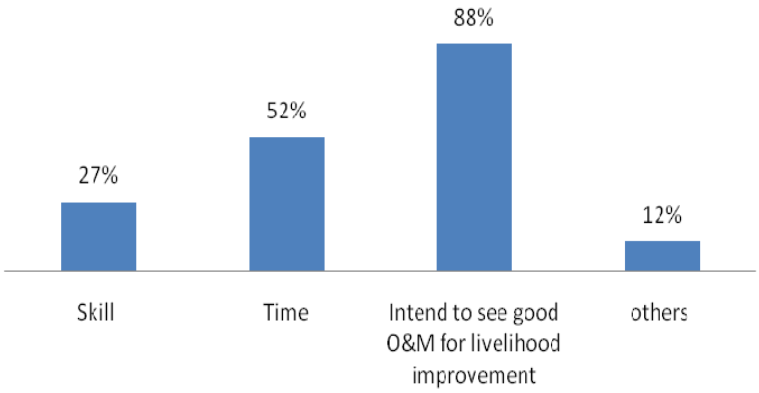


Figure 13: Type of participation in decision making

4.3.4. Religious participation in Trapaing Trabek Irrigation management

Buddhism in irrigation management is obviously important in terms of working collectively for the improvement of the Trapaing Trabek scheme. Collecting ISF for the O&M is more difficult than money contribution from villagers in the religious activities in this area. Generally, the FWUC committee leader, who has religious knowledge and used to be A-Char (Buddhist Priest) in the Kok banteay pagoda, has undertaken this strategy in order to call for participation from the community. As a result, they can contribute such as money, labor, material, time, and some farmers also share their farmland for making secondary or tertiary canal for water distribution to the community’s farmland as a whole. According to the FWUC leader, a majority of people living in this area believe in Buddhism and will get actively involved in such religious occasions. So arranging this event can provide more opportunities for the villagers to participate and to be engaged with Trapaing Trabek irrigation management. Additionally, the FWUC chief also create pleasant activities during this ceremony for them to enjoy together – it was a dancing party after the collection of Pa-Chay (money from villagers delivered to religious ceremony following a pray from the monk in order to get them to have good life either in this life or in the next life). Through this event, villagers feel fresh with their contribution and enjoyable with this. By so doing, the FWUC committee can collect more money for Trapaing Trabek scheme improvement. This is an effective method of getting people involved collectively.

4.4. Which sector could bring more socio-economic development in this area?

Regarding the survey, we can see that most farmers prefer the water distribution from FWUC. By comparing between FWUC, private, and both, there were 79% responded that they like FWUC while 4% on private sector; whereas; 17% accepted both type of irrigated water provision – FWUC and Private (Table 11). These selections can be attributed to the quality of irrigation management and O&M as well as service providing. As a majority of respondents intended to use the water provided by FWUC, most of them addressed that FWUC committees have practiced a good management then the private sector. They have spent much time to the operational system on the irrigation protection such as dredging soil from the canals and greasing the water gate through the Buddhism event such as Bun Samaky (solidarity ceremony) in order to collect money from the communities for the purpose of irrigation system improvement.

Table 11: Type of irrigation preference by farmers

Type of irrigation preference	FWUC	Private	Both
Respondents	118	6	26
Percentage	79%	4%	17%

Moreover, the assessment on the level of service providing between FWUC and Private sector from the farmers who access to the three types of irrigated water including FWUC, Private, and both (FWUC and Private), we can see that a majority of respondents' judgment on the level of irrigation service is that irrigated water under FWUC provision is better than the Private sector. The evaluation revealed that FWUC provided good service rather than Private sector. 81% scored that FWUC provided good service on water distribution while only 22% mentioned that Private sector could provide better service than FWUC (Figure 14).

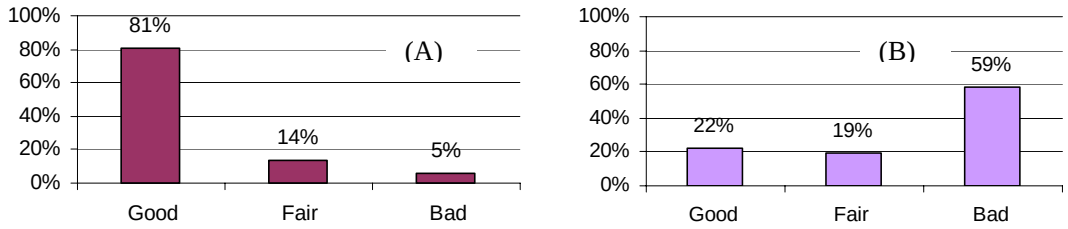


Figure 14: Assessment of FWUC (A) and Private Service (B) provision for irrigated water

Good service referred to a good communication and information sharing as well as a quick response to the communities' concerns. Good operation means that the FWUC committee

can spend more time to check the main canal, secondary, and tertiary canal whether water distribute adequately to each farmland, to monitor and adjust the water flow through opening or closing water gate in the main canal. Referring to these definitions, based on the questionnaire survey, 61% and 72% of 150 respondents (including the 6 households using only pumping water from private system) explained that the quality of irrigation management in this area was recognized significantly through a good communication and good operation respectively (Table 12). FWUC from Trapaing Trabek scheme is easy to contact with FWUC chief as he is the active leader on the scheme and canal protection. He usually calls for urgent meeting with the other FWUC committees to find out the solution to deal the problem of inadequate water used for rice cropping; then the activities to respond to these issues were set up and implemented. For example, going to check upstream water source from Chrey back catchment in Tang Krasaing scheme whether it flowed in the wrong direction or got stuck in the upstream reservoir. To be noticed, this analysis on the quality of irrigation management is mostly focused on FWUC rather than Private sector. This is due to the majority of respondents are the farmers using water under the provision of FWUC.

Table 12: Quality of irrigation management

Reasons	Fair Price	Cheap Price	Good Operation	Good maintenance	Good Service
Respondents	**48%**	**43%**	**72%**	**40%**	**61%**

However, if comparing between the farmers who use only private system (6 households) and FWUC (118 households) on the level of O&M and service provision, the result was shown inconsistency. The result of this cross-checking can be explained that Private sector seems to provide these services better than FWUC. Private sector can provide good maintenance, operation, and service than FWUC – 50% vs. 39%, 100% vs. 69%, and 83% vs. 59% respectively (Figure 15). But it is difficult to accept this result as it can be bias from the effect of the small respondents – only 6 samples who were equivalent to 100% (Private water user) and 118 samples equal to 100% (FWUC water user). Although the outcome is difficult to be approved, it can still illustrate that farmers are satisfied with the emergence of these both sectors since they have been able to do the rice cultivation after leaving it free for more than a decade (1980 – 1990).

On the other hand, between FWUC and Private sector, the ISF of FWUC is much cheaper than the private – 5 $ vs 100 $. Consequently, a majority of farmers are happy with the FWUC water provision rather than Private enterprise. However, people still complain these two sectors that only the households who have farmland nearby the main or secondary canal

could get adequate water for cropping while the farmland far from the scheme are very difficult to properly access to the irrigated water which result in the low rice yield production.

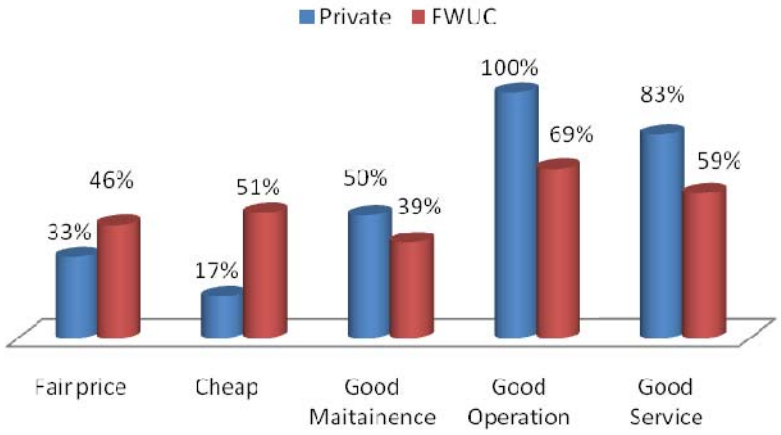


Figure 15: Comparison between FWUC and Private sector

Through the above explanation, we can see that Public Private Partnership (PPP) concept has not yet deeply integrated because there is no implementation on such a method in this area. Public sector recognized as FWUC only focuses on their own structure to manage the irrigated water supply to the FWUC farmers and plan for the irrigation system extension in the area (ideas of FWUC leader); whereas, the private sector considers using plastic tub and designing the machine which can pump much water, consuming small amount of petroleum (ideas of Private owner). Although these both sectors have different functions and ways of management, still they have the same vision of irrigation system development.

Therefore, both FWUC and private sector on irrigated water provision to farmer water user group are important to bolster socio-economic growth in this area. FWUC ISF is reasonable for farmers' affordability and private sector could not be separated as the Trapaing Trabek irrigation scheme which is the gravity system could not be expanded its potential area to the farmland near the Big Lake due to the geographical feature which is not practical for gravity irrigation. Thus, public private partnership with the participation from the farmer water user group is a useful combination to apply in this area in order to better farmers' livelihood as well as socio-economic development.

4.5. Preference payment methods and suggestions for irrigation improvement

The result of the interview indicated that a majority of farmers intended to choose the payment method through paying ISF based on farm size, which is the same method at the present time – 92% of 150 respondents mentioned that they preferred paying ISF by

calculating the farmland size using irrigated water under the operation and maintenance of the FWUC committee and/or private sector. Only 6% liked to pay through crop yield, which means that paying water fee happens after harvesting. They explained that sometimes they could not get benefits due to low rice yield collection. The demand of inputs including fertilizer, labour for transplanting and harvesting, as well as ISF for the water distribution from the canal were mainly higher than the output (rice yield). Moreover, a majority of the villagers there sell their rice crop and they just keep a little amount of rice in stock for their daily meal. Only some households, who can produce much rice, intended to sell their rice yield particularly to the middleman in order to generate more income. Only 2% want to pay ISF through the water quantity provided by the FWUC or private sector while nobody is interested in paying through the petroleum price. The Table 13 summarized the preference of payment method on water fee.

Table 13: Farmers' preference on the payment methods of water fee

Payment method	Land	Crop yield	Water quantity	Petroleum Price
Respondents	138	9	3	0
Percentages	92%	6%	2%	0%

Even though a majority of farmers are satisfied with the ISF provided to FWUC and private sector, some suggestions from the interviewees were given that the water fee should be limited to 15,000 Riel per hectare (3.75 $/ha) for FWUC water provision; whereas, a majority of them mentioned that water fee from private sector should be only 300,000 Riel per hectare (75 $/ha). As seen in the bar charts below (Figure 16), there were 28% suggesting that the ISF should be set with a fair price which the farmers can afford to pay. However, setting up a fair water fee is not the main suggestion from the farmers. 94% of them suggested the FWUC committee considering on the irrigation system enlargement since there still have more farmland which has not yet accessed to the irrigated water.

Figure 16: Suggestion from farmers for irrigation improvement

Noticeably, people raised this suggestion because they heard the future plan of the FWUC committee leader extend the Trapaing Trabek irrigated farmland – so they only repeated what FWUC leader had said, according the researcher' s analysis on the cross-checking information between the farmers and the interview with FWUC committee leader.

On the other hand, about 50% of respondents demonstrated that strengthening O&M was also vital for irrigation improvement because the farmers need water to feed the rice. Without good O&M, people will confront with inadequate water in the rice field; therefore, the rice production would not meet the expectation of each farmer as well as the FWUC committee in order to fulfill the future plan of agricultural development in the rural area.

5. Conclusion and Recommendations

5.1. Conclusion

With the implementation of either FWUC or private irrigated water provision in this area, the proportion of agricultural productivity has been improved. The amount of rice yield has increased. The area of irrigated farmland has been enlarged for both public (from 20-450 ha from 1991-2010) and private (from 13-150 ha from 2006-2010). Labour force has been also enhanced due to the expansion of irrigated land and the number of households doing farming. Also, accessibility to irrigated water is the main influential sector for farmers' decision making on whether to choose which type of irrigation such as only FWUC, only Private sector, and/or both sectors, without regard to the level of household status (rich, medium, or poor).

Participation in irrigated water management including O&M and level to join with the FWUC committee for decision making, accepting or contributing idea to the private sector for the irrigation system improvement in this study area is still low. They only participate by contributing money such as ISF to FWUC committee and water fee to Private Sector, providing labor and material to operate or maintain the scheme of Trapaing Trabek secondary or tertiary canal as well as using their own time to join the meeting to listen the FWUC committee plan on the irrigation management and/or come to share their problems and ask for consultation and solution from the FWUC leader. Nevertheless, providing ideas in the decision making toward the irrigation improvement has been not seriously taken into account within the farmers' perception. Participation in Operation and Maintenance is better than the participation in the decision making. Also, religious mainstreaming to seek for participation is another effective mechanism for irrigation development.

It is difficult to analyze which sector could bring more socio-economic because the farmers need these both systems for their agricultural production improvement. But, FWUC is considered as the better management than private sector. This is due to the activities of O&M of FWUC and the lower ISF compared with private sector. In short, people are satisfied with FWUC in terms of irrigated water management in this area, mainly also due to much lower water fee. This area is practical for the cultivation of dry rice season, which has started just after the Trapaing Trabek irrigation rehabilitation in 1991 under the technical support from PDOWRAM and financial support from AFSC; whereas, another private irrigated water pumping occurred in the early 2005 (farmers used to do floating rice, but stopped adopting this cultivation due to no suitable seed after 1980s). Therefore, the level of socio-economic

improvement before and after the application of irrigation system is significantly addressed that with these irrigation systems, the socio-economic development is going up in this area.

Although, in general, people can gain more benefits from the operation of either FWUC or private, these both sectors still haven't been yet officially recognized by the state and public. The private irrigated water provision to the farmers has just only an agreement from the commune chief without formal registration and agreement from the state. FWUC committee also has not yet applied for the official permission to be the formal FWUC from the government. Without the clear official structure, either the public or the private irrigated water provision to the farmers in this area would have challenging in terms of collecting water fee because they have no adequate power.

Regarding to the Public Private Partnership between FWUC and Private sector on irrigation system management in this area, there is no any significant point to address a good cooperation among these two sectors. The reason is that they have their own methods and mechanisms for irrigation improvement in their controlled area. The FWUC committee leader has considered the expansion of the farmland and Trapaing Trabek irrigated water to the other villages while the private owner has designed a plan to ask for a contribution from farmers to use plastic covering on the dike for maintaining water in the rice field. By so doing, the gasoline for pumping will be less consumed.

Based on the current payment method, paying ISF through farm size is still a preference method to apply in this area, comparing to the others such as paying by water quantity, crop yield, and petroleum price.

In conclusion, this study is crucial for many audiences including academic institutes, civil societies, NGOs, and the policy makers who are in charge of the rural development activities, and especially for those who are interested in learning more about the government policies related to decentralization and the promotion of privatization in the grass root level which are vital for agricultural development through irrigation advancement in Cambodia

5.2. Recommendations

FWUC committees

- Should build more capacity on technical knowledge especially the knowledge related to hydrology, irrigation management, environment, policy planning – master plan, financial management
- Should be open-minded to get more ideas from villagers
- Should strengthen a relationship and a cooperation with commune council, especially the commune chief
- Should discuss and get ideas from professional agencies such as PDOWRAM, PDA, PoE on the future plan of irrigation farmland enlargement

Private Sector

- Should clearly structure the administration system
- Should provide training to farmers to understand how to maintain water in the farmland during the rice development stages
- Should spend more time in this area to study and find out some effective ways for irrigated water management

FWUC members

- Should learn to share ideas, not just to listen and to follow with the FWUC leaders
- Should pay ISF with the accurate farm size – do not hide the real data

Commune council and provincial government

- Should consider the proposal from FWUC
- Should start to build good communication with FWUC
- Should spend time with FWUC committee to understand their plan and provide recommendations for discussion with FWUC
- Should build more capacity on hydrology, irrigation management, environment, and democracy
- Should provide farmland title
- Should understand the reason why the rice yield increase using water from private sector of 6% less than the water from FWUC and the price of private water fee is very high, but why people still keep using this system? This is because there is no main canal or secondary canal which brings water to that area. So, people don't have other options or choices for a good service with cheap water fee. Regarding to this, the

public private participation should be considered by the commune council as well as the provincial governor, and/or technical department especially PDWORAM to integrate these sectors together in order to improve rice productivity in the area

National government

Therefore, considering the adjustment of paddy rice price and promoting the government budget to spend on machine for drying the rice are very important. Another recommendation is to protect the informal loan provided with high interest rate in the community because it will affect the farmer livelihoods even though they can access to irrigation system but cannot get rid of being in debt.

Technical assistance

- Should work on hydrological assessment in improve the understanding of water availability for irrigation water allocation
- Should improve the understanding of rice water requirement through different its development stages in order to properly irrigate
- Should improve irrigation efficiency in order to decrease water losses along the canal networks
- Should sustain the technical maintenance of irrigation schemes (water gates, canal networks and other hydraulic structures) regularly

Further research

1. What are the implication of selling farmland in one place and buying another place in the same commune – can they exploit more land from the inundated forest or because they can generate more income. And how this action challenges the commune council in terms of land titling

2. Research more detail on the irrigable coverage in this area that how much water from Trapaing Trabeak scheme can irrigate accurately. The idea of doing this research is because the FWUC leader intended to enlarge the farmland and irrigation scheme. The precise study could be provided to the FWUC leader, CC, Private Sector, and communities in order to ensure that they understand well on the available water resources for irrigation in their area. Without understanding clearly on this, the master plan of the FWUC and the commune council will confront with the failure in the future as well as waste time this wrong thinking

3. Not so related to irrigation but mostly linked to social and economic development in this area. Through the interview in this research, the researcher has found that there are many villagers who are in debt because they need money to invest on agricultural activities (fertilizer, labour, water fee, etc.) and to spend on health care before they can obtain the rice yield after harvest. Regarding to this, the outside better off with good relationship with some powerful men in the area run a business such as an informal financial credit which provides loan to the villagers with high interest rate (For 1 million Riels about 250 $, villagers have to give the owner 25,000 Riels about 6.25 $ every day within 50 days counted from the beginning to the end of the loan, according to the un-structured interview with some key informants in the village). This enterprise put high rate which results in being in debt for village people. As this topic is not relevant much to the main objectives of this study, I would suggest another social research on this issue. It is one among the other issues which impact on socio-economic development in this area. If more and more people are in debt, the livelihood improvement will be difficult to occur. Also this study should compare with the community micro-credit operated by FWUC leader since he also provides a loan to the villagers.

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Appendix

Research Questionnaire

IDENTIFICATION

1. Survey N° : .....
2. Date : ..... / ..... / .....
3. Interviewer : .....

1. General information

Name:	……Age :……
Sex: □ Male □ Female	□ Married □ Single □ Widow / Widower
Nb. of people living in house	Total: …… Adults: …… Children: ……
Profession and economic activities of the members of HH	Agriculture/ Farmer/ Fisher □ Farming experience (years):…… Seller/ Trader □ Handicraft/ Manufacture □ Services/ civil servant □ Private sector salaried □ Other: …… □

2. Wealth status

Household Habitation:

house condition		*Ground*		*Wall*		*Roof*	
Bridge house	□	Tiles Pavement	□	Cement	□	Tiles roof	□
Wood house	□	Cement	□	Wooden/Iron	□	Iron roof	□
leaf house	□	Mud floor	□	Palm	□	Palm leaves	□

Items	*Number*
Bike	
Motorbike	
Car	
Truck / tractor	
TV set	
Pumping machine	
cow/buffalo	
ox-cart	
Others (specify)	

3. Resources endowment and productivity (*For farmers only*)

Type of land	Farm size (ha)	Cropping time(s)/year	Rice yield (tonne/year)
Dry rice Farm land	.....	.....	.....
Rainy rice Farm land	.....	.....	.....
Hired farm land	.....	.....	.....

4. Do you know FWUC ? Through whom ? □ **Yes** □ **No**

□ Village chief, commune council
□ FWUC
□ Farmers
□ Other.....

5. Do you access to irrigation? □ **Yes (go to B)** □ **No (go to A)**

A) For those who can't access to irrigation scheme

A.1 Reasons for having no access to irrigation (answer not given)

Items	*Answer (tick)*
Is the rainy rice cropping farmers	
Farming is not the main occupation	
Irrigation scheme far from farmland	
Expensive to pay for water fees	
Enough rainfall for farming	
Others	

A.2 Have you ever purchased irrigated water? □ Yes □ No

A.3 If yes, when and why? □ in dry season □ in rainy season

Reasons: □ not enough water for cropping
□ other.....

A.4 Do you want to connect to irrigated water? □ Yes □ No

A.5 Why?
□ can increase crop yield
□ nothing
□ other.....

B) For those who access to irrigation scheme

B.1 What type(s) of irrigation scheme do you use? Public □ Private □ both □

B.2 Reasons of irrigation choice (answers not given):

Items	*Answer (tick)*
Close to the irrigation scheme	
Increase of crop yield	
Fair water fees	
Low water fees	
No water fees	
Good services (O&M)	
Others	

B.3 What do you think about the irrigation service (verify with the B.2)

Public scheme			Private scheme		
□ Good	□ Fair	□ Bad	□ Good	□ Fair	□ Bad
Why? …….. ……			Why? ..... ……		

B.4 Type(s) of irrigating: □ pumping □ gravity irrigation □ Both □ Others……

B.5 Irrigated farm land in each season

Dry season (ha)	Rainy season (ha)
……..	……..

B.6 Compare average rice yield (tonne/ha)

With irrigation (t/ha)	Without irrigation (t/ha)
……..	……..

B.7 Compare crop yield among FWUC and Private sector

FWUC		Private	
Highly increase	□	Highly increase	□
Average increase	□	Average increase	□
Slowly increase	□	Slowly increase	□
the same	□	the same	□
decrease	□	decrease	□

B.8 Crop yield in each season by using irrigated water

Dry season (tones)	Rainy season (tones)
……..	……..

B.9 Money paid for irrigation fee (Riel)

Dry season (Riel)	Rainy season (Riel)
……..	……..

6.

B.10 Method of irrigation payment

□ Farm size (Riel/ha) □ Crop yield ((Riel / tonne) □ Water quantity (Riel/m^3) □ Petroleum Cost

□ Others…….....……

6. Household income

6.1 Farming income in each season (all crops)

Type of income	Dry season (Riel/season)	Rainy season (Riel/season)	Total
Rice	……..	……..	……..
Other:	……..	……..	……..
.....	……..	……..	……..
.....	……..	……..	……..
.....	……..	……..	……..
Grant Total			……..

7. Household expenditure

Type of expense	Dry season (Riel/season)	Rainy season (Riel/season)	Total
Food	……..	……..	……..
Farming labour	……..	……..	……..
Fertilizer	……..	……..	……..
Water fees	……..	……..	……..
seed	……..	……..	……..
hired farm land	……..	……..	……..
Transportation	……..	……..	……..
Other: (culture, study, health...)	……..	……..	……..
.....	……..	……..	……..
.....	……..	……..	……..
.....			
Grant Total			……..

8. Status of irrigation participation (for farmers only)

7.

8. 8.1 Which irrigation type do you want to participate? why? (Note: verify the question B2 and B3)

□ Public □ Private □ both

Reasons	*Answer (Tick)*
Fair Water fee	
Cheap water fee	
Good operation	
Good maintenance	
Good Service	
Others	

8.2 Do you want to support and take care this irrigation scheme? □ Yes □ No

8.3. How do you participate in sustaining and maintaining irrigation scheme? (Answer not given)

Items	*Answer (Tick)*
Contribution by money	
Contribution by labour	
Contribution by materials (land, rice, cement, brick, wood, pumping marching)	
Others	

8.4 Are you willing to participate in decision making on irrigation management?

Yes □ No □

Why? □ Education and skill
□ Times
□ Want the scheme to be well operated/livelihood improvement
□ Others……

8.5. Which type of payment on irrigated water fee you would like the most?
□ Farm size (Riel/ha) □ Crop yield ((Riel / tonne) □ Water quantity (Riel/m^3) □ Petroleum Cost

□ Others…….....……

8.6. Own suggestions to improve irrigation system
□ Want to enlarge irrigation system
□ Want to have good operation
□ Want to have good maintenance
□ Want the fair water fee.....(Riel/ha)
□ Want to see the good cooperation between FWUC committee and Commune Council
□ Don't know
□ Others……

9. General remarks (your observation in the interview – not logic and/or good providing answers)

……

……

……

……

Thanks for improving information in the interview