



Irrigation project evaluation, Takeo, Cambodia

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WITH THE ABSENCE of official aid organisations from Cambodia until the 1990s, NGOs have been the main support to development in the country. In June 1990, Oxfam initiated the Takeo Irrigation Structures Project (KAM 215) in Takeo Province, southern Cambodia, to increase the technical skills of provincial level irrigation technicians; support locally managed irrigation schemes; and develop contacts with local communities which would enable Oxfam to develop other community-based programmes. The major inputs were Technical Assistance (an Engineer), construction materials and equipment, capital for a loan scheme to farmers in a pilot project, salary subsidies for Takeo Provincial Office of Hydrology counterparts, and operation and maintenance of vehicles and equipment.

Ian Smout and Peter Robertson undertook an external evaluation of the project for Oxfam in April-May 1993. This paper is drawn from the evaluation report.

Background

Most of the area of Takeo Province is a plain which slopes eastwards towards the Tonle Bassac river. The floodplain soils are black cracking clay, with high organic matter benefitting from the annual flooding. The higher land has red soils with low organic matter. Boua and Kiernan (1989) gave the population of Takeo Province as approximately 585 000, of whom 54 per cent were female.

Under the Khmer Rouge regime Takeo was part of the Southwest Zone headed by Chhit Choeun (Mok), whose forces gained a terrible reputation for brutality (Boua and Kiernan 1989). They were ruthless in pursuing the policy of using manual labour to construct canals on a rectangular 1 km grid pattern, irrespective of the natural land forms (Pijpers, 1989) - these became known as "Pol Pot canals". According to a Vietnamese study of irrigation in Takeo Province (INPA 1988) the resulting canal network in Takeo is the densest of all the Provinces, comprising 3450 km of principal canals of which about 20 to 25 per cent were in use, according to their investigations.

The UNDP (1992) estimated the irrigated area in the Province as 30 000 ha in the wet season and 26 000 ha in the dry season. These were the responsibility of the Provincial Office of Hydrology whose resources were limited to its staff (with their private motor cycles for travel), a bulldozer, several pumps and the equipment provided under the KAM 215 project. There is no bank in Takeo, and organisations have to hold funds in cash, including both the Province and NGOs.

The water resource system in Takeo is very complex, as a result of Pol Pot's grid pattern canal building. The direction of water flow changes with the annual flooding of the Mekong and Bassac rivers. Many reservoirs were interlinked by canals so seldom is there a discrete irrigation system.

Crops

Rice is virtually the only crop cultivated on open fields in the Province. Fruit and fuelwood trees, cassava and vegetables are grown in small areas around houses and on higher land. The following paragraphs describe the various types of rice crop grown in Takeo Province.

On land which floods every year, floating rice is traditionally grown, using a photoperiodic local variety. Yields were reported to vary from 0.5 to 2 t/ha, typically about 0.8 t/ha. The risks are serious and crop losses occur if the flood rises too fast or too high.

If irrigation is available, flood recession rice may be grown instead, using a 90 day High Yielding Variety (for example IR66) which is responsive to fertiliser and gives reported yields in the range 2.5 to 4 t/ha. As the flood water levels drop on the floodplain, nurseries are planted on the higher land for flood recession rice. Then land preparation is carried out on the high fields which have a shallow depth of water, followed by transplanting. As the flood water drops further, farmers lift from it to irrigate the planted land, and start to prepare the lower land. As the flood recedes further, the critical factor becomes whether the land can be irrigated from local creeks or farmer-built channels supplied from a reservoir or canal system. The lowest land may not be planted because by the time water levels have dropped that far, it may be very difficult to get irrigation supplies to the field.

Flood recession rice has relatively low irrigation requirements, because flood water is used for land preparation and initial flooding, and percolation rates were said to be low. Most flood recession rice in Takeo Province is transplanted between November and January, and harvested 3 months later. In a few places this may be followed by a second crop on the same land (for example immediately downstream of reservoirs). Flood recession rice is also found growing inside reservoirs as the reservoir water level drops, typically transplanted between January and April (see photo 1).

On the higher land which is not subject to annual flooding (upland soils, >5 m above sea level) the main crop is rainfed wet season rice, using local varieties.



Photo 1

Where irrigation is available, there are three other types of rice: early wet season rice may be grown using supplementary irrigation for land preparation; late wet season rice (with supplementary irrigation for ripening); and dry season rice (totally dependent on irrigation).

High water requirements for land preparation result in considerably higher irrigation requirements for dry season rice than for flood recession rice.

Estimated inputs for 1 ha of transplanted rice were 10 days of an ox pair for ploughing, harrowing and seedbed preparation and another 130 adult-days labour for pulling seedlings, transplanting and harvest, plus additional labour for applying fertiliser and insecticide and transporting the harvest (Redd Barna, 1992). For irrigated rice the labour requirements for irrigation must be added.

Floating rice is not transplanted and has substantially lower labour requirements per hectare, though a larger area must be cultivated to obtain the same production.

Although rice cultivation is the major farming activity, it is not a substantial source of income. Larger farmers might have 2 ha of land yielding 4 t/ha with a market price of about \$100 per tonne, giving a gross production value of \$800 per year, before paying for seed, fertiliser, labour and fuel for irrigation. Fish, cattle, pigs, ducks, trade and employment were more important sources of income, particularly for richer people.

Irrigation

Main systems

There are three types of main system in Takeo Province, based on reservoirs, floodplain canals and to a lesser extent pump stations.

a) Reservoirs

Reservoirs were formed by constructing earthen embankments across streams or depressions, so that water is ponded behind, with a maximum depth of about 4 m. The reservoirs often form a complicated system, in some cases including several inter-connected reservoirs. There appear to be few control structures on the irrigation systems downstream of the reservoirs.

b) Floodplain canals

The major canal system in Takeo Province is based on Primary Canal 15 which was constructed under an earlier

Oxfam project by widening and deepening an abandoned Pol Pot canal. It runs east-west, bringing water from the Tonle Bassac river system to provide irrigation supplies for flood recession rice. Secondary canals and pumps from Canal 15 convey the water across the floodplain area. There were no control structures regulating the inflow into Canal 15 or into the secondary canals.

c) Pump stations

Stationary pump stations in Takeo Province were mostly located to pump from reservoirs, and often their irrigation areas were the poorer, upland soils. cursory inspection showed few working and little sign of dry season rice under pump irrigation in April 1993. This may be partly due to poor financial returns as well as technical maintenance problems.

Distribution systems

Distribution systems were rudimentary, comprising ditches dug by individual farmers or groups. In some cases the ditches were cut directly into the canal, so that water flowed along them by gravity; usually it then needed to be lifted out of the ditch to the farmer's fields. In other cases the ditch was higher than the canal, and water had to be lifted out of the canal. Both traditional human-powered devices and small diesel or petrol pumps were used for this in Takeo Province.

According to INPA, in 1988 there were still 10748 pedal-driven *rohat* traditional pumps in use in Takeo Province, and 543 tripod-mounted *snach* scoops. Boua and Kiernan (1989) describe the heavy labour demands these make, and report that replacement of *rohat* with irrigation pumps supplied by Oxfam had enabled a sample of 22 owners to make dramatic increases in their cultivated area of dry season riceland (including flood recession rice) and in their yield. There were suggestions elsewhere that shortage of labour is a constraint on rice cultivation, for example preventing widows utilising all their land. Consistent with this is the reported tendency in Takeo Province for farmers to replace their *rohat* with the petrol engine propeller pumps which can also be used to power their boats. Presumably the poorer farmers were unable to do this and may still face labour constraints on their cultivation.

In the floodplain areas the distribution systems must be flexible and change during the growing season to follow the falling water levels. Both the *rohat* and the propeller pump have a practical pumping limit of 1.5 m lift, and the *snach* less than 1 m. A reasonably efficient human powered pump worked by one adult over a prolonged period can be expected to deliver about 25 watts (Lambert & Faulkner 1991), equivalent to 5 l/s with a head of 0.5 m. To provide irrigation requirements of 6 mm/d for 1 ha of flood recession rice would then require 3.3 adult-hours of pumping every day, for a lift of 0.5 m, increasing for higher lifts as the season progresses.

Operation

There was so little engineering in the irrigation systems that systematic operation was impossible. There were no records of the dimensions or levels of the old reservoirs and canals, no gauge boards indicating water levels, no measuring structures indicating discharges, few control structures allowing flows to be regulated, rotated or divided between different areas, few operating staff and no records of operation.

In these circumstances water levels in canals were more important than discharges (though they were related) and farmers had to respond to these as best they could, by using their own pumps and trying to influence the settings of any control structures, especially if water levels fell below the limit of their pumps.

The Project

During the project period objectives were stated in different ways but had three common aspects: training activities, construction of irrigation structures and stimulating farmer participation in operation and maintenance of irrigation structures.

Two target groups were identified. Personnel in the Provincial Office of Hydrology and other government officials at provincial and district level; and villagers involved in and benefiting from the irrigation rehabilitation work. The key institutional focus was with the Provincial Office of Hydrology, in particular through the two Counterpart staff. Opportunities to work closely with District personnel varied in intensity and effectiveness.

Project Inputs

Generally inputs fell into the following four categories:

1. Personnel. An Irrigation Engineer employed by Oxfam provided technical advice. Oxfam also provided a salary supplement for the two Provincial Office of Hydrology counterpart staff.
2. Procurement:
 - construction materials (sand, gravel, cement, rebar),
 - equipment (two concrete mixers, two concrete vibrators, two earth compactors, moulds, level)
 - vehicles (three motorbikes, one Mitsubishi dump truck with spare parts, one 4wd vehicle used by Technical Advisor and counterparts),
 - capital for loans (Koh Andet Pilot Project)
 - an office/store building.
3. Training: funds for training in Thailand and various trainings in-country including English language.
4. Other: includes travel in-country and operation and maintenance of equipment.

The main physical output was some five to ten "projects" per year. There were two types of project:

Project Outputs

1. rehabilitation of "Pol Pot" canals in the floodplain as secondary canals in gravity irrigation systems
2. rehabilitation or new construction of hydraulic structures in embankments or irrigation systems, (for example weirs, regulators and spillways) and (to a lesser extent) improvement of reservoir embankments.

Evaluation

Training

A number of effective training activities were carried out under the Project. A study tour to Thailand exposed Provincial staff to new methods of operation and maintenance and farmers participation, which they were interested in pursuing. On-the-job training increased the knowledge and skills of two counterparts and several supervisors in the Provincial Office of Hydrology. However this informal training suffered from the lack of agreed systems and procedures in the Provincial Office of Hydrology or central Department of Hydrology, and from lack of training and reference material.

Without such procedures, staff could not be trained in a systematic way, particularly on operation and maintenance and farmer participation. The on-the-job training emphasised civil engineering aspects of investigation, design, construction and maintenance. This was the Technical Advisors' main skill and addressed a serious and urgent need in the Provincial Office of Hydrology.

Rehabilitation

The Project rehabilitated both canals and structures, achieving a considerable amount of cost-effective, good quality construction. This was based on needs identified by the Provincial Office of Hydrology, arising from requests received from Districts, which often originated from farmers. The work enabled the Provincial Office of Hydrology to achieve much of its programme (excluding large projects and those judged not feasible). Comments were made in the report on consolidating this work by consideration of wider design issues and improving records.

The Project emphasised rehabilitation of secondary canals in the floodplain areas as shown in photo 2. These were technically very simple, being supplied by gravity from the Bassac river system, without structures. They were effective in improving the availability of irrigation supplies to farmers for growing flood recession rice. The environmental impact of canal rehabilitation did not appear to be significant, as rice was extensively cultivated over the area under the Khmer Rouge regime, though this area has reduced considerably in the last ten years.

Work on hydraulic structures included both structures in embankments, and structures in irrigation systems supplied by reservoirs, concentrating on those which had failed or were in danger of collapse (see photo 3). Such cases might include serious problems requiring exper-



Photo 2



Photo 3

tise which was beyond the Project's capabilities without outside advice. The hydraulic structures requiring rehabilitation could be described as medium rather than small scale, though the construction works required were low cost (mostly less than \$1000 for each structure). This involved more demanding design work than would normally be expected of a civil engineer working without technical support, and a significant risk of damage if a structure failed. The need for technical support did not seem to be recognised, but no serious problems resulted. The report raised issues concerning the professional responsibility of NGOs and individual engineers.

Initially, Food-For-Work was used for canal construction, but this was replaced by a satisfactory payment system. Structures were built by small, labour-only contractors.

Impact

The rehabilitation of irrigation systems increased the availability and security of water supplies for irrigation to some 4000 ha, potentially benefitting perhaps 6000 households. If the total Project cost of £173 000 is set against this work, it amounts to less than US\$50 per household. The benefits of increased rice production depend on farmers making use of this water, usually by pumping with human-powered traditional pumps or petrol-driven propeller pumps.

The Evaluation Team found that the Project benefitted both rich and poor households, but its importance was much greater for poor farmers who relied on rice cultivation than for rich people whose major sources of income were trade, employment, fish and livestock.

One group of poor people who faced difficulties taking advantage of these opportunities were households with limited resources of adult labour, including widows and people with disabilities. Shortage of labour may force some of these families to sell some of their land. Such groups could be assisted by the supply (perhaps on credit) of small motorised pumps which could be maintained locally.

Farmer participation and operation/maintenance

Good procedures were developed for farmer participation in rehabilitation of floodplain canals. These involved

publicising the work in the villages served by the canal through the village heads, who then drew up a list of farmers wishing to work for payment on rehabilitating the canal.

The main irrigation systems of reservoirs, canals and pump stations were just operational at a minimum level. The distribution systems were constructed, operated and maintained by farmers, in an informal way.

Future programme

The Evaluation recommended that the project should continue, but reduce dependency by planning for an orderly handover of direct support to the Provincial Office of Hydrology in 2 to 3 years.

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