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# OUTCOMES OF ILO SUPPORT TO THE BOVEL AND BARAI IRRIGATION SYSTEMS

Warren Hoye
Independent Consultant

MINISTRY OF RURAL DEVELOPMENT

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International Labour Organisation
Technical Assistance to the Labour-Based Rural Infrastructure Works Programme
"Upstream Project" CMB/97/M02/SID

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# EXECUTIVE SUMMARY

**Introduction**
The International Labour Organisation (ILO) assisted in the construction, rehabilitation, maintenance and operation of the Bovel Irrigation System (BoIS) in Battambang Province and the Barai Irrigation System (BIS) in Siem Reap Province since 1992. This was achieved through three consecutive technical assistance projects. The projects evolved from generating employment through the rehabilitation of the BoIS and the BIS canal systems, to supporting farmer water users to operate and maintain the systems themselves.

**ILO Inputs**
In the course of these projects, ILO made various important inputs into the BoIS and the BIS. These included:

- Introducing and establishing Labour Based Appropriate Technology (LBAT).
- Training counterpart irrigation staff and farmer irrigation users.
- Producing substantial training materials.
- Providing technical assistance to the systems.
- Financial input of US$ 1,188,900.

The training provided by ILO and LBAT are seen as appropriate by the users and managers of the systems.

**ILO Outputs**
There were several important outputs from the ILO intervention. The ILO renovated 76.74 km, constructed 7.14 km of secondary canals and maintained 94.83 km of primary and secondary canals. The ILO also constructed 81 new irrigation structures and repaired 214 structures. Another important output was the substantial number of workdays generated. The total employment effect of the irrigation works for the three ILO projects was 1,738,274 workdays. The BoIS now has a wet season command area of 35,000 hectares, with an additional 400-500 hectares of dry season command area. The average irrigated area for the BIS is around 8,000 hectares including supplementary wet, receding and dry season crops.

**Impact Assessment**
Interviews with farmer water users in the BoIS showed increased rice production due to reliable irrigation water. New higher yielding rice varieties have been adopted and users have invested in fertiliser due to a secure water supply. Farmers no longer have to grow traditional varieties, which are tolerant to poor conditions but produce low yields.

In the BIS, the NGO ADRA compared the area under cultivation in 1993 (before the ILO intervention), to 1996 (after the ILO rehabilitation). ADRA recorded a 3,000 ha increase in the annual area of rice cultivation, including increased land area cropped and double cropping. A second ADRA project found that farmers were using improved rice varieties, crop management and water management leading to improved average yields from 1-1.5 tonnes per ha to 3.45 tonnes per ha. ADRA found there needed to be an "agricultural and water" mix, for effective utilisation and benefit from irrigation infrastructure rehabilitation and irrigation operation and maintenance. The Food and Agriculture Organization (FAO) found that agricultural extension building upon improved irrigation further increased yield.

A study of the BIS by the Center for Advanced Study (CAS) found that the land cultivated with improved irrigation had increased significantly (16%) since 1993. In addition, the area used for double cropping had increased by 45 per cent. CAS believes that this increase in double cropping demonstrates the impact of improved irrigation since the ILO intervention. There was a considerable increase in the land used for growing wet and dry season rice. Wet season rice land increased by 11 per cent, while dry season rice land increased by 23 per cent. This result, especially the increase in dry season rice cultivation, was due to improved access to irrigation. Total production (rice and other crops) increased by 28 per cent from 1993 to 1999. CAS survey respondents reported that ILO support to the BIS was more effective and sustainable than other organisations' activities.

The CAS study also revealed a 29 per cent increase in production of vegetables, fruits and aquatic products. Improved access to irrigation is likely to have contributed to this increase. Consumption of these crops increased only slightly, indicating that these are mainly used as cash crops. Farming activities (as opposed to off farm activities) have become more important for all households since the ILO intervention. This highlights the importance of improved access to irrigation.

It seems that substantial agricultural, ecological and socio-economic changes have taken place in the communities of the BIS. Although not all of these changes can be attributed to improvements in the irrigation system, there is no doubt that these improvements had a significant impact on land use and production. The impact of the ILO support was summarised by CAS as follows:

*"Improved irrigation led to increased cropping intensity and higher total production. This created more demand for labour and contributed to a reduction in poverty."*

**Conclusion**

With the introduction of the Ministry of Water Resources and Meteorology's (MWRM) 2000 policy document, the policy framework is in place and is consistent with the ILO's work in the BoIS and the BIS. The operation and management systems instigated by the ILO and the Provincial Department of MWRM (PDWRM) are still operating. These have been altered in some cases and there is still room for improvement. However, this has meant that the irrigation systems continue to function and users continue to benefit. The ILO project's achievements early in the intervention occurred in especially difficult times, which was remarked on by the MWRM. The use of LBAT for irrigation works has been established at the provincial level with Battambang PDWRM using LBAT in the current rehabilitation of the Kompong Poei Irrigation System.

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**Tables and Figures**

# Abbreviations and Acronyms

| | |
|---|---|
| ACLEDA | Association of Cambodian Local Economic Development Agencies |
| ACF/AAH | Action Against Hunger (UK) |
| ADB | Asian Development Bank |
| ADHOC | Cambodian Human Rights and Development Association |
| ADRA | Adventist Development Relief Organisation |
| AIDAB | Australian International Development Aid Bureau |
| AICF | Action Internationale Contre la Faim |
| APSARA | Authorite pour la Protection du Site et l'Amenagement de la Region d'Angkor |
| BIS | Barai Irrigation System |
| BoIS | Bovel Irrigation System |
| CARERE | Cambodian Rehabilitation and Reintegration Programme |
| CAS | Center for Advanced Study |
| CDC | Commune Development Committee |
| CIAP | Cambodia IRRI Australia Programme |
| CRC | Cambodian Red Cross |
| CTA | Chief Technical Advisor |
| DoA | Department of Agriculture |
| DoH | Department of Hydrology (forerunner of the PDWRM) |
| FAO | Food and Agriculture Organisation (UN) |
| FFW | Food for Work |
| FWUC | Farmer Water User Community |
| IFAD | International Fund for Agriculture Development |
| ILO | International Labour Organisation (UN) |
| IO | International Organisation |
| IRRI | International Rice Research Institute |
| LBAT | Labour Based Appropriate Technology |
| LP | Length Person |
| MEF | Ministry of Economics and Finance |
| MRD | Ministry of Rural Development |
| MWRM | Ministry of Water Resources and Meteorology |
| NGO | Non Government Organisation |
| PDRD | Provincial Department of Rural Development |
| PDWRM | Provincial Department of Water Resources and Meteorology |
| RGC | Royal Government of Cambodia |
| SC | Secondary Canal |
| SPFS | Special Programme for Food Security (FAO) |
| TC | Tertiary Canal |
| UN | United Nations |
| UNDP | United Nations Development Programme |
| UNESCO | United Nations Educational, Scientific and Cultural Organisation |
| UNICEF | United Nations Children's Fund |
| UNOPS | United Nations Office for Project Services |
| VDC | Village Development Committee |
| WFP | World Food Programme |
| WUG | Water User Group |
| WUC | Water User Committee |
| WUAC | Water User Association Committee |

# INTRODUCTION AND BACKGROUND

The International Labour Organisation (ILO) has been assisting in the construction, rehabilitation, maintenance and operation of the Bovel Irrigation System (BoIS) in Battambang Province and the Barai Irrigation System (BIS) in Siem Reap Province since 1992. This assistance has been through three consecutive technical assistance projects. The projects have evolved from generating employment through the physical rehabilitation of the systems, to supporting farmer water users to operate and maintain the systems. Initially the Department of Hydrology in the Ministry of Agriculture was the ILO's counterpart. After the creation of the Ministry of Water Resources and Meteorology (MWRM) this Ministry became the counterpart to the ILO projects irrigation components. Technical and capital support to the BoIS ceased in 1998, with the conclusion of the ILO's Labour Based Rural Infrastructure Rehabilitation and Maintenance Programme. Capital support to the BIS also ended at this time. However, ILO technical support to the BIS continued until the end of 2000.

## Rationale for ILO Intervention

Before the ILO interventions the secondary canals in the BoIS and BIS were poorly maintained and consequently water supply was inadequate. Because of poor maintenance, canal water gates did not function (they were rusted, parts were missing or broken), canal sections had collapsed or were full of silt, water level gauges had disappeared, etc.

In the course of the ILO assistance to the irrigation systems, numerous achievements were made; however, these have not been well documented. This report documents these achievements and outcomes. It is hoped that this report will be useful to those intending to provide assistance to these systems in the future or for those providing support to other irrigation systems.

## The ILO Projects

The initial ILO project, The Labour Based Infrastructure Rehabilitation Programme (CMB/92/008) commenced in 1992. The aim of the project was to generate employment through the rehabilitation of essential rural infrastructure. The United Nations Development Programme (UNDP) funded the project, while the ILO was the executing agency.

Because of the resettlement of some 570,000 persons in Cambodia, coming from border refugees and internally displaced persons, a situation of unemployment and underemployment and an expected reduction in the civil service, police and military, the ILO project set about expanding employment opportunities in rural areas of the country. The project concentrated its efforts in the four northwestern Provinces of Cambodia: Pursat; Battambang; Banteay Meanchey and Siem Reap. These Provinces were the most effected by resettlement. Irrigation was one of three project components. The other components were rural road rehabilitation and maintenance and the clearing and cleaning of the Angkor temple complex in Siem Reap Province. Irrigation activities were undertaken in two Provinces, the BoIS in Battambang and the BIS in Siem Reap. In 1992, the development of irrigated agriculture was urgently required for economic recovery and employment creation. Irrigated agriculture is important to Cambodia to overcome food insecurity and to generate income[1].

[1] H.E. Lim Kean Hor, Minister of Water Resources and Meteorology, June 2000

The initial ILO project addressed short and long term unemployment. Short-term aspects were addressed by creating direct employment for large numbers of people improving essential rural infrastructure. Workers were initially paid in cash. Extensive collaboration with the World Food Programme (WFP) after 1994 led to a combined food and cash system of payment to labourers. Long term aspects of unemployment were addressed by the increased socio-economic activities made possible by the improved infrastructure. This is particularly true in relation to the functioning irrigation systems that contributed to improved agricultural conditions by increasing the area under irrigation and irrigation reliability. This was combined with rural road rehabilitation, which improved access to markets for agricultural produce and access to health, education and social welfare services[2]. This project ended on June 30 1996.

The ILO's Labour Based Rural Infrastructure Rehabilitation & Maintenance Project (CMB/95/011) was the next ILO project providing assistance to the BoIS and BIS. This project continued the work of the previous project and began on 1 July 1996. The UNDP continued to finance and co-ordinate cost sharing for the project, while the United Nations Office for Project Services (UNOPS) was the executing agency and ILO was the associate agency. The main objectives were to provide immediate employment to rural Cambodians, to rehabilitate and maintain essential infrastructure and to assist provincial governments to develop a rural infrastructure maintenance strategy while strengthening the LBAT capacities of provincial departments. This project ran until the end of 1998.

The third ILO project in the irrigation sector was Technical Assistance to the Labour-based Rural Infrastructure works Programme (CMB/97/M02/SID), referred to as The Upstream Project. The project's main objective is to improve the economic and social living standards of the Cambodian rural poor. This project became operational on 1 July 1998.

Capital assistance to the BoIS and the BIS ended with the completion of the Labour Based Rural Infrastructure Rehabilitation and Maintenance Project. Without financial support to continue, the ILO had to end support to the BoIS. Technical assistance was continued in the BIS through the Siem Reap Infrastructure Maintenance and Development Programme component of The Upstream Project until the end of 2000. Counterpart staff (one engineer and one technician) from MWRM were seconded to the project to assist Water User's Groups (WUGs) to become self reliant in the maintenance and operation of the system. At the end of 2000, the Upstream Project concluded that the stakeholders in the system could continue without ILO support. Not all problems were solved, but those that the ILO could do something about had been addressed.

***Irrigation and Roads***

A previous irrigation study remarks that the bottom line should be that irrigation produces surplus crops for sale[3]. However, market conditions effect the sale of surplus produce. If transport infrastructure is in poor condition the cost of transporting produce may be too high. To reap the benefits of improved irrigation, transport infrastructure must also be improved.

ILO's irrigation works were integrated with rural road rehabilitation and maintenance. This improved the rural transport infrastructure and so improved access to markets (borne out by ILO traffic counts) for produce from the two systems. The Halcrow study also noted that better roads reduced the costs of inputs (fertiliser, seed, pesticides etc) needed for production,

[2] Termination Report, Labour Based Infrastructure Rehabilitation Programme, June 1996
[3] Halcrow, Irrigation Rehabilitation Study in Cambodia, Final Report, Main Report, June 1994.

another important benefit to agricultural production in the BoIS and the BIS. Access to markets is also remarked on in a study of the BIS undertaken by The Center for Advanced Study (CAS)[4]. The report notes that ILO road rehabilitation and maintenance in the BIS was significant in facilitating access to markets. After road rehabilitation, it had become easier to carry farm produce to market and thus it was more profitable to increase production. Some farmers in the study mentioned that retailers now came to their villages to buy farm produce. Thus, the rehabilitation of road infrastructure seems to be one of the most important improvements in the BIS.

### *The Bovel Irrigation System (BoIS)*

Plains are one of the features of Battambang Province. Rice cultivation is practised on about 90 per cent of the plains' cultivatable area. The soils of the plains are generally satisfactory for rice growing[5]. The Halcrow report states that the BoIS area benefits from some of the best agricultural soils in Cambodia. They also report the soils to be highly suitable for dry and wet season rice and other irrigated crops. The BoIS is located about 40 kilometres north west of the Battambang town centre (see map appendix 1). The water source is the Mongkol Borei River. This river has a total catchment of 4,444 square km, 29 per cent of which is in Thailand. This river also serves two irrigation systems in Banteay Meanchey. The Mongkol Borei is the second largest river in the Province. It is perennial, with maximum discharge reaching 200 $m^3/s$ in September. Dry season discharges are quite low at around one $m^3/s$. The irrigation system is a gravity system, which diverts water from the river using the Bovel diversion weir. It is mainly used for supplementary wet season irrigation although there is some dry season rice cropping.

### *The Barai Irrigation System (BIS)*

Agriculture based on irrigation has taken place in and around Siem Reap since the Angkor Empire of the $11^{th}$ century. The BIS is approximately eight kilometres from Siem Reap town (see map appendix 1). The French built an earlier system during the 1930's. The present system was constructed with USAID funding in the early 1950's. Prasat Keo, a diversion weir constructed by the French on the Siem Reap River diverts water into the Barai reservoir during the wet season. The Siem Reap River has a catchment area of 9,471 square km, mostly within the Province. The system was used until the early 1970's and regulated and maintained by the Provincial Department of Hydrology (DoH) with technical input and decision making from the central DoH. The system was used for wet season supplementary rice irrigation and dry season rice irrigation in the more fertile soils adjacent to the Tonle Sap Lake. Irrigation was also provided for dry season fruit and vegetable production.

During the civil war in the early 1970's, the system was neglected and began to deteriorate. During the reign of the Khmer Rouge from 1975 to 1979, some changes were made to the system. From 1979 to 1989, the BIS provided water to a greatly reduced area due to the deterioration of the canals. In 1989, the Adventist Development Relief Agency (ADRA), in conjunction with Siem Reap DoH began structural repair works to the BIS. Some sections of secondary canals two, four and five were renovated, with their control structures. These repairs were completed in 1991[6]. The soil found in the BIS is not as good as that of the BoIS. The predominant soil type is *Prey Khmer.* It is widely recognised that this soil, typical in the upper command area of the BIS, is sandy and lacks organic matter. However, soils closer to

[4] CAS, An Evaluation of Farm Level Impact of the Barai Irrigation System, Phnom Penh, February 2001
[5] Brown, 'Irrigation Engineer - Design of Structures and Canals', SAWA, Phnom Penh, September 1993.
[6] International Labour Organisation, Draft Barai Development Plan, Phnom Penh, 1994

the Tonle Sap, which are subject to a yearly flood inundation, are also in the command area of the BIS. Rice growing areas in Puok Commune have soils which were described as having moderate fertility, loamy or clayey texture, massive structure, were slightly acid and nitrogen, phosphorous and potassium deficient[7].

[7] SPFS, Participatory Evaluation of the First Phase, FAO, Phnom Penh May 2000

# KEY ILO INPUTS

Labour Based Appropriate Technology (LBAT) was used for all aspects of the construction, rehabilitation and maintenance of the irrigation systems. LBAT is the flexible and optimal use of labour as the main resource in works carried out. Integral to this is cost effectiveness and work quality. The aim of LBAT is not only to create jobs, but also to combine the optimum use of labour with quality work in a cost-effective manner. The Ministry of Rural Development (MRD) has adopted LBAT as the preferred method to rehabilitate rural infrastructure[8]. The ILO projects were concerned with institutional capacity building and skill development of local counterpart staff. Local capacity and self-reliance were strengthened to ensure that local labour, material and knowledge will be used for further development. Cambodian staff were trained in LBAT and in site specific techniques for administration, planning, organisation and supervision of labour based works.

**Training Provided**

The following table shows training provided for staff during the ILO projects.

| Training | Duration | Trainees |
|---|---|---|
| Introductory technical training in LBAT | 2 Weeks<br>2 Weeks<br>2 Weeks | 11 Engineers<br>18 Technicians<br>20 Supervisors |
| On the job training and LBAT refresher course in irrigation | 1 Week | 30 Engineers, technicians & supervisors |
| Maintenance course for drivers and operators | 2 Weeks | Etan & roller operators, drivers |
| Technical refresher course for engineers | 1 Week | 5 Engineers |
| Technical refresher course for technicians | 1 Week | 5 Technicians |
| Technical refresher course for supervisors | 1 Week | 7 Supervisors |
| Field visit to irrigation projects in Nepal | 2 Weeks | 4 Engineers |
| IRRI Water management training course (Philippines) | 2 Weeks | 2 Engineers |
| Engineering training course | 4 Weeks | 2 Engineers |
| In-service training for LBAT | 4 Weeks<br>1 Week<br>1 Week | 1 Engineer<br>8 Technicians<br>11 Supervisors |
| Computer training | 4 Weeks<br>17 Weeks | 2 Engineers<br>1 Engineer |
| Concrete cube testing | 0.1 Weeks | 2 Engineers |
| Contract administrators | 0.4 Weeks | 1 Engineer |
| Work term practice on irrigation | 9 Weeks | 1 ITC Student |
| Engineering training course on LBAT | 1 Week | 1 Engineer |
| General English | 46 Weeks<br>13 Weeks<br>10 Weeks<br>10 Weeks<br>4 Weeks | 1 Engineer<br>1 Engineer<br>1 Engineer<br>2 Technicians<br>1 Technician |

*Table 1: ILO Training provided to staff in the BoIS and BIS.*

[8] *op. cit.* Termination Report, 1996

On the job training of local and counterpart staff was an essential element of the ILO projects in addition to the formal training listed above. Training was also given to Water User Groups (WUG) in the BoIS and BIS. This included:

- Leadership training to WUG leaders.
- Technical training to WUG leaders/length persons in LBAT maintenance activities.
- Technical training to WUG labourers in LBAT maintenance activities.

**Training Materials Produced**

Substantial training materials were produced by the ILO projects. For the irrigation sector, these included:

- Introductory Training Course in Labour Based Technology for Irrigation Engineers.
- Introductory Training Course in Labour Based Technology for Irrigation Technicians.
- Introductory Training Course in Labour Based Technology for Irrigation Supervisors.
- Water User Association Agreements.

Non specific to the irrigation sector (also used by other sectors i.e. roads and Angkor):

- Preventative maintenance for labour based vehicles and equipment.
- Safety guidelines for operators and drivers.
- Draft Workers Compensation Agreement.
- Guidelines for tool adaptations for disabled workers.
- Course Notes - 1 Day Sensitisation Course for Development Engineering and LBAT.
- Course Notes – 3 Day Orientation Course in LBAT.

**Technical Assistance/Personnel**

A number of expatriate technical personnel worked in the ILO projects concerned with the irrigation systems. These included:

- Four Chief Technical Advisors/Team Leaders over the life of the three projects.
- Four Senior Engineers, managers of the projects in Battambang and Siem Reap Provinces.
- Two Irrigation Engineers.
- One Irrigation Design Engineer.
- Two Irrigation Consultants.
- One WUG Organiser[9].

[9] *op. cit.* ILO termination report, 1996, and, Terminal Report, Labour Based Rural Infrastructure Rehabilitation & Maintenance Programme, February 1999.

## Financial Inputs

Financial input into the systems began in 1992 with the first ILO project (CMB/92/008). Direct capital assistance to the systems ceased at the end of 1998, with the termination of the second ILO project (CMB/95/011). The BIS continued to receive technical support under the Upstream Project until the end of the year 2000.

The first two ILO projects had a total financial input of US$18.1 million (including the cash equivalent of food for work provided by WFP). Forty per cent went to overheads. The other 60 per cent (US$10.9 million) went to road and canal construction, rehabilitation and maintenance, to the cleaning and clearing of the Angkor temple complex and to training. For the US$10.9 million spent on works, 40 per cent went to purchasing hand tools and equipment and renting offices, 34 per cent was spent on wages and salaries, 24 per cent to procuring and hauling construction materials and two per cent to training[10].

Determining the exact financial inputs into the BoIS and BIS was difficult. The different projects did not keep separate project and activity (irrigation, roads, Angkor) accounts so costs could only be estimated. Based upon discussions with project staff, financial input was estimated as follows (all figures in US$):

| | |
|---|---|
| Average cost for construction/rehabilitation of one km of canal | $7,500 |
| Total kilometres constructed/rehabilitated | 83.88 km |
| Total construction/rehabilitation cost | $629,100 |
| Average cost of maintenance | $144/km/year |
| Total km-years maintained | 585 |
| Total maintenance costs | $84,240 |
| **Total capital inputs** | **$713,340** |

*Table 2: Capital Inputs on Irrigation (USD)*

For the projects, capital inputs have been estimated as representing 60 per cent of the total costs. The remaining 40 per cent of costs went to direct and indirect overheads. Therefore, the total financial inputs of the ILO projects for the BoIS and BIS is estimated at **US$ 1,188,900**.

[10] Report of the Evaluation Mission of Labour Based Infrastructure Rehabilitation Project (CMB/92/008), Labour Based Infrastructure Development Component of CARERE2 (CMB/95/011), ILO, UNDP July 1999.

# KEY ILO OUTPUTS

## Physical Outputs

ILO constructed, renovated and maintained numerous kilometres of canals in the two irrigation systems. In addition to the canals, ILO constructed or renovated large numbers of irrigation structures in the two systems.

***Works to the Canal System***

In The BoIS, 37 km of canals were renovated (secondary canals 2, 3, 4 and 5), and 41.5 km of canals were maintained by ILO. In addition, because of the dearth of tertiary canals and their large size, ILO assisted the WUGs to construct tertiary canals. The ILO constructed 18 structures and repaired 97 structures (see Appendix 2 for details).

In the BIS 41.79 km of canals were renovated. This included part of secondary canal two and secondary canals three, four, five, and seven. The ILO constructed 7.14 km of canal (secondary canal 8) and maintained 53.33 km. In addition 63 structures were constructed and a further 117 structures were repaired by ILO (see appendix 2 for details).

To summarise the ILO achieved the following physical outputs in the two irrigation systems:

- Renovated 76.74 km of canals.
- Constructed 7.14 km of canals.
- Maintained 94.83 km of canals.
- Constructed 81 new irrigation structures.
- Repaired 214 irrigation structures.

***The Command Areas***

The wet season irrigation command area for the BoIS is 35,000 hectares. This figure comes from a number of sources. In a Halcrow study, an area of 21,150 hectares was reported before the ILO rehabilitation[11]. The study reported a potential command area of 35,000 hectares if rehabilitation was carried out. In discussions with the Battambang PDWRM in July 2000, a command area for Bovel of 35,000 hectares was given. A former DoH counterpart irrigation engineer with ILO reported a command area of 35,000 hectares for the wet season. This was based on a Commune survey conducted by the ILO to determine the wet season command area of the system. In addition, there is a dry season command area of around 400-500 hectares[12].

The ILO recently conducted surveys in the BIS using GPS/GIS. These have generated detailed maps of the command area (see appendix 1). These maps show that 7,049 hectares are supplied with supplementary wet season irrigation water and 7,644-8,667 hectares of land receive irrigation water for receding rice and dry season cultivation.

## Employment

The workdays generated by the three ILO projects through construction and maintenance activities were substantial. Under project CMB/92/008, the irrigation rehabilitation and

[11] Inventory & Analysis of Existing Systems, Vol. 2, April 1994

[12] Discussions with former ILO staff, PDWRM, District staff and farmers in the system, July 2000.

maintenance generated 460,000 workdays of employment[13]. To estimate the indirect employment effect a multiplier of 1.6 can be applied to the direct employment to derive an additional 736,000 workdays of indirect employment. Thus, the total employment effect of the irrigation works for CMB/92/008 was 1,196,000 workdays.

The irrigation component of CMB/95/011 generated 200,660 workdays of employment[14]. To estimate the indirect employment effect a multiplier of 1.6 can be applied to the direct employment to derive an additional 321,056 workdays of indirect employment. Thus, the total employment effect of the irrigation works for CMB/95/011 was 521,716 workdays.

For CMB/97/M02/SID the project did not pay for workdays but provided technical support to Water User Groups and Farmer Water Users Community in the BIS. In 1999, 1,828 workdays were created. In 2000, 6,782 workdays were created, giving a total 8,610 workdays for the project[15]. To estimate the indirect employment effect a multiplier of 1.6 can be applied to the direct employment figure, to derive an additional 13,776 workdays of indirect employment. Thus, the total employment effect of the irrigation works for CMB//97/M02/SID was 20,558 workdays.
Adding the workdays for the three ILO projects together gives a total employment effect of **1,738,274 workdays** in both irrigation systems over the life of the three ILO projects.

## The Impact of Wage Earnings

In June 2000, The ILO commissioned the Center for Advanced Study (CAS) to carry out a study[16]. The purpose of the study was to estimate the impact of wage earnings from employment on labour-based rural infrastructure works, on those who are employed on these works and their families. The study was carried out among those working on road construction and maintenance supported by the ILO. Although there are some differences between those surveyed and those who worked on the irrigation systems, inferences can be drawn from the study that would apply to those employed in the irrigation works.

Most workers in the study were rural farmers. Income opportunities for them are limited and rural infrastructure projects in roads and irrigation are one of the few wage-earning opportunities for them. This is especially so for women. Rural construction and maintenance offer one of the few wage-earning opportunities with equal pay for men and women. In the survey, 43 per cent of the workers were women. A further breakdown of figures of those surveyed showed that a majority (54%) belonged to poor families, 30 per cent belonged to slightly better off families while 16 per cent came from very poor families.

The study concluded from the views expressed by the workers that development approaches insisting on "voluntary labour" in practice often encourage forced labour. This use of forced labour further limits the possibilities for very poor families to gain wage labour. This is because they had had to contribute to village communal works. Most workers were very negative about making (labour) contributions under these circumstances.

A majority of workers (50%) preferred payment for their labour to be in cash. However, 44 per cent preferred payment in cash and kind (food) or, in kind entirely. Cash was preferred, as

[13] *op.cit.* Termination Report, 1996
[14] *op. cit.* Terminal Report, February 1999
[15] The Upstream Project, Annual Report 1999 and Monthly reports 2000.
[16] CAS, Employment in ILO Supported Road Construction and Maintenance, Phnom Penh, August 2000

it was easier to carry than rice or because of negative experiences with payment in kind. Those who preferred in kind payment were mostly those living far from a market and in need of rice. Some workers expressed a preference for in kind payment to avoid the temptation of spending their earnings on entertainment.

The following table of the wealth ranks of the respondents is taken from the CAS study.

| Sample | **1st Ranking** | **2nd Ranking** | **3rd Ranking** | **4th Ranking** |
|---|---|---|---|---|
| Total | Food | Clothing | Medicines | Education |
| Better-off | Food | Clothing | Education | Farm tools |
| Poor | Food | Clothing | Medicines | Debt repayment |
| Poorest | Food | Medicines | Education | * |
| Men | Food | Clothing | Debt repayment | Education |
| Women | Food | Clothing | Medicines | Education |

*Table 3: Wealth ranking per expenditure category by gender*

* There was no clear 'fourth' ranking for the poorest group.

As can be seen from the table, food is the most important expenditure item across all wealth groups and for both sexes. However, the poorest were more likely to spend their income on basic food items like rice, salt, oil and fish paste while the better off bought more nutritious food like fish or meat. The CAS report points out that the main expenditure of income on food *"indicates the importance of extra income for the survival of poor rural farmers in Siem Reap Province during the dry season."*

# ORGANISATION, MANAGEMENT AND FINANCING

## Systems Put in Place by ILO

ILO helped set up a management and finance structure in the BoIS and BIS as part of its interventions. This structure was similar to that set out for Farmer Water User Communities (FWUC) by the MWRM - tertiary committees (WUGs) on the tertiary canals, secondary committees on the secondary canals and a committee to oversee the whole scheme which is equivalent to the FWUC board.[17] WUGs were formed, based on each tertiary canal. Elections were held for the position of WUG leader. The village chief was often elected to this position. A secondary canal committee called the Water Users Association Committee (WUAC) was also set up. It was composed of the leader of each WUG, plus the Commune leaders along the secondary canal. In Bovel, village leaders along the canal who were not WUG leaders were also in the WUAC. The ILO initiated water scheduling in the BoIS and BIS through these organisations.

WUGs were responsible for the maintenance of their tertiary canals. Each WUG was responsible for water distribution to users along the tertiary canal. In addition, each WUG was responsible for maintaining the secondary canal upstream from the tertiary canal outlet. Initially ILO paid each WUG leader to do routine maintenance (10 days per month) on the secondary canals. The person paid to maintain the secondary canal was called a length person.

Self-financing of operation and maintenance was initiated. Each farmer was asked to pay 30 kilograms of rice per year for each hectare of irrigated land. This fee was to be collected by the leader of the WUG. Even during the ILO intervention, the fee was never collected in full, but always in part, highlighting the difficulty in this critical step. In the BoIS, the ILO organised a water fee split of 25:5 to pay for maintenance. Twenty-five kilos was reserved for maintenance of the primary and secondary canals and five kg to the tertiary canals. In the BIS all 30 kg was reserved for maintenance of the primary and secondary canals.

## Current Systems

### *The Bovel Irrigation System*

The RGC owns the BoIS through the MWRM. Responsibility and authority to manage the system is passed to the PDWRM which in turn passes responsibility down to the District of Tmor Koal where the BoIS is situated. At the upper reaches of the system, the diversion structure and the primary canal are the responsibility of the District. The secondary and tertiary canals are the responsibility of the WUGs. Management ownership of the system has not been officially transferred to the users although the WUGs have responsibility for maintenance at the tertiary and secondary canal level. For this to occur, a constitution and bylaws in the form of a FWUC Statute has to be submitted to MWRM by the FWUC. If approved MWRM will formally recognise the FWUC who will take on full management responsibility. Theoretically, technical and financial support will then be available from MWRM.

[17] See Appendix 6 for more information on the National Policy and Framework.

The current situation of management, organisational structure and finance has changed from that set up by the ILO. WUGs have reversed the fee structure to five kg for primary and secondary canal maintenance and 25 kg for tertiary canal maintenance. Part of this fee was used to install culverts in the tertiary canals. It is now used to pay the length persons for routine secondary canal maintenance. WUGs are still responsible for maintenance of the secondary canal above their off-take and their own tertiary canal. Large-scale maintenance is carried out before the wet season, with WUGs providing labour. Five kg of the fee is converted to cash and goes to the Communes. This plus cash collection is used for emergency canal repair and repairs to structures. Cash is collected from a variety of sources, from farmers in the system to rice millers. The rationale is that rice production increases due to irrigation, without irrigation there is less rice production and so less business for the miller. Those who benefit are often willing to pay!

The system of fee collection and maintenance by the WUGs at the tertiary canal level is still operating, but at a lower intensity than when ILO was providing support. Along secondary canal four, WUGs were still collecting and recording the collection of water use fees in 1999. In Rong Chreav Commune in Tmor Koal District, all seven WUGs collected fees. In total 15.6 tonnes of rice was collected in 1999. This is around 33 per cent of the full fee. In 2000 (until 21/7/00), WUG two of secondary canal four collected 2.7 tonnes of rice. There are 238 ha of irrigated land on this tertiary canal. The full fee collection should be around 7.1 tonnes. The actual collection was 38 per cent of the full fee. There has been no financial disbursement from the MWRM to the system for maintenance or support to the WUGs, although the MWRM has requested MEF for support.

The current organisational structure follows the government proposal. As responsibility has devolved to the District, the key player for the BoIS at this level is the District Water Resources and Meteorology Officer. Below this is the Commune level chief of the WUGs (also chief of the commune) who has a co-ordination and problem-solving role. There are two deputies to assist. At the next level are the leaders of the WUGs - based on tertiary canals. The chief of the WUG is responsible for scheduling along the tertiary canal. The members of individual WUGs are the final tier of the structure. WUG leaders are no longer elected as they were during the ILO intervention. The Village Development Committee (VDC) now appoints them. When ILO helped set up the WUGs, they were the only non-political group operating in the villages. Now there are many groups with the VDC at the pinnacle. The WUG leaders interviewed had all been elected by the WUG and then re-appointed by the VDC.

Tmor Koal District has set up three water management zones. These are physical zones based on terrain and the primary canal. The wet season supplementary water schedule allows five days water for each zone, followed by ten days without water. The schedule was developed by the District Water Resources and Meteorology officer and approved by the PDWRM. The Commune is responsible for operating the control structure gates according to the schedule.

Despite the lack of formal recognition, it is clear to all (from PDWRM to the WUG members) that tertiary canals are 'owned' by and are the responsibility of the individual WUGs. Organisation at village level, especially for maintenance of tertiary canals and minor repairs to structures seems good. Water fees, cash collection and labour for maintenance are arranged by WUGs. There is no need to request assistance from the commune. Maintenance and structural repair is also being carried out on the secondary canals by WUGs. They were given responsibility but no resources, so they simply get on with management, operation and

maintenance. Ownership at the secondary canal level is not always clear. However, due to necessity WUGs take on this responsibility.

The WUG and Commune leaders have copies of and follow the bylaws, rules and regulations established with ILO assistance in 1994. The foundations of the organisation set up by ILO are still present and operational. There has been no new assistance from any organisation for irrigation management, operation or maintenance since the ILO ceased assistance to the WUGs and the Battambang PDWRM in 1998.

***The Barai Irrigation System***

As with BoIS, the RGC owns the BIS through MWRM. APSARA's role in managing the World Heritage Angkor Park, of which the Barai Reservoir is an integral part, overlaps this. Responsibility and authority for managing the BIS was passed to the PDWRM. The PDWRM has in turn passed most responsibility down to the Districts of Puok and Siem Reap, where the BIS is located.

At the system level, the diversion structure and the Barai reservoir are PDWRM's responsibility. Responsibility for the primary and secondary canals has been passed to the Districts. Responsibility for the secondary and tertiary canals has been passed to the WUGs. Management ownership of the system at the tertiary and secondary canal level has not yet been officially transferred to the users through a FWUC. In the BIS, where ILO support did not end until 2000, the situation is more advanced than in BoIS. A constitution and bylaws were drafted and the FWUCs will submit these to the MWRM through the PDWRM. If approved the FWUCs will be formally recognised. With this recognition will come management responsibility (which was essentially assumed). Theoretically, technical and financial support will then be available from the MWRM.

The current lack of formal recognition has not prevented WUGs from operating and maintaining the tertiary and secondary canals. One hectare of farming land in the BIS with access to irrigation water attracts a water user fee of 15,000 Riel per year. When the DoH/ILO introduced water fees, 30 kg of paddy rice per hectare per year was the fee. There were difficulties in handling and storing the rice, so this was changed to a cash fee. The fee is planned to increase when there is close to 100 per cent collection of this initial fee. The ILO estimates the full maintenance cost for the BIS to be around US$20/ha/year. At current exchange rates (US$1 = 3,900 Riel) 15,000 Riel is US$3.85. This is approximately the 20 per cent share of operation and maintenance costs set out for the first year of FWUC operation.

The fee is collected by the WUG leader from each member of the WUG and passed to the Commune. All fees collected are receipted. One copy goes to the farmer, one copy to the chief of the WUG and one to the District. The Commune checks the figures before passing the fees to the District. Twenty per cent of the total collected is passed back to the Commune. Three per cent of the total collected from each Commune goes to the Commune staff responsible for the WUGs. Two per cent of the total fee is used to pay the salary of the supervisors of operation and maintenance for each District. Fifteen per cent of the fee is given to the WUG leader, based on what he collected from group members. The remaining 80 per cent is available for operation and maintenance.

In the first year of operation, the MWRM calls for the FWUC to meet 20 per cent of operation and maintenance costs. However, only the Barai FWUC is contributing finance. The MWRM has no available funds to finance operation and maintenance. In 1999, eight million Riel

(US$2,115) was collected from Puok District. At the end of 2000, the Puok District WUGs had 4,520,000 Riel and the Siem Reap District WUGs 480,000 Riel saved for BIS maintenance. WUG leaders and Communes keep records of irrigated land in each village and for the Commune respectively. The Commune determines the water user fees from these records and families are invoiced based on this. This can be reconciled with actual fee collection providing a check and discouraging the disappearance of fees.

At the tertiary canal level all operation (including water distribution) and maintenance is carried out by individual WUGs and the WUG leader is responsible for ensuring this. This is widely accepted, from the water users up to the Ministry level. It is also accepted that maintenance of the secondary canal upstream from the tertiary canal off-take is the responsibility of the WUG on that tertiary canal. Routine maintenance for the primary and secondary canals in the year 2000 was initially funded by water user fees. Nine length persons were hired. Later in the year routine maintenance was funded by WFP and was carried out by 50 length persons. The length persons worked ten days per month and were paid 40 kg of rice + fish + salt. They maintained the primary canal and all but 3.3 km of the secondary canals.

The Water User's Committee (WUC) for Puok District consists of the First Deputy Governor of Puok District who is the chairman of the committee, Mr. Thap Bunchhean of ILO's Upstream Project, who is an advisor, the Puok District Financial Officer, the District Water Resources and Meteorology Officer and the six Chairmen of the Commune level Water User's Committees. The WUC for Siem Reap District was formed along similar lines. At the Commune level, the WUCs are composed of the chairman who is either the Commune Chief or the Deputy Chief in charge of agriculture and the leaders of the WUG from that Commune. The size of the Commune WUC varies depending on the number of WUGs in the individual Commune. Each water user group has an elected leader (see organisational chart appendix 3).

As in the BoIS, ILO introduced scheduling of water delivery in the BIS. WUG members make requests to the WUG leader who then makes a formal request to the PDWRM. The department then prepares an irrigation schedule based on these requests[18].

[18] *op. cit.* CAS Evaluation, February 2001

# INVOLVEMENT BY GOVERNMENT AND OTHER ORGANISATIONS

A literature review was undertaken and interviews were conducted with organisations involved with the irrigation systems. Some information gained from these has been incorporated into other sections of the report and is not repeated here.

## The National Level

***The Ministry of Water Resources and Meteorology***

In a meeting with Veng Sakhon, Under Secretary of State, the BoIS and BIS were discussed. MWRM has some institutional support to assist to implement its irrigation policy 2000. At the national level, there is one year's technical assistance for capacity building in water management from an ADB grant. There is also an agricultural production improvement project from the World Bank. Within this, there is an irrigated agriculture component with four sections, a) capacity building in administration and hydrology, b) small-scale gravity irrigation, c) information management systems and d) a study of medium scale irrigation. There is a proposal to JICA to fund the rehabilitation of the Barai reservoir and MWRM has requested assistance from the Indian government to install more water control structures in secondary and tertiary canals. In 1996 the Central Department of Hydrology (now MWRM) secured funding to carry out major rehabilitation of the Prasat Keo weir, which diverts water from the Siem Reap River to the Barai Reservoir. There are currently no organisations providing or proposing to provide irrigation or management support to the BoIS.

The MWRM has a department of water resource management and conservation. This department is long established but has recently been given responsibility for Farmer Water User Communities. The current organisational and management structure of the two systems was also discussed. Some management problems were reported by the Under Secretary. He mentioned difficulties in collecting water use fees in the BoIS. He also discussed poor farming practices in the BIS that lead to uneven fields, high and low areas and difficulties in irrigation flow. Financial arrangements for the two systems were also discussed. Theoretically, funds from the MEF go through the MWRM for operation and maintenance in the systems, until FWUC are self-sustaining. In practice, this has not yet taken place.

The Under Secretary expressed some comments about the ILO intervention in the BoIS and the BIS. From MWRM's point of view, the ILO projects:

- Had good co-operation at the provincial level between ILO and the PDWRM.
- Had less contact at the central level.
- Provided good operation and maintenance.
- Enabled farmers to reliably access irrigation water.

The early achievements of the ILO projects occurred in especially difficult times and the Ministry appreciated this.

***National Conference on Cambodia's Water Resources***[19]

Documents from this conference explain that most funds for the development of public infrastructure come from the national budget and foreign aid. Since 1979, funding for repair and reconstruction of irrigation systems has come from NGOs and bilateral funds. Loans from the World Bank, ADB and IFAD have been another source of funding. However, these organisations have not reserved funds for operation and maintenance of these investments. Consequently, maintenance is not always carried out. This highlights the importance of the correct decision by the ILO project to support and develop capacity in operation and maintenance over a number of years in the irrigation systems.

It was also noted that MWRM lacks the capacity to carry out their responsibilities, both at the national and provincial levels. Because of the country's recent history, government agencies lack trained or experienced staff. This problem is compounded by low public service salaries, about one tenth of those offered by the private sector or international organisations. There is limited funding for human resource development, facilities and equipment, data collection, information management or operation. ILO initially addressed this by providing training to numerous counterpart staff, mostly from the provincial level of the MWRM. An evaluation of the first two ILO projects praises the achievements in training engineers, technicians and supervisors[20]. This evaluation suggests that some of these people could become private small-scale contractors (SSC) and this has happened in some cases. SSC can be hired by FWUC to undertake works that they cannot carry out. If trained staff remain with the PDWRM, they can supervise works that cannot be done by the FWUC. One long-term ILO counterpart supervisor from the Siem Reap PDWRM now receives an allowance from the Puok WUC to supervise operation and maintenance. His knowledge of the system and his technical capacity remain with the BIS.

## The Bovel Irrigation System

***The Provincial Department of Water Resources and Meteorology, Battambang***

At the provincial level, the benefits from the ILO intervention include the obvious physical rehabilitation that allows farmers access to irrigation water. This has led to an increase in rice production. The Department has also seen social benefits, with greater social cohesion in farming communities. People now work together for mutual benefit as they have an assured water supply. The Department also mentioned the transfer and use of LBAT as a benefit from the ILO projects. The Battambang PDWRM noted that tertiary canal operation and maintenance was being carried out by the WUGs in the BoIS. WUGs have been responsible for tertiary canal operation and maintenance since the ILO rehabilitation. This highlights the clear links between ownership, benefits and responsibilities.

At the PDWRM in Battambang, the use of LBAT is seen as appropriate. The PDWRM are currently using LBAT in rehabilitation work in the Kompong Poei irrigation system. The Italian NGO APS is supporting this rehabilitation. The use of LBAT provides evidence that the technology has been successfully transferred at the provincial level. Although APS purchased a new excavator to support the rehabilitation, its use is restricted to the primary canal, while LBAT is being used throughout the rest of the system. Costs per cubic metre of soil moved are comparable for LBAT (US$1.00) and this machine (US$0.90 to $1.20). Work

[19] National Conference on Cambodia's Water Resources: an Agenda for Action, December 2000, Phnom Penh
[20] *op. cit.* Evaluation Mission Report, July 1999

norms for the LBAT rehabilitation in Kompong Poei are one cubic metre per day, with pay rates of US$1.00 per day. During the ILO rehabilitation of the BoIS work norms varied between one and two cubic metres per day (depending on conditions), with pay rates of US$1.00 per day. The costs of machine excavation at Kompong Poei do not consider capital costs of the machine, depreciation or spare parts. There was a 'dead' excavator lying in the front of the PDWRM office while the author interviewed departmental staff. In the Halcrow Main Report, this problem with plant is noted. The report states that there is a tendency in Cambodia to acquire plant without the means to operate, maintain and eventually replace it. It is used while functional, then it falls into disrepair until replacement or rehabilitation is needed. The government then looks to an outside body for a further injection of funds. This raises the issue of sustainability. Sustainability is more likely to be achieved using local resources, indigenous skills or by strengthening these skills and using appropriate technology like that used in the ILO intervention. This way there is less leakage out of the country of financial resources. Foreign exchange is conserved and the benefits of using appropriate technologies stay in the country. Purchasing plant means financial resources and benefits leave the country.

***World Food Programme, Battambang***

The World Food Programme (WFP) had a long partnership with the ILO in Battambang, providing large amounts of food for work carried out (Food for Work) in the BoIS. WFP saw obvious benefits in working with the ILO programme. The ILO intervention in the BoIS occurred in areas that WFP wished to target. There was an obvious synergy of programmes between the ILO and WFP, with a quality technical output being produced for food input. WFP's goal is to provide food security. By targeting the BoIS in conjunction with the ILO, this was achieved in the short term. Long-term food security was also improved by the increased rice production possible through assured irrigation water. WFP assessed that there is no longer any need for WFP support in the BoIS area.

***Provincial Department of Rural Development - CARERE***

SEILA is supported by CARERE. The SEILA programme has been forming Village Development Committee's (VDC) and Commune Development Committee's (CDC) with NGO support. Some of these are in the BoIS. The CDC makes a three-year Commune development plan with the assistance of SEILA. This is funded from the sources like the Local Development Fund. The SEILA programme has recently supported small irrigation works in the BoIS through the Local Development Fund. This has included further tertiary canal building. They have also assisted with installing drainage culverts into some secondary canals. In 1994/5, CARERE supported activities like fish raising, duck raising and forestry in the BoIS.

***SAWA***

In 1993 SAWA undertook a study and produced a report for CARERE, looking at possible activities for CARERE in the BoIS. At this stage the ILO was still rehabilitating secondary canal four and had not worked on any other secondary canals. Nor had any WUGs been formed. The report set out some of the problems of the BoIS, including a lack of management and maintenance. Because of these problems:

*"Rice yields in the area are still low as farmers are not sure of a regular irrigation water supply and are still using traditional cultivation methods and low yielding resistant [pest/disease/drought] rice varieties. With a regular irrigation water supply the farmers will*

*most probably be more willing to pay for fertiliser, pesticides etc. and use less resistant higher yielding rice varieties."*
In the Halcrow main report[21], this theme is also covered. Rain fed lowland rice (the cropping formerly practised in Bovel due to the lack of reliable irrigation water) uses local varieties due to tolerance to lack of water. The crops can still fail from drought and even if harvested, yields are low. In this type of cropping fertiliser and pesticides are little used, as there is no return on these investments. Interviews with farmers, village, Commune and District officials from the BoIS seem to show that this practice is changing. Profiles from these interviews appear later in this report. The interviews showed increased rice production due to reliable irrigation water. New higher yielding varieties have been adopted due to a secure water supply (of wet season supplementary irrigation water). Farmers are no longer forced to grow traditional varieties, which are tolerant to poor conditions but produce poor yields. Farmers have invested in fertilisers, as water is not a limiting factor to production. There is also increased dry season production due to the adoption of short season high yielding IRRI varieties.

## The Barai Irrigation System

***The Provincial Department of Water Resources and Meteorology, Siem Reap***

Mr Son Kim Sea, the Director of the PDWRM highlighted some aspects of the ILO's work in the BIS. This included participation, operation and management of the BIS with WUGs and farmers in the area. He also pointed out the benefits of secondary canal eight (which ILO constructed), improving water management, especially in the dry season. It allows faster water allocation along the lower reaches of secondary canals five and seven. This canal also reduced water flows in secondary canals two and four, leading to lower maintenance requirements in these canals. The director gave examples of the benefits accruing from the system, after the ILO intervention. He noted that one Commune; Krabei Real can now crop rice three times a year because water is available. He also noted that cropping has diversified, with Puok and Samrong Yea Communes planting vegetables, peanuts and sugar cane, due to water availability and suitable soils. Keo Pour Commune still grows one crop of rice per year but now plant vegetables as the (Tonle Sap) lake water recedes. At the Commune and District level, there has been improved collection of water fees due to the ILO support. Over eight million Riel was collected in 1999. The director believed the methods used in the ILO programme were appropriate. WUGs and LBAT are both seen as appropriate - people understand and can undertake both. Due to the technical knowledge of LBAT and the organisational capacity of WUGs, the users can undertake secondary canal maintenance.

One problem noted by the Director is that the Commune Chief is also the Chief of the Water User Committee at the Commune. The same scenario applies at the District. The problem is that these are very busy people. Although this is true, when one Commune in the BIS was visited without notice the Commune Chief was working on financial records for the Commune WUC. The financial incentive from WUC work may help 'prioritise' the Commune leaders work.

The PDWRM continued to support the BIS after the ILO intervention ended, although the Director notes that this has been difficult. He pointed out that there is limited staff in the

[21] *op. cit.* Halcrow, June 1994

department (Siem Reap PDWRM has 40 staff to cover 12 Districts). Some staff also lack experience and knowledge. The PDWRM have asked MWRM for more staff.
When asked what they can do themselves the director said WUGs could operate and maintain tertiary canals. WUGs can also conduct small maintenance on secondary canal structures and on the secondary canals. The WUGs have asked the PDWRM for permission to repair structures and bridges. They have the technical knowledge to do this work from the ILO. They provide their own money and do not request any from the PDWRM. The Director noted that WUGs could not repair big structures. PDWRM have two engineers and technicians who can assist. It was reported that institutional support from the MWRM was lacking. The Director pointed out it is a new Ministry, plans and policy are being set but the Ministry lacks human and financial resources.

### *World Food Programme - Siem Reap*

The co-operation between ILO and the World Food Programme (WFP) which began in Siem Reap in 1994 showed obvious synergies. Both programmes targeted the same geographical areas (BIS) and beneficiaries. The ILO provided good technical input for infrastructure rehabilitation while WFP provided food for work done. These synergies provided long term benefits and sustainability to both projects. There were short term (food/cash) and long term (rural infrastructure) benefits to the people reached by the programmes. WFP infrastructure rehabilitation provided without technical expertise, support and maintenance often deteriorated rapidly after completion. WFP's goal is to ensure food security for needy people and to sustain that security. Their current programme is called the Protracted Relief and Recovery Operation (PRRO). One part of this programme is Food for Work (FFW), which rehabilitates infrastructure like roads and irrigation systems. FFW aims to meet the short and long-term needs of target beneficiaries.

The WFP supported the WUGs of the BIS in 2000. Fifty km of primary and secondary canals were maintained by 50 length persons. The support continued until the end of 2000. This programme fits under the rehabilitation component of PRRO. Workers are paid four kg of rice (+ fish and oil) per day's work. They work ten days per month. This programme is a pilot for WFP and will be assessed. The WFP country programme is considering a more development-oriented approach for the next phase and the support of WUGs is of special interest to WFP.

## *FAO*

The main thrust of FAO in Siem Reap is Participatory Resource Management in the Tonle Sap region. In the BIS, they have supported horticulture through improved fruit tree varieties. They have assisted private businesses to produce fruit tree seedlings. Since 1998, FAO has also been involved with a Special Programme for Food Security (SPFS). This programme operates in the BIS area. The SPFS chose seven pilot sites in four Provinces and worked with 170 farmer households in the first dry season cycle of the SPFS. These included farmers from two villages in Puok District who have farming land on secondary canal four of the BIS. FAO runs integrated farmer field schools. These are held twice yearly for 20 weeks allowing the schools to follow one complete agricultural cycle. They aim to cover farming systems, techniques and technologies to increase agricultural production. This is done through four components; crop intensification and diversification, farm diversification and increasing farm income, improved water control and constraint analysis. FAO deliberately targeted the BIS for their SPFS pilot as they were in high potential areas close to irrigation systems.

The 1998 SPFS showed results in improved rice yields. Dry season (recession rice) rice yields in the two villages in Puok Commune were 1.5 tonnes per hectare without the SPFS and 2.74 tonnes per hectare with SPFS[22]. This was recession rice cropping, which should have better overall yields due to better soil fertility. Another claimed impact of the SPFS was the cultivation of dry season crops like watermelon, cucumber, long bean and maize, which provided cash income[23]. FAO states that the SPFS demonstrated the need for an extension network in rural Cambodia to provide essential support to boost agricultural production. This was evident in BIS from the results achieved. The yield increases shown demonstrate the further potential of the BIS.

***ADRA***

ADRA has had a long association with the BIS, starting in 1989. ADRA carried out rehabilitation of some canals and structures in the BIS from 1989-91. From 1992-95, ADRA ran the Siem Reap Agricultural Development project. This project had close links with the ILO in the work in the BIS. In June 1996, the Siem Reap Diversified Agriculture Project for Food Security (DAPFS), which also worked in the BIS, commenced. This project ended in May 1999. In June 1999, a new project began titled Health, Agriculture and Nutrition Development for Sustainability. ADRA agricultural projects have worked in all six Communes in Puok District in the BIS since 1992. At least two of the ADRA projects also worked in the three Communes of Siem Reap District, which are in the BIS.

The DAPFS involved ADRA, the Department of Agronomy and the Cambodia IRRI Australia Project (CIAP) in promoting new rice varieties through farm trials with varying fertiliser regimes. Demonstration areas grown by farmers using improved rice varieties, crop management and water management showed improved average yields from 1-1.5 tonnes per ha to 3.45 tonnes per ha. Rice sufficiency increased from 7.2 months to 9.2 months in areas where farmers worked with ADRA, the Department of Agronomy and CIAP on rice crop improvement[24]. Green manure cropping using mung beans was adopted in one village in Tukville Commune. In 1996, six per cent of farmers were growing mung beans. By 1999, this had increased to 34 per cent. Green manure crops are important in areas of the BIS with poor soils. They improve organic matter levels, soil structure and nutrient availability. By using mung beans, farmers also receive a food benefit by harvesting and eating the beans (which are high in protein) before the remaining plant material is ploughed into the ground.

This Project worked with WUGs in the Barai. There was a two-way information flow between the ADRA project and the WUGs. The project worked to increase WUG capacity to serve farmers interests. The continued use of WUGs by ADRA and the FAO demonstrates the long-term viability of WUGs, which were established in the BIS by the ILO.

The DAPFS project also worked on vegetable production and noted more farmers growing vegetables. ADRA states that 80-90 per cent of the farmers (729 from 30 villages) they worked with on vegetable production in 1996 now grow vegetables most of the year. These are for home consumption and excess produce is sold. ADRA claims disposable income has increased due to vegetable growing. Water is essential for vegetable production, whether from irrigation or local water sources like wells.

[22] SPFS, Results & Impact, Dry Season 1998, FAO, Phnom Penh August 1998
[23] SPFS, Participatory Evaluation of the First Phase, FAO, Phnom Penh May 2000
[24] Siem Reap Diversified Agriculture Project for Food Security, Project Completion Report, ADRA, 1999.

ADRA carried out various surveys to assess project effectiveness. These were carried out in October/November 1996 with 538 respondents (in the BIS), March/April 1999 with 602 respondents from the same villages and July 1998 with 910 farmer households surveyed. The following tables show some of the results of these surveys.

| Location | Average Annual Income ($US) | | |
|---|---|---|---|
| | October 1996 | July 1998 | April 1999 |
| Entire System Average | 105 | 186 | 204 |
| Puok District Only | 102 | N/A | 322 |

*Table 4: Average annual income in the ADRA Project Area*[25].

| Location | Months of Household Rice Sufficiency | |
|---|---|---|
| | 1996 | 1999 |
| Puok District | 7.4 | 8.64 |
| Siem Reap District | 8.8 | 9.78 |

*Table 5: Rice Sufficiency*

These tables show increased income and rice sufficiency in the BIS, due to increased agricultural production. The ADRA project completion report drew the following conclusions. A food security project must be supported with water resource management. Water management plays a major role in agricultural/food production. The reverse also applies - with better water availability and reliability there is a need for an improved agricultural programme.

The results shown above demonstrate that increased agricultural production and income are possible in the BIS with an "agricultural extension and water" mix. This combination is needed to effectively use and benefit from irrigation infrastructure rehabilitation and irrigation operation and maintenance. Water is only one component of successful agricultural production. If other components are lacking, production will be limited. The results from the FAO SPSF show the potential of the BIS with an agricultural extension programme in conjunction with water availability and management. ILO was unable to find a partner that could provide agricultural extension input on a scale to match the irrigation infrastructure improvements. If this were possible, the potential of the BIS may have been more fully realised.

The Cambodian Government echoed these sentiments in the early 1990's. The opening statement of the ADRA Siem Reap Agricultural Development project final report states:

*"In 1990, ADRA was requested by the Cambodian government to assist it in Siem Reap Province with the development of an agriculture programme to utilise the increasing potential of the BIS area (after the ADRA partial rehabilitation). The Cambodian Government representatives expressed their concern that the full potential of the irrigation system would not be utilised given the agricultural knowledge of the local people. The request was based on the need for assistance with water management, agronomy, mechanisation, agricultural extension, grain storage, marketing, alternate cash crops other*

[25] Tables are *ibid.* from ADRA, 1999

*than rice, livestock production and agricultural economics."*

ILO also recognised this. In February 1993, the ILO contracted ADRA to add three Communes in Siem Reap District to the existing project area. The purpose was to extend improved rice technology in the remaining Communes served by the BIS, which was being restored by the ILO. The ILO funding continued until the end of 1994 and ADRA's work in these additional Communes continued under AIDAB funding. ADRA also recognised the benefits of the ILO intervention in the BIS. The ADRA report notes that the ILO strengthened capacity at the Provincial DoH by appointing a full time expatriate to assist in establishing 80 WUGs and formulating guidelines for operation and management of the canal system - which were recognised by the Provincial Government.

The effectiveness of the ADRA and ILO intervention can be shown in annual rice yield per hectare. Yield surveys conducted by ADRA in 1992/3, showed an average rice yield of 1.37 tonnes across the nine Communes measuring all farming types and periods (wet, dry, receding). A second survey in 1995 used yield data collected from crop cuts, demonstration plots and field yields. By the middle of 1995, 60 per cent of rice land in the project area was yielding more than 1.8 tonnes per hectare. Most of this area was not fertilised with chemical fertiliser. ADRA claims the yield increases can be attributed primarily to improved irrigation management at Provincial and farm levels, improved farming practices and new rice varieties. The fact that yield increases were mostly attained without green manure crops or fertiliser indicates the potential for significantly higher yields. The impact of these higher yields was a dramatic increase in the area sown with new rice varieties. In 1992, less than ten hectares of receding rice was sown using new rice varieties. By the 1995/96 dry season this area had increased to 2,282 ha, or 48 per cent of the receding rice area planted.

The 1995/96 season saw an additional 1,522 ha of receding rice planted over the 1994/95 season. Before the release of the new varieties and the improved irrigation, the majority of the late maturing receding rice land was cultivated only once per year. With the release of the new early duration rice varieties farmers adopted a pre-flood rice crop on the same land (double cropping). By 1994, the pre-flood rice area had increased to 747 ha, with average yields from the new rice varieties of 2.1 t/ha. Farmers again increased the pre-flood (double cropped) area in 1995 to 1,124 ha. Farmers began broadcasting high yielding short duration rice seed shortly after the first rains in May, earlier if irrigation water was available and harvesting the crop in August. This meant that farmers had rice to eat at a time when stocks were usually low. It is also noted that the combined effect of irrigation, improved rice growing technology and varieties and continuing good security resulted in a total increase of more than 3,000 ha in the annual area of rice cultivation for the nine Communes of the BIS (comparing 1993 with 1996). This includes increased land area cropped and the practice of double cropping using new (shorter duration) rice varieties. Yield and production increases in the ADRA project area in the BIS are set out in the following table.

| | Traditional Rice Yield 1992/93 | Traditional Rice Yield 1994/95 | Yield Difference |
|---|---|---|---|
| Increase from irrigation | 0.93 t/ha | 1.75 t/ha | 0.82 t/ha |

| | Traditional Rice Yield 1994/95 | New Rice Variety Yield 1994/95 | Yield Difference |
|---|---|---|---|
| Increase from new rice varieties | 1.75 t/ha | 2.55 t/ha | 0.80 t/ha |

*Table 6: Increased Production in the BIS.*

The 2001 CAS study backs up the ADRA project report about increased land area cropped due to irrigation. In 1993, 70 per cent of the total land was cultivated with irrigation and 30 percent was cultivated without irrigation. By 1999, 86 per cent of land was cultivated with irrigation and only 14 per cent was cultivated without irrigation. This implies that the land cultivated with irrigation has increased significantly (16%) since 1993. In addition, the area used for double cropping (in the total irrigated land area) increased by 45 per cent. CAS claimed that this increase in double cropping demonstrated the impact of improved irrigation access since the ILO intervention.

### *CAS Study of the Barai Irrigation System*

One of the most comprehensive reports on the BIS was recently commissioned by the ILO Upstream Project and conducted by CAS[26]. The CAS report is an evaluation of the impact of the ILO supported improvements to the BIS at the farmer's level. Readers of this report are encouraged to read the CAS report in its entirety. A summary of the report is available in appendix four.

The CAS study set out to determine the impact of the ILO supported improvements to the BIS on the farmers who use the system. The impact of the ILO initiative was evaluated in terms of the improvements for the farming community at the household level. The report found that, in general, for all farms, the area of irrigated land under cultivation increased by 16% since 1993 and overall crop yield increased by 28%. Most farmers explained that their economic conditions had improved since the ILO support. More children go to school because living standards have improved. All respondents reported that the ILO support was preferable because it lasted for a significant period and because it was sustainable.

It seems that substantial agricultural, ecological and socio-economic changes have taken place in the communities of the BIS. Although not all of these changes can be attributed to improvements in the irrigation system, there is no doubt that these improvements had a significant impact on land use and production. The impact of the ILO support was summarised by CAS as follows – improved irrigation led to increased cropping intensity and higher total production. This created more demand for labour and contributed to a reduction in poverty.

[26] *op. cit.* CAS, 2001.

# BENEFICIARY PROFILES

The following section presents profiles of people who benefit from the two irrigation systems. Interviews were conducted to establish what impact the intervention had on them personally. There are a greater number of interviewees from the BoIS in this section due to the previous CAS study conducted in the BIS.

## The Bovel Irrigation System

***Village Chief/VDC Chairman/Farmer***

Mr Nee Yee is the village chief of Balang Krom village in Rong Chreav Commune of Tmor Koal District. He is also the VDC chairman. He is a farmer with three hectares of land, which receive irrigation water from secondary canal number four of the BoIS. Mr Nee is subsequently a member of a WUG. The village is not close to the secondary canal; therefore, he was unaware of the ILO rehabilitation work when it was initiated. He sought employment, but positions for the rehabilitation work were far less numerous than the number of applicants.

Rice is the major crop Mr Nee grows. Before the ILO rehabilitation of the BoIS, he was averaging yields of around 900 kg of paddy per hectare of wet season rice. He now averages 1.4 to 1.5 tonnes per hectare per year. He attributes this in part to the increased water availability. With this production, he is able to feed his family and produce and sell a surplus. Due to water availability (wet season supplementary) he has changed the rice varieties he grows. He can now grow varieties that are more marketable instead of being forced to grow varieties that tolerate limited water. Mr Nee was growing vegetables before the ILO rehabilitation of the BoIS. Although the duration of vegetable production (three months) has not increased, he has increased production due to improved water availability. The vegetables provide a food source for his family and he can sell vegetables in the village for added income. In this regard, Mr Nee praised the irrigation activities organised by the ILO in association with the DoA.

Maintenance work on the canals is now organised predominately by the users themselves. Mr Nee has seen how this developed, with ILO and the DoH originally organising maintenance, then farmers like himself joining in maintenance work. Now the farmers organise maintenance without assistance. Mr Nee has gained the skills to do this from the ILO intervention. He saw that LBAT was particularly appropriate as all villagers had the necessary skills to maintain the canals themselves and the necessary equipment (agricultural hand tools). With LBAT and the skills to use it, there was no need to call on or depend on others to undertake maintenance. The farmers are also managing water distribution along the tertiary canals themselves. Mr Nee saw the benefit of group organisation, like the maintenance work done by the WUG enabling all WUG members to have irrigation water. With these group activities, Mr Nee saw that the villagers related better with each other and greater association has helped the village society. This has benefited Mr Nee as village leader, with traditional or informal leaders in the village helping him in his role. As a village leader, his links to the Commune have improved with regular contact through the operation and maintenance of the irrigation system.

The WUG in Mr Nee's village continues to operate because of the benefits of group organisation. It is now a part of the larger village organisation of the VDC. The WUG was a successful example which others could use when initiating programmes. Although villagers like Mr. Nee can contribute to the operation and maintenance of the tertiary canal and undertake routine maintenance on the secondary canal, they need assistance from the PDWRM for major maintenance of the secondary canal or for structural repair. Mr Nee's wife is now able to spend less time in the rice field due to the improved irrigation. This is also the case for his children. They still help during transplanting and harvesting, but they do not have to do heavy work after that. His wife is now able to spend time at home on other activities, including vegetable production.

***Commune Official/Farmer***

Mr Som Yay is the Commune official of Rong Chreav Commune responsible for the seven WUGs in the Commune. He is a member of a WUG and a farmer with five hectares of land that receives water from secondary canal number four.

Mr Som saw his paddy production per hectare increase from one tonne to 1.4 tonnes per hectare after the ILO rehabilitation of the canals of the BoIS. At a Commune level, he saw around a 30 per cent increase in wet season rice production after the ILO rehabilitation. He attributed this to the reliability of irrigation water. This allowed farmers to change varieties grown from traditional drought tolerant varieties with low yields, to new higher yielding rice varieties. These varieties are also more marketable, so surplus production is sold for a higher price. Most farming families in the Commune produce a surplus now due to reliable irrigation water supply. Dry season rice is now grown in Rong Chreav Commune because of water availability. 70-100 hectares are grown annually. Short season IRRI varieties are grown in the dry season. Arrangements are made for cropping the land close to the secondary canals that has access to water pumped from the secondary canal. Around 30 per cent of families in the Commune are able to take advantage of this dry season cropping.

At the Commune level, Mr Som has seen an increase in the area of land planted with fruit orchards, like oranges, bananas and lomut, due to the increased availability of water. Those who have diversified their agricultural production (from rice cropping, to fruit, rice and vegetable production) now number 560 families in Rong Chreav Commune. This diversification is both for family consumption with the excess being sold and for commercial production (cash cropping). There was a dramatic increase in the Commune's farming area (irrigation command area) able to access irrigation water after the ILO rehabilitation. Mr Som saw a three-fold increase and attributed this to the improved condition of the secondary canals and to the construction of a tertiary canal network. The farming land area with access to wet season supplementary irrigation water in the Commune is now more than 1,500 hectares.

Mr Som sees operation and maintenance at the tertiary canal level proceeding smoothly, with the WUGs of each tertiary canal carrying out these activities. Small-scale maintenance is also being done by the WUGs on the secondary canals, with Mr Som (representing the Commune) responsible for operation along the secondary canals. The rules and regulations introduced by the DoH/ILO in 1994 are still used by the Commune and villages to operate their section of the system. Despite this, Mr Som sees a need for technical and financial assistance for large-scale maintenance on the secondary canals and for any structural repair that may be required. The lack of resources at the PDWRM, both financial and human, is a limiting factor. Support did come from the PDWRM when emergency assistance was required. The incomplete

collection of water user fees may also effect the finances available for large-scale maintenance. In 1999, 33 per cent of the full fee amount for the Commune was collected.

One notable change Mr Som has seen in the Commune is the level of school attendance. He sees that children now have more time to attend school, as they are required less by farming families due to the improved access to irrigation water. In fact, school attendance has increased to a level where there is now a shortage of school infrastructure in the Commune.

Other programmes have benefited from the success of the WUGs and group level activities. Mr Som quotes the example of the SEILA programme. With the benefits of group work established through the WUGs and the success of operation and maintenance by the WUGs, the SEILA programme was able to establish itself and groups (like VDCs) more rapidly. Mr Som was able to use skills learned during the ILO programme, in organising and managing people and apply them to the SEILA programme.

***Farmer***

Mr Ngun Gee is a farmer in the BoIS. He has five hectares of farmland. He worked on the rehabilitation of the irrigation system in 1994. The opportunity to work and the wages he earned were very welcome, as other employment was generally not available at that time.

After the rehabilitation of the canals, Mr Ngun saw his rice production increase by 50 per cent. He explained that before the rehabilitation, his area lacked water and was dependent on wet season rainfall for rice production. If there was a lack of rainfall in critical periods of the growing season, the crop produced 'pinched grains' which were unsuitable for sale. Now a reliable water supply benefits a much larger area. He attributed his increased rice production to this reliable supply of irrigation water. Now that lack of water no longer limits production, Mr Ngun has increased the amount of fertiliser he is using. This has also contributed to increased yields. Surplus production is more marketable now, with varieties chosen for its saleability and no risk of pinched grains. In the previous wet season (1998-9), Mr Ngun was able to sell 7.5 tonnes of his paddy crop. He produces a large excess because of his small family size. Despite a drop in paddy price over the previous season, Mr Ngun was able to sell his crop for US $75 per tonne. This realised more than US $560, a considerable sum in Cambodia. A neighbour of Mr Ngun, Ngon Hean, who has a larger family, was able to sell five tonnes of surplus paddy at the same time, generating US $375 in income. The large surplus production in the wet season means that Mr Ngun does not grow crops in the dry season, although some of his neighbours do using land close to the secondary canals. In Mr Ngun's village around 90 of 229 families have now diversified their agricultural production.

Mr Ngun saw that people in his village were now more responsive to community activities. He said around 90 per cent of those in his village now respond to community work like tertiary canal maintenance. He saw that group based activities and co-operative efforts, like canal maintenance by the WUG achieved more than individual efforts. Mr Ngun knew that no organisation would assist in canal maintenance, so there is a collective community responsibility to respond to calls for maintenance. Although the level of maintenance is lower than when ILO/DoH were operating in the area, he sees that maintenance is continued by the users themselves using methods established by the ILO. He remarked on the suitability of LBAT as something that is understood and is able to be carried out by the users of the system. He also commented that the operation and maintenance systems put in place were appropriate for farmers which was a factor leading to their continued use.

In his area, Mr Ngun said that tertiary canal operation and maintenance were undertaken exclusively by the WUG. Secondary canal maintenance upstream of the tertiary canal outlet was also undertaken by the WUG, but by group efforts, not using a length person. This consists of maintenance in the dry season, repairs that may be needed in the wet season and small-scale repairs to canal structures. If large-scale repairs are needed, or there is a substantial canal break, they go to the Commune or District to request further assistance. The links to the Commune are good, with the systems ILO introduced contributing to this and the more intensive links of the SEILA programme building on these. According to Mr Ngun, ILO pioneered the group concept in the area. In his view, SEILA was able to take advantage of this success in establishing other group-based programmes and activities. Mr Ngun also said that the processes of group organisation and group activities were applied to an IPM programme in the area and a programme supported by the NGO CRS.

***District Officer/Farmer***

Mr Yoen Sokha is the Tmor Koal District Water Resources and Meteorology officer. He is also a farmer in Tam Oeurn Commune with seven hectares of land. Before the ILO rehabilitation of the canals in the BoIS, he used to average a harvest of around 1.2 tonnes of paddy rice per hectare for wet season rice. After the rehabilitation, his production increased to between two and 2.5 tonnes per hectare. He believes the primary reason was reliable irrigation water. Reliable irrigation water supply allowed him to change rice varieties to higher yielding varieties more in demand in the market. He was also able to switch varieties according to market demand. He has also substantially increased the amount of fertiliser he uses. The combination of water, new rice varieties and fertiliser allowed the increase in his rice yields.

Before the rehabilitation, Mr Yoen left some of his land fallow, as there was insufficient water to supply his land. Now he uses all his land for wet season production and has a greater surplus of rice to sell. Throughout the District, he has seen that there is more water available for agricultural production since the ILO rehabilitation of the canals. He has also seen an improvement in operation and management of the system, with more people (users/beneficiaries) 'watching over' the system and ensuring that rules and regulations are followed. Links between villages, Communes and Districts have improved due to regular contact through the management of the system. More authority to manage the system has passed to a lower level with less centralised control. Throughout the District, Mr Yoen sees a greater percentage of children attending school. He attributes this to an increased standard of living due to improved water availability. Farmers can now afford to send their children to school. More children also have the time to attend school, as there is less work required on family farms.

## The Barai Irrigation System

***Village/WUG Leader/Farmer***

Mr Yol Som is the village leader of Krasang village in Krabei Real Commune, Puok District. He is also the WUG leader on tertiary canal number 5.15. He has two hectares of farmland. One hectare is used for wet season production and one hectare (closer to the Tonle Sap lake) he uses for dry season production. He receives wet season supplementary irrigation water from the BIS. In the dry season he plants rice on residual water from the receding Tonle Sap Lake, then irrigates with water from Bund 78 and the BIS. Mr Yol's wet season crop averaged 1.2 tonnes of paddy per hectare before the ILO rehabilitation of the canals. Now he

averages around two tonnes per hectare. He attributes this to water availability. Before renovation of the BIS, a lack of water was the major limiting factor to production. With this no longer the case, a lack of soil nutrients remained a constraint. Mr Yol now uses more fertiliser, both chemical and organic for his wet season crops.

In 1999, due to early flooding, Mr Yol's dry season rice crop was affected. Therefore, he will have a rice deficit this year. However, since the ILO rehabilitation of the BIS, he has diversified production. He now grows vegetables and raises animals for family consumption and for sale. With the sale of this produce, Mr Yol is able to purchase rice to overcome his deficit. He grows between 0.05 to 0.1 hectares of vegetables. He sells the vegetables in two ways. Firstly, he sells the vegetables himself to one of three markets, Tukville market (the adjoining Commune) or at Psar Leur or Psar Chas in Siem Reap. Mr Yol sells at whichever market is offering the best price. He can access these markets due to good road conditions in the BIS area. A second method of sale is when vendors visit him to buy his produce for resale.

Mr Yol saw benefits from the WUGs. He said that if farmers had not joined the WUGs and worked together, there would have been less development in the BIS area and therefore fewer benefits for the farmers themselves. He said that the farmers' commitment to the WUGs and the system was demonstrated by the way they paid water user fees and worked together for maintenance. Group work also enabled activities to be completed faster and more effectively. There were also improved relations within the village and between villages on one tertiary canal. Previously there was a lack of co-operation between villages on tertiary canal number 5.15. Now people from all the villages carry out maintenance work and operation is smoother.

Mr Yol also noted that his family no longer has to work as much producing rice. Previously, most members of his family went to help him in the fields. The poor condition of the irrigation system before the ILO rehabilitation meant farmers had to make long field canals to get water to their fields. Now his family usually only go to the field to help at transplanting and harvesting. His children have more time to attend school and to assist his wife in vegetable growing and basket making. These activities produce food and income. His family has not stopped working but have diversified labour efforts and increased overall production.

***Commune Leader/Farmer***

Mr Cheam Car is the chief of Krabei Real Commune. He is also a farmer in the BIS with three hectares of farmland. He uses half his land for wet season rice production and half for dry season production. He now grows two wet season rice crops and one dry season crop due to water availability from the BIS. He uses the wet season rice crop for family consumption and sells the dry season crop. Throughout the Commune, short season rice IRRI varieties are grown during the dry season. Medium duration varieties are generally grown during the wet season. There has been a widespread adoption of new varieties during the wet season and fertiliser use has increased. Another change Mr Car has observed in Krabei Real since the rehabilitation is the diversification of agricultural production. There are now more vegetables grown, generally after the wet season, for both home consumption and sale.

Mr Car said that before the ILO intervention, some villages were good at organising work in their communities and some were poor or there was no organisation. Some tertiary canals were maintained while others were not. After the ILO intervention, all tertiary canals have WUGs. They have been able to organise work in their communities themselves. They also

operate and maintain their own tertiary canals and the secondary canal upstream from their tertiary canal outlet. Control (management) of the system has also been devolved to lower levels. This has improved water availability because of local operation of the gate settings instead of having one provincial level gate controller. Mr Car also said his job of overseeing water management in the Commune had become easier with the construction of secondary canal number eight by the ILO. This has allowed better water control and management.

Although the communities can undertake most of the operation and maintenance of the system, there are some things they cannot do like repairing bridges and large control structures. The Commune leader saw two avenues for assistance with this. One is the PDWRM. In the absence of financial resources from them, the users can hire contractors to carry out the work. This is possible because of the water use fees collected for maintenance expenses. Now that the users have their own money, they have financial independence and the power to control what happens to the irrigation system.

The Commune leader noted many skills and techniques learned during the ILO intervention. These included technical skills like canal rehabilitation and maintenance through LBAT. Knowledge of agricultural techniques and how to grow other crops came from the ILO programme and the DoA. The ILO introduced the benefits of group organisation through the WUGs. Capacity increased in planning, finance, administration and management. The methods used by the ILO were seen as appropriate to the prevailing conditions in Krabei Real Commune. LBAT was appropriate as it was understood and people had the capacity and materials to apply it. WUGs were suitable for operation and maintenance activities in the system.

# FINDINGS

There were numerous changes in the Irrigation Systems of Bovel and Barai since the initial ILO project in 1992. These changes are reflected by the changing nature of the ILO assistance. The projects evolved from generating employment through the rehabilitation of the systems, to supporting farmer water users to operate and maintain the systems themselves.

Although this report was on the irrigation systems of Bovel and Barai, the ILO did not only work on these systems. ILO road rehabilitation and maintenance was integrated with the irrigation works. This road rehabilitation and maintenance was significant in facilitating access to markets. After road rehabilitation, it became easier to transport farm produce to market and thus it was more profitable to increase agricultural production.

In the course of the projects, ILO made various key inputs into the Bovel and Barai Irrigation Systems. These included: the introduction and establishment of Labour Based Appropriate Technology (LBAT); numerous training sessions for counterpart irrigation staff and farmer users; producing many training materials; technical assistance to the systems and a financial input of US $1,188,900. The users and managers of the systems report that the training and LBAT were appropriate for the systems.

There were several key outputs from the ILO intervention. In the two irrigation systems, ILO renovated 76.74 km and constructed 7.14 km of secondary canals and maintained 94.83 km of primary and secondary canals. In addition the ILO constructed 81 new irrigation structures and repaired a further 214 structures. Another important output was the workdays generated. The total employment effect of the irrigation works in the BoIS and the BIS from the three ILO projects was 1,738,274 workdays. In Bovel, there is now a wet season command area of 35,000 hectares, with an additional 400-500 hectares of dry season command area. For the Barai, an average of around 8,000 hectares receives irrigation water including wet, receding and dry season crops.

With the Ministry of Water Resources and Meteorology's Policy 2000, the policy framework is now in place to support the work, which the ILO undertook in the BoIS and the BIS. The operation and management systems put in place by ILO and PDWRM continue to function. This means that the irrigation systems continue to work and farmer users continue to benefit from irrigation. LBAT has been accepted, with the Battambang PDWRM using LBAT in current irrigation rehabilitation works.

In the BoIS, interviews with farmer water users showed increased rice production because of reliable irrigation water. Higher yielding rice varieties have been adopted and more fertiliser is used due to secure water supply. Farmers are no longer forced to grow traditional varieties, which are tolerant to poor conditions but produce poor yields.

Many benefits of the ILO contribution are evident in the BIS. A pilot FAO project showed that increased production was possible with an agricultural extension programme using irrigation water. The NGO ADRA, who worked in the area since 1989, documented production increases. ADRA recorded a 3,000 ha increase in the annual area of rice cultivation, including increased land area cropped and double cropping. A second ADRA

project found that farmers using improved rice varieties, crop management and water management showed improved average yields from 1-1.5 tonnes per ha to 3.45 tonnes per ha.

Importantly, ADRA found that there needed to be an agricultural component for effective utilisation and benefit from irrigation infrastructure rehabilitation and irrigation operation and maintenance. Had this agricultural component been implemented in the Bovel and Barai, further production increases could have been expected.

The Centre for Advanced Studies (CAS) conducted an extensive study of the BIS. This study also found increased agricultural production attributable to the irrigation rehabilitation. CAS found that land cultivated with irrigation increased by 16 per cent since 1993. The area used for double cropping increased by 45 per cent. CAS attributed this improved irrigation access to the ILO intervention. There was a considerable increase in the land used for growing wet and dry season rice. Wet season rice land increased by 11 per cent, while dry season rice land increased by 23 per cent. This result, especially the increase in dry season rice cultivation, was due to improved access to irrigation. Total production (rice and other crops) increased by 28 per cent from 1993 to 1999.

Surplus production of vegetables, fruits and aquatic products had increased by 29 per cent. Improved access to irrigation is likely to have contributed to this increase. Consumption of these crops increased only slightly, indicating that fruits and vegetables are mainly used as cash crops. Farming activities (as opposed to off farm activities) have become more important for all households since the ILO intervention. This highlights the importance of improved access to irrigation.

From this report, it is clear that the ILO support improved irrigation in the Bovel and Barai Irrigation Systems. The methods used are seen as effective and appropriate and have therefore been sustained. In the end, this effort has contributed to increased agricultural production and socio-economic activity, leading to a reduction in poverty in the local areas.

# CONCLUDING REMARKS

There are still problems within the two irrigation systems although these may be seen as opportunities. Some of these problems are discussed here along with possible solutions.

***Institutional Aspects***

While there was a new MWRM policy promoting the formation of FWUC, there was less development in the BoIS than the BIS in this regard. This was to be expected, with the ILO technical contribution continuing to support the BIS after the introduction of this policy. However, with a small allocation of resources (human, financial, technical), it should be possible for the BoIS to catch up to the BIS.

Although the WUGs appear to be institutionalised and are maintaining tertiary and secondary canals, there are no inputs from the MWRM. WUGs cannot operate and maintain the Bovel and Barai diversion structures or the Barai and the primary canals. Technical and financial resources are needed from the MWRM. This is problematic, as no resources are forthcoming. One solution for maintenance would be to hire contractors to carry out the work beyond the capacity of the users.

The new MWRM policy has been handed down to the provincial level and through them to the District and Communes level. The policy and the will to implement it seem to be evident across all levels of government/authority. However, there are no government resources to implement the policy. In much the same vein, government salaries are low. There seems to be no easy solution to the issue of low government funding.

In the proposed FWUC organisational structure for the BIS, there are no links directly from the village or Commune level to the BIS committee. If the organisational structure proposed in the document "Steps in the Formation of a FWUC" is followed, this issue will be addressed.

***Community Level Organisation***

During the initial ILO intervention, there was little community organisation carried out due to the pressing need to create employment and so contribute to stability at a time of great political and social change. Ideally, community organisation should be done before starting irrigation rehabilitation. All stakeholders should be part of planning the intervention and there should be agreements stating responsibility for activities at the various levels. WUGs could be formed for tertiary canals before work commences. If this scenario were implemented, it would be possible to target WUG leaders to work on rehabilitation, giving them a sound technical grounding for later maintenance. Although the ILO provided WUG leaders with training in LBAT, the rehabilitation work may have provided a deeper understanding and benefit to the technical quality of maintenance and repairs, especially in light of the absence of government input.

In the absence of Ministerial and provincial inputs, training and work opportunities from the ILO for staff at the Commune and District level may have provided long term benefits to the systems. Technical (maintenance and repairs) capacity would improve as would operation and management. A period of employment, including training, implementing operation and maintenance, scheduling and fee collection may have produced more sustainable benefits for the system. While the training and implementation opportunities provided by the ILO to

provincial staff benefits government capacity, this benefit is often lost at the local level as central level counterpart staffs move on. District, Commune and village staffs are less likely to move on. They live in the area and think in longer timeframes. Their commitment is to the area where they live. They think about how the system can continue operating to benefit them and their children in the future.

Throughout the ILO intervention, technical staffs from the Ministry and Provincial Departments of Water Resources and Meteorology were project counterpart staff. This raises the issue of purely technical staff being called on to do non-technical work in community organisation. With the changes at the Ministry and the new expanded role of the Department of Water Resource Management and Conservation (responsible for FWUC), organisations planning to assist in irrigation should be able to find counterparts with social development skills in this department.

***Maintenance and Operations***

Although links and co-operation between Districts, and between Districts and Communes, may be good, the lack of resources means information does not flow. The consultant saw an example of this when visiting the diversion structure in the Mongkol Borei River in Bovel District. The structure was inundated and the river was still rising. Tmor Koal District were unaware of this. Meanwhile downstream, the Tmor Koal District staffs with the consultant were able to pass this information to the Communes of Tmor Koal on the way back to the District. This facilitated gate settings for the coming floodwater and may have prevented overtopping of the canals and subsequent damage. Even with limited financial resources, some provision needs to be made for operation, not just maintenance. Small inputs for operation can lead to large savings for maintenance and structural damage.

***Water User Fees***

Full fee collection from water users is still problematic even with supplementary collection of money from various sources. If FWUC were formally registered as the legally recognised managers of the system, fee collection may improve.

The consultant was informed of a proposal to use water fees for credit to fund the purchase of agricultural inputs like fertiliser and seed. While this is probably needed and envisioned under business activities of the FWUC in the government policy, the financial situation of the FWUCs in the BIS has probably not reached a level where this is feasible. Finances cannot even pay for maintenance needs yet. It may be more prudent to wait until more finance is available, which would allow maintenance and business activities to take place concurrently. These finances may come from improved collection of water fees or from government inputs.

In BoIS, ILO instituted a water fee of 30 kg of rice per ha/year. This fee was split 25:5 with 25 kg going to maintenance and operation of the primary and secondary canals, and five kg going to maintenance of the tertiary canals. After the ILO assistance ended, the users of the system reversed this to 5:25. In BIS, no payment was ever made for tertiary canal maintenance. Notwithstanding the difference in size and volume of the tertiary canals in the two systems (Bovel tertiary canals are much larger), it seems to have been counterproductive to give payment for tertiary canal maintenance. This payment established the idea of users paying themselves for maintenance of the tertiary canals. After ILO assistance ended, users paid themselves substantially more for tertiary canal maintenance, with little going to secondary and primary canal operation and maintenance. It seems logical to advise that there be no payment for tertiary canal maintenance by water user groups.

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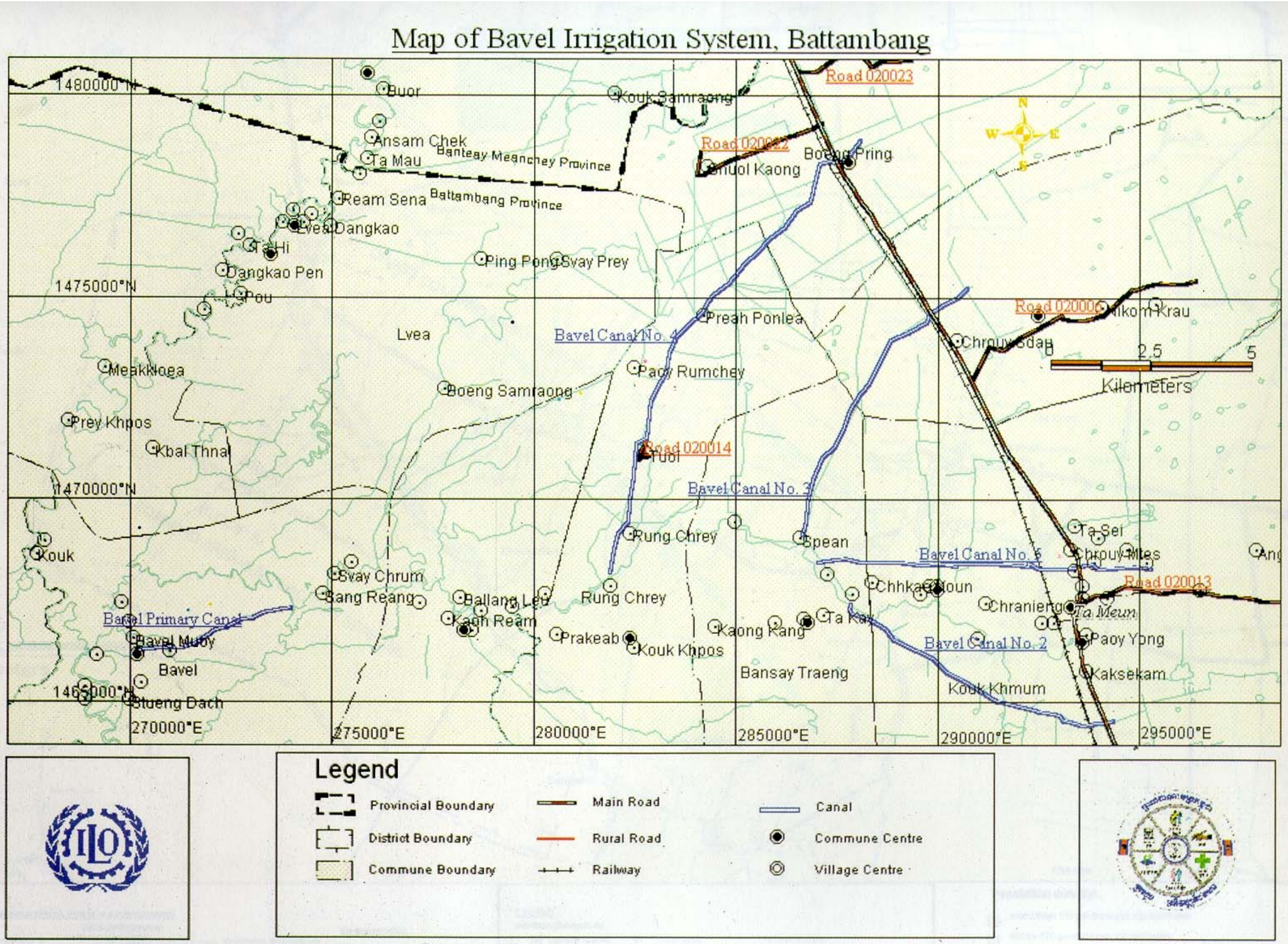
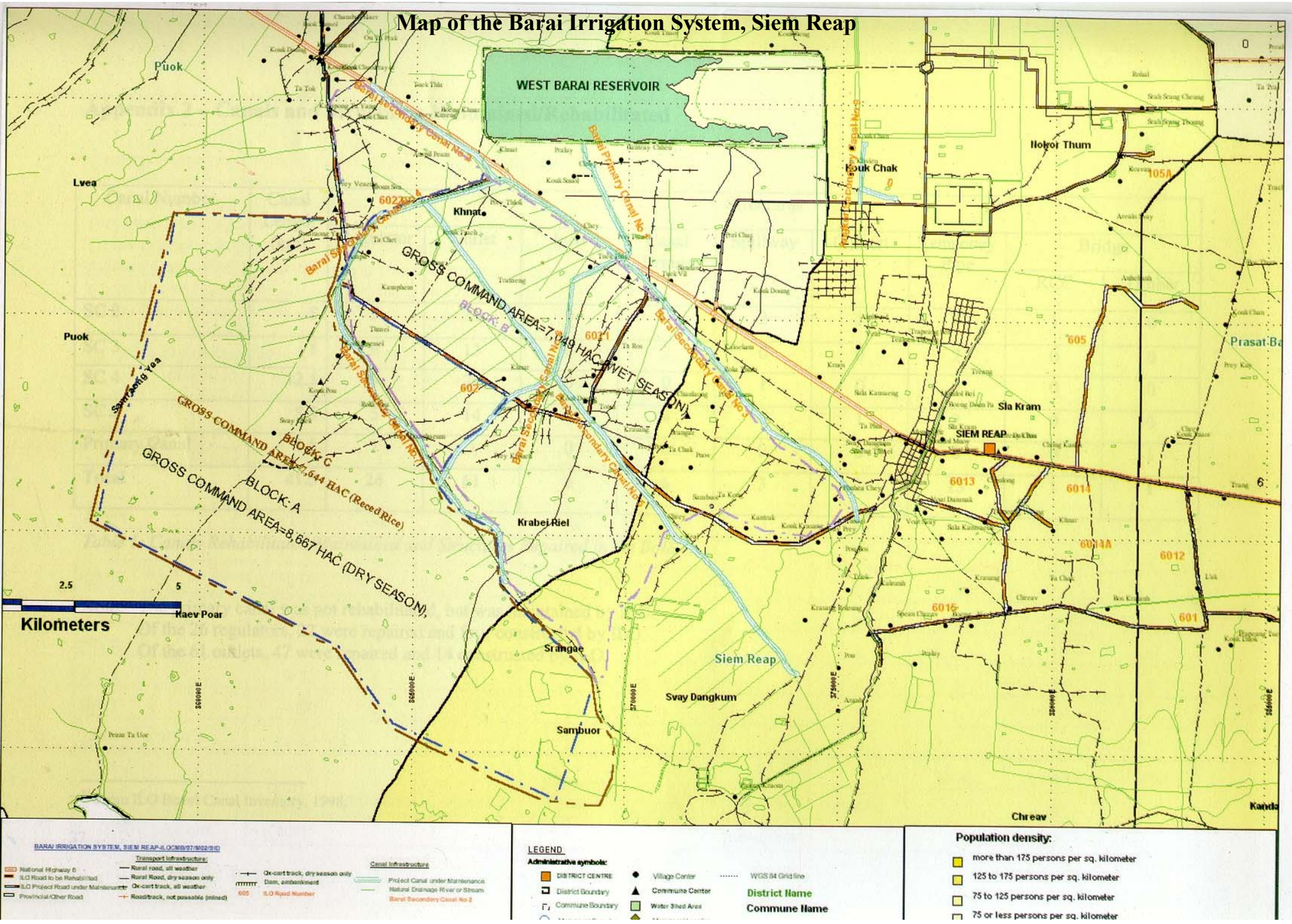
# Appendix 1: Maps



# Map of the Barai Irrigation System, Siem Reap



## Appendix 2 – Canals and Structures Maintained/Rehabilitated

| Canal Number | Canal Length (km) | Structures | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Regulator | Outlet | Inlet | Canal Drains | Spillway | Culvert | Temporary Pipe | Bridge | |
| | | | | | | | | | RCC | Timber |
| SC 2 | 8 | 5 | 11 | 0 | 0 | 2 | 1 | 4 | 1 | 0 |
| SC 3 | 8 | 6 | 13 | 0 | 2 | 0 | 0 | 2 | 0 | 0 |
| SC 4 | 12.5 | 9 | 20 | 0 | 0 | 1 | 0 | 5 | 0 | 0 |
| SC 5 | 8.5 | 5 | 14 | 2 | 4 | 0 | 1 | 2 | 0 | 0 |
| Primary | 4.5 | 1 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| **Total** | **41.5** | **26** | **61** | **2** | **6** | **3** | **2** | **13** | **1** | **1** |

*Table 1: Canals Rehabilitated/Maintained and Structures Repaired in the BoIS[27].*

Note: The primary canal was not rehabilitated, but was maintained by ILO.
Of the 26 regulators, 22 were repaired and four constructed by ILO.
Of the 61 outlets, 47 were repaired and 14 constructed by ILO.

| Canal Number | Canal Length (km) | Structures | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Regulator | Outlet | Canal Drains | Drop | Culvert | Siphon | Bridge | | |
| | | | | | | | | RCC | Timber | Palm |
| Primary Canal # 1 | 3.15 | | | 2 | | - | 1 | - | - | - |
| SC 2 | 7.80 | 2 | 13 | 3 | 1 | - | 1 | 1 | - | - |
| SC 3 | 8.20 | 4 | 15 | 1 | 1 | - | 7 | - | 5 | 5 |
| SC 4 | 4.40 | 3 | | 5 | | 1 | 3 | 1 | 1 | 1 |
| SC 5 | 14.14 | 6 | 28 | - | | - | 15 | 1 | 3 | 8 |
| SC 7 | 8.50 | 4 | 15 | 1 | | - | 9 | 2 | - | 7 |
| SC 8 | 7.14 | 3 | | 11 | 2 | 1 | 2 | - | - | 8 |
| **Total** | **53.33** | **22** | **71** | **23** | **4** | **2** | **38** | **5** | **9** | **29** |

*Table 2: Canals and Structures Maintained by the ILO in the BIS[28].*

[27] From ILO Bovel Canal Inventory, 1998.
[28] From ILO Barai Canal Inventory 1999, & discussions with ex-DoH Chief Chim Kdep.

Of the 53.33 km of canals maintained by the ILO, 39.74 Km were renovated by ILO & 7.14 Km (SC 8) were constructed.
Of the 22 regulators, 13 were repaired and four constructed by ILO.
Of the 71 outlets, 58 were repaired by ILO.
Of the 23 canal drains, 11 were repaired and 12 were constructed by the ILO.
Of the four drop structures, two were constructed by ILO.
Of the two box culverts, one was repaired & one constructed by ILO.
Of the 38 siphons, 31 were repaired & five constructed by ILO
Of the five RCC bridges, three were repaired and one constructed by the ILO.
ILO constructed all nine timber bridges.
ILO constructed all 29 palm bridges.

## Appendix 3 – Organisational Chart of the BIS

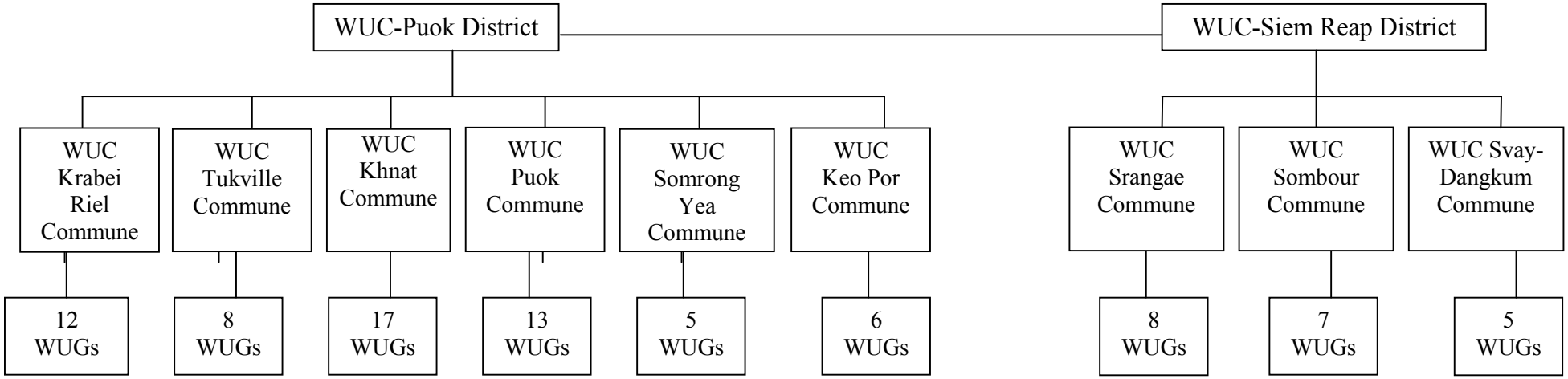



*Figure 1: Current Organisational Structure of the Barai Irrigation System*

Note: WUC is Water User Committee.
WUG is Water User Group.

# Appendix 4 – Summary of the CAS Study of the Barai

***Introduction***

One of the most comprehensive reports to date on the BIS was recently commissioned by the ILO Upstream Project and conducted by CAS. The CAS report is an evaluation of the impact of the ILO supported improvements to the BIS specifically at the farmer user level. Readers of this report are encouraged to read the CAS report however; some of the more salient issues of the CAS study are recorded here.

CAS set out to study the impact of the ILO supported improvements to the BIS on the farmers who use the system. Impact was evaluated in terms of the improvements for the farming community at the household level. The study aimed to assess the following:

- Irrigation use before and after the ILO assistance.
- The efficiency and management of irrigation and the development of WUG.
- The impact on land use, cropping patterns and diversification.
- The impact on production, yield, consumption and surplus.
- The overall economic situation - employment, income and expenditures.

The study focussed on the direct impact of ILO initiatives. The terms of reference emphasised a focus on changes in land use, crop production, productivity and on overall changes in the farmers' economy. The survey was based in the command area of secondary canal number five of the BIS. CAS was asked to carry out the study by taking small samples from different farming zones. The samples were taken from 11 tertiary canals, with an average of six farms from each tertiary canal. In total, 69 farmers were interviewed. Ten additional interviews were conducted with the chiefs of WUGs, making 79 interviews for the study. Each tertiary canal was divided into three farming zones: upstream, central and downstream. Those farmers with irrigated land within the radius of half a kilometre from the secondary canal were categorised as part of the upstream farming zone. Farmers with irrigated land between half and one kilometre from the secondary canal were classified as the central farming zone and those with irrigated land more than one kilometre away were classified as the downstream farming zone. There are differences along the secondary canal in terms of access to water, which the CAS study refers to as zones. There are also differences in the yearly inundation of some areas by the Tonle Sap Lake. The lower end of the command area of secondary canal five is inundated yearly, benefiting from silt deposits. The upper reaches of the canal command area are not.

The CAS report notes the activities implemented by different organisations in the BIS. However, it is interesting to note that local respondents reported that ILO support to the BIS was more effective and sustainable than other organisations' activities. This may have been due to the major nature of the services provided, or the duration of the ILO assistance. Other organisations work in the BIS included: ADRA, AGRIZOID who were involved in animal raising, agricultural extension services, constructing pump wells and providing seeds and natural fertiliser, FAO, UNICEF and ACLEDA who were involved in rural credit activities. The WFP who supported ILO's road construction and maintenance activities in addition to supporting the irrigation works, UNESCO provided literacy training in the early 1990's, CARERE set up health care activities, ACF provided water wells, CRC conducted a basic health programme and ADHOC provided human rights training. CAS contends that inputs like agricultural extension services, training programmes, fertilisers and pesticide provision, soil surveys and agricultural research would have been more effective if they were integrated

with the ILO BIS infrastructure improvements. This has undoubtedly affected the expected crop yields and productivity.

One of the original ILO aims was to create employment. This was accomplished, with over 1.7 million workdays of direct and indirect employment generated by the irrigation component of the projects. This aim was also fulfilled in the long term because of increased agricultural activities leading to increased farm employment.

***Farm Animals***

In developing countries like Cambodia, farm animals are an important part of the farming system. Respondents were asked about the type and number of animals they owned in 1993 and 1999. Most farmers interviewed owned one of the following five types of farm animals: cows, buffaloes, chickens, ducks and pigs. The aggregate number of farm animals owned by all farmers interviewed had increased by 30 per cent. There was a significant increase in buffalo numbers, which were 43 per cent higher in 1999. The average number of farm animals per household increased from 11.1 in 1993 to 16 per household in 1999. In 1994, it was reported that the demand for draft animals (buffalo/cows) was greater than their availability at certain periods of that year[29]. This was obviously a limitation on production. The increase in cow and buffalo numbers from 1993 to 1999 is particularly significant, as these animals are indispensable to farmers. Apart from providing milk, they are used as draught animals, provide transport and are considered a sign of relative wealth in Cambodia. The dung from these animals is also used as organic fertiliser, which is vital for the soil in the Barai area. Complementing this finding by CAS, an ADRA survey comparing 1996 to 1999 showed a 27 per cent increase in cow and buffalo numbers. The increase in farm animals since 1993 indicates increased wealth possibly due to better yields and profits based upon improved access to irrigation. ADRA claims one factor that it is due to is an increase in disposable income from selling vegetables. CAS also reports the increased popularity of vegetable production after the ILO intervention. They state that this was due to improved access to water and the increased use of vegetables as a cash crop.

***Increased Production***

Irrigation development, rehabilitation and maintenance programmes are primarily concerned with improving agricultural production. Higher agricultural production may be the result of various factors: increased land under cultivation, intensification of land use or increased productivity. Irrigation development, rehabilitation and maintenance provide critical support for increasing the crop area and for creating an environment where yield-enhancing technologies can be used profitably. In the BIS, the number of hectares of cultivated land increased by 15 per cent from 1993 to 1999. There was a considerable increase in the land used for growing wet and dry season rice. Wet season rice land increased by 11 per cent, while dry season rice land increased by 23 per cent. This result, especially the increase in dry season rice cultivation, was due to improved access to irrigation. Total production (rice + other crops) increased by 28 per cent from 1993 to 1999.

***Crop Production***

During the CAS fieldwork, research teams were informed that farmers in the upstream zone received better irrigation than the other zones. This is because their farms are closer to the secondary canal. Farmers in this zone take advantage of the improved irrigation access and therefore, the total production of the upstream zone has increased by 36 per cent. The central farming zone showed the smallest increase in production with an increase of 21 per cent.

[29] International Labour Organisation, Draft Barai Development Plan, Phnom Penh, 1994.

According to respondents, the central zone has the worst soil of all three zones, which may explain this finding. The downstream farming zone is close to the Tonle Sap Lake and the soil quality is much higher than the other two zones. This has a substantial impact on production. Moreover, the soil in the downstream zone is suitable for cultivating dry season rice. Thus, due to the soil factor and improved access to irrigation, production in this zone had risen by 28 per cent from 1993 to 1999.

CAS found that wet season rice production did not show significant changes from 1993 to 1999. However, in individual years, the irrigation provided substantial benefit. In the wet season of 1994, the rains finished early in the BIS. Those with access to irrigation water were able to 'finish' their crop and secure normal yields. Those without the benefit of irrigation were able to harvest only half their normal yields[30]. Although wet season rice production did not show significant changes, dry season rice production increased significantly. This was particularly true in the upstream zone, which showed an increase of 137 per cent and the downstream zone increased production by 147 per cent for those surveyed. This may be attributed to improved irrigation.

The average total food consumption in 1999 had increased by 30 per cent (wet season rice 4%, dry season rice 49%, soybean 12%, maize 17% and sugar cane 13%) from 1993 food consumption. This is significant, as the dry season is when food deficiencies (mainly rice) normally occur. From 1993 to 1999, there was a 49 per cent increase in dry season rice consumption. There is more rice consumption in food deficient months, indicating there is more rice available. Availability may be due to production increases or to more disposable income, which is used to buy rice. The study found that about 17 per cent of households in 1993 and 15 per cent in 1999 were producing below their annual consumption needs. So, there is a decrease in the number of households below sufficiency. However, dry season rice consumption has almost doubled. Wet season rice consumption only increased by four per cent. It could be that this increase was due to population growth, while dry season consumption increase is due to production increases and/or more cash on hand. Either way, families are better off in 1999 than in 1993.

***Aquatic and Cash Crop Production, Consumption and Surplus***

Vegetables are an important crop in the BIS area both in terms of production and consumption. Vegetables are the second largest crop after rice. They provide an important source of vitamins and minerals in what is predominantly a carbohydrate diet. They are a supplementary food source for household consumption and a source of cash income[31]. Comparing the surplus production of vegetables, fruits and aquatic products in 1993 to 1999, the total surplus had increased by 29 per cent for those BIS farmers surveyed. Improved access to irrigation is likely to have contributed to this increase. Consumption of these crops increased only slightly, indicating that fruits and vegetables are mainly used as cash crops.

***Seed, Fertiliser and Pesticides***

The CAS findings show that for the 79 farmers in the BIS, there was no increase in the use of improved seeds, for rice or other crops. Their findings actually show a decrease in the use of improved seed. In the survey sample, the total amount of chemical fertilisers used in 1999 showed a 14 per cent increase over 1993. All of this increase went to rice production. Organic fertiliser was used in much higher quantities than chemical fertiliser was. In 1999, this was by a factor of more than 13 times. Comparing 1993 to 1999, there was a ten per cent increase in

[30] ILO, Update of Progress in the BIS, Memo to Bangkok Regional Office, January 1995

[31] CAS Evaluation, citing The Ministry of Agriculture, Forestry and Fisheries.

the use of organic fertiliser. Pesticide use had declined over the same period despite an increased use in rice cropping. The decline was due to a drop in pesticide use in vegetable production. CAS judged that the changes recorded in fertiliser and pesticide use from 1993 to 1999 were not significant. The CAS study concluded that the production of dry season rice, fruits and vegetables has increased considerably in 1999 compared with 1993. This increase in production cannot be attributed to increased use of improved seed, fertiliser or pesticide. Irrigation seems to have been the most important factor in this increase in crop production.

***Use of Irrigation***

Using irrigation to grow rice was ranked first in 1993 (99%) and in 1999 (94%). However by 1999, use of irrigation for rice had declined by five per cent. This is due to increasing crop diversification, in particular vegetable and maize production, which ranked second and third, respectively. Farmers have started to grow more vegetables recently - probably due to the improved access to irrigation. This bares out comments made in the Halcrow study, that if irrigation is assured and markets are accessible, diversification will occur. During the survey, each WUG chief was asked how many farmers (water users) were registered in 1993 and in 1999. According to the WUG chiefs, there was an increase of 23 per cent. It follows that irrigation in the BIS is used predominantly to grow rice, but increasing crop diversification shows a shift in irrigation water use. There has also been an increase in the numbers of those benefiting from irrigation water in the BIS.

***Irrigation Efficiency***

Before the ILO rehabilitation and maintenance, the level of water in the canal was too low to allow farmers to get water into their rice fields using gravity. Now, the level of water in the canal is substantially higher, allowing farmers to gain water through the tertiary canals. The delivery of water through efficient irrigation management is the most important service that the irrigation system operators (managers) provide to farmers. From the farmers' point of view the important factors are:

- Timing
- Flow-rate
- Farmers' participation in scheduling (planning)
- Duration of irrigation applications

During the survey, each interviewee was asked whether irrigation supply by the central management was efficient in relation to each of these factors in 1993 compared with 1999.

Since 1993, the ILO intervention has had a positive influence on the overall timing of irrigation. Irrigation efficiency in terms of timing was reported to be good in 1999 by the majority of interviewees (64%). Only 17 per cent of respondents reported that irrigation timing was good in 1993. Forty nine per cent reported that the timing of irrigation in 1993 was medium, whereas only 25 per cent believed the timing was medium in 1999. Thirty four per cent of respondents considered timing poor in 1993, while only 11 per cent said that the timing of irrigation was poor in 1999.

Flow rate depends upon a design that allows every farmer to take as much water as they want, at any time, for as long as they need. During the survey, each farmer was asked about the efficiency of the irrigation service in terms of flow rate. Flow was rated as either good, medium or poor. The efficiency of irrigation in terms of flow rate showed that only seven per cent considered that the flow rates were good in 1993, while 54 per cent said that the flow rate was good in 1999. The majority of respondents (62%) said that in the baseline year, the

irrigation flow rate was medium, while only 38 per cent believed the flow rate in the present day was medium. Thirty one per cent of respondents said the flow rate was poor in the baseline, while only eight per cent believed it was poor in 1999.

The farmers were asked about their participation in irrigation scheduling. The majority of respondents (90%) agreed that there was user participation in scheduling irrigation in 1999, whereas in 1993 only 30 per cent reported user participation. Seventy per cent reported that there was no user participation in scheduling irrigation in 1993.

The majority of farmers (88%) indicated that the duration of irrigation was insufficient in the baseline year. Only 12 per cent believed that irrigation duration was sufficient in 1993. Conversely, the majority of farmers (81%) said that the duration of irrigation was sufficient in 1999 and only 19 per cent reported that the duration was insufficient.

***Farming Activities***

The most important farm activities in the area were rice production, both in 1993 and 1999. Better irrigation encourages farmers to expend more labour producing rice, vegetables and other crops. Double cropping also increases farm activities. In general, a successful irrigation project generates a higher demand for farm labour, which is likely to lead to an increased demand for hired labour. Most farm activities are wet season activities while most off-farm activities occur in the dry season. If there are no opportunities available in the BIS, farmers migrate temporarily to Siem Reap town to seek employment as unskilled labourers. One important trend noted during the survey was that off-farm activities were decreasing over time due to increased farming activities.

Farming activities have become more important for all households since the ILO intervention. This highlights the importance of improved access to irrigation. In 1993, 45 per cent of households were carrying out off-farm activities like fishing (5%), small business (9%), construction work (12%), service work (11%) and manual work (8%). Only 55 per cent of households were doing farm activities. By 1999, 85 per cent were engaged in their own farm activities and only 15 per cent were involved in off-farm activities. This increase in farm activities seems to indicate that improvements to the BIS encouraged farmers to engage in additional farming activities.

During the survey, respondents indicated that it was now easier for poor families with small plots of land to get farm employment as hired labour than in 1993. This implies an increase in employment opportunities for poor farmers after the ILO assistance to the BIS. However, disabled households and female-headed families with young children cannot earn income from off-farm activities, as they are busy working on their own farms.

Since 1993, there has been an increase in income from pig and animal products and most significantly, from the sale of vegetables. The decreased importance of rice income since 1993 and the increased popularity of vegetable production for cash income suggest that improved access to irrigation has contributed to diversification of income generation. ADRA also found an increase in disposable income in their 1996 to 1999 surveys.

Almost all respondents reported an increase in rice production, particularly dry season rice. Vegetable production also increased considerably due to improved access to irrigation since 1993. Some families have started growing vegetables on a large scale, although many grow vegetables in kitchen gardens, mainly for their own consumption. According to respondents, market prices for vegetables vary. Occasional low vegetable prices are a problem for farmers.

There were only ten rice mills in the area in 1993, but this figure had increased to 30 by 1999, an increase of 300 percent. In 1993, most villages had insufficient rice mills, so farmers travelled to neighbouring villages, or to Puok market. Waiting times for rice milling were from one to two days. Waiting time is now between one and two hours.

***Conclusions***

Most farmers explained that their economic conditions had improved since the ILO support. More children go to school because living standards have improved. All respondents reported that the ILO support was preferable because it lasted for a significant period and because it was sustainable.

It seems that substantial agricultural, ecological and socio-economic changes have taken place in the communities of the BIS. Although not all of these changes can be attributed to improvements in the irrigation system, there is no doubt that these improvements had a significant impact on land use and production. The impact of the ILO support was summarised by CAS as follows – improved irrigation led to increased cropping intensity and higher total production. This created more demand for labour and contributed to a reduction in poverty.

## Appendix 5 – People Met/Contacted or Interviewed

| | |
|---|---|
| Phnom Penh | |
| Veng Sakhon | MWRM, Under Secretary of State |
| David Salter | ILO, Chief Technical Advisor |
| Dara Johnston | ILO, Senior Engineer |
| Baz Rozemuller | ILO, Associate Expert |
| John Tracey White | Consultant |
| Joanne Morrison | CARERE, Assistant Programme Manager |
| Don Bishop | IFAD, Agriculture Programme |
| Mark Schwisow | ADRA, Acting Country Director |
| | |
| Battambang | |
| El Say | Provincial Director of Rural Development |
| Hong Kim San | PDWRM, Deputy Director |
| Eang Eam | PDWRM, Deputy Director |
| Sar Kheng Kuan | WFP, Provincial Field Manager |
| Cheung Ravanh | Former DoH/ILO counterpart irrigation engineer |
| Un Ro | Deputy Chief of Tmor Koal District |
| Yoen Sokha | Tmor Koal water resources and meteorology officer and BoIS farmer. |
| Kok Saroen | Deputy Chief of Tam Oeurn Commune |
| Som Yay | Commune official responsible for WUGs in Rong Chreav Commune. Also a BoIS farmer |
| Nee Yee | Village and VDC Chief, Balang Krom village Also a farmer in BoIS |
| Chop Peak | WUG leader on SC 4 and a farmer in the BoIS |
| Oo Chantrea | WUG and VDC leader and a farmer in the BoIS |
| Ngun Gee} | |
| Ngon Hean} | Farmers in the BoIS |
| Boo Reth} | |
| | |
| Siem Reap | |
| Son Kim Sea | Director, PDWRM |
| Chim Kdep | Former Director, DoH |
| Patrick Evans | FAO, Team Leader |
| Hang Sona | WFP, Provincial Field Manager |
| Bun Thong | WFP, Field Officer |
| Duong Vanna | CARERE PPM |
| David Cowled | ADRA, Management Advisor |
| Chhuy Hy Karona | ILO /MWRM Counterpart Engineer |
| Des Chan Kiri | Puok District Governor |
| Meo Chnearn | Puok District Chief of Finance |
| Mom Tiuow | Puok District Agriculture Officer |
| ??? | Tukville Commune Chief |
| Pin Pouen | Puok District Supervisor of Operation and Maintenance in the BIS |
| Cheam Car | Chief of Krabei Real Commune and BIS farmer |
| Yol Som | Krasang village chief, WUG leader on SC 5 and BIS farmer. |
| Sit Yet | Tropeang Veng village chief, WUG leader on SC 5 and BIS farmer. |
| Pon Kow | Promar village chief, WUG leader on SC 7 and BIS farmer. |

## Appendix 6 – National Policy and Framework

In 1999, a meeting was held between the MWRM, the MRD and the Prime Minister to clarify the responsibilities for irrigation and drinking water. It was decided that the MWRM would have responsibility for irrigation and would be responsible for whole irrigation systems. The MRD would be responsible for drinking water.

In June 2000, a National workshop was held by the MWRM. This workshop was titled Extending and Strengthening a National Policy for Participatory Irrigation Management and Sustainable Development in the Irrigation Sector. Presented at this workshop was the Ministry's Irrigation Policy Document titled "Irrigation Policy 2000", "Statutes for Farmer Water User Communities" and a document detailing the "Steps in the Formation of a Farmer Water User Community" (FWUC). These documents detail the management and organisational structures and the financial arrangements the MWRM is proposing for irrigation systems in Cambodia.

At a national conference on Cambodia's water resources held in December 2000, a draft law on water resources management of the kingdom of Cambodia was presented. It states that all water and water resources, the beds, banks and shores of rivers, streams, lakes, canals and reservoirs are owned by the state. The law also states that FWUC can manage irrigation systems (i.e. operate and maintain them). Some brief information from the three documents presented in the June 2000 workshop follows.

***Irrigation Policy 2000***

The rationale behind the MWRM policy is that the transfer of irrigation management to FWUC will improve maintenance and sustainable use of irrigation systems[32]. The policy is based on a number of basic principles:

- Legal status for FWUC.
- Involvement of FWUC in system development, operation and maintenance and emergency cost recovery from water using farmers.
- Improved maintenance of irrigation systems.
- Improved water delivery.
- Continued support from MWRM for technical backstopping, monitoring and evaluation.

FWUC are organisations established and managed by farmers using irrigation water, which are recognised by the RGC. Water User Groups (WUGs) refers to groups of water users set up at different levels within an irrigation scheme under the structure of the FWUC.

In new or existing irrigation projects, full participation of the users should take place from the outset, across all levels of users. Operation and maintenance responsibilities should be gradually assumed by the FWUC after the scheme is operational. This system applies to irrigation schemes constructed or rehabilitated by the Government or those supported by international agencies. Responsibilities are shared as follows:

[32] *op. cit.* Lim Kin Hor, June 2000

Year 1: The Government shares 80% and the farmer members 20%.
Year 2: The Government shares 60% and the farmer members 40%.
Year 3: The Government shares 40% and the farmer members 60%.
Year 4: The Government shares 20% and the farmer members 80%.
Year 5: The Government shares 0% and the farmer members 100%.

Irrigation systems will be transferred to FWUC for operation and maintenance based on their capacity. The FWUC and the government will jointly manage those systems not fully transferred. MWRM is responsible for providing technical and managerial support to form FWUC. The Ministry is also responsible for registering FWUC to make them legal entities and providing training so that they are more self-reliant. The FWUC will comprise farmer representatives from the various levels of the irrigation system (quaternary, tertiary, secondary, main canals). The FWUC will be managed by its board, which is elected by members of the FWUC. Responsibility for collecting irrigation service fees lies with the FWUC board. The fee level is to be determined using a formula which considers the expenditures in running the system.

The policy calls for the Ministry of Economics and Finance (MEF) to make budgetary allocation for the development of irrigated agriculture including operation and maintenance until the FWUC are self sustaining. The MWRM is responsible for developing training and curriculum materials for knowledge transfer and human resource development.

***The Statute of the FWUC***
The Statute sets out the aims of FWUC. The aims are to:

- Bring together farmers in an irrigated area to form a group to facilitate irrigation water supply.
- Supply adequate water for irrigation to the members.
- Acquire knowledge of the management, maintenance, operation and financial affairs of the irrigation system.
- Increase yields and seasonal cropping.
- Facilitate support from the government.

The statute sets out the organisational structure of FWUCs. The FWUC is led and managed by its board. The board is composed of a chairman, first and second vice chairman, treasurer and all chiefs of WUGs. The role of each is defined in the statute. Revenue sources for FWUC include; fees collected, assistance or credit from government, IOs and NGOs, profit from business operations of the community and various fines and levies. FWUC expenses include repair and maintenance of the irrigation system, fuel and support to the FWUC board.

***Steps in the Formation of a FWUC***
This document is a guide for forming FWUC - described as a formal organisation legally chartered by the government to collect irrigation fees in return for providing water to designated service area farmer members to recover annual operation and maintenance costs with some security funds for emergency maintenance. The document states that the:

*"...growing awareness [over recent years] and acceptance that construction and physical improvements alone are insufficient to improve irrigation performance and the participation of users at all stages of irrigation development and management is the only and cost effective approach to improve the performance and sustain the systems."*

This statement mirrors the ILO approach. The document also goes on to state that institutional development of FWUC is needed and outlines the process of forming FWUC. At a country level, the MWRM irrigation policy calls for the transfer of irrigation schemes to Farmer Water User Communities (FWUC) based on their capacity. The FWUC and the government will jointly manage irrigation systems not fully transferred. This latter scenario is envisaged for the BoIS and BIS until the capacity of the FWUC improves. There should currently be funding for operation and maintenance available from the MEF through the MWRM. However, this is not yet occurring.

In the MWRM Irrigation Policy 2000 document, the size of command areas is used to determine the size of the irrigation systems. A scheme of less than 100 hectares is considered small, from 100 to 500 hectares is considered medium and more than 500 hectares is considered large. Using this criteria, both the BoIS and the BIS are considered large irrigation systems.

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**Ministry of Rural Development**
Corner Rd. 169 and Soviet Blvd
Phnom Penh
Kingdom of Cambodia
Tel: 855-23-366 792
Fax: 855-23-428 049
*Contact person:*
*H.E. Suos Kong*
*Under Secretary of State*
Email: skong_mrd@forum.org.kh

**Ministry of Water Resources and Meteorology**
47 Norodom Blvd
Phnom Penh
Kingdom of Cambodia
Tel: 855-23-725 327, Cell: 855-12-876 790
Fax: 855-23-426 345
*Contact person:*
*H.E. Veng Sakhon*
*Under Secretary of State*
Email: hydro@forum.org.kh

**International Labour Organisation**
No.8 Street 352 off Norodom Blvd
PO Box 877 (UNDP)
Phnom Penh, 12302
Kingdom of Cambodia
Tel: 855-23-211 484, 428 210
Fax: 855-23-427 632
*Contact person:*
*Bas Rozemuller*
Associate Expert Socio-Economic Studies
*Email: ilo@bigpond.com.kh*

**Employment-Intensive Investment Branch (EMP/INVEST)**
Recovery and Reconstruction Department (EMP/RECON)
International Labour Office
4, Route des Morillons,
CH-1211 Geneva 22, Switzerland
Tel: +41-22-799 6546
Fax: +41-22-799 6489