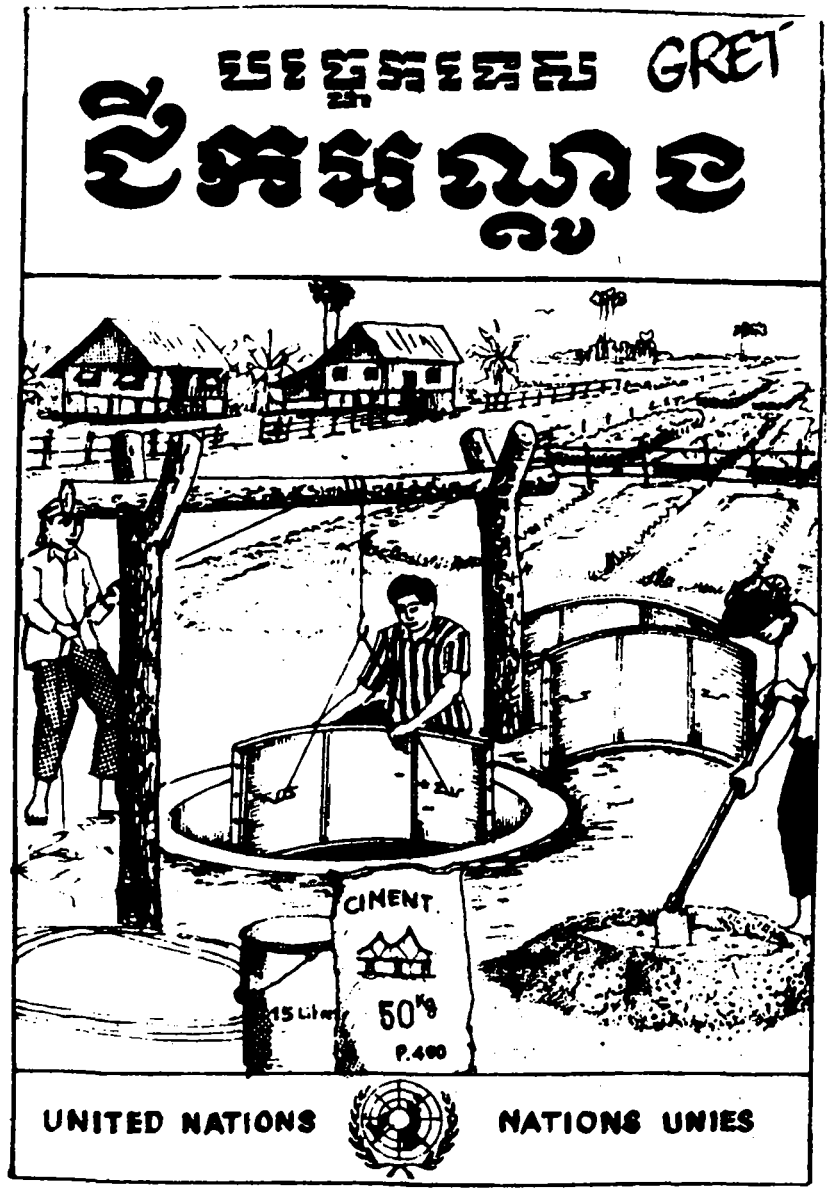
JOINT UNICEF/OXFAM EVALUATION
RURAL WATER SUPPLY PROJECTS
CAMBODIA



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EXECUTIVE SUMMARY

In the past ten years UNICEF and Oxfam have been supporting water supply development in Cambodia.

UNICEF drilling achievements have been impressive, especially considering the Cambodian circumstances. By March 1992, over 4,500 pumps had been installed on drilled boreholes, rehabilitated boreholes and larger diameter wells. The impact of developing the local PAT rig has been significant in increasing drilling capacity.

Oxfam has since 1990 worked in five provinces and constructed some 430 wells. In addition over a hundred handpumps installed on (a total of 290) wells drilled in the mid-eighties were repaired.

Descriptions are given of the UNICEF and Oxfam rural water supply programs based on documentation available to the Mission, on field visits and discussions with staff of each agency.

Both Oxfam and UNICEF outline changes in their approach to rural water activities through the stronger integration of software components aimed at raising the impact level of their inputs on health, operation and maintenance, and sustainability in general.

1 Cambodia

UNICEF and Oxfam have had to accept that the activities they executed in water supply development in the recent past were relief oriented and, due to the situation in the country, did not allow for mobilization for construction and repair of water points or hygiene education for proper water use. This situation is now rapidly changing and so it was proposed to undertake a joint evaluation of the water supply programmes of the two agencies.

The Ministry of Agriculture and the Ministry of Health are the main actors in the field of water supply development. The Ministry of Agriculture through the Department of Hydrology (DoH) and assisted by several NGOs including Oxfam executes a limited number of well construction programmes aimed at increasing access to improved water supply. The Ministry of Health, through the Centre National d'Hygiene et Epidemiologie (CNHE) and assisted by UNICEF executes a far larger water supply development programme producing 1000 to 1500 wells annually.

2 Social environment

Each village has a village chief, either elected or appointed, who constitutes the link to the administration. The current social organization of the village seems to be dependent on the people living in the village.

There generally seems to be a reluctance to participate in communal activities, as a result of the forced communalism of the past. People are very individualistic and there appears to be little solidarity among villagers, other than relatives, unless instigated by the monks.

As a result of the Pol Pot times and the war situation thereafter, 35% of the households in the villages are headed by women.

Main sources of domestic water include ponds, rivers, irrigation canals, wells and rainwater. During the dry season the number of well users increase as ponds dry out.
Improved hand dug well construction is being promoted by several agencies for both domestic and small scale irrigation uses.

3 Project Implementation

The decision on the location of the pump is usually done by either the village head, or the drilling team or by these two together.
Hand pumps were heavily used for all purposes and serve a large population. However, where alternative water sources were available, these sources are preferred for drinking purpose. Generally, the pump water was not liked for its taste. Distance or convenience did not seem to be factors which would directly induce people to use the pump water for drinking. **Health considerations were never mentioned as a factor in deciding the source of drinking water**
In the rainy season, people prefer to drink rainwater and in most villages households have jars to collect rainwater

Often the person taking on responsibilities for O&M is a woman. They never received training. The need to have somebody responsible for the pump or well was never adequately discussed in the villages and people were never formally selected for this task. Therefore, maintenance was often dependent on the ability and willingness of a person to carry out this task, be it a village head or somebody else.

UNICEF together with MoH has established a well functioning O&M system using provincial maintenance teams. Spare parts are provided through the Provincial Health Services. The O&M system is quite effective and the evaluation mission has no reason to doubt that a reported 90% of the pumps is functioning. Oxfam does not reach this level, and quite a number of handpumps as well as wells require repair.
In the case of the No. 6 suction pumps installed by AICF in Takeo, one person in the community, usually the head of the village was instructed in repair and was given a tool kit. For all Oxfam and UNICEF pumps, the provincial (or district) maintenance teams of Hydrology and Provincial/District Health Service were responsible for the maintenance. Officially, this service was free of cost, but people usually had to pay for spare parts, for transport or for both. In case of breakdown, the main problem seemed to be to contact the maintenance teams.

Appreciation for an improved water supply in many case is assumed by the outside agency rather than that it is real. No doubt there is a demand for water supply services in many communities but most probably this demand is mainly based upon the need to have a dependable source of water supply during the dry season.

The results of the field visits show that new water sources are often not used for drinking. If health improvement is to be achieved, a far broader approach to water supply delivery is required. To start with, emphasis should be placed on finding out the conditions under which people will start using the drinking water facilities for drinking. This may imply that technical options other than drilled wells with handpumps have to be considered (as Oxfam has already started to do). Upgrading of traditional wells, rainwater catchment, boreholes with hand dug wells are just a few possible options. A number of basic factors have to be taken into account when assessing possible options, such as the availability and preference of rainwater for drinking during more than half of the year.

It could not be assessed during the mission to what extent villagers are able to contribute financially, but a discussion on ability and willingness to contribute should take place at village level if only to assess the extent to which a new source is indeed needed.

If improvement of water supply is to be sustainable and leading to health benefits, an integrated package of technical, social and hygiene education inputs will be necessary. Software services such as the provision of information, training, hygiene education and facilitation for decision making by the community should be included in the standard procedures.

In the section on the process approach for the development of a water supply programme, suggestions are given for a process approach for a water supply development programme that could lead to sustainability and continued utilization of water supply facilities for improved health. The suggested process approach considers four key phases: **application and selection phase, preparation phase, execution phase and the follow-up phase.**

4 Institutional considerations

The capacity of DoH to execute projects is limited. Facilities at central and provincial are basic and offices, stores and workshops are poorly equipped. Budget allocations to Central Hydrology basically cover only salaries. This makes Central Hydrology fully dependent on external support for its operational activities. In the provinces the situation is not much different, with activities depending heavily on externally financed infrastructural development projects.

Oxfam and a number of other NGOs are supporting the Department of Hydrology by supplying several advisors for a period of two to three years. This support is provided to enable DoH to be effective as a government department with a major responsibility for water resources in the country.

For the Central Department of Hydrology to function effectively it needs to have the equipment to respond to the demand for contracted drilling in order. It further would need to formulate proposals for activities that would strengthen its resource base. This might be done in the context of the water resources management efforts in which it is proposed that

the Central DoH takes an important role as the technical secretariat to the proposed Water Resources Apportionment Board (see below).

The substantial support provided over the years by UNICEF, has allowed the CNHE to establish a well-functioning Central Water Base (CWB) in Phnom Penh. The CWB provides logistic support and technical backstopping to the water supply and sanitation programmes that UNICEF executes together with the provincial CNHE units. The cohesion in the UNICEF assisted programme is ensured through relatively clear lines of management and a bimonthly communication workshops. The programme is gradually being decentralized with more implementation capacity in place at provincial level while maintaining a substantial higher level support through the Central Water Base.

At present, responsibility for the provision and maintenance of rural water supplies rests with the government through the Ministries of Health (CNHE) and Agriculture (Department of Hydrology). Neither ministry/department has the financial resources, even if the human resources were sufficiently developed, to meet this mandate without external support. In that context the potential for private initiative in water supply development and operation and maintenance should therefore also be explored.

With the prospects for increased development assistance and a rapidly expanding private economy, coordination of water resource use is essential. The Mission is proposing that the government consider the establishment of a coordinating body - possibly called a Water Resources Apportionment Board - with Ministerial level representation. This Board would carry the responsibility to coordinate the various interests in the use of water within a political rather than technical framework.

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0. Introduction

In the past ten years UNICEF and Oxfam have been supporting water supply development in Cambodia. The interventions of both agencies were characterised by the emergency situation in the country and aimed to provide immediate relief to the affected population by the installation of handpumps on drilled wells.

Support by UNICEF and Oxfam has been administered under very trying circumstances during these years. The water points completed, offered a ray of hope to many villagers. Now that the situation in Cambodia is improving, both agencies are considering integrating complementary activities into their project implementation strategies that would ensure increased health impact.

UNICEF has worked with the Ministry of Health (MOH), while Oxfam has been a partner to various ministries and is now working together with the Department of Hydrology (DOH) within the Ministry of Agriculture. UNICEF runs two major programmes in water supply. One aimed at the provision of water and environmental sanitation in rural and sub-urban areas and another at providing similar facilities at Priority Public Institutions (PPI). Altogether UNICEF constructed and rehabilitated over 4500 wells in 14 provinces and equipped these with the INDIA Mark II handpump, the Vietnam No.6 and more recently with the "Thai" pump, a modified Dempster handpump. 90% of these pumps are reported to be functioning. Through UNICEF's Family Food Programme (FFP) another 300 shallow dug wells have been built.

Oxfam has since 1990 worked in five provinces and constructed some 430 wells. In addition over a hundred handpumps installed on (a total of 290) wells drilled in the mid-eighties were repaired. The percentage of functioning handpumps is presently not monitored. However, field visits indicate that a fair number are not working satisfactorily. In addition to its activities in the rural areas, Oxfam has since the early eighties further been working on the rehabilitation of the water supply system of the city of Phnom Penh.

Apart from UNICEF and Oxfam, there are quite a few international development or health care oriented non-government organizations (NGOs) that contribute to the development of water supply facilities in Cambodia. These agencies often work with MOH and DOH. Some of these implement there projects directly together with their counterpart organizations at provincial and district level while others collaborate with UNICEF or Oxfam to achieve their development objectives.

The situation in Cambodia over the last decade has been marked by various degrees of administrative breakdown, disruption and insecurity. Many people have at one time been displaced from their homes and sought refuge elsewhere. Uncertainty and fear among the people has made it impossible for UNICEF and Oxfam to undertake more than a token mobilization of villages for the development of improved water points.

FIGURE I

CAMBODIA

Responsibilities for repair of the handpumps have remained with the implementing agencies, with the people only very gradually taking an interest. The fact that the majority of the served rural population prefers to take drinking water from unprotected shallow wells, ponds or rivers rather than from the handpump, further compounds the issue of handpump repair.

In the last year and a half prospects for peace in Cambodia have increased considerably. On October 23, 1991, an agreement was signed between the various political factions to work towards a comprehensive political settlement. Since then, various measures have been undertaken to ensure a smooth transition to general elections in April/May 1993. Expectations are that the country will gradually return to normalcy and that an elected government will be able to play a stronger role in administering its affairs. Already now, the volume of commercial activities is on the rise and entrepreneurs are setting up new ventures both in the capital as well as in the provinces.

Increasingly developmentally oriented activities become possible even though emergency support to Khmers repatriated from the Thai border and to internally displaced persons (IDPs) will remain important for some time. Work in the provinces, in districts and communes is more and more possible and this offers opportunities for genuine participation in development by communities. Thus, for the first time in many years the prospects for self-development by community groups look favourable.

UNICEF and Oxfam have had to accept that the activities they executed in water supply development were relief oriented and, due to the situation in the country, did not allow for mobilization for construction and repair of water points or hygiene education for proper water use. This situation is now rapidly changing and so it was proposed to undertake a joint evaluation of the water supply programmes of the two agencies.

The proposal to do a joint evaluation resulted from the long-standing good operational collaboration between the two agencies and their wish to see their considerable experience reflected in recommendations and policy guidelines emanating from the evaluation exercise that would have a bearing on the development of the water sector in Cambodia. With respect to the latter the terms of reference of the evaluation requested advice on an overall framework for rural drinking water activities in Cambodia in which the UNICEF and Oxfam activities, as well as support from other organisations, could fit in and which could be managed and coordinated by the Cambodian authorities.

More specifically the evaluation mission was asked to look into the following key areas of concern:

* institutional development related to the strengthening of operational capacities and responsibilities for the water supply sector;
* technical and social measures needed to increase utilisation of water supply facilities by the community;
* planning, design and construction of water points;
* scenarios for repair and maintenance of handpumps;
* complementary activities required to increase health impact and economic benefits and the
* linkage between the support programmes for repatriates and Internally Displaced Persons (IDPs) and the present UNICEF and Oxfam programmes.

A full copy of the terms of reference of the mission is annexed as annex 1.

To study and advise on these questions an evaluation mission was fielded from June 10 to 30, 1992. UNICEF and Oxfam contracted the IRC International Water and Sanitation Centre from The Hague, The Netherlands to organize the evaluation mission.
The evaluation mission included the following persons:

- Mr. Jan Davis, water technology expert, ex-Oxfam, U.K.
- Mr. Peter Robertson, rural development expert, Australia
- Ms. Madeleen Wegelin, social scientist, IRC, Netherlands
- Mr. Han Heijnen, water development planner, IRC, Netherlands
  Teamleader

The Government of Cambodia assigned the following two resource persons to the mission:

- Dr. Chea Chhay, vice-director of CNHE, Ministry of Health
- Mr. Veng Sakhon, vice-head, water management office, DOH, Ministry of Agriculture

The missions further wishes to acknowledge the inputs of two additional resource persons:

- Mr. Bent Kjellerup, handpump development expert, Danish Cambodia Consortium, Denmark
- Mr. Bruno Lemarquis, researcher, GRET/CNEARC, France

The field programme of the mission and a list of persons met is attached as annex 2.

1 The development context in Cambodia

1.1 Introduction

Much has been written on the recent past from the Vietnam War through the "Dark Years" of Pol Pot and the subsequent legacy for Cambodians to address in rebuilding their country from 1979. External assistance since then has been limited to material (e.g. equipment, fuel, and fertiliser) and technical assistance from Vietnam and the former East Bloc countries. The latter was abruptly cut after the political and economical changes in Eastern Europe in 1990. A small number of NGOs from Europe, North America and Australia remained active throughout the eighties up to today. The United Nations system was represented through UNICEF, WFP, FAO, and ICRC which channelled emergency assistance to Cambodia from 1979 until it declared the emergency over in 1982.

In the past ten years multilateral and bilateral assistance to Cambodia has virtually been non-existent due to non-recognition of prevailing regimes by Northern ESAs, thus limiting official aid. To some extent the lack of official aid has been compensated by a strong presence of a large variety of NGOs covering emergency aid in family welfare, reconstruction, food, health, water supply, etc. Of the UN agencies only UNICEF remained on the scene and was viewed by the Cambodian authorities as a special kind of NGO. Operations of UNICEF/Cambodia were directed from Bangkok. Recently UNICEF in Phnom Penh has gained the status of independent field office.

During the 1980's NGO assistance was "emergency/restoration" in nature. Support agencies worked through central government authorities with limited contact with either provincial authorities or rural communities. By force of circumstance many NGOs took on the role of an implementing agency, rather than an agency providing support to government departments or indigenous NGOs as is often the case elsewhere. Both these points have had negative implications for NGO strategies and activities in meeting their often stated mandate to work directly with rural communities, in effect - "the poorest of the poor".

The rapidly changing geopolitical climate in the late 1980s and the subsequent liberalisation of the Cambodian economy has drastically impaired the Government's capacity to maintain its services. NGOs were approached to extend their support base to their "partner" and include financing of part or all of what were previously the Government's counterpart contributions to various project activities. For example, support for counterpart salaries either through "incentives" or "top up" needed to be negotiated and remains an important issue today.

After protracted negotiations between the various Cambodian political parties, an agreement was signed at the end of 1991 that initiated a peace process to be guided by the United Nations Transitional Authority on Cambodia (UNTAC). The process is now underway and is planned to lead to general elections by April/May 1993. The elected government will then be faced with the enormous task of rebuilding the country's infrastructure both physically as well as in personnel terms. Until that time the existing government departments at national, provincial and district level will be supported by UNDP and UNHCR, within the context of UNTAC, and assisted by aid agencies like UNICEF, Oxfam, Care, JVC, SCF and the ICRC to cope with the repatriation of some 350'000 refugees from the Thai border, some 190'000 internally displaced persons and a slightly lesser number of demobilized soldiers.

The changes of the last 12 months have had two significant impacts on ESA operations.

First of all, the prospect of peace has created increased consideration by UNICEF and NGOs of opportunities to move away from addressing immediate survival needs through "emergency" activities towards activities with a longer term "development/planning" orientation. Such a reorientation in both programmatic and management terms is complex and takes time to effect. This is further compounded by the occurrence of new emergencies caused by the urgency to resettle Internally Displaced Persons and by the floods of 1991 which placed an unexpectedly heavy burden on limited resources.

The second impact has been the increased opportunities for NGOs to work directly with Provincial and in some cases District authorities in the planning and implementation of activities. Whilst the approval to work at Provincial level and below enables NGOs to operate closer to their mandates, it has reduced the amount of contact and resources flowing through the central authorities. The impact of this is being felt presently in a number of departments including the Department of Hydrology where it appears the Government is able to provide only just sufficient funds to pay for recurrent costs (mainly salary). Few ministries have access to operational funds over and above those provided by external agencies.

1.2 Political and socio-economic context

The recent history of Cambodia has been rather traumatic with various groups holding power over a disintegrating country. The Government of the People's Republic of Kampuchea (PRK) has governed the greater area of Cambodia since 1979, while the Government of Democratic Kampuchea controlled only a small portion of Cambodian territory along the Thai border. The latter was however recognized by the United Nations as the Government of Cambodia. For several years this stalemate has led to serious outbreaks of fighting, forcing many people from their homes.

In October 1991 a peace accord was signed by the two Governments. Under the terms of the accord, each Government continues to function in its previously-held territory. A new Supreme National Council, composed of representatives of the two Governments, has been established to represent Cambodian sovereignty. Under the terms of the accord, the United Nations will also exercise authority in Cambodia until a new government is chosen as a result of elections, now expected in early 1993.

From 1979 - 1991, Cambodia was a one party state lead by the Marxist-Leninist Kampuchean People's Revolutionary Party. For most of the last 12 years, the president of the country was also the general secretary of the party, Heng Samrin. Leadership of the government has come from the politburo of the party.

In October 1991, the Kampuchean People's Revolutionary Party was renamed the Cambodian People's Party and adopted a free market, multi-party program. The new leader of the party is Chea Sim. On 14 November 1991, Prince Sihanouk returned to Cambodia to lead the Supreme National Council. On 16 November 1991, it was announced that he was now president of the State of Cambodia (SOC) as well, though Heng Samrin was also to remain president. At the time of writing, the Cambodian government is in considerable flux.

The supreme source of authority in the SOC is the National Assembly. The National Assembly chooses from among its members an eight-member Council of State which functions in lieu of the National Assembly when the latter is not in session. The Council of

Ministers is the administrative organ of the government; its membership fluctuates around 21 people, including 14 heads of ministries and 7 others with ministerial rank.

The PRK has been extremely centralized in its decision-making and policy-making and extremely decentralized in its operations. By the standards of other governments, even very small decisions are passed up to the Council of Ministers. Within the ministries, very little can occur without the direct approval of the minister or at least one of the vice ministers. There is almost no authority vested in officials below the vice-minister level. This means that the communication-information chain is very active vertically. On the other hand reports indicate very little horizontal coordination or even communication between departments.

Operations are almost without exception administered from the provincial level. The national ministries are usually limited to enunciating the broadest parameters of policies. In the social sector ministries at least, they also involve themselves in directing some of the specific programs which are financially-assisted by IOs/NGOs in ways requested by the outside organizations. However, this is rarely a regularized process, rather the staffs lurch from project to project depending on where the greatest pressure and money is coming from an IO/NGO.

There is great decentralization in operations. Most programs are administered by local authorities. Most government employees in the province for example, are employees of the provincial government rather than the national government regardless of whether they are teachers, nurses, agronomists, or policemen. Thus, agronomy offices in the provinces are run by provincial authorities, with the power to hire and fire personnel, though these offices are supposed to be implementing the policies adopted by the Ministry of Agriculture in Phnom Penh.

In reality, communications between the ministries in Phnom Penh and the provincial operating units is very, very poor, thus making any change directed from Phnom Penh hard to implement. The information flow is mostly on paper. The ministries in Phnom Penh have neither the personnel nor the vehicles to make regular trips to the provinces. Except in matters of greatest political importance to the government, most public sector activities are conducted autonomously of the national government.

In the last few years, the government has ever-decreasing amounts of resources owing to the pullout of Eastern European, Soviet, and Vietnamese aid. Government salaries have lost more than half of their already small purchasing power due to the inability of salaries to keep pace with the high inflation rate. It is unambiguously impossible for even a single person to survive on his or her government salary alone. Many people work outside jobs, or take overtime to help in family businesses. It is doubtful whether half of the workforce is actually on the job at any given time. Under the circumstances it is hard to keep enough people on the job so that absolutely essential government tasks are accomplished.

The arrival of UNTAC is likely to further fuel the inflationary pressure on the economy, making it increasingly more impossible for government civil servants to make ends meet. Trained staff will be inclined to seek jobs in UNTAC or similar agencies that can offer good salaries. A drain of staff from the public sector into the UNTAC and UNHCR related administration as well as to other development programmes and agencies is likely, thus further reducing government capacity to perform its tasks.

It is imperative to ensure that adequate administrative capacity is maintained to enable a new government to man its offices and execute its programmes properly. IOs/NGOs should

therefore be reluctant to employ additional staff over and beyond its longer term needs but rather collaborate with national and provincial government staff and encourage existing staff to improve their efforts and performance. Facilitation by external support agencies through support for more attractive working conditions and remuneration is a price that will probably has to be paid to achieve this.

1.3 Community Organization

The foundation of community organization and for communication links are the locally elected people's committees at provincial, district and commune level. The committees are responsible for implementing government policy but have considerable autonomy, particularly with respect to health, agricultural and educational services and the setting of sectoral priorities. At district and commune levels, the committees which include members responsible for health, education and agriculture determine to a large extent what information reaches village people, how it does, and the extent to which villagers participate in development activities. Apart from these government administrative links, there are the Women's Association and Youth Association which reach down to village level.

Traditionally, the village organization was based on extended family ties and cooperation within the village was within and between family clans. After Pol Pot, the villages were organized in solidarity groups (Krom Samaki) of 10-15 households each. There were three different types of Krom Samaki with a varying degree of communality. The system was established as a means of sharing scarce resources as people in the rural areas suffered shortage of labour power, draught animals and agricultural tools. Moreover, as a result of the upheaval during the Pol Pot times, villages were often inhabited by people who did not live there previously and the traditional extended families rarely existed anymore. The Krom Samaki was also meant to restore a degree of cooperation and sharing within and between communities. In 1989 the system was abandoned officially as a production unit although cooperation could continue on a private basis.

Each village now has a village chief, either elected or appointed, who constitutes the link to the administration. The current social organization of the village seems to be dependent on the people living in the village. In most villages there are achar, native ritual experts who have received extensive training and experience in Buddhist theory and practice. These old respected men may have considerable influence, although sometimes their influence does not go beyond a function in ceremonies. Since 1989, Buddhism is officially the state religion and freedom to practice is guaranteed. Thus, all villagers have access to a temple, although not each village has their own temple as yet. The Buddhist monks not only provide spiritual support to the people, but they also provide the means for people to transfer merit to their ancestors and to improve their lives in this life and the next. Usually, a school is attached to the temple and the monks are influential in development activities in the village because they have the ability to organize people for a common goal. For instance, in many temple compounds ponds, traditional wells or handpumps are located.

In addition to the achar and the monks, the traditional healers, found in every village, are respected and consulted. They form an integral part of the local communities and are familiar with the local social networks. The function of the achar, the monks and the traditional healers is all the more important because there generally seems to be a reluctance to participate in communal activities, as a result of the forced communalism of the past. People are very individualistic and there appears to be little solidarity among villagers, other than relatives, unless instigated by the monks.

As a result of the Pol Pot times and the war situation thereafter, 35% of the households in the villages are headed by women. Traditionally, women had a subordinate position in the family, either as daughters or as wives. Although they used to participate fully in the agricultural activities, ploughing was always done by the men and there was a clear division of labour.

Now, the widows have to do all agricultural work by themselves or have to hire a man to do this work for them. They either pay him in cash or do labour exchange, in which half a day ploughing has to be returned by a whole day of women's labour. This often means that the widows are able to only bring a small amount of land into cultivation. Many of the widows have young children and as a result of the breakdown of the extended families, there are often no people to look after the children when she works the land. Moreover, traditional practices for income generating activities or food preservation, as well as advice in health, hygiene and childrearing practices do not exist anymore because older female relatives do not live in the household. Although adult women outnumber adult men, their influence in the community seems to be limited as a result of the traditional views on the position of women. Their limited influence is probably further compounded also as a result of the fact that these women have limited time because they are fully occupied with agricultural activities and the responsibility to singlehandedly look after the welfare of their families.

1.4 The impact of emergency assistance on structural aid

In 1990, as a result of increased fighting in the country, the Government was faced with providing emergency support for up to 180,000 Internally Displaced Persons in seven Provinces (most in the North West of the country). Not only did this stretch the already limited financial and human resources of the Government, but it also drew the external support agencies into another emergency situation for which more often than not no additional staff resources were available to support their responses. Rather, by virtue of the 'crisis' nature of the emergency responses, activities tended to overshadow the on-going program through drawing away staff resources and/or through relocating equipment such as drilling rigs to new and sometimes unknown terrain.

On the positive side the Internally Displaced Persons activities also provided a first opportunity for NGOs and UN agencies - WFP, UNICEF, and the Bangkok based Office of the Special Representative to the Secretary General, through UNDP - to establish a joint mechanism to coordinate activities to address Internally Displaced Persons needs. With the movement towards agreement on the Peace negotiations in 1991, and the likelihood of repatriation of Khmers from camps in Thailand, it was thought that this experience could be drawn on when the larger UN presence would become a reality and repatriation was managed by UNHCR.

At present aid agencies are faced with competing demands for their experience and expertise to:

* maintain their support for Internally Displaced Persons;
* increase their involvement in the repatriation of refugees presented as a number of 'urgent' but not 'emergency' activities;
* and implement their on-going development activities.

At the same time a number of agencies are taking stock of their work of the last ten or so years and attempt to address the longer term implications for their programs, as brought on by the rapid changes of the recent past. This evaluation includes striking a balance between their own mandates and the concern to have input into the planning and possibly implementation of the large scale development activities likely to be undertaken by UN development agencies and by development banks when a new government has been elected in 1993. All this, in an environment of political uncertainty and uncontrolled, rapid expansion of the private economy through an influx of private capital and resources.

Since the arrival of UNTAC and the start of the repatriation process, support to emergency type water supply construction activities have again been high on the cards for both UNICEF and Oxfam. UNHCR has in recent months requested support in terms of surveying and implementation for the construction of quite a number of boreholes and other water supply facilities. Technical assistance staff of both agencies have been in the Battambang and Banteay Mean Chey provinces to help assess the needs for the refugee camps, for the encampments of the UNTAC forces and for resettlement. Whereas some of the work done is certainly within the planning of the agencies, the pressure under which the work has to be done in sometimes remote and relatively unknown areas, causes loss of efficiency (increasing percentage of unsuccessful boreholes, extensive movement of equipment) and, in general, drains resources away from the regular planned work.

The costs of operation are furthermore going up quite considerably in the UNTAC and UNHCR operational areas with skilled staff and construction materials shortly being at a premium. The effects this may have on the continued functioning of UNICEF and Oxfam drilling crews can only be guessed. The proposed UNDP Area Development Programmes, initially to be established in Battambang, Battam Mean Chey and Pursat Provinces, will give further rise to competition for resources required for reconstruction. For some time therefore the effects of emergency related activities will be felt strongly in some provinces and will negatively affect the long-term impact of UNICEF and Oxfam water supply development activities in those areas.

1.5 Sources of Drinking Water in Cambodia

Cambodia comprises a low lying plain with mountains to the west, an escarpment to the north and hilly plateaus to the east. The main water courses are the Mekong River and the Tonle Sap. The Tonle Sap is a large lake which acts as a great storage reservoir for the Mekong River when in flood whilst also receiving stream and river discharge from the surrounding watersheds.

The dry season lasts from November through to May. Rainfall during the wet season accounts for 85% of the annual precipitation. Annual rainfall can range from 1,000mm, in the central lowlands, to over 3,000mm in the highlands.

A variety of hydrogeological conditions exists throughout the country. Knowledge of groundwater availability is variable and further studies are required, especially in parts of the country that have seen little drilling to date. Most of the drilling has been concentrated in the low lying alluvial plains.

Main sources of domestic water include ponds, rivers, irrigation canals, wells and rainwater. Both family and village ponds are important sources of water. Ponds are dug, or re-dug, at the beginning of the wet season and are main sources of water for a variety of uses: drinking, cooking, washing and animal watering. Walkways are often provided for access away from the immediate edge of the ponds. As the dry season progresses, ponds dry out and in some cases smaller, well-like depressions are made in ponds to drain the remaining water for ease of collection.

Rainwater is an important source of water. Most ponds are recharged by direct rainfall and some runoff during the wet season. Almost every house has a method of collecting and storing rain in one way or another. A variety of roofs, gutters and containers are used to collect the valued rainfall for domestic purposes. It is now commonplace to see cement rainwater jars up to 0.5m3 capacity manufactured and sold by the roadside.

During the dry season the number of well users increase as ponds dry out. Wells can range from simple depressions in the ground, such as in the bed of drying water courses, to deeper hand dug wells with some protection from collapse. Wells are also constructed on the banks of irrigation canals. During the field visits traditional wells were observed where the lining comprised timbers set in a square to support each other. If financial circumstances allow, some traditional wells are now being lined with privately manufactured concrete rings. In some cases, private wells have been very well constructed to provide a convenient and hygienic domestic water source.

Improved hand dug well construction is being promoted by several agencies for both domestic and small scale irrigation uses. The dug wells are concrete lined and may be deepened by sinking caisson columns in some cases. Oxfam has developed the system of the improved dug well in which a small diameter borehole is drilled through the bottom of the well into the confined aquifer below.

Traditional practice in the alluvial plains has been to use a jet percussion method of drilling to reach a confined aquifer below a confining clay layer. Once tapped, water will flow under pressure up to a static water level of 2 to 6 metres. Private drillers with their own manual equipment are actively using this drilling technique.

The first organised programme of well drilling took place during 1960-63 when the USAID Rural Water Well Development Programme drilled 800 successful wells throughout the country. Many of these wells have been rehabilitated under the current UNICEF assisted drilling programme.

The UNICEF and Oxfam programmes use lightweight rotary drilling equipment from Thailand to drill boreholes of 20 - 50m deep. These so-called PAT-rigs have been developed by the UNICEF Masterdriller in collaboration with a Thai company. The lightweight rigs are also used to rehabilitate old traditional wells or construct new wells by drilling into the confined aquifer to allow water to flow under pressure into the dug section of the wells.

UNICEF supports an extensive conventional drilling programme which is now looking to expand its operations into the North-West and other areas which have until recently been inaccessible.

Water use in villages

Especially in the rainy season, several water sources are used for different purposes such as drinking, cooking, bathing, washing, for animals and gardening. A survey carried out in seven villages in Kandal and Kompong Speu in 1987 where no handpumps were provided, showed that rainwater was preferred for drinking and cooking during the rainy season. This preference was based on custom and taste and closeness to the house. The rainwater was collected from the house roofs in jars containing 80-180 litres, depending on the size. Where rainwater was not used for human consumption (27%), this was because of lack of jars or because of the vicinity of a well. Despite this preference for rainwater, most households had to rely on drinking water from other sources as well, even in the rainy season because the storage capacity was often not sufficient to bridge the time between two rainfalls.

During the rainy season, other sources used for drinking were wells (36%), ponds 9% and river water 8%. Well water was valued because of its availability, while taste, clarity and hygiene scored low as reasons. Pond water and river water were valued because of quantity and custom (including taste), while also proximity played a role. During the dry season when rainwater was not available, 57% of the households used well water for drinking followed by 31% using ponds. Where river water was available, this was used by almost all households in this season.

The UNICEF survey, carried out in 1991, gave a similar picture for the dry season. Of the more than ten thousand villages surveyed, 20% used rivers, 20% used ponds and 60% used wells as major source of drinking water during the dry season. For the rainy season the surveys give a different picture as in this survey only 11% reported to have rainwater as a major source of drinking water, while wells were quoted by 51%, ponds by 18% and river water by 20%. Most of the wells were open dug wells not lined with clay or concrete rings, but consisting of a hole in the ground.

2 Agency programmes

The following description of the UNICEF and Oxfam rural water supply programs is based on documentation available to the Mission and discussions with staff of each agency.

2.1 Oxfam

2.1.1 Past activities

Oxfam has been involved in the provision of drinking water for both rural and urban communities since 1980. Working initially in Takeo province with the Ministry of Health some 40 wells were constructed up to 1983. In 1984 the program expanded to Svey Rieng and later Prey Veng, through the Ministry of Transport and Communications, Department of Roads and Bridges. The urban program focused on supporting the upgrading and operation of the Municipality of Phnom Penh's water works and a one off project in 1985 to repair the water tower and distribution system in Svay Rieng town.

Oxfam and UNICEF have had an agreement through the 1980's to coordinate the provision of rural water supplies, with UNICEF (through the Ministry of Health) covering provinces west of the Mekong River and Oxfam east of the Mekong. In 1989 as a result of concerns with the operational effectiveness of the Ministry of Transport and Communication, Oxfam sought to change its counterpart ministry in the rural water supply program. After protracted negotiations, the Council of Ministers agreed that Oxfam should work with the Ministry of Agriculture, Department of Hydrology. It appears that after this change the agreement to divide responsibilities by the Mekong River no longer prevailed.
At this time the Council of Ministers also considered centralising rural water supply activities. Whilst it was apparently agreed in principle that some kind of central water board/authority should be established it was not considered feasible at the time. It was decided to maintain two separate programs in the Ministries of Health - through the National Centre of Hygiene and Epidemiology (CNHE) - and Agriculture - through the Department of Hydrology.

Throughout this period the Oxfam program has been project based: that is a number of specific project activities with a central, provincial or emergency focus. Oxfam has taken advantage of the opportunity to work directly with Provincial authorities by shifting its project base to the Provincial Hydrology Section within the Provincial Agricultural Service in Prey Veng/Svay Rieng and Battambang/Banteay Mean Chey. The latter project is being initiated in response to the perceived needs of the Internally Displaced Persons but does also include the provision of water points to the local population.

Oxfam's once extensive centrally-based activities are now limited to the central store at Tuk La and its involvement in the Department of Hydrology Management Support Program, a joint agency program to provide institutional support to the DOH through the provision of expatriate technical personnel based in the Department. Oxfam is providing the Rural Water Supply Specialist (already in Cambodia), and negotiating with Community Aid Abroad/Freedom From Hunger in Australia, to finance the Irrigation O&M Engineer position.

2.1.2 Strategies for the future

After over a decade in Cambodia and as a part of Oxfam UK's program to develop strategic plans for all of their country programs, Oxfam Cambodia embarked on a strategic planning exercise for the 1992-1995 period. This exercise was completed last April and appears to be the first attempt by Oxfam Cambodia to develop a strategic plan drawing together their projects into a program context.
The Strategic Plan 1992-1995 whilst still in draft form, identifies the aim of Oxfam's program to *help create the conditions with which the poor can meet their basic needs.*

This will be achieved through four components:

i. **Communication**
to communicate about the situation in Cambodia in general and about Oxfam's activities specifically; information for advocacy, development education and public relations activities for an audience primarily outside of Cambodia;

ii. **Institution Building**
to develop and support local institutions, both governmental and non-governmental;

iii. **Supportive/Funding Activities**
to fund activities of other organisations, both governmental and non-governmental active in the field of Oxfam's priorities;

iv. **Operational Activities**
to undertake activities that create some of the basic conditions for the poor to improve their situation.

Rural Water Supply activities are explicitly stated aspects of iii) and iv) above, and implicitly with regard to ii) - Oxfam's employment of the Rural Drinking Water Advisor as a member of the Central Department of Hydrology Management Support Program is an example of the latter. Oxfam's financial support for AICF's[1] rural water activities in Siem Reap province are within component iii), whilst their own rural water activities fall within component iv).

At central level the Rural Water Supply focus is through the Department of Hydrology Management Support Program. The Rural Drinking Water Advisor is one of eleven advisors with different skills in water resource management proposed to work in the Department of Hydrology.

The Job description as specified in the Program design document identifies the following tasks:
. review existing government policies and programs in developing rural water supply and formulate approaches and procedures in developing a centralised data bank on RWS;

[1] AICF, Action International Contre la Faim, a french NGO working together with DoH and Oxfam in Siem Reap Province.

- assist government in formulating an overall program delineating the roles of various ministries and levels of government hierarchy;
- review existing policies and practices in O&M of completed RWS projects;
- develop O&M manuals taking into consideration the roles of Central, Provincial and District authorities and community involvement;
- review existing feedback mechanisms from field to central and recommend improvements;

As noted above this position was conceived as being based in the central DOH offices working within the government structure to improve the overall effectiveness of service activities. As will be explained in section 5, there is a bit of a prioritization issue at stake in this set-up. Each of the participating NGOs have their own projects running in parallel, which are the primary source of operational funds for government (at provincial level). It is obvious that the primary interest of the NGOs is also with the proper implementation of these projects. But as the NGOs have committed themselves to the very necessary support to national level capacity building for water, NGOs need to be clear on the amount of time the advisors spend on activities specific to the agency employing them in addition to their broader responsibilities with the DOH. The experience with Oxfam at this moment seems to indicate that the Oxfam advisor to DOH has spent less than 50% of his time on DOH work.

The centrally located position of the Rural Drinking Water Advisor links into the Provincial/ District activities in Prey Veng/Svay Rieng and Battambang/ Banteay Mean Chey of Oxfam, as well as those of other ESA's. How this linkage occurs in Oxfam's case is not clear from the Draft Strategic Plan and is an area Oxfam needs to address given the ongoing technical and management requirements of their own rural water supply activities with Provincial Departments of Hydrology.

The Strategic Plan outlines a change in approach to rural water activities through the addition of a Water User education component. The technical support activities through Provincial Hydrology in Prey Veng/Svay Rieng and Battambang/Banteay Mean Chey will continue at least for the next *one to two years.*
The technical activities in Battambang/Banteay Mean Chey aim to *improve the living conditions of the poorest by improving their health situation* by *providing clean, accessible, sufficient sustainable water to target groups* in four districts in Battambang and five districts of Banteay Mean Chey with a total of 540 wells over the three years to 1995.

In Battambang four drilling teams and two hand dug well teams will be working along with a maintenance team. In Banteay Mean Chay four drilling teams (two Dando and two rotary teams) and two hand dug well teams are proposed. It appears that maintenance will be the responsibility of these teams as well. The team members are drawn from Provincial Hydrology staff with salaries supplemented by Oxfam.

In Prey Veng/Svay Rieng it is proposed to construct a total of 480 wells (240 in each province) and two ponds in Svay Rieng. In Prey Veng activities will be undertaken by one drilling team, three hand dug well teams, and one maintenance team in six districts (22 communes and an unspecified number (but probably about 200) of villages). In Svay Rieng the same combination of teams will work in four districts constructing and maintaining wells in 35 communes and 225 villages.

In both provincial projects Oxfam will provide training, technical assistance, materials and operational support to the Provincial Department of Hydrology, as well as strengthen procedures and administration . There is also passing reference to the provision of credit

which would have the potential to both stimulate alternative support options and influence sustainability.

The potential regarding provision of credit facilities to establish water points and regarding the privatisation of service delivery could usefully be further explored particularly in the context of the proposed Water Use Education component.

The most significant element is the proposal to *enlarge ... the programme with a Water Use Education component, focusing on social organisation to improve management and maintenance capacity of villagers and promote hygienic use of clean water.* The component aims to *improve the health situation of rural people in four provinces* by ensuring that *Provincial Hydrology water supply facilities are sustainable - long term functioning with daily care and management taken care of by communities concerned.* The intended effect is an *impact on health by provision of improved drinking water facilities ... strengthened by improved water use practices by the villagers to reduce water borne diseases [such] as diarrhoea, worm infestation, skin infections and insect borne diseases.*

It is proposed that Water User Education will be working at the provincial level with both Hydrology and Health staff in 12 districts, 44 communes and 220 water committees over the four provinces. A staff of four educationalists, and four each from Provincial Hydrology and Health will implement activities - training staff and commune/village level extension agents on both facility maintenance and water use; establishing village water committees; and developing commune/village based water user education programs.

Water User Education appears to have two key aspects: O&M of water facilities with the users taking primary responsibility; and water use education which has a health bias. Both provincial Hydrology and Health personnel are proposed to be involved which given that two different ministries are involved will require clear agreements on responsibilities and operational procedures (at least at provincial or district level). In the context of historical difficulties in achieving effective inter- (and intra-) ministerial coordination this aspect of the Water User Education component could have a critical bearing on its overall effectiveness and sustainability.

Within Oxfam there is also a need to address the relationship between the Education and Technical aspects of the rural water supply program. Although water user education is mentioned as an 'intended effect' in the Prey Veng/Svay Rieng project logframe, it appears from the logframes of both provincial projects that there is a separation rather than integration of technical and water user education activities on a 'project' basis. As the two are interdependent, for sustainable management of water resources in a village this apparent separation may need to be reconsidered.

It is understood that the Strategic Plan is a process toward developing a comprehensive program statement to guide Oxfam activities in Cambodia over the next three years. It has clearly been an important and timely development. The issues raised in the course of this evaluation, along with comments from Oxford House will be incorporated in the next series of discussions on the Strategic Plan to refine individual project activities within a program framework.

2.2 UNICEF

2.2.1 Past activities

In 1979 UNICEF established an emergency program to provide drinking water. From 1983 to 1985 UNICEF focused on the repair and installation of water systems for selected public institutions - hospitals, schools, orphanages, teacher training colleges, etc. In 1985 UNICEF, through the National Centre of Hygiene and Epidemiology (CNHE) of the Ministry of Health, established a rural water supply program in seven districts of Kandal and Kompong Speu provinces and the Municipality of Phnom Penh, aiming to provide water to 700 villages through both drilling new wells and rehabilitating existing ones. From the outset India Mark II pumps were installed (86% of all pumps installed). Bangladesh no. 6 handpumps, and a small number of locally produced pumps have been installed as well. From 1986 on the program gradually expanded to other provinces - Kampot, Takeo, Kompong Chhnang - with the acquisition of additional drilling rigs. By the end of 1987 two mechanical rigs and two manual drilling teams had provided water to 300 villages. Additional information on UNICEF's past activities can be found in annex 3.

The Central Water Base (CWB) - workshop, stores, laboratory and offices - was established in February 1987 in Phnom Penh as the operational centre of the program. Although UNICEF works directly with Provincial Health Service Centres the program is considered to be centrally-based out of the MOH/CNHE, and thus not under the direct control of the Provincial Health authorities. This is a significant operational difference between the activities of UNICEF and Oxfam.

In 1988 a pilot sanitation program involving the construction and installation of latrine slabs in the Municipality of Phnom Penh, in Kandal and in Kompong Speu was developed in cooperation with UNICEF's Health Education unit. Due to staff constraints in both UNICEF and the CNHE the programme never managed to get beyond the pilot stage. A new Sanitation Project Officer has been recently appointed to attend to environmental sanitation matters in line with UNICEF WATSAN strategies for the period 1992-1994.

In response to the emergency situation brought about by the Internally Displaced Persons, UNICEF reoriented its program in 1990 to drill wells in Kompong Speu and later in the North West provinces of Battambang and Banteay Mean Chey.

UNICEF has engaged in human resource development and institution building within the CNHE and the CWB. In an emergency situation such activities can only be very limited and geared towards direct impact. In the last year, however, these aspects have gained in importance and effect, not in the least because of the increased communication and information exchange capacity created by the bi-monthly Meeting of Representatives (from 16 provinces and the Central Water Base). More information on these human resource development and institution building issues can be found in section 5. As with other agencies, UNICEF recently received requests to supplement government salaries with 'incentives', and to improve the employment situation of so-called 'floating' staff - staff assigned to the CWB from the Ministry of Health without permanent status and supported by UNICEF.

2.2.2 Strategies for the future

The 1992 Project Plan of Action for Water Supply and Environmental Sanitation outlines the activities for the 1992 year in the context of UNICEF's sector policy objective:

> *to reduce the incidence of diarrhoeal diseases and parasitic infections to children by providing convenient and universal access to safe drinking water facilities (20 litre per person per day [lpd] with a total maximum distance of 500 metre from the user's dwelling) integrated with improved environmental sanitation (appropriate and convenient arrangements for the safe disposal of human and other wastes) and the promotion of personal and food hygiene in rural and peri-urban areas.*

Improvement of living standards of the population and institutional capacity building are further mentioned as important elements of the strategy. Consistent with previous planning documents, two projects are identified:

i) Water and Environmental Sanitation in Rural and Sub-urban areas (WATSAN)

> *aiming within the UNICEF country program cycle to provide year-round clean and safe water for about one million beneficiaries in rural areas in 11 provinces and improve sanitary facilities and hygiene practices for about 100,000 inhabitants;*

ii) Water, Environmental Sanitation and Hygiene in Priority Public Institutions (PPI)

> *aiming within the same period to provide year-round clean and safe water for about 1,200 priority public institutions in rural and sub-urban areas and improve sanitary facilities and hygiene practices.*

The WATSAN output and activity schedule goes beyond the water facility construction activities - the first three outputs listed in the workplan - to identify a broad range of thirteen other outputs which support the institutional capacity and management needs of a complex and expanding program. However, whilst the documentation identifies appropriate activities to support institutional strengthening, UNICEF staff resource constraints and the historical focus on technical solutions to the problems at hand, appear to be limiting factors in achieving the various outputs.

In May 1992 the 1992 Project Plan of Action for Water Supply and Environmental Sanitation was followed by a Master Plan of Operations 1992-1994 for UNICEF/Cambodia in which the focus of the Water Supply and Sanitation program was reviewed. The original emphasis of the 1992 Project Plan of Action reflected the emergency orientation of UNICEF's past activities, which in the changed conditions in Cambodia did not respond to a development orientation which was considered to be the opportunity for the future. The Master Plan of Operations outlines that the new Rural Water Supply and Sanitation Programme will concentrate on two areas of development concern:

i) Rural Water Supply;

ii) Environmental Sanitation and Health Education;

The Rural Water Supply project includes the provision of safe water to the rural population including returners, displaced persons and public institutions (a total of 2,400 wells in 1992; 3,300 in 1993 and 4,100 in 1994). Figure 2 overleaf gives an overview of past and planned UNICEF drilling activities. Staff training in well drilling, development and maintenance techniques is also planned.

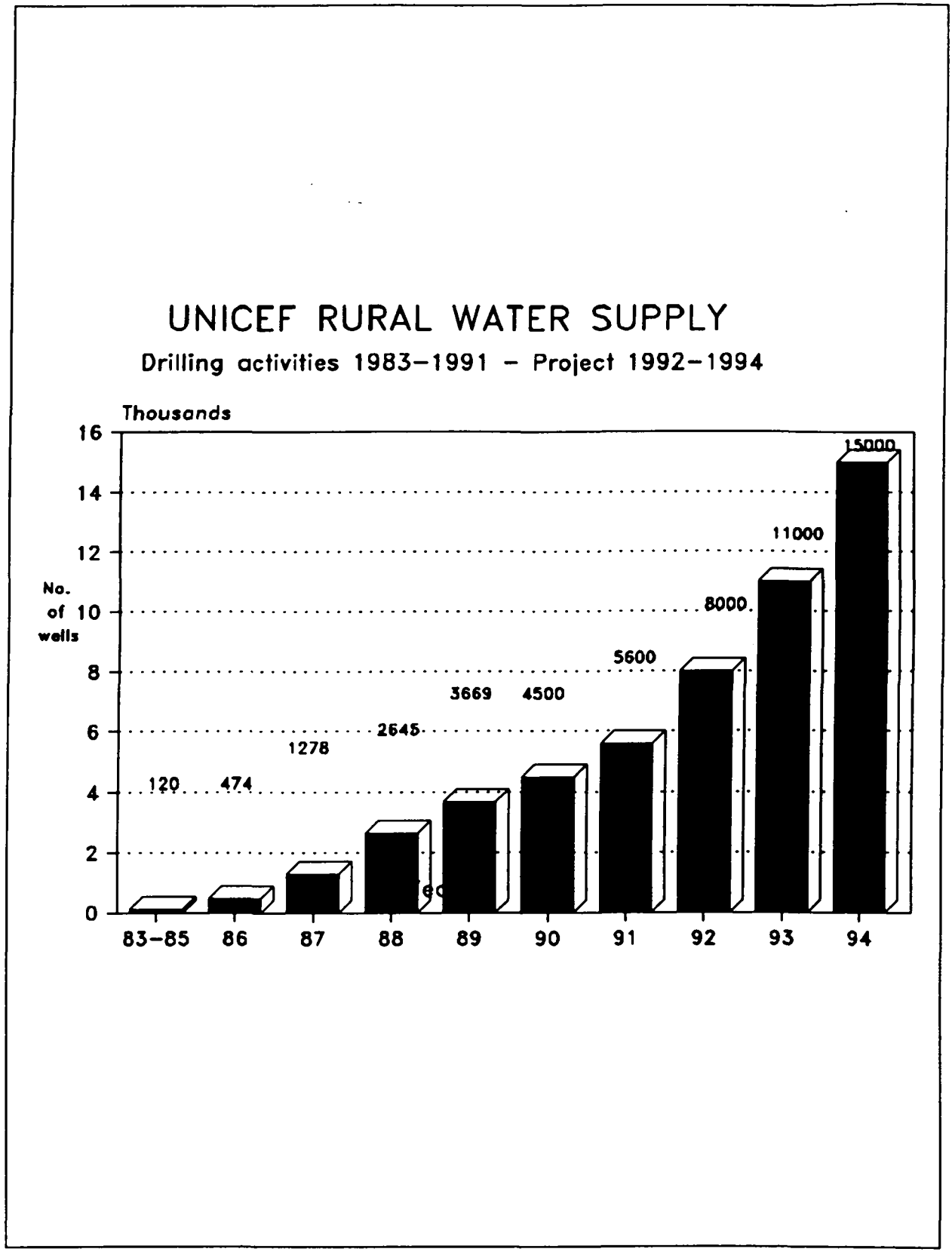
A national monitoring unit will be established based on UNICEF's Water and Sanitation Monitoring System (WASAMS). On the basis of a country-wide survey by staff of the Ministry of Health, UNICEF was able to compile the first statistics on the WATSAN situation. The returns on the country-wide survey did not to seem too reliable in all categories (latrinization and use of latrines, hand washing practices, etc.) but over the years a better picture could be had of the actual situation with regard to especially environmental sanitation. Part of the data have been used to compile the first set of WASAMS statistics contributed to the Global Joint UNICEF/WHO Monitoring Programme. A copy of part of these statistics is included in annex 3. It is further proposed to decentralise project activities to five provinces in 1992, eleven in 1993 and all others in 1994. Coordination between the inputs of various governmental agencies, external support agencies (ESAs) and NGOs, will be achieved through the establishment of Provincial Water Supply and Sanitation Committees chaired by the Provincial Governor. Similar committees already function effectively in Battambang and Banteay Mean Chey.

The sanitation facilities and hygiene education aspects of the original WATSAN programme are transferred to the Environmental Sanitation and Health Education project, which has less emphasis on the production of sanitation facilities and more on education. The Environmental Sanitation and Health Education project is primarily an awareness raising project aimed at reducing the use of surface water for drinking from 40 to 25%, increasing latrine use by 10%, and equipping public institutions with water and sanitation facilities. Strong linkages between this project and other sectoral programs in UNICEF like Women in Development, Family Food Production (FFP) and Education are foreseen.
In the Family Food Production project of the Women in Development/ Household Food Security Program *the development of the rural water supply constitutes one of the major activities .... being a critical element in vegetable and fruit tree gardening...* Water jars, ponds (through food for work schemes), and wells (approximately 1,000 traditional wells per year) are all techniques identified to provide water in the FFP project.

To provide a solid foundation for sustainability beyond the life of UNICEF support the mutually reinforcing effect of the sectoral programmes within the overall UNICEF programme should be realized through increased coordination within UNICEF/Cambodia. The recent appointment of a programme coordinator and a monitoring officer are indications of UNICEF's concern to emphasize such coordination for optimum impact in the health and well being of children and their families.

With respect to either the WATSAN Project Plan of Action for 1992 or the Master Plan it is not clear how the various programs within UNICEF will interact operationally. **It is essential that this effective coordination of activities and staff resources is established as there is considerable opportunity for complementarity**, particularly in developing health/hygiene education in villages and supporting the institutional capacity of the Ministry of Health and CNHE to more effectively deliver services to rural households.

FIGURE 2


UNICEF RURAL WATER SUPPLY
Drilling activities 1983–1991 – Project 1992–1994
Thousands
No. of wells
16
14
12
10
8
6
4
2
0
120
474
1278
2645
3669
4500
5600
8000
11000
15000
83–85
86
87
88
89
90
91
92
93
94

2.3 Activities by NGOs

2.3.1 Groupe de Recherche et d'Echanges Technologiques (GRET)

Since 1989 GRET has been working in Prey Veng province with the agronomy department of the Ministry of Agriculture. They have been involved in the development of large diameter wells for small scale irrigation, although the wells are also used for domestic water supplies. Several different approaches to well construction have been developed. These include the method employed by Oxfam in Prey Veng of a dug/drilled well combination. In addition, wells have been successfully dug without the need to drill where the recharge from the upper aquifer has been sufficient. The approach GRET usually takes is to dig the well first, before drilling.

A method of sinking a column of concrete rings, caissoning, has also been developed using a cutting ring. This has enabled a smaller diameter column of concrete rings to be sunk - in situ - inside the first larger diameter well lining. The sinking of the smaller diameter column into the water table may be sufficient to supply the quantity of water required. If not, drilling into the confined aquifer can still be carried out. The diameter of wells range from 1.35m to 1.80 m.

A method of manual drilling has been developed based on traditional practices. This has involved experimentation with different drill bits, or 'cutters', and the development of a manually operated pump to circulate the drilling water. The cost of the locally developed equipment is about $250.

GRET have a programme of well construction in Prey Veng. Teams are trained and are leased equipment for the work. After about 20 boreholes have been drilled, each team can then keep the equipment. In effect, they have been paid $12.50 per borehole. This approach continues to increase the number of trained drillers. Supervision of the work is carried out by department of agronomy staff as part of their everyday work. They are paid $10 per completed well.

By June 1992, 110 wells had been completed in Prey Veng. In addition, there are 18 completed wells in the provinces of Kandal, Kompong Speu and the municipality of Phnom Penh. Funding for the GRET programme comes partially from UNICEF.

An important part of GRET's work has been the running of training seminars for participants from other organisations. In 1991, 2 seminars were held for members of GRET, AICF, PADEK[2], MCC and Oxfam. Three further seminars have been held in 1992 in Prey Veng and Kandal with participants coming from other provinces. Seminars have lasted from 3 - 4 weeks for 25 to 35 participants. Participants have come from: UNICEF, MCC, Family Food Programme, ARC (American Refugee Committee), FHI (Food for Hunger International), Dept. of Hydrology in Prey Veng, AICF, GOAL, World Vision, Redd Barnna, PADEK and ICRC.

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[2] PADEK - Partnership for Development in Kampuchea: active in community-based water supply within the municipality of Phnom Penh and supporting the construction of village wells in Prey Veng Province;
MCC - Mennonite Central Committee: active in small scale water development for irrigation and water management in Kandal and Prey Veng Provinces.

GRET training seminars planned for the future are to be held in: November/December 1992; January 1993; February/March 1993. Note that the cover of this report has been taken from the cover of the GRET training manual on the construction of hand dug wells.

2.3.2 Action Internationale Contre la Faim (AICF)

AICF (part funded by Oxfam) is working with the department of hydrology on a programme of dug/drilled wells in Takeo province. The construction method is similar to that used by GRET and Oxfam in Prey Veng. However, due to the uncertain geology, rock is often encountered, and drilling is carried out before the dug section of the well is excavated. Department of hydrology staff sponsored by AICF have attended GRET training seminars on well construction techniques.

Unlike the GRET and Oxfam wells, the AICF supported wells are completed with a reinforced concrete cover. A No.6 type handpump is installed on each well. A covered access hole is provided for when the handpump cannot be repaired and water can then be drawn by bucket and rope.

By June 1992, AICF had completed 32 wells in Takeo province.

Under a similar arrangement to that in Takeo, AICF is being funded by Oxfam for a programme of well drilling, using a PAT rig, with the department of hydrology in Siem Reap. However, to date there have been several problems, the main problem being the unfavourable hydrogeological conditions. As a result, up to June 1992, only 10 out of 35 wells have been successful. Several other problems have been encountered concerning logistics (the supply of equipment and materials from Phnom Penh) and the lack of an adequate compressor to fully develop the successful boreholes.

The programme is now considering the construction of dug/drilled wells, similar to the AICF Takeo programme. In cases where the yield of the borehole alone would give an insufficient supply, it is expected that the dug section of the well would provide enough storage for the installation of a handpump. Another proposal they are to follow up is the construction of traditional, concrete lined wells in areas where the surface aquifer is able to provide a sufficient yield.

2.3.3 Other NGOs

24 Hours Television is a Japan based charity raising funds through a popular television programme. It has gradually entered the water supply field and has financed construction wells though the provision of drilling equipment and expertise in Kandal Stung District through the Department of Hydrology. The **Lutheran World Services** (LWS), the **Japan International Volunteer Center** (JVC), **Cooperation International pour le Développement et la Solidarité** (CIDSE) and several other NGOs have been active in the water sector by providing equipment or technical expertise.

More information on the activities of the various NGOs and UN agencies in this field in Cambodia can be obtained from the publication "Humanitarian Assistance in Cambodia, 1991/2". Mailing address: CCC/PNH, P.O.Box 2420, Bangkok 10500, Thailand; office address 3 Boulevard Keo Mony, Khan Chamcar Mon, Phnom Penh, Cambodia, at a cost of US$ 10.

3 Water Supply Activities by Oxfam and UNICEF

3.1 The Oxfam Water Supply Programme

3.1.1 Introduction

Oxfam's rural water supply programme began in 1980 through collaboration with the Ministry of Health. Boreholes were drilled in Takeo Province using a Japanese Tone drilling rig and by the end of 1983, 40 wells had been drilled. From 1984 the programme was implemented through the Department of Roads and Bridges, Ministry of Communications, and the rig moved to Svay Rieng Province. A second drilling rig (Hydreq) was provided by Oxfam in 1985 for an expanded programme of drilling in the provinces of Svay Rieng and Prey Veng.

In 1986 the programme was temporarily interrupted due to problems over fuel. Drilling recommenced in 1987 in Svay Rieng, Prey Veng, Kandal and the municipality of Phnom Penh.

In 1988, Oxfam began collaborating with the Department of Hydrology in the Ministry of Agriculture and eventually transferred all their water activities to this department from the Department of Roads & Bridges. According to the records now kept with the Central Department of Hydrology, the total number of successful boreholes drilled through collaboration between Oxfam and the Department of Roads and Bridges were:

Province	No.of Boreholes
Prey Veng	176
Svay Rieng	185
Kandal	21
Takeo	30
Phnom Penh	10
Total	422

The capital intensive drilling programme appears to have dominated Oxfam's rural water supply activities until the Tone drilling rig was handed over to the Central Department of Hydrology and the Hydreq rig to UNICEF, where it has been used for spare parts to supply their own Hydreq rig, since 1989.

With the Tone drilling rig, the Central Department of Hydrology has been able to complement their other drilling activities supported by Lutheran World Service and JVC. The Oxfam supported drilling accounts for about 80 of the 296 wells drilled up to the end of 1991 by Central Hydrology. The Tone "202" rig is now broken down and needs essential spare parts for repair.

There are many references in past Oxfam reports to the value of developing a programme component for hand dug wells to complement the drilling programme. However, for a variety of reasons, attention continued to be concentrated on drilling. Reference was made in the 1988 evaluation of Oxfam's programme in Kampuchea to the lack of a proper rural water supply policy which led to the excessive use of drilling rigs in areas where it would have been more appropriate to improve existing, or dig new, hand dug wells.

After the handover of the drilling rigs, Oxfam eventually concentrated on the development of a dug/drilled wells programme in Svay Rieng and Prey Veng provinces.

3.1.2 **Prey Veng & Svay Rieng programme**

In May 1990, Oxfam began working through the provincial Department of Hydrology in Prey Veng and Svay Rieng provinces.

The Oxfam programme follows a traditional approach to the development of groundwater in the two provinces. The lowland alluvial soils are suitable for the drilling of a small diameter borehole by a lightweight rotary drilling machine. The borehole can be drilled to over 50m, in some cases, to gain access to an aquifer below a confining clay layer. The aquifer is sub-artesian and the water level will rise to a static level of between 2 and 6 metres.

A 1 metre diameter well is then hand dug around the cased borehole to a depth of 8 - 10 metres. The well is lined with concrete rings, plugged in the bottom with concrete, and the borehole casing cut to allow the artesian flow of water into the lined well. (see also figure 3 on page 25)

The well is completed with a headwall, apron, and drainage and left open. The shaduf method of drawing water has been tried on some of the wells.

Within each province the programme concentrates in specific districts.

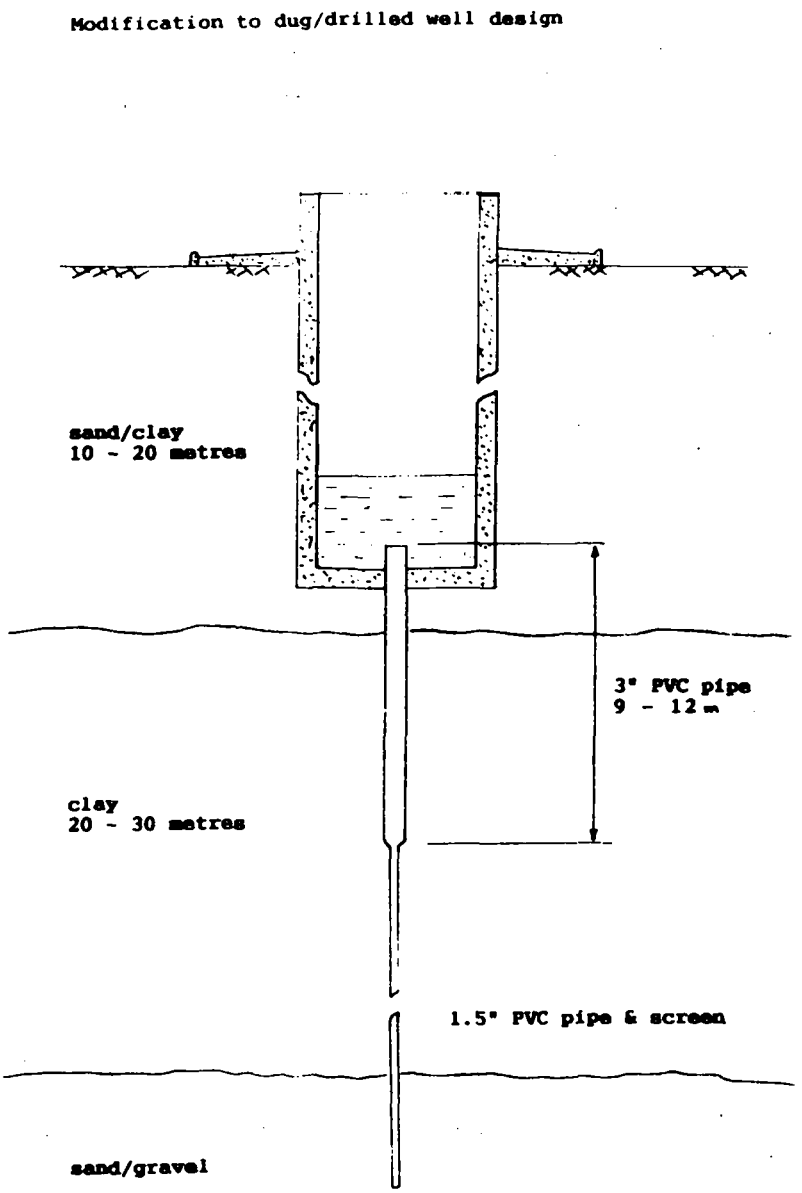
In 1990/91 a total of 75 wells in 4 districts were completed.
In 1991/92 a total of 147 wells in 4 districts were completed.

Oxfam has supplied all the equipment, tools and cement required for well construction and has trained staff for well drilling and construction work. The villagers assist in the supply of sand and gravel, site preparation and the provision of unskilled labour for drilling, digging and lining.

In addition to new well construction, the programme supports the maintenance of India MkII handpumps installed on the boreholes drilled by Oxfam and the Department of Roads & Bridges, under the previous well drilling programme. Handpump maintenance is supported by the provision of spare parts, tools and the financial support of a maintenance team in each province.

The design for the dug/drilled well is very effective at the moment. However, it is to be expected that in later years private irrigation will take place using drilled wells penetrating into the confined aquifer and equipped with motorized pumps. It is at this moment unclear what the chances are that this will happen and to what extent the Ministry of Agriculture, or for that matter, the Department of Hydrology will be able to uncontrolled abstraction.

FIGURE 3



Anyway, the experience from other countries shows that such developments are near unavoidable. The consequence will be that the water level achieved under quasi-artesian pressure will gradually lower and wells might fall dry.
This development will not take place overnight but might occur over the next few years. At that time, however, people may have developed a preference for a handpump. If such a scenario is foreseen, it may be helpful to introduce a 3" PVC pipe already now in the standard design to accommodate the installation of a handpump to a deeper level (15 - 30 m). This small design change is indicated in figure 3.
If incorporated, this design change does raise the cost of the well somewhat but also increases the useful life span of the well.

3.1.3 **Battambang & Bantey Mean Chey Programme**

Oxfam began working with the provincial departments of hydrology in Battambang from August 1990 and in Bantey Mean Chey from April 1991. The aim was to support the Department of Hydrology to implement a programme of dug and drilled wells in the provinces. The situation in the North-West meant the programme initially responded to the needs of internally displaced people (IDPs) who had been displaced within the country due to the continuing civil war. The establishment of a stable programme of well construction for settled communities has inevitably been affected by the response to the IDPs and the repatriation of refugees from Thailand.

Battambang Provincial Programme

The first activities in Battambang were to supply water to the IDP camps. The Tone drilling rig from Central Hydrology drilled 20 boreholes before returning to Phnom Penh. In January 1991 the first PAT lightweight rig arrived. Training commenced and in Battambang now there are three drilling groups, one hand dug well team and a construction team.

There are 3 PAT rigs but one of the rigs is out of action requiring repair. It was said, by the DoH, to have drilled about 141 boreholes. In addition to the 3 working PAT rigs, there is also the Eureka Port-a-Rig which has just been introduced by Oxfam.

The hand dug well team was said to be inactive due to a lack of transport. It was reported by the vice-head, provincial hydrology, Mr.Ieng Ian, that people were not keen to dig a hand dug well unless there was an exceptional water problem. There was a plan for 40 hand dug wells this year but so far only 4 have been completed plus one more to be finished. This was partly due to the difficulty of finding water. The feeling of Hydrology staff was that hand dug wells were not a realistic option in much of Battambang province although one specific area, An Loung Roun commune, was said to be suitable for hand dug wells.

The early part of the programme was also concerned with the improvement of basic facilities alongside the training of staff in rotary drilling and hand dug well techniques. Stores, a workshop and offices were built and equipped in Battambang.

Bantey Mean Chey Provincial Programme

Work began in Bantey Mean Chey in April 1991, again supplying water to IDP camps. This activity is now largely complete and the plan is to concentrate on the provision of water for settled communities although it is evident that work is being carried out for public and government institutions as well.

A store has been built just outside Sisophon, the provincial town of Bantey Mean Chey. There is also a workshop and offices but these are not yet complete.

The vice-head of provincial hydrology in Bantey Mean Chey, Mr. Heng Siv, explained the provincial plan covered 5 districts. The plan is agreed between the Governor, provincial hydrology and Oxfam. The Governor is particularly interested in the improvement of water

supplies in this province and has made personal visits to communes that have made requests for a well.

Drilling equipment includes two PAT rigs and one Dando 150 trailer mounted percussion rig. Currently, Oxfam/DoH is also operating another Dando 150 rig which is on temporary loan from UNICEF.

The work for IDPs was completed last year (50 wells). Wells have also been drilled for repatriation sites and for public institutions such as hospitals, schools and pagodas. The declared plan is to concentrate now on supplying settled communities on the basis of 20 households per well. However, it appears that if UNHCR, an NGO (Concern was given as an example) or the Governor request a borehole, then the DoH will respond and drill.

3.2 The UNICEF Water Development Programme

UNICEF support to the water and sanitation programme started in earnest just after the emergency phase of assistance in 1983 with the drilling of 10 wells and the installation of 28 pumps in the new and existing boreholes during that year. The programme in 1983-1984 initially concentrated in providing water supply and sanitation facilities to key priority institutions such as primary schools, orphanages, teacher training centres, health centres, district hospitals, pre-schools and day-care centres. Since 1985 works with the National Centre of Hygiene and Epidemiology (CNHE) of the Ministry of Health.

In 1986, the programme shifted to providing clean water and sanitation facilities to communities in several provinces located beyond the reach of public water supply distribution networks which were mostly in the capital towns. To support this shift effectively, a Central Water Base (CWB) was completed in Phnom Penh in 1987. The CWB included office space, warehouse for drilling and well construction supplies and materials, soil testing laboratory, maintenance workshop for drilling and transport equipment, class-room and meeting-room, facilities for water analysis and hydrogeological mapping.

In 1990, the programme began to move from a predominantly supply-oriented form of assistance to that of cooperation with provincial offices of CNHE. Training for managerial and organizational components of the UNICEF/CNHE programme became more important. The 1991 plan of action included a gradual expansion of the UNICEF assistance to 11 provinces.

3.2.1 Drilling

Drilling operations utilising the conventional drilling rigs operate out of the Central Water Base. These operations are termed 'mechanical drilling' by UNICEF Cambodia. This designation is used to distinguish between the larger scale, more capital intensive, drilling, and the smaller scale drilling utilising the locally developed PAT Rotadrill machine. The PAT rigs are manufactured in Thailand and have been developed with UNICEF assistance for the conditions found locally in Cambodia. Drilling operations using the PAT rigs are termed 'manual drilling' by UNICEF. This should not be confused with the more accurately termed manual drilling effected by the manual turning of drill pipe and auger in which water, or drilling fluid, is circulated by a manual, or motor, driven pump. This technique is used by private drillers and promoted in the GRET dug/drilled well programme.

PAT 'manual drilling' is carried out by drilling teams established within the Ministry of Health at Provincial level. They operate out of the Health Service Centres in, currently, 11 provinces.

Drilling achievements

The past UNICEF/MoH drilling achievements have been impressive, especially considering the Cambodian circumstances. Achievements based on UNICEF figures for the period up to March 1992 are given in the table overleaf.

By March 1992, over 4,500 pumps had been installed on drilled boreholes, rehabilitated boreholes and larger diameter wells. The impact of developing the PAT rig has been significant in increasing drilling capacity. By training teams and deploying PAT rigs in 11 provinces the 'manual' drilling teams now drill the majority of wells. There are also three PAT rigs assigned to the Central Water Base, Phnom Penh.

Boreholes drilled by 'mechanical rigs':	3754
Thereof the number dry/abandoned:	613
Successful 'mechanically drilled' wells:	3141
Mechanical drilling success rate:	84%

Boreholes drilled by manual PAT rigs:	1346
Thereof the number dry/abandoned:	162
Successful 'manually drilled' wells:	1184
Mechanical drilling success rate:	88%

In addition to new boreholes, previously drilled boreholes have also been rehabilitated where possible.

Borehole rehabilitation attempts:	204
Thereof successfully rehabilitated:	185
Rehabilitation success rate:	91%

The figures for May 1992 indicate the cumulative number of wells drilled so far in 1992:
- 370 wells were drilled by 'mechanical' drilling;
- 451 wells by 'manual' drilling.

UNICEF estimate they now have a theoretical drilling capacity of around 2,400 wells per year (approximate coverage: 7% of the population each year). This estimate is based on previous performance which takes into account the wet season drilling rate being 70% of the dry season rate. The figures up to May 1992 suggest that 2,400 wells may be an over estimate although a diversion of drilling equipment to the 'emergency' programme and UNTAC sites will have disrupted any consistent plans.

4 Issues in Water Development and Utilization

4.1 Social Considerations

4.1.1 Project identification process

In Battambang and Bantey Mean Chey provinces, sites for new water sources are selected through the provincial water committees. These committees consist of members of the provincial administration and officials representing the interests of Health, Agriculture, Hydrology, Education, displaced people and repatriated refugees (where applicable). The agencies operating in the water sector indicate to the provincial committee how many wells they can help to provide. The provincial committee divides the number of wells according to government organisation or district who, in turn, decide on the specific villages. This system seems to work well and makes good use of available (external) resources. It would be advisable to also institute a similar selection process in other provinces. Presently the Provincial Health Services and DoH decide on their own on the basis of requests received. These requests are usually not coming from the villages themselves but from government officials at various levels.

The first time the villagers hear that they are going to be provided with a new well is a few days before the drilling team actually arrives. Although this approach was maybe understandable during the 'emergency' years, there is an urgent need to change this if greater utilization of pumps for drinking water is expected and if the community is expected to be involved in operation and maintenance. Because an assessment of the real need for an additional water supply is not carried out and discussed with the villagers, they may continue to use their traditional sources as long as these supply water.

The decision on the location of the pump is usually done by either the village head, or the drilling team or by these two together. We did not find any village where meetings seemed to have taken place within the community at large to consider the location of the pumps. This will not only have affected the sense of ownership of the pump, but may well have had an impact on the use of the pump. In rural communities a strong link exists between the spirit world and the villager's environment. This may imply that a well site chosen without prior consultation of the traditional healers, achar or monks is located in a place that is not auspicious, resulting in non-use of the facility.

> *Rural villagers believe that crucial supernatural forces inhabit certain places around the village. On particular days of the week they should not walk in particular directions from their home. They may be unable to go to the latrines or to the clean water supply on those occasions. The health education remains ineffective because in the mind of the villager the water/latrine has been located in the "wrong" and forbidden place. Since it is believed that violation of a cultural taboo will lead to illness, it is a contradiction for the person to follow health education advice that allegedly reduces illness. (Maurice Eisenbruch, 1990)*

Technical staff are now mainly concerned with drilling the wells as quickly as possible. If communities are to take care of their pumps and are supposed to use them properly, then a

greater involvement of the community from site selection to the final completion of an installation needs to be assured. To achieve that, technical staff at all levels require a more open attitude to community involvement. Training of technical staff in approaches for community participation will be an important input at both the central and provincial levels in the future.

4.1.2 Utilization of water from pumps and drilled wells

The period of field work of the evaluation mission in June coincided with the beginning of the rainy season. This meant that availability of surface water sources was still limited. To a large extent ponds had run dry and also shallow wells did not have much water. Therefore, the hand pumps were heavily used for all purposes and served a large population. However, where alternative water sources were available, these sources were preferred for drinking purpose. Generally, the pump water was not liked for its taste and taste proved to be the main determinant in the choice on the water source for drinking. In some places, the pump water had indeed an iron taste, but also where this was not the case, people preferred the 'sweeter' surface water.

In a village in Takeo province, the pump was located in the middle of the village and about 50 families were using the water. The distance to the furthest house was less than 100 meter. However, for drinking water they walked about 150 meters to a traditional well, which consisted of a sump in which two rings had been put to keep the water in. The water was very muddy. The women that were interviewed said they only used pump water for drinking if they were too lazy to go to the well!!

This was by no means an exceptional case and distance or convenience did not seem to be factors which would directly induce people to use the pump water for drinking. **Health considerations were never mentioned as a factor in deciding the source of drinking water.** To the contrary, sometimes it was said that pump water made your stomach ache. Drinking water from the well or pond was kept in a jar and some people used alum to clear the water or let it stand for a day before drinking, to let it clear. If people had no alternative but to drink the pump water, they often let it stand for a night to improve the taste and sometimes boiled it for the same reason.

Where hand dug wells were constructed, well water was used for drinking because the taste was considered more acceptable. But even here, it seemed that pond water was preferred for its taste. Open wells were considered to be better in taste than closed wells and in Takeo, this was a reason not to cement the cover on the well but to leave cracks open for ventilation.

In Northeast Thailand, which is in many respects quite similar to Cambodia, field investigations regarding rural water supply showed the same trends. Here it was also found that normally villagers would not use water from drilled wells for drinking and cooking because of the taste. They preferred the sweeter taste of surface water or water from open dug wells. Moreover, some wells were preferred above others because of their taste. For other purposes, people were found to choose the water source which was closest to their houses, irrespective of whether this was a drilled well or a surface water source. However, when a drilled well was yielding water with an iron smell, the well was not used.

In the rainy season, people prefer to drink rainwater and in most villages households have jars to collect rainwater. Where roofs are made of tiles or iron sheets, the rainwater is led to the jar by placing an iron sheet under the roof above the jar. Most houses however, have a thatched roof, and only some of them have an iron sheet under the eave to collect the rainwater. The rest did not have a special provision and this made rainwater collection less effective.

About half of the jars observed, were covered, often with a wooden cover. When it rained the cover was taken off. Only when the household had more than one jar, the jar was regularly cleaned, usually by just rinsing with water, but the use of straw was also mentioned. Rainwater seemed to be used mainly for human consumption and not very much for bathing and washing because the storage capacity was not large enough.

Pump water was used for bathing. It is liked because of its cleanliness and abundancy. Usually, people bathed at the pump, not only because it reduced the need for carrying the water to the house, but also because they liked the apron to stand on. If people carried the water to their house for bathing, this was more done for reasons of congestion than for privacy. Open wells were preferred for bathing above pumps as it made it possible for several persons to bathe at the same time, at least where buckets with ropes were used. It was not possible to determine the extent of use of pump/well water for bathing in the rainy season, but it was indicated that distance was a decisive criterion for selection of water source.

The use of pump water for laundry depended to a large extent on the iron content of the water. Where this was high, people did not use the water as it stained their clothes. Where this was not the case, the pumps were very much liked, specifically because of the apron, which provided a clean space for washing. Laundry was always done by the women at the pump. With hand dug wells, the situation was slightly different because the apron provides less space for washing and, so, the women wash their clothes nearby. The extent to which people used the pump/well water also in the rainy season for washing was difficult to establish, but seemed to be determined by similar factors as mentioned in connection with water for bathing.

4.1.3 Design

All UNICEF drilled wells and boreholes were fitted with a handpump and had no possibility of drawing water by hand. Initially, Oxfam did the same, but in Svay Rieng and Prey Veng, the system was changed to the provision of open wells and in Takeo, AICF (funded by Oxfam) was providing wells with a slab, with a pump fitted onto it and also an opening for drawing water by hand.

The problem with the fitting of handpumps over boreholes as seen from the users, was that they did not like the taste of the water when it had not been in contact with the air. This might have something to do with dissolved iron in the water. When aerated, the iron is oxidized and settles out, leaving a tastier water. Moreover, in case of breakdown of the pump they could not draw water by any other means. The combination of hand dug well with a borehole was found to improve the taste, especially if the slab was not fully sealed and air could come in. If an opening was also provided for drawing with a bucket, the problem of inaccessibility at breakdown was solved as well. In Takeo, it was found that in principle the system of having both options was acceptable. A decision, however, had to be

made whether the opening should be sealed and only opened when the pump breaks down or should always be accessible. The latter has the possible consequence that the cover is not always placed back and carries the risk of the well becoming contaminated.

The pumps fitted on the handdug wells and the rehabilitated old wells were the Vietnam no. 6 type suction pumps. These pumps have the advantage that they are easy to repair and can be repaired by a trained caretaker. At the same time, the disadvantage is that they are breaking down more regularly.

In Takeo province, the district health officer suggested that people preferred handdug wells with the possibility of taking off the slab and he showed us a rehabilitated well which had this system. The well was located on the temple grounds and used by many people living in villages surrounding the temple. Young boys came on bikes to collect the water for use at home. The caretaker showed how they were able to put the slab aside if the pump had to be repaired. He also showed us how he maintained the pump.

AICF in Takeo, at first constructed open wells, but later covered these because they found that the wells became polluted mainly by children throwing dirt in the wells and through unhygienic use of the buckets. Although people said that they did tell the children not to throw anything in the well and to keep it clean, community control was obviously not very strong. This was maybe also due to the fact that the wells were sometimes located away from the houses in order to ensure equitable access for all villagers. When wells are located near a house, supervision is much easier. In addition, the height of the well head was rather low, which made it easy to throw things in. The problem of polluting the well with dirty buckets, or soiled ropes, can to some extent be solved by having a shadoof or a pulley and rope system.

UNICEF provides handpumps with either a long handle or (since 1992) a T-bar. People preferred the long handle because it was easier to operate. They could make long strokes and only needed one arm for pumping. For children the long handle was also easy to operate because they could hold the handle at a place which best suited their height. The T-bar was not liked everywhere because it was heavier to operate and people made only short strokes with it. They had to use both hands and for children the T on the T-bar was often too high. So they were jumping up and down when pumping or had to put a stone to stand on. It seems justified to evaluate whether the T-bar handle is really a good option or whether the long handle used earlier is more appreciated by children and women. Alternatively, the adjustable handle bar used on the Afridev pump may offer an option for good balancing of stroke and pump rods.

The design of the apron is very important as it determines to a large extent the use of the pump/well. The aprons constructed with the handpumps were large enough to be used for bathing and washing. In a way this enhanced use, but at the same time it increased the risk of dirty water seeping back into the well leading to contamination of the water. Drainage channels were often not very long causing the surroundings of the well to become muddy due to lack of proper drainage. A lot of aprons did not have a gentle slope to drain the water away from the pump discharge point towards the drainage channel and so the water remained standing on the slab, turning green and muddy. As the land is after quite flat it is difficult to drain the water away. It might help if the apron at the well head is raised by a foot or so to improve drainage away from the well. This will also improve drainage through the drainage channel.

None of the wells or pumps had a separate concreted space for bathing and washing, although we saw this at a privately constructed well. So far, none of the pumps or wells had a drainage channel for use in a vegetable plot or an animal drinking trough. We were told that this was done in the UNICEF supported Family Food Programme wells and worked very well.

4.1.4 Operation and maintenance

Where pumps or wells were located near houses, somebody from the household living nearest was usually considered responsible for keeping the slab clean and chasing children away when they were playing with the pump. Often the person doing this, was a woman. They had never been trained, nor had they received special instructions or were made formally responsible. Furthermore, none of the villages visited had a village water committee. Often, the head of the village was deemed to be also responsible for the pump. But this did not imply that he would or could carry out this task. Most probably this was to a large extent due to the fact that no activities were undertaken by either the Central Water Base (UNICEF) or the Department of Hydrology (Oxfam) in community mobilization for planning, design or hygiene education. The need to have somebody responsible for the pump or well was never adequately discussed in the villages and people were never formally selected for this task. Therefore, maintenance was often dependent on the ability and willingness of a person to carry out this task, be it a village head or somebody else.

In a village in Takeo, two pumps were found broken. One pump was located in the yard of the district chief and he was considered responsible to organize the repair. The pump had been broken for two weeks, but the district chief did not live in the village and in his absence nobody dared to contact the maintenance team. Only, when he returned, the maintenance team was called.
The other pump was located in front of the health post, which was no longer being used. Nobody was responsible for the pump, but it was said to have been used by at least 50 families, coming from distances up to a kilometre. The pump had broken down once earlier and was repaired for 3000 Riel (US$ 3.-). This money was collected from a number of families. Now the repair was said to be 7000 Riel (US$ 7.-) and nobody was able or willing to collect the funds for repair. Consequently, water was fetched from a well at the temple more than a kilometre away or from sumps in the field.

This case shows a number of important issues. First of all, the need for the pump water was apparently not felt to such an extent that 50 families could be organized to pay for the repair. Secondly, in the absence of a clear division of responsibilities, it was not possible to mobilize the user community to pay. Thirdly, the fact that the district maintenance team was relatively easy to contact, made it possible to get an estimate for the repair before the work was carried out. The latter obviously reflects positively on the district level O&M team in Takeo.

In the case of the No. 6 suction pumps installed by AICF in Takeo, one person in the community, usually the head of the village was instructed in repair and was given a tool kit. For all Oxfam and UNICEF pumps, the provincial (or district) maintenance teams of Hydrology and Provincial/District Health Service were responsible for the maintenance. Officially, this service was free of cost, but people usually had to pay for spare parts, for transport or for both. In case of breakdown, the main problem seemed to be to contact the maintenance teams. In case of UNICEF, people knew they had to go to the district health

service, but in case of Oxfam, people were often not sufficiently instructed where to go. Because the maintenance teams were either difficult to reach, took a long time to come or charged too much, people preferred to call a repairmen living near. This could be either bicycle repairmen or another technician. In Takeo, the district health services had organized a district maintenance crew, which seemed to work very well.

Where the handpumps were not located near a house, the issue of responsibility for keeping the slab clean, repairing the pump and contacting the maintenance team was even more distinct. Equal access for all users was found to be detrimental to the maintenance of the pumps if this meant that the pump was located in the field or on the roadside. On the other hand, location within the yard of a household made responsibility clear, but could also have a negative effect on accessibility.

In one village near Kompong Chnnang,on the main road to Phnom Penh, we found the handpump chained with a lock. The owner of the premises had decided that supervision was easier when the pump was only used when he was home. But it meant that at all other times the villagers could not draw water and always had to request that the lock be removed if they wanted to use the pump. Obviously, the public pump had been turned into a private pump.

In Banteay Mean Chey, the problem of selecting a caretaker was discussed with the governor. He felt that not necessarily the village head had to be responsible, but that the social structure of the village first had to be taken into account. A person should be selected who was acceptable to the whole village. Only such a person would be able to organize the users for either maintenance tasks or payment for repairs.

4.1.5 Water collection and storage

Water seemed to be mainly collected by children or women. Usually it was hand carried in two buckets with the help of a yoke, but also single buckets were used. If the pump or well was located some distance away, bicycles were used and two buckets attached to the rear of the bicycle. To prevent water from spilling out, leaves were put on top of the water. People seemed to have their own buckets, but in the '87 survey it was mentioned that buckets and yokes were sometimes shared between families. None of the wells we saw had a bucket specifically for drawing water, and the use of a shadoof with a bucket attached was only seen once. This meant that drawing water from the well with a bucket which had been standing on the ground was almost certainly polluting the well water. No efforts seemed to have been taken to prevent this pollution. Experience in Sri Lanka has shown that as a result of hygiene education and agreement among the users of an open well, it is possible to have one or two buckets hanging on the well head, to be used exclusively for drawing water. Such an arrangement would minimize unnecessary pollution (Heijnen pers. comment).

The water collected from the pumps or wells was usually kept in a large jar standing outside, next to or under the house. These jars were covered in about half the cases. Water was drawn from the jars with a bowl without a handle. Thus contamination by hands while taking water was also taking place. Water for cooking and drinking was often kept in a small jar or pot inside the house. Again from here the water was taken with a bowl without a handle. Because the water for drinking and cooking generally came from unsafe sources, the additional pollution was probably insignificant. Even safe water drawn from the pump,

improved well or rain water most probably gets contaminated before it is drunk due to unhygienic storage and handling. Only rarely water was boiled before drinking and if it was boiled this was done to improve the taste of the pump water and not to improve the quality of well, pond or river water.

The storage jars were said to be cleaned regularly when they were empty. The problem with the big jars for collection of rain water, was that when only one jar was available, it would rarely be completely empty for cleaning. The jars which did not have a cover were seen to contain many mosquito larvae and even many jars which were covered had larvae, be it to a lesser extent.

4.1.6 Conclusions for sustainability and impact of improvements in water supply.

The foregoing shows that the appreciation for an improved water supply in many case is assumed by the outside agency rather than that it is real. No doubt there is a demand for water supply services in many communities but most probably this demand is mainly based upon the need to have a dependable source of water supply during the dry season. In the present approach, the village leader is at best asked whether his village needs a new well/pump. Because of the fact that community contribution for this new well is not very large (provision of food and drink to the drilling team and sometimes sand and gravel), most village leaders will reply in the affirmative without even consulting the community. It could not be assessed during the mission to what extent villagers are able to contribute financially, but a discussion on ability and willingness to contribute should take place at village level if only to assess the extent to which a new source is indeed needed. If communities are going to be expected to sustain the facilities provided, this discussion is even more important because without involvement in planning, it is unlikely that people will contribute to maintenance. A broad range of factors can influence the willingness of communities to contribute in one way or another (see annex 7).

The UNICEF programme has the objective to improve health through the provision of drinking water; the Oxfam programme aims to improve living conditions by improving health through the provision of water. In both cases, it is assumed that the new water sources are used for drinking. The results of the field visits show that this is generally not the case. If health improvement is to be achieved, a far broader approach to water supply delivery is required. To start with, emphasis should be placed on finding out the conditions under which people will start using the drinking water facilities for drinking. This may imply that technical options other than drilled wells with handpumps have to be considered (as Oxfam has already started to do). Upgrading of traditional wells, rainwater catchment, boreholes with hand dug wells are just a few possible options. A number of basic factors have to be taken into account when assessing possible options, such as the availability and preference of rainwater for drinking during more than half of the year. This preference means that the chance that people will get accustomed to the taste of bore-well water is small. Taste as main determinant of choice of source for drinking water is probably very hard to change, which will narrow down possible options as it is unlikely that people will start drinking water that tastes of iron or salt. A discussion with the villagers is needed every time to come to the best possible solution for that particular village. This not only applies to the choice of technology, but also to the design of the facility, including the apron and possible separate bathing/washing slab. In addition, water user/hygiene education is necessary to ensure that clean water remains clean until it is consumed. Because of the fact that women are the main handlers of water and are also often the head of household, special attention should be given to facilitate the involvement of women in decision making.

The fact that women headed households are disadvantaged in respect of the provision of labour should get extra attention when requiring community labour contributions.

A discussion on the location of the facility is needed not only to assure that the site is well selected, but also to assure that a caretaker is formally appointed and able to keep a watch over the use and upkeep of the facility. Apart from this person, a pump committee may be needed for carrying out routine maintenance and small repairs and to have the responsibility to contact the maintenance teams and collect funds for repairs. It should be kept in mind that the monks, achar and traditional healers could be involved with benefit, not only to help determine the right location, but also because only they seem to have the ability to motivate villagers for communal activities, such as selection and functioning of a water committee.

Thus, if improvement of water supply is to be sustainable and leading to health benefits, an integrated package of technical, social and hygiene education inputs will be necessary. Software services such as the provision of information, training, hygiene education and facilitation for decision making by the community should be included in the standard procedures. To ascertain that at every stage all necessary steps have been completed before continuing to the next stage, it is important to develop yardsticks by which to monitor progress. Time should not be a yardstick as some villages may need more time than others. The pace of the process should be defined by the villagers themselves and not dictated by the programme. Giving the villagers enough time to internalize the received information, to reflect, to discuss, to reach a consensus and to mobilize required resources is very important. It is also important to keep in mind that the agricultural and religious calendar will influence the timing of construction activities. During certain times of the year people have less time to devote time to planning, preparation and execution. This means that requests, assessment and final selection may need to be timed such that sufficient lead time is incorporated for social preparation and construction.

4.2 Process approach for the development of a water supply programme

In the following section, suggestions are given for a process approach for a water supply development programme that could lead to sustainability and continued utilization of water supply facilities for improved health. The suggested process approach considers four key phases: **application and selection phase, preparation phase, execution phase and the follow-up phase.**

PHASE I: APPLICATION AND SELECTION PHASE

Goal: Selection of villages to be included in the programme

Ideally, requests for assistance in water improvements in the village should come from the village itself. However, this requires that the villagers are aware of the possibility to apply for assistance and are informed of conditions and responsibilities. A procedure should be developed through which the villages can request assistance. As it is now, the people's committee, consisting of representatives from the Health, Agriculture and Education sector more or less determine the selection of villages to be included. The village request and

selection of the people's committee should be matched and followed by an assessment of the village. This assessment should include:

- what water sources are presently available and for what purpose are they used, both in dry and wet season;
- to what extent can existing water supply, including rainwater catchment, be improved;
- how many and what type of villagers are interested in an additional water supply;
- to what extent are they willing to participate in the well construction and management (time, money, labour, responsibility);
- is there a social structure geared towards a communal type of provision;
- are water borne diseases a frequent occurrence in the village.

Because it will not always be possible to carry out all requests for assistance for all areas which have been identified by the administration, it will be necessary to develop criteria for prioritization of requests. Apart from factors covered in the assessment, these criteria could include an area-wise approach: that is an concentration within a district or within a cluster of villages at the time.

At the end of this phase, a preliminary selection of the villages for the programme should be made, so as to have an overview per district.

PHASE II: PREPARATION PHASE

Goal: Planning and design of a water supply system which is adapted to the needs of the villagers and which they will be able to operate and maintain themselves.

Community meetings have to be organized at such a time that both men and women can attend and whereby both men and women are encouraged to participate in the discussion. In view of their importance, efforts should be made to ask the monks, achar and traditional healers to also participate in these meetings. In the first meeting(s) the following issues have to be discussed:

- possible locations of the well/pump
- different design options
- advantages and disadvantages of the different design options
- financial implications of the different options
- community contribution in form of labour/materials/funds/food
- the need to select a caretaker or water committee
- tasks and responsibilities of the caretaker/water committee
- the construction of additional facilities such as washing slabs
- the relationship between health and water quality

After the meeting, the community should be given the opportunity to discuss all issues at length among themselves, specifically to ensure that the indirect influence of women can be enhanced by giving formal decision makers (mostly men) enough time for proper feedback and consultation. The villagers should be encouraged to draw maps of the village with possible locations for the pump/well and start the process of selecting a caretaker and/or water committee. In view of the fact that women are the household water managers, it is imperative that the caretaker is a woman or that the caretaker responsibilities are shared between a man and a woman. In case a water committee is selected, women have to be part

of this committee. Further community meetings are needed to discuss the outcome of the deliberations after the first meetings. The identification and prioritization of possible sites is done by the technical expert, the caretaker/water committee, the monk/traditional healer and the village head. When all decisions are made and funds have possibly been collected, a workplan for implementation can be made. This plan should take into account that certain days may be more auspicious than others according to local belief.

PHASE III: EXECUTION PHASE

Goal: Joint execution of the planned activities. Construction of water supply facilities, development of a workplan for water use education/hygiene education, training of caretaker/water committee.

At the time of construction, initial sessions should be held to develop a programme for water user education/hygiene education based on local conditions.

An excellent example of such a hygiene education programme is prepared by Mayling Simposon-Hebert in 'Hygiene Education Strategies for Region I for the Ministry of Public Health in Thailand', WASH Field Report No. 210, April 1987. In many aspects conditions in rural Thailand are comparable to those in Cambodia and the model suggested in this document could very well be adapted to suit the conditions in Cambodian villages. In this model, several people already working in the village are asked to give a few hygiene education messages to specific target groups. No one person is responsible for all messages or for all target groups. Rather, the responsibility is divided among a team of village hygiene educators. These include the midwife, the sanitarian, village sanitation craftsmen, village health volunteers and communicators, schoolteachers, monks, community development agents and agricultural extension agents. In Cambodian villages not all of these categories can be found, but it should be possible to include the traditional midwife, the district midwife, the traditional healer, the achar, the monks, the caretaker and the teacher. This group could be assisted by the district health nurse, the commune health nurse or the person from the Women's Association.

For the topics to be covered in the water user education/hygiene education, priorities have to be set together with the villagers, depending on the local conditions. These could include:

- sources of water for different uses
- location of bathing and washing activities
- water and sanitation related diseases and their transmission
- upkeep of sources of water
- water collection
- water storage
- water drinking
- water use
- food handling
- excreta disposal
- waste water disposal

These sessions have to be held regularly and a monitoring system developed to assess the impact of the sessions. Preferably the monitoring system should be such that the caretaker/water committee can carry out the monitoring themselves. For examples of

monitoring forms see 'Just stir gently - The way to mix hygiene education with water supply and sanitation', TP 29. IRC, 1991, or 'Participatory monitoring and evaluation: handbook for training field workers', FAO, Bangkok, 1988.

In addition, training for the caretaker/pump committee should take place at the time of construction. In this training, the following issues have to be covered:

- regular preventive maintenance
- site upkeep
- control on user practices
- simple repairs
- service system for major repairs
- fund collection for maintenance
- monitoring system

PHASE IV: FOLLOW UP

Goal: Support to ensure effective utilization of new facilities and sustainable operation and maintenance.

The workplan for water user education/hygiene education which was developed during the previous phase, should be executed during this phase. Care should be taken that the momentum gained during the construction activities is not lost. It is therefore recommended that education activities take place frequently during the first few weeks and continue over the first year. Before the selection of villages starts for the next year, an assessment based on monitoring reports should be made to see whether education activities should continue for another year and on what scale.

Apart from monitoring the results of the water user/hygiene education activities, monitoring should be done for the functioning of the facilities, covering reliability / quantity/quality and operation and maintenance activities. This includes the performance of the caretaker/water committee and the maintenance support provided either by the government (health service centre or provincial hydrology) or the private sector.

STAFFING AND HUMAN RESOURCE DEVELOPMENT

The supervisors of the technical teams which are now carrying out the drilling and well construction have to be trained to take on a role as communicator in the community participation process. This technician/communicator has to be present during the preliminary survey of the villages and during the consequent community meetings where he has to explain the technical details, the options and the cost involved. Because so far the technical teams are located at provincial level, work can only take place in one or two districts at a time. The technician / communicator also has to train the caretaker in basic operation and maintenance and to inform on procedures to be followed for those maintenance/repair services, which cannot be carried out by the caretaker. Apart from these technician / communicators from either Provincial Hydrology or Provincial Health (Health Service Centre), hygiene educators/community workers have to be selected at district level. Because the health system is firmly established at district level, the selection of a female health worker seems to be the most logical. However, the social communicator could also be

recruited from the educational system (schoolteacher), district agricultural services (agricultural extension worker) or the Women's Association at district level. In districts where community development activities are already being carried out, such as Family Food Programme, it would be best to make use of systems which are already established, to avoid duplication of efforts.

If possible, social workers at commune level should also be involved in the water user/hygiene education programmes. The female social communicators also have to be trained, not only in communication skills and subjects of water user training, but also in the technical aspects of wells/pump construction and different design options. It is recommended that in each province a female social worker/hygiene educator is stationed to carry out the training (provincial, district and commune level staff and village hygiene educators), to find appropriate training materials (flip charts etc. already existing), to assist in the development and implementation of the programme and to set up a monitoring system. A very useful document for the development of a programme is written by Mayling Simpson-Hebert and May Yacoob (1987)[3].

TIMING

In the wet season, construction activities, apart from drilling, are stopped for a period of four months. This period should be used to do the activities mentioned in Phase I and II. The assessment of villages to be selected for implementation over the next dry period should preferably be carried out before the rainy season or at the latest in June. Apart from starting community activities in new villages to be covered, in this period monitoring of villages covered in the previous dry season should take place and repeat training for pump caretakers/committees. Also an assessment has to be made of the need to continue water user education over the next year for the villages covered in the previous dry season. The monitoring may lead to an adaption of the programme (technical or social) for the next year. An example of a mobilization and construction cycle in use in the UNICEF/Helvetas programme in Pokhara, Nepal (during 1980-1988)[4] is given below.

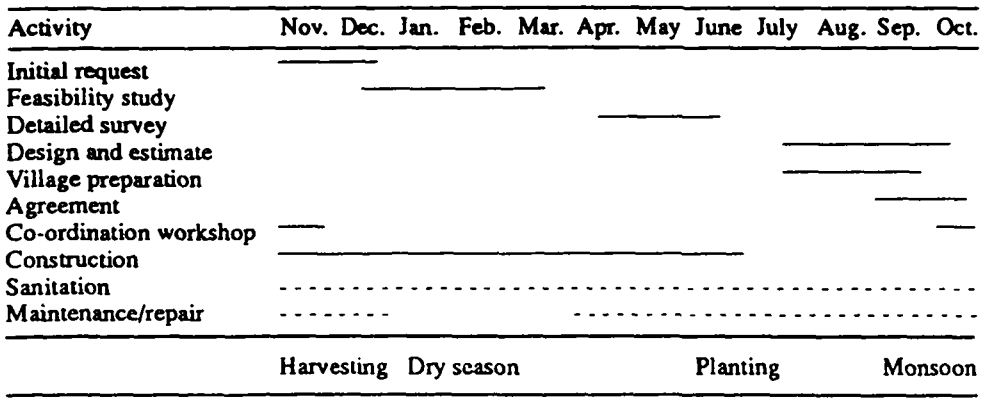


Figure 7: Annual sequence of CWSS programme activities

[3] Guidelines for Designing a Hygiene Education Program in Water Supply and Sanitation for Regional/District Level Personnel. WASH Field Report No. 218.

[4] Ten Years of Experience. TP 26. IRC/UNICEF/Helvetas

4.3 Sanitation

The UNICEF water and sanitation coverage survey '91 indicated a latrine coverage of 13% in the rural areas. While defecation at the edge of the yard was practised by 27%, 58 % used the open field and 2% the river banks. The '86 water and sanitation coverage survey in seven villages found similar percentages.

Because people have the habit of burying their faeces or simply covering the faeces with soil, no faeces was seen lying in the villages which were visited. A specific check in one village in Takeo confirmed that also the fields surrounding the village were free of visible human faeces although in one spot human defecation could be smelt. The faeces of children is also buried by the parents. The absence of latrines did not seem to be a problem for the villagers and motivation for having a latrine was consequently not very high. The latrines which we saw were almost all unsanitary and formed more of a health risk than not having a latrine at all and burying faeces in the fields surrounding the villages.

The '86 survey indicated that adults usually used leaves for anal cleaning (76%) whereas young children predominantly used water (98%). UNICEF started promotion of latrines in Kompong Chhnang by providing latrine slabs to those villagers interested in a latrine. This resulted in 55 latrines constructed in a model village in the province. The latrines were of a reasonable quality.

The quality of the latrine slabs produced in the casting yard in the premises of the provincial health office left much to be desired. The finish was not smooth and therefore the slabs are not easy to keep clean. Many slabs in the construction yard had cracks. It should have been possible to cast a tight fitting lid in the slab at the time of construction, but this had not been done. Consequently, in the latrines which were seen just bamboo leaves were used as a lid. These kept the flies out, but did not prevent smell. People threw ash in the pit against the smell. Upon inquiry, some villagers told us they would have preferred a water seal pan, but they were not inclined to pay more than 20.000 Riel (US$ 20.-) for a latrine. The fact that almost all latrines seen during the mission were pour-flush latrines indicated that this type might well be preferred above the dry type of latrines. The extent to which solid materials are used for anal cleansing would have to be checked again as these materials would very soon clog the water seal. Only when water is used for anal cleansing is a water-seal viable.

In view of the fact that there are so many other priorities for development and because environmental conditions in the villages do not pose a health risk as a result of defecation practices, it seems that for the time being the need for an active sanitation programmes is not indicated. However, the water use education/hygiene education carried out as part of the water supply programme should include a discussion on types of latrines, methods to construct latrines and the health risks connected to unsanitary latrines.

To familiarize people with latrines and to provide a possibility of constructing one, it may be possible to have in each district a cement ring producer who also is able to produce latrine slabs and water-seal pans. In exchange for a mould, the manufacturer may be willing to have one or two demonstration latrines in his yard so that people can see what is available.

UNICEF so far has concentrated on dry latrines with the free provision of latrine slabs to interested communities. However, where sanitary latrine parts are being produced privately,

these are all water-seal latrines. Thus, it may be useful to explore the (commercial) potential for pour-flush water-seal latrines. In this context it is also note worthy to mention that most of the refugees and internally displaced persons will already have been using pour-flush latrines in the camps they were residing. Some may have got used to it already and may consider it the preferred way for defecation. The recent appointment of a WATSAN Environmental Health officer may well offer an opportunity to check the potential for pour-flush water-seal latrines further.

4.4 Technical considerations

4.4.1 Traditional options

Rainwater Harvesting

Rainwater harvesting is practised throughout Cambodia. Rainwater is commonly collected from household roofs. When a house is improved the number of water collection jars increases significantly. Storage of rainwater is usually increased by the purchase of more cement water jars. Rainwater is obviously valued. As an alternative source of drinking water to more polluted sources, such as ponds and traditional wells, there appears to be the potential for the further development of rainwater catchment systems for domestic use.

At the present time, however, there seems to be little activity directed towards the development of improved rainwater catchment systems in Cambodia, although it is mentioned by UNICEF in its annual plan as a development option. Given that the quality of drinking water is still a major concern, it is suggested that the agencies involved in the water sector consider the options open for the development of simple roof catchment systems.

The main type of storage currently used are the cement water jars. In Cambodia they cost between $3 and $8 depending on size. They are constructed around wooden formwork and plastered using a strong cement/sand mortar. There is a limit to the size of cement water jars using this method. The design is suitable up to 0.5m3, without reinforcement. In Thailand wire reinforced tanks up to 2m3 have been constructed. About 10 million jars in the size 1-2 m3 were made during the 1980s. The article on rain water harvesting presented in annex 5 quotes a 1992 price of US$ 40.- for a 2m3 tank.

It is possible to construct larger household tanks from wire reinforced concrete and ferrocement. These technologies are not common in Cambodia.

The Thai rainwater jar programme is an example of a successful programme in the region which is said to have had a major impact on potable water supplies, especially in north-eastern Thailand. It is no doubt true that the social , technical and economic conditions of Thailand are different than those in Cambodia, but all the same the concept and approach of this programme may carry several useful lessons to be learnt which will be of relevance to Cambodia.

It is suggested that contacts could be established with agencies and institutions in Thailand who have been involved in the implementation of the rainwater jar programme.

UNICEF Thailand should have considerable experience to pass on and contact between the two UNICEF offices concerning rainwater catchment, if this has not already been done, could be a first step. A summary description of the Thai experience with rain water harvesting is given in annex 5.

The Division of Environmental Sciences, Asian Institute of Technology, Bangkok, have been involved in practical research and have regional experience in this field. AIT is a potential source of expertise to carry out initial surveys and research into the feasibility of promoting rainwater catchment. Expertise on ferrocement work for water supply development could further be provided by the International Ferrocement Information Centre at AIT. Mrs. Lilia Austriaco of IFIC/AIT would be the person to contact . AIT could provide appropriate support to Cambodian institutions and agencies.

The issues to consider would be the kind of assistance necessary to improve collection systems and increase storage. In Thailand, gutters and small rainwater tanks already existed before the rainwater catchment programme began. People were interested in larger tanks, but it was still found necessary to provide a considerable amount of technical assistance despite the interest and prior experience. Householders worked together in groups but needed help from a village technician who had received appropriate training. Technical assistance included the loan of formwork and tools, the bulk purchase of cement, and a scheme for the gradual payment for materials.

The proposed Oxfam water use and hygiene education programme could include the collection of specific data on both technical and social issues to determine the feasibility of rainwater projects in each village as one option, of several, for the improvement of drinking water supplies. The assessment would have to cover a range of issues including: existing rainwater collection practices; how high a priority people put on rainwater; would people consider shared tanks; how much time and money people would spend on an improved rainwater system; what existing practices could be developed; and what materials are locally available, etc.

The design and construction of storage tanks is one area of development. The type of roof catchment will determine the quantity and quality of rainwater collected. This is a factor that could determine the degree of interest in a system. If the method of collection can be improved then people might be more interested in storing the collected water. During the evaluation field visits, a variety of gutter arrangements were seen, many of which had the potential for further development.

There is no doubt there already exists a considerable interest in rainwater catchment in Cambodia which, given the appropriate support, could make a significant improvement in access to better drinking water supplies. It is suggested that the agencies involved in the water sector should consider how the promotion of rainwater catchment could be effectively included in their existing programmes.

Hand Dug Well Construction

Traditional hand dug wells are an important source of water in Cambodia. It is evident that individuals and communities are purchasing privately made concrete well lining rings to improve their own traditional wells. These wells are fairly basic, they do not necessarily supply water all the year, and suffer from potential contamination. Nevertheless, it shows

people are willing to pay for the cost of an open lined well and may value the well water more than water from a handpump.

At one village in Baty district, Takeo, an India MkII pump on a UNICEF/MoH borehole was working satisfactorily but the people had purchased locally made concrete rings and placed them upright in the middle of a traditional water hole. The rings were almost surrounded by clay laden water with a clay path for access to the column of rings. Water was being drawn by bucket and rope. In another village not far away, Rolieng, the procedure had been taken a stage further by backfilling around the column of rings to ground level.
The Rolieng well was about 4 metres deep and an attempt had been made to deepen it further by digging below the bottom ring. The nearby family had constructed the well with the help of a local railway employee who had provided steel mould for the casting of the concrete rings. We were told the cost had been about 70,000 Riels (US$ 70).

A concrete ring manufacturer was interviewed in Chambak town, Baty. Larger diameter, 1.0m, rings cost R4,700 (US$ 4.7) and smaller diameter, 0.8m, rings cost R3,700 (US$ 37). The ring mould were purchased in Phnom Penh for US$400 a set. In one day, three concrete rings could be made using one mould. He estimated his profit to be about R850 (US$ 0.85) per ring. Based on this estimate, he should break even after 6 months continuous output.

The privately manufactured concrete rings were purchased for three purposes: well lining, latrines, and for rainwater storage. He indicated not many were used for rainwater storage as it was difficult to clean them out and jars were more popular. Only wealthier customers purchased rings for latrines. The majority of customers purchased the rings for well lining.

The fact that wells were being privately lined close to boreholes equipped with India MkII handpumps, and that a private ring manufacturer had the confidence to risk investment in steel mould, confirms lined dug wells are a popular and preferred source of water. Support for the construction of lined dug wells should therefore continue and be further developed.

4.4.2 The OXFAM Programme

Prey Veng and Svay Rieng Programme

Since the project was established, 222 dug/drilled wells have been completed in two years. In addition, repairs have been carried out on 147 India MkII handpumps installed under the previous borehole drilling programme. The work has been carried out by the provincial Departments of Hydrology in Svay Rieng and Prey Veng with equipment and material support, training and technical advice from Oxfam. The output of the Oxfam supported programme had been quite impressive.

Initially, a lot of attention had been given to capacity building and training DoH drilling teams. Involvement of communities seems limited even though DoH makes agreements with the villagers for drilling and for the supply of local materials. The Oxfam advisor was now reviewing programme performance and considered moving towards greater community

mobilization. DoH would need to agree to that approach and DoH staff and field personnel would then need to be trained for it. The following comments are made bearing in mind these achievements and the advisory nature of Oxfam's programme implemented by the Department of Hydrology.

It was unfortunate that little time was available to visit more completed dug/drilled wells. Only one well was shown to the mission by the Oxfam engineer. It must be emphasized, however, that this was the only dug/drilled well visited in Prey Veng/Svay Rieng and therefore it cannot be assumed to be representative of all the wells.

The well was sited in 'Plum Chong' and was constructed on 24/8/90. It is difficult to identify wells accurately without some kind of numbering system. UNICEF/MoH wells are all numbered and the number set into the concrete apron. A similar system for the Oxfam supported programme would enable the easier identification of wells on site and avoid possible confusion.

The well was being used but it was found in a generally poor condition. The lining was cracked in places. Reinforcement bar was exposed where the concrete appeared to have been 'washed' away. The apron was also cracked and spilt water could seep back into the well through the cracks in both the apron and lining.

The well was constructed in the wet season. The high water table at this time of the year must have presented difficulties during construction. Whether this was a contributory factor to the poor state of the well is not clear. It is understood that hand dug well construction is normally left until the dry season.

A shaduf had been erected for raising water from the well but it was not being used. A local bucket and rope was used for lifting water. The bucket sat on the concrete apron when not in use. A simple support for holding the bucket and rope off the ground would have been an improvement. Further consideration should be given to the method of drawing water from an open well and developed in close consultation with well users. This might entail further development of the shaduf, trials with pulley and rope, fixed communal rope and bucket, etc. Water lifting from the wells is an area where collaboration between the proposed water use team and the technicians would be appropriate.

At the same time as looking at the method of water lifting, an alternative headwork design for the open well could be considered. At the present time the well is completely open. A reinforced concrete slab with access holes for the drawing of water, incorporating access doors, would help to improve the sanitary condition of the well. However, any design should be evolved with the participation of the users if it is to be accepted and maintained. One of the reasons given for the popularity of open wells is that several people can draw water at the same time compared to only one person collecting water from a handpump. Headwork design must bear this factor in mind.

It appears that many people use the concrete apron as a washing slab. Consideration could be given to the design of a purpose made washing area, removed from the well surround. This would help to reduce the amount of ponding of water around the well.

It is not clear how the water table will fluctuate in the future as more wells are sunk. The open wells which GRET are promoting in Prey Veng are intended to supply both domestic and irrigation water for small scale gardens. The likelihood of motorised well

pumps appearing in the near future and penetrating the deeper confined aquifer, could eventually lead to a significant lowering of the water table, as experienced in other countries in similar circumstances. With this possibility in mind, a precautionary measure would be to install a larger diameter casing in the first 9 metres, or so, of the drilled section of the well. This would allow for the installation of a handpump within the casing at a later date if the water table lowered below the level of the hand dug section of the well. Refer to figure 3 on page 25.

Monitoring of water quality and status of the wells

It is unrealistic to monitor water quality on a regular basis, even with the appropriate equipment. However, it is important to have some mechanism for the monitoring of open wells in order to detect a possible deterioration in water quality. As an example, the open well visited in Prey Veng showed a number of features which required attention if water quality was to be maintained: the ingress of spilt water, poor lining, cracked apron, etc.

Monitoring of open wells, using a sanitary checklist to identify potential areas of contamination, could be used by the proposed water use/hygiene education team to both check the current sanitary state of wells and involve users in the future monitoring of their own wells. A simple check list, which could be modified with experience, is included in appendix 5. Information from periodic surveys could be used to form the basis of a well maintenance programme. Feedback from the surveys would help to identify wells running a high risk of contamination. The proposed 'water use team' could encourage the users of the suspect wells to maintain and improve them. The aim would be to promote village maintenance of the wells and to move away from reliance on Department of Hydrology/OXFAM.

Budgeting

A more detailed form of budgeting would enable more realistic cost estimates to be made. At the present time, monitoring of expenditure cannot be clearly followed. More accurate future estimates could be made if the quantity of materials and fuel consumed per installation were regularly recorded. Also, for guiding cost figures realistic quantity estimates for standard designs should be made.

In the current budget for 1992/93 the cost of materials, fuel and allowances are all budgeted separately for the convenience of Oxfam's accounting procedure. Budgeting in this way, however, does not clearly show how the figures are related to the overall costs of an installation. We were shown a cost analysis of a water well which could form the basis of an estimate for the purpose of budgeting. However, the analysis was based on a well of maximum, not average, depth and included a very high expenditure on fuel. A revised form of analysis is included in appendix 4 as a suggested guide for future costing based on data from Prey Veng. Some of the details may vary according to actual field experience but the format can be used to show clearly the estimated expenditure.

In the budget for 1992/93, the figures used for fuel consumption are the same for both construction and maintenance. To aid monitoring, the cost of new well construction and handpump maintenance should be considered separately and detailed in a clearer format as proposed in appendix 4.

Battambang and Bantey Mean Chey Programme

By March 1992 in Battambang province, 118 boreholes and open wells had been attempted in 8 districts. Of these, 69 were said to supply water - a 59% success rate.

The boreholes were fitted with 41 India MkII handpumps and 12 of the "Thai" modified Dempster handpumps. A total of 12 dug wells were left open. Records on specific sites and borehole records were not seen. Neither Central Hydrology nor Oxfam, Phnom Penh, have any detailed records.

The situation in Bantey Mean Chey was that according to Mr. Heng Siv, vice-head, provincial hydrology, in the 14 months that the programme had been operating, 100 wells had been completed, of which 10 were dry. However, as for Battambang, no records were seen and neither Central Hydrology nor Oxfam, Phnom Penh, have records of the wells attempted or completed.

In addition to the wells drilled under the programme to supply IDPs, repatriates, public institutions, UNHCR and NGOs, the provincial DoH staff also drill a certain number of privately contracted wells.

The borehole data should provide useful information for future drilling in an area where very little information currently exists. It is therefore important for drillers to take regular samples whilst drilling and to keep accurate records on-site. The keeping of records and reporting to central offices on the number, location, and essential information about all the drilled boreholes should be a routine administrative task. It is suggested that the **information on drilled boreholes and improved open wells completed to date should be collated** and made available at provincial and central hydrology.

The monitoring of activities, borehole details, fuel used, materials consumed, should be essential management procedures. The recording of installation details is important for future maintenance. Improvements should be made to general record keeping and it is suggested that standard procedures should be clarified and established where they are lacking.

Quality of Work

It has been a considerable achievement to have established productive borehole drilling programmes in both Battambang and Bantey Mean Chey in a relatively short period of time. The difficulties of equipment and materials supply, and the additional work of building workshops and stores all takes time. However, perhaps because of the urgency to respond to the demand for new wells, corners have been cut and jobs appear to have been rushed. Now might be the time for a reassessment of procedures in order to improve the quality of installations.

From field observations it is evident the quality of work could be, and needs to be, improved. Several cases were found where borehole water from handpumps was found to be cloudy and contained sand deposits.

A "Thai" pump installed on a PAT drilled borehole in Kbar Spieng village, north of Sisophon, on 25/8/91, was delivering water of a similar turbidity to the hand dug traditional wells lined with wooden planks found elsewhere in the village.

In the Sisophon DoH store there is screen which has been made by cutting very wide longitudinal slots in PVC pipe. The use of this screen would explain the ingress of silt into the borehole. It is understood this screen is no longer installed. The Vietnamese manufactured **continuous spiral screen is far superior and should now be the preferred choice.**

It appears that the full development of each drilled borehole is not always carried out satisfactorily. At the end of one borehole drilling operation, observed during a field visit, the centrifugal circulating pump from the rig was used to pump out the drilling fluid from the borehole for just a matter of minutes. It was not clear if any further "development" was to follow but the indications were that the borehole had been "completed".

One of the problems has been the lack of equipment for proper borehole development. The number of drilling groups has been increased but equipment has not kept pace. In Battambang, there is only one trailer mounted compressor for three drilling groups. It must be difficult to programme for the compressor to follow up on each drilled borehole. This may go some way to explain why boreholes have not been adequately developed. **The situation is to be improved by the purchase of further compressors.**

The drilling groups have now become familiar with an operation that appears to omit the full development of boreholes. Borehole development takes time and the introduction of full borehole development procedures will mean a reduction in the output of boreholes. This should be acceptable to staff if it means they do a better job and it does not affect any financial gain they might get from completing a borehole. The present 'top up' system operated by Oxfam is based on a daily allowance, and is not performance related, so this should not be a problem. However, further training, or re-training, on borehole development would be advisable when the new compressors arrive to ensure each drilling group carries out adequate borehole development in the future.

It was clear from site visits that in the rush to complete installations the construction of handpump platforms has suffered as a result.

The handpump platform at Tma Koul village, Ta Poung commune in Battambang district was an extreme example. The India MkII handpump was operating but the apron had been almost totally broken up and washed away. The date on the apron was 2/3/92. A poor concrete mix and this concrete cover on the hard core appeared to be to blame although local people also said the handpump was used before the concrete had time to cure.
The mission observed the goings-on around the pump from a distance during about an hour. The pump which was situated near a small market was hardly visited by people at that time (2.00 - 3.00 p.m.) collecting water for their families. At least two "water vendors" were seen to fill some 20 containers each. They said they were not charging for the water. But that seems unlikely, as they were having quite nice carts to transport the water.

If people pay to the vendor, they could also pay for the upkeep of the pump. Or through a concession to the vendors, have the vendors pay for the maintenance and repair of the pump.

Other examples were seen where the quality of construction could have been better. It is suggested that a review be made of construction procedures, concrete mixes, etc. to identify what appropriate training, or re-training, will be required to improve the quality of construction. More importantly, perhaps, the supervision of construction should be reviewed so that a workable system of quality control can be developed.

Technology approach

A small number of wells have been hand dug in Battambang. In Bantey Mean Chey, dug/drilled wells have been completed in IDP camps but the Oxfam/DoH programme has only just started supporting village dug wells lined with concrete rings.

In Kbar Spieng village, north of Sisophon, there are six lined traditional wells, 5 - 6m deep with a 4m static water level in the dry season. The wells are approximately 1m square and are lined with wooden planks. Water is lifted in a locally made bucket on the end of a bamboo pole. It was reported one well could be dug by 4 people in 2 days.

Traditional wells and well sinking skills exist in areas where hand dug wells are suitable. The wells that were seen were providing adequate quantities of water for the small groups of families using them but from a hygienic point of view they could have been improved. Spilt water could re-enter the wells and there was no adequate protection from pollution and seepage. A pump had been installed on a drilled borehole in the village but people were still drinking water from the open wells. DoH and Oxfam should consider how these existing skills can be mobilized to increase the number of improved hand dug wells.

Here was a case where an alternative to the technical drilling team drilling a borehole would have been a water use and health education team discussing the advantages and disadvantages of the existing open wells. The technical input could then have come at a later stage if the village agreed the need for improvements to the existing sources. The technical solution could have been one of several options including:

* improvements to the existing wells;
* the digging of improved, protected wells;
* the installation of a handpump on a borehole.

There is a demand for the improvement of open ponds and wells as was seen several times in both the south-east and the north-west of the country.

At a private ring factory in Tma Koul village on the main road between Sisophon and Battambang, concrete rings of 1m diameter and 0.5m height were being sold at Riels 6,000 (US$ 6) each for both latrine and well lining. Just outside Battambang, concrete rings were ready for positioning on top of an already part lined private well in a pond where a shaduf was used for raising water.

Through the extension work of a water use and hygiene education team, existing practices and preferences to improve water sources could be identified and followed up with appropriate technical support. The kind of support offered would have to be flexible enough to respond to the needs of each community. Such a response might range from advice on the construction of a concrete headwall, platform and drain for a traditional well, to the drilling of a borehole and installation of a handpump. The important difference from the existing programme is that the technical response would be based on a consideration of existing water use practices and preferences and not on assumed needs. In view of present staffing levels at provincial DoH and the economic imperative of continuing construction work, it may presently not yet be feasible to introduce this change in the programme. However, with increased privatization, and assuming adequate remuneration for social and technical field staff, this approach offers a better chance for the right developmental process leading to the right technical option. It is recommended that Oxfam starts the discussion with DoH, for example, in Battambang to develop this new approach on the basis of a pilot project.

Many people use traditional household and village ponds for their water supply. Improving the quality of the water from these ponds is as much a management issue as it is a technical problem. In the provincial department of hydrology grounds in Battambang, an experimental infiltration gallery connected to a borehole with a "Thai" handpump has been constructed. The arrangement may work for a short period of time but will eventually need maintenance. The filter will need periodic digging out and cleaning if it is to work continuously. It appears that Oxfam has designed another pond for UNHCR last April. This design has not been reviewed.

Given the high turbidity of pond water and the small surface area of the filter, it is likely that the filter will need regular cleaning. Such a scheme will only work, therefore, where the users are willing and able to regularly clean out the filter. It would not be possible to clean the filter if it blocked when the pond was part full of water. People would then go back to taking the water directly from the pond.

Infiltration galleries are more effective where there is a flow of water to clean the filter media, as in the case of a river bed infiltration gallery. At times of high river flows, sediment in a river bed filter can be washed away and the filter will be able to continue its straining action at times of lower flows. In a pond there is no means of scouring the filter to remove the settled material and it will block very quickly.

In discussion with department of hydrology staff, they did not feel the filter was a real solution to the problem of improving pond water quality. Technical staff can give advice on pond design: siting, the gradient of side walls, the limitation of siltation, etc. However, the effective and hygienic use of ponds is more likely to be achieved through improved pond management. This is more the role of water use and education staff, complemented by technical advice.

Another point about filtration systems for ponds is that the filter and abstraction point is a relatively fixed capital cost irrespective of the size of the pond. This means that small family size ponds, which could be more easily maintained than large community ponds, are too expensive.

Provided the size of the community allows, it would probably be better to construct a shallow well with rings (and possibly equipped with a handpump) just next to the bank of the pond. Due to lower infiltration velocities, clogging will not be a major problem

The Dando 150 percussion rigs have been used where the PAT rigs were unsuitable. Drilling may be slow but it can be effective as in the case of hard rock and boulders encountered in Battambang and Bantey Mean Chey. A Dando was seen being used to rehabilitate an old silted up borehole at a school in Sisophon. The old borehole was said to be 40m deep but the cable on the Dando was very short at about 25m. Water was reached but the borehole could not be completely cleaned out due to the lack of cable. The purchase of new cable would extend the capacity of the Dando to the depths it should normally be capable of achieving.

Oxfam and drilling

Oxfam's further involvement in drilling must be dependent on where it sees its priorities. If, as is discussed elsewhere in the evaluation report, most people do not like to drink handpump water then Oxfam would want to concentrate on those supplies that people are willing to drink. Drilling rigs are still necessary in the construction of dug/drilled wells. PAT rigs are suitable in soft formations but in cases where rock is encountered, the introduction of the Eureka Port-a-Rig could make a significant difference.

One major advantage of the PAT rig is that it is manufactured locally in Thailand. It is cheaper than importing a similar rig from 'the North' and spare parts are locally available. Currently, the Port-a-Rig is nearly three times the cost of the PAT rig. See appendix 7 for a breakdown of costs. If the Eureka rig was manufactured in Thailand, and PAT are interested in the possibility, the overall cost would come down and it would become more attractive, especially bearing in mind its more sturdy design and its greater drilling capacity.

The slightly extra capacity of the Port-a-Rig would make it a suitable addition to the lightweight PAT rigs, in specific circumstances. In some cases, as in Takeo, it might make a significant improvement to drilling success rate.

In summary, the main advantage of the Port-a-Rig over the PAT rig is its ability to use a Down-the-Hole hammer in limited hard rock areas where the penetration of 10 metres of rock would make the difference between a wet and a dry well. In such circumstances it would be worth considering the deployment of a Port-a-Rig over a PAT rig. In other respects, at the present time, the relative advantages of the Port-a-Rig for applications in Cambodia appear to be outweighed by the cheapness and local manufacture of the PAT rig.

Over a period of time, however, the relative merits of the two rigs can be monitored in Battambang where they are working alongside each other. A better comparison can then be made after a period of field experience. In particular, it will be interesting to compare the 'useful life' of each machine. Currently, the department of hydrology report that the PAT rig requires significant maintenance after about 80 boreholes (new pump impellers, seals, etc.). A significant increase in 'useful life' over the PAT rig would make the Port-a-Rig a much more attractive alternative.

The Port-a-Ring is only a prototype but the manufacturer has estimated its life at 500 holes. This makes it much more competitive with the PAT rig. Also, the engine used is a

Honda which is widely used in the region. Other advantages of the Port-a-Ring are its stronger design, faster drilling with a 3m stroke, and little wear on engine bearings (a significant problem with the direct drive system of the PAT rig).

AICF (part funded by Oxfam) in Takeo

AICF have experienced a drilling failure rate of about 50% because of the presence of rock which the lightweight PAT rig cannot penetrate. Rock is commonly found at depths of 15m or so, before reaching water. The Eureka Port-a-Rig, recently given a trial by Oxfam in Battambang, might be suited to the Takeo conditions. Its ability to use a Down-the-Hole hammer for the extra 5 - 10m of rock required in drilling may be sufficient to increase the drilling success rate significantly.

The method of constructing the dug/drilled well is straightforward and suited to the participation of the community during construction. Community participation in construction requires close supervision, especially concerning safety. Well trained supervisors, able to maintain good drilling discipline and ensure necessary safety precautions should be posted to sites where community participation is expected.

Casting in-situ would be possible in the kind of sandy clay soils encountered during the dry season before the rains. It would not be possible once the rains started as the soils would become unstable.

The advantages of casting in-situ:

- less handling of heavy concrete rings;
- no need to use reinforcement thereby reducing the cost of the well and the need to supply reinforcement bar;
- a continually cast column makes a better seal avoiding the chance that cracks will appear between rings as they settle.

Disadvantages of casting in-situ:

- the well needs to be dug out accurately to avoid using excess concrete.

The wellhead incorporates both a pump and an access hole for when the pump breaks down. This is a good combination to try but several improvements could be considered:

* the pump arranged to discharge over the apron, not the well cover as at present;
* the access hole should have a raised wall & overlapping cover to avoid the possibility of the cover falling through the access hole, as could happen at present. It would also make a better seal to prevent water seeping back into the well;
* sealing of the well cover and the inclusion of a galvanised iron vent pipe with a 180 degree bend to aid aeration of the well.

4.4.3 The UNICEF Programme

The Master Plan of Operations 1992-1994 for UNICEF/Cambodia indicates that the output in drilled wells in the coming years will remain high. Numbers of wells drilled show a

planned increase from 2,400 wells in 1992 to 4,100 in 1994. Whether these number - viewed from a social and health perspective - should be met in such a short time is a matter for debate further on in the report. Here we will deal with the physical constraints to these efforts.

The areas in which the majority of the drilling has taken place since the beginning of drilling in 1983 have been in the Mekong/Tonle Sap alluvial plains. Only recently have UNICEF encountered more difficult and unpredictable drilling conditions. This is a first indication that the drilling conditions to be met in the future are going to be significantly different from those experienced to date.

Broad coverage of the areas encompassing the alluvial plains can be achieved relatively easily utilising the manual PAT rig. The average drilling depth in the municipality of Phnom Penh and Kandal Province, for example, has been 21 metres in soft, unconsolidated formations.

However, drilling success rates in the more recently accessible areas of the north-west give an indication of future difficulties. Initial drilling attempts in Battambang province were not very successful (16 holes dry out of 19 attempts). Very thick clay layers can be found around Battambang. However, by May 1992 the success rate had been significantly improved to 84% (11 holes dry out of 69 attempts). Elsewhere, rock formations also preclude the use of the lightweight PAT rigs where the conventional mechanical rigs are necessary.

The effective drilling capacity, therefore, will depend on the geographical deployment of the rigs.

Drilling capacity can be maintained, in terms of number of wells drilled, by supporting the expanded use of the PAT drilling machines in the more favourable alluvial soils where much of the drilling has already taken place. The advantages of a greater density of boreholes is that the number of users per pump can be reduced. This can have several beneficial effects including a decrease in walking distances and a longer time before handpump failure.

If drilling is to be successful in areas where few wells have been drilled and groundwater availability is not well known, then the 'mechanical' drilling capacity will need to be maintained.

The first UNICEF rig, Hydreq, started drilling in Cambodia in 1983. It has now drilled over 800 boreholes. The drilling rig used in the earlier Oxfam water programme was also a Hydreq and when Oxfam ceased using it in 1990 they passed it on to UNICEF to be used to supply spares for their rig. The Hydreq company has since been taken over by Dando and any new parts are difficult and costly to acquire. Estimated costs of repairs in March 1991 were $63,000. The other rigs first started drilling in the period 1986 - 1988 and are in a working condition. However, the situation of ageing drilling rigs together with the decision to expand into areas of more difficult geological conditions means that a new rig will be required if the present drilling capacity is to be maintained. As such, the purchase of the Ingersoll-Rand TH-10 would be an appropriate replacement for the existing Hydreq rig.

For brief specifications of the existing drilling rigs and the new rig on order, see annex 10.

Handpump platform construction

A high drilling rate has to be followed with a high pump installation and platform construction rate. A member of the CWB reported that a construction team can complete three aprons in one day. The incentive scheme has been effective in maintaining the output of completed handpump installations. In general, the standard of handpump platform construction was reasonably good. However, some cases were seen where the quality of construction had suffered, probably due to rushing the job.

The Cambodian UNICEF booklet on the installation of the India MkII handpump gives the standard platform design as developed in India. In practice, the design in the booklet has not been followed. Random inspections of pump installations showed similar alternative features to the standard design. The concrete was reasonably good although cases were seen where the concrete had cracked. In one or two instances the cracks had developed into gulleys in the apron which needed urgent repair.

Drainage was the main cause of concern. The apron sloped from the pump to the perimeter but in many cases the water did not then drain to the drainage outlet. This created stagnant pools of water on the perimeter of the apron which needed to be cleaned regularly to keep clear. In some cases an extra drainage channel had been broken, or built, into the apron wall which allowed water to spill around the apron perimeter. A positive slope built into the apron with a fall to the outlet, as shown in the installation booklet, would avoid this situation. Raising the level of the apron somewhat above the surrounding area would further reduce the risk of poor drainage.

Drainage channels leading from the apron were always very short - not more than 40cm. This is insufficient and creates pools of stagnant water very close to the well apron. Users were told to dig and clear a drainage channel regularly but this appears to be seldom done. A short concrete drainage channel is, in any case, inadequate. Lengthening of the channel should make a significant improvement to the sanitary condition of the immediate well surround.

Various modifications to the standard India MkII handpump platform shown in the booklet have undergone trials in India. The main changes are to position the outlet spout, not the pump pedestal, in the middle of the platform and to increase the size of the foot rest. These changes reduce the splashing of water and consequent pooling around the platform. It also makes pump operation more convenient.

It is suggested that a review of the platform design should be considered. Construction crews could then receive a briefing on points of platform design and construction to improve future installations. Such changes should be followed with close supervision of the construction work in the field to ensure the agreed design is followed and the quality of work maintained.

The incentive scheme to complete the target number of installations within a month will encourage the construction team to rush jobs. The suggested changes to the platform design might mean a longer construction time and therefore, to be effective, the incentives may need to be adjusted accordingly. An alternative would be to pay not only according to output, but also quality.

Hand Dug Wells

Traditional wells have been improved in the past by the sinking of concrete rings to form a lining and headwall. One example was seen in the village of Ta Poz, Prey Vieng province which had been dug and lined in 1969. It served 8 families but it did not supply water in the dry season. We were told it cost the equivalent of $200 in 1969. UNICEF/MoH have been rehabilitating similar wells which also supply water in the dry season to provide an improved, sanitary, all year supply. By March 1992, UNICEF had rehabilitated 787 existing hand dug wells.

The approach has been to clean out the well, seal cracks in the lining, improve the concrete apron surround and place a removable cover on top. A No.6 suction pump has usually been installed.

The rehabilitation is aimed at a basic low cost improvement to an existing water source. It was not possible to visit many rehabilitated dug wells and therefore the comments on the state of one well cannot be taken as representative of all the nearly 800 wells that have been rehabilitated. However, the approach to rehabilitation has been the same in all cases and therefore the points made concerning the well at Kraing Krachang, Pieriem commune, Baty District, Takeo Province, UNICEF well number: REH.1, concern the advantages and drawbacks of the current approach and design used in the rehabilitation of all dug wells.

The well was being regularly used as could be gauged from the queue of people waiting to collect water which formed whilst we inspected the pump and inside of the well.

The concrete cover had been cast a larger diameter than the well lining to overlap the headwall but it had not been sealed. The idea was to allow spilt water to drip harmlessly off the edge of the cover. However, in practice, it was possible for water to find its way through the gap between cover and well wall.

The problem of spilt water on the unsealed cover was compounded by the fact that the No.6 handpump discharged directly onto the cover. It is a drawback of the No.6 pump that it has a short delivery spout. It is, therefore, not possible to position it so that it discharges over the apron, rather than the cover.

Another drawback of the No.6 pump is the method of fixing it to the well cover. In the examples seen, the flange bolts for the fitting of the foot valve were also used for the pump holding down bolts. As a result, the distance between outlet spout and cover was insufficient to allow for the direct filling of a standard 20 litre jerry can, which is commonly used for collecting water. Raising the pump flange on a concrete pedestal would give the required pump height.

The combined reasons for water to be spilt on the cover makes it even more important for the cover to have an effective seal to prevent the regularly spilt water from washing back into the well. The uneven mounting of the flange on the cover slab may also provide a pathway for spilt water to find its way back into the well again and is another point of weakness in the present arrangement.

The design incorporating a removable cover means that if the pump breaks down and cannot be repaired, the cover can be moved to one side and water drawn from the well by

bucket. However, on some wells, the wall is very low - 10cm - and the potential for contamination with the cover removed is high.

Well No.167, in Kandal province, is an example of a once rehabilitated well where the people have removed the pump and cover completely. They draw water by bucket and rope. The water in this well was brown due to the ingress of silt laden water through open joints in the lining.

A more hygienic design might be a sealed cover slab incorporating an access hole and cover which could be used for the drawing of water by bucket when the pump cannot be repaired. This is a design being tried in Takeo by AICF which is still under development but could also be considered by UNICEF/MoH for their rehabilitated traditional wells. This would avoid the need to move the cover slab to gain access to the well water and would provide a more sanitary solution to the drawing of water from the well.

Another alternative would be to omit the pump altogether, if the users make such a choice. The well could then be purpose made for the lifting of water by bucket and rope, or through a pulley system.

Handpumps installed

About a quarter of the handpumps installed in the UNICEF/MoH programme are Vietnamese or Cambodian made **No.6 suction pumps** based on the design of the No.6 pump from Bangladesh. Unfortunately, the factory that was making the No.6 pump in Phnom Penh has now changed hands and production has ceased. They are readily available from Vietnam and currently cost about $25.

The **India MkII** handpumps are installed in two different configurations referred to as INDIA-1 and INDIA-2 in the Central Water Base records.

INDIA-1 Standard diameter cylinder with 1¼" riser pipe,
12mm pump rod, and a discharge of about 1 m3/hr.
Suitable for a cylinder setting of greater than 21 metres.

INDIA-2 Shallow well cylinder with 3" riser pipe,
16mm pump rod, and a discharge of about 2 m3/hr.
Suitable for a cylinder setting of 12 - 15 metres.
Fitted with a T-bar handle.

INDIA MkIII, standard design, has been ordered and is to arrive soon but no trials have been possible yet.

It appears that in some cases the T-bar handle has been fitted to the INDIA-1 configuration. Well No. E-597, Baty District, Takeo Province, is an example. Several were also seen in Kompong Chnnang. It is recommended that further consideration be given to this procedure as complaints of difficult operation were heard where a T-bar handle had been fitted to a pump with a 21 metre pump setting. The heavy operation was particularly difficult for children.

In response to the need for a medium lift handpump suitable for the lift range of 7 - 20 metres, a **local variant of the Dempster handpump** has been developed and produced both in Thailand and Cambodia. The pump is variously referred to as the "Thai" or Dempster derivative. The cost of the pump in Cambodia was $50. Since the closure of the factory in Phnom Penh, however, the pump can only be obtained from Thailand. The cost of the pump, as above, from Thailand is $70.

It comprises the Dempster pump head with locally developed below ground parts. The PVC riser pipe acts as the cylinder and the foot valve locates in a taper formed in the rising main. Both the piston and foot valve can then be removed without removing the riser pipe.

It is difficult to make any firm conclusions about this pump as few were seen. Those that were inspected ranged from one which broke down after 5 days operation to one which had been operating for nearly 10 months. Others were seen operating but with leaking foot valves. It should be of some concern that the pump mechanic at Baty was unaware the failed foot valve of a modified Dempster could be extracted without removing the rising main. In order to remove the riser pipe he was prepared to break the concrete apron in which it was cast. As a district based mechanic he had not received adequate training on this specific pump.

It was also observed that a more satisfactory means of fixing the rising main of the "Thai" pump is required when installing on top of dug wells. The rising main can become loose in the concrete cover slab. It can then slip down. Recently installed (April '92) examples were seen in Kompong Chnnang where wooden wedges had been hammered between the riser and concrete to prevent the riser pipe from slipping. This is not very satisfactory. The situation could be improved by welding angled steel anchor bars onto the riser at the point where the pipe is encased in concrete. A concrete pedestal would increase the thickness of concrete at this point and would help to both fix the riser and prevent seepage of spilt water past the joint between pipe and concrete cover slab.

4.4.4 Handpump maintenance

So far different approaches have been used with respect to maintenance of handpumps. UNICEF has established a workable system through the provincial health services, while Oxfam has given relatively little thought to maintenance aspects. UNICEF's system is working well and has already been taken on in one case as a model for a district level maintenance system.

UNICEF has supported the establishment of provincial maintenance teams attached to the Health Service Centres. The maintenance team may, or may not, be the same as the pump installation team, according to the arrangement in each province.
Pump breakdowns are reported from the village to the commune to the district to the province, for repair. Contributions from the village to the maintenance team for repairs varies. In practice, there appear to be parallel maintenance systems working alongside each other. The systems identified in Baty district, with over 170 wells, illustrate the mechanisms at work.

the 'official' system

In each commune there is a clinic. Someone is appointed from the clinic to be responsible for the maintenance of installed India MkII handpumps in their area. They are responsible for reporting a pump breakdown to the district pump mechanic. In Baty district, the well drilling programme has been running for several years and, apparently, the provincial HSC has been able to develop its maintenance support. The provincial team have trained a district pump mechanic who became independent of the provincial team in April 1992.

Money is collected at the time of repair. People near a pump may pay extra than those further away as they will use the pump more. To obtain spare parts the mechanic will report their needs to the provincial level. The HSC will report to the Central Water Base. However, this procedure can take time and spares described as "Chinese parts" can apparently be obtained more quickly from a shop in Phnom Penh.

the 'key person'

An alternative system depends on a key individual. Some handpumps are situated close to, or in front of, a more wealthy household compared to those nearby. When the pump breaks down, the wealthier householder contacts the district maintenance mechanic. The mechanic will inspect the pump and advise on the parts required. The householder will advance the money to buy the spares, perhaps involving sending to Phnom Penh for the "Chinese parts". The mechanic will then be paid by the householder for repairing the pump. It is then up to the householder to collect money for the cost of the repair from the pump users.

The mechanic said this system works faster than going through the provincial maintenance team for the spares.

temporary repair

A local bicycle repair man is able to make leather seals which can be fitted by the mechanic. This acts as a temporary repair until people have enough money to pay for parts through either of the two other systems. This only works for worn seals.

The quality of the repair decreases from the 'official' to the temporary repair system. This means the seals repaired under the 3rd system will only last 2 months compared to 6 - 12 months for the 1st system. The choice of system will be a compromise based on overall cost, time for repair, and, perhaps, the season.

The No.6 suction pump breaks down frequently but it can be repaired relatively easily. The district mechanic said that he did not repair the No.6 pump as the users repaired it themselves. He also reported that in salty areas it rusted. People then did not like it and either removed the pump, if installed on a dug well, or they used traditional wells.

A review of pump maintenance in Baty district (Takeo province) suggests that pump maintenance is already being 'privatised' in some form or other. Payments are being made to the pump mechanic and parts can be obtained in the market. However, the type

of parts that can be obtained are at the present time restricted. The pump can be repaired if it is just a seal replacement but replacement of an India MkII cylinder, for example, would not be so straightforward.

A cost breakdown, based on UNICEF figures, for the maintenance of 600 India MkII handpumps in Kompong Speu province in 1991 gives an indication of the cost of pump maintenance. The analysis is given in appendix 2. In this analysis, the cost of pump spare parts is of the order of US$19 per pump per year. In addition to this there will be a payment to a pump mechanic for the repairs. Indications are that payments may be in the order of R7,000 (US$7) making the total cost of pump maintenance about US$25 per year, assuming a reasonable average of one repair a year.

On the whole the UNICEF system seems to be working well. The mission has not reason to doubt the reported figure of around 90% of handpumps functioning at any given time. Not only did the mission notice very few pumps out of order out of several hundred seen, but evaluation of the maintenance arrangements in Baty district, Kompong Chnnang, Battambang and Bantey Mean Chey indicate that matters are reasonably in hand and that indeed repairs are made within a week or so. While comparing the log of the local health post of a district just East of Kompong Chnnang with the pumps actually working and needing repair, it was seen that the figures reported tallied with reality. And also that pumps reportedly repaired in the earlier reporting period were indeed functioning.

In Prey Veng and Svay Rieng Oxfam have been supporting the provincial departments of hydrology in the maintenance of the India MkII handpumps installed under the previous Oxfam drilling programme. Many of the handpumps now need repair and some have corroded rising mains which need replacement. The handpumps could either be repaired or replaced completely.

Many of the handpumps installed on the previous Oxfam supported borehole programme were located in the middle of villages or, in one case inspected, in the grounds of a now abandoned dispensary. As a consequence, no individual is responsible for the maintenance of each handpump and no handpump committees exist. Even if the pumps were either repaired, or replaced, there is no indication that people will look after the handpump in the future. This is in contrast to some of the UNICEF located boreholes which are adjacent to a particular individuals house. The individual association appears to ensure that pumps are looked after.

At the present time the Department of Hydrology or Oxfam have no strategy for the training of local mechanics for handpump maintenance. All repairs are carried out by the provincial department of hydrology maintenance team.
Handpump breakdowns are reported from the chief of the village to commune to district to the provincial department of hydrology. Until now, handpump maintenance has been carried out by the drilling and construction teams. Two vehicles have recently been purchased, but not yet arrived, for the use of a mobile handpump maintenance team based in each province.

One problem for provincial hydrology has been to obtain the handpump spares required from central hydrology stores. The system of releasing spares from the central stores has meant going through a time consuming and frustrating process. For example, in order to obtain some India MkII pump seals to be carried to Battambang on the evaluation field trip, a total of 12 signatures were required to release the seals from central hydrology stores. All

spares appear to be stored in Phnom Penh. For the provincial maintenance teams to work effectively they will need a good stock of spares and this has to be arranged in advance with central hydrology.

The different systems of maintenance identified in Baty district, Takeo province are described in the section on handpump maintenance under the UNICEF/MoH programme. The installation of handpumps in Takeo has been going on for several years and there are many more pumps installed than in the north-west. The experience in Takeo, therefore, gives an indication of how maintenance might evolve elsewhere in Cambodia. Private pump maintenance seems a realistic possibility given sufficient support.

In the context of the Oxfam/DoH programme, consideration should be given to how private maintenance mechanics can be trained and supported. Liaison with the UNICEF programme is obviously important so that a coherent approach can be developed. The handpump maintenance teams, which are to be established in Battambang and Bantey Mean Chey, should be involved as much in training village appointed mechanics as repairing the pumps themselves. As skills are acquired locally then private mechanics will become established. The main problem will be how to maintain a reliable supply of spare parts.

In the case of Svay Rieng and Prey Veng it is recommended that before it is decided to maintain, or replace, a handpump the water use/hygiene team should discuss with the potential beneficiaries what they would like to do with the borehole. As the static water levels in the boreholes are generally between 2 and 5 metres, it would be possible to convert them into open wells in the manner that is being followed in the current programme of dug/drilled well construction. This could be included as one of the options to be discussed with the users.

The options are then:

* repair and maintain the existing India MkII handpump;
* replace existing handpump with a low to medium lift VLOM handpump following the standardisation of handpumps;
* remove the pump and convert the borehole to a dug/drilled well similar to the type being constructed under the present programme;
* if there is no current interest from the users, remove the handpump and cap the borehole.

The 1992/93 estimates, quoted by Oxfam, for the maintenance of India MkII handpumps seem very high. For the maintenance of 50 existing India MkII handpumps in each province, and the replacement of another 20 with 'shallow well pumps', a figure of £16,020 has been allowed, for each province. This is an amount of £229 per pump which is more than the total replacement cost of an India MkII handpump.

If the maximum possible number of pumps installed on Oxfam drilled boreholes in Svay Rieng are taken, for example, the total is 180. If the proposed expenditure is spread over all these pumps then the cost would be £89 per pump. This figure of $160 compares with $19 for the annual maintenance of India MkII pumps in Kompong Speu under the UNICEF/MoH programme (see annex 11). The annual maintenance cost including repair of the apron would amount to around US$ 30; still considerably lower than what Oxfam is budgeting. It is understood that the pumps have been neglected and some are suffering from

corrosion problems. However, the figures budgeted still seem high and a more careful appraisal of the actual needs is recommended.

Spare parts supply is crucial to the sustainability of handpump maintenance. Presently UNICEF and Oxfam supply spare free of charge through their Cambodian partners. UNICEF, Oxfam and the other actors in the sector should consider whether that situation is sustainable or should gradually change toward commercialization of parts. The mission feels there is scope for a large degree of privatization and especially UNICEF could be instrumental in encouraging this. Privatised pump maintenance requires spare parts to be available for purchase by users or private pump mechanics. A means of spare parts supply through the private market needs to be identified and encouraged if dependency on government agencies or external support agencies such as UNICEF and Oxfam as the supplier of parts is to be reduced and eventually eliminated. It is recommended that UNICEF and Oxfam encourage a private agency, or agencies, to import the required spares, and new handpumps, for the Cambodian market. UNICEF and Oxfam would initially be the main customers able to guarantee a minimum demand for handpumps through which a business could be developed. The Provincial offices of the Department of Hydrology, the Provincial Health Service Centres maintenance teams and private mechanics could purchase parts directly from the supplier. In the longer term private marketing of spares and complete pumps would allow government and external support agencies to withdraw from pump maintenance.

Handpump standardisation

Any maintenance strategy is dependent on the handpumps installed. UNICEF have been supplying the India MkII, the "Thai" modified version of the Dempster handpump and the No.6 suction pump (Cambodian and Vietnamese made) for high lift, medium lift and low lift applications, respectively. Other agencies, including Oxfam, have been installing these pumps. Several other pumps are being considered by different agencies including the India MkIII (UNICEF) and UPM pump, which GRET is developing.

As more agencies become involved in rural water supply there is a danger of an increasing number of different types of handpumps and associated maintenance strategies. There is therefore an urgent need to coordinate approaches to handpump selection and maintenance.

The standardisation of handpumps is not a technical decision alone but should also consider operation and maintenance, spare parts supply, and the potential for local manufacture. GRET, UNICEF and Oxfam had taken up the issue of standardization before the evaluation, however the results of the evaluation were awaited before the process was taken a step further. A draft proposal for the establishment of standard specifications for handpumps has been drawn up by the Danish Cambodian Consortium (DCC) and is included, for information only, in annex 7. This kind of proposal will require the involvement of the main agencies and government departments involved in the rural water sector if a move towards the standardisation of handpumps is to be effective.

The experience of the "Thai", modified Dempster, handpumps seen in the field confirms the need to identify an alternative more reliable medium lift handpump. The medium lift pump is required for those applications where: the "Thai" pump is currently used; the India

MkII is currently installed in wells which require a more appropriate medium lift pump; and, possibly in the future, the replacement of some of the No.6 suction pumps may be necessary if the water table lowers significantly. Several pumps already developed for medium lift applications could be considered under a scheme similar to that outlined in the draft DCC proposal.

In summary, a well developed handpump maintenance system relies upon several important factors:

* good quality of work: properly constructed wells and aprons, correct choice and installation of handpumps, good supervision;

* standardisation of handpump types to avoid a wide range of different pumps;

* training of pump mechanics and provision of basic tools;

* decentralized monitoring of status of boreholes/wells and handpumps through provincial and district offices of agriculture or health;

* availability of spare parts and repair services at proper market prices (not subsidized) to be paid for by consumers.

Monitoring of the water table

In relation to the standardisation of handpumps, it will be necessary to estimate the different low, medium and high lift requirements. The type of handpump will vary for each application. The data available on static water levels are those measured at the time of drilling. What is important, however, is the static water level at the height of the dry season together with the expected drawdown during pumping. At the present time this information is not accurately known although some estimate can be made based on existing data recorded at the time of drilling.

It is therefore suggested that consideration be given to designing into a proportion of handpump installations a means of ready access to borehole or dug well for the measurement of static and dynamic water levels. What is required is a convenient means of inserting a dip tape in the well to avoid having to remove the pump, or part of the pump head, in order to measure the water level in a well. This will facilitate the monitoring of water levels and changes over time. Such data will also be important for future planning and development of groundwater resources.

To allow for access of an electrical water level indicator (a dip tape activating a lamp or buzzer) a modification to selected installations will be required. A small screwed cover fitted to the pump stand of the India MkII handpump would give access to the gap between the rising main and the borehole sufficient for the insertion of a water level dip tape. Measurements of static and dynamic water levels could then be made through the removable cover.

Data on average groundwater levels could be used to monitor the groundwater fluctuations over time. It would then be possible to give an early warning of any critical

lowering of the groundwater table. The data could also be used by agencies to provide guidance for appropriate water sector interventions. The relevant government department to hold such records would be the Central Department of Hydrology.

According to the Central Water Base records of pump installations up to March 1992, the number of low-lift suction pumps (No.6 pumps) installed was 1296 out of a total of 4459 pumps - 29%. The majority of the installations are in the alluvial plains but as drilling moves out of these areas into the more unpredictable formations the proportion of low/medium/high lift applications may be expected to change.

It is important to monitor this change in order to estimate the likely demand for handpumps of different lift capabilities in the future. Another important reason to keep a tab on water levels lies in the fact that presently in provinces such as Prey Veng or Svay Rieng the confined aquifer is tapped. At the moment no substantial motorized irrigation is taking place using boreholes penetrating to the confined aquifer. It is unlikely that situation will continues to persist when the Cambodian farmer gets access to agricultural credits that allow him to purchase the small type Japanese tractor trailer and fertilizer. The second thought will then be to also use the dry season for planting using deep-well irrigation. The experience of several Asian countries has shown that uncontrolled extraction of groundwater for agricultural purposes can have very serious consequences for the groundwater table and indirectly, for the wear and tear of handpumps. Sometimes the water level falls so deep that the handpump stops functioning.
Monitoring water levels is thus an important issue, not only to detect trends in water level variation, but also to be able to regulate and control groundwater utilization in the face of competing interests.

4.4.5 Water quality

UNICEF has initially tested the water quality of its wells. This only concerned physical parameters and not bacteriological quality. Recently water quality measurement has been difficult due to lack of reagents. The UNICEF master plan lists the establishment of a basic water quality laboratory (in Phnom Penh) as one of the key activities.

Bacteriological water quality is normally not monitored, so no statements can be made about the absolute quality of the water in boreholes and protected wells. However, in relative terms the quality of the improved water points will be better than the one of open hand dug wells and very much better than that of ponds and rivers. All the same it would be advisable to establish a limited bacteriological water quality effort to establish the water quality during various times of the year and in different technical conditions: open well, open lined well, borehole, shallow well with handpump, rainwater collection system, India Mk II, Thai Pump, water container near the home, etc. When done consistently for some time important information about difference in water quality between various options, quality of construction work, effect of insufficient drainage, etc. could be learned. This may lead to adaptation of technical options presently offered. It may also help to establish the urgency and the focus of a hygiene education campaign. For logistical reasons it would be advisable to base such a bacteriological monitoring effort in provinces near Phnom Penh.

High **iron** content in some wells limits the use of the well. Water with a lot of iron does not taste well and causes stains in laundry. UNICEF has been experimenting with various technical solutions for on-the-well treatment. After some initial half-failures, often relating to

the degree of operation and maintenance needed to make the treatment plant work, the latest design seems to work well. It uses crushed polystyrene packing material in a boxed upflow filter connected to the outlet of the pump. The polystyrene floats on the water and provides a large oxidation surface. The ferric oxides remain behind and gradually settle out. Occasionally the filter has to be cleaned by backwashing it. On the basis of first results the effectiveness of the filter is suggested to be around 90 percent.

The Cambodian National Oral Health Survey that was undertaken between November 1990 and April 1991 established that signs of mild fluorosis are present in some provinces. However, **fluoride** contents in drinking water remained within the guidelines suggested by the WHO as acceptable: 0.2-1.5 mg/l. Only in the case of a well in Kampong Speu was a fluoride level of 3.77 mg/l measured. This reflects the upper limit of the fluoride concentration that is considered safe and is already associated with mottled teeth. Higher fluoride concentrations could lead to skeletal fluorosis. The survey considered only some sites in and around Phnom Penh. It did not take many watersamples but only considered clinical signs of fluorosis. The extent of the fluoride issue can not be assessed on the basis of the few data available sofar. However, the mission saw also distinct cases of mottled enamel on several people in one particular settlement 10 miles north east of Battambang. These people seemed to use the Oxfam constructed well as their only water source.
The agency that executed the oral health survey, World Concern, indicated that they were continuing research into the fluoride issue. It would be useful to develop a simple test programme to establish the extent of the fluoride issue in various provinces. Then, it can also be established whether the fluoride content in water does affect the potability of water point sources.
World Concern is located on 48 street 334 in Phnom Penh.

5 Institutional responsibilities for water supply development

5.1 Background

The Ministry of Agriculture and the Ministry of Health are the main actors in the field of water supply development. The Ministry of Agriculture through the Department of Hydrology (DoH) and assisted by several NGOs executes a limited number of well construction programmes aimed at increasing access to improved water supply. The Ministry of Health, through the Centre National d'Hygiene et Epidemiologie (CNHE) and assisted by UNICEF executes a far larger water supply development programme producing 1000 to 1500 wells annually.

The capacity of DoH to execute projects is limited. Facilities at central and provincial are basic and offices, stores and workshops are poorly equipped. Budget allocations to Central Hydrology basically cover only salaries. This makes Central Hydrology fully dependent on external support for its operational activities. In the provinces the situation is not much different, with activities depending heavily on externally financed infrastructural development projects.

Thanks to substantial support provided over the years by UNICEF, the CNHE has been able to establish a well-functioning Central Water Base (CWB) in Phom Penh. The CWB provides logistic support and technical backstopping to the water supply and sanitation programmes that UNICEF executes together with the provincial CNHE units. The cohesion in the UNICEF assisted programme is ensured through relatively clear lines of management and a bimonthly communication workshops. The programme is gradually being decentralized with more implementation capacity in place at provincial level while maintaining a substantial higher level support through the Central Water Base.

In addition to the Ministries of Agriculture and Health, there are a few more agencies that carry responsibilities for or undertake work in water supply such as the Regie des Eaux of the municipality of Phnom Penh and those municipal water companies that through the Ministry of Industry provide water to provincial towns; the provincial people's committees and their departments, as well as an increasing number of private contractors and NGOs.

5.2 Roles in Water Supply Development

The provision of rural water supply services involves two key groups - the water users and the institutions taking responsibility to provide services. To date the focus has been on technical aspects of the provision of rural water supply facilities. That is the construction of the water facility itself and attempting to ensure the on-going operation and maintenance of each facility, particularly where pumps are installed. There has been little attention given to either how the water is used, or at the other end of the scale, the overall management of water resources *per se*, and in particular how the competing demands of different water users influences the character of the water resource.
The respective roles of the water user(s), the government and ESA's is critical to long term sustainability of rural water supply facilities. In this context there is a concern with who 'owns' a water facility in a village? Is it the users, the caretaker, the village chief, the CNHE, DoH, UNICEF or Oxfam? There is so far no simple answer to this question and at any point in time any one of the above may be attributed as the 'owner' depending on the questioner and respondent.

At present, responsibility for the provision and maintenance of rural water supplies rests with the government through the Ministries of Health (CNHE) and Agriculture (Department of Hydrology). Neither ministry/department has the financial resources, even if the human resources were sufficiently developed, to meet this mandate without external support.

Further, given the ever increasing number of water facilities, a majority with pumps, (an additional 10,000 over the next three years planned by UNICEF alone), and the need for on-going maintenance, the question of whether the government, irrespective of whether it has the capacity, should take responsibility for operations and maintenance of individual pumps needs to be addressed.

Other concerns include whether the government should shoulder the operational responsibility of developing water facilities alone. Is there an opportunity for the privatisation of rural water supply development? And if so, how does the government ensure that those communities too impoverished to develop appropriate clean water sources with their own resources gain access to clean water? How then does the government coordinate and manage the development of water resources, including rural water supply? How do ESA's like UNICEF and Oxfam develop programs of support to ensure that government is able to provide sustainable services to rural communities in need, maximising the limited resources available to all? With regard to privatisation, is support for private initiatives consistent with the mandates of UNICEF and Oxfam?

How each agency develops a program in which the 'ownership' of water facilities is clearly acknowledged by the users is linked with the question of how much responsibility the government should (and is able to) take in the provision and maintenance of rural water facilities. An agency's program reflects its rationale for involvement (definition of need) and the nature of the relationship with its partner - counterpart ministry/department. UNICEF and Oxfam began their respective activities in response to emergency needs of a nation wrought by on-going conflict. Thus rural water supply activities were based on a perception of an 'emergency' situation regarding the availability of clean water to rural communities resulting what is essentially 'gifting' of the facilities. In this case the perception of need and associated urgency has resulted in a program driven by technical considerations with longer term O&M (health/hygiene education) aspects being of low priority. By virtue of the approach O&M also becomes the responsibility of those providing the water facility. Consequently, it is often only the technical dimension of O&M that is addressed. The role of users and the negative impact on health and hygiene when the pump has broken down are not addressed in the context of O&M.

There are areas of Cambodia where water is in short supply particularly during the dry season when traditional sources are limited. Whether the availability of water for rural communities is an 'emergency' to the degree that development implications of cannot be incorporated in agency activities, is open to question. It seems with the evolution in agency approaches from an 'emergency' to a 'development' orientation, that although there is a concern with the availability of clean water, it is not, for the rural populace, of 'emergency' proportions. That is, in terms of the sustainability of interventions, no longer can institutions providing the service afford to focus on technical issues only to the detriment of socio-cultural concerns.

In this regard, how the decision to site a pump is made and by whom is important. It appears that the present decision making process is driven by a technical capability and

planning decisions of UNICEF and Oxfam at the beginning of each year - "We have resources to develop 'x' number of wells nationally and/or provincially this year." This figure, agreed with the CNHE (UNICEF) and the respective Provincial Hydrology offices (Oxfam), is the basis for the authorities to move to district, commune and finally to the village chief to determine which communities will receive water facilities. Neither agency is directly involved in discussions beyond the initial one at central, provincial or district level. On the basis of its field work, the Mission feels that UNICEF and Oxfam should undertake or support to undertake monitoring activities at the village level. Such monitoring will provide insights in the degree of community involvement, the quality of the work executed, etc. It also provides important feedback for follow-up, training and institution building.

How much consultation occurs at each level is not clear, however the end users of water facilities do not appear to be consistently and systematically involved in the decision making process. There is of course an expectation that there will be modest village counterpart support - food for the drilling team, sand and gravel - around ten percent of costs. This does not appear to be a large amount in terms of 'ownership' of the facility. But given the apparent lack of involvement in the decision to site a water facility, the amount seems to be acceptable.

Whether individuals and communities are able to contribute a larger amount is difficult to determine given the limited direct contact with villagers to date. In discussions with CNHE, DoH, and ESA staff there are different views. Some say no larger contribution is possible given the state of the rural economy, whereas others agree that perhaps even fifty percent of the cost may not be out of the question. The reality is likely to be somewhere in the middle, depending upon the community in question. Either way, the process of establishing the limits of contributions would also provide an opportunity for the users to participate in the decision to have a new water point with pump, and appreciate the associated O&M responsibilities and costs.

Interestingly the Mission met a widow in Kompong Chhnang who had recently completed the construction of her own 9m deep open well and separate washing platform. She had saved since the overthrow of Pol Pot to have her own water point. The total cost was R200,000 (about US$200 on June '92 exchange rates). With only 0.2 ha of land and one surviving daughter married with three young children, this industrious woman illustrates the fact that when a need is perceived as great enough the resources can be found, albeit over a long timeframe.

The concern regarding 'ownership' is not addressed solely through the community paying for a facility. Experience elsewhere suggests that the financial contribution becomes less important as the opportunity for the community to participate in decision making increases. Given the substantial resource implications of government responsibility for O&M of existing and proposed pumps the time is ripe for the agencies and government to review their respective roles in the decision making processes.

Present, and possible future scenarios, regarding O&M have been discussed in previous sections of the report. There are already a number of examples of privatised pump maintenance operators both within the system and outside it. Again the situation varies but it is not unusual for government maintenance teams to charge for labour and/or spares. There are also an increasing number of private well drilling activities, again within and outside the system. Although in theory the maintenance operations are free of cost to the

villagers the need for government employees to supplement meagre salaries may be one reason for charges being demanded for the service.

To ensure a better quality of construction and finish by small private contractors, UNICEF and Oxfam in collaboration could facilitate regular training courses at district level. The target group would be the masons and artisans usually engaged in the construction of hand dug well and (PAT)-drilled wells. Good understanding of technical issues and their linkages to the quality of work and the quality of the drinking water, will greatly help to raise quality of project implementation. Those who have passed the courses should be given a certificate as proof of themselves having mastered their craft.

The training courses should be supported by manuals in the Khmer language as prepared by GRET (see cover). An essential element of the privatization approach would also be that the public is informed about project standards through appropriate technical leaflets and - maybe - the occasional radio programme. The leaflets could be disseminated through Health and Hydrology. they will contain an explanation of the materials needed for construction, how it is done and who should be contacted to get such a well constructed.

The issue for both agencies and their partners is how they respond to private initiatives. For example, is credit made available for individuals and/or teams to operate within a district to maintain pumps? Should credit be made available to existing DoH/CNHE/HSC staff to develop private operations? As these teams are likely to get involved in drilling for more affluent citizens should credit be available for the purchase and operation of manual rigs? How do spare parts enter the system to support O&M? Is there an opportunity for agencies to underwrite the supply of spares in the market? If decisions are made to develop a pilot credit program for example, the agencies need to be clear on their own roles in managing credit schemes, develop mechanisms and procedures, and recognise that such schemes are long term commitments particularly as the amounts required for initial capital increase and the period of repayment lengthens.

Further, Cambodia's experience in rural credit is limited although increasing.
If the villagers agree that a pump will make a difference to their lives and they are prepared to contribute to, and maintain it, then perhaps the opportunity may exist for the role of government to change from being the provider to all, to focusing on those who are unable and facilitating/coordinating a service to others. With a more active private sector responsibility the government take the overarching responsibility regarding the management of water resources, but not total operational responsibility for the provision and maintenance of all facilities.

However, there is a concern that successful privatisation will result in the poorest missing out on access to clean water. Consideration therefore needs to be given to how best to continue supporting the government's capacity to provide for these communities too poor to generate sufficient capital to drill a well, but prepared to take responsibility to maintain it.

Given the government's financial constraints and the need to utilise existing assets to generate capital for operational activities, consideration should be given to piloting innovative ways of reducing external dependence. For example, supporting the contracting of well drilling by CNHE through the CWB and/or DoH central or provincial to UNTAC and NGOs at cost, might be a useful approach to broaden the resource base beyond UNICEF and Oxfam. If such an approach is chosen, attention also needs to be given to the development of budgeting and management skills to ensure that contracts are effectively

covering both the material/labour and recurrent costs associated with running a well drilling operation.

Water User (Oxfam) and Health and Hygiene (UNICEF) Education activities are central to enabling agencies to better target resources in communities where the need is greatest. This however will require both agencies to coordinate complementary programs in order to maximise relatively limited resources. Further, because of the limited number of Khmer staff experienced in community organising/education in villages, initial activities will need to be modest in their targets and geographic spread.

The staffing implications of village based activities will need to be carefully considered. Already there are limitations on the number of Khmer counterparts available to ESAs, and this number is being influenced by new factors. Whilst the need for ESAs to provide salary (allowances or incentives are often used to describe this) support for counterparts working directly on projects has been unofficially accepted in recent times, the inflationary impact of UNTAC and new ESAs competing for the limited pool of experienced Khmers is being felt. This has long term implications for UNICEF and Oxfam in assessing the nature and sustainability of their future activities.

The inability of almost all expatriate agency staff to communicate in Khmer is a serious limitation and, for some staff the Mission met, a source of frustration. As agencies refocus their activities to villages the need for Khmer language skills increases significantly. Although Khmer is a difficult language for many, attention needs to be given to providing the maximum opportunity for expatriate staff to at least get a good grounding in the language prior to commencing their full time commitments. This may mean up to six months (at least three) of intensive language training preferably in-country. Given the large numbers of expatriate staff consideration should be given to agencies cooperating in establishing language training facilities.

5.3 Capacity building at the Central Level

The UNICEF supported programme is directed from the Central Water Base which is part of the "Centre of Hygiene and Epidemiology" (CNHE), one of the most important divisions of the Ministry of Health. CNHE is also responsible for implementing the Expanded Programme of Immunization, that is also supported by UNICEF.

According to UNICEF, the capacity of CNHE to implement the rural water supply and sanitation programme is hampered by lack of budgetary support, weakness in planning, monitoring, implementation, evaluation and management of projects, inadequacies in the number of qualified personnel assigned to the project and low priority given to the project within the CNHE.

UNICEF WATSAN feels it is not working with the right partner as CNHE does seem to have the interest to really invest in making the CWB sustainable and so giving the WATSAN programme the priority it deserves.

At present, the Central Water Base is just a unit under the CNHE which is one department in the Ministry. While the Central Water Base looks impressive with its large drilling machines, transport equipment, warehouse with forklifts, laboratory equipment, photocopying machine and computers with printer provided by UNICEF, attention to the

full utilization of this equipment or even interest in developing capacity to fully utilize it seem to be lacking. The programme does not even continue to use the sanitation unit which was made at the Central Base to promote environmental sanitation and the construction of latrines. At the provincial level, the provincial health service centres have continued production of concrete latrine slabs and installing latrines in the communities (quoted from UNICEF 1992 plan).

The combination with the Ministry of Health is an awkward one for a technically and output oriented Programme. It is quite obvious that the priorities of the Ministry of Health are different, and should be different at least for the time being! UNICEF complains about the difficulty of getting well trained staff to manage the Programme. Still, it has staff willing to work in a situation where there is an acute shortage of qualified personnel. A situation further compounded by growing opportunities in the booming "development business" of the day and the expanding economy now that so much money and opportunity is around. This drain can probably not be stopped as the earnings of government employees, even when they receive incentives and perks, is small compared to the newly arisen opportunities for trained and english (or french) speaking professionals.

During the last few years insufficient numbers of staff to manage and supervise the key units of the Programme, have caused UNICEF to run the Programme on behalf of the CNHE. This is obviously not a sustainable and preferred situation. There are probably few solutions to this. Some can however be suggested:

1. reduce the UNICEF physical output to a manageable level for the Ministry of Health and shift the emphasis from delivery of technical facilities to the delivery of an integrated health promotion package in which a sanitary well, a handpump, sanitary facilities, immunisation and kitchen farming may be steps to improved living conditions for children and mothers;
2. contract out well drilling and construction to the (Provincial) Department of Hydrology;
3. induct young khmers as trainee overseers to be attached to the provincial HCS water projects (refer to UNICEF-Nepal capacity building activities 1976-1980);
   The planned UNICEF support to the Khmer-Sovjet Technical High School already points in that direction.

Though there are constraints, the UNICEF programme benefits from its links with the provincial Health Services Centres for the delivery of its Programme. The coordination meeting that was attended by the mission was impressive in its broad representation (of all provinces). The later **visits to Battambang and Kompong Chhnang confirmed the capability and interest of the medical officer-in-charge and his staff. Though the health services staff** undoubtedly were more oriented towards the curative side, they also showed a good degree of interest in the development of the water supply and sanitation programme. The mission felt that UNICEF was not too bad off with CNHE as a partner. Or in other words, to court DoH as a new partner may not overcome the problems mentioned earlier either.

However, when in the coming years a government department or Ministry would come to the fore that would have a **clear mandate towards rural (social, economical) development,** then such an organisation may prove a better partner for UNICEF, and maybe even for Oxfam. Such a national level agency would have to provide the policy and support framework, with actual work being planned and implemented at provincial and district level.

In view of UNICEF's mandate it is recommended that UNICEF WATSAN stays with CNHE. With the Ministry of Health as a partner, UNICEF has presently the best chance of encouraging Health into a primary health care direction that will integrate all quite some of UNICEF's programme activities into a strong programme for the improvement of living conditions for children and mothers. UNICEF WATSAN should further liaise with other agencies that are important to its Programme for delivery of water supply and sanitation facilities. As is already the case UNICEF can collaborate increasingly with other sector partners to still achieve a good physical output. It is assumed that with increasing capacity of DoH and with a growth in private drilling the pressure for UNICEF to establish and maintain a large implementation capacity at the CNHE will gradually diminish. UNICEF will then position itself more as a motivator and facilitator for qualitative sector development that will include all the elements that are currently en vogue such as community management, hygiene education, IEC, cost recovery, etc. As there is often no emergency for water, but rather a situation in which diarrhoea morbidity is induced due to people unknowingly consuming polluted water or infecting themselves due to poor hygiene and food preparation habits, the mission considers it more in line with UNICEF's mandate to support health impact in a comprehensive way, rather than just focusing on numbers of wells drilled knowing at the same time that such wells are often not being used. This comment subscribes as well to the note from UNICEF WATSAN NYHQ on the last annual report in which the high planned coverage goal was criticized as being unrealistic especially in view of the required financial and manpower requirements.

A decentralization of UNICEF WATSAN activities to the provinces is further foreseen to make programme activities more effective.

Oxfam and a number of other NGOs are supporting the Department of Hydrology by supplying several advisors for a period of two to three years. This support is provided to enable DoH to be effective as a government department with a major responsibility for water resources in the country. The rationale and the details of the management support programme can be found in the proposal formulated by a group of NGOs in November 1991. Whereas the concept of merging staff resources to strengthen DoH is to be applauded, it may well be that it proves deficient in its execution. For instance, as indicated in the next section, the time that can be spent by the Oxfam Rural Drinking Water Coordinator in his capacity as Rural Drinking Water Advisor, is reduced by inputs of himself and his colleagues in UNDP and UNHCR activities. These are activities which may well be part of DoH responsibilities but which divert his energies from important long term strategy development. In addition his responsibilities towards Oxfam mean that substantial time is spent on Oxfam related matters. This may not be very much different for other staff assigned to the DoH. It is clear that even in the best of cases an exclusive assignment to DoH is unlikely on the part of NGO affiliated staff. This situation may seriously jeopardize expatriate staff identification with DoH and thus the acceptance by DoH of their contributions towards the development of policies and procedures.

While the NGO effort is commendable it is also clear that it is a situation that is not sustainable. More likely than not DoH will require expatriate subject specialists that can assist it to develop a groundwater resources mapping system or a water resources master plan. Such staff is unlikely to be hired through NGOs. So, in two to three years the torch has to be handed on to multi- or bilateral agencies that are capable of recruiting the specialized personnel needed at that time. Oxfam does not have the financial resources or technical capability of the larger bilateral and multilateral agencies and, therefore, what it

can offer is limited. It is, however, in a position to bridge the gap until the larger agencies are able to provide assistance.

In fact that is all for the better, because NGOs are better placed at provincial and district level to communicate directly with their target group, the communities, and in the process develop capacities for implementation, than sitting at the Central Department of Hydrology. In the meantime the group of NGOs should undertake efforts to interest donors to gradually take over from them at the centre. UNDP might be interested, under its advisory services, baseline studies and training component, to support the fielding of a mission that could look in the staff needs of DoH and that could develop proposals for continuation of capacity building support after the NGOs have withdrawn.

For the Central Department of Hydrology to function effectively under the present circumstances it needs to be able to secure resources. Part of such resources might come from drilling services contracted out to UN agencies and NGOs. To perform such tasks it would need to have the equipment and staff.
Oxfam does not want to become directly involved in contract drilling but it is interested in keeping Central Hydrology working as an effective department.

The drilling rigs will need to be maintained and for this they will require spare parts. In addition to the one working Russian rig, there is another Russian rig which is out of action due to the breakdown of its generator. There is also a non-working Tone TDC "202" rig which was originally donated by Oxfam. This is out of action because it needs a new piston for the mud pump and a gear for the swivel head assembly.

If the Department is receiving income from its drilling activities it should be able to generate funds for spare parts. It may not, however, be in a position to purchase them. This is an area where Oxfam might assist in the procurement of parts from outside Cambodia on behalf of the Department but paid for by them. In this way, it would be possible for Oxfam to assist the Department to continue functioning whilst supporting, in other ways, the development of both Central and Provincial Hydrology.

One of the areas which requires support is the systematic collection of hydrogeological data. Some written information and data from the logs of boreholes drilled so far does exist. If a start can be made on training staff within Central Hydrology in hydrogeological data collection and interpretation it will help in preparing the ground for future water resource developments. It is unlikely that Oxfam would be able to provide the specialist skills required but they might be able to facilitate such a short term mission by an appropriate specialist agency.

Whilst the multilateral agencies, such as UNDP, are not in a position to fund long term projects before the elections, they are in a position to fund short term missions. Oxfam could assist Central Hydrology in the preparation of documents to attract appropriate short term projects. Linked to the above is the need for a geophysical exploration capability within the country. As drilling moves into more difficult geological conditions, compared to the more recent predictable drilling, then the need for geophysical surveying becomes more important. None of the organisations currently drilling have either the equipment or the expertise to carry out such surveys. This is an area where the department of hydrology could provide a service but are unable to do so at the present due to a lack of equipment and skills. Funding and specialist expertise for training is again required and could be linked

to the collection and interpretation of existing data under a short term mission as discussed above.

The benefits of short term specialist inputs are that: it prepares the ground for the later larger scale inputs; it provides specific professional training for Central Hydrology staff; it supports Central Hydrology to provide a hydrological information service which could be charged on a fee paying basis to cover costs.

Further Oxfam support to Central Hydrology concerns its relationship with the provinces and the manner in which they can effectively work together. Through the support of the Oxfam funded Rural Drinking Water Advisor to Central Hydrology there are a number of issues which need to be jointly considered by both Central and Provincial departments of Hydrology. These include most of the points which are already on the agenda of a meeting arranged in August between Central Hydrology, provincial offices of hydrology, and external support agencies:

- Coordination of designs to include feedback from a broad range of experience and to ensure appropriate standards;

- Establishment of a more efficient system of equipment and material request from central stores;

- A clarification of the method of site selection especially concerning the involvement of beneficiaries;

- The extent to which beneficiaries are involved, and can be involved, in the development of their own water sources. That is, village participation beyond the provision of village labour alone;

- The arrangements for operation and maintenance of improved supplies. In particular, the maintenance of handpumps and scope for the training and support of private handpump mechanics;

- Support of the draft DCC proposal for the establishment of standard specifications for handpumps in Cambodia;

- The identification of training needs at both central and provincial level. Oxfam may be able to respond at the Central level by facilitating specialist training through short term missions as discussed above. At the provincial level, the training needs identified could be addressed in the provinces where Oxfam engineers are posted, by the engineers themselves, or arranged through them with the assistance of other agencies such as GRET.

5.4 Water Resources Management

The issues outlined above are complemented by institutional concerns regarding the management of water resources in Cambodia, the future relationship between UNICEF and Oxfam and their government partners, and the impact of substantial UN assistance. As noted earlier, two ministries share, but seldom coordinate, the responsibility to provide rural water

facilities. Within the Ministry of Agriculture the Department of Hydrology is the main, but not the only actor. GRET's rural water supply activities are for instance conducted with the Department of Agronomy. In addition, questions have been raised as to the appropriateness of the Ministry of Health taking an operational role in the provision of water facilities. This seems to be out of character with the rest of its operations. The lack of coordination between government agencies is problematic not only regarding rural water supply, but in the management of water resources *per se.*

Whilst there are historical reasons for the coordination weaknesses, the scale of potential interventions affecting the character of water resources is such that there is an urgent need for the government to consider the most effective means of long term management of water resources in Cambodia. The UN through UNTAC, UNHCR and UNDP have substantial interventions planned for the period up to December 1993 when a newly elected government is expected to have been installed. Based on the Declaration on the Rehabilitation and Reconstruction of Cambodia within the October 23, 1991 Peace Plan, the UN Secretary General has prepared a Consolidated appeal of US$ 608 million for Cambodia's Immediate Needs and National Rehabilitation for consideration at the Tokyo Donors meeting in June 1992. US$ 15 million is requested for provision of drinking water and sanitation in rural areas.

UNHCR and UNDP commissioned a mission to develop a Rural Integration Strategy with particular focus on the 377,000 refugees to be repatriated, 180,000 internally displaced persons, an estimated 190,000 demobilised military personnel and "the essential needs of communities expected to absorb the various categories of returners" (Report of the Cambodia Rural Integration Strategy Mission, pp4). The UNDP Mission focused on the four northwestern provinces expected to receive most of the returners (an assumption now under question), but notes that it "was expected to develop a strategy that could apply equally to all of Cambodia" (Report of the Cambodia Rural Integration Strategy Mission, pp4).

With the prospects for increased development assistance and a rapidly expanding private economy, coordination of water resource use is essential. The Mission proposes that the government consider the establishment of a coordinating body - possibly called a Water Resources Apportionment Board - with Ministerial level representation. This Board would carry the responsibility to coordinate the various interests in the use of water within a political rather than technical framework. To provide an independent chairmanship the Ministry of Planning could be proposed to head this Board. To represent the donors and to provide technical assistance to assure integrity of the water resources management policies and activities UNDP could be on that Board as an observer. To assure adequate reflection on regional water resources implications, it would be good to invite the Intergovernmental Committee on the Mekong on the Board as an observer as well.

The Board will make policy within the framework of a water resource development plan, ratifying procedures and guidelines on the use of the resource. Such a body will require secretarial and technical support. In order to minimise duplication of activities, it is proposed that consistent with the mandate of the Department of Hydrology for technical oversight of the development of ground and surface water resources, that it is chosen to provide support to the Board and to act as its secretariat.

The Government will have to formulate the necessary legislation to enable the Board to be established and to ensure that DoH can execute the tasks assigned to it.

It is assumed that the present autonomy of provincial government operations will remain largely unchanged. To ensure good coordination and communication, it is proposed that Provincial Inter-agency Water Sector Committee are established to coordinate the two-way flow of information on resource management and the application of policies, guidelines, procedures and monitoring systems. DOH by appointment of the Provincial Governor would act as the secretary to this Committee, which at the provincial level would carry similar functions as the Water Resources Apportionment Board at national level. Provincial DoH will provide the link with Central Hydrology and The Water Resources Apportionment Board. At district level another committee will need to be formed along the lines of the Provincial Inter-agency Water Sector Committee to regulate and monitor water use. This Committee will be the lowest administrative rung of the water resources management structure.

As the secretary to the Water Resources Apportionment Board, the DOH will have specific responsibility on behalf of the Board through the conduct of regular consultations among central, provincial, and district sector agencies to:

* develop technical standards and operating procedures;
* establish national ground and surface water databases and geohydrological maps; and
* establish and operate monitoring and evaluation systems for water resources utilization at various administrative levels.

It is assumed that the operational responsibilities of central DOH with regard to undertaking water related development activities in irrigation and rural drinking water will remain unchanged. For reasons of efficiency it could be considered that over time the deep well drilling capacity of the government should be under the responsibility of the DOH rather than split between two ministries as it is at present.

Oxfam in particular needs to support the DOH in developing proposals which meet the criteria within the existing Training, Advisory Services and Baseline Studies theme of UNDP to generate operational support in the interim period before the elections. Such activities are a necessary precursor to development projects which will be undertaken by bi- and multi-lateral agencies after the elections. Capacity building of provincial authorities, in particular Hydrology is a priority in order to both service the information needs of the centre, and take the major implementing responsibility in the field.

5.5 Coordination among donors

For quite some years the collaboration between development agencies working in Cambodia has been very good. The water sector is no different. UNICEF and Oxfam have been working together in operational sense and have spread their support to other agencies such as GRET and AICF. These coordination efforts also show up in the bimonthly meetings that take place at UNICEF and that brings together all the important agencies supporting the sector. Agency policies; information about incentives schemes, training needs and opportunities; problem solving for sector development are key points in these meetings. These efforts are quite commendable and should be continued with vigour. The commendable and long-standing collaboration between UNICEF and Oxfam is a sign of the wish to work together for the best result and least duplication and waste of effort.

Similar communication and coordination meetings are now being organized by UNHCR to consult and inform its partners. These meetings are quite important to be able to discuss and

negotiate in a broader forum the type and urgency of the inputs to be provided to the repatriation effort.

5.6 Incentives

The mission has been asked to comment on the incentives structure. The mission feels incompetent to make any statements or provide guidance on allowances and incentives. The reasons being that it is felt that the issue of incentives should be settled between the various donors, development agencies and programmes, or that the market itself needs to take care of this phenomenon. With the present inflationary pressures brought about by the UNTAC interventions, the issue of incentives will become even more pregnant. Also, as has been indicated earlier in the document, it will get difficult to even hire good people because of the fierce competition for staff.

At the project level the effects of incentives have to be considered well. Do incentives achieve their intended goals: better performance, or do they lead to rush-jobs? Should incentives be linked to output performance (production) or should incentives be construed such that people feel it worth their while to stay in their job and perform at quite a reasonable level at the same time? This could for instance be done through provision of training opportunities, establishment of a pension fund and by ensuring interesting work.

5.7 Decentralization

For some time it has been quite difficult for UNICEF and Oxfam to work at provincial level, let alone the district level. Now that the opportunities to work directly with provincial and district level are increasing, sector agencies should consider how best they can encourage decentralization of their activities. For UNICEF that will initially mean that they will need to reinforce the capacities of the Provincial Health Services to survey, plan and implement projects. Discussions, participatory training exercises with senior provincial level staff and classroom sessions are needed to provide staff with the intellectual baggage to contribute to programme development and actually implement the programme independently. Once the provincial level is confident that it can handle the programme well, the district level can be approached and strengthened for the delivery of an integrated approach in which all UNICEF's elements are coming together. The Family Food Programme and the district level O&M arrangement in Takeo District may well provide lessons on how to decentralize effectively for better communication, for planning and delivery of services. Oxfam is already working at the district level, but needs to strengthen its programme by encouraging Provincial DoH and their offices at district level to hire additional staff for project preparation and implementation. Also these people need training in technical, social, economic and environmental issues relating to project design and implantation. There is a lot of scope for collaboration between sector agencies with regard to this training.

In conclusion it can be said that the district level offers the best opportunity for effective capacity building by UNICEF and Oxfam. This capacity building will have an impact on the way the projects are being executed because by proper retraining of agency field staff a lot of participatory elements can be introduced in the implementation process at village level that will enhance the sustainability of the project (especially with respect to O&M).

5.8 The Rural Integration Strategy

The Rural Integration Strategy identifies a package of short term Quick Impact Projects and recommends developing further medium term Area Development Schemes. USD4.3 million is requested to implement ten Quick Impact Projects aimed at improving drinking water for the target communities in northwestern provinces. This includes 240 hand dug wells, 600 shallow bore holes, 75 infiltration galleries, 150 slow sand filtration water treatment plants, and other projects to construct latrines, rainwater collection, communal ponds etc. As has been evident for some time prior to the Peace Agreement, the UN would not be in a position to implement most of the projects it is responsible for. Other agencies would be implementing or acting as managing agents to the UN, either UNHCR or UNDP.

Thus, the UNDP Mission proposed that water supply activities would be "centralis[ed] ... under a technically oriented agency who would act as UNHCR's implementing partner ... Initial contacts indicate the willingness of OXFAM/UK to assume this role ... [and that] any agency or group willing to collaborate with UNHCR in the provision of drinking water will carry out its work under the technical guidance, coordination supervision and support of OXFAM who will ensure that project tools and mechanical equipment are appropriately operated and maintained and adequate priorities and timing are maintained to permit an efficient and timely support to agencies or groups involved in construction of water supply systems" (Report of the Cambodia Rural Integration Strategy Mission, pp27).

This is a substantial management role and in discussions with Oxfam's Phnom Penh staff in June 1992 it appeared that there was not the same degree of "willingness" as attributed in the UNDP report. The situation is complex with the 'urgency' associated with UNHCR activities increasing with each passing day. Whilst the Mission understands that there are on-going discussions within Oxfam regarding their potential role in these Quick Impact Projects, the scale and nature of the responsibilities identified need to be carefully assessed against Oxfam's present staff resources and its future role in Cambodia. Although UNHCR will provide appropriate resources this is not necessarily the key issue in Oxfam's decision to be their managing agent.

Oxfam's relationship with its partner the Department of Hydrology at the centre and with Prey Veng/Svey Rieng and Battambang/Banteay Mean Chey provincial offices has a bearing on this decision. This Mission has identified a number of technical and management concerns relevant to both Oxfam and the Department of Hydrology central and province, which need to be addressed irrespective of involvement in UNHCR/UNDP activities.

Further, Oxfam's rural water supply activities require a coordinator, and prior to the arrival of an engineer for Battambang/Banteay Mean Chey program, someone to support activities there. This means that the Rural Water Supply Advisor appointed to the Management Support Program position has added agency responsibilities which will limit his time and effectiveness in the position. As noted earlier the implications of this situation need to be addressed, but also the Mission was concerned whether Oxfam (and other involved agencies) have the capacity to sustain the level of inputs required over the long term (5-10 years) to develop human resources in government departments.
Constraints on operational staff resources exist in UNICEF, which may need to be addressed in light of the intensive nature of the institutional strengthening aspects of their current program. With the technical capacity of UNICEF and the CNHE there is a need to have commensurate management and administrative support. As noted above concerns have been

raised as to whether the Ministry of Health's substantial technical water supply capacity is consistent with the mandate of a health ministry. Whilst this is essentially a political decision which may not be addressed in the short term, there are two important aspects to be considered.

First, there is a need to manage the present capacity including logistic support and administration in order to maximise the effectiveness of operations over the next twelve months. Second, UNICEF may wish to review its longer term role in technical provision of rural water facilities and the priorities it attaches to other aspects of rural water supply. However any changes need not be sudden as the opportunity exists for UNICEF to ensure that within the life of its next program cycle, it is able to withdraw from direct technical support through the CNHE. Decisions UNICEF may make on the nature and phasing of activities need to take into account the government's response to the need for effective coordination in the management of water resources.

Drinking water is but one of a number of uses for the resource - irrigation, transport, fishing, industry, etc. Although the main actors in drinking water are the Ministries of Health and Agriculture, there are a number of other government ministries and municipal bodies involved in decisions about water. In the absence of an overall plan on the management of water resources, ad hoc decisions are made on the basis of technical considerations relevant to the interests of those who are considering the development.

6 Recommendations

6.1 Sector responsibility

Key players in the sector include the Ministry of Health/Centre National d'Hygiene et d'Epidemiologie (CNHE), municipality of Phnom Penh, Ministry of Industries (drinking water supplies for provincial towns and possibly some industries), UNICEF and NGOs. The council of ministers has decided some time ago that MoA (for water development) and MoH (for water quality) are the ministries that should take prime responsibilities for the implementation of water supply projects.

6.1.1 It is recommended that the Government of Cambodia consider the establishment of a **water resources apportionment board** to coordinate water resources development activities as part of a larger water resources management responsibility. This board should further develop the legal framework relating to water use, control of water quality and (in future) environmental impact of water development activities. It will prepare policy decisions and recommendations for the approval of projects to the council of ministers.
The Water Resources Apportionment Board could be chaired by the Ministry of Planning and has as its members the ministries of Agriculture; Industries; Communication, Transport and Posts; and Interior. The Department of Hydrology is acting as the secretariat of the Board and maintains the necessary national level information management systems to supports its tasks. The Intergovernmental Committee on the Mekong and the United Nations Development Programme could be invited to the Board in an observer status.

To ensure good coordination and communication, it is proposed that Provincial Inter-agency Water Sector Committee are established to coordinate the two-way flow of information on resource management and the application of policies, guidelines, procedures and monitoring systems. DOH by appointment of the Provincial Governor would act as the secretary to this Committee, which at the provincial level would carry similar functions as the Water Resources Apportionment Board at national level. At district level another committee will need to be formed along the lines of the Provincial Inter-agency Water Sector Committee to regulate and monitor water use. This Committee will be the lowest administrative rung of the water resources management structure.

The Department of Hydrology under the Ministry of Agriculture has at the moment the responsibility for development of irrigation and drinking water projects, for maintenance of information management systems for meteorological and climatological data, for technical quality control and approval of proposals put forward by provincial offices of the Department of Hydrology.

6.1.2 To reinforce the capacity of DoH to perform its monitoring role it would be advisable to establish a geohydrological survey capacity in the Department.

To start off the geo-hydrological survey, data available at DoH, UNICEF and a range of NGOs on well characteristics and geological configurations could be used. For future

reference and to establish a higher drilling success rate in difficult geological areas a proposal should be prepared for the development of a geo-hydrological survey in Cambodia.

6.1.3 UNDP should be requested to fund a three months expert mission to advise on:
- establishment of a geohydrological database
- data collection format (in consultation with sector partners)
- establishment of a central geo-physical surveying unit with a limited capacity

The sectoral working group meeting on WS&S led by UNICEF and providing a very useful exchange between UNICEF and NGOs working in water, is a commendable effort in communication. Care should be taken to invite other developmentally oriented sector partners to this meeting as well as to further enhance collaboration in various sector capacity building activities

6.1.4 It is recommended that informal representation from DOH's office of water management (and from the MoP and MoH) could be considered for enhanced planning and execution of activities.

6.1.5 A note could be prepared by the working group to indicate contact persons and key-areas of intervention, by organization, This note could be provided as an addendum to the CCC publication on "Humanitarian Assistance in Cambodia".

Now that the situation in the country is gradually improving, water supply development work at provincial and district level will increase. In some provinces coordination of both emergency and development water activities is assured through provincial Inter-agency Water Sector Committees chaired by provincial governors.

6.1.6 Government departments and sector partners should strive to establish similar coordination mechanisms in other provinces. In addition to matching of needs and available capacities, the committees could also develop guidelines for prioritization and selection of projects

Following the earlier initiative by GRET, UNICEF and Oxfam a draft has been prepared for a standardization of handpumps in Cambodia.

6.1.7 UNICEF and Oxfam are urged to support the draft DCC proposal for the establishment of standard specifications for handpumps in Cambodia.

6.1.8 Further installations of handpumps are to be based on the outcome of the standardisation process and the response of users to the review of existing handpump installations.

6.1.9 UNICEF should explore ways in which it can reduce, and finally eliminate, its role, together with other ESAs, as the (near exclusive) supplier of handpumps (in particular the India MkII) to the water sector in Cambodia. It should explore the potential for the supply of handpumps and spare parts through the private sector and how UNICEF could encourage this move.

6.1.10 Sector partners should review the potential for privatisation of handpump maintenance by looking at the workings of the current provincial maintenance teams.

There seems to be a potential for the establishment of private mechanics. This should be encouraged.

6.1.11 Users carry their own responsibility for upkeep and maintenance. Through information, education and communication, users should continuously be reminded of these responsibilities and what their own duties are in ensuring that proper O&M takes place.

6.2 Capacity building

DoH presently has insufficient qualified staff, skills and operational funds to undertake the variety of tasks that are proposed. A reinforcement of technical capacity assured for the next few years by the joint initiative of the NGOs to provide 12 experts to DoH. Though this resolves the immediate problem of qualified staff for some critical positions in the Department it can not be expected that the NGOs will continue funding their staff input for more than one programme cycle. Neither should they as capacity building at national level can only in exceptional cases be considered within the mandate of NGOs.

6.2.1 As a longer-term capacity building effort needs to be undertaken, DOH and the group of NGOs now working with it should contact UNDP, ODA and possibly other bilateral agencies for development support. It is suggested that 5 to 10 year capacity building programme needs to be formulated to really equip MoA and the DoH to execute its national and international tasks in water supply development and water resources management.
UNDP should be approached to explore whether it can fund a broad preliminary study outlining the tasks and matching resources.

In the present socio-economic and political context, DoH hardly executes any activities. Projects are decentralized and so hardly any operational funds remain at the central level.

6.2.2 Provinces and third parties should be charged by Central Hydrology for services rendered (drilling, consultancy, etc.)

6.2.3 In order to generate operational funds Central Hydrology should develop proposals for support activities and submit these to donors.

A combined NGO effort is underway to strengthen DOH and its activities at central and provincial level.

6.2.4 Project implementation procedures and guidelines need to be developed that focus on consumer interests and participation, favour consumer initiation and controlled privatization and take into account other development interests in particular related to health and environment (impact) all with a view to establish sustainable development activities

Each of the participating NGOs has committed it selves to the very necessary support to national level capacity building for water. However, the experience with Oxfam at this moment seems to indicate that the Oxfam advisor to DOH has spent less than 50% of his time on DOH work. This does not seem adequate for the task.

6.2.5 NGOs need to be clear on the amount of time the advisors spend on activities specific to the agency employing them in addition to their broader responsibilities with the DOH.

UNICEF is working within CNHE/MOH, and has established a proper framework to execute water supply activities through the provincial health services committee and CNHE and supported by the Central Water Base. Both drilling activities and O&M arrangements are quite satisfactory. However, any further increase in drilling capacity will require a corresponding increase in technical staff and support that the Ministry of Health does not have the capability to provide without increasing its already considerable dependency on UNICEF's external support.

Assumptions: **UNICEF will** gradually **concentrate more on an integrated delivery of health** and well-being **related services.** The relative importance of drilling for safe water declines with more agencies (DOH/NGOs, private companies) developing capacities in this field. Also, other external support agencies will soon be entering the water sector who will be in a better position to support a long term drilling programme, e.g. UNDP and bilateral donors.
Hygiene education, sanitation, FFP, MCH become more important.

Conclusion: there appears a decreasing need for drilled wells in the new programme cycle (1994-1999), but there is at the same time an increased importance of sanitation/HE/MCH and integration with activities of MOH and Social Action. Strategically the alliance with MOH is considered more important to UNICEF and should not be jeopardized by a transfer of drilling activities to DOH.
However, when in the coming years a government department or Ministry would come to the fore that would have a **clear mandate towards rural (social, economical) development** then such an organisation may prove a better partner for UNICEF.
UNICEF should chose its government partners on the basis of the strategic importance of its Programme and not confuse these strategic issues with the need to make the link with sector agencies when so needed for specific sector services (in for instance water supply development or sanitation).

6.2.6 It is recommended that UNICEF WATSAN remains with CNHE, accepts a decreasing water programme in the next programme cycle and will tailor staff resources of CNHE and UNICEF to reflect change. Increasingly undertake subcontracting for water to Hydrology, NGOs and private contractors.

6.2.7 UNICEF should use its vast expertise to concentrate capacity building with CNHE on management and planning, on integration and synchronization of health-related inputs in support to target groups, on monitoring for public health improvement (WASAMS), on training and recruitment of sanitary engineers or public health officers to guide provincial programmes. It should concentrate on capacity building for communication and change (IEC) at national/provincial and district level. Technical staff should be made part of the IEC effort. Health impact should the real objective of the WATSAN programme (supported by MOH and interventions by UNICEF and NGOs)

To reinforce this gradual shift to a more health-impact facilitating role, UNICEF should urgently increase its international staff with a sanitary engineer with experience in public

health engineering and planning. Simultaneously it should co-opt 5 or 6 young Khmer professionals to act as trainee overseers or junior field officers in key provinces to support water and sanitation activities and generally to ensure integration of WATSAN inputs with other UNICEF activities.

6.3 Community Involvement Issues

Several issues have been mentioned in the earlier text on the subject. It suffices here to list the key issues relating to a shift from a hardware emphasis to a software focus.

* Concentrate on providing drinking water facilities which are acceptable in taste for the people;
* Select villages based on demand, finalize selection of villages only after social assessment has taken place;
* develop a range of technical options for the community to choose from: handpump, closed well, open well, bucket and rope, pully, shadoof, handpump and opening for drawing by hand, separate apron for washing and bathing, improvement of existing well, digging of shallow well and provision of rings, improvement of rainwater catchment, including manufacturing of cement jars or cement tanks (see Thailand).
* give the community **TIME** to make decisions on facilities;
* involve formal and informal leaders such as monks, traditional healers and achar;
* provide training in communication for and about water supply to technical staff, this should include training in participatory discussion techniques and emphasize the role of women;
* select and train one woman per district to be responsible for the hygiene education/water user education;
* involve women at commune level for carrying out education and monitoring. This could be a nurse, midwife, teacher, extension worker.
* develop a system for hygiene educators at village level involving people who already work at the community level;
* improve collaboration and integration with other development programmes such as FFP, Women's Association, Agriculture programmes.
* use community motivation and development experience from elsewhere in the region to improve impact of the water supply programmes (e.g. programmes carried out in Thailand, especially in the Northeast);
* for sanitation, concentrate on facilitating the production of latrine parts by private enterprises

6.4 Technical Issues

6.4.1 Review the handpump platform and rehabilitated dug well design and construction to improve the long term sanitary conditions of the improved water sources.

The review to take into account the following:

* the way people currently use the water obtained from improved sources, i.e. body washing and clothes washing at, or near, the source which results in large quantities of waste water;

* the uses to which people might put the water from improved sources in the future: drinking, animal watering, small scale gardens, etc.

* a payment scheme which takes into account the quality of construction as well as the number of installations completed.

6.4.2 Further support the development of hand dug wells by continuing to support and encourage existing programmes such as FFP, GRET, and integrate with water user education through linkages with the UNICEF health programme.

6.4.3 Study the potential for the support of rainwater catchment improvements in order to increase the availability of potable water from this source.

6.5 OXFAM

To improve the technical quality and accountability of the existing water programmes by taking the following actions:

* improve record keeping, and where records are incomplete, initiate the establishment of an inventory of completed installations (boreholes, open wells, ponds, etc.).

* establish a budgeting, accounting and monitoring procedure based on accurate estimates of expected costs, more effective stock control and recording of material used in construction.

* initiate a process to identify the areas requiring support in provincial hydrology offices which will lead to an improvement in quality of work. This will involve the issues of incentives and payment of allowances; assessment of further training needs; the establishment of effective supervision and monitoring of site work.

* through the advisor to Central Hydrology, assist in the establishment of standard procedures for drilling, construction and design within the department of hydrology.

* to reconsider the level of community participation in water source development so that users are more involved in site selection, technology choice, design and construction.

* establish a policy for the maintenance of installations after the withdrawal of Oxfam. In the case of handpumps, close liaison with UNICEF concerning the privatisation of pump maintenance will be required. The maintenance of open wells by users to be included in the proposed complementary water use education programme.

* review the demand for the continued maintenance of previously installed handpumps on Oxfam drilled boreholes. Through the activities of the water use education programme choices can be made by users on the future of these installations. Appropriate action by the Oxfam/DoH provincial programme to follow the consultations.

Until the elections are held there will be limited support given to the Dept. of Hydrology from large ESAs except through specific project based interventions. Oxfam can use this period, both in Central and Provincial Hydrology, to prepare the DoH for the large scale inputs which are likely to occur in the near future. This can be done in several ways:

* give support to Central Hydrology to attract short term funding for specific projects from other donors.

* to consider moving to an approach whereby Oxfam and other sector support agencies contract the Department of Hydrology, at both Central and Provincial level, to drill boreholes or carry out other work in response to the needs identified through the proposed water use and health education activities.

Within Oxfam there is also a need to address the relationship between the Education and Technical aspects of the rural water supply program. Although water user education is mentioned as an 'intended effect' in the Prey Veng/Svay Rieng project logframe, it appears from the logframes of both provincial projects that there is a separation rather than integration of technical and water user education activities on a 'project' basis. As the two are interdependent, for sustainable management of water resources in a village, this apparent separation may need to be reconsidered.

6.6 UNICEF

Strong linkages between the WATSAN programme and other sectoral programs in UNICEF like Women in Development, Family Food Production and Education are foreseen. In the Family Food Production project of the Women in Development/ Household Food Security Program *the development of the rural water supply constitutes one of the major activities .... being a critical element in vegetable and fruit tree gardening...* Water jars, ponds (through food for work schemes), and wells (approximately 1,000 traditional wells per year) are all techniques identified to provide water in this project.

To provide a solid foundation for sustainability beyond the life of UNICEF support the mutually reinforcing effect of the sectoral programmes within the overall UNICEF programme should be realized through increased coordination within UNICEF/Cambodia. The recent appointment of a programme coordinator and a monitoring officer are indications of UNICEF's concern to emphasize such coordination for optimum impact in the health and well being of children and their families.

With respect to either the WATSAN Project Plan of Action for 1992 or the Master Plan it is not clear how the various programs within UNICEF will interact operationally.

6.6.1 It is essential that effective coordination of activities and staff resources is established as there is considerable opportunity for complementarity, particularly in developing health/hygiene education in villages and supporting the institutional capacity of the Ministry of Health and CNHE to more effectively deliver services to rural households.

The WATSAN programme is struggling with the requirement to pay incentives lest all staff assigned or recruited will leave the Programme. Although it may be the only way to

pay money, it would be preferable to find a sensible mix between payment in cash and rewards through training and gaining of experience.

6.6.2 UNICEF should study ways by which it can retain trained staff in other ways than just paying money. Study opportunities, skills transfer and enhanced job satisfaction can be considered in this context.

In addition to the programme documents of UNICEF and Oxfam, additional literature was reviewed as follows:

Action International Contre la Faim (1991). Syntheses de projet/Annee I

Boua, Chantou and Kiernan, Ben (1989). Oxfam in Takeo. Department of History and Politics, University of Wollongong, NSW 2500 Australia.

Boua, Chantou (1980). Women in Kampuchea. UNICEF, Bangkok, Thailand.

Sonnois, Brigitte (1990). Women in Cambodia. Redd Barna, Cambodia.

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Draft Terms of Reference

(Evaluation of the OXFAM and UNICEF assisted Rural Water Supply projects in Cambodia)

1. Background

UNICEF and Oxfam and various other NGOs have been working for many years in rural drinking water projects in Cambodia. Up to now no detailed evaluation of these activities has been made.
Given the rapid changes which at present take place in the development context in Cambodia, and in which UNICEF and Oxfam have to work, both organisations feel a strong and urgent need to evaluate their past activities in rural drinking water and to prepare themselves, as well as their Cambodian counterparts, for future assistance in this sector.

2. Objectives

-- review of past experiences in rural drinking water in Cambodia, with special emphasis on the experiences of UNICEF and Oxfam
-- evaluation of the results of the UNICEF and Oxfam drinking water programmes in Cambodia, indicating their strengths and weaknesses, taking into account the constraints under which both organisations had to work
-- provide recommendations for future drinking water programmes in Cambodia,
at one hand advising UNICEF and Oxfam on the content and technicalities of their specific programmes,
secondly preparing an overall framework for rural drinking water activities in which the UNICEF and Oxfam activities, as well as support from other organisation could fit in and which could be managed/coordinated by the Cambodian authorities.

3. Purpose

- to improve the planning of future rural water projects
- to take corrective action to improve the content functioning, utilization and impact of existing projects.
- to clarify the institutional structures of the sector and prepare operational advice on possibilities of decentralization to the provinces/districts
- to develop recommendations of the following types:
  - o actions needed to
    - get a non-functioning/non-existing system for management and coordination for rural drinking water activities into operation including joint management of logistics
    - to improve the utilization of created facilities by the community
  - o complementary activities that need to be initiated or re-emphasized to increase impact and benefits
  - o improved planning, design, construction and/or operation and maintenance of future programmes and projects
  - o communicate lessons learned to other agencies and areas

- to establish benefits from water supply facilities on health (CDD) and economic benefits
- to establish the relationship of the present UNICEF/OXFAM programmes with the issue of repatriates and Internally Displaced Persons (IDP) and advise how OXFAM and UNICEF can respond to their needs in their geographical areas of intervention.

3. Dimensions of the evaluation and its recommendations

The major dimensions are:

3.1 the Cambodian political, socio-economic environment and comment on its influence on programme development

3.2 programme goals and objectives and their development over the review period and major factors influencing the development of the current programme.

3.3 programme planning/formulation
- o project identification and appraisal procedures employed
- o social, economic, institutional and technical elements versus project design and strategies for project implementation
- o constraints on the project planning process
- o capacity of agencies for the planning and implementation of projects versus their performance

3.4 efficiency of programme implementation
- o forms of assistance employed (e.g. provision of technical assistance, finance, training institutional support etc.)
- o methods of programme implementation employed
- o project organisation and its institutional integration within existing structures
- o extent and adequacy of project monitoring and evaluation
- o availability and use of resources
- o analysis of costs, per well, including costs of institutional development, revenue form government and beneficiaries' participation
- o cooperation between projects

3.5 effectiveness of programmes in meeting its objectives
- o extent to which project objectives have been or are being met
- o factors influencing effectiveness

3.6 sustainability
- o community participation respectively community management
- o involvement of women, disadvantaged groups
- o appropriateness of technologies for the users
- o operation and maintenance systems
- o contribution of beneficiaries (e.g. status of cost-sharing systems)
- o transfer of knowledge (eg. training counterparts)
- o factors influencing sustainability

3.7 related project components
- o education (eg. water use, maintenance, management, environmental sanitation, health, hygiene)

3.8 The possibility of assessment of outputs and outcomes in a limited/selected number of districts in 2 (?) provinces focusing among others on
- o construction and maintenance (drilling, digging, rehabilitation with focus on capital, manpower, technology, institutional integration, planning, control, education)
- o operation (functioning) with focus on recurrent funds, manpower, institutional integration, planning, organisation, control, promotion, education, reliability of the water supply and the choice and convenience of water points
  Special issue: the payment of Cambodian counterparts/staff
- o utilization of water supply facilities established in the programmes (who, how much, benefits for women and disadvantaged groups)
  Special issue: the existence of and access to private drinking water

3.9 communication and cooperation between government agencies, inter agency coordination, and collaboration between ESAs and national institutions

4. **Evaluation area**

The evaluation will be conducted in the provinces covered by the prior and ongoing water supply programmes of UNICEF and OXFAM, but for practical reasons the evaluation team may decide to restrict detailed field work to about 2 to 3 districts of 2 to 3 priority provinces of the implementing agencies where a considerable number of handpumps have already been installed.

5. **Evaluation method**

It is assumed that the availability of data will be limited and that access to project sites and beneficiaries for field assessment will be partly difficult. In view of the complexity of the situation and in order to make valid assessments, it will be necessary to collect the required data through the use of observations, interviews, field investigations and by screening of documents.

For the institutional dimensions of the evaluation, extensive briefings and discussions with partners in the institutions involved will be necessary.

To the extent that reliable data is available, the review will consider quantitative indicators in working programme evaluation. However, assessments will have to be partially based on the consideration of informal personal judgement.

5.1 Data sources

The following data sources will be utilized

- o published reports (the agencies will prepare a list of documents available in their offices)
- o both UNICEF and Oxfam will write a position paper on their project before the mission comes out
- o UNICEF and OXFAM project personnel as well as Cambodian counterparts
- o Cambodian officials at national, provincial and local level
- o personnel of other ESAs
- o beneficiaries

6. Workplan

The team will prepare a special workplan prior to in-country work in Cambodia. This plan will confirm the scope of the evaluation with regard to areas of focus and principal issues, as well as indicators to be utilized and the means of verification to be employed. The eventual selection of the most appropriate districts and provinces for detailed field studies will be determined in concertation with Oxfam and UNICEF. The objective oriented evaluation (regarding functioning of the projects and their practical organization, utilization of water supply facilities, cost effectiveness, organisation, interagency coordination and collaboration, user aspects etc.) will demand extensive field visits.

The institutional and management issues will demand extensive discussions with national and provincial authorities and institutions and organisations involved.

The team leader will prepare and present a report outline after the first week of in-country work in Cambodia and after discussion with UNICEF and OXFAM assign writing tasks to team members. This outline will also be submitted to interested NGOs working in the sector. It is understood that the discussion as specified under point 3 could be further expanded or pruned on the basis of collective judgement of the various partners which include primarily UNICEF, OXFAM and the two ministries. The draft report shall be prepared prior to departure from Cambodia. The team will complete preparation of the final report at least one month after departure from Cambodia.
The draft report will be discussed with UNICEF and Oxfam at the end of the mission. The report will also be presented and discussed with the ministries directly involved in rural drinking water. The team leader may consider weekly meetings with UNICEF, Oxfam and the ministries to inform about the progress of the mission.

At the beginning of the evaluation, the team will in a general way present the evaluation and the approach to follow to all agencies and institutions involved in rural drinking water. A similar briefing will be organised at the end of the mission to present findings and recommendations.

The final report is expected to comprehend an analytical part as well as a more comprehensive part of recommendations for future drinking water programme in Cambodia as specified prior in the objectives and dimensions. The main report may not exceed 150 pages including an executive summary of not more than 5 pages (Annexes are possible).

The report will be considered as basic working material for both the External Support Agencies and the responsible policy makers at governmental level. It will also be distributed to the main donors supporting the rural water supply projects activities of UNICEF and OXFAM.

The team leaders contact person will be
from UNICEF Juergen Teech, Programme Officer WATSAN
from OXFAM Tonie Nooyens, Representative

7. <u>Composition of the evaluation team</u>
The broad scope of the evaluation necessitates an evaluation team with a diverse range of skills and experience

Team leader: == general rural drinking water expert
focus: - coordination
- institutional aspects (national/provincial)
- management issues

Team members: == rural drinking water technical expert
focus: - technical aspects
- material and sources for materials
- appropriate technology
- training of counterparts
== economist
focus: - cost analysis (wells ,institutional support, local contributions, private sector)
== rural development expert/sociologist
focus: - project beneficiaries and water use issues (participation, training, the impact on women and defavorized groups
Three experts, preferably coming from Sweden, Australia and United Kingdom (the main funding countries of the UNICEF and OXFAM supported projects. The candidates are not selected or nominated yet).

Team members from Cambodian side:
== one representative from the Ministry of Agriculture (Department of Hydrology)
== one representative from the Ministry of Health

8. **Logistic arrangement**
UNICEF and OXFAM will support the mission with appropriate logistic facilities during the in-Cambodia programme. They will support the mission in organising meetings and field visits with Cambodian and NGO officials.

9. **Time Schedule**
The team will be required to complete the evaluation within 6 weeks (4-5 weeks overseas). Preferable timing will be middle of March and April 1992.

Mission Itinerary Annex 2

June 10	Wed.	am	Peter Robertson (**PR**) arrives PNP
		pm	UNICEF office reviewing documentation
June 11	Th.	am	Han Heijnen (**HH**), Madeleen Wegelin (**MW**) Jan Davis (**JD**) arrive PNP
		pm	Initial Mission Team Mtg UNICEF office with: Jeremy Ockelford, Yohannes Hagos (Oxfam), Bernard Gilbert Juergen Tesch, Waldemar Pickardt, Jamie Meikeljohn, Prabu, (UNICEF)
June 12	Fr.	am	Field visit to Oxfam operations in Prey
		pm	Veng/Svay Rieng with Yohannes Hagos
June 13	Sat.	am	HH/PR briefing Oxfam re-UNHCR HH/PR UNHCR mtg
		pm	Team review documentation
June 14	Sun	am	Team review documentation
		pm	Team review documentation
June 15	Mon	am	HH/PR Mtg Joop Schaap (AFFHC/SAWA)
		pm	Team briefing UNICEF
June 16	Tue.	am	Team field visit Baty district, Takeo Pr.
		pm	(UNICEF)
June 17	Wed	am	MW/JD field visit Kandal HH mtg UNICEF Prov. HSC Workshop PR arrange appointments HH/PR mtg World Concern
		pm	MW/JD field visit Kandal HH/PR mtg Chris Flint IMC/UNDP Irrigation Rehabilitation Project HH mtg UNICEF Prov. HSC Workshop HH/PR mtg Tony Nooyens Oxfam
June 18	Thu	am	MW/JD field visit Kp Speu HH/PR mtg UNICEF Prov. HSC Workshop HH/PR mtg Roeland Kortas UNDP
		pm	MW/JD field visit Kp Speu HH mtg UNICEF Prov. HSC Workshop PR mtg Hans van Zoggel CRC
June 19	Fr	am	Team flight PNP-Battambang Mtg Murray Wilson Oxfam engineer
		pm	MW/JD leave for Banteay Mean Chey field visit HH/PR field visit Battambang (Oxfam)
June 20	Sat	am	HH/PR field visit Battambang (Oxfam) MW/JD field visit Banteay Mean Chey
		pm	HH/PR field visit Battambang MW/JD field visit Banteay Mean Chey, rtn Battambang

June 21	Sun	am	HH/PR/MW travel by car Battambang-Kp Chhnang
		pm	Mtg Director HSC re plan for Mon.
			continue to PNP due to lack of accomodation
			in Kp Chhnang
			JD Battambang (Oxfam)
June 22	Mon	am	HH/PR/MW Kp. Chhnang field visit
		pm	HH/PR/MW Kp. Chhnang field visit
			JD flight Batt-PNP
June 23	Tue	am	
		pm	
June 24	Wed	am	HH mtg Min. of Health
			PR mtg Steve Thorne CDRI
		pm	PR mtg Vice Dir. DOH The Lim Tong
			HH/PR mtg Gayle Miller UNDP-OPS
June 25	Thu	am	Team prep. Preliminary Draft/debriefing
		pm	Team prep. Preliminary Draft/debriefing
June 26	Fri	am	Team prep. Preliminary Draft/debriefing
		pm	Team UNICEF debriefing
			Team Vice Minister of Health debriefing
			Team Oxfam debriefing
June 27	Sat	am	Team Vice Minister of Agriculture Mr. Chhea
Song debriefing			
			HH/MW mtg UNICEF Res. Rep
			HH depart BKK
			PR prep draft report
			JD prep draft report
		pm	MW/PR/JD relax
June 28	Sun	am	MW/PR/JD relax
		pm	MW/PR/JD relax
June 29	Mon	am	PR/MW mtg UNICEF
			PR/MW research AFFHC
		pm	PR mtg Oxfam
June 30	Tue	am	JD mtg Oxfam
			MW/PR/JD mtg UNICEF
		pm	MW/PR/JD depart BKK

WATER AND SANITATION MONITORING SYSTEM

* W A S A M S *

Status as at 31 December 1990

COUNTRY NAME: DEMOCRATIC KAMPUCHEA

SOURCE OF INFORMATION

The statistics provided in this questionnaire are issued by: (name and address of the issuing institution)

Data received under cover of a memo of 4/9/91 from

Ms Anne Bruzelius, Special Representative, UNICEF, Phnom Penh.

WATER AND SANITATION MONITORING SYSTEM

* W A S A M S *

Status as at 31 December 1990

LOCALITY CODE | KAM / / / / /

Country : DEMOCRATIC KAMPUCHEA

Sub-level 1 : .....

Sub-level 2 : .....

Sub-level 3 : .....

Sub-level 4 : .....

Sub-level 5 : .....

PART I. SERVICE COVERAGE

I. P O P U L A T I O N

1. Estimated population (in thousands)

Urban 1)	Rural 2)	Total 3)
733.92	7,399.80	8,133.72
9.0 %	90.9 %	

1.1 Disaggregate the above urban data into following two categories (if practicable)

High-income 4)	Low-income 5)
.00	733.92
.0 %	100.0 %

WATER AND SANITATION MONITORING SYSTEM

* W A S A M S *

Status as at 31 December 1990

LOCALITY CODE | KAM / / / / /

PART I. SERVICE COVERAGE (continued)

II. S A F E W A T E R S U P P L Y

Population with access to functioning safe water supply (in thousands)

		Urban			Rural	
House Connections	6)	366.28	76.4 %	7)	2.50	.1 %
Yard taps	8)	46.61	9.7 %	9)	.00	.0 %
Public standpipes	10)	10.30	2.1 %	11)	.00	.0 %
Boreholes with handpumps	12)	28.71	5.9 %	13)	718.25	29.0 %
Protected dug wells	14)	22.16	4.6 %	15)	514.98	20.8 %
Rainwater collection	16)	2.51	.5 %	16)	8.55	.3 %
Other high-cost technologies	18)	2.50	.5 %	19)	1.50	.0 %
Other low-cost technologies	20)	.00	.0 %	21)	1,224.59	49.5 %
Total served	22)	479.07	65.2 %	23)	2,470.37	33.3 %
Total unserved	24)	254.85	34.7 %	25)	4,929.43	66.6 %

Disaggregate the above urban data into following two categories (if practicable)

		Urban high-income			Urban low-income	
House Connections	26)	.00	..... %	27)	366.28	76.4 %
Yard taps	28)	.00	..... %	29)	46.61	9.7 %
Public standpipes	30)	.00	..... %	31)	10.30	2.1 %
Boreholes with handpumps	32)	.00	..... %	33)	28.71	5.9 %
Protected dug wells	34)	.00	..... %	35)	22.16	4.6 %
Rainwater collection	36)	.00	..... %	37)	2.51	.5 %
Other high-cost technologies	38)	.00	..... %	39)	2.50	.5 %
Other low-cost technologies	40)	.00	..... %	41)	.00	.0 %
Total served	42)	.00	..... %	43)	479.07	65.2 %
Total unserved	44)	.00	..... %	45)	254.85	34.7 %

WATER AND SANITATION MONITORING SYSTEM

* W A S A M S *

Status as at 31 December 1990

LOCALITY CODE | KAM / / / / /

PART I. SERVICE COVERAGE (continued)

III. S A N I T A T I O N (sanitary means of excreta disposal)

Population with access to adequate excreta disposal (in thousands)

		Urban			Rural	
Household connections to conventional public sewers	46)	231.54	39.1 %	47)	.00	.0 %
Household connections to small-bore public sewers	48)	.00	.0 %	49)	.00	.0 %
Household connections to septic systems	50)	117.31	19.8 %	51)	7.00	1.2 %
Latrines, wet (pour flush etc.)	52)	72.69	12.2 %	53)	31.04	5.3 %
Latrines, dry (ventilated improved pit)	54)	30.84	5.2 %	55)	9.92	1.7 %
Latrines, dry (simple pit etc.)	56)	139.12	23.5 %	57)	534.15	91.7 %
Other high-cost technologies	58)	.00	.0 %	59)	.00	.0 %
Other low-cost technologies	60)	.00	.0 %	61)	.00	.0 %
Total served	62)	591.50	80.5 %	63)	582.11	7.8 %
Total unserved	64)	142.42	19.4 %	65)	6,817.69	92.1 %

Disaggregate the above urban data into following two categories (if practicable)

		Urban high-income			Urban low-income	
Household connections to conventional public sewers	66)	.00	..... %	67)	231.54	39.1 %
Household connections to small-bore public sewers	68)	.00	..... %	69)	.00	.0 %
Household connections to septic systems	70)	.00	..... %	71)	117.31	19.8 %
Latrines, wet (pour flush etc.)	72)	.00	..... %	73)	72.69	12.2 %
Latrines, dry (ventilated improved pit)	74)	.00	..... %	75)	30.84	5.2 %
Latrines, dry (simple pit etc.)	76)	.00	..... %	77)	139.12	23.5 %
Other high-cost technologies	78)	.00	..... %	79)	.00	.0 %
Other low-cost technologies	80)	.00	..... %	81)	.00	.0 %
Total served	82)	.00	..... %	83)	591.50	80.5 %
Total unserved	84)	.00	..... %	85)	142.42	19.4 %

WATER AND SANITATION MONITORING SYSTEM

* W A S A M S *

Status as at 31 December 1990

LOCALITY CODE | KAM / / / / /

PART I. SERVICE COVERAGE (continued)

IV. S Y S T E M U T I L I Z A T I O N

1. Percentage of population using drinking water primarily from a safe source:

Urban 86) 4.5 % Rural 87) 3.3 %

1.1 Disaggregate the above urban data into following two categories (if practicable)

High-income 88) .0 % Low-income 89) 4.5 %

2. Percentage of population using sanitary excreta disposal:

Urban 90) 5.0 % Rural 91) 1.0 %

2.1 Disaggregate the above urban data into following two categories (if practicable)

High-income 92) .0 % Low-income 93) 5.0 %

Comment : _____

WATER AND SANITATION MONITORING SYSTEM

* W A S A M S *

Status as at 31 December 1990

LOCALITY CODE | KAM / / / / /

PART II. FACILITIES MANAGEMENT

94) Average annual exchange rate : 1 US$ = 600.000 national currency units.

1. Participants' Contribution to Operation and Maintenance Costs (in 1,000 USD)

1.1 Safe Water Supply		GOV'T		ESAs		COMMUNITY	OTHER LOCAL		TOTAL
a) Urban	95)	472.10	96)	6.30	97)	68.90	98) .00	99)	547.30
		86.2 %		1.1 %		12.5 %	.0 %		76.4 %
Disaggregate the above urban data into following two categories (if practicable)									
b) Urban high-income	100)	.00	101)	.00	102)	.00	103) .00	104)	.00
		..... %		..... %		..... %	..... %		.0 %
c) Urban low-income	105)	472.10	106)	6.30	107)	68.90	108) .00	109)	547.30
		86.2 %		1.1 %		12.5 %	.0 %		76.4 %
d) Rural	110)	47.10	111)	53.00	112)	68.50	113) .00	114)	168.60
		27.9 %		31.4 %		40.6 %	.0 %		23.5 %
Water Total	115)	519.20	116)	59.30	117)	137.40	118) .00	119)	715.90
		72.5 %		8.2 %		19.1 %	.0 %		84.6 %
1.2 Sanitation									
a) Urban	120)	62.50	121)	.00	122)	42.70	123) .00	124)	105.20
		59.4 %		.0 %		40.5 %	.0 %		81.3 %
Disaggregate the above urban data into following two categories (if practicable)									
b) Urban high-income	125)	.00	126)	.00	127)	.00	128) .00	129)	.00
		..... %		..... %		..... %	..... %		.0 %
c) Urban low-income	130)	62.50	131)	.00	132)	42.70	133) .00	134)	105.20
		59.4 %		.0 %		40.5 %	.0 %		81.3 %
d) Rural	135)	.70	136)	.00	137)	23.50	138) .00	139)	24.20
		2.8 %		.0 %		97.1 %	.0 %		18.7 %
Sanitation Total	140)	63.20	141)	.00	142)	66.20	143) .00	144)	129.40
		48.8 %		.0 %		51.1 %	.0 %		15.3 %
SECTOR TOTAL	145)	582.40	146)	59.30	147)	203.60	148) .00	149)	845.30
		68.9 %		7.0 %		24.0 %	.0 %		

WATER AND SANITATION MONITORING SYSTEM

* W A S A M S *

Status as at 31 December 1990

LOCALITY CODE | KAM / / / / /

PART II. FACILITIES MANAGEMENT (continued)

2. Number of people (in thousands) served by safe water facilities managed by

	GOV'T	PRIVATE	COMMUNITY	OTHER LOCAL	TOTAL
a) Urban	150).....	151) .00	152).....	153) .00	154).....
	..... %	..... %	..... %	..... %	..... %
Disaggregate the above urban data into following two categories (if practicable)					
b) Urban high-income	155).....	156).....	157).....	158).....	159).....
	..... %	..... %	..... %	..... %	..... %
c) Urban low-income	160).....	161).....	162).....	163).....	164).....
	..... %	..... %	..... %	..... %	..... %
d) Rural	165).....	166).....	167).....	168) .00	169).....
	..... %	..... %	..... %	..... %	..... %
SECTOR TOTAL	170).....	171).....	172).....	173).....	174).....
	..... %	..... %	..... %	..... %	

Comment : _____

WATER AND SANITATION MONITORING SYSTEM

* W A S A M S *

Status as at 31 December 1990

LOCALITY CODE | KAM / / / / /

PART III. FUNDING

1. Participants' Contribution to Capital Costs for NEW FACILITIES (in 1,000 USD)

1.1 Safe Water Supply		GOV'T		ESAs		COMMUNITY	OTHER LOCAL		TOTAL
a) Urban	175)	727.20	176)	216.80	177)	100.00	178) 37.10	179)	373.30
		194.8 %		58.0 %		26.7 %	9.9 %		100.0 %
Disaggregate the above urban data into following two categories (if practicable)									
b) Urban high-income	180)	.00	181)	.00	182)	.00	183) .00	184)	373.30
		.0 %		.0 %		.0 %	.0 %		100.0 %
c) Urban low-income	185)	727.20	186)	216.80	187)	100.00	188) 37.10	189)	.00
		..... %		..... %		..... %	..... %		.0 %
d) Rural	190)	1,777.20	191)	44.90	192)	1,703.00	193) 29.30	194)	373.30
		476.0 %		12.0 %		456.2 %	7.8 %		100.0 %
Water Total	195)	2,504.40	196)	261.70	197)	1,803.00	198) 66.40	199)	373.30
		670.8 %		70.1 %		482.9 %	17.7 %		62.2 %
1.2 Sanitation									
a) Urban	200)	91.80	201)	35.70	202)	25.00	203) 31.10	204)	.00
		..... %		..... %		..... %	..... %		..... %
Disaggregate the above urban data into following two categories (if practicable)									
b) Urban high-income	205)	.00	206)	.00	207)	.00	208) .00	209)	.00
		..... %		..... %		..... %	..... %		..... %
c) Urban low-income	210)	91.80	211)	35.70	212)	25.00	213) 31.10	214)	.00
		..... %		..... %		..... %	..... %		..... %
d) Rural	215)	240.90	216)	2.00	217)	225.00	218) 13.90	219)	.00
		..... %		..... %		..... %	..... %		..... %
Sanitation Total	220)	332.70	221)	37.70	222)	250.00	223) 45.00	224)	.00
		..... %		..... %		..... %	..... %		.0 %
SECTOR TOTAL	225)	2,837.10	226)	299.40	227)	2,053.00	228) 111.40	229)	600.00
		472.8 %		49.9 %		342.1 %	18.5 %		

WATER AND SANITATION MONITORING SYSTEM

* W A S A M S *

Status as at 31 December 1990

LOCALITY CODE | KAM / / / / /

PART III. FUNDING (continued)

2. Participants' Contribution to Capital Costs for REHABILITATED FACILITIES (in 1,000 USD)

2.1 Safe Water Supply		GOV'T		ESAs		COMMUNITY		OTHER LOCAL		TOTAL
a) Urban	230)	1,187.30	231)	30.60	232)	396.00	233)	.70	234)	760.00
		156.2 %		4.0 %		52.1 %		.0 %		100.0 %
Disaggregate the above urban data into following two categories (if practicable)										
b) Urban high-income	235)	.00	236)	.00	237)	.00	238)	.00	239)	760.00
		.0 %		.0 %		.0 %		.0 %		100.0 %
c) Urban low-income	240)	1,187.30	241)	30.60	242)	396.00	243)	.70	244)	.00
		..... %		..... %		..... %		..... %		.0 %
d) Rural	245)	22.20	246)	2.00	247)	19.00	248)	1.20	249)	760.00
		2.9 %		.2 %		2.5 %		.1 %		100.0 %
Water Total	250)	1,209.50	251)	32.60	252)	415.00	253)	1.90	254)	760.00
		159.1 %		4.2 %		54.6 %		.2 %		..... %
2.2 Sanitation										
a) Urban	255)	348.97	256)	7.97	257)	250.00	258)	91.00	259)	.00
		..... %		..... %		..... %		..... %		..... %
Disaggregate the above urban data into following two categories (if practicable)										
b) Urban high-income	260)	.00	261)	.00	262)	.00	263)	.00	264)	.00
		..... %		..... %		..... %		..... %		..... %
c) Urban low-income	265)	348.97	266)	7.97	267)	250.00	268)	91.00	269)	.00
		..... %		..... %		..... %		..... %		..... %
d) Rural	270)	.60	271)	.00	272)	.00	273)	.60	274)	.00
		..... %		..... %		..... %		..... %		..... %
Sanitation Total	275)	349.57	276)	7.97	277)	250.00	278)	91.60	279)	.00
		..... %		..... %		..... %		..... %		..... %
SECTOR TOTAL	280)	1,559.07	281)	40.57	282)	665.00	283)	93.50	284)	.00
		..... %		..... %		..... %		..... %		

Comment : 0.00

WATER AND SANITATION MONITORING SYSTEM

* W A S A M S *

Status as at 31 December 1990

LOCALITY CODE | KAM / / / / /

PART IV. GENERAL COMMENTS

1. Quality of Data Reported

Please comment on the quality of data.

2. Definitions Used

Please comment on the local definitions used if different from the indicative ones (1).

3. Decentralization of Monitoring

The lowest administrative level from which data was obtained this year is:

National	X	Sub-level 1.		Sub-level 2.	
Sub-level 3.		Sub-level 4.		Sub-level 5.	

COST OF A DUG/DRILLED WELL

OXFAM CONTRIBUTION

1. Cement

	concrete volume m3	cement kg/m3	cement kg	bags	unit cost $	total cost $
Lining 8m O.D. 1.14m I.D. 1.00m	1.880	326	613			
Headwall Height 1m	0.235	326	77			
bottom of well 1m x 0.07m	0.055	326	18			
Apron Dia. 3.5m	0.884	326	288			
Drainage 4m x 0.0125m2	0.050	326	16			
Total:	3.104	326	1012	20	4	80

The total cost of cement is: $80

2. Sand

For a 1:2:4 mix, the quantity of sand in 1 m3 of concrete is 0.45 m3

For a total of 3.104 m3 of concrete, the quantity of sand will be 1.4 m3

Sand is provided by the beneficiaries.
The fuel cost will be for one trip only.

3. Gravel

For a 1:2:4 mix, the quantity of gravel in 1 m3 of concrete is 0.90 m3

For a total of 3.104 m3 of concrete, the quantity of gravel will be: 2.8 m3

Gravel is provided by the beneficiaries.
The fuel cost will be for one trip only.

4. Reinforcement

	Unit Length m	Number of Lengths	Total Length m	Weight kg/m	Total Weight kg
Lining & headwall					
Vertical 8mm rod	9	11	99	0.43	43
Horizontal 6mm rod	3.36	30	101	0.24	24
Apron					
Circumferential	5.6	1			
	8.0	1			
	11.0	1	24.6		
Radial	1.2	8	9.6		
			34.2	0.43	15
Drain					
8 mm	4.0	4	16.0	0.43	7
6 mm	0.42	14	6.0	0.24	1.5
Total weight of reinforcement				kg	90

The cost of reinforcement bar is $0.6/kg

Total cost of reinforcement bar: $54

5. Borehole cost

Casing and screen

	Quantity	Unit Cost $	Total Cost $
Plain PVC casing 1.5" x 3 m for average depth, 36m	9	6	54
PVC Screen 1.5" x 3 m	3	9	27
PVC Adhesive and end cap			3
		Total:	84

Total cost of borehole casing & screen: $84

6. Fuel costs

	Quantity litres	Unit Cost $	Total Cost $
Fuel for drilling and development	150	0.25	37.5
Transport for sand & gravel 2 trips x 100km at 5 km/l	40		10
Transport for drilling eqpt. 100km at 7 km/l	14		3.5
Supervision - 3 site visits 210km at 7 km/l	30		7.5
Technicians motorbike	10		2.5
Totals:	244	0.25	61.0

Total cost of fuel: $61

7. Allowances paid by Oxfam

Allowances paid to provincial hydrology staff, per well: $100

SUMMARY OF OXFAM COSTS

ITEM	COST $
1. Cement	80
2. Sand (under fuel costs)	
3. Gravel(under fuel costs)	
4. Reinforcement	54
5. Borehole	84
6. Fuel	61
7. Allowances	100
OXFAM CONTRIBUTION TO A DUG/DRILLED WELL	$379

DEPT. OF HYDROLOGY, MIN. OF AGRICULTURE CONTRIBUTION

Technicians salary

15 working days x 2 technicians: $28

VILLAGE CONTRIBUTION

Assume a labour contribution of 5 men per day for 15 days
If village labour is costed at the equivalent provincial staff allowance of $1 per day, then 75 man days village contribution will be: $75

Village contribution of food for 2 technicians for 15 days: $30

Total village contribution: $105

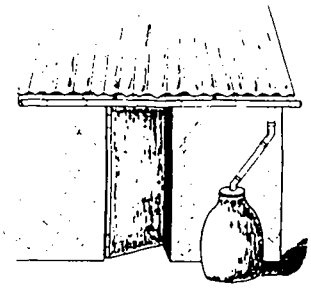
TOTAL COSTS

The direct cost, without taking into account the depreciation on capital equipment and the Oxfam engineer's salary, is: $512

Proportion of cost to be met by Oxfam, per well, is: $379 (74%)

RAINDROP

Rainwater Harvesting Bulletin



July 1992 Volume 7

Focus on Thailand:

Thai Jar Program Reaches Millions of Families

Rainwater harvesting (RWH) is more widespread in Thailand than any other country in the world. The level of effort and results are astounding: more than 10 million 1-2 m3 (1 m3 = 1000 liters) rainwater jars and hundreds of thousands of 6-12 m3 rainwater tanks have been constructed the last seven years. Most households in northeastern Thailand, where the program has been most successful, have at least one and many have several rainwater jars.

The Thailand RWH program is considered to be one of the most successful examples in the world of how potable water supplies can be increased on a national scale. It is one of the few countries to even approach the International Drinking Water Supply and Sanitation Decade targets for rural water supplies.

Village craftsmen assemble a star fruit mold rainjar.

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The Thai jar program is the most successful example of a country-wide RWH program that significantly increased rural water supplies.

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The successes of the program are largely a product of strong governmental support at all levels, combined with the efforts of nongovernmental organizations (NGOs), the private sector, and grassroots initiatives. It is noteworthy that the government of Thailand, in addition to a variety of standard water supply technology options, chose to wholeheartedly promote rooftop rainwater harvesting as a practical and cost-effective way to increase water availability in under-served rural areas.

Major Lessons Learned

The rapid growth of the Thai program was made possible by a combination of factors that may be relevant to other countries interested in developing broad, as well as limited-scale RWH programs. Governmental commitment and support has been very strong; and national targets and objectives were clearly defined. Rainwater harvesting is a long standing tradition in Thailand, and the annual rainfall is high relative to many other regions of the world. The demand for improved water supplies in rural areas was tremendous, and this demand led to the emergence and growth of many independent jar making micro-enterprises. Thailand also experienced a period of national economic growth and an increase in private affluence during the life of the program which made it easier for families to invest in RWH technologies.

Several jar and tank designs were tested and used on a large scale in the early stages of the program. Problems did occur with some of these designs, particularly the use of bamboo-reinforcement, which had been widely publicized as successful. This experience underlines the need to apply preliminary findings with caution, and when design problems are uncovered, these need to be communicated widely so others do not repeat the same mistakes.

As in many other water and sanitation projects worldwide, health and hygiene considerations were not built into the planning and implementation of the project.

Not surprisingly, the achievement of targeted increases in water supply has not been accompanied by a correspond-

continued on Page 3 (Thailand)

Thailand (continued from Page 1)

ing drop in water-borne and sanitation diseases. It is now recognized that social and health considerations are essential in order to achieve the health impacts that can result from improved access to clean water supplies. The government of Thailand is now placing more of its attention on improving hygiene and health education on a national scale.

RWH is Thai Tradition

Villagers in rural Thailand have harvested rainwater for many generations, long before the national-level promotional campaign for rainwater storage in the 1980's, but most families did not collect sufficient quantities of rainwater or enough to last through the dry season. Traditional storage containers have typically been 20-40 liter clay or 100-400 liter ceramic jars.

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Thailand has a high annual rainfall compared with many countries in the world, averaging 1,000-2,000mm per year.

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Thailand enjoys a higher than average annual rainfall compared with countries in other parts of the world, with an average rainfall of 1,000-2,000 mm per year. Eighty-five percent of this annual rainfall occurs during the six months of the rainy season.

The rainfall in the southern region is higher than in the rest of the country, more than 2,000 mm per year. Even during the three month dry season, there is still about 50 mm of rainfall per month.

Thai Government with NGOs Pioneered Massive Initiatives

In early 1985, the Ministry of Interior outlined its ambitious objectives for the nationwide Rainwater Jar Construction Program at a meeting of governors and heads of provincial offices of government agencies. The government, in collaboration with locally-active NGOs, initiated and supported the construction of the first several million rainwater jars and tanks.

Implementation of the program is largely in the hands of the districts, with district officers serving as program managers. The governors, as the program directors for each province, are responsible for fulfilling the objectives of the program.

Each district has its own methods for getting operating funds, but the major source for the program budget has come from the well-established Rural Job Creation Project. Other financial sources have included the Provincial Development Fund from Members of Parliament, the Provincial Administrative Organization, as well as the private sector and non-profit organizations.

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The success of the Thai RWH program results from favorable rainfall patterns as well as strong governmental and popular support at all levels including NGOs, community-based initiatives, and the private enterprise sector.

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A number of multilateral and bilateral agencies also provided funding, including UNICEF and the government of Australia. Research, especially on jar and tank designs and rainwater quality, has been carried out by Khon Kaen University; Mahidol University; and the Asian Institute of Technology.

Rural Areas Targeted

Seventy-two percent of the 57 million people in Thailand live in rural areas. These areas have typically lacked access to clean and adequate drinking water supplies. The overall goal of the national program was to provide the rural population with 5 liters/capita/day (lcpd) of clean drinking water and 45 lcpd for domestic use by 1990.

In order to meet this goal, the government set two major objectives: to provide one 2,000 liter jar (enough for 2 lcpd) to households lacking adequate drinking water storage by the end of 1987, and for each household to acquire two additional jars, enough for 5 lcpd by 1990.

Jars Built by Users and Micro-enterprises

Originally the jar construction program was to be financed by a revolving fund, using start-up money from the government. Villagers were to be involved in the management of these revolving funds. However, the program expanded so rapidly that the administration of the revolving fund could not keep up with the demand, and these funds were generally not used.

Many districts provided construction materials, tools, and training, and people contributed labor to construct their own jars under the supervision of experienced technicians. Khon Kaen University and government agencies provided technical assistance in the preparation and dissemination of construction manuals, and in training technicians. Jar construction centers were established and located either in individual villages or in villages that served whole subdistricts.

It was initially envisioned that villagers would construct their own jars. However, as the program evolved, a number of other options emerged, and the private sector became very much involved in rainjar construction. In some districts, groups of villagers were paid to construct the rainjars and deliver them to households, often with funding from the Rural Job Creation Program.

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Thailand (continued from Page 3)

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As the program evolved, micro-enterprises began to produce good quality rainjars at prices affordable to millions of rural Thai families.

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Other districts subcontracted small jar-making factories which sprang up and developed into successful micro-enterprises in many provinces. These village micro-enterprises began producing 2 m3 jars for U.S.$22.00 (1988) including delivery. The current (1992) rainjar price is about US$40, but even at this price, villagers could save very little by constructing the jars themselves.

Estimates vary on the number of jars built by commercial enterprises but these probably amount to over half the total number constructed. Most are built by village-based companies which produce up to 30 jars per day. Completed jars are delivered to customers on small trucks that can carry up to six jars at a time.

Ferrocement rainjar with tap and plastic tube to draw off water.

High Coverage Achieved

Drinking water supply coverage for Thailand based on the intermediate criteria of 2 lcpd was 26 percent in 1981. This increased to 70 percent in 1986, and reached 76 percent by 1988. The rapid coverage increases have been primarily due to the Thai Rainjar Program. Using the 2 lcpd interim criteria, 65 percent of the rural population are provided with drinking through RWH. If the 5 lcpd criteria is used, 36 percent obtain adequate quantities of drinking water through RWH.

Implementation More Rapid Than Planned

In 1985, the program set the ambitious target of constructing 6 million rainjars by June of 1987 as a 60th birthday gift for the venerated King of Thailand. Not only was the goal met, but by 1992, over 10 million rainwater jars were in use. The rapid development of the program is due to a number of factors. There was a large felt need for increased water supplies, and a preference for the taste of rainwater in certain parts of the country, especially in the northeast region.

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In 1985, the national program set the ambitious target of constructing 6 million rainjars in 2 years as a 60th birthday gift for the Thai King. By 1992, there were over 10 million jars in use.

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Adding to the conditions that favored the program's success were Thailand's period of national economic growth and increased private affluence during this time period. Subsidized and affordable cement was readily available, and many skilled artisans already had experience in constructing traditional rainwater jars, who readily learned how to construct the new jar models. There were also many local engineers, technicians, and administrators with a commitment to rural development programs.

While the construction of rainwater jars was much more popular and rapid than originally planned and led to greatly increased access to water supplies, there were also some disadvantages to the rapid growth of the program.

Initially many jars were built without design features to enhance health impacts, such as taps, drainage plugs, and lids. Development of guidelines and dissemination of information on proper operation and maintenance of the systems, and large scale health education did not begin until recently. Rationing of collected rainwater has not always been effectively followed, so many families still rely on contaminated sources during part of the year.

RWH Most Popular in Northeast Thailand

Implementation of the program has been more successful in some parts of the country than others. Forty percent of the jars built are in the northeast region, while only 13 percent are in the southern region. Fewer jars were constructed in the south because alternative sources of water such as shallow wells are more readily available, and the taste of rainwater is less appealing in the south.

continued on Page 7 (Thailand)

Thailand (continued from Page 6)

A major study found that in northeast and central Thailand, 75 percent rated rainwater as their preferred drinking water source. In the south, where ground water is available, shallow well water is often preferred to rainwater for drinking. Many cite the unpleasant salty taste of rainwater, probably due to the adjacent oceans. Rainwater collection is also common in the south, but smaller jars are more common because rainfall is higher and less erratic in the south. This decreases the storage requirements so that one smaller jar is usually sufficient.

Jar and Tank Designs Refined

In the early 1980s, more than 50,000 bamboo reinforced cement tanks were constructed. Many of these failed due to fungal, termite and bacterial attacks on the bamboo reinforcement. Unfortunately, this design had been widely publicized as successful. In fact many of the bamboo reinforced tanks are still in use, but have been strengthened by wrapping metal reinforcing belts around them.

An interlocking brick design was also developed, but this was later abandoned since the workmanship and skills required were not practical for village conditions. Because the existing Thai rainjar models have proven to be successful on a large scale, major research is no longer being conducted to develop new jar or tank designs.

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Several RWH jar and tank designs were tested and used in the early stages of the program. Major problems occurred with bamboo-reinforced jars, which initially were publicized widely as a successful innovation.

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The jar design which has been promoted by the Ministry of Health has a lid on the top to prevent contamination; a tap for easy access to water; and a drainage plug for easy cleaning. However, jars made commercially usually do not have taps or drainage plugs and are often sold without nets and lids.

This is at least in part because jars with taps and drainage plugs are considerably more difficult to construct and transport. Some villagers also prefer jars without taps because taps may leak and are difficult to repair, and because children play with taps and waste water. If taps are not used, then access to water is usually by bucket or by siphoning off water with a hose. Program authorities have expected the lid and the net to be supplied by jar owners, which often does not occur.

The Thai rainjars are made of sand and cement mortar, and the capacity is typically 1-2 m3. Jars can be constructed using various kinds of molds including home-made jute bag molds filled with rice husks, or standardized Ministry of Health molds including the 54 piece cement mold and star fruit iron or cement mold. After the cement is cured, the jar is slowly filled with water. Sour leaves are recommended to clean the jars before they are used to take away the smell and taste of cement.

Larger rainwater tanks for individual households are typically 3-5 m3 capacity and constructed with iron reinforcement. The Ministry of Health tank design includes a tap, drainage plug, overflow outlet, incoming water tube, bypass tube, and a lid. Construction is typically carried out using a standard mold at the villager's house. Thousands of larger tanks (6-12 m3) have also been constructed at schools, clinics, temples, and private homes.

Rainwater Quality Assessed

A major study, published in 1989, was undertaken by Khon Kaen University[1] in which stored rainwater was analyzed bacteriologically for pathogens. The results from the study of rainwater quality of outside rainwater tanks and jars showed that only 40 percent of samples met WHO standards for total bacterial counts of drinking water; 66 percent met standards for total coliforms; and 57 percent met standards for fecal coliforms.

The route of contamination was investigated by evaluating the quality of rainwater samples collected from the roofs and gutter systems, and outdoor and indoor storage containers. It was found that poor water handling was a major cause of secondary contamination of rainwater. Despite the problems found with water quality, the study concluded that rainwater is still the safest and most economical source of drinking water available in most rural areas.

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Unsanitary water handling was found to be a major cause for secondary contamination of rainwater. Jar designs often did not include a water tap or cover making sanitary water handling nearly impossible.

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Rather than trying to achieve the idealistic goal of meeting WHO safe drinking water guidelines, researchers advocated it would be more beneficial to concentrate resources on improving sanitary water handling practices to reduce secondary contamination of rainwater.

Concerns have been raised that uncovered rainwater jars can lead to increased breeding of mosquitos, which spread dengue fever and malaria. However, research carried

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[1]Khon Kaen University. *Evaluation of Rainwater Quality: Heavy Metals and Pathogens*. Khon Kaen, Thailand. June 1989.

Thailand (continued from Page 7)

out by the Thai-Australia Project found that rainwater jars only rarely contain mosquito larvae, larvae were found in only 0.2 percent of jars. Much more frequently, smaller containers inside the house were found to be the site of mosquito larvae. Covering jars with nylon or wire mesh has been recommended, which would also keep out lizards and rodents.

Widespread Health Impacts Not Yet Achieved With RWH

The achievement of target increases in water supply has not been accompanied by a corresponding drop in water and sanitation related diseases. In fact, little has been achieved in implementing effective hygiene education programs necessary to achieve the health impacts that can result from the provision of clean drinking water.

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In the push to achieve broad dissemination of RWH technology, health and hygiene considerations were not essential parts of the program design or implementation.

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There are a number of reasons for this. Implementing agencies have been directed by technical specialists with little training and background in social processes. Success has been measured by the number of jars built, in part because it is much easier to count jars and tanks than to measure a behavioral change such as improved water handling practices.

Also, not enough is understood about behavioral practices which can have an impact on health (for example, water handling, or hand washing) and there is little understanding of what villagers consider "clean" or "healthy" and how such concepts vary geographically and ethnically throughout the country. It is difficult to handle water in a hygienic way given the design of many existing jars, since many jars were not constructed with a tap, a drainage plug, or provided with a lid or net, as recommended in the Ministry of Health designs.

Water from the collection jar is often transferred to a smaller jar and a communal and multi-purpose dipper is used to get the drinking water from these smaller jars. This added water handling step leads to contamination of the water, especially when hands are not washed before using the dipper. Many villagers do not yet understand that improper water handling can lead to a variety of illnesses.

Health and Education Reach the National Agenda

Social and health considerations are crucial to any water supply program if it is to have lasting health impacts. The government has recently started to move towards developing a re-focused program, shifting from an emphasis on construction to a combination of construction and support programs. A Sanitation Action Plan has been drafted which includes a major health education component, based on social considerations, such as a need to understand the differing attitudes, beliefs, and sanitation behaviors of rural people in all regions of the country.

The focus of national plans is shifting from how to implement and finance the rainjar program on a national scale to improving water quality and health through better use, operation, and maintenance of systems by encouraging the use of health-related design features (such as taps, nets, and lids) and more effective hygiene education. Thai research activities are shifting to measure impacts of the program, and to develop effective hygiene education strategies.

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The focus of national priorities is shifting from jar construction to improving water quality and health, especially through more effective hygiene education.

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It is expected that this new focus will mean fundamental changes from the "top-down" and earlier passive educational approaches which relied heavily on distributing printed materials and using village loudspeakers. The new strategy will be more "bottom-up" with more active person-to-person communication, reinforced by the use of mass media, including television and radio. The plan also calls for greater involvement in active health education by all community groups, including religious leaders, village health volunteers, craftsmen, youths, school teachers--and special input from women in the community.

For schools, a long-term goal of improving sanitation and personal hygiene has been set. Teachers will explain practical hygiene and sanitation practices, and basic water and sanitation facilities will be provided to schools. At the community level, the extension skills of the Ministry of Public Health staff will be targeted so they will be better able to communicate with villagers, understand local practices, and develop programs which are meaningful and necessary for villagers.

As an example of the new emphasis on improving hygiene, the Thai-Australia Project and the Ministry of Health produced materials for primary schools in northeast Thailand based on a rainwater jar cartoon character. This health education program is being extended and hopes to reach 75,000 primary school students. If successful, the program will be expanded to other provinces. Poster competitions are also being held and the best posters on how

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Thailand (continued from Page 10)

to use rainwater jars are being printed and used as part of the campaign.

Future Directions

Improved relations and communication with neighboring countries should offer opportunities to translate successful aspects of the Thai rainjar program to Laos, Burma and Cambodia. Rural poverty in these countries will however make it difficult to achieve rapid replication of RWH.

Links between Khon Kaen University and Water Resources Institutes in Vientiane, Laos are promising of future opportunities for RWH promotion. Over a quarter of a million Cambodians are living in U.N. camps in eastern Thailand, and more than 80,000 rainwater jars have been built in one camp alone. Many refugees could help disseminate the technology in Cambodia once repatriated. Technical assistance has already been provided by Khon Kaen University to projects which are introducing the technology to parts of Nepal and the Philippines.

Conclusions and Major Findings

The size and scope of the rainjar construction program in Thailand is an unprecedented example of what is possible to achieve in a relatively short time to increase access to water supplies through RWH.

The rapid growth of the program demonstrates that the demand for improved access to water supplies was tremendous. Private businesses were able to produce rainjars at a price affordable to many rural families, and helped the program grow rapidly.

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The major challenge that remains for the Thai Jar Program is to maximize the potential health impacts of this far-reaching program.

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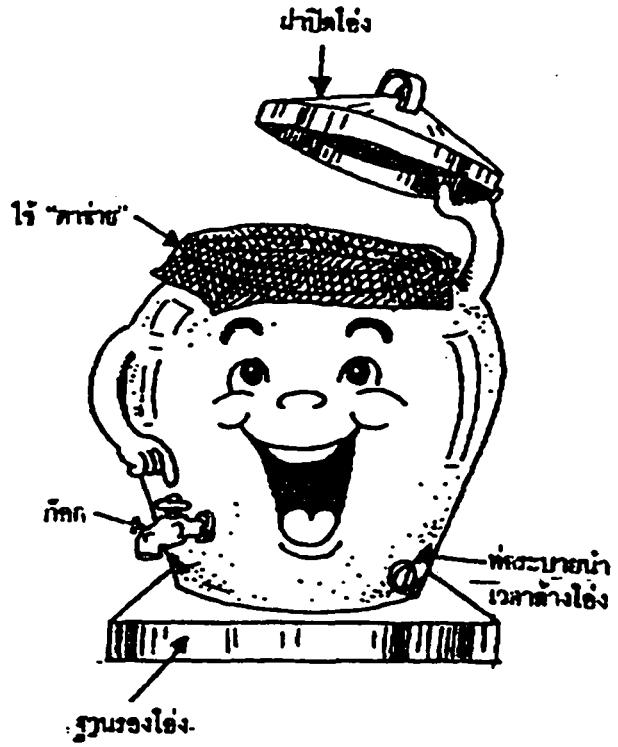
Problems with some of the earlier designs, especially the bamboo-reinforced jars and tanks, highlight the need to communicate research findings, both the positive and the negative, widely and rapidly. This is especially critical when design problems are uncovered in a new technology, so that others using these designs are alerted and faulty designs are not replicated elsewhere.

Recent studies have pointed out problems with rainwater quality, and much of this contamination is due to unsanitary handling of stored rainwater. In the push to achieve high levels of coverage, health and hygiene considerations were not developed as essential parts of the design and implementation of the rainjar construction phase.

Now, families need to learn how to improve the ways they operate and maintain their rainwater systems. Well planned and effective health education and mass media campaigns, especially on hygiene practices and water handling, are essential to improve drinking water quality and health. The major challenge that remains for the Thai Jar Program is to maximize the potential health impacts of this far-reaching program which has been remarkably successful in so many other ways.

This article was prepared by Bonnie Bradford, a public health consultant specializing in water and sanitation, housing, and the environment, in collaboration with Nongluk Tunyavanich, Associate Professor, Mahidol University, Faculty of Social Sciences and Humanities, Salaya, Nakorn Pathom, Thailand; and John E. Gould, University of Botswana, Department of Environmental Science, Gaborone, Botswana. The article also draws upon a number of published documents about the Thailand program.

Thai rainjar cartoon character is happy to have a cover and screen, tap, outlet drain, and solid foundation.



Information Resources

Concrete Roof Tile

The Swiss Center for Appropriate Technology (SKAT) is an information center on small-scale clay and cement roofing tile manufacture. Low cost, durable roofing materials that can be locally manufactured may be a key component of a successful RWH program, especially where the only option is imported metal sheet roofing. SKAT now distributes free copies of two four-page leaflets about small-scale manufacturing of concrete roof tile in India and in the Republic of Kiribati in the Central Pacific. The Indian document includes information on cost, maintenance, and marketing issues, and gives useful information about the regional center in New Delhi. The Kiribati document discusses a flat roof tile design made with a low water content cement sand mix that was developed to cope with poor quality coral sand causing major problems in tile strength and high porosity. For free copies of the leaflets and a free publications catalog covering 350 titles on Building Materials, Energy and Rural Water Supply, contact: SKAT Bookshop, Tigerbergstrasse 2, CH-9000 St. Gallen, Switzerland

Rainwater Catchment Systems for Household Water Supply, by John Gould, 57p., 1991.

This new publication reviews state of the art RWH systems technologies. Using case studies from Asia, Africa, and Australia, major technology and program issues are reviewed. Successful strategies and approaches to project planning, implementation and evaluation are examined, with information regarding costs, financing mechanisms, and water quality. The report is available from: ENSIC, Asian Institute of Technology, POBox 2754, Bangkok 10501, Thailand. US$20 air-mailing included. US$12 for requests from developing countries.

RAINDROP is available in FRENCH!

Expand the RHIC Network

Membership in the RHIC Network is free of charge and open to any individual or organization interested in rainwater harvesting. Membership includes access to the RAINCOLL database and being added to the mailing list for RAINDROP.

The RAINCOLL database is intended to serve all RHIC Network members, and access to its extensive collection of publications and data is available to any member. RHIC currently receives 20-30 requests per month for technical information. If you request information, please be as specific as possible concerning the information you are want, and address your request to Dan Campbell at RHIC, WASH Operations Center, 1611 North Kent Street, Room 1001, Arlington, VA 22209, USA.

The wider the RHIC network is, the more information and experience there will be to offer Network members. You can help expand the Network by passing on to RHIC the names and addresses of other individuals or organizations who may wish to be nominated as Network members. Thank you for taking the time!

WATER AND SANITATION FOR HEALTH PROJECT

For additional information about activities and reports highlighted in this issue, contact:

WASH Operations Center
1611 North Kent Street, Room 1001
Arlington, Virginia 22209 USA

Water and Sanitation for Health Project, Contract No. DPE 5973-Z-00-8081-00, Project No. 836-1249. Sponsored by the Office of Health, Bureau for Research and Development, U.S. Agency for International Development, Washington, DC 20523.

Sanitary inspection check list for a hand dug well

1. Is there a source of potential pollution within 30 metres?
2. Is there evidence of animals fouling the well surround?
3. Is there ponding of water around the well?
4. Is the drainage channel broken or does it need cleaning?
5. Are there any cracks in the well apron or wall?
6. Is the well lining in good condition?
7. Is the well cover clean?
8. Does the inside of the well look as though it needs cleaning?

For wells without a handpump:

9. Is there a sanitary means of drawing water from the well?

For wells fitted with a handpump:

10. Is the handpump firmly installed on the well?
11. Is there any ponding of water around the handpump?
12. Can spilt water from the handpump re-enter the well?

PROPOSAL

ESTABLISHMENT OF STANDARD SPECIFICATIONS FOR HANDPUMPS

Background:

It has been recognised world wide that some of the ways to overcome maintenance and operation problems in connection with providing handpumped drinking water, are by establishing uniformity among handpumps, by ensuring high production and installation quality etc. Furthermore, a maintenance and operation concept where the community takes over most of the responsibility for keeping their installation in working conditions will also have significant impact on the reliability of the handpumped water supply source.

The present proposal will discuss the introduction of standard specifications for handpumps. Issuing of such a specification should not be regarded as a purely technical issue. It should be looked at as a step towards improving the rural water supply sector and should therefore be seen together with other tasks such as, introduction of a village level operation and maintenance system, improved distribution of spare parts, monitoring of scheme performance, and establishment of local production of handpumps,

The advantage of having handpumps produced and installed according to standard specifications are:

- The number of types of handpump to be installed will be kept to a minimum,
- stock keeping of spare parts will subsequently become easier,
- mechanics will need to know about fewer pump types,
- parts from qualified manufacturers are interchangeable, and
- the introduction of standard specifications will also provide the chance to introduce the latest achievements within handpump development.

The following describes how establishment of standard specifications could be achieved.

Objective:

The objective of this task is to establish a set of standard specifications for public handpumps, and to have them endorsed by the responsible Government authorities, whereby it is ensured that all future public handpumps will comply with these standards.

Strategy:

The responsible authorities will give to a lead agency the task of preparing a recommendation based on which final decision regarding standard specifications will be made. The strategy below should be followed by the lead agency:

- It is essential that all organisations, agencies and NGOs, involved in rural water supply are given the chance to express their views and have an influence on the final selection of a handpump.

- The final selection will take place at a workshop where potential pumps will be presented and evaluated by the participants.
- A detailed study of the Cambodia situation with respect to ground water quality, water table fluctuations, number of pumps required etc., together with essential information regarding pumps considered , should form the basis for the selection procedure.
- Specifications should give details for any parts, so that parts from one manufacture are interchangeable with parts from another manufacture.
- A rating system could be considered as the evaluation tool,
- Parameters against which potential pumps will be rated will be given final approval by the workshop.
- Only pumps which have already proved their reliability, and can produce minimum two years of performance record will be considered.
- After standard specifications have been issued amendments if found necessary, will be issued by the responsible authorities, once a year. An annual workshop should review experiences of the past year, and forward recommendations.

Process:

A process which eventually will lead to issuing of standard specifications could look like the following:

- The authorities responsible for rural water supply give a lead agency the task of initiate and coordinate the process described below. The aim of this process is to prepare recommendations for standard specifications for a family of handpumps suitable for Cambodia.

- The appointed lead agency will collect all necessary background information. As a minimum they should collect:
- Lift requirement, the following categories are suggested:
  low lift 0 - 7 meters
  medium lift 7 - 15/20 meters
  high lift 15/20 - 45 meters
- number of existing handpumps by type and by location.
- expected total number of handpumps to be installed by category over a five year period
- expected user group size and quantity of water required
- expected annually replacement requirement
- for all potential handpumps collect:
  design specifications,
  lift and volume capacity,
  available performance data,
  VLOM status,
  corrosion and abrasion resistance,
  manufacturing needs, and
  capital and running cost

- The lead agency will also prepare an evaluation format, based on which rating of the included handpumps can take place.
- A workshop will be arranged by the lead agency where the above will be presented followed by selection of a handpump for each lift category.
- Following the workshop the responsible authorities will prepare and issue the final set of specifications.

The consequences of issuing standard specifications are:

- The authorities responsible for rural water supply issue instructions to all organisations, agencies etc. installing handpumps, that only the type of handpumps for which standard specifications have been issued can be accepted in connection with public water supply.
- All future installed handpumps will thereafter conform to the same set of specifications,
- A detailed specification will make quality control possible, subsequently, a quality control system should be introduced.
- Potential manufacturers will be encouraged to establish a production line. They will be provided with production specification, they do not need to concentrate on development of design as well.
- By issuing standards free to be used by potential manufacturers, a monopoly will be avoided,

Bent Kjellerup
Danish Cambodian Consortium
June 1992

Factors influencing people's willingness to pay and manage water supplies

* **Service level**
  The level of service provided has an important influence on whether or not people will pay for it. The lowest (and cheapest) level of service can not always be assumed to be the most marketable. In some cases, consumers who are not willing to pay a modest rate for a simple point-source supply will gladly pay much more for a higher level of service such as a house connection.

* **Service standard**
  If a system does not perform consistently, and does not continue to provide an acceptable level of service, willingness to pay is likely to diminish. This might be the case with certain piped water schemes in the Programme area.

* **Perceived benefits**
  Paying for a service is effectively a decision to invest. Continuing willingness to repeat this expenditure is dependent on the benefits to be gained. Since some benefits can be easily seen and others can not, the extent to which possible benefits are perceived and recognized by consumers is important. For example, health benefits are often indirect and many consumers may not perceive them as a benefit at all. Other factors, such as the taste, smell and colour of water from an improved supply, may be perceived as being more important.

  Economic and financial benefits, in so far as they are more obvious and direct, may also have a greater influence on people's willingness to pay. If an improved service does not provide perceivable benefits in comparison to an existing source of supply, users are unlikely to be willing to pay for it. Agencies and communities may not share the same perception of the benefits to be gained from service improvements. Within communities there can be important variations too. Different sections of a community may have different levels of interest in improved services, particularly where some stand to gain more than others. An awareness of consumer perceptions, and possible variations within communities, is therefore crucial in developing a sustainable programme.

* Relationship to production
  Where water can be used for productive purposes, such as gardening or livestock watering (zero-grazing), willingness to pay is likely to be higher than where it can not. Again, however, an improved supply must be able to deliver this advantage to a greater extent than an existing source if this factor is to be of importance.

* **Price**
  Often alternative sources of water are available, even if of poor quality. The level at which water charges are set is likely to influence people's decisions as to whether to pay for a better service or stick with the old one. A balance needs to be drawn between establishing a price which will meet costs, on the one hand, and which people will be prepared to pay, on the other.

* **Relative cost**
  In deciding whether the cost of a service is acceptable or not, people will often compare it to the costs of other services which they value equally, or which they consider to be of a higher or lower priority. The costs, for example, of electricity supply, schooling, or health care, may be used as benchmarks against which the relative costs of water and sanitation services are measured. If the costs are considered to be too high in relation to others, willingness to pay may be affected.

* **Opportunity cost of time**
  Where water is free, the basic cost to users, apart from the energy consumed in carrying it, is the time it takes to collect. The extent to which this time is valued may influence whether people are willing to pay for a service which will save time in meeting water needs. In most cases, the time in question is that of women. Men, however, may have a different perception about the value of women's time than women themselves.

* **Characteristics of existing sources**
  Where users consider their traditional water sources to be acceptable, it is unlikely that they will be willing to pay for an improved service. Relative factors such as the quantity of water available, perceived quality, distance from home, potential economic uses, and the reliability of the supply, are all likely to influence whether people will continue using existing sources, or pay for an improved supply.

* Reputation of service agency
The credibility of an agency providing a service will have an important influence on willingness to pay. In many developing countries, people have had experiences of development efforts which have promised much but, in the end, delivered little. The service agency - whether it is a government department, public enterprise, private company, or community management body - must be able to deliver the goods, and be seen to be doing so by the consumers.

* **Community cohesion**
Cost recovery is usually managed through voluntary contributions to a common fund. Good cohesion within a community is essential for this, but can not be taken for granted. Factional conflicts, or lack of trust in the village leadership or office holders, may mean that consumers are unwilling to cooperate in a joint venture of this kind, irrespective of felt needs. This factor is likely to be linked to others, such as the method devised for collecting and managing contributions, the distribution of water points in the community, and so on.

* **Policy environment**
The previous policy of seeking to provide basic services free of charge can make the covering of costs a difficult proposition. People are unlikely to be prepared to pay for services while they know that others got them free. When a free water policy is abandoned, it is important that new policies are clearly communicated and are implemented consistently.

* **Perception of ownership and responsibility**
The degree to which people feel responsible for their own water services may affect their willingness to pay. If they believe that a water supply system belongs to the government or Programme, for example, they may feel that it is the government's responsibility to take care of it. Even when systems have been formally handed over to communities, many people still do not accept ownership and responsibility. This factor may often be symptomatic of other problems, such as an inappropriate approach to implementation, inadequate consultation, or dissatisfaction with the type or level of service. A system which is imposed from the outside is unlikely to be fully accepted by a community, and willingness to pay is likely to be adversely affected as a consequence.

* **Transparency of financial management**
This factor may be closely linked to the reputation of the service agency or local management organization and is basically a matter of trust. If people can not see clearly what is happening to the contributions they make towards the upkeep of their water supply or sanitation system they are unlikely to be motivated to pay for it. An acceptable and

clear financial management system, with high levels of accountability, should help to instill trust and reassure people that their contributions are being used for the intended purpose.

* **Institutional framework**
  The establishment of water committees which bypass existing authority or local management structures, for example, may limit the effectiveness of such bodies and make people reluctant to support them. A framework which is insufficiently open to users as a whole may also diminish willingness to pay if people feel that their views will not be accounted for in the development and management of systems.

EVANS, Phil; "Paying the Piper, An overview of community financing of water and sanitation", IRC OP 18, 1992

COSTS OF THE PAT AND PORT-A-RIG DRILLING MACHINES

Promotion of Appropriate Technology (PAT) Co. Ltd.

PAT DRILLING MACHINE MODEL: ROTADRILL 201	US$
1. Drilling unit (4 h.p. petrol engine)	1,896
2. Drillpipe (60m x 1 5/8")	800
3. 3 3/4" Drill bit x 3 5 3/4" Drill bit x 3 5 3/4" Reamer x 1	768
4. Circulation pump - 9 h.p.	2,472
5. Tools & spares	292
6. Packing	132
Thailand Tax	445
TOTAL ex-factory, Bangkok	$6,805

Eureka UK Ltd.

EUREKA PORT-A-RIG	US$
1. Drilling unit with 30m drillpipe (with 5.5 h.p. petrol engine)	9,975
2. Drillpipe (extra 30m, to make up to 60m)	1,520
3. 100mm Dragblade x 3 150mm Dragblade x 3	884
4. Circulation pump - 11 h.p.	3,515
Sea-freight to Cambodia	3,325
TOTAL Cambodia	$19,219

N.B. Compressors not included

All prices as at June 1992

Exchange rates taken as: US$1 = 25 Baht

US$1 = £0.53

DRILLING EQUIPMENT

Mechanical Drilling

Current UNICEF drilling rigs and brief specifications:

EDSON 5000

Mud/Air drilling with DTH

Maximum drilling depth: 150m
Maximum diameter: 9 7/8" with mud
6½" DTH

1 x IVECO Deutz truck mounted drilling rig
1 x IVECO Deutz truck mounted water tanker
1 x IVECO Deutz truck mounted Atlas Copco 350 l/s compressor
1 x Toyota station wagon

EDSON 2000

Mud/Air drilling

Maximum drilling depth: 60 - 70m
Maximum diameter: 7" with mud
4½" air

1 x Ford tractor mounted rig
1 x IVECO Deutz truck mounted water tanker
1 x trailer mounted Atlas Copco 175 l/s compressor
1 x Toyota station wagon

HYDREQ

Mud/Air drilling

Maximum drilling depth: 120m
Maximum diameter: 9 7/8" with mud
6½" **air**

1 x IVECO Deutz truck mounted drilling rig
1 x IVECO Deutz truck mounted water tanker
1 x IVECO Deutz truck mounted Atlas Copco 350 l/s compressor
1 x Toyota station wagon

BOURNEDRILL I

Reverse Circulation Drilling/Air

Maximum drilling depth: 200m with 6" drill pipes
70m with 4" drill pipes
80m with air at a diameter of 4½"

1 x Ford tractor mounted drilling rig
1 x Massey Ferguson tractor pulling transport trailer and water tanker trailer
1 x IVECO truck mounted Ingersoll 175 l/s compressor
1 x Toyota station wagon

BOURNEDRILL II & III

As Bournedrill I but with smaller compressor -

1 x Trailer mounted Atlas Copco 85 l/s compressor

Plus an additional truck mounted water tanker.

INGERSOLL-RAND Model TH-10 (to arrive in July)

Mud/Air drilling

Maximum drilling depth: 125 m
Maximum diameter: 200mm

1 x Truck mounted (Magirus Deutz) drilling rig
1 x Trailer mounted compressor
1 x Trailer mounted water tanker
1 x 4WD Tractor

Manual Drilling

22 x PAT Rotadrill 201

Mud/Water drilling

Maximum drilling depth: 20 - 30m (at a diameter of 4")
> 30m (at a diameter of 2½")
Maximum drilling diameter: 5 3/4"

1 x Toyota pick-up
1 x Tanker trailer 1500l

SUPPLEMENT TO THE CAMBODIA EVALUATION TECHNICAL REPORT

Borehole Costings

Borehole records are completed by UNICEF Central mechanical drilling teams and Provincial manual drilling teams. They are copied to the Central Water Base where they are entered into the data base.

A copy of a borehole record sheet is attached. It indicates the materials and quantity of fuel consumed, and the start and end of drilling. These figures can be used to estimate the cost of the borehole. In this example of well no. E 639, the depth of drilling was 31m but the bottom 12m was not cased as it was drilled into fractured hard rock which did not require casing. The length of 4 inch casing was 16m with 3m of screen. The quantity of cement used was 25kg for the grout seal. The platform and pump installation was carried out separately by the construction crew. The quantity of fuel used for drilling was: 183 litres; and for Toyota site transport: 20.35 litres.

The above information is fed into the Central Water Base data files where it is available for carrying out a cost analysis. However, it takes time to extract such information and in the time available for the evaluation it was not possible to carry out any detailed cost analysis exercises.

Information on the cost of pump maintenance was extracted for Kompong Speu province and this has been used in the report to illustrate the cost of pump maintenance in that province. Similar exercises could be carried out for other provinces on the cost of pump maintenance and on the cost of borehole drilling. Such exercises would provide valuable information for both monitoring and planning purposes. Consideration could be given to carrying out cost analyses on a regular periodic basis.

It will be particularly important when moving into the new areas of unpredictable drilling to monitor expenditure on a regular basis to assist accurate planning and budgeting of the expanded drilling programme.

Lightweight drilling costs

Some indication of lightweight drilling costs can be obtained from figures obtained in the field for PAT drilling in soft formations in Bantey Mean Chey. These are figures obtained from the Oxfam supported programme within the Provincial Department of Hydrology. Similar costs would be expected in the UNICEF PAT drilling programme.

Direct drilling costs for a well of depth 36m in soft formations using a PAT lightweight drilling machine.

Mobilisation costs (transport of rig, materials, etc.), pump installation and platform not included.

Labour costs -

Time required for drilling & development: 4 days

Labour required: 5 men for 4 days = 20 man.days

Allowance of R 1,800 per man.day

Total allowance for 20 man.days = R 36,000

Salary: R 30,000 per month or R 1,000 per day

Total salary for 20 man.days = R 20,000

Total labour cost: R 56,000 ($ 47)

Fuel costs -

Take an average figure of 300 litres of fuel (diesel & petrol) and oil for drilling with the PAT rig to a depth of 36 metres.

Approximate cost of fuel & oil: R 300 per litre

Total cost of fuel & oil: R 90,000 ($ 75)

Material costs -

Material	Unit cost	Total cost
30m of 4" PVC casing	$ 5	$ 150
6m of 4" PVC screen	$10	$ 60
sand & gravel		$ 20
25kg cement (half bag)	$ 4	$ 2
Total material cost		$ 232

Summary of costs -

1. Labour costs	$ 47
2. Fuel costs	$ 75
3. Material costs	$ 232
Total cost	$ 354

INDIA MK II
OPERATION & MAINTENANCE COST

The analysis is based on information for Kompong Speu province for 1991. Number of handpumps: 600

Actual expenditure, 1991 -	Total US$	Per Pump US$
Cost of essential spare parts	457	0.76
Riser pipe & pump rod	720	1.20
Platform repair	350	0.58
Replacement of 20 pumps (3%)	7,000	11.67
Maintenance team	900	1.50
Fuel consumption	504	0.84
Depreciation of vehicle (3yrs)	5,000	8.33
Total:	14,931	24.89

The riser pipe and pump rod replacement are a major portion of the spares required. According to UNICEF's experience, a set of riser pipe and pump rod will last for approximately 6 years. Therefore, to estimate the actual cost per year over a more representative period of 6 years, the cost of riser pipe and pump rod replacement should be taken into account.

The cost of riser pipe and pump rod replacement will be:

	Total US$	Per year US$
1¼" riser pipe of 21 metres	52.80	8.80
12mm pump rod of 21 metres	54.50	9.08
Total:	107.30	17.88

The figure of $17.88 is a more accurate reflection of pipe and pump rod replacement than the allowance made for this in the annual expenditure for 1991. Total spare parts cost per pump per year can then be calculated as follows:

	US$
Cost of essential spare parts (less riser pipe & pump rods)	0.76
riser pipe & pump rod replacement	17.88
Cost of spare parts per pump/year:	18.64

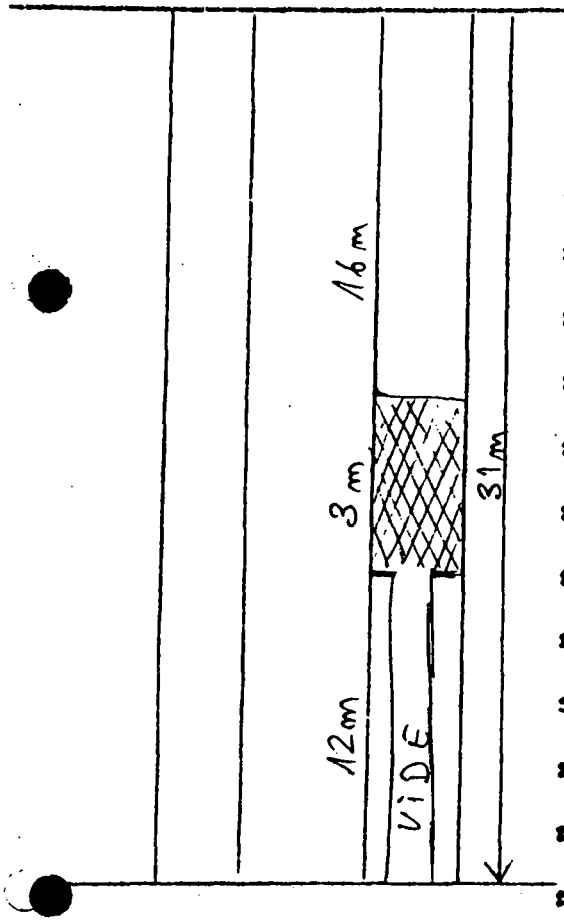
Included in the actual expenditure for 1991 is the replacement of 20 handpumps. However, a well maintained handpump should not require total replacement. Riser pipe is replaced because of worn threads. The pipes still have a resale value which is not accounted for in the above calculation.

(UNICEF)

25/06

FORAGE	COMMUNE	DISTRICT	PROVINCE
ANGSEREI	KANAK RAING	OUDONG	K. Sp.

- FORAGE N .E...63.9.....
- FORAGE DEB .08...06...92.....
- FORAGE FIN 09...06...92.....

FORMATION GEOLOGIE	L'ESSAI DEBIT	REMARQUE
	: N.S ..... :	
	: MIN ...0.-15...Sable. :	
	: 2 . ..5.-15...Argile.. :	
	: 3 . ..15.-31...Dacite.. :	
	: 4 . ..... :	
	: 5 . ..... :	
	:10 . ..... :	
	:15 . ..... :	
	:20 . ..... :	
	:25 . ..... :	
	:30 . ..... :	
	:40 ..... :	
	:50 . ..... :	
	:60 . ..... :	

- FORAGE DIAM ...4"/.....	:		:	
- PROFONDEUR ....31m/....	:		:	
- CREPINE .....3.m/....	:		:	
- TUBAGE .....16.m./.....	:		:	
- N.S .....5,3.m....:	T	6"	:	81
- DEBIT 0,6.5.m³/h:	iN	3	:	25,5
- DEBIT POMP .....:	T	119	:	14
- CIMENT .....25kg.....:	Com	3	:	60
- BENTONITE .....:	N/A	1	:	2
- SALINITE .....782.....:	TOY 14020 - 14155 -	135	:	20,25
- TEMP .....:			:	203,45
- POPULATION .....:			:	
.....:			:	

unicef

United Nations Children's Fund
Fonds des Nations Unies pour l'enfance

No 11, 75th
Srachark Q..
Phnom Pe..
CAMBODIA
Tel:2-6282

FACSIMILE UNICEF BANGKOK NO. (66-2-2803563)

To: Mr. Lay Maung — 16 September 1991
Regional Adviser
UNICEF Bangkok

From: Anne Bruzelius — PRO/300-1173
Special Representative

Re your fax of 5 September 1991 re average cost of well drilling NW Cambodia:

1. Construction of Water wells in Battambang and Bantheay Mean cheay (Medium to hard rock formation below Alluvium)

- Drilling of deep tube wells with appropriate technology for hard rock formations; minimum capacity:100m recommanded: EDSON 500, partly HYDREQ
-Deep well pump
-Camp situation requires over-sized dimension of platform and drainage (sanitation aspect)
-basis for cost calculation:
Depth: about 100 m or more; dia: min. 4"; Indian Mark II pump; well platform: dia. about 4.5 - 5 m and 10 m drainage.
- Calculation of Unit cost (1 completed well) (US$)

a)	Transport:	1 Drilling equipment and accessories	400.00
		1 Transport of material as pipes, pumps, cement, etc for 5 wells simultaneously;	350.00
		for 1 well, but economically not feasible. (All related to Battambang distance)	70.00
b)	Drilling:	3 days operation estimated; including, fuel, personnel, temp. casing (Excluding community support)	1,200.00
c)	Material:	100 m PVC pipes, 4"	500.00
		6 m PVC screens 4"	60.00
		2 m3 gravel for gravel pack	20.00
		2 m3 sand	5.00
		10 bags cement	40.00
		India Mark II pump (complete)	220.00
		Sub-total	2,515.00

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Srachark
Phnom Pe
CAMBOD
Tel:2-628

d) Replacement costs:.....	200.00
e) Programme Support (national + UNICEF)	1,000.00
Total (a-e)	3,715.00

II. Construction of Water wells in Pursat and Seam Reap
(Soft rocks, mostly alluvium)
- Drilling of deep wells by Reverse Circulation, recommended BOURNEDRILL
- Deep well pump; oversized platforms and drainage in regards of camp sites

- Basis for cost calculation (US$):

Drilling depth: 50 - 70 m; dia. 4-6"; pump type: India Mark II;

a) Transport: 1 Drilling equipment		200.00
1 Transport of material (See point I a)		70.00
b) Drilling: 1-2 days		800.00
c) Material 70 m PVC pipes 4"		350.00
6 m PVC screens 4"		60.00
2.5 m3 gravel		25.00
2 m3 sand		5.00
10 bags cement		40.00
India Mark II (complete)		220.00
	Sub-total	1,770.00
d) Replacement costs		170.00
e) Programme Support		700.00
	Total	2,640.00

Sorry for delay to reply. Regards.

JT/