REPORTS FROM THE FIELD

A comparative analysis of water provision in four Thai refugee camps

Tony Waters

1525 Capitol Avenue
Sacramento
CA 95814
U.S.A.

INTRODUCTION

Specialized problems are inherent in providing water of adequate quantity and quality in a refugee camp. The author became aware of these constraints during the 15 months he worked in Thai refugee camps. The significance of these problems become more apparent as field level experience increased, and professional contacts were developed. It became apparent that each camp had developed practices and policies independently. As a result, water rations, water quality, and means of delivery varied greatly from camp to camp.

This study was undertaken to determine what these differences were, and make a comparative analysis of the various methods of water provision used in Thai camps. Investigation indicated that systems had evolved primarily in the context of donated foreign equipment and expertise. Operational and maintenance requirements were given lesser consideration. The needs of the refugees for an abundance of washing and bathing water were also given lesser consideration. On the other hand, there was an emphasis on ensuring that the small quantities of water provided were of high potability.

METHODS OF FIELD STUDY

A systematic survey was made of water supply systems in four Thai refugee camps. These camps were selected for their diversity of geographic, ethnic and water delivery systems; and for their accessibility to the author. In three of these camps, the author was, at one time or another, a sanitation consultant. The author visited the fourth camp, Khao I Dang, for observations and discussions with the resident sanitarian.

In assessing the water delivery systems in each camp, refugees, resident sanitarians (Thai and expatriate), UNHCR officials, Thai government officials, and voluntary agency personnel were consulted. Consultations were generally on an informal basis in the course of the days' work, though once the study was undertaken in late 1983, appropriate persons were approached with specific questions.

The following camps were surveyed (see also Fig. 1).

Ban Nam Yao

Ethnic groups: Highland Lao (Hmong, Mien, Htin)
Population: 10,000 — 13,000
Date established: 1976
Water sources and estimation of relative importance:
Hand-dug wells: 70%
Water system: 30%
Water rationing: None.

Sikkhiu

Ethnic group: Vietnamese
Population: 0 — 8,000
Date established: 1976
Water sources and estimation of relative importance:
Water system: 0% (not operational at time of study)
Trucks: 100%
Water rationing: 40 l. per refugee per day.

Khao I Dang

Ethnic group: Cambodian (Khmer)
Population: 50,000 — 150,000
Date established: 1979
Water sources and estimation of relative importance:
Water system: 0% (not operational)
Hand-dug wells: 0 — 40%
Trucks: 60 — 100%
Water rationing: 15 l. per day per refugee.

Phanat Nikhom

Ethnic groups: Cambodian (Khmer), Lao, Vietnamese
Population: 13,000 — 23,000
Date established: 1981
Water sources and estimations of relative importance:
Water system: 70%
Trucks: 15%
Hand-dug wells: 10%
Rain catchments: 5%
Water rationing: 12.5 — 20 l. per day per refugee.

FINDINGS

Ban Nam Yao

This camp is built on the slope of a steep mountain which makes water delivery by any method difficult. Pumping costs for the gas-powered pumps are high, and wells are far from the houses, which are concentrated on three adjacent ridges. Indeed, refugees living near the crest of the ridges obtain most required water from the piped water system, while refugees living further away from the pipeline, i.e. nearer the streambeds, typically obtain water from wells.

The refugees have dug over 100 wells in the four stream beds draining the camp. Initially, most of these wells were unlined, or lined with wood. Cement linings, however, have

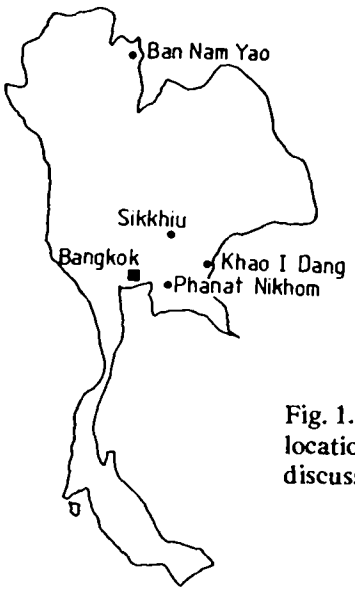

Fig. 1. Map of Thailand showing locations of refugee camps discussed.

been installed in most wells since 1979, using concrete rings purchased by the UNHCR and voluntary agencies. Donations of cement, sand and stone have resulted in the pouring of skirts at many well sites. Many of the wells used by the ethnic Hmong are private, and have been fitted with covers and locks by the refugee owners. Wells of the Mien and Htin refugees are without locks and are used communally.

Water is pumped to the camp at the rate of about 60 cubic metres per day. However, the system has often proved unreliable because of maintenance and management problems. The pipeline of this system follows the crest of the three ridges on which the camp is situated.

Chlorination of piped water is intermittent at best because of conflicting values between the voluntary agency providing the chlorine and the refugee consuming the water. Caught in the middle are the refugee workers responsible for the reservior above the camp. Pressures applied by voluntary agency sanitarians generally result in over-chlorination by the workers, which in turn prompts "forgetfullness" in the addition of chlorine. A middle ground has not been found, a condition caused by the inability of inadequately educated refugee workers to fully understand the chlorination programme. Irregular pumping schedules (i.e. variable volumes which do not permit a standardized "cookbook" approach to chlorination) further complicate the situation.

Parts for the pumps and water system were available in the provincial capital, one hour's drive from the camp. Other parts were ordered from Bangkok. Breakdowns requiring such parts have resulted in system breakdowns of up to five days.

Complicating the maintenance problems was the frequent absence of the one Thai technician hired (at a relatively low salary) to maintain the system, and the expatriate manager of the programme who was often out of town on business. For a short time, there was also a camp policy of not providing piped water on Sundays so that the one technician could have the day off. In the event of system breakdowns, all refugees used well water for all uses.

Khao I Dang

Water in Khao I Dang is provided by truck and hand-dug well. The official ration for trucked water in 1983 was 15 litres per person per day, which is only slightly higher than the 13—14 litres provided in early 1980 (Buist, 1980). Piping and water towers for a water system were installed in 1980—1981, though this water system has never been operational.

Water has been trucked to Khao I Dang from distances of up to 100 kilometres. At one time, the water was chlorinated in the truck. At the time of the study however, it was chlorinated at the distribution points. The distribution points are stations of 30—40 water tanks (1,700 litres each) which serve each refugee section.

The water table at Khao I Dang is two to three metres below the surface in most areas and, as a result, ground water is readily available. An estimated 2,000 wells have been hand dug. However, until recently, all wells were unimproved. Well improvement projects were begun in 1982, and at the time of this study were being installed. It is planned that by the end of 1983, there will be over 400 improved wells.

Pot chlorinators have been installed in Khao I Dang wells. The acceptance of the chlorinators is mixed. Over dosage of the chlorinators with chlorine results in bad odours and tastes which prompt the refugees to remove them.

The improved wells at Khao I Dang are 80 centimetres in diameter with a cement cover and lid. The lid is wide enough for only one bucket to be used at a time. This is an attempt to limit bucket-borne surface contamination, by making use of more than one bucket at a time a physical impossibility. The current well-construction project goal of providing one well per 80 persons should also limit the number of buckets used in any one well.

The camp water system was installed with the intent of using pumped sub-artesian wells. However, test drills conducted after the system was installed indicated that the amount of water available was insufficient for the projected needs. As a result, the installed water towers and pipelines remain unused.

Phanat Nikhom

No provision for water was made when Phanat Nikhom camp was established in 1980 as the Processing and Transit Centre for refugees emigrating to third countries. As a result, all water was trucked into the camp until early 1982. Small amounts of water were also available from unimproved wells dug in a flood plain through which the camp wastes flow, and water could also be purchased from Thai villagers who have houses and wells adjacent to the camp. The ration from legitimate sources, i.e. trucked water, was 12.5—15 litres per day.

A 30,000,000 Baht (U.S. $1.3 million) water system was installed in 1982 as a gift from the Japanese government. The construction project included a 79,000 cubic metre reservoir, modern water treatment facilities, two 15 cubic metre water towers, in-camp pipelines and seven pumps.

The various pumps were co-ordinated by a modern automatic switching system. With the completion of this water plant, delivery of water by truck was curtailed; deliveries continuing only for agency offices, and other areas of the camp not served by the pipeline. As before, small amounts of water were available from unimproved wells.

Engineers designed the new water system to provide a water ration of 15 litres per day per refugee, assuming a 33,000 person population. The water treatment facilities installed insured that the water was not only highly potable but also included additional steps to produce a highly palatable product. The quality produced was, in fact, much higher than that found in the water systems of most Thai municipalities.

In practice, the Phanat Nikhom water plant has provided approximately 650,000 cubic metres of water per day on a 14—16 hour pumping schedule. Because the population has not exceeded 23,000, the actual water ration from the plant has been, in practice, about 20 litres per refugee. In addition, an unrationed supply is pumped for the hospital, kitchens, and a few offices. Use is lower on rainy days when refugees substitute rainwater collected from roofs for part of their ration.

During 1983, the first full year of operation for the system, problems in operation and maintenance were experienced despite the state-of-the-art technology. In fact, the modern technology was the source of several problems, especially breakdowns in the automatic switching system.

Management of the system was complicated by the absence of any of the persons, primarily foreigners, who had designed it, and the failure to leave as-built plans or blueprints in Phanat Nikhom. As a result, hot season rations were not geared to take advantage of the available water.

An example of the management errors that plagued the system is provided by the establishment of the dry season water ration in March, 1983. Before the arrival of the as-built plans in April, 1983, in-camp administrators were unaware of the assumptions engineered into the system, i.e. the available volume in the reservoir, and the predicted length of the dry season. As a result, the refugees had a lower ration than necessary, because of conservative "guesstimates."

The consequence of this planning error was that the daily water ration was limited to 12.5—15 litres per refugee per day during the critical hot season months, even though the system could have provided a ration in excess of 20 litres. The ration provided, it should be noted, is significantly below the 20—30 litre international standard recommended by Simmonds *et al.* (1983). It is also sparse given the high value that Southeast Asians place on general cleanliness and frequent bathing, particularly during the hot season. Priorities used in the construction of the water system instead focused on providing a highly potable product, in less than abundant quantities. Similar priorities were noted at Khao I Dang during this study (see above), and Haynal (1981) made similar observations during visits to seven other Thai refugee camps in 1981.

The water plant operators at Phanat Nikhom are paid wages comparable to those earned by similar technicians working for Thai municipal water systems. Salary comparisons, however, are more often made with Thai and expatriate workers working inside the camp, than with other water works technicians in Thailand. Thais working for agencies inside the camp are paid, generally, 2—5 times the standard Thai wage. Expatriate workers often receive considerably more. This discrepancy was the source of morale problems which were reflected in the implementation of operational and maintenance policies at the water plant.

Wells at Phanat Nikhom have been dug by refugees since the opening of the camp, especially during the dry season. These wells are used for domestic purposes, and watering gardens. They are occasionally lined using 60—100 centimetre diameter culverts discarded from the camp drainage construction project.

A well chlorination project was begun for improved wells in 1983. The wells are manually chlorinated by a refugee worker each evening. The effectiveness of this programme has not yet been assessed, though some complaints about the taste and smell of the chlorine were noted.

Well water is used by refugees primarily for bathing and washing, while piped water is used for drinking. However, water from wells which have a reputation among the refugees for "good taste" and cleanliness are also used for drinking by some families.

Water is trucked from the camp reservoir to some in-camp offices. Several major offices, such as the UNHCR, and the Thai administrative facilities, were not included in the piped water project because camp officials at the time of construction were concerned that not enough water would be available in the reservoir if it were piped to offices as well. As a result, water from the reservoir is trucked to the camp.

Water is also trucked to the camp kitchen where the volume of water received through the pipes is insufficient. The kitchen has been responsible for the daily meals of up to 9,000 refugees, and requires approximately 30 cubic metres of water per day.

Rainwater is collected from the roofs of refugee houses during the rainy season. Refugee housing at Phanat Nikhom has metal roofs to which gutters have been attached. Rainwater is a major source of water during the rainy season, from May until November. On rainy days, the consumption of water drops by about 100 cubic metres.

Sikkhiu

Water in Sikkhiu Camp is trucked from a reservoir two kilometres from the camp. The reservoir provides a consistent and generous water ration. The refugees report receiving "as much water as we can use." The Thai Camp Commander, who is responsible for providing the water ration, indicated that the actual ration was about 40 litres per day per refugee, significantly higher than either Khao I Dang, or Phanat Nikhom. From the trucks, the water is pumped untreated into water basins and tanks from where it is obtained by the refugees.

The water at Sikkhiu camp is distributed without treatment. During the years that the reservior has been used as a source of water for the camp, and also for the surrounding Thai villages, there has been no reported

Table 1. *Relative* costs of water provision at Phanat Nikhom refugee camp*

	Start-up costs	Continuing costs	Yield (m3)	Continuing costs/m3	Potability
Wells	$110/well	Negligible	10—12 per well	Negligible	Low
Water system	$1.3 million	$23,500 per year	650/day	$0.10	High
Three trucks	$61—90,000	$12,600 per year	150/day	$0.23	Medium

*Figures taken from proposals by the Catholic Office for Emergency Relief and Refugees to the UNHCR, Water System plans, and observations by the author.

epidemic of water-borne disease. This observation has been the source of resistance by the Thai camp officials to the initiation of a general chlorination programme for the refugee water supply. If such a programme were started in the camp, water quality standards for refugees would be higher than for nearby Thais, a situation considered politically undesirable.

A water system was installed in Sikkhiu by the Japanese government in late 1982. Operation awaits arrival of a converter for the 110 volt pumps so that they can be connected to Thailand's 220 volt electrical supply.

The soil at Sikkhiu is too rocky for well digging in the vicinity of the refugee camp.

Relative costs of water provision

Trucked water is the most expensive of the various sources of water used in the four camps surveyed. Cost estimates obtained from Phanat Nikhom indicate that continuing costs for the provision of trucked water are U.S.$0.23 per cubic metre, over twice the cost of water piped to the camp by the water system (Table 1).

Continuing costs for the maintenance of hand-dug wells are negligible. Wells are dug, lined and skirted at a one time cost of approximately U.S.$110.00. Well yield varied with depth, soil type and construction specifications. However, experience at Phanat Nikhom where the soil has a high clay content, indicate that wells of standard construction (100 centimetre diameter) can provide 10—12 cubic meters of water during the dry season.

Well water, which is the cheapest to provide, is often of the lowest potability. To meet international standards (see, for example, *Simmonds et al.*, 1983), well water must be boiled or chlorinated before drinking. However, local standards for water potability are often different, both in Thailand and Indochina where the refugees came from. Well water, for practical purposes, is often used for drinking.

Trucked water which has been chlorinated, such as is found at Khao I Dang and Phanat Nikhom, is of only medium potability despite the high cost. The chlorine destroys bacteria and viruses. However, since the surface water for the trucks often comes from surface sources, there has been no provision for the elimination of parasite cysts.

Water which has been treated, filtered and chlorinated, such as is available to refugees at Phanat Nikhom, is of the highest potability and quality. Provision is made in the system for the elimination of bacteria, viruses and parasite cysts.

DISCUSSION

The provision of water is critical in any community. Refugee camps are, of course, no exception to this rule. However, with the establishment of refugee camps, special problems for the provision and distribution of water often arise. It is necessary to provide sufficient quantities of water of adequate quality for people living in an unnatural and often crowded environment, at a minimum cost. The availability of water in the community must be assessed to take optimal advantage of the available resources. Experience in Thailand has demonstrated that these assessments must be made in the context of (1) physical constraints imposed by the camp site, (2) the availability of water to host country nationals, especially in the immediate vicinity of the camp, (3) social, cultural and biological needs of the refugees, and (4) the donation of equipment and expertise from foreign donors.

The experience in Thailand, where water delivery has been primarily provisioned by the use of water systems, water trucks, and hand-dug wells, are briefly discussed below.

Water systems

The experience with water systems in Thai refugee camps has not been particularly good. Systems in all four camps surveyed were plagued with management and/or design problems. Most notable are the systems at Khao I Dang and Sikkhiu, both of which remained unused because basic surveys of local conditions were not made by equipment donors, or recipients, prior to installation. The Ban Nam Yao system suffered from management and maintenance problems which resulted in prolonged breakdowns.

The water system at Phanat Nikhom is the major source of water in the camp. It has been managed comparatively well, and there have been no prolonged breakdowns. However, there have been planning and operational

mistakes. Perhaps the biggest flaw in the planning was the provision of sub-optimal water rations to refugees, while making the capital investment to provide an unnecessarily high quality of water. The failure to install pipelines to offices in the camp which, instead, must use expensive trucked water was also a planning error.

Water systems in Thai refugee camps have typically been designed and/or managed by foreigners. An unfortunate byproduct of this general practice has been that systems are built that are not particularly appropriate in the context of the resources available in the community. For example, despite the fact that functional water systems have been fixtures in Thai communities for many years, the plants have not been designed to take advantage of locally available parts, or locally available labour. In the case of the Ban Nam Yao system, this oversight has resulted in shut-downs of several days while parts are ordered from Bangkok. At Phanat Nikhom, extra expense has been incurred when purchases of rare foreign-manufactured parts are necessary.

Wells

Hand-dug wells provide a reliable source of water in three of the camps studied. In Ban Nam Yao, hand-dug wells are the major source of water, and at Khao I Dang, wells are a significant source. At Phanat Nikhom, wells provide a supplement to the piped system.

Well-digging projects have typically been organized spontaneously by refugees upon establishment of the camps. Only after the wells have been dug have the UNHCR and Voluntary Agencies responded by financing projects to improve sanitation and safety. The lag-time for well-improvement projects has ranged from two years at Phanat Nikhom, to five years at Ban Nam Yao.

Hand-dug wells are used as a water source throughout Southeast Asia, including Thailand. The refugees are generally familiar with maintenance procedures, and generally good sanitation practices were observed. Given these factors, it is surprising that refugee assistance agencies have not placed greater emphasis on simple well-improvement and development projects.

Trucked water

Trucking is traditionally used in emergency situations as a short-term alternative until cheaper and more manageable means of water can be developed. In the Thai refugee camps surveyed, particularly Sikkhiu and Khao I Dang, trucked water has continued to be the major source of water four to seven years after the camps have been established. This continued use of water trucks is necessary because of the apparent disinterest in developing wells as an alternative water source, and the failure of water systems in both camps.

CONCLUSIONS AND RECOMMENDATIONS

The experience with water supply in Thai refugee camps has offered several lessons. Future refugee camp planners might take note of the following points.

1. Successful water provision for refugee camps should be modelled after systems already functioning in the local community. While donated equipment of foreign origin can make this difficult, acceptance of such equipment should be made only after careful consideration has been given to future maintenance and operation costs, in the context of locally available labour and spare parts.

2. If hand-dug wells are a major water source in the local community, they should also be considered for use in the refugee camp.

3. Realistic standards for the provision of water should be established soon after establishment of the camp, in the context of practical, political and cultural considerations. International standards, such as those published by the UNHCR and Simmonds *et al.* (1983) can be used as a guide, but local conditions have to be considered also. Field-level sanitatians from Thai camps suggested the following local standard for water quality and quantity in late 1983:

> A quality of 7—10 litres per day of highly potable water (e.g. water with 0.1—0.5 ppm residual chlorine), is recommended and 20—30 litres of water, not necessarily potable, for bathing and washing purposes. Hand-dug wells were considered to be a practicable source of this bathing and washing water. Regular water testing under field conditions was not considered practical. However, it was recommended that testing be done in the event that new sources of potable water were developed.

4. Use of expensive trucked water should be quickly phased out as water becomes available first, from adequate numbers of hand-dug wells, and later, perhaps water systems.

5. Water systems should be installed only after local technicians, who will inevitably play a long-term maintenance role, have been consulted. Surveys should include the yields of local wells and streams measured during the dry season. The characteristics of the local electrical system, locally available operational and maintenance technicians and spare parts need also to be considered.

6. Consideration should be given to equalizing salaries paid to water system technicians with other personnel working in refugee camps.

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