Mekong River Commission Secretariat (MRCS)
Agriculture, Irrigation and Forestry Program (AIFP)

Field Observation and Data Analysis for Irrigation Efficiency on IIEPF

Improvement of Irrigation Efficiency on Paddy Fields in the Lower Mekong Basin (IIEPF)

Final Report

By

Lao National Mekong Committee Secretariat (LNMCS)

Ministry of Agriculture & Forestry (MAF)
Department of Irrigation (DOI)

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Abbreviation

ADB	Asian Development Bank
AIFP	Agriculture, Irrigation and Forestry
DAFSO(s)	District Agriculture and Forestry Service Office(s)
DMH	Department of Meteorology and Hydrology
DOI	Department of Irrigation
ET	Evapotranspiration
ET_c	Crop Evapotranspiration
GDP	Gross Domestic Product
ha	hectare
IIEPF	Improvement of Irrigation Efficiency on the Paddy Fields
ISF	Irrigation Service Fee
IMT	Irrigation Management Transfer
K_c	Crop Coefficient
Lao PDR	Lao People Democratic Republic
MAF	Ministry of Agriculture and Forestry
MC	Main Canal
MCM	Million Cubic Meter
MRCS	Mekong River Commission Secretariat
NGO(s)	Non-Government Organization(s)
O&M	Operation & Maintenance
P	Percolation
PAFSO(s)	Provincial Agriculture and Forestry Service Offices(s)
RAP	Rapid Appraisal Process
SC	Secondary Canal
SWR	System Water Requirement
TC	Tertiary Canal
UDD	US dollar
WUA	Water User Association
WDF	Water Delivery to the Field
WUG	Water User Group
WP	Water Productivity

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1. Summary of major findings

With increasing demand on the water resources for agriculture, irrigation efficiency is becoming one of the key issues for water management. The improvement of irrigation efficiency and water productivity under the frame work of IIEPF through MRC, therefore, fits and is suitable with the real need of the development of water resource and irrigation sector of the Lao PDR.

The Num Houm irrigation project was selected as the pilot site for field observation and data collection with period of one-year round covering two seasonal crops: dry season from November 2006 to April 2007 and wet season from June to November 2007. The analyses of field observation are summarized as follows:

Cultivated areas:

The total original designed-command area of the irrigation project is 2,400 ha, but it was actually cultivated only 1,525.7 ha in dry season of 2006-07 due to insufficient water in the reservoir. According to the project, 2,400 ha could be fully cultivated if the reservoir is filled up with full capacity at 60 MCM at the end of rainy season. However, only 44 MCM were filled at the end of rainy season 2006. Much water lost to drainage due to poor control structures and weak in management are also the main reasons that total cultivated areas could not be reached the designed areas. With the total cultivated areas, 97.4% is accounted for paddy area, 1.2 % for cash crops, and 1.4% for fishponds.

In wet season 2007, the total of 2,263.20 ha were cultivated, 98.8% of total as paddy, 0.2% for cash crops, and 1% for fishponds. The observed areas are different from 3,000 ha which project usually reports. That is because the project counts the external area which locates next to the project command areas, but not in command area.

Irrigation days:

Although standard growing period of dry season variety is approximately 90 days, 128 days of irrigation was supplied because the rotation of the cultivated area was made zone by zone which is the strategy of the project to deal with water allocation problem when water shortage in reservoir occurs.

Meanwhile, only 65 days of irrigation water was supplied during wet season, although the period is long usually 120 days, longer than dry season. The irrigation supply in wet season is in principle for supplementary purpose, mainly for land preparation and transplanting stages.

Evapotranspiration (ET_c) and Percolation (P):

Observed ETc shows 4.03 mm/d in dry season and 6.33 mm/d in wet season. The higher ETc in wet season may be caused by high temperature and strong sunshine even duration is short in wet season. The peaks are observed in February and Mach in the dry season, and September and October in the wet season.

Average percolation shows 3.21 mm/d in the dry season, but 1.19 mm/d in the wet season. The lower value in the wet season is probably influent by high ground water level.

Rainfall and effective rainfall:

Almost no rainfall was observed in dry season of 2006 /07 with average of 0.07 mm/d, but more than 21 mm/d were found in wet season of 2007. The peak in wet season is occurred in September. The effective rainfall is calculated at 0.048 MCM in the dry season and 19.79 MCM in the wet season.

Water requirement:

Total crop water requirements for dry season was estimated at 10.13 MCM or 663.90 mm at on-farm level, 95.95% of this value is accounted as paddy water requirement, 0.78 as cash crops, and 2.27% as fish farming.

As much as twice of dry-season value is estimated in wet season (20.67 MCM or 913.7 mm). The unit requirement is accounted for 9,133.09 m^3/ha. The higher water requirement in wet season is because of higher ET_c and longer cultivated period.

Efficiencies:

Conveyance efficiency of 69.07% was calculated in dry and wet seasons. The conveyance test was conducted at one time in dry season and the same value is applied for wet season. The value is relatively low compared with designed value of 75%.

The overall command area efficiency was calculated at 65.30% in dry season and 78.17% in wet season. The observed values are generally high compared to previous study of 40-60%. The main reason is that the water balance definition applied to this calculation is taken into account of the drainage, no consideration under for classical concept. Detail is explained in 3.2 of methodology.

Higher efficiency in wet season is also observed, which is not as a usual. The reason found is that less amount of irrigation was input because of shortening irrigation days. Most of water supply is filled up mainly by rainfall and rest is natural streams inflows.

Water productivity:

The water productivity is average of US$ 0.114/m^3 in dry season and US$0.097/ m^3 in wet season. Higher productivity is observed in dry season due to the higher yields and better prices for all products.

Project water management appraisal:

The Num Houm irrigation project is under management project office which belongs to the PAFSO and MAF. There are four main units under the project offices namely: agriculture and extension unit, irrigation unit, livestock unit and forestry unit. Irrigation activity is under the irrigation units which is responsible for reservoir and main canal operations. These units are called WUA. From secondary canal, O&M work is done by WUGs which are formed as farmers' groups. Sub groups are the last organizations which mainly deal with water distribution and maintenance of irrigation facilities at on-farm level.

The water allocation plan is produced in every dry season. The plan is quite strictly fixed and allows very limited changes or flexibilities. However, the plan is not well adapted to the actual water requirement in each cultivated stage. The monitoring and feed back plan between receivers and suppliers is not yet well established causing to water loss at spill to drainage without controlling. In wet season, irrigation plan is not practiced. Although irrigation water supply is limited is limited in wet season, plan is necessary in order to save water and reserve for dry season cultivation.

The ISF plays important role for sustaining the project O& M since limited subsidies by the government is observed. The collection of ISF is not well successful. From around 47 % of total planted area was collected in 2007. The major reasons are because of poor performance of irrigation delivery service caused by poor structures and weakness of accurate water allocation plan not adapting to the actual water requirement, as well as lacking of monitoring and feed back system. Weak sense of responsibility and participation of farmers are also the reasons for the low percentage of ISF collection.

The general major constraints found in the project are limitation of the budget due to low percentage of ISF collection, poor condition of irrigation infrastructures, and low performance of WUG functioning. The management in the WUGs with large command areas is commonly difficult because of many members and not well water distributed.

2. Background

2.1 Country Outline

The Lao People's Democratic Republic is a landlocked country in Southeast Asia and it is in central strip of the Indochinese peninsula. Landscape of Lao PDR is dominated by densely forested mountains, occupies an area of 236,800 km^2 stretching more than 1,700 kilometers, and bordered with 5 neighboring countries as 505 km with China and 236 km with Myanmar to North, 2,069 km with Vietnam to East, 1,835 km with Thailand to the West, 435 km with Cambodia to the South.

According to Lao National Statistic in 2005, the estimation of total population is 5.9 million, of which 85% live in countryside where the incidence of poverty is higher than the national average of 46%.

Agriculture is the main sector contributing to 56% of total GDP in the country. The Agricultural Sectored Strategy proposed in November, 1999 and endorsed by the Minister of Ministry of Agriculture and Forestry (MAF) in February, 2000 was based on sectored policy developed in 1993 that included the following programs:

(1) Food production
(2) Commodity production support
(3) Stabilization/reduction of slash and bum cultivation
(4) Irrigation development
(5) Agriculture and forestry research, and
(6) Human resources development

Irrigation development plan placed on the fourth priority of the six-government agriculture strategies. The major key objectives of irrigation project development is to increase rural income and to stabilize rice availability by expanding irrigated areas for both wet season and dry season and to improve performance of the operation and maintenance of existing irrigation systems.

During 1996-2000, huge investment was made in irrigation development. The budget used for investment and improvement of irrigation systems accounted for 40-50% of the total MAF budget, foreign donors, and NGOs supports to the national irrigation sectors. As a result, irrigation area increased up to 276,062 ha in wet season and 174,350 ha in dry season of 2006. The total production accounted for 1.8 million tons in wet season and 0.36 million tons in dry season of the same year. Although there was huge investment in irrigation sector, large agriculture areas have not been fully irrigated compared to total potential irrigable areas. More than 70% of the total potential agriculture areas are still rain-fed (non-irrigated) area through the country. Since 2000, the investment in irrigation work was rarely made. Some fund allocated only for improvement of existing scheme on O&M works.

Policy:

Irrigation development policy published by DOI on January 1994 is the latest updated policy paper. There are three keywords identified for this irrigation development according to the department announcement i.e. participation, de-centralization, and integration of irrigation.

The policy places on five subjects as follows.

(1) Six national programs (mentioned above) on the agricultural sector policy self-sufficient in food production
(2) Promotion of agricultural products, diversification of crops in terms of quantity, type, and quality improvement,
(3) Promotion of integrated area development to rural development, and
(4) Irrigation development as a part of an integrated area development

As current situation, policy is modified and implemented as follows

(1) Promotion and support of irrigation projects and the encouragement of participation of farmers, farmer groups, community groups and the private sector:
(2) Improvement of efficiency of expenditure in both the public sector and in areas of external assistance
(3) Ensuring that work undertaken within the irrigation sector is economically effective; environmentally sound and does not disadvantage any group within the community

Vision:

One of the major visions of the government is to achieve the irrigation expanded area up to 800,000 ha in wet season and 400,000 ha in dry season by 2020. In parallel of the area expansion, it is also necessary to improve performance of water management and increase water productivity of the existing irrigation schemes.

Strategy:

Many strategies have been developed and modified based on the purpose and concept and objective development projects. Some of the main activities carried out under irrigation development are described as follows.

Strategy on irrigation project development:

The strategic vision developed under policy during 1996-2000 based on the "Government's Strategic Vision", is summarized as follows:

(1) Ensure food security by improvement of productivity under irrigated agriculture,
(2) Alleviation of poverty in remote areas by generating cash income through introduction and promotion of crop diversification under irrigation,
(3) Stabilization in the area of shifting cultivation and protection of watersheds,
(4) Assisting the Water Users' Association (WUA) through training organizational strengthening and institutional set-up under Irrigation Management Transfer (IMT) process.

The details strategy developed for irrigation water management for the sustainable of irrigation project has been set as follows:

(1) Increasing the effective use of scheme performance according to their life spans and their potentials,

(2) Assuring water supply for cultivation according to crop-water requirement,
(3) Raising percentage of ISF collection and saving for scheme infrastructure maintenance,
(4) Increasing irrigation efficiency, and
(5) Improving the responsibility of operator

Strategies on IMT:

Currently, the government has been trying to adopt IMT policy nationwide for all the irrigation schemes to transfer the ownership as well as associated cost to beneficiary farmers to reduce subsidies of irrigation sector from the government. However, the processes have not been made smoothly and yet successful because there are a lot of challenges and issues still remaining. These issues includes poor and deterioration of existing irrigation, lacking of farmers' incentive due to low income from rice cultivation caused by uncertainty and unavailability of market particularly in the rural area, and cropping intensity in the dry season under irrigation is still low. In other words, farmers are not willing to grow rice in the dry season and this affects to the serious issue in cost recovery. The government, therefore, currently is working on rehabilitation of existing facilities appareling with strengthening of WUA to recover and upgrade their function before IMT is materialized.

Through IMT process, agricultural sector makes provision for the devolution of responsibilities and activities to Provincial Agriculture and Forestry Service Offices (PAFSOs) and District Agriculture and Forestry Service Offices (DAFSOs). This process of devolution of responsibility is in line with Prime Ministerial Decree 01/PM on decentralization and is central to the Strategy, and an innovative approach to agricultural extension has been adopted. This approach relies heavily on subject matter specialists at provincial level, and generalist extension staff at district level.

The details of strategy based on the decentralizing ownership through IMT are summarized as follows.

(1) Shift the "high profile" role of the government in irrigation schemes from direct involvement to a "low key" advisory role
(2) Support and promote the participation of farmers, community groups and the private sector
(3) Strengthen the capabilities of government agencies at Provincial and sub-provincial levels and farmer and the community group levels, and
(4) Include irrigation development as a part of a coordinated and integrated area development.

The strategy recognizes the need for:

(1) A participatory approach to ensure the participation of farmers, as well as district and provincial officials
(2) Training in technical matters related to irrigation
(3) Decentralization of responsibility for decision making to the provincial level with related administrative change, and
(4) High level of capital investment.

Strategies on the development of water resources for irrigation:

The government also has been seeking to develop water resources for irrigation development. Groundwater resources still remain generally unknown and largely untapped as a source of irrigation water. Irrigation has traditionally been, and continues to be, served by surface water resources.

According to the draft National Water Sector Profile by ADB in 1998, the most important river basin in Lao PDR is that part of the Mekong Basin, inside Lao Territory where the basin accounts for 80% of the country's area. The major tributaries of the Mekong all are significant to develop for irrigation. However, most tributaries have a torrential regime during the wet season and have a very low or no flow during the dry season. Because of the apparent abundance of water, water resources management and river basin management have not been seen as a high priority.

With the continuing degradation of the catchments and increasing demand on water use, as a resource, the Government now appears keen to support efforts in these areas. The brief description of the country's Agricultural Sector Strategy regarding surface water resources is to support and to intent to consider separate strategies for upland and lowland agriculture. Clearly separate strategies are also required for irrigation. One strategy for the irrigation on the flood plains of the Mekong and its major tributaries, and another strategy for irrigation on the valley floors of the uplands. Apart from their basic differences, the two strategies share many common points.

Classification of irrigation system

Irrigation type in Laos can be classified into pump lifting, weir, gate, and small reservoir, depending on topographic condition and accessibility to water sources. The size of its command areas ranges between 50 ha to 1,000 ha which is categorized as small to medium scale compared with other Asian counties. The rivers which are water resources in the areas have small catchments' areas and base flow is few.

The calcification of irrigation system in Laos based on the MAF is classified according to the command area:

Small scale:
With command area of less than 100 ha is categorized as small scale for whole irrigation types including weir, reservoir, and pump. This type is largely located at the northern part of Laos (Fig.1) where geographic limits command areas due to mountainous area. The area have difficulty to access to market and usually poor and have the greatest need for food buffer stocks and developing the potential of farming systems diversification.

Medium scale:
The command area between 100 ha to 1,000 ha is classified as medium scale for weir and reservoir system, but not pump system. The medium and large scale of pump system is ranged its command area of greater 100 ha. This type is located in the central and southern parts of Laos where geographic condition allows good condition to establish such system.

Large scale:
More than 1,000 ha of command area is classified as large scale for weir and reservoir systems. The large pump system, its command area is greater than 100 ha as mentioned above. This type is located in the flatlands along the Mekong River and its major tributaries where there are good accesses to market.

The Fig.1 shows the distribution of irrigation type classified by command area through nation wide and the pie chart shows the proportion of command area for each irrigation type in dry and wet seasons of 2003. Pump irrigation system occupies highest percentage of command areas compared to other irrigation systems.

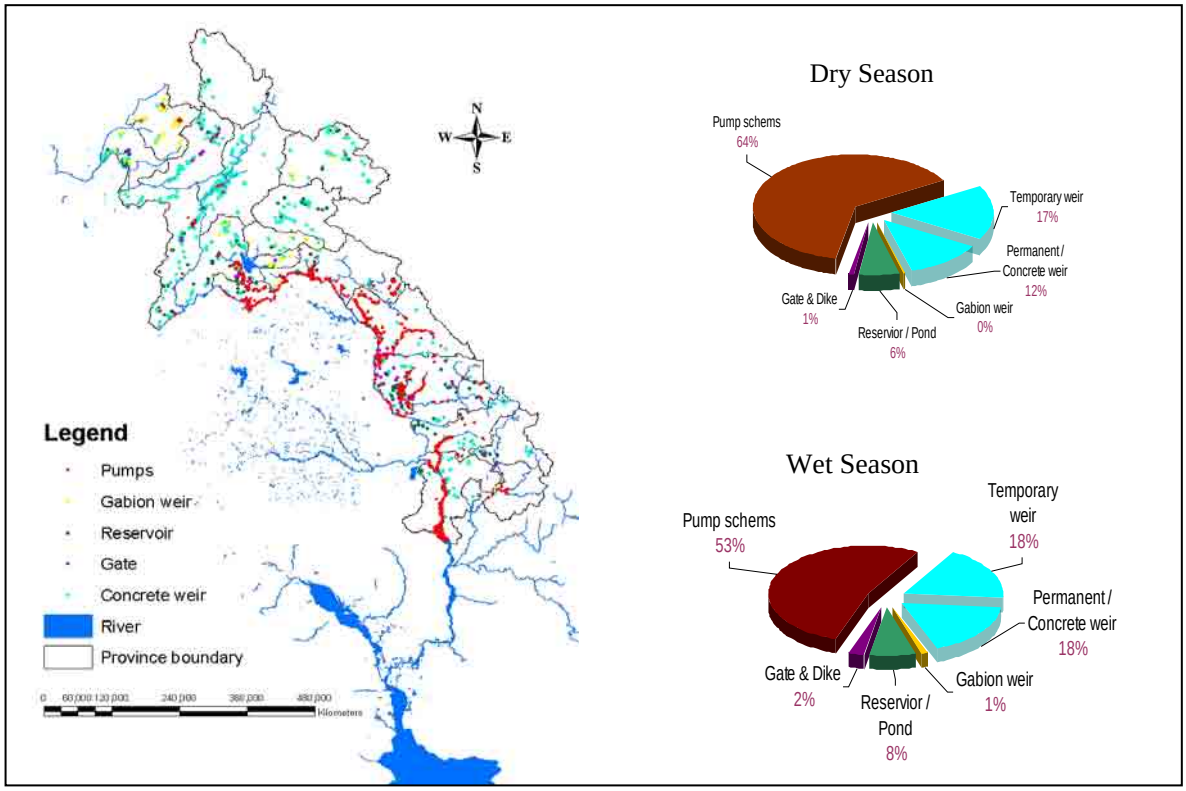


Figure 1: Distribution of Irrigation Type in 2003

2.2 General information of IIEPF project

2.2.1 Objectives

This mission aims to analyze and document the actual conditions of water use in selected irrigation schemes representing irrigation typology of the Mekong Basin in order to support the objective of the "Improvement of Irrigation Efficiency on Paddy Fields in the Lower Mekong Basin, IIEPF" project of the MRCS.

For this purpose, the contract was made between MRCS and working team under scoping of field observations and data analysis.

2.2.2 Background of the pilot project

Location:
The project is gravity irrigation, located about 35 km to the north from Vientiane capital by road No. 13 north. The project is sited in the Naxaythong district, Vientiane Capital. It is one of the big-scale irrigation schemes in Laos and this area is considered as the major production area of rice, cash crops, and aquaculture around Vientiane city. The project map is shown in the Fig. 2 as follows.

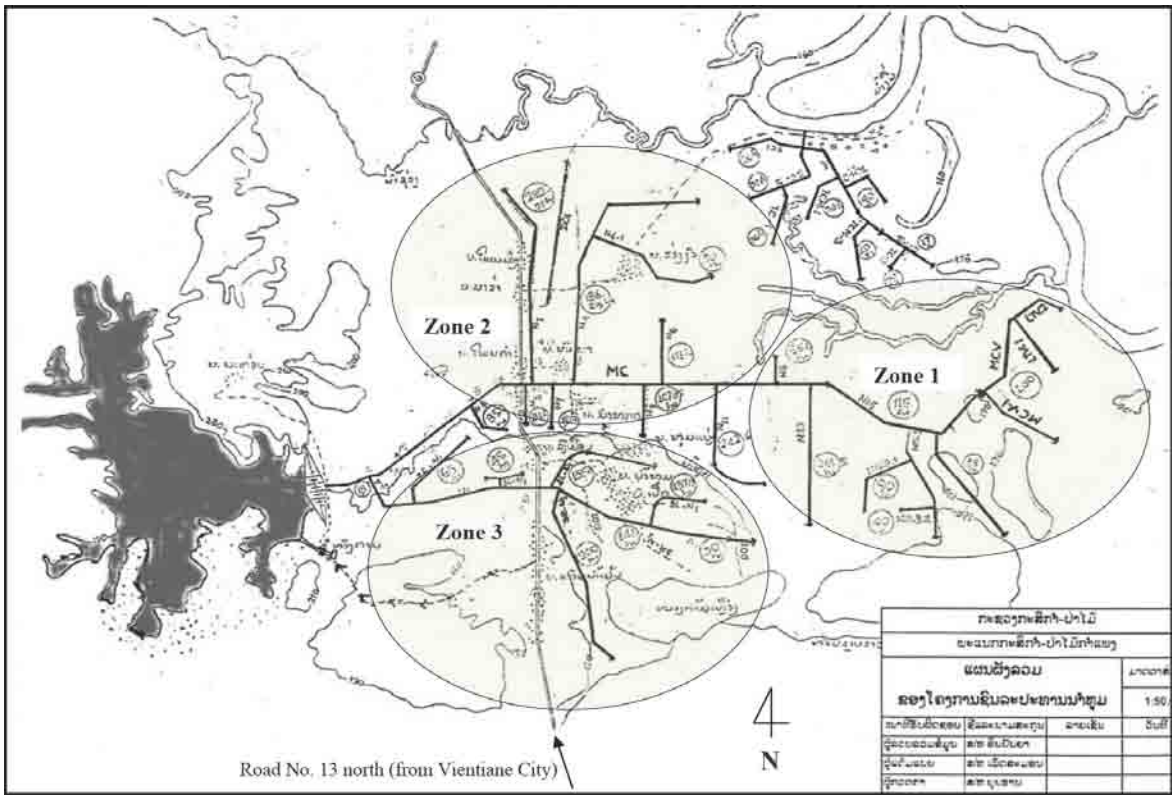


Figure 2: Num Houm Irrigation Project

Operation objective:
As same as other irrigation project in Laos, the Num Houm irrigation project supplies water mainly for dry-season cultivation and also supplementary for wet- season cultivation, mainly in land preparation and transplanting of cultivation stages.

Construction year:
The construction works were made by 3 phases. Under phase 1 in 1978-82, the work included construction of reservoir, main intake, spillway, main canal and some on-farm canals with irrigated area of 150 ha by national budget, loan from OPEC and grant aid from Japanese government. The phase 2 (1990-93) comprised construction of a secondary canal and irrigated areas of 400 ha by financial assistance from Italian government through interim Mekong Committee. In the phase 3 (1997-2000), main canal was extended and full system was completed with irrigated area of around 2,400 ha by national budget.

System infrastructures:
In the year 1978, the Num Houm was constructed with full reservoir storage of 60 MCM (active storage of 53.8 MCM, and dead storage of 6 MCM) and catchments area of 108 km^2.

It is earth dam with dimension of 22.50 m in height, 770.00 m in length and the crest width is 6.00 m. The reservoir has three streams inflows estimating of 149.5 MCM as annual inflow. The estimation of maximum flood level is 190.100 m and crest of dam of 192.200m, spillway at 189.1m and intake at 178.8m. The elevation of the dam crest is 191.7m.

The excess water is released through the spillway, which has a dimension of 2 m in height and 30 m in width with a capacity of 122 m^3/sec. The elevation of the spillway, inlet and outlet of the intake gate is 189 m, 178.8m and 177.2 m respectively.

The Table 1 shows the original designed capacity of the system including length, command area, and discharge of each canal.

Table 1: Canal System

No	Canal's Name	Length (m)	Designed Command Area (ha)	Designed Q (m^3/s)
1	IRN1	280	15	0.167
2	N1	7,510	91.3	1.61
3	2LN	875	53.72	0.157
4	3L N1	400	45	0.177
5	4L N1	3,300	135	0.33
6	2R N	3,366	110	0.55
7	5L N1	1,900	137.9	0.21
8	MC	9,300	428.08	6.7
9	N2	3,600	325.46	0.567
10	N3	1,571	35	0.165
11	N4	4,610	295.94	0.874
12	N5	900	34	0.21
13	N6	1,000	118	0.246
14	N7	732	47	0.21
15	N8	1,855	95.6	0.177
16	N9	896	103	0.247
17	N11	2,175	89	0.277
18	N13	1,800	147	0.339
19	N15	2,307	115	1.723
20	N15-3	1,852	130	0.316
21	N15-3-1	1,607	90	0.126
22	N15-3-2	637	40	0.073
23	N15-4	2,304	55	0.386
24	MCV	2,050	149	0.48
25	MCV1	560	34	0.24
26	LTV1	1,030	43	0.24
27	LTV2	2,910	38	0.24
Total		61,323 m	3,000 ha	17.037 m^3/s

***Climate*:**
As mentioned above, Num Houm project is sited in the area of Vientiane Capital. Therefore the climate in this area is similar to the climate in Vientiane. The seasonal climate has been divided into two different seasons, wet and dry seasons. The wet season is from May to

October and dry season is from November to April. The average annual rainfall in Vientiane is about 1,693 mm (Table 2). The other parts of Laos, for instance the central and southern parts, may have more annual precipitation, which accounts for about 3,000 mm.

The high percentage of humidity in the area occurs during the rainy season; the average humidity ranges from around 73% to 80%. The average annual humidity is approximately 72.1%.

The temperature in this area is quite warm comparing to the other part of Laos. The cooler months in Vientiane are December and January. During these months, the temperature becomes lower during the night and early morning, so the average temperature is around 23°C. The hottest months are in April and May; the temperature may reach 30°C or higher. The annual average temperature in this area accounts about 26.9°C.

The average rainfall, humidity, and temperature during 1987-2004 are shown in Table 2 as follows.

Table 2: Hydro-Meteorological Characteristic of Vientiane Capital (1987-2004)

Months	Rainfall(mm)	Humidity (%)	Temperature(°c)
January	4.91	68.2	23.3
February	19.44	64.9	24.9
March	42.06	64.9	27.6
May	87.60	66.3	29.6
April	253.63	74.3	29.1
June	302.33	78.3	28.7
July	257.41	79.5	28.3
August	320.39	80.2	28.0
September	277.46	79.4	27.8
October	95.94	73.9	27.3
November	9.94	68.8	25.3
December	4.06	66.7	23.2
Annual Average	1,693.20	72.1	26.9

Source: Department of Meteorology, WREA, NSC (2005)

Command Area:

During wet season, around 3,000 ha can be cultivated in this project area, but around 2,400 ha are designed for dry-season irrigated areas. The main crop is paddy rice (approximately 97%); the others are fishpond farming (1.5%), and cash crops (0.5%). The cash crops are mainly cucumbers, long beans and vegetables. These crops are largely grown in dry season. The rice yield ranges from 2.8 to 3.45 T/ha in wet season and 3.5- 4.15 T/ha in dry season, while cucumber and long bean are 6 to 10 T/ha.

The cultivated and harvested areas of rice and cash crops recorded from 1990 to 2005 are indicated as Table 3.

Table 3: Cultivated and Harvested Areas

Year	Cultivated Areas (ha)			Harvested Areas (ha)		
	DS paddy	WS paddy	Cash crops	DS paddy	WS paddy	Cash crops
1990	1,307.00	468.98	18.00	849.55	337.67	18.00
1991	1,327.00	559.00	20.00	902.36	424.84	20.00
1992	1,350.00	682.70	20.00	958.50	532.51	20.00
1993	1,450.00	600.40	25.00	1,000.50	438.29	25.00
1994	1,058.00	494.00	30.00	878.14	414.96	30.00
1995	1,196.00	652.94	50.00	944.84	535.41	50.00
1996	1,500.00	916.16	70.00	1,260.00	723.77	70.00
1997	2,326.00	970.00	100.00	1,744.50	834.20	100.00
1998	2,326.00	1,273.00	120.00	2,046.88	1,132.97	120.00
1999	2,326.00	1,304.00	120.00	1,977.10	1,147.52	120.00
2000	2,326.00	1,440.00	120.00	2,172.36	1,209.60	120.00
2001	2,526.00	2,200.00	150.00	2,071.32	1,716.00	150.00
2002	2,526.00	2,391.00	150.00	2,046.06	1,984.53	150.00
2003	2,526.00	2,400.00	180.00	2,121.84	2,112.00	180.00
2004	2,526.00	1,400.00	140.00	2,146.00	1,088.00	140.00
2005	2,526.00	2,415.47	164.32	2,460.00	2,004.84	164.32

Note: DS-Dry season, WS- Wet season

Benefited Households:

The project has organized three WUGs within 19 benefited villages to be responsible for the O&M activities. The benefited households and population of the project is shown in the Table 4 below.

Table 4: Beneficiary Households

Groups	Beneficiaries		
	No. of Village	Total Households	Beneficiary persons
WUA1 (N1)	7	441	4,970
WUA2 (RMC)	6	501	7,559
WUA3 (LMC)	6	644	7,821
Total	19	1,586	20,350

2.2.3 Why scheme was selected as pilot site

The project was selected based on the criteria provided by MRCS. The criteria includes (1) representatively of irrigation system in the country, (2) easy accessibility, (3) appropriate command area size, and (4) availability of relevant information.

Another reason of selecting this project is that the project is representing the large scale irrigation system in Laos and playing role of multiple functions of agricultures in Laos. This area is also important as a major supplier of agricultural production and economy nearby Vientiane capital.

3. Outline of field observation

3.1 Field work implementation plan

The field work was processed firstly with preparation works including preparation of schematic plan, scaled-command area map, and collection of existing available information in the project site. The schematic plan and scaled-command area map are useful to identify flow measurement points and other relevant planned field works to be conducted.

The monitoring plan included field work implementation was prepared to monitor and investigate field work properly. The implementation plan is shown in Table 5.

3.2 Methodology and Approach

Assessment of Water Requirement:
The water requirement is assessed using all parameters collected from the fields. Those parameters are described as follows.

[Evaporation, ET_o]
The ET_o was recorded using A-pan installation as shown in Photo 1. The data was recorded on daily basis and the results are made available in Annex 1(a) for dry season and Annex 1(b) for wet season. The ET_o is used for calculation of ET_c for cash crops, but it is not used for calculation of ET_c of paddy since the ET_c of paddy is directly measured in the paddy field.

[Rainfall]
Rainfall (R) was recorded by simple rain gage at the same place as ET_o observation shown in Photo 1. The results are shown in Annex 3 (a) for dry season and Annex 3 (b) for wet season.

Photo 1: A-Pan and Rain Gauge

Table 5: Activity and Timeframe

No.	Project Activities	Year 2006								Year 2007												Year 2008	
		M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F
	1. Preparation for data collection																						
1	identify appropriate pilot project sites (irrigation schemes)																						
2	prepare schematic plan of irrigation system																						
3.1	prepare scaled command area map of the irrigation scheme																						
3.2	prepare GIS																						
	2. Assessment of Irrigation Efficiencies																						
	-Conducting Water Balance																						
4	inflow and outflow measurement :																						
	- identify flow measurement points covering all inflows and outflows for selected command area																						
	- civil work preparation																						
	- conduct measurement and calculate flow quantity based on selected points ¨																						
	-Assessment of Water Requirement :																						
5	obtain rainfall and other climate data from the nearest meteorological station ¨																						
6	calculate or obtain potentail (reference) evapotranspiration (ET_o) and crop coefficient values (K_c)																						
	for paddy,fishponds, and other crops																						
7	calculate crop evapotraspiration (ET_c) based on (ET_o) and (K_c) obtained																						
8	identify actual irrigated areas																						
9	record cropping pattern and crop calendar for different crops ¨																						
10	record multiple use of irrigation water quantity (e.g. water use for fishpond etc.) ¨																						
11.1	civil work preparation																						
11.2	record water level changed in paddy fields and fishponds ¨																						
12	calculate total scheme water requirement																						
	-Calculate Irrigation Efficiencies :																						
13	conduct conveyance losses test and calculate conyeyance efficiency																						
14.1	calculate command areas efficiency based on water balance concept																						
14.2	prepare measurements (GPS, computer notebook, etc)																						
	3. Assessment of water productivity																						
15	obtain yield of paddy																						
16	calculate crop water productivity (yield per cubic meter of water diverted, and water consumption																						
	4. Scheme management appraisal																						
17	identify stakeholders for decision making on distributton of irrigation water within the scheme																						
18	draw organisational charts of stakeholders (irigation managers, water users, others) involved in the																						
	decision making of the scheme management																						
19	document procedure of decision making for water allocation and distribution																						
20	document operation rules and actual practices to ensure delivery of the above allocated and																						
	planned water to the users																						
21	Office expenses, stationary, miscellaneous for field expenses and making reports																						
22	Total gasoline																						
23	TNMC expenses																						
	5. RAPs																						
24	conduct RAP, at the end of data collection period, based on the training provided by IIEPF during																						
	the field data collection period																						
	6. Others																						
25	facilitate technical backstopping by the MRCS made of demand by implementing agency																						
26	take part in the training workshops organized by MRCS within the framework of IIEPF																						
27	assist Programme Officer in collecting any other information required for analysis within																						
	the framework IIEPF																						
28	assist MRCS in organizing national workshops planned to be conducted in January 2008																						

[K_c]
The K_c is borrowed from the past activity study of water requirement by MAF. The applied figures in dry and wet seasons are distinguished as Annex 1(a) for dry season and Annex 1(b) for wet season.

[ET_c and Percolation]
The ET_c and Percolation were directly recorded in the paddy field by equipment shown in Photo 2. The water level changes which include ET_c and Percolation were recorded every day. The installation was made in 3 places at up-, middle-, and down-stream of the commanded area. The data used for the calculation is average of these 3 stations.

Photo 2: ET_c Apparatus

The ET_c of paddy is shown in Annex 1(a) for dry season and Annex 1(b) for wet season. The percolation is shown in Annex 2(a) for dry season and Annex 2(b) for wet season. The result of ET_c paddy measured in the field is also cross checked with data calculated by theory using ET_o from the measurement, ($ETc = ET_o \times K_c$).

The ET of fish pond is measured by staff gauges in two fish ponds at up- and middle-stream command area (Photo 3). The water level changes of fish pond which comprise of ET and percolation was recorded every day as Annex 4 (a) for dry season and Annex 4(b) for wet season. The inflows and outflows of fish pond during water level monitoring were controlled and recoded in order to obtain proper values. These values are used for calculation of fish pond water requirement.

Photo 3: Water Level Monitoring at Fish Pond

[Identification of actual planted area]
Actual irrigated areas were investigated in both dry and wet seasons. The GPS was used to record points and boundaries of planted areas. The head of WUGs were interviewed to mark their own actual boundary of irrigated area. The collected information was then plotted into schematic ground plan of irrigation scheme. The irrigated areas were monitored every 10 days. This data was used to calculate system water requirement.

[Cropping pattern and crop calendar]
Data collection form was produced and provided to each water user group to record cropping pattern and crop calendar for their own groups. The information was checked by conducting field observation twice each dry season and wet seasons. This information includes

- Growing crops and their planted areas
- Periods (starting and ending dates) of land preparation, transplanting, and harvesting for each agriculture type practiced within command area

The result of this survey is shown in Table 7.

[Water requirement for different crops]

Because various agricultural activities are practiced in the project, water requirement (*WR* in mm/d) for each agricultural practice was calculated by following equations.

Water requirement for paddy:

$$WR_p = ET_c + P + LP \quad (1)$$

Water requirement for non-paddy crops (cash crops):

$$WR_n = ET_o \times k_c \quad (2)$$

Water requirement for fishponds:

$$WR_f = ET_o \times k_c + P \quad (3)$$

Where
ET_o : Potential or reference evapotranspiration in mm/d
ET_c : Crop Evapotranspiration in mm/d
Kc : Crop coefficient (dimensionless)
LP : Land preparation in mm/d
P : Percolation in mm/d

Percolation is considered for paddy and fishpond only and it is assumed to be minor and neglectable for cash crops.

The total scheme water requirement (SWR in m^3) is calculated based on the requirements for multiple uses of all above agricultural activities within command area including paddy, cash crops, and fishpond as follows.

$$SWR = \sum_{i=1}^{n} \int_{j=1}^{m} WR_{ji} \times A_{ji} \quad (4)$$

Where

i : Type of agricultural activity (e.g. paddy, non-paddy, fish farming)
j : Day
m : Number of days
n : Number of agricultural activities practiced within command area, here n = 3 (paddy, cash crops and, and fish farming)
WR_{ji} : Water requirement (mm/day x 10^{-3}) of crop type (i) at the day (j)
A_{ji} : Actual cultivated area (m^2) of crop type (i) at the day (j)

[Effective Rainfall]
Effective rainfall (ER) in m^3 was calculated using FAO formula suggested by MRCS as follows.

$$ER = \sum_{i=1}^{n} [10 \times A_i \times (1 - 0.006 R_i) R_i] \quad (5)$$

Where

i : Day
n : Number of days
A_i : Actual cultivated area (ha) on the day (i)
R_i : Rainfall (mm) on the day (i)

***Assessment of Water Balance*:**

[Water Balance Concept]
The water balance concept introduced by MRCS provides information on all inflows and outflows in a command area and also determines the water delivery destinations, while taking into account the multiple uses of water within the command area. Water balance is used to calculate water productivity.

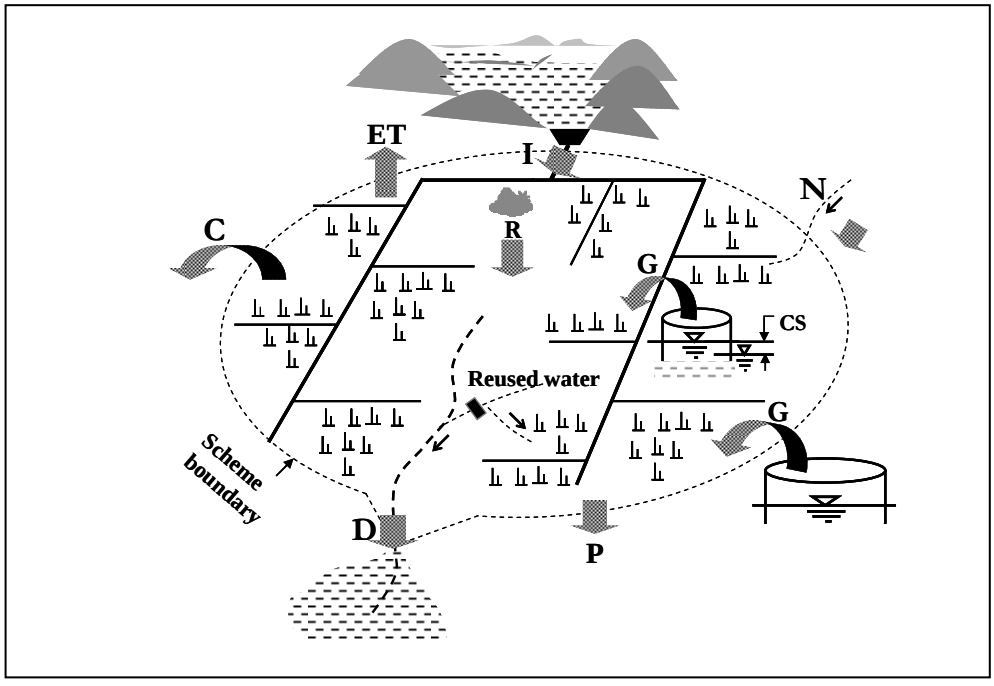


Figure 3: System Water Balance

Fig. 3 shows water balance components in an irrigation scheme. Available water supply in the system can be determined as follows.

$$AWS = (R + I + N + G - CS) - (ET + P + D + C) \quad (6)$$

Where
AWS : Available water supply within command area (m^3)
R : Rainfall (m^3)
I : Intake from main canal (m^3)
N : Natural flow entering command area (m^3)
G : Ground water from deep layer into the command area (m^3)
CS : Changes in storage (m^3)
ET : Evapotranspiration (m^3)
P : Percolation (m^3)
D : Drain water to sinks outside without reuse or non-utilizable water supplies (m^3)
C : Committed flows to the other areas (reuse flow), for example legally or conventionally committed outflows from the command area to outside (m^3)

The changes of storage (*CS*) and ground water inflow (*G*) are not considered in this analysis because no significant ground water use is observed.

[Inflow and outflow measurements]
To assess water balance, flow measurement points were determined with all inflows and out flows. Not only flows from irrigation canals, but all natural inflows and outflow were also covered. The measured data in each canal is provided in Annex 6 (a) for dry season and Annex 6(b) for wet season.

The measurements (in irrigation canals) were conducted according to the irrigation schedule of the project or gate operation at the intake of each canal, but mostly with average of twice a month. One time measurement spends approximately for seven days. Measurement teams were divided into two, one team conducted flow measurement along canal system and another team conducted flow measurement at natural steams.

The current meter (Photo 4) was lent from MRCS for this purpose. The Photo 5 shows the field work of the team at main (left) and tertiary (right) canals.

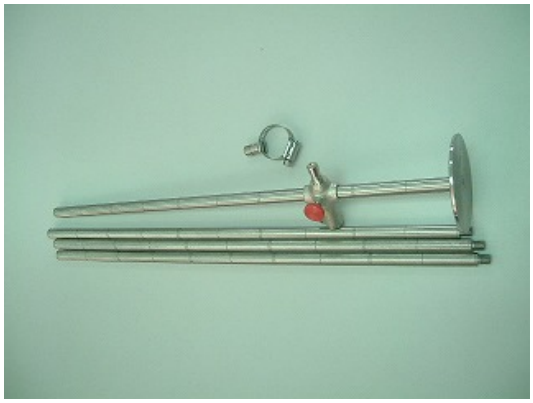
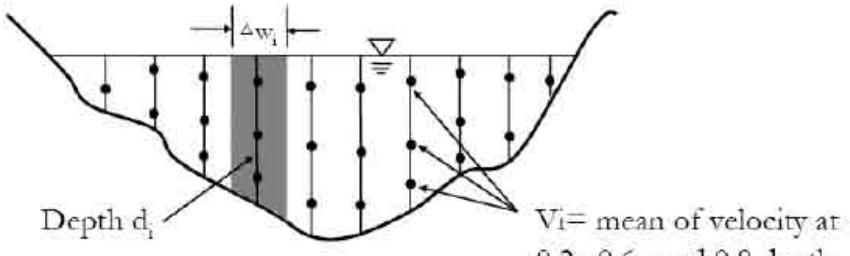


Photo 4: Flow Meter Equipments

Photo 5: Flow Measurement

The methodology of flow rate calculation was followed the instruction by MRCS and briefly summarized as follows.



Flow Calculation:

$$V_i = \frac{(V_i 0.2 + V_i 0.6 + V_i 0.8)}{3} \quad ; \quad a_i = d_{ix} \times \Delta w_i$$

$$q_n(partial) = v_n \times a_n \quad ; \quad Q(total) = \sum_1^n v_i a_i \quad or \quad n\sum_i q_n$$

Figure 4: Calculation of Flow Quantity

As shown in Fig 4, measurement was conducted along the vertical depth of 0.2, 0.6, and 0.8 in each divided segment at cross section. In case water level is lower than 0.6 m, only 0.2 and 0.8 of depth were measured. The average velocity (V_i) was calculated in each segment, and then discharge (q_i) of each segment was calculated with each cross section area (a_i). The total discharge, *Q (total)*, at each measurement point is to sum up discharge (q_i) of each segment cross section area.

Conveyance efficiency:

The conveyance efficiency test (E_c in %) was conducted using long reaches at three canal levels (main, second and tertiary) by measuring all inflows and outflows at selected sections. The measurement was taken throughout the seasons, from the banging and to the end of irrigation period. It is computed based on the following formula.

$$E_C = \frac{\sum_{i=1}^{n} Q_{out}}{\sum_{i=1}^{n} Q_{in}} \times 100 \quad (7)$$

Where
i : Number of inlet and outlet from selected canal sections
n : Number of inlets and outlets of the canal when conducting conveyance loss test
O_{out} : Water flowing out from the canal section (m^3/s)
Q_{in} : Water diverted into the canal section (m^3/s)

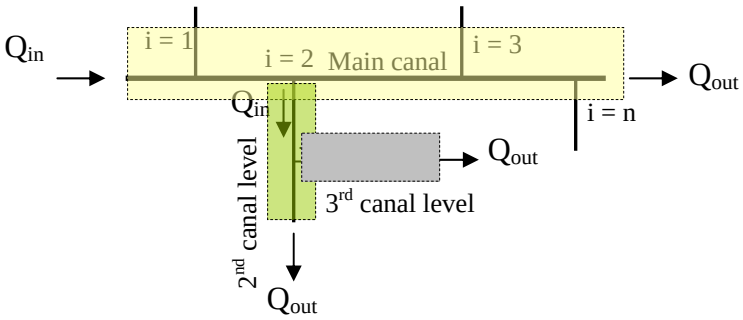


Figure 5: Sketch of Conveyance Test

Water Delivered to the fields:
Once water balance is defined, water delivered to the fields (WDF) in m^3 is calculated. In other words, WDF is modified from water balance estimation, its concept is provided as follows.

$$WDF = (I \times E_c + N) - (D + C) \quad (8)$$

Where
I : Total diversions or surface inflows from irrigation canal into the command area (m^3)
E_c : Conveyance efficiency (%)
N : Total natural flows entering command area (m^3)
D : Drain water to sinks outside without reuse or non-utilizable water supplies (m^3)
C : Committed flows to other areas (e.g. legally or conventionally committed outflows from command areas to outside (m^3)

Conveyance loss along canal to the field is considered when delivering water from intake water to the target fields.

There is no committed flow in the area. Only very small part of water is taken from reservoir for domestic water use, it is ignored for this calculation.

Overall command area efficiency:
With the concept of water balance, inflow and outflow are computed and once conveyance efficiency is calculated, overall command area efficiency is computed based on follow equation.

$$E_{overall} = \frac{SWR - ER}{WDF} \times 100 \quad (9)$$

Where
SWR : Total scheme water requirement (m^3)
ER : Effective rainfall (m^3)
WDF : Water Delivered to the fields (m^3)

Water productivity:
There are several definitions to calculate water productivity. According to the instruction of MRCS, water productivity (WP) is defined (in USD/m^3) as the economic value of all agricultural productions per one unit of available water supply in the system which is calculated by water balance method. The water productivity is defined as follows.

$$WP = \frac{Value\ of\ total\ production\ output\ (USD)}{WDF(m^3)} \quad (10)$$

Where
Value of total output : The total production value in the command areas calculated (USD)
WDF : Water Delivered to the fields (m^3)

All kinds of productions were recorded by preparing form provided to head of WUGs to collect information of their own groups. The data was crosschecked with field observation by sample (production) test from 32 selected plots (1m x 1m) during harvesting season.

Scheme management appraisal:
The document of stakeholders for decision making on water distribution, resource mobilization, etc were collected and identified. Available existing information was collected for this purpose. Procedure and participation of farmers in water delivery were also examined at different levels of canal system (main, secondary, tertiary).

Conducting RAP:
RAP was supervised by MRCS and FAO. It was conducted before field observation commenced. The missing information for RAP is filled by supplementary data through field observation. Its results are not included in this report.

4. Major Findings

4.1 System Water Requirement (SWR)

The system water requirement was calculated from different agricultural activities practiced in the command area. Based on equations 1 to 4, the calculated results are summarized in Table 6 and detailed results are attached in the Annexes 4(a) and 5(a) for dry season and Annexes 4(b) and 5(b) for wet season.

In order to obtain water requirement, numbers of items are identified and calculated including planted areas, cropping pattern, ETo, rainfall, effective rainfall, ETc, and deep percolation. These items are described as follows.

Planted Areas:
As shown in Table 6, the overall planted areas was estimated at 1, 525.70 ha in dry season and 2,236.20 ha in wet season. Fig. 6 indicates the schematic plan of the system including designed command area and capacity of each canal. Based on the field observation, these actual planted areas for both dry and wet seasons are smaller than original designed command area.

In the dry season 2006-07, actual planted area is only accounted for 62% of designed area (2,441.92 ha). The major reasons are caused by reservoir was not filled up with full capacity due to the dry spell and shortage of rain in 2005. Poor infrastructure and weak of proper water control leading to the water loss seems to be common reason in dry-season cultivation.

In wet season 2007, although the actual planted area was larger than dry season, the area is still smaller than designed command area of 8.41 % in 2007. The actual planted area in wet season suppose to be the same as designed area due to water availability by rainfall and supplementary by irrigation, but the gap/error might be cause by data collection or designed work. Other reason why wet season area is always larger than dry season is because of the lower investment.

Table 6: Summarization of Planted Areas for Different Crops

Crop type	Dry Season (2006-07)		Wet Season (2007)	
	(ha)	(%)	(ha)	(%)
Paddy	1,485.20	97.40	2,236.48	98.80
Cash crops	18.78	1.20	5.00	0.20
Aquaculture	21.72	1.40	21.72	1.00
Total	**1,525.70 ha**		**2,263.20 ha**	

Paddy rice is the major crop grown in the project which is accounted for 97.4% of total cultivated areas in dry season and 98.8% in wet season. Cash crops (mainly long been, sweet corn, cucumber, water melon, etc) are usually well promoted by the government in this project site since the farmers easily access to market and the site locates close to Vientiane capital. However the small proportions were observed such as 1.2% of total cultivated areas in dry season and only 0.2 % in wet season. Skills and capacities of farmers to develop industrial crops in large scale are still limited and the marketing is also not yet well implemented .Farmers sometimes face difficulty of fluctuation of market price.

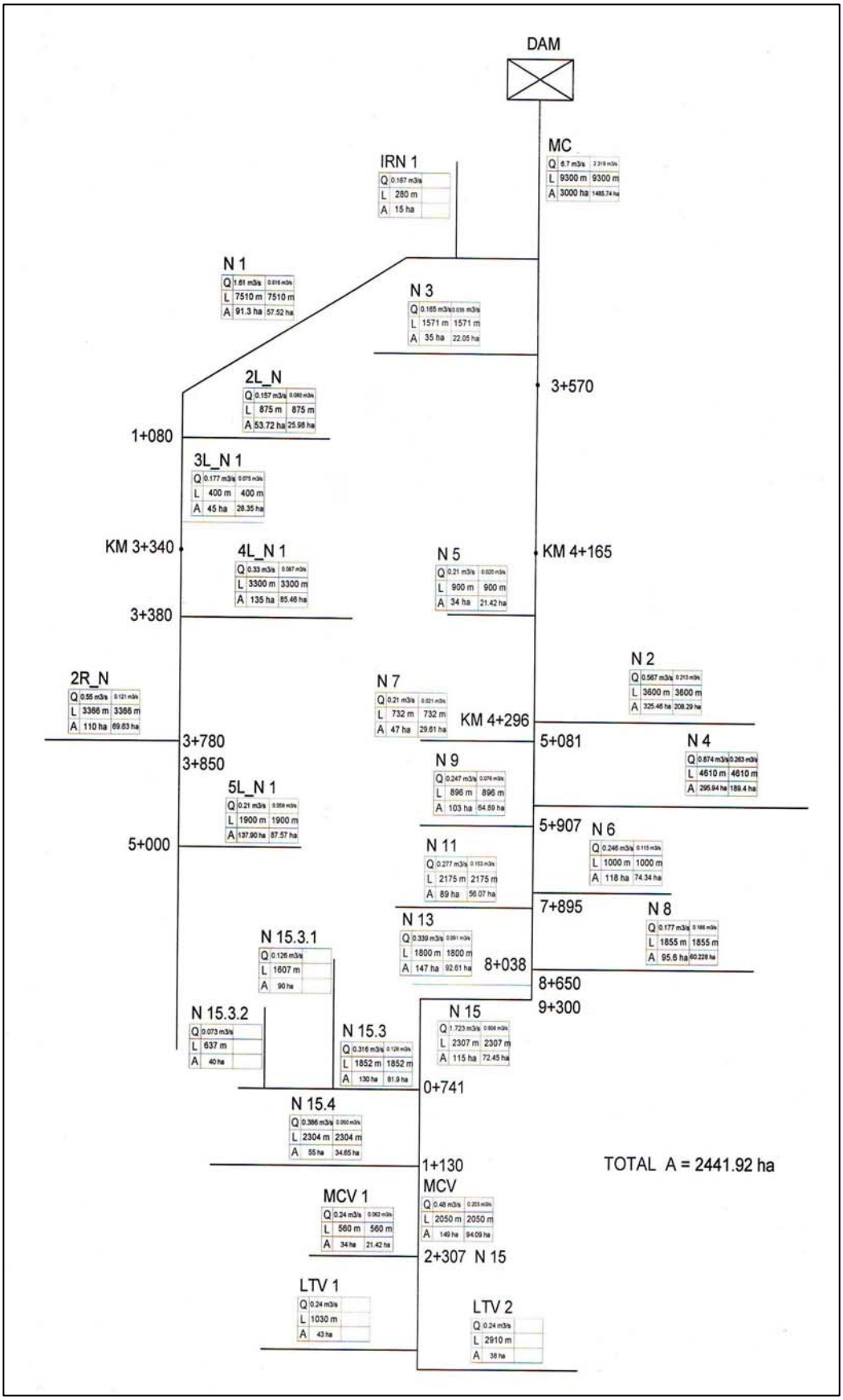


Figure 6: Schematic Plan of Pilot Site

The aquaculture is well practiced in the area. The popular species are Carps and Tilapias. There are totally 26 families conducting fish farming. The fish farming are not only practiced by farmers, but also demonstrated by international development projects such as MRC fishery project, Swedish fishery project, etc. Some private companies have also invested in this business, mainly Chinese and Vietnamese companies. Although the fish farming area is currently observed as 1.4 % only in dry season, this will increase steadily in the near future because there is a good market for this activity. Most of fish farming areas are located along the irrigation canal where water can be easily accessed.

The actual planted areas observed by GPS and interview shows that the gap between command area and actual planted areas are clearly identified. Those unplanted areas are mainly sited in the higher elevation and also in the far distance from canal where water hardly reaches, water does not reach easily.

Cropping calendar and irrigation days:

Based on field observation, cropping pattern is shown in Table 7. The standard of dry season rice is 90 days, but total cultivation length was accounted for 128 days. Transplanting was made by rotation from zone 1 to zone 3 as Fig. 1. This practice is applied when the drought occurs or when reservoir is not filled up to the full capacity by the end of the previous crop. Dry season of 2006-07 was the same drought year that reservoir stored only 44 MCM, instead of 60 MCM as a full capacity in the normal year.

The wet-season paddy is cultivated from early June to the end of November. The rice variety of this season needs 120 days. However, irrigation supply is only for 65 days, mainly for land preparation and transplanting period.

The Table 7 also includes calendar of cash crop and fish farming. The cash crop is mainly grown in dry season from October to early May (164 days) and early stage of wet season with short period of 74 days from mid April to the end of June in order to avoid heavy rain in July and August.

Fish farming is practiced through the year. Irrigation water for this activity is not continuous supplied through the wet season, but on the request basis by the fish farm owners. However, in 2007 the request was rarely made in wet-season cultivation.

Table 7: Cropping pattern and Crop Calendar

Agriculture Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Paddy		Land Preparation	DS Paddy						Land Preparation	WS Paddy		
Cash crops	DS cash crops						WS cash crops					
Aquaculture	Fish Farming											
Irrigation days		128 days						65 days				

Note: DS – Dry season; WS – Wet season

Evaporation (ET_o):

Fig. 7 shows the monthly average ET_o recorded from November 2006 to October 2007. The average ET_o is estimated at 3.32 mm/d in dry season and 4.47 mm/d in wet season. The ET_o is generally lower in dry season and higher in wet season. The high temperature and strong sunlight in wet season might be the reason of the high ET_o. The peak is clearly observed in February and May in dry season and in August in wet season. The daily recorded value is presented in Annexes 1(a) and 1(b) for both seasons.

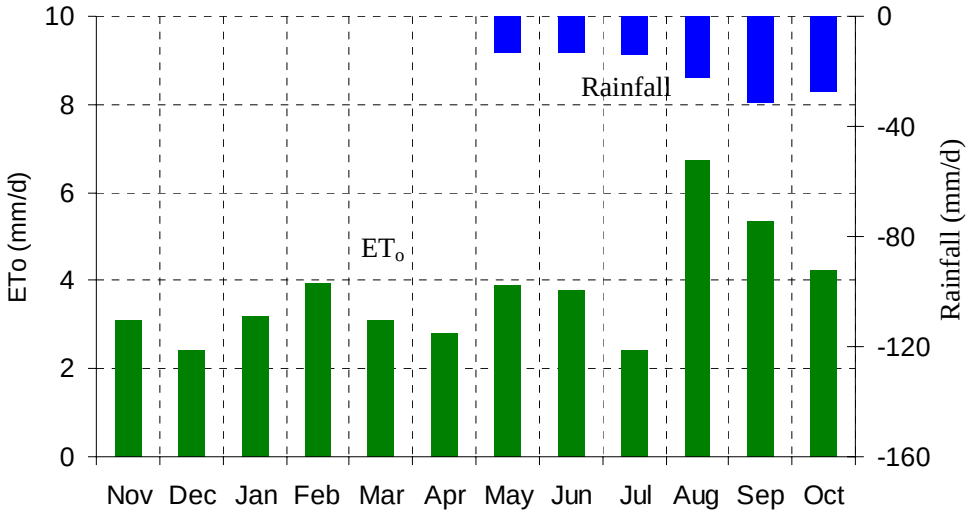


Figure 7: Evaporation and Rainfall

Rainfall:

The Fig. 7 also shows the rainfall observed at the same period. Almost no rainfall was observed in dry season of 2006 /07. The average rainfall in dry season was 0.07 mm/d, while 21.09 mm/d in wet season. The peak time of rain occurs late (September) in 2007, while it usually occurs in July or August in normal years. The total rainfall is also slightly lower than usual with 1,395.10 mm, while approximately 1,700mm as average from 1987-2004 recorded by the DMH at Vientiane City. The daily recorded value is made available in Annex 3(a) for dry season and Annex 3(b) for wet season.

Effective rainfall:

The effective rainfall was estimated based on Equation 5. The total effective rainfall estimated in dry season is 0.048 MCM and 19.79 MCM in wet season. The effective rainfall is used to calculate water balance. The detailed calculated value is given in Annex 3(a) for dry season and Annex 3(b) for wet season.

Evapotranspiration (ETc):

The calculated ET_c is shown Fig.8 covering dry and wet seasons. The average of 4.03 mm/d was obtained in dry season and 6.33 mm/d in wet season. The high ET_c period occurs from February to March in the dry season and from September to October in wet season. The ET_c is generally higher in wet season. High temperature and sunshine in wet season could be the reason of the high ET_c

The ET_c was recorded at three: up-middle- and down-stream parts the command area at up-middle, and - down stream command area. The detailed calculation at each station is shown in Annex 1(a) for dry season and Annex 1(b) for wet season.

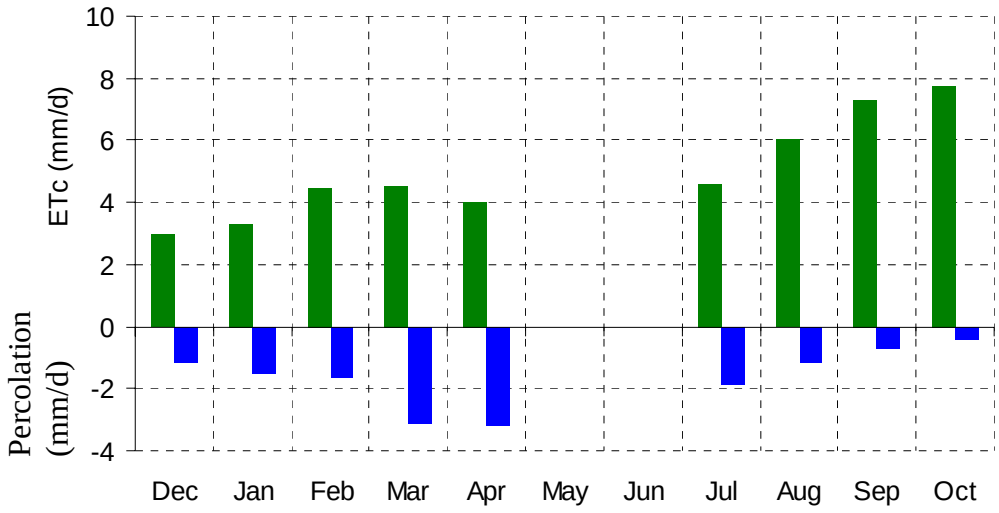


Figure 8: Evapotranspiration

Deep Percolation:

The Fig.8 also shows monthly percolation recorded at the same stations with ET_c. The percolation is higher in dry season (3.21 mm/d), then 1.19 mm/d only in wet season. The reason could be lower ground water level in dry season. High percolation is also observed near the Nun Ngum river bank. The difference of soil type in the command area might be on of the factors. The daily value is provided in Annex 2(a) for dry season and Annex 2(b) for wet season.

The highest percolation was observed March and April during hottest period in Laos. In the wet season, percolation was gradually reduced from the beginning to the end cultivation stages.

Total System Water requirement:

Taking all the items into consideration, system water requirement is calculated. The results are summarized in the Table 8.The detailed analysis is attached in Annexes 5(a) and 5(b) for dry and wet seasons.

Table 8: Water Requirement for Each Agricultural Type

Water requirement for each agricultural activity		Dry season	Wet season
Paddy (MCM)		9.817	20.370
Cash crops (MCM)		0.078	0.006
Aquaculture (MCM)		0.234	0.296
Total	MCM	10.129	20.672
	mm	663.90	913.700

Total crop water requirements for dry season was estimated at 10.13 MCM (6,638.92 m^3/ha or 663.90 mm) at on-farm level. Of these, 96. 95% is accounted for paddy requirement and 0.78% for cash crops, and 2.27% for fishpond of.

In the wet season, as much as twice of dry-season value is estimated (20.67 MCM). That is 9,133.09 m^3/ha, or 913.4 mm. The higher water requirement in the wet season is due to longer cultivation days, higher ET_c, and larger planted area. Less amount is required for cash

crop because less planted areas, while demand for aquaculture is almost constant through dry and wet seasons.

Considering 69.07% of conveyance efficiency observed in the project, the total water requirement at headwork or main intake is accounted for 9,621.62 m^3/ha in dry season and 13,236.36 m^3/ha in wet season. These actual observed values are significantly low compared with standard value being practiced in water management plan by the Num Houm project (20,000 m^3/ha). The standard value was not taken by experiment, but borrowed from case study in Thailand.

Water Requirement and Irrigation Water Supply:
Figs.9 and 10 show irrigation water supply and daily and weekly water requirements for dry and wet seasons. These values are calculated at the on-farm level. The irrigation water supply uses flow data measured at the main intake multiply by conveyance efficiency (69.07%). The water requirement is calculated based on data collected in the paddy field. Daily water requirement is not discussed in detail, but the discussion is more emphasized on comparison of weekly water requirement and weekly irrigation supply of dry and wet seasons as follows.

In the dry season (Fig.9), weekly irrigation water supply increases sharply at the beginning of December and drops in February before reaching to the peak at March. Water is supplied based on irrigation schedule established by project officials and this schedule allows limited changes or less flexibility adapting to the real demand. Weekly water requirement is high at land preparation and transplanting stages from November to December and drops at development stage from middle November to the end of January. The water requirement then increase steadily from development stage to the end of the season. In comparison of these two observed facts, there is a gap between required and supplied amount. The supplied amount is generally higher than the required amount. The huge gap could be observed at development stages from middle December to the end of January. The irrigation supply, therefore, needs to be reconsidered in order to match and in accordance with the real water requirement.

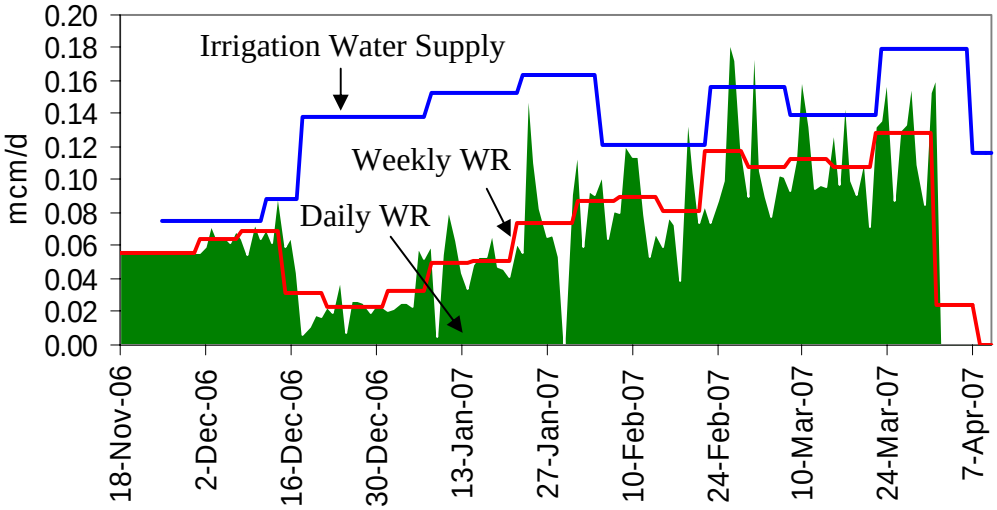


Figure 9: Water Requirement and Water Supply at Field Level (Dry Season)

In the wet season (Fig.10), the schedule of irrigation water supply is not established, but the supply is made up on the requests. In this wet season, the supply period was observed at the middle June to the end of June. For the rest periods, the demand is filled by rainfall and natural streams by surface inflows. The water requirement in this season is greatly fluctuated thought the season. The reasons are caused by rainfall error by data recorders. The high water requirement appears at different stages such as between mid to end of June, at the beginning of September, and at the beginning of October. It is hard to interpret the relation of these supply and required amounts since the supply amount also dampens largely on rainfall and natural stream. On fact could be observed here is that the supply was happened in Land preparation and transplanting stages (June to July). During these stages, water requirement is high especially at the end of July, but less rainfall. The irrigation water therefore was supplied for this purpose. Another fact is that the supply period was happened slightly earlier than the required period. If this supply period shifts to haft month later, the supplied and required amounts will be in a good match.

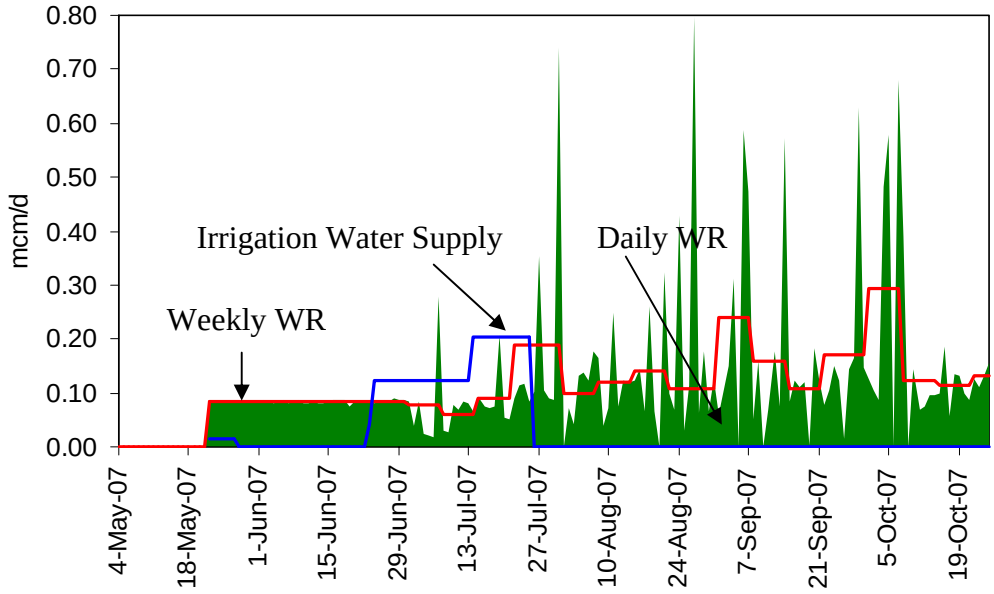


Figure 10: Water Requirement and Water Supply at Field Level (Wet Season)

4.2 Water balance

Surface Inflow and Outflows:

Figs.11 and 12 show the results of flow monitoring in dry and wet seasons conducted at the boundary of command area for water balance analysis at irrigation scheme level. Three major kinds of flows are clearly identified including inflow from irrigation water delivered from main canal, inflow from natural streams, and outflow (drainage) to natural streams.

In the dry season (Fig.11), inflow by irrigation increased from 1.2 MCM in December to around 2.8 MCM at the end of January. The highest irrigation supply occurred in mid to the end of March and the low irrigation supply was observed in early February. The natural stream inflow is stable through the season with approximately 0.7 MCM to 1.0 MCM. The outflow to the drainage is however not stable, although there was almost no rain in this season. Thus the fluctuation of this flow depends mainly on irrigation water supply.

According to the graph, more than 0.1 MCM of drainage was observed per week. The highest drained period is observed in early to middle March while irrigation supply was also high in this month. This interesting trend is observed by this flow monitoring and attention should be paid to control this loss. The water supply plan should be also adapted in accordance with the trend and changing of the system water requirement.

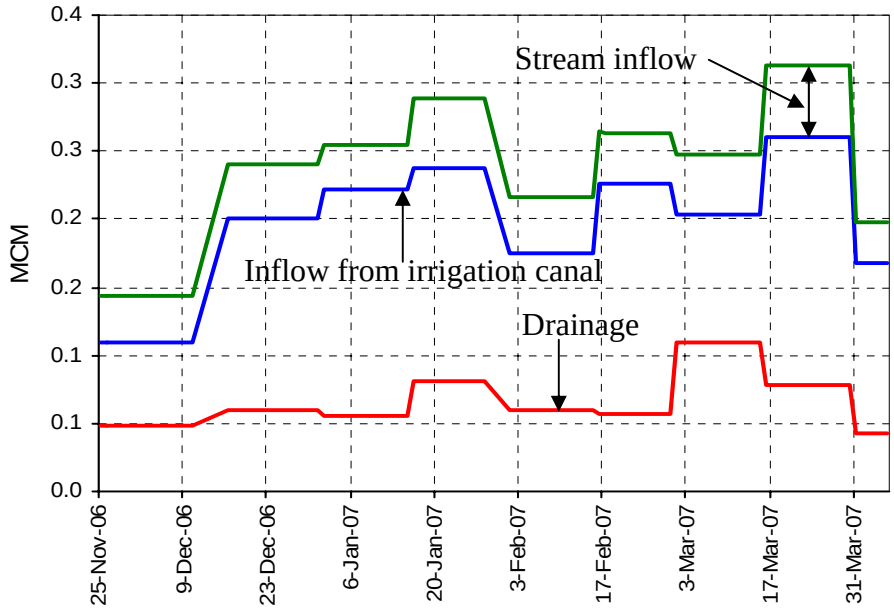


Figure 11: Surface Inflows and Outflows (Dry Season)

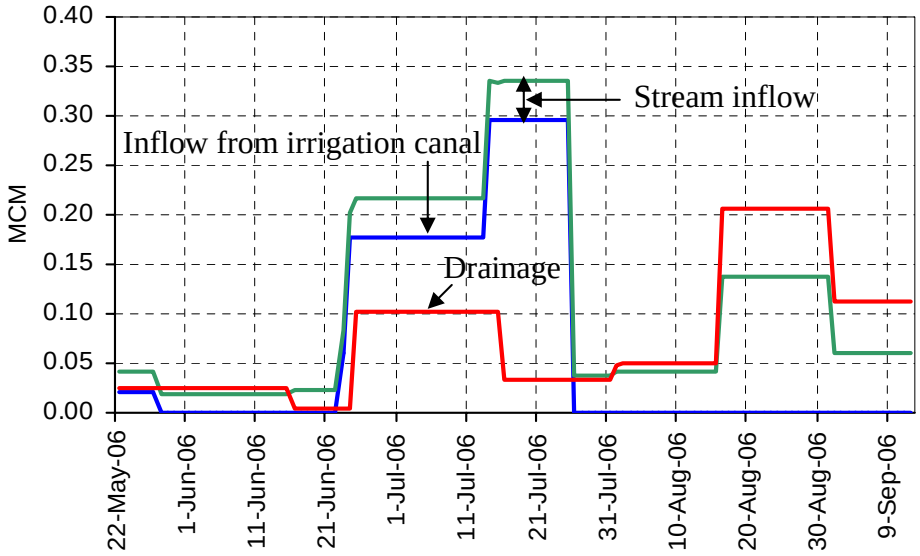


Figure 12: Surface Inflows and Outflows (Wet Season)

In the wet season (Fig.12), inflow by canal was not main part but most parts are inflows by rain and natural streams. In flow by irrigation was observed at the end of June to the end of July with peak of nearly 0.3 MCM a week. In flow by natural streams were fluctuated affected by rainfall pattern. The peak was found in August at the highest rainfall concentration. However, in this season, not all amount of natural stream was used for irrigation; most of the flows go to drainage. Outflow (drainage) has similar trend to the

natural steam. The high drainage occurred at the end of June to the beginning of July when high irrigation water supply and in August when heavy rain.

All of inflows and outflows components are summarized in Table 9 and the detail calculations are made available in Annex 6 (a) for dry season and Annex 6 (b) for wet season.

Water available in the scheme:

As inflows, rainfall in wet season is ten times higher than in dry season, while three times higher in dry season irrigation water supply than in wet season. The natural inflow in wet season is two times higher than in dry season. As total, inflows are calculated at 33.07 MCM in dry season and 50.94 MCM in wet season.

As outflows, evapotranspiration (ET) for paddy is high in wet season, while not much different for fish pond and cash crops. Total percolation was estimated at 3.12 MCM in dry season and 2.85 MCM in wet season. The higher drainage in wet season is estimated. There is no committed flow in command area. Total outflows are estimated at 18.58 MCM in dry season and 35.86 MCM in wet season.

As a result, the water balance or net available water supply in dry and wet seasons is almost the same, i.e. 14.49 MCM and 15.08 MCM respectively. These results use to calculate water productivity.

Table 9: Available Water Supply at Scheme

Flows	Water Balance components	Dry Season (MCM)	Wet Season (MCM)
Inflows	Rainfall	0.15	1.43
	Irrigation from main canal	27.33	7.30
	Inflow from natural streams	5.59	12.21
	Total Inflows	***33.07***	***50.94***
Outflows	Evapotranspiration of paddy	6.03	16.56
	Evapotranspiration of fishpond	0.10	0.32
	Evapotranspiration of cash crops	0.08	0.01
	Dee percolation	3.21	2.85
	Drainage	9.16	16.12
	Committed flows	0.00	0.00
	Total Outflows	***18.58***	***35.86***
Available Water Supply		**14.49**	**15.08**

4.3 Efficiencies

In this study, the two efficiencies are analyzed i.e. conveyance efficiency and overall-command area efficiency. The results are described as follows.

Conveyance efficiency:

According to equation 7, the conveyance efficiency is summarized as Table 10. The detailed calculation is provided in Annex 7. As mentioned in the section 3.2, the conveyance test was conducted only one time in dry season because it is assumed that the value is not much different between dry and wet seasons.

Only some representative canals were selected for conducting conveyance test for second and tertiary canals. The names of representative canals are mentioned in the Table 10. Higher efficiency is appeared at main canal and lower in second and tertiary canals. As a result, the system conveyance efficiency was estimated at 69.06 %.

The estimated conveyance efficiency is relatively low compared with the original designed value of 75%. The major reason is water losses occurred through gates and other control structures because of the poor condition and insufficient maintenance. Earth type of the most parts of canal resulting to high seepage along canal profile is also the reason.

Table 10: Conveyance Efficiency

Canal Level	Canal's Name	Efficiency (%)	Average (%)
Main Canal	MC	96.98	96.98
Secondary Canal	N1	83.28	82.26
	N14	81.23	
Tertiary Canal	MCV	86.57	86.57
System Conveyance Efficiency			69.06

Overall- command area efficiency:

In order to compute the overall-command area efficiency, the calculation of water delivered to the fields is necessary. Table 11 shows calculated results of water delivered to the fields based on equation 8. The values obtained are largely different between dry and wet seasons. Approximately 15 MCM in dry season and 1 MCM in wet season are estimated.

The reason of very low value in wet season is that little amount of Total Diverted Water from Main Canal (TDW) as inflow. The net inflow by irrigation water and natural stream are almost equal to drainage and this makes the balance of these two terms are almost the same. Different from dry season, much irrigation water is supplied compared to drained amount.

Table 11: Water Delivered to the Fields and Overall-Command Area Efficiency

Items	Unit	Dry Season	Wet Season
Total system water requirement (SWR)	MCM	10.13	20.67
Effective rainfall (ER)	MCM	0.15	19.79
Total diverted water from main canal (TIW)	*MCM*	*27.33*	*7.30*
Total diverted water from natural streams (TNW)	*MCM*	*5.59*	*12.21*
Total out flow or drained water (TDW)	*MCM*	*9.16*	*16.12*
Total committed water (TCW)	*MCM*	*0.00*	*0.00*
Conveyance efficiency (E_c)	%		69
Water delivered to the fields (WDF)	*MCM*	***15.29***	***1.12***
Overall-command area efficiency	%	**65.30**	**78.17**

Committed water: water supplied for other place outside command area

Based on equation 9, the overall command area efficiency is presented in Table 11. Detailed calculation is shown in Annex 8(a) for dry season and Annex 8(b) for wet season. The efficiency calculated at 65.30% in dry season and 78.17% in wet season. These estimated values are generally high if compared with values conducted by previous studies (40-60%).

One of the main reasons is due to the water balance approach applied to this study. Water balance approach considers drainage while previous studies did not count it.

The efficiency in dry season (65.30%) is lower than in wet season (78.17%) which is not usual. The shorter irrigation period which means less irrigation input is the main reason of high efficiency in wet season.

4.4 Water productivity

Table 12 shows the estimation of water productivity based on equation 10. Detailed calculation is made available in Annex 9(a) for dry season and Annex 9(b) for wet season. The production of each agricultural activity is separately estimated. As shown in the Table 12, dry season yield is higher than wet season. The prices are also higher. As a result, the total production value is higher in dry season although cultivated area was smaller. The aquaculture usually provides higher price compared to other agricultural activities.

The water productivity is calculated at US$ 0.107/m^3 in the dry season and US$0.097/ m^3 in wet season. Higher water productivity is obtained in dry season due to higher yield and prices of productions.

Table 12: Water Productivity

Item	Areas (ha)	Yield (T/ha)	Price (US$/T)	Total Cost (US$)
Dry Season				
Paddy	1,485.20	3.88	239.65	1,524,384.17
Cash crops	18.78	8.93	167.72	
Aquaculture (fish)	21.72	4.07	1,307.35	
Wet Season				
Paddy	2,209.67	2.85	217.86	1,468,953.20
Cash crops	5.00	2.1	108.93	
Aquaculture (fish)	21.72	4.05	1,089.32	
Estimation of Water Productivity				
Net available water supply (MCM)	Dry Season		Wet season	
	14.49		15.08	
Water Productivity (US$/$m^3$)	Dry Season		Wet Season	
	0.107		**0.097**	

Note: Price in April 2007 for dry Season and December 2007 for wet Season

4.5 Project water management appraisal

Stakeholders involved in water management in the project:
The Num Houm irrigation project is jointly managed by government and farmers. Therefore, stakeholders involved in water management in the project are comprised of the MAF level down to farmer organizations. The management appraisal of the project is described as follows.

[Organization chart]
The project is operated by Num Houm project office belonged to the PAFSOs of Vientiane capital under the Ministry of Agriculture and Forestry. As shown in organization chart in Fig.13, there are four main units under Num Houm project office namely agriculture and extension unit, irrigation unit, livestock unit and forestry unit. Irrigation unit is fully responsible for irrigation water management through three Water User Associations (WUAs). There are 11 WUGs in total working under WUAs, of these permanent members are 960 persons and temporary members are 380 persons. The agriculture service unit supports mainly for agricultural extension work such as training on agriculture production, technical on fertilizer application, pest and disease protection, etc.

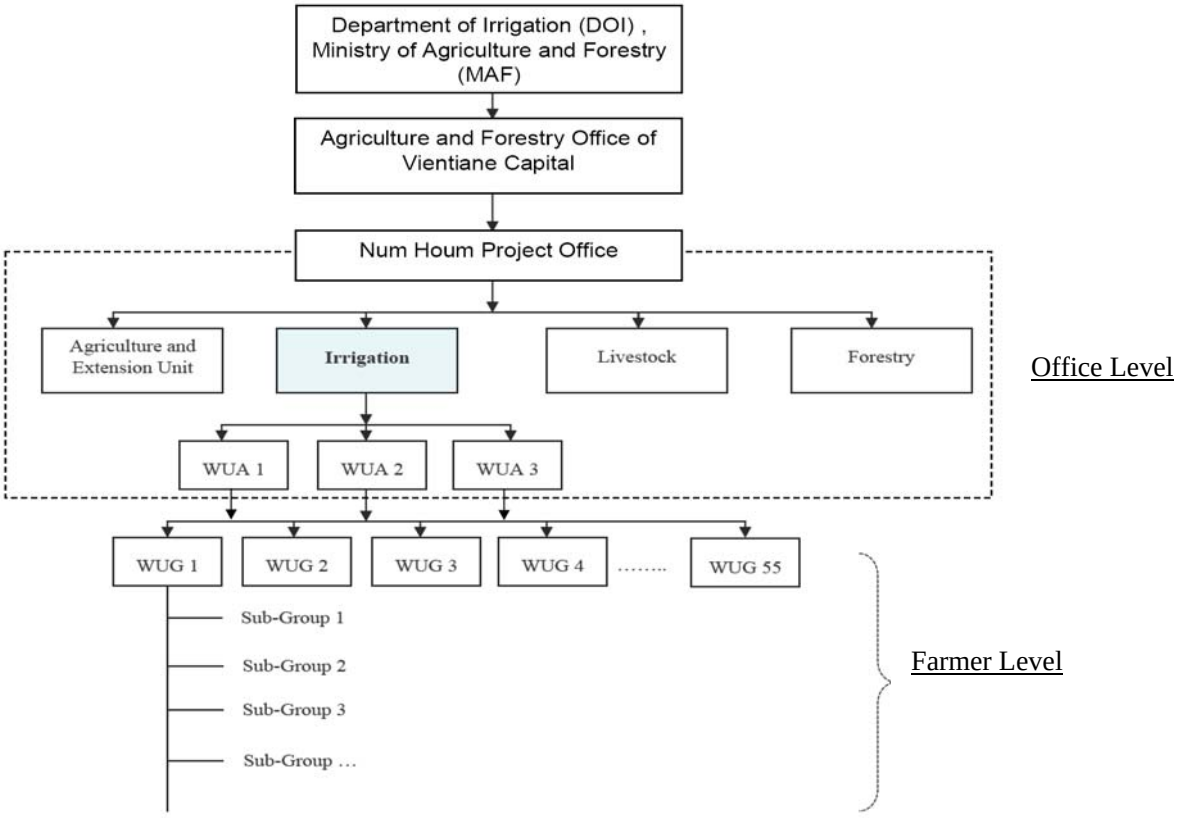


Figure 13: Organization Chart of Num Houm Irrigation Project

[Responsibility of stakeholders]
At office level, project is being managed by six officials in irrigation unit including Head, Deputy Head, three irrigation engineers, and one agriculture extension staff. The Head and the Deputy Head oversee overall management and supervision of O&M work. Each

irrigation engineer is assigned for each WUA to supervise O & M work. The responsibility of level includes:

- O&M of the dam and reservoir,
- O&M of main canal,
- Arrangement of budget proposal for major repairs of all irrigation facilities and structures of the scheme. This proposal is submitted from the District level to Central Government through Provincial level,
- Overall planning and supervision of the water allocation planning, implementation, monitoring and evaluation, and
- Coordination with the district and provincial government for emergency repair needs of the scheme.

At farmer level, the O&M work is under responsibility of WUGs (55 WUGs as total). The responsibility covers the O&M work from intake of secondary canals. The steering committee is formed by composing one project official or head of WUA, WUG head (farmer), and chiefs of the villages that command area belong to. The steering committee performs the functions of planning, problem-solving, decision-making, supervision, and technical assistance.

The WUGs consists of a leader, two deputies, and one accountant. The main task of this level is responsible for water distribution, routine maintenance, and assisting sub group to collect Irrigation Service Fees (ISF). The detailed responsibilities of WUGs are listed below.

- Coordination and followed up the supervision of WUAs for irrigation schedule planning,
- Monitoring water distribution,
- Maintenance of major repairs of irrigation facilities and structures secondary canals to farm level,
- Collection and remittance of ISF to the project, and
- Monitoring progress of planted and to charge ISF.

The O&M work lower than WUG level is responsibility of sub group which is comprised of one head and one deputy. The group has responsibilities of O&M work at on-farm level from intake of tertiary canal.

[Water management procedure]
The water management and service are conducted as following procedures. The reservoir and the main canal operation is responsibility of the WUAs under the project office. The WUGs are responsible for operating secondary canal level coordinating with the project office and their unit groups. The unit groups cover activities at the tertiary and on-farm level.

Water allocation plan and practice:
Water allocation plan is made for dry- season cultivation, but not for wet season cultivation. The plan is fixed and has little flexibility adapting water allocation to actual water requirement in each cultivation stage. Observation showed monitoring of water allocation was also not active in the project.

Based on observation on water allocation practice, the reservoir is operated mainly for dry season cultivation, but rarely operated during the wet season cultivation, except land preparation and transplanting and dry spell of the rain. The simple rotation method is applied at the main canal level by dividing command area into three parts as shown in Fig. 2: (1) left side of the main canal that delivering the areas of N1, 2LN1, 3LN1, 4LN1, 2RN1, 5LN1 with total areas of 335.24 ha in dry season 2006/07. The supply schedule is from Monday to Thursday, and (2) right side of main canal that delivering the areas under N3, N5, N7, N9, N11, N13, N15, N15.3, N15.4, MCV1, N2, N4, N6, N8 and MCV with total of 1,125.42 ha. The water delivery is from Friday to Sunday.

The main rotation points are made at the junction of MC and N1 and MC and N4. These two gates were calibrated and H-Q curves are provided in Annex 10.

ISF collection:
ISF collection rate set up in 2002 is 120 kg /ha for paddy in dry season and 80 kg /ha in wet season. In case of aquaculture, the rate is 180 kg of paddy /ha, and 87.5kg of paddy/ha for cash crop growing through the year.

Based on the price of rice (1,200 kip/kg) announced by Ministry of Commerce in 2003, the ISF is collected in cash instead of in kind as Table 13.

Table 13: ISF Rate

	Kg of paddy/ha		Kip/ha	
	Dry season	Wet season	Dry season	Wet season
Paddy	120.00	80.00	144,000	96,000
Aquaculture	180.00	180.00	216,000	216,000
Cash crops	87.50	87.50	105,000	105,000

Note: Aprox.1,200 kip/ kg of paddy (2006-07)

The ISF is important to sustain the O& M of the project under limited subsidies by the government. In other words, the project should run its own management by its own budget. According to the project staff, the project has received only 1.5 billion kip a year from the provincial government since 1997 to support O& M work such as major repairing of infrastructures and rehabilitation of the system. The IFS is therefore a key element of management of the project. The uses of ISF are set as regulation as follows.

With total collected amount, 60% is remitted to the project, and with this amount

- 10% are remitted to DAFEO,
- 25% are spent for administration work, and
- 25% are for minor repairs of irrigation infrastructures for the reservoir and main canal.

The rest (40%) is retained by the WUGs and used as follows:

- 15% for incentive for WUA staff,
- 5% allocated for village chief service to support ISF collection work,
- 5% for minor repairs of irrigation infrastructures within command area of WUGs, and
- 15% for the staff assigned for supervising WUGs and O&M steering committee members of each WUG.

It is mater of fact that ISF is not collected successfully. Only 30%-60% of total planted areas can be collected. Approximately 47% was collected in 2007. There are number of reasons for unsuccessful ISF collection as follows.

- Farmers complain and do not trust the water services by the project because they often experience water insufficient and not in time receiving water,
- Poor irrigation structure resulting to difficulty of controlling water properly,
- Some farmers have very low income and cannot pay ISF in time,
- Crops damaged by natural disaster e.g. flooding or by untimely water supply
- Weak participation and weak sense of responsibility of farmers.

Project constraints:

According to the project, the constraints can be summarized as follows.

- Limited budget due to poor ISF collection and limited funds from the provincial or central government,
- Limited experience and capability of staff,
- Poor condition of irrigation infrastructures,
- Insufficient vehicles to facilitate O&M work,
- Weak WUG function, especially WUG3 does not function as planned,
- Some WUGs have around 550 ha of command area and over 600 beneficiaries. This makes management difficult.

Others:

Under the field work assignment, team members were requested to present the summarization and major findings of the field observation in the 2nd IIEPF regional workshop. The power point presentation for this presentation is attached Annex 11. The photos of field activities during the field observation are also shown in Annex 12.

5. Conclusion and Recommendation

Conclusion:
Assessment of the improving irrigation efficiency in the paddy field is one of the valuable results fitting inline with the government's objective to promote and expand irrigated areas by examining of existing irrigation performance and by putting emphasis on improvement of irrigation management in order to increase and stabilize rice production at plains along Mekong River.

This study not only covers appraisal of general scheme performance, but also includes detailed analysis of experiential data which can be used as reference for different purpose in related fields studied in Laos. Some data including water requirements for different agriculture types which are not often found in the country are clearly identified in this study. Water productivity as production in form of economic value per unit water input or consumption is another important indicator to be considered by decision makers to put on the development strategy of irrigation sector.

Recommendations:
The results of this study are applicable and should be disseminated to the actual implementation of water management in the irrigation projects in Laos.

Considering the necessity in the Lao PDR, the similar study shall be further conducted in different locations in Laos such as North, Center, and South in order to further understand feature of water use and irrigation performance in different geographic conditions and in different irrigation types.

Annexes

Annex 1(a): Evapotranspiration (ETc)

Dry Season 2006-07

	ETc (by measurement)				**ET'c=Kc*Eto**		
	Canal N4	Canal N9	Canal N15	ETc	ETo	Kc	ET'c
Date	mm	mm	mm	mm	mm		mm
25-Dec-06	N/A	N/A	N/A	N/A	N/A	N/A	N/A
26-Dec-06	2.35	2.35	1.70	2.13	0.45	1.00	0.45
27-Dec-06	3.45	2.75	2.35	2.85	0.35	1.00	0.35
28-Dec-06	2.95	2.63	3.50	3.03	4.70	1.00	4.70
29-Dec-06	3.05	1.93	2.70	2.56	1.85	1.00	1.85
30-Dec-06	2.79	3.11	2.85	2.92	3.50	1.00	3.50
31-Dec-06	3.07	2.86	7.45	4.46	3.60	1.00	3.60
1-Jan-07	0.55	2.04	2.00	1.53	4.15	1.00	4.15
2-Jan-07	1.08	1.95	2.70	1.91	2.95	1.00	2.95
3-Jan-07	5.05	2.00	3.40	3.48	4.05	1.00	4.05
4-Jan-07	2.40	2.00	2.85	2.42	3.65	1.00	3.65
5-Jan-07	3.45	2.00	2.45	2.63	4.05	1.00	4.05
6-Jan-07	1.98	2.00	2.70	2.23	3.00	1.00	3.00
7-Jan-07	1.89	1.95	3.10	2.31	2.80	1.00	2.80
8-Jan-07	1.19	10.30	7.35	6.28	2.65	1.00	2.65
9-Jan-07	2.15	1.85	3.00	2.33	2.45	1.00	2.45
10-Jan-07	1.88	3.10	3.35	2.78	3.00	1.00	3.00
11-Jan-07	10.30	2.00	2.70	5.00	2.25	1.01	2.27
12-Jan-07	2.00	3.10	4.05	3.05	2.85	1.01	2.88
13-Jan-07	1.95	3.70	3.20	2.95	3.00	1.01	3.03
14-Jan-07	2.05	2.15	2.32	2.17	3.15	1.01	3.18
15-Jan-07	1.95	1.95	2.53	2.14	2.85	1.01	2.88
16-Jan-07	2.30	2.10	4.45	2.95	3.05	1.01	3.08
17-Jan-07	0.80	6.20	2.00	3.00	6.05	1.01	6.11
18-Jan-07	2.03	13.43	2.30	5.92	3.50	1.01	3.54
19-Jan-07	1.98	1.95	2.50	2.14	3.75	1.01	3.79
20-Jan-07	1.98	2.00	2.90	2.29	2.85	1.01	2.88
21-Jan-07	2.00	3.98	2.45	2.81	3.00	1.03	3.09
22-Jan-07	2.53	4.03	1.75	2.77	3.55	1.03	3.66
23-Jan-07	3.05	3.07	3.00	3.04	3.15	1.03	3.24
24-Jan-07	11.38	4.01	8.30	7.90	2.60	1.03	2.68
25-Jan-07	2.98	12.43	3.10	6.17	2.00	1.03	2.06
26-Jan-07	1.80	1.78	4.15	2.58	2.25	1.03	2.32
27-Jan-07	2.75	3.23	3.00	2.99	3.00	1.03	3.09
28-Jan-07	3.53	2.93	3.90	3.45	2.90	1.03	2.99
29-Jan-07	3.03	3.05	3.45	3.18	2.40	1.03	2.47
30-Jan-07	3.50	2.90	3.55	3.32	4.10	1.03	4.22
31-Jan-07	10.40	3.25	4.15	5.93	3.85	1.03	3.97
1-Feb-07	4.05	3.45	10.75	6.08	3.30	1.04	3.43
2-Feb-07	2.50	3.05	2.85	2.80	2.20	1.04	2.29
3-Feb-07	4.00	3.00	3.00	3.33	3.60	1.04	3.74
4-Feb-07	3.50	3.00	3.00	3.17	3.25	1.04	3.38
5-Feb-07	3.25	2.95	3.15	3.12	2.55	1.04	2.65
6-Feb-07	3.75	3.00	3.10	3.28	3.25	1.04	3.38
7-Feb-07	3.50	3.20	3.70	3.47	4.60	1.04	4.78
8-Feb-07	3.45	2.60	3.90	3.32	3.85	1.04	4.00
9-Feb-07	3.80	12.75	3.10	6.55	3.30	1.04	3.43
10-Feb-07	12.45	3.55	2.95	6.32	3.40	1.04	3.54
11-Feb-07	2.85	2.65	10.75	5.42	3.35	1.05	3.52
12-Feb-07	2.90	1.30	3.60	2.60	3.45	1.05	3.62
13-Feb-07	3.45	3.75	4.20	3.80	3.60	1.05	3.78
14-Feb-07	3.65	2.80	3.80	3.42	4.60	1.05	4.83
15-Feb-07	2.85	3.10	3.80	3.25	1.95	1.05	2.05
16-Feb-07	3.90	2.10	3.50	3.17	4.80	1.05	5.04
17-Feb-07	3.30	4.10	3.60	3.67	6.15	1.05	6.46
18-Feb-07	3.00	3.20	2.60	2.93	5.70	1.05	5.99
19-Feb-07	4.35	10.40	9.85	8.20	7.90	1.05	8.30
20-Feb-07	4.35	3.50	3.05	3.63	3.55	1.05	3.73

Annex 1(a): Evapotranspiration (ETc)

Dry Season 2006-07

	ETc (by measurement)				**ET'c=Kc*Eto**		
	Canal N4	Canal N9	Canal N15	ETc	Eto	Kc	ET'c
Date	mm	mm	mm	mm	mm		mm
21-Feb-07	2.95	4.50	3.15	3.53	2.55	1.05	2.68
22-Feb-07	8.65	4.40	3.05	5.37	4.70	1.05	4.94
23-Feb-07	3.45	4.50	3.40	3.78	4.10	1.05	4.31
24-Feb-07	3.10	4.40	2.95	3.48	4.05	1.05	4.25
25-Feb-07	3.15	4.50	3.30	3.65	2.75	1.05	2.89
26-Feb-07	19.15	4.30	3.80	9.08	2.70	1.05	2.84
27-Feb-07	10.80	10.80	10.40	10.67	8.70	1.05	9.14
28-Feb-07	4.50	4.50	2.85	3.95	2.00	1.05	2.10
1-Mar-07	4.15	4.15	3.65	3.98	2.05	1.05	2.15
2-Mar-07	11.30	11.75	3.55	8.87	3.35	1.05	3.52
3-Mar-07	4.00	3.55	9.20	5.58	2.15	1.05	2.26
4-Mar-07	3.50	3.50	3.50	3.50	3.10	1.05	3.26
5-Mar-07	4.45	3.10	3.15	3.57	3.15	1.05	3.31
6-Mar-07	11.40	3.35	3.60	6.12	3.45	1.05	3.62
7-Mar-07	4.70	3.55	3.35	3.87	3.95	1.05	4.15
8-Mar-07	5.20	3.50	3.30	4.00	3.05	1.05	3.20
9-Mar-07	5.05	3.45	3.30	3.93	3.50	1.05	3.68
10-Mar-07	4.70	3.40	3.55	3.88	3.80	1.05	3.99
11-Mar-07	4.80	3.25	3.00	3.68	2.85	1.05	2.99
12-Mar-07	5.65	3.85	3.10	4.20	3.60	1.05	3.78
13-Mar-07	5.20	3.20	3.20	3.87	4.25	1.05	4.46
14-Mar-07	10.15	3.00	3.35	5.50	3.45	1.05	3.62
15-Mar-07	5.55	10.50	2.15	6.07	3.15	1.05	3.31
16-Mar-07	5.75	3.45	8.90	6.03	3.00	1.05	3.15
17-Mar-07	5.20	3.80	3.10	4.03	3.15	1.05	3.31
18-Mar-07	5.75	3.35	3.55	4.22	2.65	1.05	2.78
19-Mar-07	N/A	3.55	3.05	3.30	2.05	1.05	2.15
20-Mar-07	N/A	4.45	3.45	3.95	1.05	1.05	1.10
21-Mar-07	N/A	3.40	3.45	3.43	2.55	1.05	2.68
22-Mar-07	N/A	2.95	4.35	3.65	4.70	1.01	4.75
23-Mar-07	N/A	3.05	3.30	3.18	4.10	1.01	4.14
24-Mar-07	N/A	3.60	2.45	3.03	4.05	1.01	4.09
25-Mar-07	N/A	3.45	3.30	3.38	2.75	1.01	2.78
26-Mar-07	N/A	3.20	3.50	3.35	2.60	1.01	2.63
27-Mar-07	N/A	3.45	9.85	6.65	2.60	1.01	2.63
28-Mar-07	N/A	10.60	4.40	7.50	2.00	1.01	2.02
29-Mar-07	N/A	6.35	6.25	6.30	4.75	1.01	4.80
30-Mar-07	N/A	4.05	5.35	4.70	2.65	1.01	2.68
31-Mar-07	N/A	3.20	3.55	3.38	2.15	1.01	2.17
1-Apr-07	N/A	4.10	3.90	4.00	2.80	0.92	2.58
Average	4.27 mm/d	3.96 mm/d	3.87 mm/d	**4.03 mm/d**	3.32 mm/d		**3.42 mm/d**
Total ETc				**6.03 MCM**			

Note: Kc is taken from "Crop Water Requirement in Lao PDR", MAF (DOI)-JICA, 2001

Annex 1(b): Evapotranspiration (ETc)

Wet Season 2006-07

	ETc (by measurement)				**ET'c=Kc*Eto**		
	Canal N4	Canal N9	Canal N15	ETc	ETo	Kc	ET'c
Date	mm	mm	mm	mm	mm		mm
2-Jul-07	2.00	3.45	-0.40	1.68	2.50	1.15	2.88
3-Jul-07	6.15	6.30	4.30	5.58	2.20	1.15	2.53
4-Jul-07	3.15	0.00	1.20	1.45	3.50	1.15	4.03
5-Jul-07	2.85	2.40	-9.60	-1.45	6.00	1.15	6.90
6-Jul-07	30.05	N/A	28.85	N/A	N/A	1.15	N/A
7-Jul-07	25.95	23.00	26.65	25.20	N/A	1.15	N/A
8-Jul-07	3.15	0.00	4.55	2.57	N/A	1.15	N/A
9-Jul-07	2.75	0.00	-0.95	0.60	3.55	1.15	4.08
10-Jul-07	3.15	2.50	2.70	2.78	4.05	1.15	4.66
11-Jul-07	3.00	2.90	3.15	3.02	5.95	1.05	6.25
12-Jul-07	6.45	2.90	4.20	4.52	1.55	1.05	1.63
13-Jul-07	6.80	2.85	4.00	4.55	3.45	1.05	3.62
14-Jul-07	1.70	3.25	5.00	3.32	3.90	1.05	4.10
15-Jul-07	1.15	3.05	-2.70	0.50	2.45	1.05	2.57
16-Jul-07	2.70	3.05	2.65	2.80	2.10	1.05	2.21
17-Jul-07	1.80	2.95	2.30	2.35	3.10	1.05	3.26
18-Jul-07	2.05	2.90	2.95	2.63	0.90	1.05	0.95
19-Jul-07	6.00	10.10	7.70	7.93	N/A	1.05	N/A
20-Jul-07	-1.85	3.25	0.60	0.67	-5.10	1.05	-5.36
21-Jul-07	4.85	10.90	-16.10	-0.12	10.10	1.00	10.10
22-Jul-07	3.00	2.90	3.85	3.25	-7.90	1.00	-7.90
23-Jul-07	2.90	5.25	5.95	4.70	1.00	1.00	1.00
24-Jul-07	1.45	5.50	5.90	4.28	-1.55	1.00	-1.55
25-Jul-07	1.35	2.55	2.20	2.03	5.25	1.00	5.25
26-Jul-07	8.50	-2.15	-2.60	1.25	3.80	1.00	3.80
27-Jul-07	-2.90	19.85	14.75	10.57	3.80	1.00	3.80
28-Jul-07	1.10	2.80	5.00	2.97	0.85	1.00	0.85
29-Jul-07	3.55	3.10	3.30	3.32	1.95	1.00	1.95
30-Jul-07	0.35	3.05	3.20	2.20	2.55	1.00	2.55
31-Jul-07	N/A	N/A	27.70	27.70	N/A	1.01	N/A
1-Aug-07	N/A	N/A	44.55	N/A	N/A	1.01	N/A
2-Aug-07	1.05	1.25	0.10	0.80	1.40	1.01	1.41
3-Aug-07	1.95	1.00	2.80	1.92	2.10	1.01	2.12
4-Aug-07	3.00	5.50	1.00	3.17	2.65	1.01	2.68
5-Aug-07	5.50	3.15	3.05	3.90	4.25	1.01	4.29
6-Aug-07	4.65	2.80	3.25	3.57	4.95	1.01	5.00
7-Aug-07	3.40	9.10	8.75	7.08	2.45	1.01	2.47
8-Aug-07	7.90	19.20	2.60	9.90	7.50	1.01	7.58
9-Aug-07	-1.65	2.50	-0.20	0.22	1.20	1.01	1.21
10-Aug-07	N/A	N/A	35.40	N/A	34.70	1.01	35.05
11-Aug-07	8.80	8.80	10.25	9.28	8.80	1.03	9.06
12-Aug-07	3.55	2.10	3.70	3.12	2.05	1.03	2.11
13-Aug-07	3.05	3.45	3.70	3.40	2.20	1.03	2.27
14-Aug-07	4.85	3.15	4.65	4.22	2.30	1.03	2.37
15-Aug-07	4.20	2.90	4.95	4.02	1.60	1.03	1.65
16-Aug-07	9.40	8.95	-3.00	5.12	1.90	1.03	1.96
17-Aug-07	N.A	N/A	N/A	N/A	N/A	1.03	N/A
18-Aug-07	13.10	12.00	10.25	11.78	13.90	1.03	14.32
19-Aug-07	0.70	3.00	2.55	2.08	3.55	1.03	3.66
20-Aug-07	N.A	N/A	N/A	N/A	N/A	1.03	N/A
21-Aug-07	15.20	N/A	13.35	14.28	15.00	1.04	15.60
22-Aug-07	2.50	2.50	4.25	3.08	3.05	1.04	3.17
23-Aug-07	0.00	N/A	-0.20	-0.10	0.35	1.04	0.36
24-Aug-07	16.20	16.20	21.30	17.90	15.30	1.04	15.91
25-Aug-07	0.70	1.15	3.65	1.83	2.35	1.04	2.44
26-Aug-07	3.40	3.80	4.20	3.80	1.90	1.04	1.98
27-Aug-07	34.20	27.10	37.10	32.80	28.75	1.04	29.90

Annex 1(b): Evapotranspiration (ETc)

Wet Season 2006-07

	ETc (by measurement)				**ET'c=Kc*Eto**		
	Canal N4	Canal N9	Canal N15	ETc	ETo	Kc	ET'c
Date	mm	mm	mm	mm	mm		mm
28-Aug-07	1.00	N/A	3.80	2.40	1.55	1.04	1.61
29-Aug-07	16.30	N/A	-2.80	6.75	17.05	1.04	17.73
30-Aug-07	2.10	N/A	1.35	1.73	1.20	1.04	1.25
31-Aug-07	4.30	5.50	4.30	4.70	4.30	1.04	4.47
1-Sep-07	2.55	2.85	3.60	3.00	1.80	1.05	1.89
2-Sep-07	2.65	3.00	5.60	3.75	2.00	1.05	2.10
3-Sep-07	0.50	-4.15	22.20	6.18	0.00	1.05	0.00
4-Sep-07	17.00	15.20	N/A	16.10	N/A	1.05	N/A
5-Sep-07	N/A	N/A	N/A	N/A	N/A	1.05	N/A
6-Sep-07	26.00	26.00	N/A	26.00	26.00	1.05	27.30
7-Sep-07	19.90	19.90	22.90	20.90	N/A	1.05	N/A
8-Sep-07	0.00	0.00	2.30	0.77	-7.50	1.05	-7.88
9-Sep-07	0.00	0.00	N/A	0.00	-4.75	1.05	-4.99
10-Sep-07	N/A	N/A	N/A	N/A	N/A	1.05	N/A
11-Sep-07	3.10	3.10	N/A	3.10	N/A	1.05	N/A
12-Sep-07	7.20	7.20	6.70	7.03	22.00	1.05	23.10
13-Sep-07	3.40	3.40	N/A	3.40	18.50	1.05	19.43
14-Sep-07	26.50	23.90	26.40	25.60	N/A	1.05	N/A
15-Sep-07	2.95	0.95	2.70	2.20	N/A	1.05	N/A
16-Sep-07	3.25	3.60	2.70	3.18	3.80	1.05	3.99
17-Sep-07	2.80	4.95	2.55	3.43	1.95	1.05	2.05
18-Sep-07	1.85	3.95	3.05	2.95	2.10	1.05	2.21
19-Sep-07	N/A	N/A	N/A	N/A	N/A	1.05	N/A
20-Sep-07	3.15	6.00	4.25	4.47	2.30	1.05	2.42
21-Sep-07	2.70	3.90	5.30	3.97	2.20	1.05	2.31
22-Sep-07	3.15	5.40	5.30	4.62	1.80	1.05	1.89
23-Sep-07	0.60	5.60	5.35	3.85	2.05	1.05	2.15
24-Sep-07	2.55	5.10	8.75	5.47	1.95	1.05	2.05
25-Sep-07	3.50	4.40	5.10	4.33	1.90	1.05	2.00
26-Sep-07	-6.20	5.50	4.95	1.42	2.30	1.05	2.42
27-Sep-07	0.25	5.00	4.70	3.32	1.60	1.05	1.68
28-Sep-07	7.15	9.15	-0.46	5.28	4.10	1.05	4.31
29-Sep-07	25.05	31.80	N/A	28.43	N/A	1.05	N/A
30-Sep-07	4.60	3.90	5.05	4.52	2.75	1.05	2.89
1-Oct-07	6.45	4.90		5.68	1.95	1.05	2.05
2-Oct-07	3.75	5.15		4.45	2.10	1.05	2.21
3-Oct-07	3.05	5.05		4.05	2.25	1.05	2.36
4-Oct-07	19.20	17.55		18.38	6.55	1.05	6.88
5-Oct-07	26.50	N/A		26.50	N/A	1.05	N/A
6-Oct-07	N/A	N/A		N/A	N/A	1.05	N/A
7-Oct-07	30.00	N/A		30.00	N/A	1.05	N/A
8-Oct-07	17.70	17.10		17.40	25.90	1.05	27.20
9-Oct-07	35.00	36.60		N/A	20.15	1.05	21.16
10-Oct-07	3.00	10.10		6.55	2.35	1.05	2.47
11-Oct-07	0.00	5.85		2.93	3.65	1.01	3.69
12-Oct-07	0.50	5.05		2.78	4.10	1.01	4.14
13-Oct-07	2.25	5.00		3.63	4.10	1.01	4.14
14-Oct-07	1.70	4.95		3.33	4.10	1.01	4.14
15-Oct-07	3.05	4.00		3.53	4.30	1.01	4.34
16-Oct-07	5.20	5.95		5.58	4.15	1.01	4.19
17-Oct-07	1.75	N/A		1.75	4.10	1.01	4.14
18-Oct-07	8.15	5.90		7.03	4.25	1.01	4.29
19-Oct-07	5.60	5.10		5.35	4.20	1.01	4.24
20-Oct-07	4.30	4.95		4.63	4.10	1.01	4.14
21-Oct-07	2.20	5.10		3.65	N/A	0.92	N/A

Annex 1(b): Evapotranspiration (ETc)

Wet Season 2006-07

Date	**ETc** (by measurement)				**ET'c=Kc*Eto**		
	Canal N4	Canal N9	Canal N15	ETc	ETo	Kc	ET'c
	mm	mm	mm	mm	mm		mm
22-Oct-07	8.03	4.95		6.49	N/A	0.92	N/A
23-Oct-07	N/A	5.00		5.00	4.00	0.92	3.68
24-Oct-07	4.95	5.05		5.00	4.25	0.92	3.91
25-Oct-07	3.30	5.10		4.20	4.00	0.92	3.68
Average	6.27mm/d	6.55 mm/d	6.47 mm/d	**6.33 mm/d**	4.80 mm/d		4.98 mm/d
Total ETc				16.56 MCM			

Annex 2(a): Deep Percolation

Dry Season 2006-07

Date	Deep percolation			
	Canal N4	Canal N9	Canal N15	Avearge
	mm	mm	mm	mm
25-Dec-06	N/A	N/A	N/A	N/A
26-Dec-06	0.55	0.15	4.35	1.68
27-Dec-06	0.35	1.10	2.65	1.37
28-Dec-06	0.45	N/A	0.30	0.38
29-Dec-06	0.65	1.95	0.90	1.17
30-Dec-06	0.27	1.89	8.90	3.69
31-Dec-06	3.44	0.69	3.55	2.56
1-Jan-07	4.03	0.75	1.65	2.14
2-Jan-07	3.43	1.81	0.30	1.85
3-Jan-07	0.95	0.05	1.59	0.86
4-Jan-07	0.75	1.65	1.15	1.18
5-Jan-07	0.40	0.10	0.55	0.35
6-Jan-07	9.38	4.65	2.74	5.59
7-Jan-07	- 0.09	10.30	1.00	3.74
8-Jan-07	0.84	0.57	1.65	1.02
9-Jan-07	- 0.13	0.30	0.55	0.24
10-Jan-07	0.48	1.46	0.45	0.80
11-Jan-07	2.00	0.60	6.85	3.15
12-Jan-07	0.30	0.50	6.95	2.58
13-Jan-07	1.25	- 0.32	1.36	0.76
14-Jan-07	0.65	- 0.13	1.23	0.58
15-Jan-07	1.00	0.95	1.97	1.31
16-Jan-07	0.60	- 0.10	1.51	0.67
17-Jan-07	12.58	0.78	1.70	5.02
18-Jan-07	0.65	0.57	0.80	0.67
19-Jan-07	0.33	5.03	0.75	2.04
20-Jan-07	N/A	1.00	1.20	1.10
21-Jan-07	0.05	0.79	0.65	0.50
22-Jan-07	1.38	0.62	2.05	1.35
23-Jan-07	- 0.50	0.91	0.95	0.46
24-Jan-07	1.10	1.57	4.00	2.22
25-Jan-07	1.83	1.23	0.05	1.03
26-Jan-07	2.20	3.93	1.62	2.58
27-Jan-07	1.20	1.28	0.95	1.14
28-Jan-07	- 0.50	1.08	1.66	0.75
29-Jan-07	- 0.02	- 0.08	0.60	0.17
30-Jan-07	N/A	0.97	0.55	0.76
31-Jan-07	0.05	0.40	0.75	0.40
1-Feb-07	- 0.55	0.15	5.25	1.62
2-Feb-07	1.50	0.25	0.80	0.85
3-Feb-07	0.90	4.90	1.45	2.42
4-Feb-07	0.55	1.50	5.55	2.53
5-Feb-07	0.70	8.50	0.85	3.35
6-Feb-07	0.25	0.50	1.00	0.58
7-Feb-07	0.50	4.34	0.20	1.68
8-Feb-07	0.65	3.40	0.90	1.65
9-Feb-07	0.15	2.03	1.10	1.09
10-Feb-07	0.45	0.15	1.80	0.80
11-Feb-07	1.20	1.30	0.70	1.07
12-Feb-07	1.10	5.06	0.00	2.05
13-Feb-07	0.35	1.25	0.88	0.83

Dry Season 2006-07

Date	Deep percolation			
	Canal N4	Canal N9	Canal N15	Avearge
	mm	mm	mm	mm
14-Feb-07	- 0.05	2.07	0.55	0.86
15-Feb-07	0.05	0.85	0.20	0.37
16-Feb-07	- 0.55	4.44	0.30	1.40
17-Feb-07	1.15	0.55	0.40	0.70
18-Feb-07	0.40	1.10	1.40	0.97
19-Feb-07	1.20	1.00	0.95	1.05
20-Feb-07	5.85	1.65	0.45	2.65
21-Feb-07	2.70	0.70	1.65	1.68
22-Feb-07	0.25	0.70	1.10	0.68
23-Feb-07	2.30	1.10	0.80	1.40
24-Feb-07	1.70	0.55	3.50	1.92
25-Feb-07	1.40	0.45	6.80	2.88
26-Feb-07	1.95	5.67	1.05	2.89
27-Feb-07	0.45	1.40	1.25	1.03
28-Feb-07	6.50	6.50	2.20	5.07
1-Mar-07	3.85	1.10	1.30	2.08
2-Mar-07	3.90	2.95	3.05	3.30
3-Mar-07	1.70	2.15	0.70	1.52
4-Mar-07	3.50	2.10	1.45	2.35
5-Mar-07	0.80	1.50	1.90	1.40
6-Mar-07	1.60	0.55	0.75	0.97
7-Mar-07	3.50	0.50	5.63	3.21
8-Mar-07	0.90	0.80	5.58	2.43
9-Mar-07	3.95	1.15	5.57	3.56
10-Mar-07	9.30	10.35	0.50	6.72
11-Mar-07	13.20	0.45	0.60	4.75
12-Mar-07	4.05	2.15	0.10	2.10
13-Mar-07	1.10	0.70	7.30	3.03
14-Mar-07	1.85	0.95	0.80	1.20
15-Mar-07	0.35	5.40	1.75	2.50
16-Mar-07	0.25	0.20	0.65	0.37
17-Mar-07	5.80	11.20	0.40	5.80
18-Mar-07	5.55	0.35	0.35	2.08
19-Mar-07	1.81	1.55	4.71	2.69
20-Mar-07	N/A	0.55	6.53	3.54
21-Mar-07	N/A	1.85	0.30	1.08
22-Mar-07	N/A	9.15	1.10	5.13
23-Mar-07	N/A	4.38	8.13	6.26
24-Mar-07	N/A	0.30	15.34	7.82
25-Mar-07	N/A	0.45	5.70	3.08
26-Mar-07	N/A	4.40	7.40	5.90
27-Mar-07	N/A	2.22	1.60	1.91
28-Mar-07	N/A	1.40	4.60	3.00
29-Mar-07	N/A	0.33	1.15	0.74
30-Mar-07	N/A	0.29	1.42	0.86
31-Mar-07	N/A	0.95	12.45	6.70
1-Apr-07	N/A	0.90	12.10	6.50
Average	1.85 mm/d	1.92 mm/d	2.42 mm/d	**2.15 mm/d**
Total				**3.21 MCM**

Annex 2(b): Deep Percolation

Wet Season 2007

Date	Deep percolation			
	Canal N4	Canal N9	Canal N15	Avearge
	mm	mm	mm	mm
25-Dec-06	1.95	1.4	1.35	1.57
26-Dec-06	1.95	1.85	1.45	1.75
27-Dec-06	1.80	N/A	-0.30	0.75
28-Dec-06	2.30	4.05	N/A	3.18
29-Dec-06	1.70	0.25	N/A	0.97
30-Dec-06	2.05	- 9.65	N/A	-3.80
31-Dec-06	- 0.25	-	-1.65	-0.63
1-Jan-07	2.45	-	1.00	1.15
2-Jan-07	3.90	1.90	2.29	2.70
3-Jan-07	1.40	2.25	0.85	1.50
4-Jan-07	- 1.05	4.95	-1.40	0.83
5-Jan-07	0.85	- 0.80	1.44	0.50
6-Jan-07	4.05	1.70	-3.15	0.87
7-Jan-07	2.00	2.00	11.70	5.23
8-Jan-07	2.97	1.60	-0.35	1.41
9-Jan-07	2.55	2.50	0.10	1.72
10-Jan-07	3.00	2.00	-1.10	1.30
11-Jan-07	2.80	N/A	3.30	3.05
12-Jan-07	2.70	- 0.40	3.96	2.09
13-Jan-07	3.15	2.15	N/A	2.65
14-Jan-07	4.20	2.25	-2.30	1.38
15-Jan-07	1.50	1.80	0.01	1.10
16-Jan-07	6.05	2.30	-3.45	1.63
17-Jan-07	4.65	2.20	-0.15	2.23
18-Jan-07	0.70	7.05	3.40	3.72
19-Jan-07	7.60	N/A	5.78	6.69
20-Jan-07	5.30	2.70	-2.00	2.00
21-Jan-07	1.45	1.95	-0.65	0.92
22-Jan-07	9.35	- 3.25	-0.70	1.80
23-Jan-07	N/A	6.60	N/A	6.60
24-Jan-07	N/A	N/A	N/A	N/A
25-Jan-07	0.60	0.80	5.67	2.36
26-Jan-07	0.60	N/A	-0.90	-0.15
27-Jan-07	0.15	2.90	4.56	2.54
28-Jan-07	3.35	1.85	0.95	2.05
29-Jan-07	3.85	2.25	-0.20	1.97
30-Jan-07	4.70	1.90	-3.85	0.92
31-Jan-07	- 2.70	N/A	N/A	-2.70
1-Feb-07	1.90	1.90	0.05	1.28
2-Feb-07	N/A	3.00	N/A	3.00
3-Feb-07	-	2.40	2.76	1.72
4-Feb-07	0.50	- 0.20	-0.05	0.08
5-Feb-07	2.50	3.25	0.45	2.07
6-Feb-07	1.55	1.70	-0.10	1.05
7-Feb-07	1.85	2.20	-0.15	1.30
8-Feb-07	-	N/A	2.56	1.28
9-Feb-07	N/A	2.90	N/A	2.90
10-Feb-07	- 0.50	- 1.70	1.20	-0.33
11-Feb-07	- 0.65	2.40	1.00	0.92
12-Feb-07	N/A	N/A	N/A	N/A
13-Feb-07	-	N/A	N/A	0.00

Wet Season 2007

Date	Deep percolation			
	Canal N4	Canal N9	Canal N15	Avearge
	mm	mm	mm	mm
14-Feb-07	0	N/A	2.34	1.17
15-Feb-07	0	N/A	5.98	2.99
16-Feb-07	0	2.1	N/A	1.05
17-Feb-07	-0.2	-1.45	0.15	-0.50
18-Feb-07	-0.85	3.5	0.55	1.07
19-Feb-07	-0.7	6.3	N/A	2.80
20-Feb-07	-0.5	N/A	1.05	0.28
21-Feb-07	1.2	N/A	N/A	1.20
22-Feb-07	0	N/A	3.07	1.54
23-Feb-07	0.55	-0.3	2.15	0.80
24-Feb-07	-0.5	0.15	-0.05	-0.13
25-Feb-07	0.75	2.45	-0.55	0.88
26-Feb-07	0.5	0.45	N/A	0.48
27-Feb-07	-0.5	-3.95	N/A	-2.23
28-Feb-07	0	0	N/A	0.00
1-Mar-07	0	0	N/A	0.00
2-Mar-07	0	0	N/A	0.00
3-Mar-07	0	2.1	2.65	1.58
4-Mar-07	0	0	N/A	0.00
5-Mar-07	0	0	N/A	0.00
6-Mar-07	0	0	N/A	0.00
7-Mar-07	0	0	2.18	0.73
8-Mar-07	0	-0.1	N/A	-0.05
9-Mar-07	1.25	-2	N/A	-0.38
10-Mar-07	1.25	1.05	2.05	1.45
11-Mar-07	0.25	4.9	1.6	2.25
12-Mar-07	1.2	1.6	1.9	1.57
13-Mar-07	2.2	3	1.7	2.30
14-Mar-07	0.2	N/A	N/A	0.20
15-Mar-07	1.45	4.1	5.3	3.62
16-Mar-07	1.4	4	-1.15	1.42
17-Mar-07	-4.15	1.4	-0.65	-1.13
18-Mar-07	N/A	0.7	N/A	0.70
19-Mar-07	1.55	0.7	1.23	1.16
20-Mar-07	1.4	1.65	0.25	1.10
21-Mar-07	-2.3	N/A	0.5	-0.90
22-Mar-07	0.25	1.9	6.73	2.96
23-Mar-07	1.9	2.05	N/A	1.98
24-Mar-07	-2.2	0.9	N/A	-0.65
25-Mar-07	2.2	2.2	1.4	1.93
26-Mar-07	-3.55	3.25		-0.15
27-Mar-07	0.25	0.15		0.20
28-Mar-07	-0.25	N/A		-0.25
29-Mar-07	N/A	3.1		3.10
30-Mar-07	6.5	-7.95		-0.73
31-Mar-07	0	0		0.00
1-Apr-07	0	0.35		0.18
2-Apr-07	0	-0.35		-0.18
3-Apr-07	0	-0.65		-0.32
4-Apr-07	0	-0.2		-0.10
5-Apr-07	0	0.1		0.05

Annex 2(b): Deep Percolation

Wet Season 2007

	Deep percolation			
	Canal N4	Canal N9	Canal N15	Avearge
Date	mm	mm	mm	mm
6-Apr-07	0	1		0.50
7-Apr-07	-0.4	1.65		0.63
8-Apr-07	0.5	1.5		1.00
9-Apr-07	-0.15	2		0.93
10-Apr-07	2.7	N/A		2.70
11-Apr-07	0.85	N/A		0.85
12-Apr-07	-2.45	0.3		-1.08
13-Apr-07	0.4	0.7		0.55
14-Apr-07	-1.7	1.2		-0.25
15-Apr-07	-0.1	0.8		0.35
16-Apr-07	-2.925	1.2		-0.86
17-Apr-07	N/A	N/A		N/A
18-Apr-07	-0.35	1.95		0.80
19-Apr-07	4.55	0.9		2.73
Average	1.04 mm/d	1.24 mm/d	1.17 mm/d	1.09 mm/d
Total Percolation				2.847 MCM

Annex 3(a): Rianfall and Effective Rainfall

Dry Seaon 2006-07

Date	Rainfall mm/d	Planted Area ha	Effective Rainfall m3
18-Nov-06	0.00	23	0.00
19-Nov-06	0.00	23	0.00
20-Nov-06	0.00	23	0.00
21-Nov-06	0.00	23	0.00
22-Nov-06	0.00	23	0.00
23-Nov-06	0.00	23	0.00
24-Nov-06	0.00	23	0.00
25-Nov-06	0.00	23	0.00
26-Nov-06	0.00	23	0.00
27-Nov-06	0.00	23	0.00
28-Nov-06	0.00	23	0.00
29-Nov-06	0.00	23	0.00
30-Nov-06	0.00	23	0.00
1-Dec-06	0.00	23	0.00
2-Dec-06	0.00	23	0.00
3-Dec-06	0.00	23	0.00
4-Dec-06	0.00	23	0.00
5-Dec-06	0.00	23	0.00
6-Dec-06	0.00	23	0.00
7-Dec-06	0.00	23	0.00
8-Dec-06	0.00	23	0.00
9-Dec-06	0.00	23	0.00
10-Dec-06	0.00	23	0.00
11-Dec-06	0.00	23	0.00
12-Dec-06	0.00	23	0.00
13-Dec-06	0.00	23	0.00
14-Dec-06	0.00	23	0.00
15-Dec-06	0.00	23	0.00
16-Dec-06	0.00	23	0.00
17-Dec-06	0.00	23	0.00
18-Dec-06	0.00	23	0.00
19-Dec-06	0.00	23	0.00
20-Dec-06	0.00	23	0.00
21-Dec-06	0.00	23	0.00
22-Dec-06	0.00	23	0.00
23-Dec-06	0.00	23	0.00
24-Dec-06	0.00	23	0.00
25-Dec-06	0.00	23	0.00
26-Dec-06	0.00	23	0.00
27-Dec-06	0.00	23	0.00
28-Dec-06	0.00	23	0.00
29-Dec-06	0.00	23	0.00
30-Dec-06	0.00	23	0.00
31-Dec-06	0.00	230.72	0.00
1-Jan-07	0.00	230.72	0.00
2-Jan-07	0.00	230.72	0.00
3-Jan-07	0.00	230.72	0.00
4-Jan-07	0.00	230.72	0.00
5-Jan-07	0.00	230.72	0.00
6-Jan-07	0.00	230.72	0.00
7-Jan-07	0.00	478.44	0.00

Dry Seaon 2006-07

Date	Rainfall mm/d	Planted Area ha	Effective Rainfall m3
8-Jan-07	0.00	478.44	0.00
9-Jan-07	0.00	478.44	0.00
10-Jan-07	0.00	478.44	0.00
11-Jan-07	0.00	478.44	0.00
12-Jan-07	0.00	478.44	0.00
13-Jan-07	0.00	478.44	0.00
14-Jan-07	0.00	719.27	0.00
15-Jan-07	0.00	719.27	0.00
16-Jan-07	0.00	719.27	0.00
17-Jan-07	0.00	719.27	0.00
18-Jan-07	0.00	719.27	0.00
19-Jan-07	0.00	719.27	0.00
20-Jan-07	0.00	719.27	0.00
21-Jan-07	0.00	1041.05	0.00
22-Jan-07	0.00	1041.05	0.00
23-Jan-07	0.00	1041.05	0.00
24-Jan-07	0.00	1041.05	0.00
25-Jan-07	0.00	1041.05	0.00
26-Jan-07	0.00	1041.05	0.00
27-Jan-07	0.00	1041.05	0.00
28-Jan-07	0.00	1362.77	0.00
29-Jan-07	0.00	1362.77	0.00
30-Jan-07	0.00	1362.77	0.00
31-Jan-07	0.00	1362.77	0.00
1-Feb-07	0.00	1362.77	0.00
2-Feb-07	0.00	1362.77	0.00
3-Feb-07	0.00	1362.77	0.00
4-Feb-07	0.00	1525.49	0.00
5-Feb-07	0.00	1525.49	0.00
6-Feb-07	0.00	1525.49	0.00
7-Feb-07	0.00	1525.49	0.00
8-Feb-07	0.00	1525.49	0.00
9-Feb-07	0.00	1525.49	0.00
10-Feb-07	0.00	1525.49	0.00
11-Feb-07	0.00	1525.49	0.00
12-Feb-07	0.00	1525.49	0.00
13-Feb-07	0.00	1525.49	0.00
14-Feb-07	0.00	1525.49	0.00
15-Feb-07	0.00	1525.49	0.00
16-Feb-07	0.00	1525.49	0.00
17-Feb-07	0.00	1525.49	0.00
18-Feb-07	0.00	1525.49	0.00
19-Feb-07	0.00	1525.49	0.00
20-Feb-07	0.00	1525.49	0.00
21-Feb-07	0.00	1525.49	0.00
22-Feb-07	0.00	1525.49	0.00
23-Feb-07	0.00	1525.49	0.00
24-Feb-07	0.00	1525.49	0.00
25-Feb-07	0.00	1525.49	0.00
26-Feb-07	0.10	1525.49	1524.57
27-Feb-07	6.60	1525.49	96695.32

Annex 3 (a): Rianfall and Effective Rainfall

Dry Seaon 2006-07

Date	Rainfall mm/d	Planted Area ha	Effective Rainfall m3
28-Feb-07	0.00	1525.49	0.00
1-Mar-07	0.00	1525.49	0.00
2-Mar-07	1.20	1525.49	18,174.08
3-Mar-07	0.00	1525.49	0.00
4-Mar-07	0.00	1525.49	0.00
5-Mar-07	0.00	1525.49	0.00
6-Mar-07	0.00	1525.49	0.00
7-Mar-07	0.00	1525.49	0.00
8-Mar-07	0.00	1525.49	0.00
9-Mar-07	0.00	1525.49	0.00
10-Mar-07	0.00	1525.49	0.00
11-Mar-07	0.00	1525.49	0.00
12-Mar-07	0.00	1525.49	0.00
13-Mar-07	0.00	1525.49	0.00
14-Mar-07	0.00	1525.49	0.00
15-Mar-07	0.00	1525.49	0.00
16-Mar-07	0.00	1525.49	0.00
17-Mar-07	0.00	1525.49	0.00
18-Mar-07	0.00	1525.49	0.00
19-Mar-07	0.00	1525.49	0.00
20-Mar-07	0.00	1525.49	0.00
21-Mar-07	0.00	1525.49	0.00
22-Mar-07	0.00	1525.49	0.00
23-Mar-07	0.00	1525.49	0.00
24-Mar-07	0.00	1525.49	0.00
25-Mar-07	0.00	1525.49	0.00
26-Mar-07	0.00	1525.49	0.00
27-Mar-07	0.00	1525.49	0.00
28-Mar-07	0.00	1525.49	0.00
29-Mar-07	1.70	1525.49	25,668.81
30-Mar-07	0.00	1525.49	0.00
31-Mar-07	0.00	1525.49	0.00
1-Apr-07	0	1525.49	0.00
2-Apr-07	0	1525.49	0.00
3-Apr-07	0	1525.49	0.00
4-Apr-07	0	1525.49	0.00
5-Apr-07	0	1525.49	0.00
6-Apr-07	0	1525.49	0.00
7-Apr-07	0	1525.49	0.00
8-Apr-07	0	1525.49	0.00
9-Apr-07	0	1525.49	0.00
10-Apr-07	0.30	1525.49	4560.02
Average	0.07 mm/d		
	3.20 mm		
Total	0.15 MCM	1525.49 ha	0.048 MCM

Annex 3(b): Rainfall and Effective Rainfall

Wet Season 2007

Date	Rainfall	Planted A (ha)				Effective Rainfall
	mm/d	paddy	fishpond	Cash Crops	Sum A	m3
4-May-07	11.70		21.72	5.00	26.72	2906.78
5-May-07	39.30		21.72	5.00	26.72	8024.83
6-May-07	1.20		21.72	5.00	26.72	318.33
7-May-07			21.72	5.00	26.72	0.00
8-May-07			21.72	5.00	26.72	0.00
9-May-07			21.72	5.00	26.72	0.00
10-May-07			21.72	5.00	26.72	0.00
11-May-07			21.72	5.00	26.72	0.00
12-May-07	8.50		21.72	5.00	26.72	2155.37
13-May-07	2.10		21.72	5.00	26.72	554.05
14-May-07			21.72	5.00	26.72	0.00
15-May-07	54.90		21.72	5.00	26.72	9837.22
16-May-07	2.50		21.72	5.00	26.72	657.98
17-May-07	6.30		21.72	5.00	26.72	1619.73
18-May-07	3.70		21.72	5.00	26.72	966.69
19-May-07	17.30		21.72	5.00	26.72	4142.74
20-May-07			21.72	5.00	26.72	0.00
21-May-07			21.72	5.00	26.72	0.00
22-May-07		2,236.48	21.72	5.00	2,263.20	0.00
23-May-07		2,236.48	21.72	5.00	2,263.20	0.00
24-May-07		2,236.48	21.72	5.00	2,263.20	0.00
25-May-07		2,236.48	21.72	5.00	2,263.20	0.00
26-May-07	5.00	2,236.48	21.72	5.00	2,263.20	109765.20
27-May-07		2,236.48	21.72	5.00	2,263.20	0.00
28-May-07		2,236.48	21.72	5.00	2,263.20	0.00
29-May-07	20.30	2,236.48	21.72	5.00	2,263.20	403471.07
30-May-07		2,236.48	21.72	5.00	2,263.20	0.00
31-May-07		2,236.48	21.72	5.00	2,263.20	0.00
1-Jun-07		2,236.48	21.72	5.00	2,263.20	0.00
2-Jun-07		2,236.48	21.72	5.00	2,263.20	0.00
3-Jun-07		2,236.48	21.72	5.00	2,263.20	0.00
4-Jun-07		2,236.48	21.72	4.00	2,262.20	0.00

Wet Season 2007

Date	Rainfall	Planted A (ha)				Effective Rainfall
	mm/d	paddy	fishpond	Vegetable	Sum A	m3
5-Jun-07	2.00	2,236.48	21.72	4.00	2,262.20	44701.07
6-Jun-07		2,236.48	21.72	4.00	2,262.20	0.00
7-Jun-07		2,236.48	21.72	4.00	2,262.20	0.00
8-Jun-07		2,236.48	21.72	4.00	2,262.20	0.00
9-Jun-07		2,236.48	21.72	4.00	2,262.20	0.00
10-Jun-07		2,236.48	21.72	4.00	2,262.20	0.00
11-Jun-07		2,236.48	21.72	4.00	2,262.20	0.00
12-Jun-07		2,236.48	21.72	4.00	2,262.20	0.00
13-Jun-07		2,236.48	21.72	4.00	2,262.20	0.00
14-Jun-07		2,236.48	21.72	4.00	2,262.20	0.00
15-Jun-07		2,236.48	21.72	4.00	2,262.20	0.00
16-Jun-07	10.00	2,236.48	21.72	4.00	2,262.20	212646.80
17-Jun-07	24.20	2,236.48	21.72	3.00	2,261.20	467755.45
18-Jun-07	15.00	2,236.48	21.72	3.00	2,261.20	308653.80
19-Jun-07	0.00	2,236.48	21.72	3.00	2,261.20	0.00
20-Jun-07	4.80	2,236.48	21.72	3.00	2,261.20	105411.72
21-Jun-07		2,236.48	21.72	3.00	2,261.20	0.00
22-Jun-07		2,236.48	21.72	3.00	2,261.20	0.00
23-Jun-07		2,236.48	21.72	3.00	2,261.20	0.00
24-Jun-07		2,236.48	21.72	3.00	2,261.20	0.00
25-Jun-07	4.50	2,236.48	21.72	3.00	2,261.20	99006.64
26-Jun-07	25.20	2,236.48	21.72	3.00	2,261.20	483665.25
27-Jun-07	14.40	2,236.48	21.72	3.00	2,261.20	297479.85
28-Jun-07	35.80	2,236.48	21.72	3.00	2,261.20	635626.94
29-Jun-07		2,236.48	21.72	3.00	2,261.20	0.00
30-Jun-07		2,236.48	21.72	3.00	2,261.20	0.00
1-Jul-07		2,236.48	21.72	3.00	2,261.20	0.00
2-Jul-07		1,137.04	21.72	3.00	1,161.76	0.00
3-Jul-07	3.20	1,148.43	21.72	3.00	1,173.15	36820.02
4-Jul-07		1,158.87	21.72	3.00	1,183.59	0.00
5-Jul-07		1,211.86	21.72	2.00	1,235.58	0.00
6-Jul-07	26.90	1,213.34	21.72	2.00	1,237.06	279060.20

Annex 3(b): Rainfall and Effective Rainfall

Wet Season 2007

Date	Rainfall	Planted A (ha)				Effective Rainfall
	mm/d	paddy	fishpond	Cash Crops	Sum A	m3
7-Jul-07	23.00	1,274.19	21.72	2.00	1,297.91	257323.64
8-Jul-07		1,295.53	21.72	2.00	1,319.25	0.00
9-Jul-07		1,307.05	21.72	2.00	1,330.77	0.00
10-Jul-07		1,402.45	21.72	2.00	1,426.17	0.00
11-Jul-07		1,418.64	21.72	2.00	1,442.36	0.00
12-Jul-07		1,493.06	21.72	2.00	1,516.78	0.00
13-Jul-07		1,510.09	21.72	2.00	1,533.81	0.00
14-Jul-07		1,557.15	21.72	2.00	1,580.87	0.00
15-Jul-07		1,632.18	21.72	2.00	1,655.90	0.00
16-Jul-07		1,704.42	21.72	2.00	1,728.14	0.00
17-Jul-07		1,753.21	21.72	1.00	1,775.93	0.00
18-Jul-07		1,823.82	21.72	1.00	1,846.54	0.00
19-Jul-07	7.20	1,845.92	21.72	1.00	1,868.64	128729.86
20-Jul-07		1,890.76	21.72	1.00	1,913.48	0.00
21-Jul-07	8.00	1,903.07	21.72		1,924.79	146592.01
22-Jul-07		1,914.12	21.72		1,935.84	0.00
23-Jul-07	2.20	1,932.59	21.72		1,954.31	42427.29
24-Jul-07	2.50	1,955.10	21.72		1,976.82	48679.19
25-Jul-07		1,977.87	21.72		1,999.59	0.00
26-Jul-07		1,996.19	21.72		2,017.91	0.00
27-Jul-07	11.60	2,026.43	21.72		2,048.15	221049.46
28-Jul-07		2,040.94	21.72		2,062.66	0.00
29-Jul-07		2,065.58	21.72		2,087.30	0.00
30-Jul-07		2,102.57	21.72		2,124.29	0.00
31-Jul-07	40.40	2,158.67	21.72		2,180.39	667352.84
1-Aug-07	43.30	2,236.48	21.72		2,258.20	723768.00
2-Aug-07		2,236.48	21.72		2,258.20	0.00
3-Aug-07		2,236.48	21.72		2,258.20	0.00
4-Aug-07		2,236.48	21.72		2,258.20	0.00
5-Aug-07		2,236.48	21.72		2,258.20	0.00
6-Aug-07		2,236.48	21.72		2,258.20	0.00
7-Aug-07	6.10	2,236.48	21.72		2,258.20	132708.54

Wet Season 2007

Date	Rainfall	Planted A (ha)				Effective Rainfall
	mm/d	paddy	fishpond	Vegetable	Sum A	m3
8-Aug-07	19.20	2,236.48	21.72		2,258.20	383626.63
9-Aug-07		2,236.48	21.72		2,258.20	0.00
10-Aug-07	35.50	2,236.48	21.72		2,258.20	630907.21
11-Aug-07	8.80	2,236.48	21.72		2,258.20	188229.10
12-Aug-07		2,236.48	21.72		2,258.20	0.00
13-Aug-07		2,236.48	21.72		2,258.20	0.00
14-Aug-07		2,236.48	21.72		2,258.20	0.00
15-Aug-07		2,236.48	21.72		2,258.20	0.00
16-Aug-07	8.40	2,236.48	21.72		2,258.20	180128.48
17-Aug-07	45.40	2,236.48	21.72		2,258.20	745952.11
18-Aug-07	13.10	2,236.48	21.72		2,258.20	272572.42
19-Aug-07		2,236.48	21.72		2,258.20	0.00
20-Aug-07	85.20	2,236.48	21.72		2,258.20	940444.55
21-Aug-07	15.20	2,236.48	21.72		2,258.20	311942.33
22-Aug-07	2.50	2,236.48	21.72		2,258.20	55608.18
23-Aug-07		2,236.48	21.72		2,258.20	0.00
24-Aug-07	16.20	2,236.48	21.72		2,258.20	330269.88
25-Aug-07		2,236.48	21.72		2,258.20	0.00
26-Aug-07		2,236.48	21.72		2,258.20	0.00
27-Aug-07	33.00	2,236.48	21.72		2,258.20	597655.21
28-Aug-07		2,236.48	21.72		2,258.20	0.00
29-Aug-07	18.00	2,236.48	21.72		2,258.20	362576.59
30-Aug-07	2.10	2,236.48	21.72		2,258.20	46824.68
31-Aug-07	4.30	2,236.48	21.72		2,258.20	94597.35
1-Sep-07		2,236.48	21.72		2,258.20	0.00
2-Sep-07		2,236.48	21.72		2,258.20	0.00
3-Sep-07		2,236.48	21.72		2,258.20	0.00
4-Sep-07	17.50	2,236.48	21.72		2,258.20	353690.58
5-Sep-07	97.40	2,236.48	21.72		2,258.20	914106.71
6-Sep-07	26.00	2,236.48	21.72		2,258.20	495539.41
7-Sep-07	19.90	2,236.48	21.72		2,258.20	395725.61
8-Sep-07		2,236.48	21.72		2,258.20	0.00

Annex 3(b): Rainfall and Effective Rainfall

Wet Season 2007

Date	Rainfall	Planted A (ha)				Effective Rainfall
	mm/d	paddy	fishpond	Cash Crops	Sum A	m3
9-Sep-07		2,236.48	21.72		2,258.20	0.00
10-Sep-07	85.80	2,236.48	21.72		2,258.20	940092.27
11-Sep-07	3.10	2,236.48	21.72		2,258.20	68702.12
12-Sep-07	7.20	2,236.48	21.72		2,258.20	155566.49
13-Sep-07	3.40	2,236.48	21.72		2,258.20	75212.51
14-Sep-07	23.90	2,236.48	21.72		2,258.20	462315.41
15-Sep-07		2,236.48	21.72		2,258.20	0.00
16-Sep-07		2,236.48	21.72		2,258.20	0.00
17-Sep-07		2,236.48	21.72		2,258.20	0.00
18-Sep-07		2,236.48	21.72		2,258.20	0.00
19-Sep-07	91.2	2,236.48	21.72		2,258.20	932531.82
20-Sep-07		2,236.48	21.72		2,258.20	0.00
21-Sep-07		2,236.48	21.72		2,258.20	0.00
22-Sep-07		2,236.48	21.72		2,258.20	0.00
23-Sep-07		2,236.48	21.72		2,258.20	0.00
24-Sep-07		2,236.48	21.72		2,258.20	0.00
25-Sep-07		2,236.48	21.72		2,258.20	0.00
26-Sep-07		2,236.48	21.72		2,258.20	0.00
27-Sep-07		2,236.48	21.72		2,258.20	0.00
28-Sep-07	5.1	2,236.48	21.72		2,258.20	111644.05
29-Sep-07	26.8	2,236.48	21.72		2,258.20	507881.83
30-Sep-07		2,236.48	21.72		2,258.20	0.00
1-Oct-07		2,236.48	21.72		2,258.20	0.00
2-Oct-07		2,236.48	21.72		2,258.20	0.00
3-Oct-07		2,236.48	21.72		2,258.20	0.00
4-Oct-07	12.7	2,236.48	21.72		2,258.20	264937.90
5-Oct-07	33	2,236.48	21.72		2,258.20	597655.21
6-Oct-07	63.2	2,236.48	21.72		2,258.20	885994.83
7-Oct-07	30	2,236.48	21.72		2,258.20	555517.20
8-Oct-07	17.7	2,236.48	21.72		2,258.20	357253.11
9-Oct-07	35	2,236.48	21.72		2,258.20	624392.30
10-Oct-07	3	2,236.48	21.72		2,258.20	66526.57

Wet Season 2007

Date	Rainfall	Planted A (ha)				Effective Rainfall
	mm/d	paddy	fishpond	Vegetable	Sum A	m3
11-Oct-07		2,236.48	21.72		2,258.20	0.00
12-Oct-07		2,236.48	21.72		2,258.20	0.00
13-Oct-07		2,236.48	21.72		2,258.20	0.00
14-Oct-07		2,236.48	21.72		2,258.20	0.00
15-Oct-07		2,236.48	21.72		2,258.20	0.00
16-Oct-07		2,236.48	21.72		2,258.20	0.00
17-Oct-07		2,236.48	21.72		2,258.20	0.00
18-Oct-07		2,236.48	21.72		2,258.20	0.00
19-Oct-07		2,236.48	21.72		2,258.20	0.00
20-Oct-07		2,236.48	21.72		2,258.20	0.00
21-Oct-07		2,236.48	21.72		2,258.20	0.00
22-Oct-07		2,236.48	21.72		2,258.20	0.00
23-Oct-07		2,236.48	21.72		2,258.20	0.00
24-Oct-07		2,236.48	21.72		2,258.20	0.00
25-Oct-07		2,236.48	21.72		2,258.20	0.00
Average	21.09 mm/d					
	1391.90 mm					
Total	31.43 MCM	2,236.6 ha	21.72 ha	2 ha	2,258.8 ha	19.79 MCM

Annex 4(a): Water Requirement for Each Agriculture Activity

Paddy Water Requirement

Dry Season 2006-07

Date	LS & LP	ETc	Perc.	IWR	Planted Area (ha)		Paddy WR
	mm/d	mm/d	mm/d	mm/d	Land Pre A	Planted A	m^3/ d
18-Nov-06	3.67			3.67	1485.20		54,506.84
19-Nov-06	3.67			3.67	1485.20		54,506.84
20-Nov-06	3.67			3.67	1485.20		54,506.84
21-Nov-06	3.67			3.67	1485.20		54,506.84
22-Nov-06	3.67			3.67	1485.20		54,506.84
23-Nov-06	3.67			3.67	1485.20		54,506.84
24-Nov-06	3.67			3.67	1485.20		54,506.84
25-Nov-06	3.67			3.67	1485.20		54,506.84
26-Nov-06	3.67			3.67	1485.20		54,506.84
27-Nov-06	3.67			3.67	1485.20		54,506.84
28-Nov-06	3.67			3.67	1485.20		54,506.84
29-Nov-06	3.67			3.67	1485.20		54,506.84
30-Nov-06	3.67			3.67	1485.20		54,506.84
1-Dec-06	3.67			3.67	1485.20		54,506.84
2-Dec-06	3.67			3.67	1485.20		54,506.84
3-Dec-06	3.67			3.67	1485.20		54,506.84
4-Dec-06	3.67			3.67	1485.20		54,506.84
5-Dec-06	3.67			3.67	1485.20		54,506.84
6-Dec-06	3.67			3.67	1485.20		54,506.84
7-Dec-06	3.67			3.67	1485.20		54,506.84
8-Dec-06	3.67			3.67	1485.20		54,506.84
9-Dec-06	3.67			3.67	1485.20		54,506.84
10-Dec-06	3.67			3.67	1485.20		54,506.84
11-Dec-06	3.67			3.67	1485.20		54,506.84
12-Dec-06	3.67			3.67	1485.20		54,506.84
13-Dec-06	3.67			3.67	1485.20		54,506.84
14-Dec-06	3.67			3.67	1485.20		54,506.84
15-Dec-06	3.67			3.67	1485.20		54,506.84
16-Dec-06	3.67			3.67	1485.20		54,506.84
17-Dec-06	3.67			3.67	1485.20		54,506.84
18-Dec-06		4.52	1.6	6.12		186.36462	11,405.51
19-Dec-06		4.52	1.6	6.12		186.36462	11,405.51
20-Dec-06		4.52	1.6	6.12		186.36462	11,405.51
21-Dec-06		4.52	1.6	6.12		186.36462	11,405.51
22-Dec-06		4.52	1.6	6.12		186.36462	11,405.51
23-Dec-06		4.52	1.6	6.12		186.36462	11,405.51
24-Dec-06		4.52	1.6	6.12		403.79	24,711.95
25-Dec-06		4.52	1.6	6.12		403.79	24,711.95
26-Dec-06		2.13	1.68	3.82		403.79	15,411.32

Fishpond Water Requirement

Dry Season 2006-07

WR recorded (mm/d)		Ave.	Area	Fishpond WR
Khantheo Sta	Kuaysiew Sta	mm/d	ha	m^3/ d
		4.71	21.72	1023.01
		4.71	21.72	1023.01
		4.71	21.72	1023.01
		4.71	21.72	1023.01
		4.71	21.72	1023.01
		4.71	21.72	1023.01
		4.71	21.72	1023.01
		4.71	21.72	1023.01
		4.71	21.72	1023.01
		4.71	21.72	1023.01
		4.71	21.72	1023.01
		4.71	21.72	1023.01
		4.71	21.72	1023.01
		4.71	21.72	1023.01
20.00	-250.00	20.00	21.72	4344.00
30.00	130.00	80.00	21.72	17376.00
50.00	40.00	45.00	21.72	9774.00
-90.00	50.00	50.00	21.72	10860.00
30.00	-260.00	30.00	21.72	6516.00
30.00	100.00	65.00	21.72	14118.00
30.00	60.00	45.00	21.72	9774.00
-80.00	80.00	0.00	21.72	0.00
20.00	160.00	90.00	21.72	19548.00
40.00	-280.00	40.00	21.72	8688.00
-70.00	70.00	70.00	21.72	15204.00
10.00	50.00	30.00	21.72	6516.00
20.00	320.00	170.00	21.72	36924.00
20.00	-390.00	20.00	21.72	4344.00
-10.00	110.00	50.00	21.72	10860.00
10.00	-110.00	-50.00	21.72	-10860.00
-50.00	0.00	-25.00	21.72	-5430.00
0.00	-210.00	-105.00	21.72	-22806.00
10.00	50.00	30.00	21.72	6516.00
0.00	50.00	25.00	21.72	5430.00
10.00	90.00	50.00	21.72	10860.00
-30.00	100.00	35.00	21.72	7602.00
50.00	80.00	65.00	21.72	14118.00
-20.00	-280.00	-150.00	21.72	-32580.00
30.00	70.00	50.00	21.72	10860.00

Cash Crops Water requirement

Dry Season 2006-07

ETo	Kc	$ET_{cashcrops}$	Planted Area	Vegetable WR
mm/d		mm/d	ha	m^3/ d
3.12	0.5	1.56	11.8	184.08
3.12	0.5	1.56	12.77	199.212
3.12	0.5	1.56	12.77	199.212
3.12	0.5	1.56	12.77	199.212
3.12	0.5	1.56	12.77	199.212
3.12	0.5	1.56	12.77	199.212
3.12	0.5	1.56	12.77	199.212
3.12	0.57	1.78	13.97	248.44248
3.12	0.57	1.78	13.97	248.44248
3.12	0.57	1.78	13.97	248.44248
3.12	0.57	1.78	15.22	270.67248
3.12	0.57	1.78	15.22	270.67248
3.12	0.57	1.78	18.78	333.98352
3.12	0.71	2.22	18.78	416.01456
3.12	0.71	2.22	18.78	416.01456
3.12	0.71	2.22	18.78	416.01456
3.12	0.71	2.22	18.78	416.01456
3.12	0.71	2.22	18.78	416.01456
3.12	0.71	2.22	18.78	416.01456
3.12	0.71	2.22	18.78	416.01456
3.12	0.71	2.22	18.78	416.01456
3.12	0.71	2.22	18.78	416.01456
3.12	0.84	2.62	18.78	492.18624
3.12	0.84	2.62	18.78	492.18624
3.12	0.84	2.62	18.78	492.18624
3.12	0.84	2.62	18.78	492.18624
3.12	0.84	2.62	18.78	492.18624
3.12	0.84	2.62	18.78	492.18624
3.12	0.84	2.62	18.78	492.18624
3.12	0.84	2.62	18.78	492.18624
3.12	0.84	2.62	18.78	492.18624
3.12	0.98	3.06	18.78	574.21728
3.12	0.98	3.06	18.78	574.21728
3.12	0.98	3.06	18.78	574.21728
3.12	0.98	3.06	18.78	574.21728
3.12	0.98	3.06	18.78	574.21728
0.45	0.98	0.44	18.78	82.8198

Annex 4(a): Water Requirement for Each Agriculture Activity

Paddy Water Requirement

Dry Season 2006-07

Date	LS & LP	ETc	Perc.	IWR	Planted Area (ha)		Paddy WR
	mm/d	mm/d	mm/d	mm/d	Land Pre A	Planted A	m^3/ d
27-Dec-06		2.85	1.37	4.22		403.79	17,026.48
28-Dec-06		3.03	0.38	3.40		403.79	13,728.86
29-Dec-06		2.56	1.17	3.72		403.79	15,034.45
30-Dec-06		2.92	3.69	6.60		403.79	26,650.14
31-Dec-06		4.46	2.56	7.01		403.79	28,319.14
1-Jan-07		1.53	2.14	3.67		674.1425	24,741.03
2-Jan-07		1.91	1.85	3.75		674.1425	25,302.82
3-Jan-07		3.48	0.86	4.35		674.1425	29,302.73
4-Jan-07		2.42	1.18	3.60		674.1425	24,269.13
5-Jan-07		2.63	0.35	2.98		674.1425	20,111.92
6-Jan-07		2.23	5.59	7.81		674.1425	52,673.00
7-Jan-07		2.31	3.74	6.05		674.1425	40,785.62
8-Jan-07		6.28	1.02	7.30		944.495	68,916.65
9-Jan-07		2.33	0.24	2.57		944.495	24,305.00
10-Jan-07		2.78	0.80	3.57		944.495	33,749.95
11-Jan-07		5.00	3.15	8.15		944.495	76,976.34
12-Jan-07		3.05	2.58	5.63		944.495	53,206.55
13-Jan-07		2.95	0.76	3.71		944.495	35,040.76
14-Jan-07		2.17	0.58	2.76		944.495	26,052.32
15-Jan-07		2.14	1.31	3.45		1214.8475	41,912.24
16-Jan-07		2.95	0.67	3.62		1214.8475	43,977.48
17-Jan-07		3.00	5.02	8.02		1214.8475	97,410.52
18-Jan-07		5.92	0.67	6.59		1214.8475	80,078.70
19-Jan-07		2.14	2.04	4.18		1214.8475	50,740.13
20-Jan-07		2.29	1.10	3.39		1214.8475	41,203.58
21-Jan-07		2.81	0.50	3.30		1214.8475	40,130.46
22-Jan-07		2.77	1.35	4.12		1485.2	61,140.73
23-Jan-07		3.04	0.46	3.49		1485.2	51,882.99
24-Jan-07		7.90	2.22	10.12		1485.2	150,252.73
25-Jan-07		6.17	1.03	7.20		1485.2	106,934.40
26-Jan-07		2.58	2.58	5.16		1485.2	76,586.81
27-Jan-07		2.99	1.14	4.13		1485.2	61,388.27
28-Jan-07		3.45	0.75	4.20		1485.2	62,304.14
29-Jan-07		3.18	0.17	3.34		1485.2	49,630.43
30-Jan-07		3.32	0.76	4.08		1485.2	60,546.65
31-Jan-07		5.93	0.40	6.33		1485.2	94,062.67
1-Feb-07		6.08	1.62	7.70		1485.2	114,360.40
2-Feb-07		2.80	0.85	3.65		1485.2	54,209.80
3-Feb-07		3.33	2.42	5.75		1485.2	85,399.00

Fishpond Water Requirement

Dry Season 2006-07

Date	WR recorded (mm/d)		Ave.	Area	Fishpond WR
	Khantheo Sta	Kuaysiew Sta	mm/d	ha	m^3/ d
27-Dec-06	40.00	50.00	45.00	21.72	9774.00
28-Dec-06	-80.00	50.00	50.00	21.72	10860.00
29-Dec-06	-10.00	50.00	20.00	21.72	4344.00
30-Dec-06	0.00	-30.00	-15.00	21.72	-3258.00
31-Dec-06	0.00	-60.00	-30.00	21.72	-6516.00
1-Jan-07	10.00	-60.00	-25.00	21.72	-5430.00
2-Jan-07	0.00	-40.00	-20.00	21.72	-4344.00
3-Jan-07	0.00	-40.00	-20.00	21.72	-4344.00
4-Jan-07	0.00	0.00	0.00	21.72	0.00
5-Jan-07	10.00	10.00	10.00	21.72	2172.00
6-Jan-07	0.00	60.00	30.00	21.72	6516.00
7-Jan-07	0.00	100.00	50.00	21.72	10860.00
8-Jan-07	0.00	-80.00	-40.00	21.72	-8688.00
9-Jan-07	-100.00	-90.00	-90.00	21.72	-19548.00
10-Jan-07	10.00	180.00	95.00	21.72	20634.00
11-Jan-07	60.00	-10.00	25.00	21.72	5430.00
12-Jan-07	10.00	80.00	45.00	21.72	9774.00
13-Jan-07	10.00	60.00	35.00	21.72	7602.00
14-Jan-07	10.00	60.00	35.00	21.72	7602.00
15-Jan-07	0.00	60.00	30.00	21.72	6516.00
16-Jan-07	20.00	60.00	40.00	21.72	8688.00
17-Jan-07	-90.00	-210.00	-210.00	21.72	-45612.00
18-Jan-07	30.00	-150.00	-60.00	21.72	-13032.00
19-Jan-07	20.00	-60.00	-20.00	21.72	-4344.00
20-Jan-07	0.00	40.00	20.00	21.72	4344.00
21-Jan-07	0.00	0.00	0.00	21.72	0.00
22-Jan-07	-40.00	40.00	0.00	21.72	0.00
23-Jan-07	10.00	20.00	15.00	21.72	3258.00
24-Jan-07	30.00	30.00	30.00	21.72	6516.00
25-Jan-07	10.00	20.00	15.00	21.72	3258.00
26-Jan-07	20.00	30.00	25.00	21.72	5430.00
27-Jan-07	0.00	30.00	15.00	21.72	3258.00
28-Jan-07	10.00	30.00	20.00	21.72	4344.00
29-Jan-07	0.00	30.00	15.00	21.72	3258.00
30-Jan-07	-80.00	-280.00	-280.00	21.72	-60816.00
31-Jan-07	20.00	-60.00	-20.00	21.72	-4344.00
1-Feb-07	0.00	30.00	15.00	21.72	3258.00
2-Feb-07	0.00	40.00	20.00	21.72	4344.00
3-Feb-07	1.00	60.00	30.50	21.72	6624.60

Cash Crops Water requirement

Dry Season 2006-07

Date	ETo	Kc	$ET_{cashcrops}$	Planted Area	Vegetable WR
	mm/d		mm/d	ha	m^3/ d
27-Dec-06	0.35	0.98	0.34	18.78	64.4154
28-Dec-06	4.7	0.98	4.61	18.78	865.0068
29-Dec-06	1.85	0.98	1.81	18.78	340.4814
30-Dec-06	3.5	0.98	3.43	18.78	644.154
31-Dec-06	3.6	0.98	3.53	18.78	662.5584
1-Jan-07	4.15	1.05	4.36	18.78	818.3385
2-Jan-07	2.95	1.05	3.10	18.78	581.7105
3-Jan-07	4.05	1.05	4.25	18.78	798.6195
4-Jan-07	3.65	1.05	3.83	18.78	719.7435
5-Jan-07	4.05	1.05	4.25	18.78	798.6195
6-Jan-07	3	1.05	3.15	18.78	591.57
7-Jan-07	2.8	1.05	2.94	18.78	552.132
8-Jan-07	2.65	1.05	2.78	18.78	522.5535
9-Jan-07	2.45	1.05	2.57	18.78	483.1155
10-Jan-07	3	1.05	3.15	18.78	591.57
11-Jan-07	2.25	1.05	2.36	18.78	443.6775
12-Jan-07	2.85	1.05	2.99	18.78	561.9915
13-Jan-07	3	1.05	3.15	18.78	591.57
14-Jan-07	3.15	1.05	3.31	18.78	621.1485
15-Jan-07	2.85	1.05	2.99	18.78	561.9915
16-Jan-07	3.05	1.05	3.20	18.78	601.4295
17-Jan-07	6.05	1.05	6.35	18.78	1192.9995
18-Jan-07	3.5	1.05	3.68	18.78	690.165
19-Jan-07	3.75	1.05	3.94	18.78	739.4625
20-Jan-07	2.85	1.05	2.99	18.78	561.9915
21-Jan-07	3	1.05	3.15	18.78	591.57
22-Jan-07	3.55	1.05	3.73	18.78	700.0245
23-Jan-07	3.15	1.05	3.31	18.78	621.1485
24-Jan-07	2.6	1.05	2.73	18.78	512.694
25-Jan-07	2	1.05	2.10	18.78	394.38
26-Jan-07	2.25	1.05	2.36	18.78	443.6775
27-Jan-07	3	1.05	3.15	18.78	591.57
28-Jan-07	2.9	1.05	3.05	18.78	571.851
29-Jan-07	2.4	1.05	2.52	18.78	473.256
30-Jan-07	4.1	1.05	4.31	18.78	808.479
31-Jan-07	3.85	1.05	4.04	18.78	759.1815
1-Feb-07	3.3	1.05	3.47	18.78	650.727
2-Feb-07	2.2	1.05	2.31	18.78	433.818
3-Feb-07	3.6	1.05	3.78	18.78	709.884

Annex 4(a): Water Requirement for Each Agriculture Activity

Paddy Water Requirement

Dry Season 2006-07

Date	LS & LP	ETc	Perc.	IWR	Planted Area (ha)		Paddy WR
	mm/d	mm/d	mm/d	mm/d	Land Pre A	Planted A	m^3/ d
4-Feb-07		3.17	2.53	5.70		1485.2	84,656.40
5-Feb-07		3.12	3.35	6.47		1485.2	96,042.93
6-Feb-07		3.28	0.58	3.87		1485.2	57,427.73
7-Feb-07		3.47	1.68	5.15		1485.2	76,438.29
8-Feb-07		3.32	1.65	4.97		1485.2	73,764.93
9-Feb-07		6.55	1.09	7.64		1485.2	113,518.79
10-Feb-07		6.32	0.80	7.12		1485.2	105,696.73
11-Feb-07		5.42	1.07	6.48		1485.2	96,290.47
12-Feb-07		2.60	2.05	4.65		1485.2	69,111.31
13-Feb-07		3.80	0.83	4.63		1485.2	68,715.25
14-Feb-07		3.42	0.86	4.27		1485.2	63,467.55
15-Feb-07		3.25	0.37	3.62		1485.2	53,714.73
16-Feb-07		3.17	1.40	4.56		1485.2	67,774.63
17-Feb-07		3.67	0.70	4.37		1485.2	64,853.73
18-Feb-07		2.93	0.97	3.90		1485.2	57,922.80
19-Feb-07		8.20	1.05	9.25		1485.2	137,381.00
20-Feb-07		3.63	2.65	6.28		1485.2	93,320.07
21-Feb-07		3.53	1.68	5.22		1485.2	77,477.93
22-Feb-07		5.37	0.68	6.05		1485.2	89,854.60
23-Feb-07		3.78	1.40	5.18		1485.2	76,982.87
24-Feb-07		3.48	1.92	5.40		1485.2	80,200.80
25-Feb-07		3.65	2.88	6.53		1485.2	97,033.07
26-Feb-07		9.08	2.89	11.97		1485.2	177,827.95
27-Feb-07		10.67	1.03	11.70		1485.2	173,768.40
28-Feb-07		3.95	5.07	9.02		1485.2	133,915.53
1-Mar-07		3.98	2.08	6.07		1485.2	90,102.13
2-Mar-07		8.87	3.30	12.17		1485.2	180,699.33
3-Mar-07		5.58	1.52	7.10		1485.2	105,449.20
4-Mar-07		3.50	2.35	5.85		1485.2	86,884.20
5-Mar-07		3.57	1.40	4.97		1485.2	73,764.93
6-Mar-07		6.12	0.97	7.08		1485.2	105,201.67
7-Mar-07		3.87	3.21	7.08		1485.2	105,102.65
8-Mar-07		4.00	2.43	6.43		1485.2	95,448.85
9-Mar-07		3.93	3.56	7.49		1485.2	111,241.48
10-Mar-07		3.88	6.72	10.60		1485.2	157,431.20
11-Mar-07		3.68	4.75	8.43		1485.2	125,251.87
12-Mar-07		4.20	2.10	6.30		1485.2	93,567.60
13-Mar-07		3.87	3.03	6.90		1485.2	102,478.80
14-Mar-07		5.50	1.20	6.70		1485.2	99,508.40

Fishpond Water Requirement

Dry Season 2006-07

WR recorded (mm/d)		Ave.	Area	Fishpond WR
Khantheo Sta	Kuaysiew Sta	mm/d	ha	m^3/ d
4.00	50.00	27.00	21.72	5864.40
1.00	60.00	30.50	21.72	6624.60
4.00	50.00	27.00	21.72	5864.40
20.00	-500.00	20.00	21.72	4344.00
0.00	50.00	25.00	21.72	5430.00
0.00	70.00	35.00	21.72	7602.00
10.00	60.00	35.00	21.72	7602.00
-70.00	80.00	80.00	21.72	17376.00
30.00	50.00	40.00	21.72	8688.00
0.00	-150.00	-75.00	21.72	-16290.00
10.00	20.00	15.00	21.72	3258.00
-10.00	60.00	25.00	21.72	5430.00
30.00	50.00	40.00	21.72	8688.00
0.00	60.00	30.00	21.72	6516.00
0.00	-190.00	-95.00	21.72	-20634.00
10.00	0.00	5.00	21.72	1086.00
0.00	100.00	50.00	21.72	10860.00
-30.00	-10.00	-20.00	21.72	-4344.00
-10.00	-40.00	-25.00	21.72	-5430.00
0.00	-30.00	-15.00	21.72	-3258.00
0.00	60.00	30.00	21.72	6516.00
-20.00	40.00	10.00	21.72	2172.00
10.00	50.00	30.00	21.72	6516.00
0.10	-29.90	-14.90	21.72	-3236.28
16.60	-153.40	-68.40	21.72	-14856.48
-20.00	10.00	-5.00	21.72	-1086.00
30.00	30.00	30.00	21.72	6516.00
-18.80	11.20	-3.80	21.72	-825.36
-10.00	30.00	10.00	21.72	2172.00
0.00	30.00	15.00	21.72	3258.00
20.00	-40.00	-10.00	21.72	-2172.00
0.00	-40.00	-20.00	21.72	-4344.00
10.00	-30.00	-10.00	21.72	-2172.00
20.00	-20.00	0.00	21.72	0.00
0.00	50.00	25.00	21.72	5430.00
10.00	50.00	30.00	21.72	6516.00
-40.00	40.00	0.00	21.72	0.00
-10.00	-50.00	-30.00	21.72	-6516.00
0.00	-40.00	-20.00	21.72	-4344.00

Cash Crops Water requirement

Dry Season 2006-07

ETo	Kc	$ET_{cashcrops}$	Planted Area	Vegetable WR
mm/d		mm/d	ha	m^3/ d
3.25	1.05	3.41	18.78	640.8675
2.55	1.05	2.68	18.78	502.8345
3.25	1.05	3.41	18.78	640.8675
4.6	1.05	4.83	18.78	907.074
3.85	1.05	4.04	18.78	759.1815
3.3	1.05	3.47	18.78	650.727
3.4	1.05	3.57	18.78	670.446
3.35	1.05	3.52	18.78	660.5865
3.45	1.05	3.62	18.78	680.3055
3.6	1.05	3.78	18.78	709.884
4.6	1.05	4.83	18.78	907.074
1.95	1.05	2.05	18.78	384.5205
4.8	1.05	5.04	18.78	946.512
6.15	1.05	6.46	18.78	1212.7185
5.7	1.05	5.99	18.78	1123.983
7.9	1.05	8.30	18.78	1557.801
3.55	0.99	3.51	18.78	660.0231
2.55	0.99	2.52	18.78	474.1011
4.7	0.99	4.65	18.78	873.8334
4.1	0.99	4.06	18.78	762.2802
4.05	0.99	4.01	18.78	752.9841
2.75	0.99	2.72	18.78	511.2855
2.7	0.99	2.67	18.78	501.9894
8.7	0.99	8.61	18.78	1617.5214
2	0.99	1.98	18.78	371.844
2.05	0.88	1.80	18.78	338.7912
3.35	0.88	2.95	18.78	553.6344
2.15	0.88	1.89	18.78	355.3176
3.1	0.88	2.73	18.78	512.3184
3.15	0.88	2.77	18.78	520.5816
3.45	0.88	3.04	18.78	570.1608
3.95	0.88	3.48	18.78	652.7928
3.05	0.88	2.68	18.78	504.0552
3.5	0.88	3.08	18.78	578.424
3.8	0.88	3.34	18.78	628.0032
2.85	0.88	2.51	18.78	471.0024
3.6	0.88	3.17	18.78	594.9504
4.25	0.88	3.74	18.78	702.372
3.45	0.88	3.04	18.78	570.1608

Annex 4(a): Water Requirement for Each Agriculture Activity

Paddy Water Requirement

Dry Season 2006-07

Date	LS & LP	ETc	Perc.	IWR	Planted Area (ha)		Paddy WR
	mm/d	mm/d	mm/d	mm/d	Land Pre A	Planted A	m^3/ d
15-Mar-07		6.07	2.50	8.57		1485.2	127,232.13
16-Mar-07		6.03	0.37	6.40		1485.2	95,052.80
17-Mar-07		4.03	5.80	9.83		1485.2	146,044.67
18-Mar-07		4.22	2.08	6.30		1485.2	93,567.60
19-Mar-07		3.30	2.69	5.99		1485.2	88,953.04
20-Mar-07		3.95	3.54	7.49		1485.2	111,241.48
21-Mar-07		3.43	1.08	4.50		1485.2	66,834.00
22-Mar-07		3.65	5.13	8.78		1485.2	130,326.30
23-Mar-07		3.18	6.26	9.43		1485.2	140,054.36
24-Mar-07		3.03	7.82	10.85		1485.2	161,069.94
25-Mar-07		3.38	3.08	6.45		1485.2	95,795.40
26-Mar-07		3.35	5.90	9.25		1485.2	137,381.00
27-Mar-07		6.65	1.91	8.56		1485.2	127,133.12
28-Mar-07		7.50	3.00	10.50		1485.2	155,946.00
29-Mar-07		6.30	0.74	7.04		1485.2	104,558.08
30-Mar-07		4.70	0.86	5.56		1485.2	82,502.86
31-Mar-07		3.38	6.70	10.08		1485.2	149,633.90
1-Apr-07		4.00	6.50	10.50		1485.2	155,946.00
2-Apr-07							
3-Apr-07							
4-Apr-07							
5-Apr-07							
6-Apr-07							
7-Apr-07							
8-Apr-07							
9-Apr-07							
10-Apr-07							
Average (mm/d)	3.67	4.07	2.15				0.86 m^3/s
Total (MCM)	1.68	6.03	3.21				**9.82**

Fishpond Water Requirement

Dry Season 2006-07

Date	WR recorded (mm/d)		Ave.	Area	Fishpond WR
	Khantheo Sta	Kuaysiew Sta	mm/d	ha	m^3/ d
15-Mar-07	10.00	20.00	15.00	21.72	3258.00
16-Mar-07	0.00	10.00	5.00	21.72	1086.00
17-Mar-07	20.00	20.00	20.00	21.72	4344.00
18-Mar-07	20.00	30.00	25.00	21.72	5430.00
19-Mar-07	10.00	10.00	10.00	21.72	2172.00
20-Mar-07	0.00	10.00	5.00	21.72	1086.00
21-Mar-07	20.00	20.00	20.00	21.72	4344.00
22-Mar-07	0.00	10.00	5.00	21.72	1086.00
23-Mar-07	-30.00	-20.00	-25.00	21.72	-5430.00
24-Mar-07	0.00	10.00	5.00	21.72	1086.00
25-Mar-07	20.00	-100.00	-40.00	21.72	-8688.00
26-Mar-07	0.00	-70.00	-35.00	21.72	-7602.00
27-Mar-07	10.00	40.00	25.00	21.72	5430.00
28-Mar-07	0.00	30.00	15.00	21.72	3258.00
29-Mar-07	20.00	20.00	20.00	21.72	4344.00
30-Mar-07	-8.30	31.70	11.70	21.72	2541.24
31-Mar-07	10.00	20.00	15.00	21.72	3258.00
1-Apr-07	30.00	30.00	30.00	21.72	6516.00
2-Apr-07					
3-Apr-07					
4-Apr-07					
5-Apr-07					
6-Apr-07					
7-Apr-07					
8-Apr-07					
9-Apr-07					
10-Apr-07					
Average (mm/d)	6.14	6.13	8.34		0.02 m^3/s
Total (MCM)			0.097		**0.23**

Cash Crops Water requirement

Dry Season 2006-07

Date	ETo	Kc	$ET_{cashcrops}$	Planted Area	Vegetable WR
	mm/d		mm/d	ha	m^3/ d
15-Mar-07	3.15	0.88	2.77	18.78	520.5816
16-Mar-07	3	0.88	2.64	18.78	495.792
17-Mar-07	3.15	0.88	2.77	18.78	520.5816
18-Mar-07	2.65	0.88	2.33	18.78	437.9496
19-Mar-07	2.05	0.88	1.80	18.78	338.7912
20-Mar-07	1.05	0.88	0.92	18.78	173.5272
21-Mar-07	2.55	0.88	2.24	18.78	421.4232
22-Mar-07	4.7	0.88	4.14	18.78	776.7408
23-Mar-07	4.1	0.88	3.61	18.78	677.5824
24-Mar-07	4.05	0.76	3.08	18.78	578.0484
25-Mar-07	2.75	0.76	2.09	18.78	392.502
26-Mar-07	2.6	0.76	1.98	18.78	371.0928
27-Mar-07	2.6	0.76	1.98	18.78	371.0928
28-Mar-07	2	0.76	1.52	18.78	285.456
29-Mar-07	4.75	0.76	3.61	18.78	677.958
30-Mar-07	2.65	0.76	2.01	18.78	378.2292
31-Mar-07	2.15	0.76	1.63	18.78	306.8652
1-Apr-07	3.12	0.76	2.37	18.78	445.31136
2-Apr-07	3.12	0.76	2.37	18.78	445.31136
3-Apr-07	3.12	0.76	2.37	18.78	445.31136
4-Apr-07	3.12	0.76	2.37	18.78	445.31136
5-Apr-07	3.12	0.76	2.37	18.78	445.31136
6-Apr-07	3.12	0.76	2.37	18.78	445.31136
7-Apr-07	3.12	0.76	2.37	18.78	445.31136
8-Apr-07	3.12	0.76	2.37	18.78	445.31136
9-Apr-07	3.12	0.76	2.37	18.78	445.31136
10-Apr-07	3.12	0.76	2.37	18.78	445.31136
Average (mm/d)	3.25		2.93		0.06 m^3/s
Total (MCM)			0.08		**0.08**

Note:

(1) Land Soaking & Land Preparation (LS&LP) of 3.67 mm/d is estimated from 110 mm/season with 30 days (15 days for LS and 15 days for LP).
The measurement is not conducted in this IIEPF project, but value is borrowed from existing available information " the study of waer management in the Num Houm Project 1996".

(2) ETc (mm/d), WR mm/d (fishpond), and ETo (mm/d) shown in the table are already minus rainfall

(3) Skip value (not included in the calculation) in the fishpond WR is marked with "   "

Annex 4(b): Water Requirement for Each Agriculture Activity

Paddy Water Requirement

Wet Season 2007

Date	LS & LP	ETc	Perc.	IWR	Planted Area (ha)		Paddy WR
	mm/d	mm/d	mm/d	mm/d	Land Pre A	Planted A	m^3/ d
4-May-07							
5-May-07							
6-May-07							
7-May-07							
8-May-07							
9-May-07							
10-May-07							
11-May-07							
12-May-07							
13-May-07							
14-May-07							
15-May-07							
16-May-07							
17-May-07							
18-May-07							
19-May-07							
20-May-07							
21-May-07							
22-May-07	3.67			3.67	2,028.27	208.21	82,078.82
23-May-07	3.67			3.67	2,027.03	209.45	82,078.82
24-May-07	3.67			3.67	2,011.54	224.94	82,078.82
25-May-07	3.67			3.67	2,007.56	228.92	82,078.82
26-May-07	3.67			3.67	2,002.55	233.93	82,078.82
27-May-07	3.67			3.67	1,998.83	237.65	82,078.82
28-May-07	3.67			3.67	1,986.88	249.60	82,078.82
29-May-07	3.67			3.67	1,986.88	249.60	82,078.82
30-May-07	3.67			3.67	1,986.23	250.25	82,078.82
31-May-07	3.67			3.67	1,986.23	250.25	82,078.82
1-Jun-07	3.67			3.67	1,985.50	250.98	82,078.82
2-Jun-07	3.67			3.67	1,982.45	254.03	82,078.82
3-Jun-07	3.67			3.67	1,981.57	254.91	82,078.82
4-Jun-07	3.67			3.67	1,976.10	260.38	82,078.82
5-Jun-07	3.67			3.67	1,970.22	266.26	82,078.82
6-Jun-07	3.67			3.67	1,963.99	272.49	82,078.82
7-Jun-07	3.67			3.67	1,945.23	291.25	82,078.82
8-Jun-07	3.67			3.67	1,939.20	297.28	82,078.82
9-Jun-07	3.67			3.67	1,923.24	313.24	82,078.82
10-Jun-07	3.67			3.67	1,911.07	325.41	82,078.82
11-Jun-07	3.67			3.67	1,902.33	334.15	82,078.82
12-Jun-07	3.67			3.67	1,892.12	344.36	82,078.82

Fishpond Water Requirement

Wet Season 2007

Date	WR recorded (mm/d)		Ave.	Area	Fishpond WR
	Khantheo Sta	Kuaysiew Sta	mm/d	ha	m^3/ d
4-May-07					
5-May-07					
6-May-07					
7-May-07					
8-May-07					
9-May-07					
10-May-07					
11-May-07					
12-May-07					
13-May-07					
14-May-07					
15-May-07					
16-May-07					
17-May-07					
18-May-07					
19-May-07					
20-May-07					
21-May-07					
22-May-07			9.46	21.72	2054.74
23-May-07			9.46	21.72	2054.74
24-May-07			9.46	21.72	2054.74
25-May-07			9.46	21.72	2054.74
26-May-07			9.46	21.72	2054.74
27-May-07			9.46	21.72	2054.74
28-May-07			9.46	21.72	2054.74
29-May-07			9.46	21.72	2054.74
30-May-07			9.46	21.72	2054.74
31-May-07			9.46	21.72	2054.74
1-Jun-07			9.46	21.72	2054.74
2-Jun-07	0	30	15.00	21.72	3258.00
3-Jun-07	5	N/A	5.00	21.72	1086.00
4-Jun-07	N/A	N/A	0.00	21.72	N/A
5-Jun-07	7.00	N/A	7.00	21.72	1520.40
6-Jun-07	0.00	30.00	15.00	21.72	3258.00
7-Jun-07	0.00	N/A	0.00	21.72	N/A
8-Jun-07	5.00	N/A	5.00	21.72	1086.00
9-Jun-07	5.00	30.00	17.50	21.72	3801.00
10-Jun-07	-5.00	N/A	-5.00	21.72	-1086.00
11-Jun-07	N/A	N/A	0.00	21.72	N/A
12-Jun-07	5.00	N/A	5.00	21.72	1086.00

Cash Crops Water requirement

Wet Season 2007

Date	Eto	Kc	$ET_{cashcrops}$	Planted Area	Cash Crops WR
	mm/d		mm/d	ha	m^3/ d
4-May-07	3.12	0.5	1.56	5	78
5-May-07	3.12	0.5	1.56	5	78
6-May-07	3.12	0.5	1.56	5	78
7-May-07	3.12	0.5	1.56	5	78
8-May-07	3.12	0.5	1.56	5	78
9-May-07	3.12	0.5	1.56	5	78
10-May-07	3.12	0.5	1.56	5	78
11-May-07	3.12	0.5	1.56	5	78
12-May-07	3.12	0.5	1.56	5	78
13-May-07	3.12	0.5	1.56	5	78
14-May-07	3.12	0.5	1.56	5	78
15-May-07	3.12	0.5	1.56	5	78
16-May-07	3.12	0.5	1.56	5	78
17-May-07	3.12	0.5	1.56	5	78
18-May-07	3.12	0.5	1.56	5	78
19-May-07	3.12	0.5	1.56	5	78
20-May-07	3.12	0.5	1.56	5	78
21-May-07	3.12	0.5	1.56	5	78
22-May-07	3.12	0.5	1.56	5	78
23-May-07	3.12	0.5	1.56	5	78
24-May-07	3.12	0.5	1.56	5	78
25-May-07	3.12	0.5	1.56	5	78
26-May-07	3.12	0.5	1.56	5	78
27-May-07	3.12	0.5	1.56	5	78
28-May-07	3.12	0.5	1.56	5	78
29-May-07	3.12	0.5	1.56	5	78
30-May-07	3.12	0.5	1.56	5	78
31-May-07	3.12	0.5	1.56	5	78
1-Jun-07	3.12	0.57	1.7784	5	88.92
2-Jun-07	3.12	0.57	1.7784	5	88.92
3-Jun-07	3.12	0.57	1.7784	5	88.92
4-Jun-07	3.12	0.57	1.7784	4	71.136
5-Jun-07	3.12	0.57	1.7784	4	71.136
6-Jun-07	3.12	0.57	1.7784	4	71.136
7-Jun-07	3.12	0.57	1.7784	4	71.136
8-Jun-07	3.12	0.57	1.7784	4	71.136
9-Jun-07	3.12	0.57	1.7784	4	71.136
10-Jun-07	3.12	0.57	1.7784	4	71.136
11-Jun-07	2.5	0.71	1.775	4	71
12-Jun-07	2.2	0.71	1.562	4	62.48

Annex 4(b): Water Requirement for Each Agriculture Activity

Paddy Water Requirement

Wet Season 2007

Date	LS & LP	ETc	Perc.	IWR	Planted Area (ha)		Paddy WR
	mm/d	mm/d	mm/d	mm/d	Land Pre A	Planted A	m^3/ d
13-Jun-07	3.67			3.67	1,883.85	352.63	82,078.82
14-Jun-07	3.67			3.67	1,872.75	363.73	82,078.82
15-Jun-07	3.67			3.67	1,854.01	382.47	82,078.82
16-Jun-07	3.67			3.67	1,833.96	402.52	82,078.82
17-Jun-07	3.67			3.67	1,815.74	420.74	82,078.82
18-Jun-07	3.67			3.67	1,795.60	440.88	82,078.82
19-Jun-07	3.67			3.67	1,777.89	458.59	82,078.82
20-Jun-07	3.67			3.67	1,679.52	556.96	82,078.82
21-Jun-07	3.67			3.67	1,655.54	580.94	82,078.82
22-Jun-07	3.67			3.67	1,591.14	645.34	82,078.82
23-Jun-07	3.67			3.67	1,563.09	673.39	82,078.82
24-Jun-07	3.67			3.67	1,494.66	741.82	82,078.82
25-Jun-07	3.67			3.67	1,426.97	809.51	82,078.82
26-Jun-07	3.67			3.67	1,371.76	864.72	82,078.82
27-Jun-07	3.67			3.67	1,320.16	916.32	82,078.82
28-Jun-07	3.67			3.67	1,252.80	983.68	82,078.82
29-Jun-07	3.67			3.67	1,233.36	1,003.12	82,078.82
30-Jun-07	3.67			3.67	1,112.25	1,124.23	82,078.82
1-Jul-07	3.67			3.67	1,111.61	1,124.87	82,078.82
2-Jul-07		1.68	1.57	3.25		1,137.04	36,953.80
3-Jul-07		5.58	1.75	7.33		1,148.43	84,218.20
4-Jul-07		1.45	0.75	2.20		1,158.87	25,495.14
5-Jul-07		-1.45	3.18	1.73		1,211.86	20,904.59
6-Jul-07		N/A	0.97	0.97		1,213.34	11,830.07
7-Jul-07		25.20	-3.80	21.40		1,274.19	272,676.66
8-Jul-07		2.57	-0.63	1.93		1,295.53	25,046.91
9-Jul-07		0.60	1.15	1.75		1,307.05	22,873.38
10-Jul-07		2.78	2.70	5.48		1,402.45	76,854.26
11-Jul-07		3.02	1.50	4.52		1,418.64	64,075.24
12-Jul-07		4.52	0.83	5.35		1,493.06	79,878.71
13-Jul-07		4.55	0.50	5.05		1,510.09	76,209.21
14-Jul-07		3.32	0.87	4.18		1,557.15	65,140.78
15-Jul-07		0.50	5.23	5.73		1,632.18	93,578.32
16-Jul-07		2.80	1.41	4.21		1,704.42	71,699.27
17-Jul-07		2.35	1.72	4.07		1,753.21	71,297.21
18-Jul-07		2.63	1.30	3.93		1,823.82	71,736.92
19-Jul-07		7.93	3.05	10.98		1,845.92	202,743.55
20-Jul-07		0.67	2.09	2.75		1,890.76	52,027.41
21-Jul-07		-0.12	2.65	2.53		1,903.07	48,211.11
22-Jul-07		3.25	1.38	4.63		1,914.12	88,687.56

Fishpond Water Requirement

Wet Season 2007

Date	WR recorded (mm/d)		Ave.	Area	Fishpond WR
	Khantheo Sta	Kuaysiew Sta	mm/d	ha	m^3/ d
13-Jun-07	N/A	N/A	0.00	21.72	N/A
14-Jun-07	N/A	N/A	0.00	21.72	N/A
15-Jun-07	5.00	20.00	12.50	21.72	2715.00
16-Jun-07	15.00	30.00	22.50	21.72	4887.00
17-Jun-07	19.20	N/A	19.20	21.72	4170.24
18-Jun-07	20.00	N/A	20.00	21.72	4344.00
19-Jun-07	10.00	-70.00	-30.00	21.72	-6516.00
20-Jun-07	9.80	14.80	12.30	21.72	2671.56
21-Jun-07	5.00	N/A	5.00	21.72	1086.00
22-Jun-07	5.00	N/A	5.00	21.72	1086.00
23-Jun-07	5.00	30.00	17.50	21.72	3801.00
24-Jun-07	-5.00	N/A	-5.00	21.72	-1086.00
25-Jun-07	4.50	N/A	4.50	21.72	977.40
26-Jun-07	20.20	N/A	20.20	21.72	4387.44
27-Jun-07	9.40	N/A	9.40	21.72	2041.68
28-Jun-07	30.80	N/A	30.80	21.72	6689.76
29-Jun-07	0.00	30.00	15.00	21.72	3258.00
30-Jun-07	5.00	30.00	17.50	21.72	3801.00
1-Jul-07	5.00	N/A	5.00	21.72	1086.00
2-Jul-07	5.00	N/A	5.00	21.72	1086.00
3-Jul-07	3.20	N/A	3.20	21.72	695.04
4-Jul-07	-5.00	N/A	-5.00	21.72	-1086.00
5-Jul-07	0.00	N/A	0.00	21.72	0.00
6-Jul-07	21.90	N/A	21.90	21.72	4756.68
7-Jul-07	25.00	N/A	25.00	21.72	5430.00
8-Jul-07	3.00	30.00	16.50	21.72	3583.80
9-Jul-07	0.00	30.00	15.00	21.72	3258.00
10-Jul-07	5.00	N/A	5.00	21.72	1086.00
11-Jul-07	5.00	30.00	17.50	21.72	3801.00
12-Jul-07	10.00	20.00	15.00	21.72	3258.00
13-Jul-07	10.00	30.00	20.00	21.72	4344.00
14-Jul-07	N/A	N/A	N/A	21.72	N/A
15-Jul-07	N/A	N/A	N/A	21.72	N/A
16-Jul-07	10.00	N/A	10.00	21.72	2172.00
17-Jul-07	10.00	0.00	5.00	21.72	1086.00
18-Jul-07	10.00	30.00	20.00	21.72	4344.00
19-Jul-07	17.20	N/A	17.20	21.72	3735.84
20-Jul-07	10.00	20.00	15.00	21.72	3258.00
21-Jul-07	-2.00	28.00	13.00	21.72	2823.60
22-Jul-07	-10.00	20.00	5.00	21.72	1086.00

Cash Crops Water requirement

Wet Season 2007

Date	Eto	Kc	$ET_{cashcrops}$	Planted Area	Cash Crops WR
	mm/d		mm/d	ha	m^3/ d
13-Jun-07	3.5	0.71	2.485	4	99.4
14-Jun-07	6	0.71	4.26	4	170.4
15-Jun-07	3.12	0.71	2.2152	4	88.608
16-Jun-07	3.12	0.71	2.2152	4	88.608
17-Jun-07	3.12	0.71	2.2152	3	66.456
18-Jun-07	3.55	0.71	2.5205	3	75.615
19-Jun-07	3	0.71	2.13	3	63.9
20-Jun-07	5.95	0.71	4.2245	3	126.735
21-Jun-07	1.55	0.84	1.302	3	39.06
22-Jun-07	3.45	0.84	2.898	3	86.94
23-Jun-07	3.9	0.84	3.276	3	98.28
24-Jun-07	2.45	0.84	2.058	3	61.74
25-Jun-07	2.1	0.84	1.764	3	52.92
26-Jun-07	3.1	0.84	2.604	3	78.12
27-Jun-07	0.9	0.84	0.756	3	22.68
28-Jun-07	3.12	0.84	2.6208	3	78.624
29-Jun-07	3.12	0.84	2.6208	3	78.624
30-Jun-07	10.1	0.84	8.484	3	254.52
1-Jul-07	3.12	0.98	3.0576	3	91.728
2-Jul-07	1	0.98	0.98	3	29.4
3-Jul-07	3.12	0.98	3.0576	3	91.728
4-Jul-07	5.25	0.98	5.145	3	154.35
5-Jul-07	3.8	0.98	3.724	2	74.48
6-Jul-07	3.8	0.98	3.724	2	74.48
7-Jul-07	0.85	0.98	0.833	2	16.66
8-Jul-07	1.95	0.98	1.911	2	38.22
9-Jul-07	2.55	0.98	2.499	2	49.98
10-Jul-07	3.12	0.98	3.0576	2	61.152
11-Jul-07	3.12	1.05	3.276	2	65.52
12-Jul-07	1.4	1.05	1.47	2	29.4
13-Jul-07	2.1	1.05	2.205	2	44.1
14-Jul-07	2.65	1.05	2.7825	2	55.65
15-Jul-07	4.25	1.05	4.4625	2	89.25
16-Jul-07	4.95	1.05	5.1975	2	103.95
17-Jul-07	2.45	1.05	2.5725	1	25.725
18-Jul-07	7.5	1.05	7.875	1	78.75
19-Jul-07	1.2	1.05	1.26	1	12.6
20-Jul-07	3.12	1.05	3.276	1	32.76
21-Jul-07					
22-Jul-07					

Annex 4(b): Water Requirement for Each Agriculture Activity

Paddy Water Requirement

Wet Season 2007

Fishpond Water Requirement

Wet Season 2007

Cash Crops Water requirement

Wet Season 2007

Date	LS & LP	ETc	Perc.	IWR	Planted Area (ha)		Paddy WR	WR recorded (mm/d)		Ave.	Area	Fishpond WR	Eto	Kc	$ET_{cashcrops}$	Planted Area	Cash Crops WR
	mm/d	mm/d	mm/d	mm/d	Land Pre A	Planted A	m^3/ d	Khantheo Sta	Kuaysiew Sta	mm/d	ha	m^3/ d	mm/d		mm/d	ha	m^3/ d
23-Jul-07		4.70	1.10	5.80		1,932.59	112,154.64	-2.80	32.20	14.70	21.72	3192.84					
24-Jul-07		4.28	1.63	5.92		1,955.10	115,676.75	7.50	N/A	7.50	21.72	1629.00					
25-Jul-07		2.03	2.23	4.27		1,977.87	84,389.12	10.00	-20.00	-5.00	21.72	-1086.00					
26-Jul-07		1.25	3.72	4.97		1,996.19	99,144.10	10.00	N/A	10.00	21.72	2172.00					
27-Jul-07		10.57	6.69	17.26		2,026.43	349,694.27	21.60	N/A	21.60	21.72	4691.52					
28-Jul-07		2.97	2.00	4.97		2,040.94	101,366.69	-10.00	30.00	10.00	21.72	2172.00					
29-Jul-07		3.32	0.92	4.23		2,065.58	87,442.89	5.00	30.00	17.50	21.72	3801.00					
30-Jul-07		2.20	1.80	4.00		2,102.57	84,102.80	5.00	30.00	17.50	21.72	3801.00					
31-Jul-07		27.70	6.60	34.30		2,158.67	740,423.81	N/A	N/A	N/A	21.72	N/A					
1-Aug-07		N/A	N/A	0.00		2,236.48	N/A	N/A	N/A	N/A	21.72	N/A					
2-Aug-07		0.80	2.36	3.16		2,236.48	70,598.22	0.00	20.00	10.00	21.72	2172.00					
3-Aug-07		1.92	-0.15	1.77		2,236.48	39,511.15	10.00	20.00	15.00	21.72	3258.00					
4-Aug-07		3.17	2.54	5.70		2,236.48	127,553.91	10.00	30.00	20.00	21.72	4344.00					
5-Aug-07		3.90	2.05	5.95		2,236.48	133,070.56	10.00	30.00	20.00	21.72	4344.00					
6-Aug-07		3.57	1.97	5.53		2,236.48	123,751.89	N/A	N/A	N/A	21.72	N/A					
7-Aug-07		7.08	0.92	8.00		2,236.48	178,918.40	-13.90	N/A	-13.90	21.72	-3019.08					
8-Aug-07		9.90	-2.70	7.20		2,236.48	161,026.56	39.20	-0.80	19.20	21.72	4170.24					
9-Aug-07		0.22	1.28	1.50		2,236.48	33,547.20	20.00	20.00	20.00	21.72	4344.00					
10-Aug-07		N/A	3.00	3.00		2,236.48	67,094.40	15.50	N/A	15.50	21.72	3366.60					
11-Aug-07		9.28	1.72	11.00		2,236.48	246,087.35	8.80	N/A	8.80	21.72	1911.36					
12-Aug-07		3.12	0.08	3.20		2,236.48	71,567.36	10.00	30.00	20.00	21.72	4344.00					
13-Aug-07		3.40	2.07	5.47		2,236.48	122,260.91	5.00	N/A	5.00	21.72	1086.00					
14-Aug-07		4.22	1.05	5.27		2,236.48	117,787.95	5.00	N/A	5.00	21.72	1086.00					
15-Aug-07		4.02	1.30	5.32		2,236.48	118,906.19	10.00	30.00	20.00	21.72	4344.00					
16-Aug-07		5.12	1.28	6.40		2,236.48	143,060.17	8.40	N/A	8.40	21.72	1824.48					
17-Aug-07		N/A	2.90	2.90		2,236.48	64,857.92	N/A	N/A	N/A	21.72	N/A					
18-Aug-07		11.78	-0.33	11.45		2,236.48	256,076.96	23.10	N/A	23.10	21.72	5017.32					
19-Aug-07		2.08	0.92	3.00		2,236.48	67,094.40	N/A	N/A	N/A	21.72	N/A					
20-Aug-07		N/A	N/A	N/A		2,236.48	N/A	N/A	N/A	N/A	21.72	N/A					
21-Aug-07		14.28	0.00	14.28		2,236.48	319,257.52	25.20	25.20	25.20	21.72	5473.44					
22-Aug-07		3.08	1.17	4.25		2,236.48	95,124.95	12.50	N/A	12.50	21.72	2715.00					
23-Aug-07		-0.10	2.99	2.89		2,236.48	64,634.27	10.00	20.00	15.00	21.72	3258.00					
24-Aug-07		17.90	1.05	18.95		2,236.48	423,812.96	N/A	16.20	16.20	21.72	3518.64					
25-Aug-07		1.83	-0.50	1.33		2,236.48	29,819.73	N/A	N/A	N/A	21.72	N/A					
26-Aug-07		3.80	1.07	4.87		2,236.48	108,842.03	10.00	30.00	20.00	21.72	4344.00					
27-Aug-07		32.80	2.80	35.60		2,236.48	796,186.88	3.00	N/A	3.00	21.72	651.60					
28-Aug-07		2.40	0.28	2.68		2,236.48	59,825.84	10.00	30.00	20.00	21.72	4344.00					
29-Aug-07		6.75	1.20	7.95		2,236.48	177,800.16	-2.00	N/A	-2.00	21.72	-434.40					
30-Aug-07		1.73	1.54	3.26		2,236.48	72,909.25	N/A	-27.90	-27.90	21.72	-6059.88					
31-Aug-07		4.70	0.80	5.50		2,236.48	123,006.40	N/A	14.30	14.30	21.72	3105.96					

Annex 4(b): Water Requirement for Each Agriculture Activity

Paddy Water Requirement

Fishpond Water Requirement

Cash Crops Water requirement

Wet Season 2007 (Paddy) | Wet Season 2007 (Fishpond) | Wet Season 2007 (Cash Crops)

Date	LS & LP	ETc	Perc.	IWR	Planted Area (ha)		Paddy WR	WR recorded (mm/d)		Ave.	Area	Fishpond WR	Eto	Kc	$ET_{cashcrops}$	Planted Area	Cash Crops WR
	mm/d	mm/d	mm/d	mm/d	Land Pre A	Planted A	m^3/d	Khantheo Sta	Kuaysiew Sta	mm/d	ha	m^3/d	mm/d		mm/d	ha	m^3/d
1-Sep-07		3	-0.133333	2.86667		2,236.48	64,112.43	0.00	-30.00	-15.00	21.72	-3258.00					
2-Sep-07		3.75	0.883333	4.63333		2,236.48	103,623.57	10.00	0.00	5.00	21.72	1086.00					
3-Sep-07		6.18333	0.475	6.65833		2,236.48	148,912.29	-30.00	30.00	0.00	21.72	0.00					
4-Sep-07		16.1	-2.225	13.875		2,236.48	310,311.60	17.50	-12.50	2.50	21.72	543.00					
5-Sep-07		N/A	N/A	N/A		2,236.48	N/A	N/A	N/A	N/A	21.72	N/A					
6-Sep-07		26	0	26		2,236.48	581,484.80	31.00	N/A	31.00	21.72	6733.20					
7-Sep-07		20.9	0	20.9		2,236.48	467,424.32	24.90	N/A	24.90	21.72	5408.28					
8-Sep-07		0.76667	1.583333	2.35		2,236.48	52,557.28	0.00	-10.00	-5.00	21.72	-1086.00					
9-Sep-07		0	0	7		2,236.48	156,553.60	10.00	0.00	5.00	21.72	1086.00					
10-Sep-07		N/A	0	0		2,236.48	N/A	N/A	N/A	N/A	21.72	N/A					
11-Sep-07		3.1	0	3.1		2,236.48	69,330.88	-26.90	13.10	-6.90	21.72	-1498.68					
12-Sep-07		7.03333	0.726667	7.76		2,236.48	173,550.85	17.20	N/A	17.20	21.72	3735.84					
13-Sep-07		3.4	-0.05	3.35		2,236.48	74,922.08	3.40	N/A	3.40	21.72	738.48					
14-Sep-07		25.6	-0.375	25.225		2,236.48	564,152.08	43.90	N/A	43.90	21.72	9535.08					
15-Sep-07		2.2	1.45	3.65		2,236.48	81,631.52	N/A	10.00	10.00	21.72	2172.00					
16-Sep-07		3.18	2.25	5.43		2,236.48	121,515.41	N/A	10.00	10.00	21.72	2172.00					
17-Sep-07		3.43	1.57	5.00		2,236.48	111,824.00	-30.00	10.00	-10.00	21.72	-2172.00					
18-Sep-07		2.95	2.30	5.25		2,236.48	117,415.20	20.00	10.00	15.00	21.72	3258.00					
19-Sep-07		N/A	0.20	0.20		2,236.48	4,472.96	N/A	N/A	N/A	21.72	N/A					
20-Sep-07		4.47	3.62	8.08		2,236.48	180,782.13	10.00	10.00	10.00	21.72	2172.00					
21-Sep-07		3.97	1.42	5.38		2,236.48	120,397.17	10.00	10.00	10.00	21.72	2172.00					
22-Sep-07		4.62	-1.13	3.48		2,236.48	77,904.05	-20.00	10.00	-5.00	21.72	-1086.00					
23-Sep-07		3.85	0.70	4.55		2,236.48	101,759.84	10.00	10.00	10.00	21.72	2172.00					
24-Sep-07		5.47	1.16	6.63		2,236.48	148,204.07	10.00	10.00	10.00	21.72	2172.00					
25-Sep-07		4.33	1.10	5.43		2,236.48	121,515.41	10.00	10.00	10.00	21.72	2172.00					
26-Sep-07		1.42	-0.90	0.52		2,236.48	11,555.15	10.00	10.00	10.00	21.72	2172.00					
27-Sep-07		3.32	2.96	6.28		2,236.48	140,376.39	N/A	10.00	10.00	21.72	2172.00					
28-Sep-07		5.28	1.98	7.26		2,236.48	162,256.62	15.10	-4.90	5.10	21.72	1107.72					
29-Sep-07		28.43	-0.65	27.78		2,236.48	621,182.32	36.80	N/A	36.80	21.72	7992.96					
30-Sep-07		4.52	1.93	6.45		2,236.48	144,252.96	10.00	10.00	10.00	21.72	2172.00					
1-Oct-07		5.68	-0.15	5.53		2,236.48	123,565.52	10.00	10.00	10.00	21.72	2172.00					
2-Oct-07		4.45	0.20	4.65		2,236.48	103,996.32	10.00	10.00	10.00	21.72	2172.00					
3-Oct-07		4.05	-0.25	3.80		2,236.48	84,986.24	10.00	20.00	15.00	21.72	3258.00					
4-Oct-07		18.375	3.1	21.475		2,236.48	480,284.08	-7.3	22.7	7.7	21.72	1672.44					
5-Oct-07		26.5	-0.725	25.775		2,236.48	576,452.72	3	N/A	3	21.72	651.6					
6-Oct-07		N/A	N/A	N/A		2,236.48	N/A	N/A	N/A	N/A	21.72	N/A					
7-Oct-07		30	0.175	30.175		2,236.48	674,857.84	30	N/A	30	21.72	6516					
8-Oct-07		17.4	-0.175	17.225		2,236.48	385,233.68	22.7	N/A	22.7	21.72	4930.44					
9-Oct-07		N/A	-0.325	-0.325		2,236.48	(7,268.56)	40	25	32.5	21.72	7059					
10-Oct-07		6.55	-0.1	6.45		2,236.48	144,252.96	3	N/A	3	21.72	651.6					

Annex 4(b): Water Requirement for Each Agriculture Activity

Paddy Water Requirement

Wet Season 2007

Date	LS & LP	ETc	Perc.	IWR	Planted Area (ha)		Paddy WR
	mm/d	mm/d	mm/d	mm/d	Land Pre A	Planted A	m^3/ d
11-Oct-07		2.925	0.05	2.975		2,236.48	66,535.28
12-Oct-07		2.775	0.5	3.275		2,236.48	73,244.72
13-Oct-07		3.625	0.625	4.25		2,236.48	95,050.40
14-Oct-07		3.325	1	4.325		2,236.48	96,727.76
15-Oct-07		3.525	0.925	4.45		2,236.48	99,523.36
16-Oct-07		5.575	2.7	8.275		2,236.48	185,068.72
17-Oct-07		1.75	0.85	2.6		2,236.48	58,148.48
18-Oct-07		7.025	-1.075	5.95		2,236.48	133,070.56
19-Oct-07		5.35	0.55	5.9		2,236.48	131,952.32
20-Oct-07		4.625	-0.25	4.375		2,236.48	97,846.00
21-Oct-07		3.65	0.35	4		2,236.48	89,459.20
22-Oct-07		6.4875	-0.8625	5.625		2,236.48	125,802.00
23-Oct-07		5	N/A	5		2,236.48	111,824.00
24-Oct-07		5	0.8	5.8		2,236.48	129,715.84
25-Oct-07		4.2	2.725	6.925		2,236.48	154,876.24
Average (mm/d)	3.67	6.33	1.09				1.57 m^3/s
Total (MCM)	1.68	16.560	2.85				**20.370**

Fishpond Water Requirement

Wet Season 2007

Date	[WR recorded (mm/d)]		Ave.	Area	Fishpond WR
	Khantheo Sta	Kuaysiew Sta	mm/d	ha	m^3/ d
11-Oct-07	5	N/A	5	21.72	1086
12-Oct-07	0	10	5	21.72	1086
13-Oct-07	5	-10	-2.5	21.72	-543
14-Oct-07	0	0	0	21.72	0
15-Oct-07	0	0	0	21.72	0
16-Oct-07	5	0	2.5	21.72	543
17-Oct-07	0	N/A	0	21.72	0
18-Oct-07	5	10	7.5	21.72	1629
19-Oct-07	0	N/A	0	21.72	0
20-Oct-07	5	N/A	5	21.72	1086
21-Oct-07	0	-10	-5	21.72	-1086
22-Oct-07	5	0	2.5	21.72	543
23-Oct-07	0	-10	-5	21.72	-1086
24-Oct-07	5	N/A	5	21.72	1086
25-Oct-07	0	0	0	21.72	0
Average (mm/d)	8.20	12.40	9.46		0.24 m^3/s
Total (MCM)			0.323		**0.296**

Cash Crops Water requirement

Wet Season 2007

Eto	Kc	$ET_{cashcrops}$	Planted Area	Cash Crops WR
mm/d		mm/d	ha	m^3/ d
3.2		2.28		0.01 m^3/s
		0.013		**0.006**

Note: (1) Land Soaking & Land Preparation (LS&LP) of 3.67 mm/d is estimated from 110 mm/season with 30 days (15 days for LS and 15 days for LP).
The measurement is not conducted in this IIEPF project, but value is borrowed from existing available information " the study of waer management in the Num Houm Project 1996".
(2) ETc (mm/d), WR mm/d (fishpond), and Eto (mm/d) shown in the table are already minus rainfall
(3) Skip value (not included in the calculation) in the fishpond WR is marked with " "

Annex 5(a): Total System Water Requirement

Dry Season 2006-07

Date	Paddy WR mm/d	Fishpond WR mm/d	Cash Crops WR mm/d	Total WR mm/d
18-Nov-06	0.055	0.001	0.000	0.06
19-Nov-06	0.055	0.001	0.000	0.06
20-Nov-06	0.055	0.001	0.000	0.06
21-Nov-06	0.055	0.001	0.000	0.06
22-Nov-06	0.055	0.001	0.000	0.06
23-Nov-06	0.055	0.001	0.000	0.06
24-Nov-06	0.055	0.001	0.000	0.06
25-Nov-06	0.055	0.001	0.000	0.06
26-Nov-06	0.055	0.001	0.000	0.06
27-Nov-06	0.055	0.001	0.000	0.06
28-Nov-06	0.055	0.001	0.000	0.06
29-Nov-06	0.055	0.001	0.000	0.06
30-Nov-06	0.055	0.001	0.000	0.06
1-Dec-06	0.055	0.001	0.000	0.06
2-Dec-06	0.055	0.004	0.000	0.06
3-Dec-06	0.055	0.017	0.000	0.07
4-Dec-06	0.055	0.010	0.000	0.06
5-Dec-06	0.055	0.011	0.000	0.07
6-Dec-06	0.055	0.007	0.000	0.06
7-Dec-06	0.055	0.014	0.000	0.07
8-Dec-06	0.055	0.010	0.000	0.06
9-Dec-06	0.055	0.000	0.000	0.05
10-Dec-06	0.055	0.020	0.000	0.07
11-Dec-06	0.055	0.009	0.000	0.06
12-Dec-06	0.055	0.015	0.000	0.07
13-Dec-06	0.055	0.007	0.000	0.06
14-Dec-06	0.055	0.037	0.000	0.09
15-Dec-06	0.055	0.004	0.000	0.06
16-Dec-06	0.055	0.011	0.000	0.07
17-Dec-06	0.055	-0.011	0.000	0.04
18-Dec-06	0.011	-0.005	0.000	0.01
19-Dec-06	0.011	-0.023	0.000	- 0.01

Dry Season 2006-07

Date	Paddy WR mm/d	Fishpond WR mm/d	Cash Crops WR mm/d	Total WR mm/d
20-Dec-06	0.01	0.01	0.00	0.02
21-Dec-06	0.01	0.01	0.00	0.02
22-Dec-06	0.01	0.01	0.00	0.02
23-Dec-06	0.01	0.01	0.00	0.02
24-Dec-06	0.02	0.01	0.00	0.04
25-Dec-06	0.02	-0.03	0.00	-0.01
26-Dec-06	0.02	0.01	0.00	0.03
27-Dec-06	0.02	0.01	0.00	0.03
28-Dec-06	0.01	0.01	0.00	0.03
29-Dec-06	0.02	0.00	0.00	0.02
30-Dec-06	0.03	0.00	0.00	0.02
31-Dec-06	0.03	-0.01	0.00	0.02
1-Jan-07	0.02	-0.01	0.00	0.02
2-Jan-07	0.03	0.00	0.00	0.02
3-Jan-07	0.03	0.00	0.00	0.03
4-Jan-07	0.02	0.00	0.00	0.02
5-Jan-07	0.02	0.00	0.00	0.02
6-Jan-07	0.05	0.01	0.00	0.06
7-Jan-07	0.04	0.01	0.00	0.05
8-Jan-07	0.07	-0.01	0.00	0.06
9-Jan-07	0.02	-0.02	0.00	0.01
10-Jan-07	0.03	0.02	0.00	0.05
11-Jan-07	0.08	0.01	0.00	0.08
12-Jan-07	0.05	0.01	0.00	0.06
13-Jan-07	0.04	0.01	0.00	0.04
14-Jan-07	0.03	0.01	0.00	0.03
15-Jan-07	0.04	0.01	0.00	0.05
16-Jan-07	0.04	0.01	0.00	0.05
17-Jan-07	0.10	-0.05	0.00	0.05
18-Jan-07	0.08	-0.01	0.00	0.07
19-Jan-07	0.05	0.00	0.00	0.05
20-Jan-07	0.04	0.00	0.00	0.05

Dry Season 2006-07

Date	Paddy WR mm/d	Fishpond WR mm/d	Cash Crops WR mm/d	Total WR mm/d
21-Jan-07	0.04	0.00	0.00	0.04
22-Jan-07	0.06	0.00	0.00	0.06
23-Jan-07	0.05	0.00	0.00	0.06
24-Jan-07	0.15	0.01	0.00	0.16
25-Jan-07	0.11	0.00	0.00	0.11
26-Jan-07	0.08	0.01	0.00	0.08
27-Jan-07	0.06	0.00	0.00	0.07
28-Jan-07	0.06	0.00	0.00	0.07
29-Jan-07	0.05	0.00	0.00	0.05
30-Jan-07	0.06	-0.06	0.00	0.00
31-Jan-07	0.09	0.00	0.00	0.09
1-Feb-07	0.11	0.00	0.00	0.12
2-Feb-07	0.05	0.00	0.00	0.06
3-Feb-07	0.09	0.01	0.00	0.09
4-Feb-07	0.08	0.01	0.00	0.09
5-Feb-07	0.10	0.01	0.00	0.10
6-Feb-07	0.06	0.01	0.00	0.06
7-Feb-07	0.08	0.00	0.00	0.08
8-Feb-07	0.07	0.01	0.00	0.08
9-Feb-07	0.11	0.01	0.00	0.12
10-Feb-07	0.11	0.01	0.00	0.11
11-Feb-07	0.10	0.02	0.00	0.11
12-Feb-07	0.07	0.01	0.00	0.08
13-Feb-07	0.07	-0.02	0.00	0.05
14-Feb-07	0.06	0.00	0.00	0.07
15-Feb-07	0.05	0.01	0.00	0.06
16-Feb-07	0.07	0.01	0.00	0.08
17-Feb-07	0.06	0.01	0.00	0.07
18-Feb-07	0.06	-0.02	0.00	0.04
19-Feb-07	0.14	0.00	0.00	0.14
20-Feb-07	0.09	0.01	0.00	0.10
21-Feb-07	0.08	0.00	0.00	0.07

Annex 5(a): Total System Water Requirement

Dry Season 2006-07

Date	Paddy WR mm/d	Fishpond WR mm/d	Cash Crops WR mm/d	Total WR mm/d
22-Feb-07	0.090	-0.005	0.001	0.09
23-Feb-07	0.077	-0.003	0.001	0.07
24-Feb-07	0.080	0.007	0.001	0.09
25-Feb-07	0.097	0.002	0.001	0.10
26-Feb-07	0.178	0.007	0.001	0.18
27-Feb-07	0.174	-0.003	0.002	0.17
28-Feb-07	0.134	-0.015	0.000	0.12
1-Mar-07	0.090	-0.001	0.000	0.09
2-Mar-07	0.181	0.007	0.001	0.19
3-Mar-07	0.105	-0.001	0.000	0.10
4-Mar-07	0.087	0.002	0.001	0.09
5-Mar-07	0.074	0.003	0.001	0.08
6-Mar-07	0.105	-0.002	0.001	0.10
7-Mar-07	0.105	-0.004	0.001	0.10
8-Mar-07	0.095	-0.002	0.001	0.09
9-Mar-07	0.111	0.000	0.001	0.11
10-Mar-07	0.157	0.005	0.001	0.16
11-Mar-07	0.125	0.007	0.000	0.13
12-Mar-07	0.094	0.000	0.001	0.09
13-Mar-07	0.102	-0.007	0.001	0.10
14-Mar-07	0.100	-0.004	0.001	0.10
15-Mar-07	0.127	0.003	0.001	0.13
16-Mar-07	0.095	0.001	0.000	0.10
17-Mar-07	0.146	0.004	0.001	0.15
18-Mar-07	0.094	0.005	0.000	0.10
19-Mar-07	0.089	0.002	0.000	0.09
20-Mar-07	0.111	0.001	0.000	0.11
21-Mar-07	0.067	0.004	0.000	0.07
22-Mar-07	0.130	0.001	0.001	0.13
23-Mar-07	0.140	-0.005	0.001	0.14
24-Mar-07	0.161	0.001	0.001	0.16

Dry Season 2006-07

Date	Paddy WR mm/d	Fishpond WR mm/d	Cash Crops WR mm/d	Total WR mm/d
25-Mar-07	0.096	-0.009	0.000	0.09
26-Mar-07	0.14	-0.01	0.00	0.13
27-Mar-07	0.13	0.01	0.00	0.13
28-Mar-07	0.16	0.00	0.00	0.16
29-Mar-07	0.10	0.00	0.00	0.11
30-Mar-07	0.08	0.00	0.00	0.09
31-Mar-07	0.15	0.00	0.00	0.15
1-Apr-07	0.16	0.01	0.00	0.16
2-Apr-07		0.00	0.00	0.00
3-Apr-07		0.00	0.00	0.00
4-Apr-07		0.00	0.00	0.00
5-Apr-07		0.00	0.00	0.00
6-Apr-07		0.00	0.00	0.00
7-Apr-07		0.00	0.00	0.00
8-Apr-07		0.00	0.00	0.00
9-Apr-07		0.00	0.00	0.00
10-Apr-07		0.00	0.00	0.00
Total	**9.82 MCM**	**0.23 MCM**	**0.08 MCM**	**10.13 MCM**

Annex 5(b): Total System Water Requirement

Wet Season 2007

Date	Paddy WR mm/d	Fishpond WR mm/d	Cash Crops WR mm/d	Total WR mm/d
4-May-07			78	78.00
5-May-07			78	78.00
6-May-07			78	78.00
7-May-07			78	78.00
8-May-07			78	78.00
9-May-07			78	78.00
10-May-07			78	78.00
11-May-07			78	78.00
12-May-07			78	78.00
13-May-07			78	78.00
14-May-07			78	78.00
15-May-07			78	78.00
16-May-07			78	78.00
17-May-07			78	78.00
18-May-07			78	78.00
19-May-07			78	78.00
20-May-07			78	78.00
21-May-07			78	78.00
22-May-07	82,078.816	2,054.74	78	84,211.56
23-May-07	82,078.816	2,054.74	78	84,211.56
24-May-07	82,078.816	2,054.74	78	84,211.56
25-May-07	82,078.816	2,054.74	78	84,211.56
26-May-07	82,078.816	2,054.74	78	84,211.56
27-May-07	82,078.816	2,054.74	78	84,211.56
28-May-07	82,078.816	2,054.74	78	84,211.56
29-May-07	82,078.816	2,054.74	78	84,211.56
30-May-07	82,078.816	2,054.74	78	84,211.56
31-May-07	82,078.816	2,054.74	78	84,211.56
1-Jun-07	82,078.816	2,054.74	88.92	84,222.48
2-Jun-07	82,078.816	3,258.00	88.92	85,425.74
3-Jun-07	82078.816	1,086.00	88.92	83,253.74
4-Jun-07	82078.816	N/A	71.136	82,149.95
5-Jun-07	82078.816	1,520.40	71.136	83,670.35
6-Jun-07	82078.816	3,258.00	71.136	85,407.95
7-Jun-07	82078.816	N/A	71.136	82,149.95

Wet Season 2007

Date	Paddy WR mm/d	Fishpond WR mm/d	Cash Crops WR mm/d	Total WR mm/d
8-Jun-07	82078.816	1,086.00	71.136	83,235.95
9-Jun-07	82078.816	3,801.00	71.136	85,950.95
10-Jun-07	82078.816	-1086.00	71.136	81,063.95
11-Jun-07	82078.816	N/A	71	82,149.82
12-Jun-07	82078.816	1,086.00	62.48	83,227.30
13-Jun-07	82,078.82	N/A	99.4	82,178.22
14-Jun-07	82,078.82	N/A	170.4	82,249.22
15-Jun-07	82,078.82	2,715.00	88.608	84,882.42
16-Jun-07	82,078.82	4,887.00	88.608	87,054.42
17-Jun-07	82,078.82	4,170.24	66.456	86,315.51
18-Jun-07	82,078.82	4,344.00	75.615	86,498.43
19-Jun-07	82,078.82	-6516.00	63.9	75,626.72
20-Jun-07	82,078.82	2,671.56	126.735	84,877.11
21-Jun-07	82,078.82	1,086.00	39.06	83,203.88
22-Jun-07	82,078.82	1,086.00	86.94	83,251.76
23-Jun-07	82,078.82	3,801.00	98.28	85,978.10
24-Jun-07	82,078.82	-1086.00	61.74	81,054.56
25-Jun-07	82,078.82	977.40	52.92	83,109.14
26-Jun-07	82,078.82	4,387.44	78.12	86,544.38
27-Jun-07	82,078.82	2,041.68	22.68	84,143.18
28-Jun-07	82,078.82	6,689.76	78.624	88,847.20
29-Jun-07	82,078.82	3,258.00	78.624	85,415.44
30-Jun-07	82,078.82	3,801.00	254.52	86,134.34
1-Jul-07	82,078.82	1,086.00	91.728	83,256.54
2-Jul-07	36,953.80	1,086.00	29.4	38,069.20
3-Jul-07	84,218.20	695.04	91.728	85,004.97
4-Jul-07	25,495.14	-1086.00	154.35	24,563.49
5-Jul-07	20,904.59	0.00	74.48	20,979.07
6-Jul-07	11,830.07	4,756.68	74.48	16,661.23
7-Jul-07	272,676.66	5,430.00	16.66	278,123.32
8-Jul-07	25,046.91	3,583.80	38.22	28,668.93
9-Jul-07	22,873.38	3,258.00	49.98	26,181.36
10-Jul-07	76,854.26	1,086.00	61.152	78,001.41
11-Jul-07	64,075.24	3,801.00	65.52	67,941.76
12-Jul-07	79,878.71	3,258.00	29.4	83,166.11

Wet Season 2007

Date	Paddy WR mm/d	Fishpond WR mm/d	Cash Crops WR mm/d	Total WR mm/d
13-Jul-07	76,209.21	4,344.00	44.1	80,597.31
14-Jul-07	65,140.78	N/A	55.65	65,196.43
15-Jul-07	93,578.32	N/A	89.25	93,667.57
16-Jul-07	71,699.27	2,172.00	103.95	73,975.22
17-Jul-07	71,297.21	1,086.00	25.725	72,408.93
18-Jul-07	71,736.92	4,344.00	78.75	76,159.67
19-Jul-07	202,743.55	3,735.84	12.6	206,491.99
20-Jul-07	52,027.41	3,258.00	32.76	55,318.17
21-Jul-07	48,211.11	2,823.60		51,034.71
22-Jul-07	88,687.56	1,086.00		89,773.56
23-Jul-07	112,154.64	3,192.84		115,347.48
24-Jul-07	115,676.75	1,629.00		117,305.75
25-Jul-07	84,389.12	-1086.00		83,303.12
26-Jul-07	99,144.10	2,172.00		101,316.10
27-Jul-07	349,694.27	4,691.52		354,385.79
28-Jul-07	101,366.69	2,172.00		103,538.69
29-Jul-07	87,442.89	3,801.00		91,243.89
30-Jul-07	84,102.80	3,801.00		87,903.80
31-Jul-07	740,423.81	N/A		740,423.81
1-Aug-07	N/A	N/A		N/A
2-Aug-07	70,598.22	2,172.00		72,770.22
3-Aug-07	39,511.15	3,258.00		42,769.15
4-Aug-07	127,553.91	4,344.00		131,897.91
5-Aug-07	133,070.56	4,344.00		137,414.56
6-Aug-07	123,751.89	N/A		123,751.89
7-Aug-07	178,918.40	-3019.08		175,899.32
8-Aug-07	161,026.56	4,170.24		165,196.80
9-Aug-07	33,547.20	4,344.00		37,891.20
10-Aug-07	67,094.40	3,366.60		70,461.00
11-Aug-07	246,087.35	1,911.36		247,998.71
12-Aug-07	71,567.36	4,344.00		75,911.36
13-Aug-07	122,260.91	1,086.00		123,346.91
14-Aug-07	117,787.95	1,086.00		118,873.95
15-Aug-07	118,906.19	4,344.00		123,250.19
16-Aug-07	143,060.17	1,824.48		144,884.65

Annex 5(b): Total System Water Requirement

Wet Season 2007

Date	Paddy WR mm/d	Fishpond WR mm/d	Cash Crops WR mm/d	Total WR mm/d
17-Aug-07	64,857.92	N/A		64,857.92
18-Aug-07	256,076.96	5,017.32		261,094.28
19-Aug-07	67,094.40	N/A		67,094.40
20-Aug-07	N/A	N/A		N/A
21-Aug-07	319,257.52	5,473.44		324,730.96
22-Aug-07	95,124.95	2,715.00		97,839.95
23-Aug-07	64,634.27	3,258.00		67,892.27
24-Aug-07	423,812.96	3,518.64		427,331.60
25-Aug-07	29,819.73	N/A		29,819.73
26-Aug-07	108,842.03	4,344.00		113,186.03
27-Aug-07	796,186.88	651.60		796,838.48
28-Aug-07	59,825.84	4,344.00		64,169.84
29-Aug-07	177,800.16	-434.40		177,365.76
30-Aug-07	72,909.25	-6059.88		66,849.37
31-Aug-07	123,006.40	3,105.96		126,112.36
1-Sep-07	64,112.43	-3258.00		60,854.43
2-Sep-07	103,623.57	1,086.00		104,709.57
3-Sep-07	148,912.29	0.00		148,912.29
4-Sep-07	310,311.60	543.00		310,854.60
5-Sep-07	N/A	N/A		N/A
6-Sep-07	581,484.80	6,733.20		588,218.00
7-Sep-07	467,424.32	5,408.28		472,832.60
8-Sep-07	52,557.28	-1086.00		51,471.28
9-Sep-07	156,553.60	1,086.00		157,639.60
10-Sep-07	N/A	N/A		N/A
11-Sep-07	69,330.88	-1498.68		67,832.20
12-Sep-07	173,550.85	3,735.84		177,286.69
13-Sep-07	74,922.08	738.48		75,660.56
14-Sep-07	564,152.08	9,535.08		573,687.16
15-Sep-07	81,631.52	2,172.00		83,803.52
16-Sep-07	121,515.41	2,172.00		123,687.41
17-Sep-07	111,824.00	-2172.00		109,652.00
18-Sep-07	117,415.20	3,258.00		120,673.20
19-Sep-07	4,472.96	N/A		4,472.96
20-Sep-07	180,782.13	2,172.00		182,954.13
21-Sep-07	120,397.17	2,172.00		122,569.17
22-Sep-07	77,904.05	-1086.00		76,818.05
23-Sep-07	101,759.84	2,172.00		103,931.84

Wet Season 2007

Date	Paddy WR mm/d	Fishpond WR mm/d	Cash Crops WR mm/d	Total WR mm/d
24-Sep-07	148,204.07	2,172.00		150,376.07
25-Sep-07	121,515.41	2,172.00		123,687.41
26-Sep-07	11,555.15	2,172.00		13,727.15
27-Sep-07	140,376.39	2,172.00		142,548.39
28-Sep-07	162,256.62	1,107.72		163,364.34
29-Sep-07	621,182.32	7,992.96		629,175.28
30-Sep-07	144,252.96	2,172.00		146,424.96
1-Oct-07	123,565.52	2,172.00		125,737.52
2-Oct-07	103,996.32	2,172.00		106,168.32
3-Oct-07	84,986.24	3,258.00		88,244.24
4-Oct-07	480,284.08	1,672.44		481,956.52
5-Oct-07	576,452.72	651.6		577,104.32
6-Oct-07	N/A	N/A		N/A
7-Oct-07	674,857.84	6516		681,373.84
8-Oct-07	385,233.68	4,930.44		390,164.12
9-Oct-07	-7268.56	7059		(209.56)
10-Oct-07	144,252.96	651.60		144,904.56
11-Oct-07	66,535.28	1,086.00		67,621.28
12-Oct-07	73,244.72	1,086.00		74,330.72
13-Oct-07	95,050.40	-543		94,507.40
14-Oct-07	96,727.76	0.00		96,727.76
15-Oct-07	99,523.36	0.00		99,523.36
16-Oct-07	185,068.72	543		185,611.72
17-Oct-07	58,148.48	0.00		58,148.48
18-Oct-07	133,070.56	1,629.00		134,699.56
19-Oct-07	131,952.32	0.00		131,952.32
20-Oct-07	97,846.00	1,086.00		98,932.00
21-Oct-07	89,459.20	-1086		88,373.20
22-Oct-07	125,802.00	543		126,345.00
23-Oct-07	111,824.00	-1086		110,738.00
24-Oct-07	129,715.84	1,086.00		130,801.84
25-Oct-07	154,876.24	0.00		154,876.24
Total	20.365 MCM	0.297 MCM	0.006 MCM	20.667 MCM

Annex 6(a): Surface Inflows and Outflows

Dry Season 2006-07

	Surface Inflows									Surface Outflows						Main Gate Opening	
	Main canal		Natural streams					Sum N.Inflows		Natural Streams				Sum Outflows			H-Q curve reading
Date	m3/s	mcm	H.Xaykhao	H.Sala	H.NamYen	H.Houm	N.Kham	m3/s	mcm	H.Konh	H. HongXone	H. KoutPoun	H.Lan	m3/s	mcm	cm	m^3/s
25-Nov-06	1.265	0.109	0.046	0.012	0.044	0.260	0.029	0.391	0.034	0.482	0.018	0.066	0	0.566	0.049	15	
19-Nov-06	1.265	0.109	0.046	0.012	0.044	0.260	0.029	0.391	0.034	0.482	0.018	0.066	0	0.566	0.049		
20-Nov-06	1.265	0.109	0.046	0.012	0.044	0.260	0.029	0.391	0.034	0.482	0.018	0.066	0	0.566	0.049		
21-Nov-06	1.265	0.109	0.046	0.012	0.044	0.260	0.029	0.391	0.034	0.482	0.018	0.066	0	0.566	0.049		
22-Nov-06	1.265	0.109	0.046	0.012	0.044	0.260	0.029	0.391	0.034	0.482	0.018	0.066	0	0.566	0.049		
23-Nov-06	1.265	0.109	0.046	0.012	0.044	0.260	0.029	0.391	0.034	0.482	0.018	0.066	0	0.566	0.049		
24-Nov-06	1.265	0.109	0.046	0.012	0.044	0.260	0.029	0.391	0.034	0.482	0.018	0.066	0	0.566	0.049		
25-Nov-06	1.265	0.109	0.046	0.012	0.044	0.260	0.029	0.391	0.034	0.482	0.018	0.066	0	0.566	0.049		
26-Nov-06	1.265	0.109	0.046	0.012	0.044	0.260	0.029	0.391	0.034	0.482	0.018	0.066	0	0.566	0.049		
27-Nov-06	1.265	0.109	0.046	0.012	0.044	0.260	0.029	0.391	0.034	0.482	0.018	0.066	0	0.566	0.049		
28-Nov-06	1.265	0.109	0.046	0.012	0.044	0.260	0.029	0.391	0.034	0.482	0.018	0.066	0	0.566	0.049		
29-Nov-06	1.265	0.109	0.046	0.012	0.044	0.260	0.029	0.391	0.034	0.482	0.018	0.066	0	0.566	0.049		
30-Nov-06	1.265	0.109	0.046	0.012	0.044	0.260	0.029	0.391	0.034	0.482	0.018	0.066	0	0.566	0.049		
1-Dec-06	1.265	0.109	0.046	0.012	0.044	0.260	0.029	0.391	0.034	0.482	0.018	0.066	0	0.566	0.049		
2-Dec-06	1.265	0.109	0.046	0.012	0.044	0.260	0.029	0.391	0.034	0.482	0.018	0.066	0	0.566	0.049		
3-Dec-06	1.265	0.109	0.046	0.012	0.044	0.260	0.029	0.391	0.034	0.482	0.018	0.066	0	0.566	0.049		
4-Dec-06	1.265	0.109	0.046	0.012	0.044	0.260	0.029	0.391	0.034	0.482	0.018	0.066	0	0.566	0.049		
5-Dec-06	1.480	0.128	0.046	0.012	0.044	0.260	0.029	0.391	0.034	0.482	0.018	0.066	0	0.566	0.049	20	
6-Dec-06	1.480	0.128	0.046	0.012	0.044	0.260	0.029	0.391	0.034	0.482	0.018	0.066	0	0.566	0.049	1.480	
7-Dec-06	1.480	0.128	0.046	0.012	0.044	0.260	0.029	0.391	0.034	0.482	0.018	0.066	0	0.566	0.049		
8-Dec-06	1.480	0.128	0.046	0.012	0.044	0.260	0.029	0.391	0.034	0.482	0.018	0.066	0	0.566	0.049		
9-Dec-06	1.480	0.128	0.046	0.012	0.044	0.260	0.029	0.391	0.034	0.482	0.018	0.066	0	0.566	0.049		
10-Dec-06	1.480	0.128	0.046	0.012	0.044	0.260	0.029	0.391	0.034	0.482	0.018	0.066	0	0.566	0.049		
16-Dec-06	2.323	0.201	0.043	0.001	0.061	0.337	0.012	0.454	0.039	0.329	0.022	0.137	0.203	0.691	0.060	30	
16-Dec-06	2.323	0.201	0.043	0.001	0.061	0.337	0.012	0.454	0.039	0.329	0.022	0.137	0.203	0.691	0.060	2.530	
16-Dec-06	2.323	0.201	0.043	0.001	0.061	0.337	0.012	0.454	0.039	0.329	0.022	0.137	0.203	0.691	0.060	0.207	
16-Dec-06	2.323	0.201	0.043	0.001	0.061	0.337	0.012	0.454	0.039	0.329	0.022	0.137	0.203	0.691	0.060		
16-Dec-06	2.323	0.201	0.043	0.001	0.061	0.337	0.012	0.454	0.039	0.329	0.022	0.137	0.203	0.691	0.060		
16-Dec-06	2.323	0.201	0.043	0.001	0.061	0.337	0.012	0.454	0.039	0.329	0.022	0.137	0.203	0.691	0.060		
17-Dec-06	2.323	0.201	0.043	0.001	0.061	0.337	0.012	0.454	0.039	0.329	0.022	0.137	0.203	0.691	0.060		
18-Dec-06	2.323	0.201	0.043	0.001	0.061	0.337	0.012	0.454	0.039	0.329	0.022	0.137	0.203	0.691	0.060		
19-Dec-06	2.323	0.201	0.043	0.001	0.061	0.337	0.012	0.454	0.039	0.329	0.022	0.137	0.203	0.691	0.060		
20-Dec-06	2.323	0.201	0.043	0.001	0.061	0.337	0.012	0.454	0.039	0.329	0.022	0.137	0.203	0.691	0.060		

Annex 6(a): Surface Inflows and Outflows

Dry Season 2006-07

	Surface Inflows									Surface Outflows						Main Gate Opening	
	Main canal		Natural streams					Sum N.Inflows		Natural Streams				Sum Outflows			H-Q curve reading
Date	m3/s	mcm	H.Xaykhao	H.Sala	H.NamYen	H.Houm	N.Kham	m3/s	mcm	H.Konh	H. HongXone	H. KoutPoun	H.Lan	m3/s	mcm	cm	m^3/s
21-Dec-06	2.323	0.201	0.043	0.001	0.061	0.337	0.012	0.454	0.039	0.329	0.022	0.137	0.203	0.691	0.060		
22-Dec-06	2.323	0.201	0.043	0.001	0.061	0.337	0.012	0.454	0.039	0.329	0.022	0.137	0.203	0.691	0.060		
23-Dec-06	2.323	0.201	0.043	0.001	0.061	0.337	0.012	0.454	0.039	0.329	0.022	0.137	0.203	0.691	0.060		
24-Dec-06	2.323	0.201	0.043	0.001	0.061	0.337	0.012	0.454	0.039	0.329	0.022	0.137	0.203	0.691	0.060		
25-Dec-06	2.323	0.201	0.043	0.001	0.061	0.337	0.012	0.454	0.039	0.329	0.022	0.137	0.203	0.691	0.060		
26-Dec-06	2.323	0.201	0.043	0.001	0.061	0.337	0.012	0.454	0.039	0.329	0.022	0.137	0.203	0.691	0.060		
27-Dec-06	2.323	0.201	0.043	0.001	0.061	0.337	0.012	0.454	0.039	0.329	0.022	0.137	0.203	0.691	0.060		
28-Dec-06	2.323	0.201	0.043	0.001	0.061	0.337	0.012	0.454	0.039	0.329	0.022	0.137	0.203	0.691	0.060		
29-Dec-06	2.323	0.201	0.043	0.001	0.061	0.337	0.012	0.454	0.039	0.329	0.022	0.137	0.203	0.691	0.060		
30-Dec-06	2.323	0.201	0.043	0.001	0.061	0.337	0.012	0.454	0.039	0.329	0.022	0.137	0.203	0.691	0.060		
31-Dec-06	2.323	0.201	0.043	0.001	0.061	0.337	0.012	0.454	0.039	0.329	0.022	0.137	0.203	0.691	0.060		
1-Jan-07	2.57	0.222	0.046	0.017	0.038	0.252	0.029	0.382	0.033	0.425	0.020	0.067	0.13	0.642	0.055		
2-Jan-07	2.57	0.222	0.046	0.017	0.038	0.252	0.029	0.382	0.033	0.425	0.020	0.067	0.13	0.642	0.055		
3-Jan-07	2.57	0.222	0.046	0.017	0.038	0.252	0.029	0.382	0.033	0.425	0.020	0.067	0.13	0.642	0.055		
4-Jan-07	2.57	0.222	0.046	0.017	0.038	0.252	0.029	0.382	0.033	0.425	0.020	0.067	0.13	0.642	0.055		
5-Jan-07	2.57	0.222	0.046	0.017	0.038	0.252	0.029	0.382	0.033	0.425	0.020	0.067	0.13	0.642	0.055		
6-Jan-07	2.57	0.222	0.046	0.017	0.038	0.252	0.029	0.382	0.033	0.425	0.020	0.067	0.13	0.642	0.055		
7-Jan-07	2.57	0.222	0.046	0.017	0.038	0.252	0.029	0.382	0.033	0.425	0.020	0.067	0.13	0.642	0.055		
8-Jan-07	2.57	0.222	0.046	0.017	0.038	0.252	0.029	0.382	0.033	0.425	0.020	0.067	0.13	0.642	0.055		
9-Jan-07	2.57	0.222	0.046	0.017	0.038	0.252	0.029	0.382	0.033	0.425	0.020	0.067	0.13	0.642	0.055		
10-Jan-07	2.57	0.222	0.046	0.017	0.038	0.252	0.029	0.382	0.033	0.425	0.020	0.067	0.13	0.642	0.055		
11-Jan-07	2.57	0.222	0.046	0.017	0.038	0.252	0.029	0.382	0.033	0.425	0.020	0.067	0.13	0.642	0.055		
12-Jan-07	2.57	0.222	0.046	0.017	0.038	0.252	0.029	0.382	0.033	0.425	0.020	0.067	0.13	0.642	0.055		
13-Jan-07	2.57	0.222	0.046	0.017	0.038	0.252	0.029	0.382	0.033	0.425	0.020	0.067	0.13	0.642	0.055		
14-Jan-07	2.57	0.222	0.046	0.017	0.038	0.252	0.029	0.382	0.033	0.425	0.020	0.067	0.13	0.642	0.055		
15-Jan-07	2.57	0.222	0.046	0.017	0.038	0.252	0.029	0.382	0.033	0.425	0.020	0.067	0.13	0.642	0.055		
16-Jan-07	2.755	0.238	0.03	0.001	0.019	0.515	0.015	0.58	0.050	0.224	0.015	0.426	0.279	0.944	0.082		
17-Jan-07	2.755	0.238	0.03	0.001	0.019	0.515	0.015	0.58	0.050	0.224	0.015	0.426	0.279	0.944	0.082		
18-Jan-07	2.755	0.238	0.03	0.001	0.019	0.515	0.015	0.58	0.050	0.224	0.015	0.426	0.279	0.944	0.082		
19-Jan-07	2.755	0.238	0.03	0.001	0.019	0.515	0.015	0.58	0.050	0.224	0.015	0.426	0.279	0.944	0.082		
20-Jan-07	2.755	0.238	0.03	0.001	0.019	0.515	0.015	0.58	0.050	0.224	0.015	0.426	0.279	0.944	0.082		
21-Jan-07	2.755	0.238	0.03	0.001	0.019	0.515	0.015	0.58	0.050	0.224	0.015	0.426	0.279	0.944	0.082		
22-Jan-07	2.755	0.238	0.03	0.001	0.019	0.515	0.015	0.58	0.050	0.224	0.015	0.426	0.279	0.944	0.082		
23-Jan-07	2.755	0.238	0.03	0.001	0.019	0.515	0.015	0.58	0.050	0.224	0.015	0.426	0.279	0.944	0.082		
24-Jan-07	2.755	0.238	0.03	0.001	0.019	0.515	0.015	0.58	0.050	0.224	0.015	0.426	0.279	0.944	0.082		

Annex 6(a): Surface Inflows and Outflows

Dry Season 2006-07

Date	Surface Inflows									Surface Outflows						Main Gate Opening	
	Main canal		Natural streams					Sum N.Inflows		Natural Streams				Sum Outflows			H-Q curve reading
Date	m3/s	mcm	H.Xaykhao	H.Sala	H.NamYen	H.Houm	N.Kham	m3/s	mcm	H.Konh	H. HongXone	H. KoutPoun	H.Lan	m3/s	mcm	cm	m^3/s
25-Jan-07	2.755	0.238	0.03	0.001	0.019	0.515	0.015	0.58	0.050	0.224	0.015	0.426	0.279	0.944	0.082		
26-Jan-07	2.755	0.238	0.03	0.001	0.019	0.515	0.015	0.58	0.050	0.224	0.015	0.426	0.279	0.944	0.082		
27-Jan-07	2.755	0.238	0.03	0.001	0.019	0.515	0.015	0.58	0.050	0.224	0.015	0.426	0.279	0.944	0.082		
28-Jan-07	2.755	0.238	0.03	0.001	0.019	0.515	0.015	0.58	0.050	0.224	0.015	0.426	0.279	0.944	0.082		
1-Feb-07	2.033	0.176	0.027	0	0.033	0.406	0.001	0.467	0.040	0.177	0.035	0.365	0.114	0.691	0.060	22	
1-Feb-07	2.033	0.176	0.027	0	0.033	0.406	0.001	0.467	0.040	0.177	0.035	0.365	0.114	0.691	0.060		
1-Feb-07	2.033	0.176	0.027	0	0.033	0.406	0.001	0.467	0.040	0.177	0.035	0.365	0.114	0.691	0.060		
1-Feb-07	2.033	0.176	0.027	0	0.033	0.406	0.001	0.467	0.040	0.177	0.035	0.365	0.114	0.691	0.060		
2-Feb-07	2.033	0.176	0.027	0	0.033	0.406	0.001	0.467	0.040	0.177	0.035	0.365	0.114	0.691	0.060		
3-Feb-07	2.033	0.176	0.027	0	0.033	0.406	0.001	0.467	0.040	0.177	0.035	0.365	0.114	0.691	0.060		
4-Feb-07	2.033	0.176	0.027	0	0.033	0.406	0.001	0.467	0.040	0.177	0.035	0.365	0.114	0.691	0.060		
5-Feb-07	2.033	0.176	0.027	0	0.033	0.406	0.001	0.467	0.040	0.177	0.035	0.365	0.114	0.691	0.060		
6-Feb-07	2.033	0.176	0.027	0	0.033	0.406	0.001	0.467	0.040	0.177	0.035	0.365	0.114	0.691	0.060		
7-Feb-07	2.033	0.176	0.027	0	0.033	0.406	0.001	0.467	0.040	0.177	0.035	0.365	0.114	0.691	0.060		
8-Feb-07	2.033	0.176	0.027	0	0.033	0.406	0.001	0.467	0.040	0.177	0.035	0.365	0.114	0.691	0.060		
9-Feb-07	2.033	0.176	0.027	0	0.033	0.406	0.001	0.467	0.040	0.177	0.035	0.365	0.114	0.691	0.060		
10-Feb-07	2.033	0.176	0.027	0	0.033	0.406	0.001	0.467	0.040	0.177	0.035	0.365	0.114	0.691	0.060		
11-Feb-07	2.033	0.176	0.027	0	0.033	0.406	0.001	0.467	0.040	0.177	0.035	0.365	0.114	0.691	0.060		
12-Feb-07	2.033	0.176	0.027	0	0.033	0.406	0.001	0.467	0.040	0.177	0.035	0.365	0.114	0.691	0.060	25	
13-Feb-07	2.033	0.176	0.027	0	0.033	0.406	0.001	0.467	0.040	0.177	0.035	0.365	0.114	0.691	0.060		
14-Feb-07	2.033	0.176	0.027	0	0.033	0.406	0.001	0.467	0.040	0.177	0.035	0.365	0.114	0.691	0.060		
15-Feb-07	2.033	0.176	0.027	0	0.033	0.406	0.001	0.467	0.040	0.177	0.035	0.365	0.114	0.691	0.060		
16-Feb-07	2.626	0.227	0.016	0.000	0.000	0.413	0.000	0.429	0.037	0.212	0.007	0.369	0.065	0.653	0.056		
17-Feb-07	2.625	0.227	0.016	0.000	0.000	0.413	0.000	0.429	0.037	0.212	0.007	0.369	0.065	0.653	0.056		
18-Feb-07	2.625	0.227	0.016	0.000	0.000	0.413	0.000	0.429	0.037	0.212	0.007	0.369	0.065	0.653	0.056		
19-Feb-07	2.625	0.227	0.016	0.000	0.000	0.413	0.000	0.429	0.037	0.212	0.007	0.369	0.065	0.653	0.056		
20-Feb-07	2.625	0.227	0.016	0.000	0.000	0.413	0.000	0.429	0.037	0.212	0.007	0.369	0.065	0.653	0.056		
21-Feb-07	2.625	0.227	0.016	0.000	0.000	0.413	0.000	0.429	0.037	0.212	0.007	0.369	0.065	0.653	0.056		
22-Feb-07	2.625	0.227	0.016	0.000	0.000	0.413	0.000	0.429	0.037	0.212	0.007	0.369	0.065	0.653	0.056		
23-Feb-07	2.625	0.227	0.016	0.000	0.000	0.413	0.000	0.429	0.037	0.212	0.007	0.369	0.065	0.653	0.056		
24-Feb-07	2.625	0.227	0.016	0.000	0.000	0.413	0.000	0.429	0.037	0.212	0.007	0.369	0.065	0.653	0.056		
25-Feb-07	2.625	0.227	0.016	0.000	0.000	0.413	0.000	0.429	0.037	0.212	0.007	0.369	0.065	0.653	0.056		
26-Feb-07	2.625	0.227	0.016	0.000	0.000	0.413	0.000	0.429	0.037	0.212	0.007	0.369	0.065	0.653	0.056		
27-Feb-07	2.625	0.227	0.016	0.000	0.000	0.413	0.000	0.429	0.037	0.212	0.007	0.369	0.065	0.653	0.056		
28-Feb-07	2.625	0.227	0.016	0.000	0.000	0.413	0.000	0.429	0.037	0.212	0.007	0.369	0.065	0.653	0.056		

Annex 6(a): Surface Inflows and Outflows

Dry Season 2006-07

	Surface Inflows									Surface Outflows						Main Gate Opening	
	Main canal		Natural streams					Sum N.Inflows		Natural Streams				Sum Outflows			H-Q curve reading
Date	m3/s	mcm	H.Xaykhao	H.Sala	H.NamYen	H.Houm	N.Kham	m3/s	mcm	H.Konh	H. HongXone	H. KoutPoun	H.Lan	m3/s	mcm	cm	m^3/s
1-Mar-07	2.348	0.203	0.03	0.000	0.000	0.488	0.000	0.518	0.045	0.315	0.123	0.728	0.102	1.268	0.110	30	
2-Mar-07	2.348	0.203	0.03	0.000	0.000	0.488	0.000	0.518	0.045	0.315	0.123	0.728	0.102	1.268	0.110		
3-Mar-07	2.348	0.203	0.03	0.000	0.000	0.488	0.000	0.518	0.045	0.315	0.123	0.728	0.102	1.268	0.110		
4-Mar-07	2.348	0.203	0.03	0.000	0.000	0.488	0.000	0.518	0.045	0.315	0.123	0.728	0.102	1.268	0.110		
5-Mar-07	2.348	0.203	0.03	0.000	0.000	0.488	0.000	0.518	0.045	0.315	0.123	0.728	0.102	1.268	0.110		
6-Mar-07	2.348	0.203	0.03	0.000	0.000	0.488	0.000	0.518	0.045	0.315	0.123	0.728	0.102	1.268	0.110		
7-Mar-07	2.348	0.203	0.03	0.000	0.000	0.488	0.000	0.518	0.045	0.315	0.123	0.728	0.102	1.268	0.110		
8-Mar-07	2.348	0.203	0.03	0.000	0.000	0.488	0.000	0.518	0.045	0.315	0.123	0.728	0.102	1.268	0.110		
9-Mar-07	2.348	0.203	0.03	0.000	0.000	0.488	0.000	0.518	0.045	0.315	0.123	0.728	0.102	1.268	0.110		
10-Mar-07	2.348	0.203	0.03	0.000	0.000	0.488	0.000	0.518	0.045	0.315	0.123	0.728	0.102	1.268	0.110		
11-Mar-07	2.348	0.203	0.03	0.000	0.000	0.488	0.000	0.518	0.045	0.315	0.123	0.728	0.102	1.268	0.110		
12-Mar-07	2.348	0.203	0.03	0.000	0.000	0.488	0.000	0.518	0.045	0.315	0.123	0.728	0.102	1.268	0.110		
13-Mar-07	2.348	0.203	0.03	0.000	0.000	0.488	0.000	0.518	0.045	0.315	0.123	0.728	0.102	1.268	0.110		
14-Mar-07	2.348	0.203	0.03	0.000	0.000	0.488	0.000	0.518	0.045	0.315	0.123	0.728	0.102	1.268	0.110		
15-Mar-07	2.348	0.203	0.03	0.000	0.000	0.488	0.000	0.518	0.045	0.315	0.123	0.728	0.102	1.268	0.110		
16-Mar-07	3.010	0.260	0.02	0.000	0.000	0.587	0.000	0.607	0.052	0.312	0.076	0.431	0.09	0.909	0.079	40	
17-Mar-07	3.010	0.260	0.02	0.000	0.000	0.587	0.000	0.607	0.052	0.312	0.076	0.431	0.09	0.909	0.079		
18-Mar-07	3.010	0.260	0.02	0.000	0.000	0.587	0.000	0.607	0.052	0.312	0.076	0.431	0.09	0.909	0.079		
19-Mar-07	3.010	0.260	0.02	0.000	0.000	0.587	0.000	0.607	0.052	0.312	0.076	0.431	0.09	0.909	0.079		
20-Mar-07	3.010	0.260	0.02	0.000	0.000	0.587	0.000	0.607	0.052	0.312	0.076	0.431	0.09	0.909	0.079		
21-Mar-07	3.010	0.260	0.02	0.000	0.000	0.587	0.000	0.607	0.052	0.312	0.076	0.431	0.09	0.909	0.079		
22-Mar-07	3.010	0.260	0.02	0.000	0.000	0.587	0.000	0.607	0.052	0.312	0.076	0.431	0.09	0.909	0.079		
23-Mar-07	3.010	0.260	0.02	0.000	0.000	0.587	0.000	0.607	0.052	0.312	0.076	0.431	0.09	0.909	0.079		
24-Mar-07	3.010	0.260	0.02	0.000	0.000	0.587	0.000	0.607	0.052	0.312	0.076	0.431	0.09	0.909	0.079		
25-Mar-07	3.010	0.260	0.02	0.000	0.000	0.587	0.000	0.607	0.052	0.312	0.076	0.431	0.09	0.909	0.079		
26-Mar-07	3.010	0.260	0.02	0.000	0.000	0.587	0.000	0.607	0.052	0.312	0.076	0.431	0.09	0.909	0.079		
27-Mar-07	3.010	0.260	0.02	0.000	0.000	0.587	0.000	0.607	0.052	0.312	0.076	0.431	0.09	0.909	0.079		
28-Mar-07	3.010	0.260	0.02	0.000	0.000	0.587	0.000	0.607	0.052	0.312	0.076	0.431	0.09	0.909	0.079		
29-Mar-07	3.010	0.260	0.02	0.000	0.000	0.587	0.000	0.607	0.052	0.312	0.076	0.431	0.09	0.909	0.079		
30-Mar-07	3.010	0.260	0.02	0.000	0.000	0.587	0.000	0.607	0.052	0.312	0.076	0.431	0.09	0.909	0.079		
31-Mar-07	1.943	0.168	0.013	0.000	0.000	0.327	0.000	0.34	0.029	0.199	0.127	0.088	0.084	0.498	0.043		
1-Apr-07	1.943	0.168	0.013	0.000	0.000	0.327	0.000	0.34	0.029	0.199	0.127	0.088	0.084	0.498	0.043		
2-Apr-07	1.943	0.168	0.013	0.000	0.000	0.327	0.000	0.34	0.029	0.199	0.127	0.088	0.084	0.498	0.043		
3-Apr-07	1.943	0.168	0.013	0.000	0.000	0.327	0.000	0.34	0.029	0.199	0.127	0.088	0.084	0.498	0.043		

Annex 6(a): Surface Inflows and Outflows

Dry Season 2006-07

	Surface Inflows									Surface Outflows						Main Gate Opening	
	Main canal		Natural streams					Sum N.Inflows		Natural Streams				Sum Outflows			H-Q curve reading
Date	m3/s	mcm	H.Xaykhao	H.Sala	H.NamYen	H.Houm	N.Kham	m3/s	mcm	H.Konh	H. HongXone	H. KoutPoun	H.Lan	m3/s	mcm	cm	m^3/s
4-Apr-07	1.943	0.168	0.013	0.000	0.000	0.327	0.000	0.34	0.029	0.199	0.127	0.088	0.084	0.498	0.043		
5-Apr-07	1.943	0.168	0.013	0.000	0.000	0.327	0.000	0.34	0.029	0.199	0.127	0.088	0.084	0.498	0.043		
Total (MCM)		**27.327**							**5.59**						**9.16**		

Annex 6(b): Surface Inflows and Outflows

Wet Season 2007

	Surface Inflows									Surface Outflows						Main Gate Opening	
	Main canal		Natural streams					Sum N.Inflows		Natural Streams				Sum Outflows			H-Q curve reading
Date	m3/s	mcm	H.Xaykhao	H.Sala	H.NamYen	H.Houm	N.Kham	m3/s	mcm	H.Konh	H. HongXone	H. KoutPoun	H.Lan	m3/s	mcm	cm	m^3/s
22-May-07	0.25	0.022	0.024	0	0	0.194	0	0.218	0.019	0.152	0.001	0.107	0.04	0.3	0.026	3	
23-May-07	0.25	0.022	0.024	0	0	0.194	0	0.218	0.019	0.152	0.001	0.107	0.04	0.3	0.026	0.253	
24-May-07	0.25	0.022	0.024	0	0	0.194	0	0.218	0.019	0.152	0.001	0.107	0.04	0.3	0.026		
25-May-07	0.25	0.022	0.024	0	0	0.194	0	0.218	0.019	0.152	0.001	0.107	0.04	0.3	0.026		
26-May-07	0.25	0.022	0.024	0	0	0.194	0	0.218	0.019	0.152	0.001	0.107	0.04	0.3	0.026		
27-May-07	0.25	0.022	0.024	0	0	0.194	0	0.218	0.019	0.152	0.001	0.107	0.04	0.3	0.026		
28-May-07	0.00	0.000	0.024	0	0	0.194	0	0.218	0.019	0.152	0.001	0.107	0.04	0.3	0.026	close	
29-May-07	0.00	0.000	0.024	0	0	0.194	0	0.218	0.019	0.152	0.001	0.107	0.04	0.3	0.026		
30-May-07	0.00	0.000	0.024	0	0	0.194	0	0.218	0.019	0.152	0.001	0.107	0.04	0.3	0.026		
31-May-07	0.00	0.000	0.024	0	0	0.194	0	0.218	0.019	0.152	0.001	0.107	0.04	0.3	0.026		
1-Jun-07	0.00	0.000	0.024	0	0	0.194	0	0.218	0.019	0.152	0.001	0.107	0.04	0.3	0.026		
2-Jun-07	0.00	0.000	0.024	0	0	0.194	0	0.218	0.019	0.152	0.001	0.107	0.04	0.3	0.026		
3-Jun-07	0.00	0.000	0.024	0	0	0.194	0	0.218	0.019	0.152	0.001	0.107	0.04	0.3	0.026		
4-Jun-07	0.00	0.000	0.024	0	0	0.194	0	0.218	0.019	0.152	0.001	0.107	0.04	0.3	0.026		
5-Jun-07	0.00	0.000	0.024	0	0	0.194	0	0.218	0.019	0.152	0.001	0.107	0.04	0.3	0.026		
6-Jun-07	0.00	0.000	0.024	0	0	0.194	0	0.218	0.019	0.152	0.001	0.107	0.04	0.3	0.026		
7-Jun-07	0.00	0.000	0.024	0	0	0.194	0	0.218	0.019	0.152	0.001	0.107	0.04	0.3	0.026		
8-Jun-07	0.00	0.000	0.024	0	0	0.194	0	0.218	0.019	0.152	0.001	0.107	0.04	0.3	0.026		
9-Jun-07	0.00	0.000	0.024	0	0	0.194	0	0.218	0.019	0.152	0.001	0.107	0.04	0.3	0.026		
10-Jun-07	0.00	0.000	0.024	0	0	0.194	0	0.218	0.019	0.152	0.001	0.107	0.04	0.3	0.026		
11-Jun-07	0.00	0.000	0.024	0	0	0.194	0	0.218	0.019	0.152	0.001	0.107	0.04	0.3	0.026		
12-Jun-07	0.00	0.000	0.024	0	0	0.194	0	0.218	0.019	0.152	0.001	0.107	0.04	0.3	0.026		
13-Jun-07	0.00	0.000	0.024	0	0	0.194	0	0.218	0.019	0.152	0.001	0.107	0.04	0.3	0.026		
14-Jun-07	0.00	0.000	0.024	0	0	0.194	0	0.218	0.019	0.152	0.001	0.107	0.04	0.3	0.026		
15-Jun-07	0.00	0.000	0.024	0	0	0.194	0	0.218	0.019	0.152	0.001	0.107	0.04	0.3	0.026		
16-Jun-07	0.00	0.000	0.023	0	0	0.252	0	0.275	0.024	0.044	0.000	0.009	0.001	0.054	0.005		
17-Jun-07	0.00	0.000	0.023	0	0	0.252	0	0.275	0.024	0.044	0.000	0.009	0.001	0.054	0.005		
18-Jun-07	0.00	0.000	0.023	0	0	0.252	0	0.275	0.024	0.044	0.000	0.009	0.001	0.054	0.005		
19-Jun-07	0.00	0.000	0.023	0	0	0.252	0	0.275	0.024	0.044	0.000	0.009	0.001	0.054	0.005		
20-Jun-07	0.00	0.000	0.023	0	0	0.252	0	0.275	0.024	0.044	0.000	0.009	0.001	0.054	0.005		
21-Jun-07	0.00	0.000	0.023	0	0	0.252	0	0.275	0.024	0.044	0.000	0.009	0.001	0.054	0.005		
22-Jun-07	0.00	0.000	0.023	0	0	0.252	0	0.275	0.024	0.044	0.000	0.009	0.001	0.054	0.005	0.69	

Annex 6(b): Surface Inflows and Outflows

Wet Season 2007

	Surface Inflows									Surface Outflows						Main Gate Opening	
	Main canal		Natural streams					Sum N.Inflows		Natural Streams				Sum Outflows			H-Q curve reading
Date	m3/s	mcm	H.Xaykhao	H.Sala	H.NamYen	H.Houm	N.Kham	m3/s	mcm	H.Konh	H. HongXone	H. KoutPoun	H.Lan	m3/s	mcm	cm	m^3/s
23-Jun-07	0.69	0.060	0.023	0	0	0.252	0	0.275	0.024	0.044	0.000	0.009	0.001	0.054	0.005	10	
24-Jun-07	2.06	0.178	0.023	0	0	0.252	0	0.275	0.024	0.044	0.000	0.009	0.001	0.054	0.005	30	
25-Jun-07	2.06	0.178	0.002	0.046	0.047	0.337	0.01	0.442	0.038	0.475	0.009	0.663	0.033	1.18	0.102		
26-Jun-07	2.06	0.178	0.002	0.046	0.047	0.337	0.01	0.442	0.038	0.475	0.009	0.663	0.033	1.18	0.102		
27-Jun-07	2.06	0.178	0.002	0.046	0.047	0.337	0.01	0.442	0.038	0.475	0.009	0.663	0.033	1.18	0.102		
28-Jun-07	2.06	0.178	0.002	0.046	0.047	0.337	0.01	0.442	0.038	0.475	0.009	0.663	0.033	1.18	0.102		
29-Jun-07	2.06	0.178	0.002	0.046	0.047	0.337	0.01	0.442	0.038	0.475	0.009	0.663	0.033	1.18	0.102		
30-Jun-07	2.06	0.178	0.002	0.046	0.047	0.337	0.01	0.442	0.038	0.475	0.009	0.663	0.033	1.18	0.102		
1-Jul-07	2.06	0.178	0.002	0.046	0.047	0.337	0.01	0.442	0.038	0.475	0.009	0.663	0.033	1.18	0.102		
2-Jul-07	2.06	0.178	0.002	0.046	0.047	0.337	0.01	0.442	0.038	0.475	0.009	0.663	0.033	1.18	0.102		
3-Jul-07	2.06	0.178	0.002	0.046	0.047	0.337	0.01	0.442	0.038	0.475	0.009	0.663	0.033	1.18	0.102		
4-Jul-07	2.06	0.178	0.002	0.046	0.047	0.337	0.01	0.442	0.038	0.475	0.009	0.663	0.033	1.18	0.102		
5-Jul-07	2.06	0.178	0.002	0.046	0.047	0.337	0.01	0.442	0.038	0.475	0.009	0.663	0.033	1.18	0.102		
6-Jul-07	2.06	0.178	0.002	0.046	0.047	0.337	0.01	0.442	0.038	0.475	0.009	0.663	0.033	1.18	0.102		
7-Jul-07	2.06	0.178	0.002	0.046	0.047	0.337	0.01	0.442	0.038	0.475	0.009	0.663	0.033	1.18	0.102		
8-Jul-07	2.06	0.178	0.002	0.046	0.047	0.337	0.01	0.442	0.038	0.475	0.009	0.663	0.033	1.18	0.102		
9-Jul-07	2.06	0.178	0.002	0.046	0.047	0.337	0.01	0.442	0.038	0.475	0.009	0.663	0.033	1.18	0.102		
10-Jul-07	2.06	0.178	0.002	0.046	0.047	0.337	0.01	0.442	0.038	0.475	0.009	0.663	0.033	1.18	0.102		
11-Jul-07	2.06	0.178	0.002	0.046	0.047	0.337	0.01	0.442	0.038	0.475	0.009	0.663	0.033	1.18	0.102		
12-Jul-07	2.06	0.178	0.002	0.046	0.047	0.337	0.01	0.442	0.038	0.475	0.009	0.663	0.033	1.18	0.102		
13-Jul-07	2.06	0.178	0.002	0.046	0.047	0.337	0.01	0.442	0.038	0.475	0.009	0.663	0.033	1.18	0.102		
14-Jul-07	3.43	0.297	0.002	0.046	0.047	0.337	0.01	0.442	0.038	0.475	0.009	0.663	0.033	1.18	0.102	50	
15-Jul-07	3.43	0.297	0.002	0.046	0.032	0.337	0.01	0.427	0.037	0.475	0.009	0.663	0.033	1.18	0.102	3.43	
16-Jul-07	3.43	0.297	0.032	0.002	0.032	0.375	0	0.441	0.038	0.32	0.002	0.036	0.03	0.388	0.034		
17-Jul-07	3.43	0.297	0.032	0.002	0.032	0.375	0	0.441	0.038	0.328	0.002	0.036	0.03	0.396	0.034		
18-Jul-07	3.43	0.297	0.032	0.002	0.032	0.375	0	0.441	0.038	0.328	0.002	0.036	0.03	0.396	0.034		
19-Jul-07	3.43	0.297	0.032	0.002	0.032	0.375	0	0.441	0.038	0.328	0.002	0.036	0.03	0.396	0.034		
20-Jul-07	3.43	0.297	0.032	0.002	0.032	0.375	0	0.441	0.038	0.328	0.002	0.036	0.03	0.396	0.034		
21-Jul-07	3.43	0.297	0.032	0.002	0.032	0.375	0	0.441	0.038	0.328	0.002	0.036	0.03	0.396	0.034		
22-Jul-07	3.43	0.297	0.032	0.002	0.032	0.375	0	0.441	0.038	0.328	0.002	0.036	0.03	0.396	0.034		
23-Jul-07	3.43	0.297	0.032	0.002	0.032	0.375	0	0.441	0.038	0.328	0.002	0.036	0.03	0.396	0.034		
24-Jul-07	3.43	0.297	0.032	0.002	0.032	0.375	0	0.441	0.038	0.328	0.002	0.036	0.03	0.396	0.034		
25-Jul-07	3.43	0.297	0.032	0.002	0.032	0.375	0	0.441	0.038	0.328	0.002	0.036	0.03	0.396	0.034		
26-Jul-07	0.00	0.000	0.032	0.002	0.032	0.375	0	0.441	0.038	0.328	0.002	0.036	0.03	0.396	0.034	close	

Annex 6(b): Surface Inflows and Outflows

Wet Season 2007

	Surface Inflows									Surface Outflows						Main Gate Opening	
	Main canal		Natural streams					Sum N.Inflows		Natural Streams				Sum Outflows			H-Q curve reading
Date	m3/s	mcm	H.Xaykhao	H.Sala	H.NamYen	H.Houm	N.Kham	m3/s	mcm	H.Konh	H. HongXone	H. KoutPoun	H.Lan	m3/s	mcm	cm	m^3/s
27-Jul-07	0.00	0.000	0.032	0.002	0.032	0.375	0	0.441	0.038	0.328	0.002	0.036	0.03	0.396	0.034		
28-Jul-07	0.00	0.000	0.032	0.002	0.032	0.375	0	0.441	0.038	0.328	0.002	0.036	0.03	0.396	0.034		
29-Jul-07	0.00	0.000	0.032	0.002	0.032	0.375	0	0.441	0.038	0.328	0.002	0.036	0.03	0.396	0.034		
30-Jul-07	0.00	0.000	0.032	0.002	0.032	0.375	0	0.441	0.038	0.328	0.002	0.036	0.03	0.396	0.034		
31-Jul-07	0.00	0.000	0.032	0.002	0.032	0.375	0	0.441	0.038	0.328	0.002	0.036	0.03	0.396	0.034		
1-Aug-07	0.00	0.000	0.011	0.001	0.019	0.449	0.011	0.491	0.042	0.023	0.001	0.516	0.025	0.565	0.049		
2-Aug-07	0.00	0.000	0.011	0.001	0.019	0.449	0.011	0.491	0.042	0.023	0.001	0.526	0.025	0.575	0.050		
3-Aug-07	0.00	0.000	0.011	0.001	0.019	0.449	0.011	0.491	0.042	0.023	0.001	0.526	0.025	0.575	0.050		
4-Aug-07	0.00	0.000	0.011	0.001	0.019	0.449	0.011	0.491	0.042	0.023	0.001	0.526	0.025	0.575	0.050		
5-Aug-07	0.00	0.000	0.011	0.001	0.019	0.449	0.011	0.491	0.042	0.023	0.001	0.526	0.025	0.575	0.050		
6-Aug-07	0.00	0.000	0.011	0.001	0.019	0.449	0.011	0.491	0.042	0.023	0.001	0.526	0.025	0.575	0.050		
7-Aug-07	0.00	0.000	0.011	0.001	0.019	0.449	0.011	0.491	0.042	0.023	0.001	0.526	0.025	0.575	0.050		
8-Aug-07	0.00	0.000	0.011	0.001	0.019	0.449	0.011	0.491	0.042	0.023	0.001	0.526	0.025	0.575	0.050		
9-Aug-07	0.00	0.000	0.011	0.001	0.019	0.449	0.011	0.491	0.042	0.023	0.001	0.526	0.025	0.575	0.050		
10-Aug-07	0.00	0.000	0.011	0.001	0.019	0.449	0.011	0.491	0.042	0.023	0.001	0.526	0.025	0.575	0.050		
11-Aug-07	0.00	0.000	0.011	0.001	0.019	0.449	0.011	0.491	0.042	0.023	0.001	0.526	0.025	0.575	0.050		
12-Aug-07	0.00	0.000	0.011	0.001	0.019	0.449	0.011	0.491	0.042	0.023	0.001	0.526	0.025	0.575	0.050		
13-Aug-07	0.00	0.000	0.011	0.001	0.019	0.449	0.011	0.491	0.042	0.023	0.001	0.526	0.025	0.575	0.050		
14-Aug-07	0.00	0.000	0.011	0.001	0.019	0.449	0.011	0.491	0.042	0.023	0.001	0.526	0.025	0.575	0.050		
15-Aug-07	0.00	0.000	0.011	0.001	0.019	0.449	0.011	0.491	0.042	0.023	0.001	0.526	0.025	0.575	0.050		
16-Aug-07	0.00	0.000	0.093	0.011	0.072	1.185	0.230	1.591	0.137	1.059	0.202	1.078	0.045	2.384	0.206		
17-Aug-07	0.00	0.000	0.093	0.001	0.072	1.185	0.230	1.581	0.137	1.059	0.202	1.078	0.045	2.384	0.206		
18-Aug-07	0.00	0.000	0.093	0.001	0.072	1.185	0.230	1.581	0.137	1.059	0.202	1.078	0.045	2.384	0.206		
19-Aug-07	0.00	0.000	0.093	0.001	0.072	1.185	0.230	1.581	0.137	1.059	0.202	1.078	0.045	2.384	0.206		
20-Aug-07	0.00	0.000	0.093	0.001	0.072	1.185	0.230	1.581	0.137	1.059	0.202	1.078	0.045	2.384	0.206		
21-Aug-07	0.00	0.000	0.093	0.001	0.072	1.185	0.230	1.581	0.137	1.059	0.202	1.078	0.045	2.384	0.206		
22-Aug-07	0.00	0.000	0.093	0.001	0.072	1.185	0.230	1.581	0.137	1.059	0.202	1.078	0.045	2.384	0.206		
23-Aug-07	0.00	0.000	0.093	0.001	0.072	1.185	0.230	1.581	0.137	1.059	0.202	1.078	0.045	2.384	0.206		
24-Aug-07	0.00	0.000	0.093	0.001	0.072	1.185	0.230	1.581	0.137	1.059	0.202	1.078	0.045	2.384	0.206		
25-Aug-07	0.00	0.000	0.093	0.001	0.072	1.185	0.230	1.581	0.137	1.059	0.202	1.078	0.045	2.384	0.206		
26-Aug-07	0.00	0.000	0.093	0.001	0.072	1.185	0.230	1.581	0.137	1.059	0.202	1.078	0.045	2.384	0.206		
27-Aug-07	0.00	0.000	0.093	0.001	0.072	1.185	0.230	1.581	0.137	1.059	0.202	1.078	0.045	2.384	0.206		
28-Aug-07	0.00	0.000	0.093	0.001	0.072	1.185	0.230	1.581	0.137	1.059	0.202	1.078	0.045	2.384	0.206		
29-Aug-07	0.00	0.000	0.093	0.001	0.072	1.185	0.230	1.581	0.137	1.059	0.202	1.078	0.045	2.384	0.206		

Annex 6(b): Surface Inflows and Outflows

Wet Season 2007

	Surface Inflows									Surface Outflows						Main Gate Opening	
	Main canal		Natural streams					Sum N.Inflows		Natural Streams				Sum Outflows			H-Q curve reading
Date	m3/s	mcm	H.Xaykhao	H.Sala	H.NamYen	H.Houm	N.Kham	m3/s	mcm	H.Konh	H. HongXone	H. KoutPoun	H.Lan	m3/s	mcm	cm	m^3/s
30-Aug-07	0.00	0.000	0.093	0.001	0.072	1.185	0.230	1.581	0.137	1.059	0.202	1.078	0.045	2.384	0.206		
31-Aug-07	0.00	0.000	0.093	0.001	0.072	1.185	0.230	1.581	0.137	1.059	0.202	1.078	0.045	2.384	0.206		
1-Sep-07	0.00	0.000	0.1	0.016	0.075	0.472	0.043	0.706	0.061	0.823	0.014	0.417	0.053	1.307	0.113		
2-Sep-07	0.00	0.000	0.1	0.016	0.075	0.472	0.043	0.706	0.061	0.823	0.014	0.417	0.053	1.307	0.113		
3-Sep-07	0.00	0.000	0.1	0.016	0.075	0.472	0.043	0.706	0.061	0.823	0.014	0.417	0.053	1.307	0.113		
4-Sep-07	0.00	0.000	0.1	0.016	0.075	0.472	0.043	0.706	0.061	0.823	0.014	0.417	0.053	1.307	0.113		
5-Sep-07	0.00	0.000	0.1	0.016	0.075	0.472	0.043	0.706	0.061	0.823	0.014	0.417	0.053	1.307	0.113		
6-Sep-07	0.00	0.000	0.1	0.016	0.075	0.472	0.043	0.706	0.061	0.823	0.014	0.417	0.053	1.307	0.113		
7-Sep-07	0.00	0.000	0.1	0.016	0.075	0.472	0.043	0.706	0.061	0.823	0.014	0.417	0.053	1.307	0.113		
8-Sep-07	0.00	0.000	0.1	0.016	0.075	0.472	0.043	0.706	0.061	0.823	0.014	0.417	0.053	1.307	0.113		
9-Sep-07	0.00	0.000	0.1	0.016	0.075	0.472	0.043	0.706	0.061	0.823	0.014	0.417	0.053	1.307	0.113		
10-Sep-07	0.00	0.000	0.1	0.016	0.075	0.472	0.043	0.706	0.061	0.823	0.014	0.417	0.053	1.307	0.113		
11-Sep-07	0.00	0.000	0.1	0.016	0.075	0.472	0.043	0.706	0.061	0.823	0.014	0.417	0.053	1.307	0.113		
12-Sep-07	0.00	0.000	0.1	0.016	0.075	0.472	0.043	0.706	0.061	0.823	0.014	0.417	0.053	1.307	0.113		
13-Sep-07	0.00	0.000	0.1	0.016	0.075	0.472	0.043	0.706	0.061	0.823	0.014	0.417	0.053	1.307	0.113		
14-Sep-07	0.00	0.000	0.1	0.016	0.075	0.472	0.043	0.706	0.061	0.823	0.014	0.417	0.053	1.307	0.113		
15-Sep-07	0.00	0.000	0.1	0.016	0.075	0.472	0.043	0.706	0.061	0.823	0.014	0.417	0.053	1.307	0.113		
16-Sep-07	0.00	0.000	0.710	0.010	0.210	1.2	0.200	2.33	0.201	1.08	0.015	1.148	0.01	2.253	0.195		
17-Sep-07	0.00	0.000	0.710	0.010	0.210	1.2	0.200	2.33	0.201	1.08	0.015	1.148	0.01	2.253	0.195		
18-Sep-07	0.00	0.000	0.710	0.010	0.210	1.2	0.200	2.33	0.201	1.08	0.015	1.148	0.01	2.253	0.195		
19-Sep-07	0.00	0.000	0.710	0.010	0.210	1.2	0.200	2.33	0.201	1.08	0.015	1.148	0.01	2.253	0.195		
20-Sep-07	0.00	0.000	0.710	0.010	0.210	1.2	0.200	2.33	0.201	1.08	0.015	1.148	0.01	2.253	0.195		
21-Sep-07	0.00	0.000	0.710	0.010	0.210	1.2	0.200	2.33	0.201	1.08	0.015	1.148	0.01	2.253	0.195		
22-Sep-07	0.00	0.000	0.710	0.010	0.210	1.2	0.200	2.33	0.201	1.08	0.015	1.148	0.01	2.253	0.195		
23-Sep-07	0.00	0.000	0.710	0.010	0.210	1.2	0.200	2.33	0.201	1.08	0.015	1.148	0.01	2.253	0.195		
24-Sep-07	0.00	0.000	0.710	0.010	0.210	1.2	0.200	2.33	0.201	1.08	0.015	1.148	0.01	2.253	0.195		
25-Sep-07	0.00	0.000	0.710	0.010	0.210	1.2	0.200	2.33	0.201	1.08	0.015	1.148	0.01	2.253	0.195		
26-Sep-07	0.00	0.000	0.710	0.010	0.210	1.2	0.200	2.33	0.201	1.08	0.015	1.148	0.01	2.253	0.195		
27-Sep-07	0.00	0.000	0.710	0.010	0.210	1.2	0.200	2.33	0.201	1.08	0.015	1.148	0.01	2.253	0.195		
28-Sep-07	0.00	0.000	0.710	0.010	0.210	1.2	0.200	2.33	0.201	1.08	0.015	1.148	0.01	2.253	0.195		
29-Sep-07	0.00	0.000	0.710	0.010	0.210	1.2	0.200	2.33	0.201	1.08	0.015	1.148	0.01	2.253	0.195		
30-Sep-07	0.00	0.000	0.710	0.010	0.210	1.2	0.200	2.33	0.201	1.08	0.015	1.148	0.01	2.253	0.195		
1-Oct-07	0.00	0.000	0.553	0.037	0.226	0.957	0.179	1.952	0.169	1.123	0.269	1.148	0.06	2.6	0.225		
2-Oct-07	0.00	0.000	0.553	0.037	0.226	0.957	0.179	1.952	0.169	1.123	0.269	1.148	0.06	2.6	0.225		

Annex 6(b): Surface Inflows and Outflows

Wet Season 2007

	Surface Inflows									Surface Outflows						Main Gate Opening	
	Main canal		Natural streams					Sum N.Inflows		Natural Streams				Sum Outflows			H-Q curve reading
Date	m3/s	mcm	H.Xaykhao	H.Sala	H.NamYen	H.Houm	N.Kham	m3/s	mcm	H.Konh	H. HongXone	H. KoutPoun	H.Lan	m3/s	mcm	cm	m^3/s
3-Oct-07	0.00	0.000	0.553	0.037	0.226	0.957	0.179	1.952	0.169	1.123	0.269	1.148	0.06	2.6	0.225		
4-Oct-07	0.00	0.000	0.553	0.037	0.226	0.957	0.179	1.952	0.169	1.123	0.269	1.148	0.06	2.6	0.225		
5-Oct-07	0.00	0.000	0.553	0.037	0.226	0.957	0.179	1.952	0.169	1.123	0.269	1.148	0.06	2.6	0.225		
6-Oct-07	0.00	0.000	0.553	0.037	0.226	0.957	0.179	1.952	0.169	1.123	0.269	1.148	0.06	2.6	0.225		
7-Oct-07	0.00	0.000	0.553	0.037	0.226	0.957	0.179	1.952	0.169	1.123	0.269	1.148	0.06	2.6	0.225		
8-Oct-07	0.00	0.000	0.553	0.037	0.226	0.957	0.179	1.952	0.169	1.123	0.269	1.148	0.06	2.6	0.225		
9-Oct-07	0.00	0.000	0.553	0.037	0.226	0.957	0.179	1.952	0.169	1.123	0.269	1.148	0.06	2.6	0.225		
10-Oct-07	0.00	0.000	0.553	0.037	0.226	0.957	0.179	1.952	0.169	1.123	0.269	1.148	0.06	2.6	0.225		
11-Oct-07	0.00	0.000	0.553	0.037	0.226	0.957	0.179	1.952	0.169	1.123	0.269	1.148	0.06	2.6	0.225		
12-Oct-07	0.00	0.000	0.553	0.037	0.226	0.957	0.179	1.952	0.169	1.123	0.269	1.148	0.06	2.6	0.225		
13-Oct-07	0.00	0.000	0.553	0.037	0.226	0.957	0.179	1.952	0.169	1.123	0.269	1.148	0.06	2.6	0.225		
14-Oct-07	0.00	0.000	0.553	0.037	0.226	0.957	0.179	1.952	0.169	1.123	0.269	1.148	0.06	2.6	0.225		
15-Oct-07	0.00	0.000	0.553	0.028	0.226	0.957	0.179	1.943	0.168	1.123	0.269	1.148	0.06	2.6	0.225		
16-Oct-07	0.00	0.000	0.61	0.028	0.051	1.165	0.053	1.907	0.165	0.414	0.046	1.176	0.036	1.672	0.144		
17-Oct-07	0.00	0.000	0.61	0.028	0.051	1.165	0.053	1.907	0.165	0.414	0.046	1.176	0.036	1.672	0.144		
18-Oct-07	0.00	0.000	0.61	0.028	0.051	1.165	0.053	1.907	0.165	0.414	0.046	1.176	0.036	1.672	0.144		
19-Oct-07	0.00	0.000	0.61	0.028	0.051	1.165	0.053	1.907	0.165	0.414	0.046	1.176	0.036	1.672	0.144		
20-Oct-07	0.00	0.000	0.61	0.028	0.051	1.165	0.053	1.907	0.165	0.414	0.046	1.176	0.036	1.672	0.144		
Total (MCM)		7.303							12.205						16.123		

Annex 7: Converyance Efficiencies

Converyance Efficiency of Main Canal

Dry Season 2006-07

Code	Canal	Mesurement Date									Qaverage(m^3/s)	Remark
		25-Nov-06 (m^3/s)	16-Dec-06 (m^3/s)	1-Jan-07 (m^3/s)	16-Jan-07 (m^3/s)	1-Feb-07 (m^3/s)	16-Feb-07 (m^3/s)	1-Mar-07 (m^3/s)	6-Mar-07 (m^3/s)	31-Mar-07 (m^3/s)		
1	MC	1.27	2.32	2.57	2.76	2.03	2.63	2.35	3.01	1.94	2.80	Intake
2	N1	0.13	0.63	0.57	0.00	1.20	1.14	1.17	1.27	1.24	0.82	Off take
5	N5	0.00	0.00	0.00	0.01	0.03	0.06	0.00	0.07	0.00	0.02	Off take
6	N2	0.00	0.44	0.00	0.07	0.26	0.24	0.27	0.35	0.29	0.21	Off take
7	N7	0.01	0.00	0.02	0.03	0.02	0.03	0.01	0.06	0.02	0.02	Off take
8	N4	0.19	0.00	0.33	0.28	0.24	0.21	0.28	0.46	0.38	0.26	Off take
9	MC	0.25	0.00	0.20	1.33	0.56	1.61	1.47	0.25	0.88	0.73	Off take
10	N9	0.01	0.00	0.02	0.13	0.14	0.12	0.18	0.04	0.05	0.08	Off take
11	N6	0.09	0.11	0.09	0.03	0.14	0.30	0.26	0.03	0.00	0.11	Off take
12	N11	0.05	0.41	0.07	0.15	0.09	0.16	0.27	0.09	0.10	0.15	Off take
13	N8	0.03	0.11	0.14	0.13	0.24	0.03	0.33	0.22	0.26	0.17	Off take
14	N13	0.00	0.10	0.07	0.17	0.10	0.04	0.25	0.10	0.00	0.09	Off take
Converyane Effi.(%)		59.76	77.10	58.56	84.68	148.84	150.04	190.93	**96.98**	165.57	95.12	

Conveyance Efficiency [(all oftakes / Inake)*100] of MC is selected at the measurement on 6-Mar-2007 because water was supplied continuestly, while other measurement time, rotation of water delivery was praticed

Converyance Efficiency of Secondary Canal N1

Dry Season 2006-07

Code	Canal	Mesurement Date									Qaverage(m^3/s)	Remark
		25-Nov-06 (m^3/s)	16-Dec-06 (m^3/s)	1-Jan-07 (m^3/s)	16-Jan-07 (m^3/s)	1-Feb-07 (m^3/s)	16-Feb-07 (m^3/s)	1-Mar-07 (m^3/s)	6-Mar-07 (m^3/s)	31-Mar-07 (m^3/s)		
	N1	0.13	0.63	0.57	0.00	1.20	1.14	1.17	1.27	1.24	0.82	Intake
	2L-N1	0.00	0.11	0.08	0.10	0.07	0.08	0.10	0.18	0.00	0.08	Off take
1	3L-N1	0.00	0.22	0.03	0.22	0.04	0.04	0.03	0.07	0.03	0.08	Off take
2	4L-N1	0.00	0.05	0.09	0.09	0.16	0.14	0.07	0.06	0.13	0.09	Off take
27	2R-N1	0.00	0.05	0.06	0.16	0.16	0.26	0.37	0.03	0.00	0.12	Off take
29	5L-N1	0.00	0.06	0.11	0.11	0.07	0.09	0.01	0.00	0.05	0.06	Off take
31	N1	0.00	0.02	0.08	0.07	0.08	0.02	0.01	0.05	0.25	0.06	Off take
Conveyance Effi.(%)		0.00	**83.28**	78.21	N.A	47.96	53.91	50.73	30.88	37.38	59.32	

Conveyance efficiency of canal N1 was conducted on 16-Dec-2006

Annex 7: Converyance Efficiencies

Converyance Efficiency of Secondary Canal N15

Dry Season 2006-07

Code	Canal	Mesurement Date									Qaverage(m^3/s)	Remark
		25-Nov-06	16-Dec-06	1-Jan-07	16-Jan-07	1-Feb-07	16-Feb-07	1-Mar-07	6-Mar-07	31-Mar-07		
		(m^3/s)	(m^3/s)	(m^3/s)	(m^3/s)	(m^3/s)	(m^3/s)	(m^3/s)	(m^3/s)	(m^3/s)		
16	N15	0.00	0.76	0.76	1.02	0.41	0.93	0.60	0.34	0.66	0.608	Intake
17	N15-3	0.30	0.07	0.05	0.08	0.10	0.19	0.14	0.07	0.14	0.126	Off take
18	N15-4	0.00	0.08	0.08	0.08	0.08	0.07	0.06	0.00	0.00	0.050	Off take
19	MCV-1	0.05	0.06	0.07	0.20	0.01	0.06	0.04	0.01	0.07	0.062	Off take
20	MCV	0.09	0.26	0.30	0.43	0.08	0.22	0.20	0.09	0.18	0.203	Off take
21	LTV1	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.002	Off take
22	LTV2	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.003	Off take
Conveyance Effi. (%)		N.A	61.53	63.94	**81.23**	64.08	57.74	71.29	52.07	58.75		

Conveyance efficiency of canal N1 was conducted on 16-Jan-2007

Converyance Efficiency of Tertiary Canal MCV

Dry Season 2006-07

Code	Canal	Lengh	Q start	Q end	Converyance Effi.
		km	m^3/s	m^3/s	%
Tertiarry canal	MCV	2.5	0.931	0.806	**86.57**

Conveyance efficiency of tertiarry canal is conducted by taking dicharge measurment at the canal intake and canal of take

System Converyance Efficiency

Dry Season 2006-07

Canal level	Name	Efficeincy (%)	Ave. (%)
Main Canal	MC	96.98	96.98
	N1	83.28	
Secondarry Canal	N14	81.23	82.26
Tertiarry Canal	MCV	86.57	86.57
System Converyance Efficiency			**69.06**

Annex 8 (a): Overall Command Area Efficiency

Dry Season 2006-07

Items	Unit	Values
Total System water requirement (SWR)	MCM	10.13
Effective Rainfall (ER)	MCM	0.15
Total diverted water from Main canal (TDW)	MCM	27.33
To diverted water from Natural Sreams (TNS)		5.59
Total Drain Water (TDW)	MCM	9.16
Conveyance Efficiency (CE)	%	0.69
Water delivered to the fileds (WDF) = (TDW*CE+TNS)-(TDW)	MCM	15.287
Overal command area efficiency [(SWR-ER)/(WDF)]	%	**65.30**

Annex 8(b): Overall Command Area Efficiency

Wet Season 2007

Items	Unit	Values
Total System water requirement (SWR)	MCM	20.67
Effective Rainfall (ER)	MCM	19.79
Total diverted water from Main canal (TDW)	MCM	7.30
To diverted water from Natural Sreams (TNS)	MCM	12.21
Total Drain Water (TDW)	MCM	16.12
Conveyance Efficiency (CE)	%	0.69
Water delivered to the fileds (WDF) = (TDW*CE+TNS)-(TDW)	MCM	1.121
Overal command area efficiency [(SWR-ER)/(WDF)]	%	**78.17**

Note: the same value of conveyance efficiency conducted in dry season is used for calcualtion

Annex 9(a): Water Productivity

System Water Balance

Dry Season 2006-07

Flows	Water Balance Components	Value (MCM)
Inflow	Precipitation	0.15
	Intake from main canal	27.33
	Natural streams	5.59
Total Inflows		*33.07*
Outflow	Evapotranspiration of Paddy	6.03
	Evapotranspiration of Fishpond	0.10
	Evapotranspiration of Cash Crops	0.08
	Percolation	3.21
	Drainage	9.16
	Committed Flow	0.00
Total Outflows		*18.58*
Available Water Supply (AWS)		**14.49**

Note: the value of each water balance component is taken from calculation of prevoiuse tables

Water Productivity [US$/$m^3$]

Dry Season 2006-07

Crop Type	Area (ha)	Production (T)	Price (US$)/T	Total price (US$)
Paddy	1525.5	5,918.94	239.65	1,418,482.35
Cash Crop: (cucumber, long been, cabage)	2.48	167.72	136.17	22,837.69
Agroculture (fish+ chichken)	21.72	88.35	1,307.19	115,490.20
			Total	1,556,810.24

Note: 1US$=9,180 kip (2007)

Water Productivity (WP): [Total Production Value in US$/ m^3 of AWS] **0.107** US$/m3

Annex 9(b): System Water Balance

Wet Season 2007

Flows	Water Balance Components	Value (MCM)
Inflow	Precipitation	31.43
	Intake from main canal	7.30
	Natural streams	12.21
Total Inflows		*50.94*
Outflow	Evapotranspiration of Paddy	16.56
	Evapotranspiration of Fishpond	0.32
	Evapotranspiration of Cash Crops	0.01
	Percolation	2.85
	Drainage	16.12
	Committed Flow	0.00
Total Outflows		*35.86*
Available Water Supply (AWS)		**15.08**

Note: the value of each water balance component is taken from calculation of prevoiuse tables

Water Productivity [US$/$m^3$]

Wet Season 2007

Crop Type	Area (ha)	(T/ha)	Price (US$)/T	Total price (US$)
Paddy	2,209.67	2.85	217.86	1,371,986.31
Cash Crop: (cucumber, long been, cabage)	5	2.1	108.93	1,143.77
Agroculture (fish+ chichken)	21.72	4.05	1,089.32	95,823.12
			Total	1,468,953.20

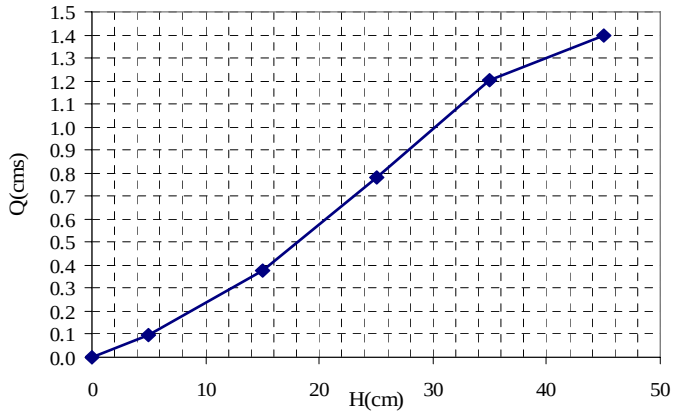
Note: 1US$=9,180 kip (2007)

Water Productivity (WP) : [Total Production Value in US$/ m^3 of AWS] **0.097** US$/m3

Annex 10: Calibration of Canals N1 and N4

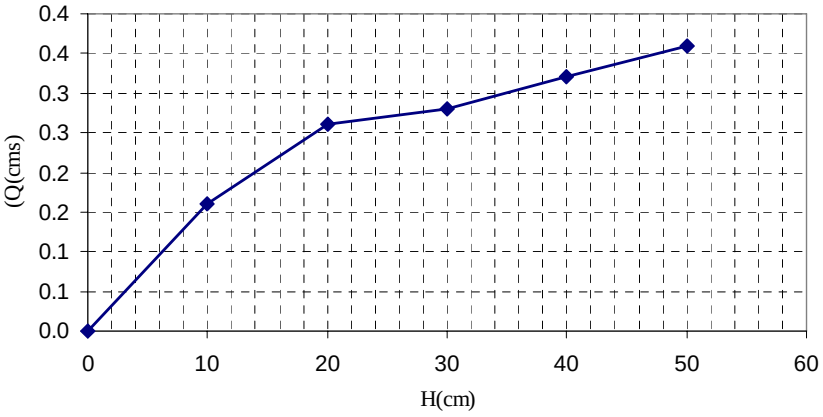
N1

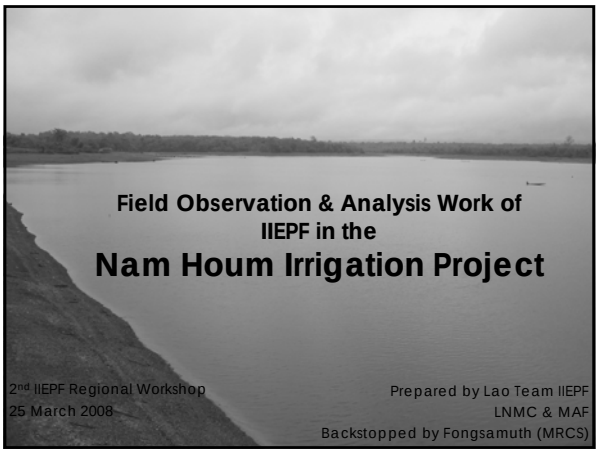
Q(mcs)	H(cm)
0	0
0.098	5
0.375	15
0.779	25
1.205	35
1.398	45



N4

Q(mcs)	H(cm)
0	0
0.16	10
0.26	20
0.28	30
0.32	40
0.36	50





Field Observation & Analysis Work of IIEPF in the

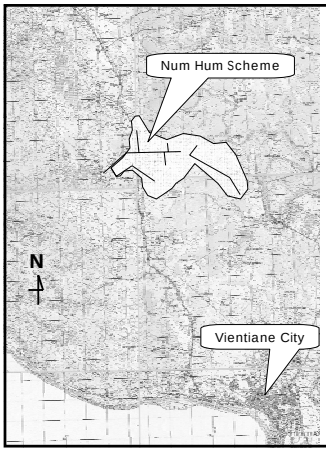
Nam Houm Irrigation Project

2nd IIEPF Regional Workshop
25 March 2008

Prepared by Lao Team IIEPF
LNMC & MAF
Backstopped by Fongsamuth (MRCS)

Contents

1. Scheme Location
2. Scheme Outline
3. Brief IIEPF Activities conducted in the Scheme
4. Major Findings
5. Conclusion



1. Location

- Located in Vientiane Capital
- 35 Km from Vientiane Capital City by road No. 13 to the north
- Project areas cover two districts:
  - Naxaythong District
  - Xaythany District

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2. Scheme Outline

Constructed in 3 phases:

Phase 1 : 1978 - 82
The construction works included: Dam, intake, spillway, main canal, and some on - farm canals (irrigated 150 ha) by govt. budget with loan from OPEC & grand aid from Japanese govt.

Phase 2 : 1990 - 93
N1 secondary canal (400 ha) with financial assistance from Italian govt. through interim Mekong Committee.

Phase 3 : 1997- 2000
Additional main canal (2.3 km) , secondary and the remaining canals (completed 3000ha) by govt budget.

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2. Scheme Outline (1)

Project Type:

Gravity Basin Irrigation

Scheme Overall Objective:

Generating household income surrounding Vientiane capital and supporting & promoting agricultural industrialization with irrigation service

Scheme Specific Objective:

Mainly supply water for dry-season agricultural activities & supplementary supply water for wet-season agriculture, but not supply water for domestic & other water uses

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2. Scheme Outline (2)

Project Major Duties:

- Reservoir Watershed Management
- Irrigation Infrastructure Operation and Maintenance
- Irrigation Water Delivery Service & Management

Benefit Area :

- Original Designed Command Area : 2,400 ha
- Dry Season (2006-07) : 1,525.7 ha
- Wet Season (2007) : 2,263.2 ha

Benefit People:

- 17 Villages
- 18, 879 farmers

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2. Scheme Outline (3)

Storage Capacity

Maximum Storage : 60 MCM
Active storage : 54 MCM

Canals : 60.635 km
MC : 9.30 km
SC : 46. 84 km
TC : 4.50 km (367 gates + check structures)

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- Unstable rainfall ----> shortage water in some years (1995 & 2005, 2007)
- Strict water management needed

2 July 19, 2007 Vientiane Times

Nam Houm reservoir abnormally low

□ KHONESAVANH LATSAPHAO

THE Nam Houm reservoir in Naxaithong district, Vientiane is abnormally low this year, because there has not been the usual amount of rain.

Normally, the volume of the water is 60 million cubic metres at this time of year, the Deputy Head of Agriculture and Forestry Extension in Naxaithong district, Mr Nantha Phandavong said.

"This is the first time that the volume of water has fallen to 44 million cubic metres," he said.

This year the rain has arrived so late that rivers and waterfalls are also affected and show lower levels of water than usual for this time of year.

However, the reservoir still supplies water to over 100 hectares of wet-season rice fields through the irrigation system.

If the level of water remains at 44 cubic metres until the dry season the reservoir will not have enough water to provide rice fields.

All farmers in the area of the Nam Houm irrigation system will use water from these channels to supply their dry-season rice fields.

Nam Houm reservoir is about 26 km from Vientiane, and is a popular place for locals and foreigners to have picnics.

Many people like to visit this area on Saturday and Sunday, because the reservoir has a waterfall called Tad Houm. But now only a few people go there, because of the lack of water feeding the waterfall, Mr Nantha said.

3. Field Activities

Major Field Activities:

- Conducting RAP as first system performance assessment
- Identifying cropping pattern
- Monitoring ETo, ETc, Percolation, rainfall ----> water requirement
- Flow measurement in & out of system & inside system ------> water balance
- Conveyance efficiency test
- Crop production survey
- Overall command area efficiency
- Water productivity
- Identifying management appraisal

Not all activities presented

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3. Field Activities & Its Results (1)

Irrigation days & Cropping Pattern

- 90 days of dry-season rice & 120 days of wet-season rice
- Cash crops mainly grown in dry season & beginning of wet season (not heavy rain period)
- Fish farming practiced thought the year
- Irrigation in wet season mainly in Land preparation &Transplanting period s

Agriculture Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Paddy			DS Paddy							WS Paddy		
Cash Crops		DS Cash crops						WS Cash crops				
Aquaculture		Fish farming										
Irrigation days			128 days					65 days				

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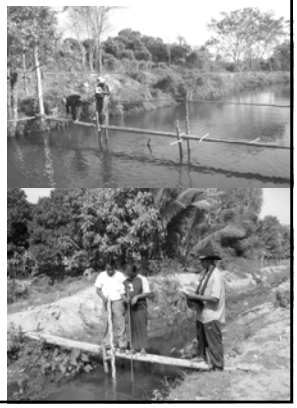
3. Field Activities & Its Results (2)

Flow Monitoring:

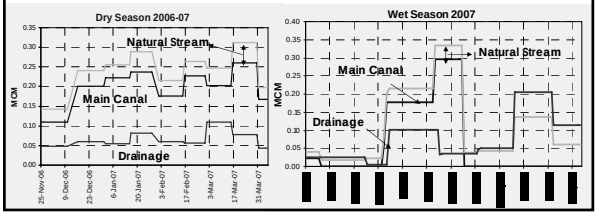
- Construction of Bamboo bridges at all measurement points
- Every 15 days (7 days spending for each measurement)
- 2 measurement teams
- Total 44 points (5 natural inflow streams, 4 natural outflow streams)
- 7 places of conveyance tests



3. Field Activities & Its Results (3)

Summary of Total Flows

	Dry Season	Wet Season
Original Design Capacity	46.6 MCM (6 m³/s)	
In flow from main canal into system	27.33 MCM	7.31 MCM
Inflow from natural stream into system	5.59 MCM	12.21 MCM
Drainage (outflows)	9.16 MCM	16.12 MCM

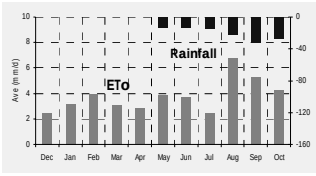


3. Field Activities & Its Results (4)

ET_o & Rainfall

- Daily measurement
- No rainfall in dry season (Dec- April)
- High rainfall in Aug & Sep
- **Dry Season**: High ETo in Feb.
- **Wet Season**: High ETo in Aug & Sep

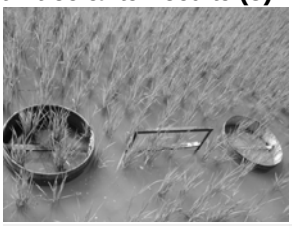
	ETo (mm/d)	Rain (mm/d)
Dry S.	3.08	0.07
Wet S.	4.04	20.36



3. Field Activities & Its Results (5)

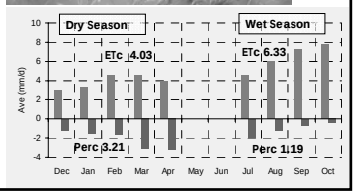
ETc

- Lesser in Dry Season
- Dry Season: high in Feb & March
- Wet Season: High in Sep & Oct



Percolation

- Higher in dry season
- Dry season: High in Mar & Apr
- Wet Season: high in July & Aug



3. Field Activities & Its Results (6)

Crops Production Survey

- Apply Unit harvested method (1 m X 1m) for collecting paddy production
- Total samples of 24 points in dry seasons & 20 points in wet seasons
- Collecting value cross checked with farmers' interview

(Price in 2006-07)

Crop Types	Dry Season Area ha	%	Yield (T/ha)	Price (US$/T)	Wet Season Area ha	%	Yield (T/ha)	Price (US$/T)
Paddy	1,485.2	97.4	3.88	239.65	2,236.48	98.8	2.85	217.86
Cash crops	18.78	1.2	8.93	167.72	5	0.2	2.15	108.93
Aquaculture	21.72	1.4	4.07	1,307.35	21.72	1	4.05	1,089.32
Total	**1,525.7**				**2,263.2**			

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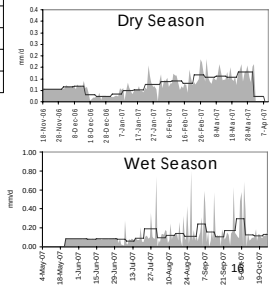
4. Major Findings (1)

Summary of Water Requirement (WR)

WR of each sector	Dry Season	Wet Season
Paddy (MCM)	9.817	20.370
Cash Crops (MCM)	0.078	0.006
Aquaculture (MCM)	0.234	0.296
Total (MCM)	**10.129**	**20.672**
Total (mm)	**663.90**	**913.7**

- Higher WR in wet season due to longer period & larger planted areas
- **Dry Season** : high WR in Dec. (Land Preparation stage) & in Feb. & Mar. (flowering stage)
- **Wet Season**: WR fluctuated due to rainfall, high WR in early Sep. & Oct.



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4. Major Findings (2)

Efficiencies & Water Productivities

- Conveyance Efficiency: The same value used in both dry & wet seasons because the test conducted at one time
- Higher overall efficiency in wet season due to shorter irrigation days, although much more rainfall observed
- Higher water productivity in dry season due to higher yields & higher price

	Dry Season	Wet Season
Conveyance Efficiency (canal off takes/canal intakes)	69.06 %	
Overall Command Area Efficiency (SWR-ER)/(total inflow * Conveyance Effi.- drainage)	65.30 %	78.17 %
Water Productivities (US$/$m^3$ of water use)	0.114 US$/$m^3$	0.097 US$/$m^3$

SWS : System Water Requirement
ER : Effective Rainfall

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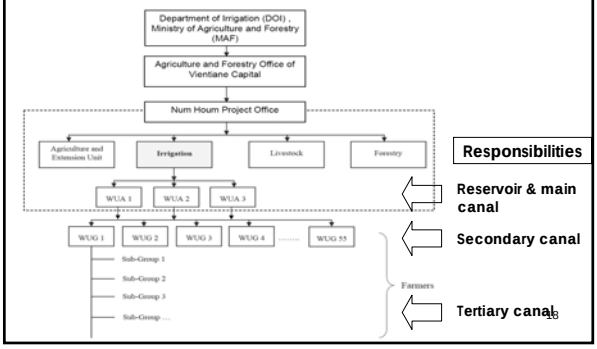
4. Major Findings (3)

Organization & Water Management



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4. Major Findings (4)

Water Allocation

- Water allocation plan for every dry- season cultivation, but not for wet season
- Continues/free water supply (no control) when full storage of reservoir
- Rotation in 3 zones when less reservoir storage (unstable rainfall

- Water supply plan fixed (no flexibility)
- Few feedback system
- Less monitoring

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4. Major Findings (5)

Irrigation Service Fee - ISF

- Water fee important for water management as covering facility maintenance & incentive for staff
- Rate of ISF: 150,000 Kip/ha
- 47 % collected in 2006-07 & 40% collected in 2007-08

Project Constraints

- Poor irrigation infrastructures
- Lack of effective water distribution plan & monitoring system
- Lax enforcement regulation in water management practice
- Low skill of staff on proper water management

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5. Conclusion

- High efficiency compared with other schemes in Laos (40-50% in general)
- Outflows not observed & controlled by the project
- Water allocation plan not suitable with actual water requirement, adoption plan needed
- Higher efficiency in wet season because of shorter irrigation days (lesser irrigation water Supply)
- Water productivity in dry season higher than wet season due to higher paddy yield and higher production prices
- Good water management practice needs to be implemented to trail the best solution in order to increase water use efficiency, water productivities & farmers' income household

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Thank You for your Kind Attention

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Annex 12: Photos of Field Activities

Making Cross Section Area at Bamboo Bridge at Tertiary Canal

Observing Cash Crops (long been) Growing Next to Paddy Nursery Plots

Paddy Nursery Plots

Land Preparation

Making Measurement Points

Vehicle Used for Field Observation

Installation of ETc and Percolation Measurement

Measurement of Water Requirement for Fish Pond

ETo and Rainfall Measurement

Construction of Bamboo Bridge for all Measurement Points

ETc and Percolation Measurement at Up-Stream Command Area

ETc and Percolation Measurement at Down-Stream Command Area

Flow Measurement Point at Natural Stream

Measurement Point at Intake (Main Canal)

Flow Measurement Conducted at Main Canal

Flow Measurement Conducted at Main Canal

Gates at Rotation Point (N4)

Main Intake

Reservoir

Main Intake

RAP Conducting-Observation of N1 Intake

RAP Conducting- Observation of Structures along Main Canal

RAP Conducting – Backstopping by MRCS

RAP Conducting – Backstopping by MRCS

Observation at End-Canal Spill point

Siphon at Main Canal

Secondary Canal Intake

Meeting with WUGs

Main Gate (at reservoir)

Gate at Canal N4