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A Study of Some Community Water Supply Problems in Wilayah Persekutuan

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ABSTRAK

Kajian ini dijalankan untuk meneliti sumber-sumber air yang digunakan oleh penduduk-penduduk di kawasan setinggan di sekeliling bandar Kuala Lumpur. Keputusan kajian ini menunjukkan bahawa hanya air paip daripada paip bekalan air awam digunakan untuk minuman dan masakan tetapi air daripada sumber-sumber lain juga diperolehi bagi menambah bekalan air mereka untuk tujuan-tujuan lain seperti membasuh, bercucuk-tanam dan lain-lain. Pemeriksaan ke atas cara-cara yang digunakan untuk mengumpul dan menyimpan air daripada sumber-sumber selain daripada air paip menunjukkan bahawa sistem ini boleh dipertingkatkan lagi untuk menghasilkan air yang berkualiti baik dengan menggunakan teknologi rawatan air yang sesuai bagi rumah persendirian.

ABSTRACT

This study was carried out to examine the various sources of water which are being used by residents in squatter settlements around Kuala Lumpur. The results showed that piped water from the public stand-pipes was used primarily for drinking and cooking purposes but water from other sources was also collected to augment their water supply for use in washing, gardening, etc. An evaluation of the methods used for the collection and storage of water other than piped water, indicated that the system can be further improved to yield good quality water by adoption of appropriate technologies for household water treatment.

INTRODUCTION

Recent estimates of the domestic and industrial water demand in Malaysia has been projected to increase from 598 $\times$ $10^6 m^3$ in 1978 to 2.2 $\times$ $10^9 m^3$ in 1990 and 4.2 $\times$ $10^9 m^3$ for the year 2000. This is based on an average per capita supply for domestic consumption of 180 1/day and a total water supply per capita including water use for public purpose of 250 1/day. The demand centres are usually located in the cities and townships along the west coast of Peninsular Malaysia.

With respect to Wilayah Persekutuan, the current sources of water supply are from the Bukit Nenas, Sungai Langat, Gombak and Ampang intakes. These stations with a combined capacity of about 308 $\times$ $10^3 m^3$/day currently meet the water requirements in the territory. Additional water demands which may arise due to industrial growth and increases in the urban population would, as stated in the Third and Fourth Malaysia Plans, be met by constructing new water supply projects and the expansion of services of the existing systems. Nonetheless, the provision of water services which has come to be regarded as essential is often out of reach for some sections of the urban communities particularly those living in squatter or illegal settlements. Although these communities cannot legally demand piped water supplies, the implications on health due to inadequate safe water supplies may be very significant in these areas. Recent policies have stipulated the provision of a public stand-pipe for every 50 squatter houses built on State land, and for every 100 houses built on Federal land. However, the provision of this facility would only be given priority for squatter areas which had already been in existence for more than five years.

In the light of the problems faced by the squatter communities with regards to water availability and realiability, this study was conducted to examine the existing and potential strategies that can be used to cope with the water supply problems in these areas. It would seek to identify and evaluate the existing and potential sources of water supply, to assess the degree to which improvements in water supply could be brought about, and to determine the relative importance of factors that affect the daily household water consumption, in selected squatter settlements, namely Kampung Mengkudu Dalam in the Ampang area (Area 1) and Kampung Puah Seberang in the Sentul area (Area 2).

METHODOLOGY

Study Areas

Kampung Mengkudu Dalam (Area 1) has been in existence for more than 15 years whereas construction in Kampung Puah Seberang (Area 2) started less than 5 years prior to the time of the study. It was estimated that there were about 350 and 400 houses in the study areas 1 and 2 respectively. Questionnaire surveys were carried out on about 15 – 20 percent of the total household populations in both areas using a systematic random sampling approach.

Study Procedure

Most of the data obtained in this study was achieved via household interviews. A pre-survey was carried out in both areas which consisted of an examination of the physical structure of the study locations and discussions with the local headman or *ketua kampung*.

Additional data were also obtained from stand-pipe meter readings and from related government agencies such as the Waterworks Department. In some instances, it was not possible to quantify accurately the volume of water consumed or stored by individual households; instead alternative estimates of such capacities was obtained indirectly using the four-gallon kerosene tin and the forty-five gallon oil drum as comparative scales for the estimations.

Most squatters react very suspiciously when they are interviewed. However, errors arising from such responses were reduced when they were given an explanation regarding the objectives of the study and the benefits that they could derive from it. A total of 50 and 60 households were studied in Kampung Mengkudu Dalam and Kampung Puah Seberang respectively (Table 1).

TABLE 1
Size distribution of households involved in the study

	Number of households			
Household size	Area 1	%	Area 2	%
1 – 4	20	40	19	31.6
5 – 8	28	56	31	51.7
> 9	2	4	10	16.7
Total	50	100	60	100
Mean household size	4.8		5.9	

RESULTS

Sources of Water Supply

The survey revealed that the major source of piped water supply in both areas comes from the existing public stand-pipes. These were ten public stand-pipes in Study Area 2 but only three in Study Area 1, which included 2 former mining stand-pipes. Water was supplied to the houses either via plastic hoses which extended from the public stand-pipe to the individual homes; or was carried to each home manually using plastic containers or drums (Table 2). The total percentage do not add up to exactly 100 percent because in many instances, one household may abstract water from more than one source.

An interesting observation was the system of understanding that evolved among the various users with regards to getting their water supply from the stand-pipe. Since there was only one stand-pipe for several households, a system of rotation was devised wherein each household could collect water direct from the stand-pipe via its own hose connection for a fixed period daily. After the period has expired, the connection to the stand-pipe was freed for the next user. Some free time was included to allow for the manual collection of water for those who did not have a hose connection. However, not all stand-pipes were operated in this manner.

Apart from the public stand-pipes, water was also obtained from neighbouring houses that have piped water supplies from the main distribution pipe lines. Usually, this occurred at the fringe of the settlements where approved households were established. However in these cases, the squatters had to pay for their water supply which ranged from $6.00 to $10.00 per household per month, compared to the free water supply from the public stand-pipe.

The other major sources of water supply in the two study areas included rain water collection from the roofs, water from abandoned

TABLE 2
Sources of water supply for the study areas concerned

	Sources of water supply*	Area 1		Area 2	
		Number of household users	%	Number of household users	%
1.	Public stand-pipe with plastic hose connection to households	5	10	50	83.3
2.	Public stand-pipe; manual collection	34	68	10	16.7
3.	Piped water from neighbouring areas (hose connections plus manual collection)	11	22	—	—
4.	Hand pumps from tube wells on individual basis	2	4	1	1.7
5.	Hand pumps from sanitary wells on shared basis	1	2	—	—
6.	Open well with concrete linings	5	10	8	13.3
7.	Open well with wooden, asbestos or other linings	1	2	1	1.7
8.	Collection of rain water from roof run-offs	7	14	7	11.7
9.	Mining pool water	26	52	5	8.3

*Each household may use more than one source of water.

TABLE 3
Households water storage capacities

	Types of storage vessels used	Area 1 Total capacity in litres	Area 1 %	Area 2 Total capacity in litres	Area 2 %
a.	Barrels (drums)	6,341	25.62	14,522.7	31.02
b.	Concrete tanks	13,473	54.44	27,718.0	59.21
c.	Plastic vessels	245.5	0.99	736,4	1.57
d.	Plastic cans (more than 5 l)	1,986	8.02	754.5	1.61
e.	Earthenware vessels	2,704.5	10.93	3,081.8	6.59
	Total	24,750	100.00	46,813.4	100.00
	Mean.	495	—	780.5	—
	Std. Dev.	517.7	—	961.8	—

mining pools, sanitary wells, and from tube wells using hand-pumps. It must be emphasized that these other sources constitute raw water sources without any form of treatment or disinfection. Typical roof run-off collection systems comprise of a gutter along the lower edge of the roof which leads into a narrow cylindrical channel which empties into an oil drum. In some households, the drums are placed a few feet above ground level so that water can flow by gravity into the house. Similarly, a few houses in Study Area 1 had water from the hand pumps fed directly into large containers which were about 6 feet above ground level and distributed to two or more households by gravity flow.

In general, there were more sanitary wells in Area 2 compared to Area 1. Most of the wells were properly constructed with concrete linings and had cylindrical concrete upper portions extending 2 to 3 feet above ground. However, there were some wells which had asbestos sheet linings with wooden structures at the top. None of the wells observed had any cover.

Water from the disused mining pools was extensively used by the residents in Area 1 for bathing and washing. This may be because there were more pools in Area 1 compared to Area 2. Nonetheless it was never used for drinking or cooking purposes by any of the residents in question.

Water Storage in Individual Households

Table 3 shows the water storage capacities for households in the two study areas. On an average, the household water storage capacity was higher (781 litres) in Area 2 compared to Area 1 (495 litres). Household water storage capacity was found to have an important relationship with household water consumption, as will be discussed later. The higher value for Area 2 could be attributed to it having more public stand-pipes thus making it relatively easier to collect and store water.

Amongst the various types of containers used by the squatters to store water were disused oil drums or barrels, concrete water tanks, plastic pails and bottles, and earthenware vessels. These types of containers are available locally and are relatively cheap.

Accessability is an important factor in determining the usage of a particular source of water supply. As shown in Table 4, the distance between users to the public stand-pipes is generally closer in Area 2 compared to Area 1. Thus, all of the households in the latter area obtained their piped water from the public stand-pipes whereas only 78% did so in the former area. The remainder obtained their piped water supplies, at a cost, from neighbouring houses which had approved tap water connections. Well and hand-pumps which form a popular source of water for non-drinking purposes, are mainly located close to individual households. However, less than 15% of the households studied collected rain water from the roof.

Piped Water Consumption Patterns

For this purpose, fortnightly meter readings were obtained from one stand-pipe (SP1) in Area 1 and two stand-pipes (SP2, SP3) in Area 2. Direct house to tap hose connections were practised for SP1 and SP2 but not for SP3.

Table 5 represents a sample for the piped water consumption pattern at the locations studied.

It can be seen that SP2, on an average, supplied 4 times as much water as SP3 in the same area. On the other hand, there was only a slight difference between the water consumption

TABLE 4
Accessability to various sources of water supply

Source of water supply	Area 1			Area 2		
	Average distance (m)	No. of users	%	Average distance (m)	No. of users	%
Public stand-pipes with hose connections	38.5	5	10	34.4	50	83.3
Public stand-pipes with manual collection	127.9	34	68	37.6	10	16.7
Piped water from neighbouring houses through hose connections	78.0	11	22	—	—	—
Individual household hand pumps	6.9	2	4	5.1	1	1.6
Shared hand pumps	9.2	1	2	—	—	—
Open well with concrete linings	9.2	5	10	6.3	8	13.3
Open well with other linings	9.3	1	2	13.8	1	1.6
Roof rain water collection	—	7	14	—	7	11.7
Mining pool water	33.2	26	52	29.8	5	8.3

TABLE 5
Fortnightly water consumption patterns

Area	Selected stand pipe	Water consumption (× 100 l) July 8	July 22	Aug 5	Aug 19	Sept 2	Sept 16	Ave.
1	SP 1	109.3	138.3	112	73.3	90.4	95.7	103.1
2	SP 2	154.9	175.1	169.6	154.3	138	145.6	156.2
	SP 3	57.7	40.5	37.8	26.1	29.3	32.2	37.3

rates at SP1 and SP2. Unfortunately, the author was not able to determine the exact number of households served by each of the stand-pipes which were monitored. However, it was evident from the survey that most of the piped water demand was between 4 a.m. to 7 p.m. daily except during the weekends when the piped water consumption was higher than on other days.

Water Uses

Table 6 shows a breakdown of the water consumption in terms of types of uses. The major household uses of water are for drinking, cooking, washing and bathing, which accounts for approximately 95% of the total daily water consumption. The average daily water consumption in both areas was about 346 litres per household i.e. about 72 litres per capita in Area 1 and 59 litres per capita in Area 2. This is well below the average figure of 200 litres per capita for the Wilayah Persekutuan.

Attitudes and Priorities

The study revealed that the majority of the respondents wished for further improvements in the water supply above anything else. Only a small minority indicated that the water supply was either satisfactory or that they were indifferent to the problem since they had their own hand-pumps or wells.

Given the choice among the four basic amenities, the majority of the respondents chose water supply as their first priority (Table 7). This choice was more prominent in Area 1 (82%) compared to Area 2 (63%).

TABLE 6
Breakdown of daily water consumption by types of uses

	Uses	Area 1 Vol. (1)	%	Area 2 Vol. (2)	%
a.	Drinking & Cooking	2572.0	14.74	3800.0	18.25
b.	Laundry	4836.4	27.71	5454.5	26.20
c.	Washing	2363.6	13.55	2959.1	14.22
d.	Bathing	7281.8	41.73	7786.4	37.40
e.	Washing vehicles, etc.	50.0	0.29	272.7	1.31
f.	Gardening	345.4	1.98	545.5	2.62
	Total	17450.0	100	208018.2	100
	Mean per household	349		346.9	

TABLE 7
Priority order of the four basic amenities

Choice of preference	Number of households Area 1	%	Area 2	%
Water supply	41	82	36	60.00
Electricity	9	18	22	36.67
Proper sanitation	—	—	1	1.67
Proper roads	—	—	1	1.67
Total	50		60	

DISCUSSION

The study shows that several alternative water sources are available to the residents of squatter settlements. These include piped water from the public stand-pipes or from approved neighbouring sources, water from sanitary and tube wells, water from disused mining pools, and rain water.

In terms of specific usage, water for drinking and cooking purposes was obtained primarily from the public stand-pipes and for those living on the fringe of the squatter settlements, from neighbouring houses with approved pipe water supply. The fact that only portable water was used for drinking and cooking purposes, sometimes at some costs, reflects the priority given to health considerations by the squatters. Although mining pool or well water was more easily available, it was used for other purposes such as washing, bathing, and cleaning. It was generally regarded that the water from the mining pools was unsafe for drinking and cooking partly due to its slightly dark colour and disagreeable taste. Although well water is clearer, the disagreeable taste still persisted. The average depth of the wells was about 4 to 5 metres and it could be that since both of the settlements in this study was located in what was formerly tin mining areas, leachate from the mines could have penetrated through the sandy soils to pollute the wells. It was unfortunate that due to several constraints, a water quality assessment could not be carried out at the same time.

Deep tube wells which can yield large quantities of good quality water are used by a number of households in Kampung Mengkudu Dalam. Nonetheless, less than 15% of households in both areas utilize this source, the main reason being the relatively higher costs of purchasing a hand-pump and boring the tube well compared to sanitary wells. A simple hand-pump imported from Japan or Taiwan costs somewhere between $80 to $100 and the total costs may exceed $200 for construction of the tube well compared to about $150 for a sanitary well. Their operation can be interrupted depending on the availability of spare-parts but if the bore-hole depth averages about 7 – 8 metres, the tube well water is often of good quality and can be used for drinking and cooking purposes. The study revealed that tube wells operated by manual hand-pumps can be economically feasible if employed on a cost-sharing basis between several households.

Another potential source of water is rain water collected from the roof. However, rain water collection is still not very popular since its reliability depends very much upon the variability of rainfall and also on the conditions of the zinc roofs of the houses (clear or heavily corroded). Nonetheless, this method of water collection is relatively inexpensive and easy to construct. With the high rainfall in Peninsular Malaysia, the squatters could arrange for larger storage capacities and take advantage of the heavy downpours in the Wilayah Persekutuan. Rain water collection is also an advantage in terms of distance since it is an *in-situ* set-up. Public stand-pipes or wells are usually located at some distance away and obviously, the further the sources of water, more time and labour will have to be incurred to obtain the water. It was logical then that the piped water storage was 2 fold higher in Kampung Puah Seberang compared to Kampung Mengkudu Dalam. The fact that the average distance to the stand-pipes was smaller and that there was three times more public stand-pipes in Kampung Puah Seberang contributed to the higher piped water storage capacity in that area.

An examination of the types of water use revealed that the single largest use in both areas was for bathing, followed by laundry, and drinking and cooking. This is in sharp constrast to reports in the literature concerning water use in other countries where water for drinking and cooking purposes would take first place in terms of the volume used followed by water for washing (Feachem, *et al.*). This is partly a reflection of the cultural and religious observations of the squatters which emphasize on personal cleanliness and the use of ablution water for cleansing and for prayers. Computations for regression and correlation analysis showed a positive correlation between household daily water consumption and household size ($r = 0.74$).

The results of the study reveal several important factors. Firstly, the number of existing public stand-pipes in both areas are inadequate to provide enough piped water to the majority of the squatters. Thus other sources of raw water were sought which has been discussed earlier. From the stand-point of public health, shallow groundwater and surface water are particularly vunerable to pollution, and with no treatment or disinfection being normally applied, there is considerable concern over individual water supply systems. The major effort should be towards getting more piped water supplies in squatter settlements at a ratio of one stand-pipe for every 20 houses. Nonetheless, this involves a lengthy argument as regards the economics and legality of the situation. The other alternative is the provision of effective disinfection. However, this is also not easy because of costs and shortage of skills for operation of a disinfection system. There is also resistance to its introduction (Anon, 1982). For example cartridge chlorination units, which are immersed in the well water, are available, yet people do not like having these devices in the well water, nor are they prepared to tolerate the taste of the chlorine. They prefer to drink the untreated and possibly contaminated water.

The nearest untreated wholesome water which is available to the squatters is rain water. As mentioned earlier, greater advantage should be taken of the heavy downpours which occur intermittently to store larger volumes of the rain water falling from the roof. The storage system can comprise several oil drums or metal tanks and the stored raw water can be partially treated by screens and a by-pass for the first part of the shower which cleans the roofs, or by using a household sand filter *(Figure 1)* assembled in a gravity flow system *(Figure 2)* (Anon, 1984). This sand filter is designed to remove turbidity and bacteria from the water. Construction does not require any special skills and the materials are easily available locally at a low cost. However, care must be taken to ensure that the sand layer in the filter is always under water in order for it to be effective in removing bacteria. Provided that the initial microbiological quality of the raw water is not too poor, the household sand filter should be able to provide water good enough for washing and cooking purposes. For drinking purposes, the water should be chlorinated or boiled after filtration to be safe for human consumption.

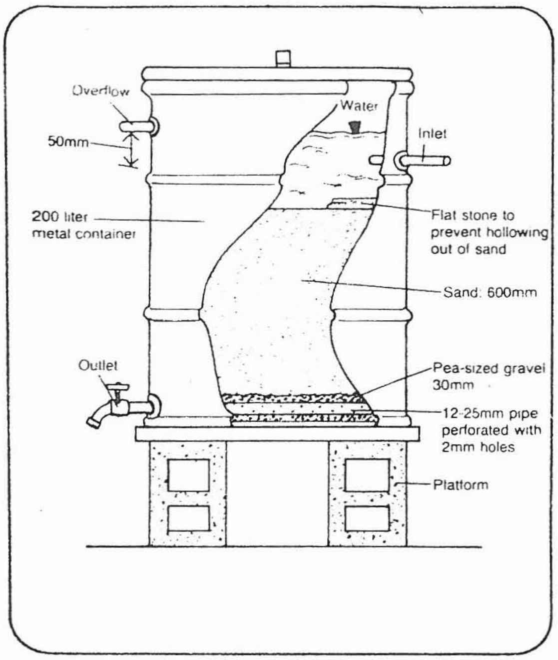

Fig. 1. Household sand filter

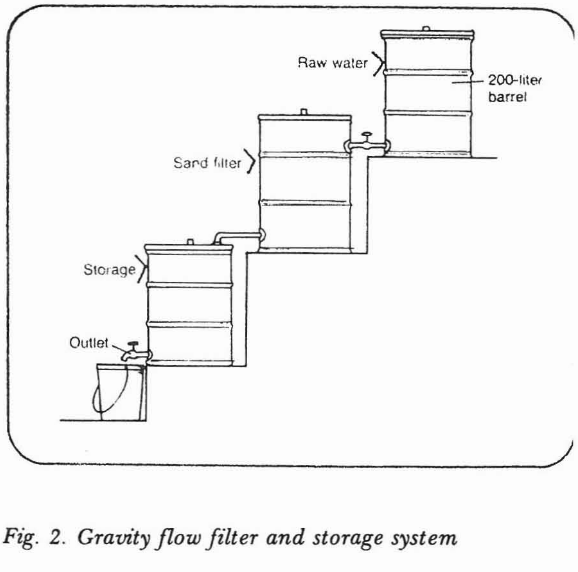

Fig. 2. Gravity flow filter and storage system

Secondly, a greater utilization of cheap and easily adopted strategies by the squatters is essential to reduce time, costs, and efforts to obtain and to store water. Such strategies include the greater use of plastic hose connections from the public stand-pipes to individual homes, the use of bamboo gutters and pipes to collect rain water, to increase the exploitation of sanitary wells and boreholes through proper construction and on a cost-sharing basis among a larger number of households, and using pumps connected to a communal storage tank where feasible. Some experimentation with the household sand filters could be carried out using water from the disused mining pools.

Nonetheless, the provision of an adequate water supply, with the concomitant increase in consumption, can bring its own problems unless steps are taken at the same time to provide an adequate sewage disposal system. In the squatter areas, this may be a cherished dream because of complex institutional requirements and therefore any continuation of this study may do well to investigate the water quality scenario of the various water sources and storage conditions which are in existence in these settlements.

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