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-Scale Gravity Flow Water Systems in Phrae Province, Thailand

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ABSTRACT

Small gravity flow water systems using small diameter PVC pipe are an increasingly popular technology in the mountains of Phrae Province, Thailand. The systems are appropriate to the needs and capabilities of the rural Thai village users; rural Thai villagers have been able to independently design, finance, and construct systems serving from 10–30 houses.

Technical details about the construction, maintenance, and finance of two systems in Ban Nam Jom Village are described. The systems include sedimentation and sand filtration tanks, and also galvanized iron reservoirs. One system, serving 22 houses, was constructed at a cost of US $904.72.

Low cost gravity flow water systems are a new technology for accessible mountain areas in countries where cheap PVC pipe is available.

INTRODUCTION

Solutions to water supply problems can be approached using technological advances in both a simple and complex manner. This paper describes how rural northern Thai villagers used a newly available technology, inexpensive small-diameter PVC pipe, to improve the quality and delivery of water in remote mountain villages. PVC pipe, which has only recently been introduced to the region, has been used by villagers to install small-scale gravity flow water systems with in-house delivery.

Unique to these projects is the demonstrated ability of the villagers to independently design and finance projects without engineering or technical training. Rural Thai villagers have also been able to mobilize themselves to improve water provision in their villages. This utilization of local human resources to install a water system, would not have been possible had the easily-installed PVC pipe not been available. While not a highly technical solution to water supply needs, such systems are a reminder of how water supply problems can be solved at a local level without large inputs of outside expertise.

The author surveyed seven systems in four villages of Phrae Province in 1982 while assigned to the local Malaria Zone Office as a Peace Corps Volunteer. The survey focused on Ban Nam Jom Village, where Peace Corps funds provided limited assistance for installation of one of two gravity flow water systems.

DESCRIPTION

Small-scale gravity flow water systems are a locally based technology which is becoming popular in the remote mountains of Phrae Province, Thailand. The new systems provide a higher quality of water, and improved delivery, over the traditional sources of water. Traditional sources of water in such villages are in-village hand-dug wells, and streams. The new water systems have become possible with the introduction of inexpensive small-diameter (1/2″–1″) PVC pipe manufactured in Thailand, and a road system which makes mountain villages accessible.

Systems generally include sedimentation tanks, sand filtration, reservoirs, and a main line up to 500 meters long. In-house domestic supply has been provided to 10–30 house hamlets.

Financing is from a variety of sources, including public schools, rural health programs, rural development services, private companies, and the malaria service. However, the majority of money has come from public subscription purchased by villagers, who also provide labor for installation.

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BAN NAM JOM VILLAGE

Ban Nam Jom is a village of three hamlets, each nestled in small adjacent valleys about 30 kilometers from the main provincial town of Phrae, and 200 kilometers Southeast of Chiangmai (Fig. 1). A laterite road was completed to the village in 1976–77. There are a total of about 40 houses with a population of approximately 200.

In January 1981, the hamlet nearest the school (10 houses) installed a gravity flow water system under the direction and design of the school principal. The school principal, who had no formal training in technical or engineering subjects, was the sole source of technical advice for this project. The system provides water to the school, each of the 10 houses, and a water fountain, approximately 6 meters high. Water for the system is diverted from a small stream 400 meters above the village through a split bamboo trough, into a sedimentation tank, and through three sand filters. The tanks used for sedimentation and filtration were made from concrete well rings left over from a government-sponsored well construction project. The sand was obtained from the village stream bed. After filtration, water entered two galvanized iron (1700 liter) rain catchment tanks appropriated from the school, and from there flowed through a 1" diameter PVC main line to the hamlet (Fig. 2). Piping into each house and the school was 1/2" PVC pipe.

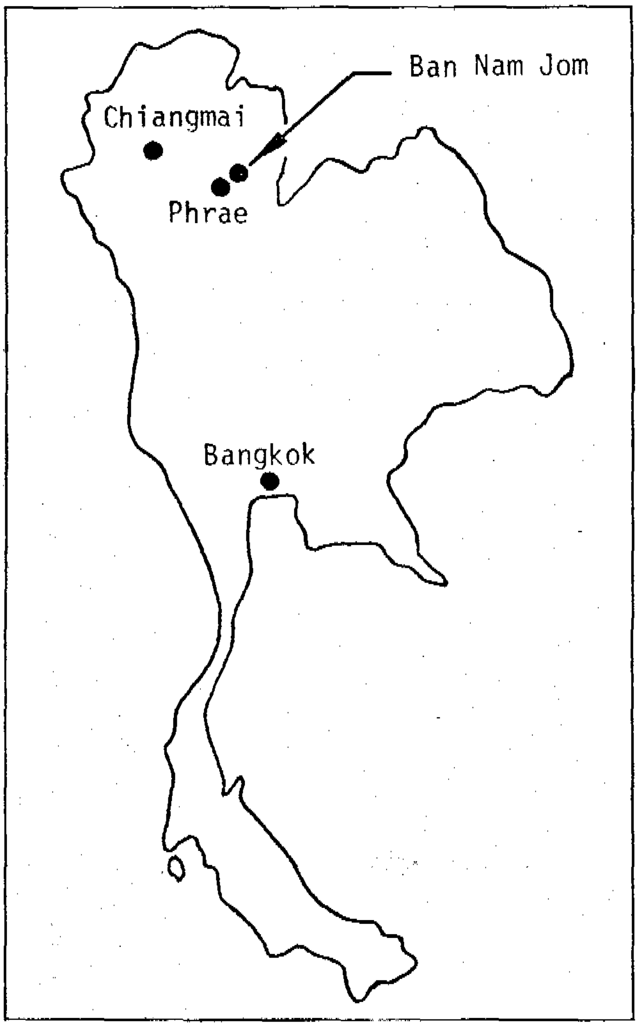

Fig. 1. Map of Thailand showing location of Ban Nam Jom.

A similar system was installed in the main 22 house hamlet in June–July 1982, under the direction of the village headman in consultation with the school principal. A small spring 37 meters in elevation above the village (0.079 liter per second dry season flow) was capped for use as a water source. All families in the hamlet contributed labor and money to the project, which was completed during a six-week period. Because of the larger population of the hamlet, and the low stream flow, three reservoir tanks were necessary, instead of the two used in the smaller hamlet. A 420 meter 1" main line was installed. 940 meters of 1/2" pipe was used to make the in-village connections to the 22 houses.

Total cash expenditures for the 22 houses were US $904.72. Labor, tools, and a few locally available incidental items (lumber, sand, rock, etc.) were provided by the villagers, exclusive of the project budget.

Of the total budget, US $436.68 was provided from Thai government funds channeled through the US Peace Corps and Thai Malaria Service. Villagers were assessed US $21.83 per house by the village leaders for a total of US $480.35 ($12.31 was left in the village's account after installation was completed). Each family also provided labor for the assembly of the system, under the direction of the village headman. Approximately 80 man days were needed to make complete connections to all 22 houses.

The largest expense was for the three catchment tanks which cost 31% of the project total. Half-inch PVC pipe was 25% of the total, and one-inch PVC pipe 20% of the cost (Table 1).

OPERATION AND MAINTENANCE

It is necessary to divert stream-fed systems during rainstorms to avoid overload of sand filters, and entry of silty water into the system. This was not necessary with spring fed systems.

Sedimentation tanks and sand filters need to be rinsed periodically. This is done by opening a cock at the bottom of the tanks to permit drainage of collected silt. After several cleanings, the rock and sand is completely changed.

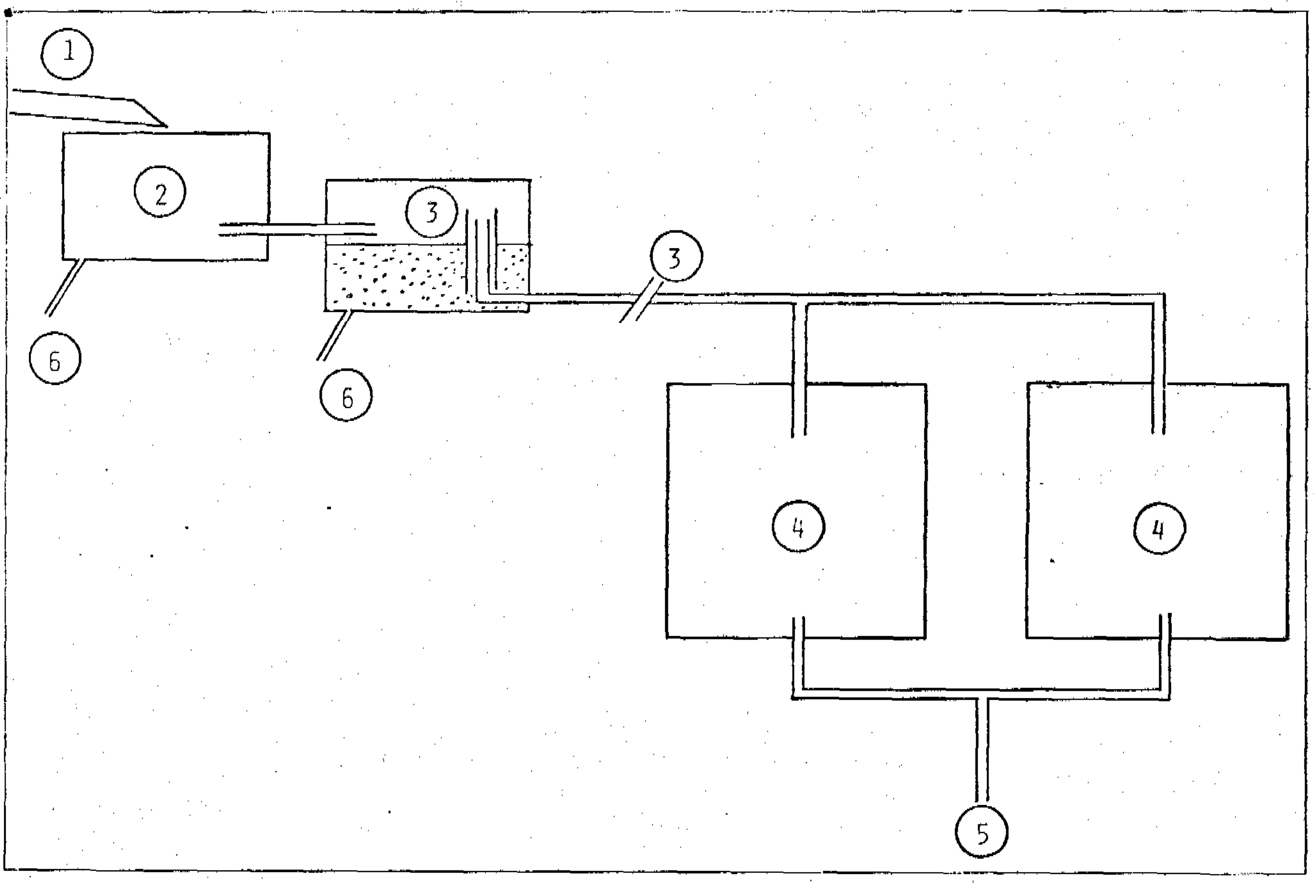

Fig. 2. Gravity Flow Water System, Ban Nam Jom Village showing (1) split bamboo intake, (2) sedimentation tank, (3) sand filters (two filters omitted from drawing), (4) reservoir tanks, (5) pipe to village, and (6) drainage valves.

TABLE 1

Cost of 22 House Gravity Flow Water System, Ban Nam Jom Village, Thailand

Item	Cost (as % of project)
1/2" PVC pipe	25
1" PVC pipe	20.5
3 Catchment tanks	31.5
PVC pipe fittings	11
Brass faucets	5
Construction materials (cement, roofing, etc)	7

Occasional leaks in the main line and in-village pipelines were repaired with PVC fittings and cement. Leaks were most frequent in areas near trails where pipe was not properly buried, and subject to damage by foot traffic.

Exposed pipe was seen in three villages. How-

Pipe exposed to sunlight is subject to damage from ultraviolet radiation. Exposed pipe was seen in three villages. However, repairs were within the financial capabilities of the villagers, and the exposed pipe was not considered to be a major problem.

Insufficient pressure was a problem in some houses of the 22 house Ban Nam Jom Village system during evening peak-use periods. These difficulties can be attributed to the small-diameter (1") main line pipe. Villagers accommodated for this problem by informally staggering use. No pressure problems were reported in the 10 house system which also had a 1" main line.

Pipe exposed to sunlight is subject to damage from ultraviolet radiation

(Public tapstands were not installed by villagers who preferred taps in individual houses. Close grouping of the houses made this financially feasible).

ADVANTAGES

Small-scale gravity flow water systems provide villagers with notable savings in labor, i.e., time previously spent carrying water from wells or streams.

Water quality is also improved with the installation of water systems. Moving the water source away from the village reduces possible sources of human contamination. Passing domestic water through filters removes dirt and parasite cysts.

None of the villages surveyed in 1982 had begun chlorination programs, although they had been discussed.

COMMENTS

Low-cost gravity flow water systems are a new technology for mountainous areas where inexpensive PVC pipe is available. Maintenance and assembly of the systems has been demonstrated to be within the capabilities of the rural Thai. Financing of initial construction costs has generally required the input of outside materials, or money. Still a majority of the costs, and all the labor and design needs of small gravitational flow water systems are within the resources available to the rural Thai villager.

While small-scale gravity flow water systems have to date only been installed in a small number of villages, there is good potential for replication in Phrae Province, and other mountainous areas of Thailand. For example, in Phrae Province, perhaps 10% of the villages are in remote mountainous areas which could be served economically by such systems. Typically, these villages, because of their remoteness, are among the more economically disadvantaged, and do not have access to pumps, long main lines, electricity, technical advice, or management expertise needed for operation of more traditional water systems. Nor are the population concentrations necessary for economical installation of traditional systems found in the remote mountains. Small-scale gravity flow water systems are a technology that can, ironically, take advantage of the inherent remoteness of small mountain villages, and turn this condition to an advantage.

As gravity flow water systems become more popular, it is expected that more villages will install pipelines to replace on-site wells and streams as domestic water sources. Widespread implementation will probably involve the rural health and development services of the Thai government, though there could be a role for non-governmental agencies as well. In-village contacts and catalysts for such development projects are often school teachers who, traditionally, serve as technical consultants to indigenous village leaders.

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