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ADDITIONAL ACTIVITIES

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Technical report

Survey of Water Selling Points

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EXECUTIVE SUMMARY

SAWA Projects & Consultancy, The Netherlands, and SAWA Cambodia have been involved in a number of urban water supply projects in Cambodia. A special measure in these projects was the installation of Water Selling Points in order to reach the poorer sections of Cambodia's urban population. These Water Selling Points (WSP) buy water per m^3 from the towns' Water Works (WW) and sell it to the consumers per drum.

An evaluation of these Water Selling Points (WSP) has been conducted under the Two Towns Project. This report discusses the methodology and findings of this evaluation, which focuses on the consumers' choice of water source (Water Works Selling Point versus other sources).

Methodology used

A survey was conducted among 145 households in seven towns (Pursat, Kg Chhnang, Kg Cham, Kampot, Svey Rieng, Takmao and Kratie) in the month of December 1998. The interviewees (90 % women) were selected with a stratified sampling procedure. Furthermore, information was collected from the sellers of the Water Selling Points, and the Water Works in the towns.

All data were processed with SPSS (Statistical Package for Social Sciences). The statistical techniques used were Student's t-test for comparisons of averages and Ordinary Least Square Regression Analysis to explain the preference for WW WSP as the main source of water. The number of respondents was sufficient to draw statistically significant conclusions at the level of groups of towns (where WSP are successful versus those where WSP are unsuccessful), but not at the level of the individual towns.

Findings

A) Functioning of WW WSP

On the basis of data on the water delivered by the WW to the WSP, we may conclude that the WW WSP in Pursat and Kampot are functioning rather well. Those in Svey Rieng and Kg Cham were not working at all during the period November 1997 – October 1998. In the other towns (Kg Chhnang, Takmao and Kratie), water was sold, but still far less than the 110 m^3 per month, which is required for the investment in the WSP to break even.

B) Respondents' features

The features of the towns' people interviewed could be summarised as follows: Ninety per cent was female, and 50 % of all respondents mentioned "Housewife" as their first profession Other professions were business (20 %), farmers (15 %) and government servant (15 %). Fifty per cent had completed more than 6 years of school (while only 20 % had not attended any school at all). Average household size was six persons. Thirty per cent may be considered as exposed to the outside world (i.e. not limited to the life in their own town). Income distribution is rather unequal, with 40 %

having less than 100,000 Riels per month and only 5 % more than 200,000 Riel per month.
The respondents seem to be aware of the importance of good quality water for their health. Yet, safe water is mostly defined as clear water (i.e. not turbid). One quarter of the respondents is aware of the health risk of bacteriological contamination.

Daily water consumption amounts to 285 litres per household in the dry season and 183 litres per household during the rainy season, of which 8 litres is for drinking purposes only.

C) Preference for a water source

Most households prefer water from the WW WSP. In the dry season, 70 % of the respondents prefer this source, while this percentage drops to 44 % in the rainy season (when rainwater is preferred by 45 % of all respondents).

In order to explain the consumers' preference two kind of comparisons were made, and, additionally, a regression analysis was conducted.

Firstly, the towns where WW WSP (Pursat and Kampot) are successful were compared with those where they are clearly not successful (Sv Rieng and Kg Cham). It appeared that the success can not be explained by differences in personal features (age, sex, education, income etc.). Neither can they be explained by the distance from the house to the source, nor by the price of water that the households have to pay at the WSP. A striking difference between the these towns is that the Water Works themselves are far better functioning in Kampot and Pursat than in Sv Rieng and Kg Cham.

The second comparison is between respondents around successful and unsuccessful WW WSP in Kg Chhnang, where half of the WW WSP is selling water while the other half is not functioning at all. Again, it appeared that personal features of the respondents can hardly explain the success of WSP (which is the result of the revealed preference). The main difference is related to pressure in the network, and thus the availability of water at the WW WSP.

Also, the respondents indicated that availability of water was the prime reason for their preference of a certain source. If the source is more reliable (in terms of time of the day and quantity of water), the respondents tend to prefer that source to others.

The importance of the price of water sold at WW WSP was examined by questions on the purchasing behaviour in case of reduction and an increase of the price (compared to the price currently paid). It appeared that the price is not an important factor for those who are currently using a WW WSP (70 % would even accept an increase by 100 Riels per drum, or roughly 25 %). Forty per cent of the respondents who have a preference for another source would be prepared to use the WW WSP instead, if its price would be 100 Riels lower. Even though these results may point to (absolute) price elasticity of demand bigger than 1, the results are too uncertain and the risks too high to recommend a reduction in the price as a means for increasing water sales.

Besides, such a strategy was rejected by all sellers as it would substantially erode their income.

The last step of the analysis was limited to the households near a functioning WW WSP (leaving out not functioning WW WSP). The preference of these households was re-coded in a dummy variable, reflecting a preference for a WW WSP as 1 and for all other sources as 0 (zero). Regression analysis revealed that for this group of respondents, their preference may be explained by their perception of the water's taste, the possession of a rain water tank (if they have a tank, they do not prefer the WW WSP during the rainy season), and the distance from the river (if the distance is bigger, it is more likely that the respondent prefers the WW WSP).

Conclusions

From the analysis we may conclude that the main reasons why respondents prefer a water source is its reliability, i.e. the availability of water. Contrary to our expectations, factors such as personal feature, distance to the source, the price paid at the WW WSP (relative to the price at other WSP) are of virtually no relevance. The consumers' perception of the quality of the water is likely to be slightly more important for the choice of water source

Recommendations

It is evident from above, that all projects should do their utmost to ensure reliability of the WW WSP, during design as well as operation of the WSP.

With regard to new projects considering the installation of WW WSP, it is recommended:

1. To select towns and villages that are not, literally and figuratively, at the end of the pipeline. It does not make sense to construct WW WSP in towns where there often is limited pressure in the network.
2. To select areas without house connections.
3. When the project aims at dissuading people from using river water, even more attention should be paid to the reliability of the WSP, since a river generally is a reliable source of water.

With regard to the existing facilities, the following is recommended:

1. A policy of decreasing prices in order to increase a market share be avoided, as it will only lead to eroding the income of the water sellers (as they themselves have indicated), making the investment in WSP a far less profitable venture (especially compared to other investments)
2. A policy of increasing the prices at WW WSP may, on the other hand, be cautiously implemented. It is highly recommended that the increased profit of the sellers be re-invested to upgrade the service levels (by e.g. buying a hose to deliver at the houses' threshold), or to increase availability of water.
3. It may be useful to introduce transportable WSP that are refilled at the WW WSP, in order to enhance the accessibility to a reliable water source. Yet, the coverage area of a WW WSP should never be expanded at the expense of the reliability of services delivered at the WW WSP. Besides, the coverage area should only be

expanded to the extent that it can be done in a reliable manner, viz. with water delivered at the same hours in the day and in sufficient quantity.

4. Health and Hygiene campaigns be implemented at an increased scale, in order to increase the consumers' awareness about the need for safe water.

List of abbreviations used

Conf.interval	Confidence interval
CBA	Cost-benefit analysis
Kg	Kompong
N	Number of cases
WSP	Water Selling Point
WTP	Willingness to Pay
WW	Water Works (the municipal company in charge of water supply)
WW WSP	Water Works' Water Selling Point

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1. INTRODUCTION

1.1 Background to the study

Since 1991, SAWA Projects & Consultancy and SAWA Cambodia, Consultants for Development have been involved in a number of urban water supply projects in Cambodia, funded by the World Bank, European Union and the Government of The Netherlands, with local support of the Government of Cambodia. Most of these projects aimed at rehabilitating the urban infrastructure, starting with emergency measures[1] and later upgrading services beyond minimum standards.

During the implementation of these projects, it was discovered that the poorer sections of the population, often living at the some distance from the town's centre, could not be reached by the ordinary project measures. They lacked the money for house connections that would hook them up to the improved water supply network. As a result, some "*households on the periphery of the network had to travel up to 3 km to obtain untreated water. Many of them were not able to transport the water themselves, so they had to pay for transportation in addition to water from their own uncontrolled wells*" (SAWA, 1996, p. 18).

Furthermore, many people belonging to the low-income group were using river water that was only treated with Alum to reduce its turbidity. Obviously, this type of drinking is a considerable health risk.

The solution for these problems was to establish Water Selling Points (WSP) which are provided with good quality water from the town's Water Works (WW), the company in charge of water supply in the municipality. These WSP usually comprise of a concrete reservoir with a volume of 4-5 m^3, which is filled up from the ordinary town's network. There is a tap from which drums (mostly of 220 litres) are filled. The consumers usually pay a price of 350 –550 Riels per drum, depending on the operator of the WSP. Many WW WSP have a cart that can be used by the consumers to transport the drum home, where it is emptied in a container belonging to the consumers.

The supply line to the water selling reservoir is connected to a water meter, and the WSP's operator has to pay a monthly bill for the water (s)he has received. The margin between the price for water sold (to the consumers) and water bought (from the town's WW) is an income for the operator (or for the person who employs the operator).

During the Two Towns Project, it was foreseen that the functioning of these WSP was evaluated. This paper reports on the intended evaluation. It was decided that the focus of the evaluation should be the choice of the consumers whether or not to use the WW WSP.

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[1] E.g. Emergency Rehabilitation of the Urban Water Supply System in Five Towns, funded by th WB and The Netherlands Government.

It is easy to understand that this individual choice determines the success of the project's efforts, if we take into account that there are manifold water selling points (they are a traditional source of water for the households in Cambodia) and that Cambodia is rich in its water resources (and thus there are many "competing sources).

1.2 Objective of the study

The study has the following objectives:

- Determine the factors that have an impact on a household's choice of water source, in a situation where water selling points are available.
- Recommend improved criteria for site selection for new Water Selling Points
- Recommend measures to improve the attractiveness of Water Selling Points where they have already been installed

The basic premise, based on observations and discussions with project staff, was that Water Selling Points getting water from the Water Works (**WW WSP**, hereafter), supply water of a better quality than competitive sources.

Often, the most important competitive source is water from a river (or pond) that is only treated with Alum to reduce its turbidity. These sources may still be bacteriological (and chemically) polluted and are therefore a health risk. It should be kept in mind that boiling might involve some cost to be incurred by the households.

Water supplied by the towns' Water Works is supposed to be safe, and is not expected to form any substantial risk for the consumers' health. This water is therefore preferred to competitive sources.

1.3 This report

This report deals with the findings of the study. The methodology used is described in Chapter 2. Chapter 3 deals with the volumes of water sold by the Water Selling Points selected in our sample. Chapter 4 describes the respondents, in terms of some socio-economic characteristics and their water use. Chapter 5, the core of the report, discusses the factors that determine the preference for a certain water source. Chapter 6 presents the conclusions and recommendations.

2. RESEARCH DESIGN AND METHODOLOGY

2.1 Research Design

Data were collected from three sources, for each of which a questionnaire was designed. The first source was the household, the second the water seller and the third the Water Works. The latter was visited in order to verify the data of the seller.

Given the available staff and time, the number of interviews at household level was limited to 145, according to the distribution specified in table 1.

Table 1: Number of WW WSP installed and the number of interviews, by town.

Town	# of Water Works' WSP	# of interviews
Pursat	17	40
Kg Chhnang	7	23
Kg. Cham	4	17
Kampot	5	16
Sv Rieng	2	16
Takmao	3	17
Kratie	5	16
Total	43	145

In order to save time, the number of water sellers interviewed was limited to a maximum of four per town (and less if, there are less WSPs). With these numbers, the study yields results that are statistically significant at the level of each variable and for a comparison between groups of towns (the towns where WW WSP are and are not successful). The number of cases per town is, nevertheless, too small to produce results that are statistically significant at the level of the individual towns.

2.2 Research object

The focus of the study was the household, the main decision of which is mostly taken by the women who fetch the water. The questions were asked to the female part of the population. If no female was available, the questions were asked to a male adult instead.

The second research object was WW WSP itself. Information on its functioning was collected from the Sellers, and compared with information from the Director of the Water Works for the purpose of verification.

2.3 Research subjects

The main question is about the source of water that is mainly (or most often) used for drinking and other purposes. Data were collected on household's water use and a number of socio-economic variables. These variables have been specified in appendix 2 - A. The questionnaire itself is presented as appendix 1.

These data were compared with data acquired from the WW WSP's operator (see appendix 2 – B) , which, on their turn, were cross-checked with the director of the WW.

2.4 Sampling

2.4.1 selection of water selling points

In the towns with more than four WW WSP, all were numbered, and four were selected out of these by random sampling. The sellers at these WSP were interviewed, as well as a number of women from households around them. If there were less than four WW WSP in a town, all of them were visited.

2.4.2 selection of the households

The streets around the WW WSP were numbered on the town's map, and three to five streets were selected on a random basis. In each selected street, 4 – 8 women were interviewed, depending on the total number of interviews required.

The interviewer selected from each street the 1st, 3rd, 5th, 7th, 9th, 11th, 13th and 15th house, starting from the entrance of the street nearest to the WSP. In the first, third, and (where applicable) the fifth street, the interviewer started counting on the right hand side. In the second and fourth street, they started counting on the left-hand side.

If a street appeared to have less houses than the above numbers, the interviewer, having arrived at the end, crossed the street, moved backward and continued counting at the other side. Alternatively, if there was an intersection with another street, he turned the corner (either left or right, depending on the side he started counting on) and continued counting in the road crossing the street that he had started in.

3 FUNCTIONING OF WATER WORKS' WATER SELLING POINT (WW WSP)

3.1 Sales of water

As the name says, at Water Selling Points (WSP) water is sold to consumers. The operator of these WSP may get the water from various sources, such as their private well or the river.

WW WSP get their water from the town's Water Works (WW), for which they have to pay the price that is usually paid by households who have a house connection. Except for losses at the tap, the volume sold by the WW WSP to the consumers is equal to the volume bought from the Water Works.

This study sampled 25 WW WSP, from which we intend to draw conclusions for all WSP installed under the various projects.

The first thing to be noted is, that out of these 25 WSP seven were not functioning at all (see table 2). The main reason why these WSP were not functioning was lack of water. As reasons for this problem was given: Pressure in network (Kg Cham), seasonal lack of water (Takmao). For the other towns, it was not clear what the reason was for this problem. The two WSP in Svay Rieng were said to be not functioning for too great a number of private wells

Table 2: Average monthly purchase of water by WW WSP, Nov 97 - Oct 1998

WW WSP	S. Rieng	Kg Cham	Kg Chhnang	Takmao	Pursat	Kampot	Kratie *
Examined							
1	0	0	57	49	278	316	71
2	0	n.a	67	37	36	379	129
3	-	0	0	61	82	381	29
4	-	0	0	-	80	793	55
Average	0	n.a.	31	49	119	467	71

Footnotes: * March - Nov. 1998
n.a. Not available
- not existing

Source: Water Works in the various towns

It appeared that the WW WSP in Kampot and Pursat are selling most water[2] (see table 2). As water selling points were established for the very purpose of selling water, we may also conclude that the WW WSPs in these towns are most successful. Another indication of their success is the fact that 100 % of the WSP sampled at randomly are still functioning 3 years after they have been installed.

However, a note of caution is warranted. The data collected from the water works in Kampot may not tally fully with those collected from the sellers at the WW WSPs. The latter, without any exception, indicated that they had no customers in the rainy season, and that their average daily sales was nil. The WW in Kampot, on the other hand, provided us with data from which it appears that the water supplied to four WW WSP decreases substantially in the month of October, but that the volume still remains between 13 and 76 m^3 for that month, or between 2 and 13 drums per day. We are inclined to believe that the Sellers were exaggerating the decline in sales.

Given the success of two towns and the limited success in other towns, an important question in this study is: what are the differences between Kampot and Pursat, on the one hand, and the other towns, on the other hand? This question will be elaborated upon in section 5.1 below.

3.2 Break Even analysis of WW WSP

The finding that 7 out of the 25 (or roughly 25 %) of the WW WSP are not selling any water warrants caution for future activities. On the other hand, it is very encouraging that 75 % of the WW WSP do function, and that 96 % of the respondents living near a functioning WW WSP prefer that water. This section examines the financial criterion for success of a WW WSP.

The average cost of the WW WSP funded from the Social Fund amounted to US $ 2,349 For those constructed under the Two Towns Project, the cost were slightly lower: US $ 2,200, which most likely reflects the experience gained over the years.

An important question is of course, whether it would be a financially sound decision to invest in a water selling point of the same structure as the WW WSP. The answer to this question depends on a number of basic parameters determining: the prices received and paid for water, the monthly sale, the salary to be paid to the seller and the volume sold.

This volume sold is of course the main unknown variable, which determines the profitability. The most appropriate analysis for evaluating a financial investment decision is Cost-Benefit Analysis.

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[2] Assuming that all water purchased is sold. Or, alternatively, assuming that the percentage of water that was purchased but not sold (i.e wasted or given away) is the same in all towns.

Appendix 12 presents the table of a cost benefit analysis under the following realistic assumptions:

Price of water at WW WSP:	2000 Riels/m^3
Price paid by WW WSP to WW:	1000 Riel/m^3
Salary of seller:	US $ 10/month (in many places it is an additional income)
Annual Maintenance Cost:	0.5 % of investment cost

On the basis of these assumptions, we have computed the volume of water that needs to be sold in order for the benefits to be equal to the cost. It appeared that this break even point arises at 110 m^3 of water sold. Investment in a WW WSP is not profitable if it sells less than this 110 m^3 of water per month. If the sales are higher than this volume, it makes sense, from a financial point of view to invest in a WW WSP.

It is evident from table 2, that this volume is realistic in the successful towns of Pursat and Kampot. In the unsuccessful towns, Svey Rieng, Kg Cham and Kg Chhnang, the volumes sold remain far under this break even point.

Yet, from a sensitivity analysis it appeared that these results are very sensitive to changes in the price of the water at the WW WSP. If the price would be decreased by 10 % (from 2,000 to 1,800 Riel) the volume of water that needs to sold in order to break even would have to increase by 30 m^3 to 140, or more than 25 %. This obviously explains the sellers' reluctance to reduce their prices.

4. DESCRIPTION OF THE RESPONDENTS

This chapter gives a description of the respondents in terms of a number of important socio-economic variables as well as their water use. The data presented below are a summary of the data collected with the general part of the questionnaire.

An attempt has been made to detect differences among the towns. It appeared, however, that the characteristics of these geographical distinctions, socio-religious groups and age and sex groups, do not differ significantly. In order to assess the difference, Student t-tests were used, and differences that were not statistically significant at the 5 or 10 % level are not mentioned in this chapter[3].

4.1 Socio-economic characteristics

In line with the intended selection of the respondents, 90 % were female. The female respondents had an average age of 39 years. The youngest was 15 while the oldest was 83. The average age of the men was 47 with a minimum of 31 and a maximum of 65.

4.1.1 Education

Eighty-seven per cent of the respondents attended school with 50 % having completed more than 6 years. All 14 men (or 100 %) indicated they had attended school, while for the female respondents this percentage amounted to 86.

On the average, the respondents completed 5.8 years of schools (with the 95 % confidence interval: 5.2 – 6.4 years). There appeared to be a difference between men and women: the women had completed 5.5 years (with 95 % conf.interval: 4.9- 6.1), while the men had completed 8.8 years on the average (95 % conf interval: 6.7 – 10.9). As the confidence intervals do not overlap, we can safely conclude that the female respondents had a significantly lower education than the men. In spite of the small number of respondents – N) this observation holds at the 5 % level.

4.1.2 Profession

It appears from table 3, that half of the respondents considered their first profession "housewife". Twenty-one per cent of the respondents has a second occupation, of which managing the household is again the biggest group, while farmer comes the second. Forty

[3] The average values for two groups differ significantly at the 5 % level if the 95 % confidence intervals of their averages do not overlap at all. The term Confidence Interval may in this respect need some clarification. A sample only presents a part of the population. As each different sample of the same population will comprise a different combination of individuals, a different sample will also give a different average value. The 95 % confidence interval presents the range within which the average will fall in 95 out of the 100 samples. For instance, if our sample gives an average age of 47 (for men) and the 95 % confidence interval is 42 - 54 years, it means that 95 % of all samples will give an average age for men between 42 and 54 years. This is implies that there is a 5 % chance that any sample of the same population would have an average age lower than 42 or higher than 54 years.

per cent of those with housewife as second occupation are principally businesswomen; another 30 % are farmer, and 17 % is govt servant.

Table 3: Percentage of respondents mentioning their first and second profession

	First profession	Second
Housewife	50 %	17 %
Business	20 %	< 1 %
Farming	15 %	3 %
Govt servant	10 %	< 1 %
Misc.	5 %	
Total (% of all respondents)	100 %	21 %

4.1.3 Household size

Average household size of the respondents amounts to six, with 90 % falling between three and nine persons per household.

4.1.4 Exposure

Thirty percent of the respondent has at least one household member who spent 3 months or more outside their own town, and could thus be considered exposed to the outside world.

4.1.5 Income

As appears from figure 1 and Appendix 3, forty per cent of the respondents have a household income lower than 100,000 Riels, or US $ 27 per month. There appeared not to be a statistically significant difference among the towns, which may be explained by the fact that all households have in common that they live near a WSP. In addition, as discussed in the introduction to this report, the WSPs were in particular aimed at the poorer sections of the population. Richer households are expected to live closer to the centre of town, where they have better access to the town's facilities, including a house connection.

4.16 Health awareness

Ten per cent of the respondents do not have any idea why safe water is important. The remaining 90 % are aware that bad quality water affects health.

However, 62 % of the respondents define safe water in terms of turbidity. They feel that it is sufficient that water is clear in order to be safe. Only 5 % of the persons who

mentioned that water needs to be clear (68% of all respondents), mention as a second criterion that one should not fall ill from drinking water

Only 25 % of all respondents mentioned germs as a reason for unsafe water as a first criterion.

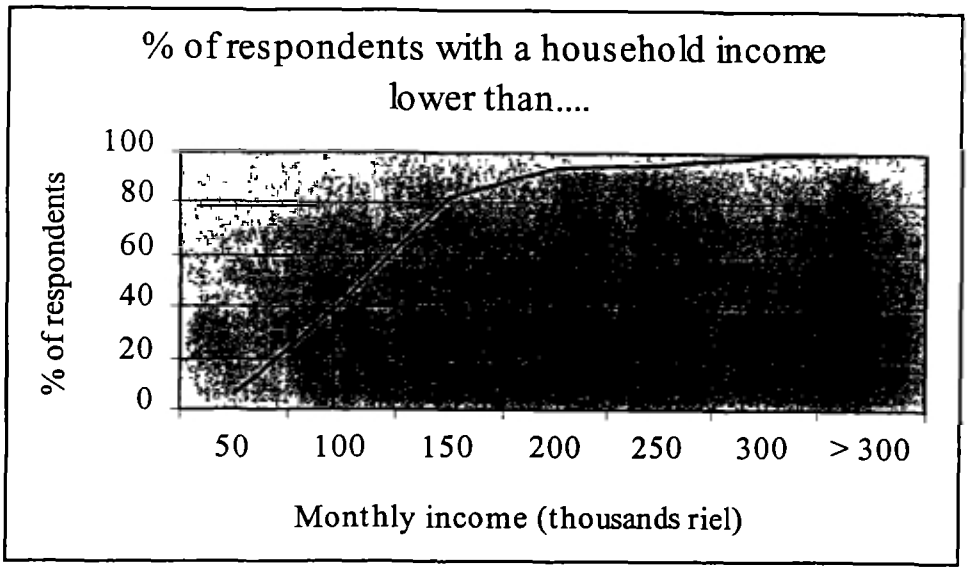

Figure 1: Distribution of respondent's household income

4.2 water use

4.2.1 Daily consumption

Table 4 presents the average daily volume of water used by season

Table 4: Average daily consumption of water for dry and rainy season, and their 95 % confidence limits.

	Average per household	95 % confidence level	
		Lower limit	Upper limit
All uses –dry season	285	255	323
All uses –rainy season	183	152	214
Drinking water only	8.4	9.6	10.8

The decline in water consumption, which corresponds to from 47 to 30 litres per person per day is significant at the 5 % level. The most likely reason for this decline is the drop in temperature during the rainy season leading to less bathing and washing.

4.2.2 Water sources preferred

The respondents were asked about the sources they preferred during the dry and the rainy season. Many respondents on their own initiative mentioned the preference of a second source.

Table 5: Percentage of the respondents preferring a certain water source, during dry and rainy season

Source	Dry season		Rainy season	
	1st preference	2nd preference	1st pref.	2nd pref
0. WW WSP	71	-	44	-
1. Other WSP	15	13	3	4
2. River	1	23	1	6
3.Pond	4	5	6	3
4. Rainwater tank	2	20	45	60
5. Own well	7	13	1	17
6. Well (not known whether own property)	-	25	-	7
Other	-	-	-	3
Total	100	99	100	100
N	145	40	145	70

Water purchased from a Water Selling Point (WW and other WSP) is preferred by 86 % of the respondents during the dry season, with the WW WSP the main seller. It is remarkable that of the respondents mentioning a second source, 23 % indicate a preference for river water.

When the rains come, WSPs loose their relative importance to more traditional sources, and in particular rainwater harvesting. Yet the WW WSP still accounts for 44 % of the respondents' preferences.

These observations on the preference will be further elaborated in section 5.3, where we will try to explain them in terms of the consumers' characteristics and the source characteristics

5 FACTORS DETERMINING THE PREFERENCE FOR A WATER SOURCE

This chapter tries to analyse the reasons for the success of WW WSP in some towns, while they are not functioning in other towns. It first examines the differences between consumers' features in the towns with successful WW WSP (Pursat and Kampot) and in towns where the WW WSP are evidently not successful (Svey Rieng and Kg Cham). It should be noted that this is a comparison between two groups of towns and not between individual towns.

A second comparison made in this chapter (section 5.2) is between the respondents in Kg Chhnang living around the WW WSPs that are successful and those around unsuccessful WSP.

The results of these comparisons are supported, in section 5.3, by an analysis of the reasons for the preferences as mentioned by the respondents. Section 5.4 examines the importance of the price of the water sold, and 5.5 looks only at respondents who live near a functioning WSP.

5.1 Comparison of 2 groups of towns

It appeared that there are no statistically significant differences between the respondents in Svay Rieng and Kg Cham, on the one hand, and Pursat and Kampot, on the other hand, if it concerns personal features (age, education, number of household members and exposure).

As for the variables pertaining to water use, it appeared that the respondents in Pursat and Kampot, on the average, use less water during the rainy season (155 litres per day per household) than in the other two towns (276 litres per day per household, see table 6). The reasons for this difference are not clear. It did appear, however, that it does not result from different family size.

Other variables in which the two groups of towns differ are: average distance to WW WSP, to non–WW WSP, perception of WW water quality, and price of WW WSP water. It is interesting to note, that in the towns where WW WSP are not successful, the distances to WW WSP are smaller and the distance to non-WW WSP bigger. Apparently, the factor distance does not explain the noted difference in success.

Similarly, and contrary to expectations, the price of WW WSP is, on the average, lower in the group of unsuccessful towns than in towns where WW WSP are successful. This may be explained by a reverse causality: water sellers setting their price at a minimum when the sales are low due to other factors. According to this reasoning, the water sellers

do not feel a need to use an absolute minimum price, when the WSP is successful anyway.

It also appears that the water quality of the WW WSP is perceived to be better in Pursat and Kampot, than in Svey Rieng and Kg Cham. This difference in perception may also contribute to the success of WW WSP in Kampot and Pursat.

The average distance to wells (mostly with a handpump) is 17 meter in Svey Rieng, compared to 145 meters in Pursat and Kampot. However, it appears that the variance of this distance is that big[4], that these average distances do not differ significantly. (In other words: another sample among the population in Pursat and Kampot may have produced a far lower average distance to wells than our sample).

Table 6: Average values and their 90 % confidence limits for a number of variables at which the two groups of towns differ significantly.

Variable	Average value Sv R. and Kg Cham	Average value Pursat + Kampot
Vol. Consumed during rainy season	276 (216 – 336)	155 (116 – 194)
Distance to WW WSP (in meters)	66 (47 – 86)	150 (121 –235)
Distance to non-WW WSP (meters)	400 (257 – 542)	178 (120 – 235)
Distance to well (meters)	17 (7 - 27)	145 (-40 –330)
Price WW WSP water (Riel/liter)	.76 (.24 – 1.3)	2.85 (2.6 – 3.0)
% of respondents believing WW WSP water :	9 (0.5 – 18)	51 (40 –62)
- Looks good	----------	----------
- Tastes good	9 (0.5 – 18)	51 (40 –62)
- Smells good	----------	----------
	3 (2 – 8)	47 (36 – 59)

[4] The average distance to wells in Pursat and Kampot does not even significantly from zero (note negative distance , - 40, as the lower level of the conf. interval, in table 6)

See Appendix 5 and 6 for more details.

However, there is no use denying that there are considerably more wells in Svay Rieng than in the two successful towns. In Svay Rieng 10 out of the 16 respondents have their own well, while there are no well owners among our respondents in Pursat or Kampot. We may thus conclude that it is likely that the presence of wells have some relevance for the success of WSP, but it is apparently not the distance that counts.

conclusion
From the analysis in this section, we may conclude that, contrary to our expectations the success or failure of WW WSP can not be explained by difference in:
- Personal features
- Distance
- Price of water (we even see a reverse causality).

5.2 Comparison of respondents around successful and unsuccessful WW WSP in Kg Chhnang

As we saw in table 2, two out of the four WW WSP in Kg Chhnang visited were not successful, according to the data provided by the WW. In this section, the differences between the beneficiaries living around the successful and unsuccessful WSP are analysed.

Student's T-test of the averages of some principal variables (the same as for a comparison between the group of successful and unsuccessful towns) reveals the following (see also appendix 7 and 8):

1. There are no differences at the level of personal characteristics, or at the level of water use.
2. The situation of water resources does differ: The distance to WW WSP is far less for the respondents around the successful WSP (100 meters) than for the unsuccessful WSP (600 meters). This difference might result from the respondents referring to a working WSP rather than one that is not functioning at all. The respondents around WSP 3 and 4 were apparently not thinking about the WW WSP they are living nearby, but to one which is functioning, but at a far larger distance[5].
3. However, the distance to other water sources (non- WW WSP and river) is also smaller for the respondents around the successful than around the unsuccessful WSP. This suggests that the successful WSP is located in an area with better water resources availability than the environment of the non-successful WSP.

[5] This explanation was discussed with the interviewers, who confirmed it. They also added that the WW WSP 3 and 4 that were not operation are positioned close to the river

4. All respondents around the functioning WW WSP indicated that water is always available[6], while only 50 % of those around the non-functioning WSP said there always is water.
5. The price of water of non-WW WSP is significantly lower around the functioning WW WSP than around the non-functioning WW WSP. Similar to the comparison of the two groups of towns, this suggests a reverse relationship: a well functioning WW WSP forces the competition to lower their prices. Besides, the price of water around a non-functioning WW WSP is relatively high because of the conduct of sellers. The interviewers observed that some people buy water from WW WSP or directly from the WW to sell it around a WW WSP that is not in operating.

conclusion
This comparison confirms the results of the comparison of the two groups of towns in section 4.1: the explanation for WW WSP being successful, while others are not, does not depend much on factors such as personal features, distance from the household to WSP and prices.

It is interesting that the WWs relate the very low sales of certain WW WSP to too limited pressure in the distribution network, leading to limited availability of water for the WSP. This observation is confirmed by the fact that WSP are most successful in towns that are generally known for good management of public water supply, in particular Kampot, but also Pursat and Kratie.

5.3 Reasons for preferring a specific source

The respondents were also asked about the reasons for their preference of a specific water point. Irrespective of the water points used, availability of water was mentioned as the prime reason for preferring a water source (see tables 7 and 8) in the dry season as well as in the rainy season

The importance of the factor availability applies also for the households who indicated a preference for WW WSP (see appendix 4). However, when a second reason for their preference for the WW WSP was indicated, in more than 50 % of the cases, quality was mentioned.

Even the owners of a private well (in Svey Rieng, where there is no river near the WW WSP) indicated that the main reason for their preference was the quantity of water availability (and not the distance to the source).

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[6] The proportion of respondents around the functioning WW WSP who indicated that water is always available does not appear in Appendix 8, since the standard deviation on this question was zero (all indicated it was always available)

Furthermore, this finding has also been confirmed by an observation of the interviewers. In Takeo, they noted, some people moved to another WSP if there is no drum card available (or if the seller of the WW WSP is not there), even though the WW WSP may be far closer than the other WSP.

Conclusion

It appeared that the main reason why the respondents prefer a certain source is the availability of water. The consumers, understandably, do not want to go a WSP only to find out that little or no water is available. They prefer to walk a bigger distance or pay slightly more if they know another water source where water supply is more reliable

Table 7: Absolute and relative number of respondent with a given preference for water source

Reason for pref in dry season

		Frequency	Percent	Cumulative Percent
Valid	1. quantity available	126	86.9	86 9
	2. quality	16	11.0	97.9
	3. distance from house	1	.7	98.6
	8. no other source available	2	1.4	100.0
	Total	145	100.0	

reason for preference source rainy season

		Frequency	Valid Percent	Cumulative Percent
Valid	1. quantity available	123	84.8	84.8
	2. quality of water	15	10.3	95.2
	3. distance from house	2	1.4	96.6
	5	1	.7	97.2
	6. free of charge	1	.7	97.9
	others	3	2.1	100.0
	Total	145	100.0	

5.4 Willingness to Pay (WTP) for water

The study also tried to assess the impact of a change of price of the WW WSP on the choice for water source. Some forty per cent of the respondents were prepared to give up using other water sources if the price of the WW WSP was reduced by 50 Riels or 100 Riel per drum[7].

One might argue that these findings might point to (absolute) price elasticity of demand bigger than 1, which would imply that the gross revenues from selling water would increase when the price is reduced. Yet, the results are too uncertain and the risks too high to recommend an reduction in the price as a means for increasing water sales. Besides, virtually all sellers indicated that they are not prepared to lower their price in an attempt to enlarge their market share, since they fear for their income.

As for an increase of the price, it appeared that 76 % of the respondents who are presently using a WW WSP would continue doing so, if the price would be increased by 50 Riel per drum. In case of an increase by 100 Riel, the percentage would amount to 69 %. So one may roughly conclude that the price is not such an important factor for some 70 % of the respondents who are currently using a WW WSP[8]. This inelasticity of demand with respect to price may be explained by the known hours and volume at which the WW WSP is supplying water.

A question was also asked about the maximum price that the respondent was prepared to pay for a drum of water from the WW WSP. Unfortunately, the results are not useful since they appeared to be subject to substantial strategic bias[9]: e.g., there are some 30 respondents who indicate their maximum WTP is less than what they are currently paying.

5.5 Features of consumers preferring a WW WSP.

The previous sections dealt with the characteristics of the water sources that determine the preference for a water source. In this section, we will further examine the features of the consumers that have a preference for WW WSP. The same phenomena were examined in section 5.1, where we compared averages for two groups of towns (successful versus unsuccessful towns). In this section we will study the individuals'

---

7 The number of respondents answering yes to the question pertaining to a decrease by 100 Riel was less than in case of the question on a decrease of 50 Riel per drum.

8 I.e if the price does not increase above a certain limit. Doubling of the price, for instance, may have a more tangible impact.

9 Strategic bias occurs when the respondents believe they will benefit by deliberately under-reporting their max. Willingness to Pay.

choice in greater depth. Obviously we have to consider only the respondents that are living in the vicinity of a WW WSP that is working and not one that is not.
The technique used in this section is regression analysis, by which we try to develop an equation comprising a series of independent variables and one dependent variable. The dependent variable is whether or not the respondent prefers the WW WSP to other water sources. This choice (represented by a dummy variable – 0 for no; 1 for yes) will be explained by the independent variables.

There are various methods to arrive at a regression equation. Appendix 9 elaborates on the method used in this section. The results of the regression analysis are discussed below, while the regression coefficients for the dry and the rainy season are presented in Appendix 10 and 11 respectively.

All towns together – dry season
A model appeared (see appendix 10) for which the correlation coefficient (R) was only 0.245, which implies that the model explains only 6 % of the variation in the preferences ($R^2 = 0.06$). However, the regression coefficients are rather insignificant, and the same applies to the F- value[10].

This bad fit is due to the fact that during the dry season 96 % of the respondents (living near a functioning WW WSP) prefer that WW WSP. The preference of the remaining 4 % (four cases) can hardly be explained by the independent variables.

All towns together – rainy season
During the rainy season, the variation in preference is slight bigger (see table 8)

Table 8: Frequencies of sources preferred during the rainy season – only the respondents near a functioning WW WSP

Type of source	Frequency	Percentage
0. WW WSP	57	60.0
1. Other WSP	2	2.1.1
2. River	2	2
3. Pond	1	1.1
4 Rain Water tank	33	34.7
Total	95	100

[10] Further deleting some variables from our model, will raise the coefficients t-value, but will further reduce the R and F value.

The regression analysis produced a model (see Appendix 11) from which it appeared that people with the following characteristics are more likely to opt for a WW WSP, when they are given the choice between various water sources:

- Person considering the taste of WW WSP water good,
- Those who do not have a rainwater collection tank[11] and
- Who are living at a greater distance from the river.

[11] The distance to the rain water tank does not appear from this short list of important variables, because there is hardly any variation in the variables, since all rain water tanks will be in the household's premises

6. CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

From the above one may conclude that the prime reason for success of a WW WSP is availability of water. The WW WSP are not functioning in towns where the pressure in the network is low, Kg. Cham, or where there is relatively low demand, such as Svey Rieng. They are working well in the towns where the WW are in general well managed (Kampot, Pursat and Kratie)

The Break Even Analysis of Chapter 3, indicted that, given the cost of the WSP, the sales should at least be 110 m^3 per month. If it is lower than this volume, there are probably more interesting investments to put one's money in. If the volume is higher than this 110 m^3, the WW WSP may also be a financially sound investment. Of course, this reasoning does not take into account the social and health benefits of the WW WSP, and should therefore be considered as a supplementary argument to increase the sales, by ensuring a reliable supply.

During the dry season, practically all households around a functioning WW WSP have a preference for this water from this source. The main reason is the quantity of water available of water (which apparently is better than of other water sources), followed by perceived water quality (for which taste and turbity are important parameters).

Even the owners of a well in Svey Rieng prefer their own source for its better availability of water, and not for other convenience factors such as distance or better quality. We may therefore conclude that preference for source is to a great extent determined by the reliability of that source, in terms of the probability that there is no water available, when the consumer will arrive at the source.

During the rainy season, the competition is bigger but also during this season the prime factor determining the preference for a water source is related to the quantity of water available. This tallies well with the finding of the regression analysis that distance from the house to the river (and absence of a rain water collection tank) are factors determining the preference.

Personal features such as the consumers' age, education, income and exposure are of negligible importance if it comes to choosing a water source. This finding is the evident from the comparison of the towns with successful and unsuccessful WW WSP, It is confirmed by the analysis of the respondents in Kg Chhnang where two out of the four WW WSP are functioning reasonably well and two not at all. Besides, it also appears from the regression analysis, where none of variables related to personal features had a regression coefficient that differed significantly from zero.

An interesting finding is that even the price of water is of comparatively little significance. Neither the price of the WW WSP, nor the competing WSP appeared to be of any significance in the regression analysis. At the level of the towns, we saw that the presence of well functioning WW WSP is likely to drive down the price paid at competing WSP. The data also showed that some 70 % of the users of the WW WSP would be prepared to accept a price increase of 100 riels per drum, which is around 25 % of the price they are paying now.

Finally, it has been the objective of the WW WSP to dissuade people from using river water and use better quality WW water. We may conclude however from the above that this objective may only be achieved, if the water supply at the WW WSP is very reliable. If the target population gets the impression that they run the risk that there is no or little water when they arrive at the WW WWP, they will in future be inclined to collect the water from a more reliable source, such as a river or pond.

6.2 Recommendations

In line with the objectives of the study (see page 1), two different types of recommendations are formulated: for improved site selection and for measures to improve the attractiveness of the existing WW WSP. Additionally one general recommendation follows from the analysis:

A) General

It is evident from above, that all projects should do their utmost to ensure reliability of the WW WSP, during design as well as operating the facility.

A) Improved site selection

With regard to new projects considering the installation of WW WSP, it is recommended

1. To select towns and villages that are not, literally and figuratively, at the end of the pipeline. It does not make sense to construct WW WSP in towns where there often is limited pressure in the network.
2. To select areas without house connections. These house connections will have a higher reliability than the WW WSP, and may provide water also to the neighbours.
3. When it is the project's objective to dissuade people from using river water, even more attention should be paid to the reliability of the WSP, since rivers are generally reliable as far as the availability of water is concerned.

B) Existing facilities

With regard to the existing facilities, the following is recommended:

1. A policy of decreasing prices in order to increase a market share be avoided, as it will only lead to eroding the income of the water sellers (as they themselves have indicated), making the investment in WSP a far less profitable venture (especially compared to other investments)

2. A policy of increasing the prices at WW WSP may, on the other hand, be cautiously implemented. It is highly recommended that the increased profit of the sellers be re-invested to upgrade the service levels (by e.g. buying a hose to deliver at the houses' threshold), or to increase availability of water.
3. It may be useful to introduce transportable WSP that are refilled at the WW WSP, in order to enhance the accessibility to a reliable water source. Yet, the coverage area of a WW WSP should never be expanded at the expense of the reliability of services delivered at the WW WSP. Besides, the coverage area should only be expanded to the extent that it can be done in a reliable manner, viz. with water delivered at the same hours in the day and in sufficient quantity.
4 Health and Hygiene campaigns be implemented at an increased scale, in order to increase the consumers' awareness about the need for safe water.

Literature:

- SAWA, Provincial Towns Water Supply Rehabilitation Project II, Cambodia, Proposal for technical assistance & equipment & materials, March 28, 1996
- SAWA, Emergency Rehabilitation of the Urban Water Supply System in Five Towns, Final Report, SAWA, August 1996
- SAWA Cambodia, Provincial Towns Water Supply Rehabilitation Project II, Fact Finding Report of Kampong Chhnang Town, Phnom Penh September 1996

List of apendices

Appendix 1: Questionnaires

EVALUATION OF WATER SELLING POINTS

Questionnaire for households

December 1998

QNUM

PART A IDENTIFICATION OF RESPONDENT

1. LOCATION TOWN
   - A. Town ....
   - B District . . ..
   - C. Commune ....
   - D Village ....

2 Water Selling point WSP
   1
   2
   3
   4

3. Date of the interview . ... DATE

4. Number of visits to respondent: NUMVIS
   1
   2
   3

PART B GENERAL INFORMATION ON THE HOUSEHOLD

1 Age of respondent AGE
.... years old

Interviewer, observe the following

2 Sex of respondent SEX
   - Male 0
   - Female 1

EXPLANATION A person belongs to a household if he/she has slept in the same house for more than six months and usually shares his meals with the other members.

3 How many people belong to your household?

Head of household	.....	
Spouse	.....	
Daughters	....	
Sons	.....	
Parents	. . .	
Relatives	.....	
Other	. . .	
TOTAL	.. .	TOTNUM

4. Have you ever attended any school?
   Yes 1
   No 0 → Question 6

5. How many years of school did you complete EDUC
   .... years

6 May I know your profession. PROF

Farmer	1
Agricultural labourer	2
Other Labour	3
Govt servant	4
Service	5
Business	6
Artisan	7
Housewife	8
Other profession	9, please specify ....

7. Did you or any other member of your household spend more than 6 months outside this village? OUTS
   Yes 1
   No 0 → Question C 1 (Water sources used)

8. Where did he or she stay? WHERE
   ....

9. And for how many month did he or she stay there? DURA
   . ... Months

C WATER SOURCES USED

1. How much water do you need for your household every day in the dry season (all purposes)? VOLDRY

   No of drums or jars ... .
   Vol per drum or jar ..... litres
   Total Volume .... Litres

2 How much water do you need for your household every day in the rainy season (all purposes)? VOLRAIN

   No. of drums or jars .....
   Vol per drum or jar .. ... litres
   Total Volume ..... Litres

3 How much do you need for drinking water only? NEEDDRI

   ... . Litres

4. Which sources of water exist in the area, what is the distance to the house and are they used by the respondent?

Source	Distance from respondent's house (meters)	Used by respondent 0 = no; 1 = yes	Variable Names
WW WSP			WWd and WWu
Other WSP			OWSPd and OWSPu
River			RIVERd and RIVERU
Pond			PONDd and PONDu
Well			WELLd and WELLu
Rain water tank			RAINd and RAINu
Others			
....			

5. If there is another WSP, what is the source of the water?

   River 1
   Pond 2
   Well 3
   Rain water tank 4
   Others 9

6. Which of all these sources do you prefer in the dry season? PREFDRY

WW WSP	0
Other WSP	1
River	2
Pond	3
Rain water tank	4
Other	9, specify ... .

7 What is the most important reason why you prefer this source to the other ones in the dry season? WHYPRDRY

Quantity of water available	1
Quality of water	2
Distance from house	3
Tastes better	4
Other	9, specify ....

8 What is a second reason why you prefer this source to the other ones in the dry season?

Quantity of water available	1
Quality of water	2
Distance from house	3
Tastes better	4
Other	9, specify .. ..

9 Which of all these sources do you prefer in the rainy season? PREFRAIN

WW WSP	0
Other WSP	1
River	2
Pond	3
Rain water tank	4
Other	9, specify .....

10 What is the most important reason why do you prefer this source to the other ones in the rainy season? WHYPRRAI

Quantity of water available	1
Quality of water	2
Distance from house	3
Tastes better	4
Other	9, specify ....

11 What is a second reason why you prefer this source to the other ones in the rainy season?

Quantity of water available	1
Quality of water	2
Distance from house	3
Tastes better	4
Other	9, specify ... .

12 What do you feel about the taste of WW WSP water? TASTE

Do not know	0
It has a good taste	1
It has a metallic taste	2
Chlorine taste	3
Other	9, specify ....

13 What do you feel about the smell of the WW WSP water? SMELL

Do not know	0
It is smells good	1
Not good	2
Other	9, specify ....

14. How does the WW WSP water look? LOOK

Do not know	0
Good	1
Coloured	2
Unclear	3
Other	9, specify.....

15 Do you think that the WW WSP water is safe to drink? SAFE

Do not know	0
Yes	1
No	2

16. Is the water from WSP always available when you need it? AVAIL

No	0
Yes	1

17. How many Riels do you pay for the water from the WW WSP PWW

Price per drum, jar or container	..... Riel
Volume per drum, jar or container	.....litre

18. What is the price if you transport the water on your own cart? PTRANS1

Price per drum, jar or container	... .. Riel
Volume per drum, jar or container	....litre

19. How many Riels do you pay for the water from another WSP? POTHER

Price per drum, jar or container	..... Riel
Volume per drum, jar or container	.....litre

20 What is the price if you transport the water on your own cart? PTRANS2

Price per drum, jar or container	.. ... Riel
Volume per drum, jar or container	... ...litre

21. If the price of the WW water would be reduced by R 50 per drum, would you stop using the other sources and only use the WW water instead? LESS50

No	0
Yes	1 → Question 23

22. If the price of the WW water would be reduced by R 100 per drum, would you then stop using the other source and only use the WW water instead? LESS100

No	0
Yes	1

23. Would you still use the WW WSP if its price would increase by 50 Riels per drum PLUS50

No	0
Yes	1

24. Would you still use the WW WSP if its price would increase by 100 Riels per drum PLUS100

No	0
Yes	1

25. What is the maximum price you would be prepared to fpy for WW water per drum
... . Riel

26. Why does one need safe drinking water? NEEDSAFE

Do not know	0
In order not to fall ill	1
Not to get diarrhoea	2
Others	9, ...

27. How would you define safe water? DEFSAFE

Do not know	0
When it has a good smell and taste 1	
When it is clear	2
When it is not contaminated with germs	3
When you do not fall ill after drinking it	4
Other	9, specify. . .. .

28 Could you please also give the category in which your household's monthly income belongs INCOME

1– 50,000 Riels per month	1
50,001 – 100,000 Riels per month	2
100,001 – 150,000 Riels per month	3
150,001 – 200,000 Riels per month	4
200,001 – 250,000 Riels per month	5
250,001 - 300,000 Riels per month	6
> 300,000 Riels per month	7
No answer	0

TWO TOWNS PROJECT

EVALUATION OF WATER SELLING POINTS

Questionnaire for Water sellers

December 1998

1. LOCATION
   A. Town . ...
   B District . .. .
   C Commune . . . .
   D. Village .. ....

2. Date· . ...

3. WW Water Selling Point number.
   1
   2
   3
   4

4. Name Water Seller· .....

5. Sex water seller
   female 0
   male 1

6. Age Water Seller· . .. .

7. How long have you been working as a water seller at this point?

   . . .. months

8. What kind of training did you receive before you started selling water?
   None 0
   training by WW 1
   other 9, specify .....

9 How many customers do you have at this WSP per day in the dry season?

   . ..

10 How much water do you sell every day (on the average) in the dry season?

   . m3

11. How many customers do you have at this WSP per day in the rainy season?

12 How much water do you sell every day (on the average) in the rainy season?

   . . .. .. m3

13. How much do you charge for the water?
   Price per drum, jar or container .... Riel
   Volume per drum, jar or container ..... Litres

14. What do you charge if a customer has its own transport?
    Price per drum, jar or container ..... Riel
    Volume per drum, jar or container ..... Litres

15. Why do you think that your customers prefer your water to the other sources?
    Short distance 1
    Availability 2
    Better quality 3
    4
    Other 9, specify. . ...

16 Why do you think other people prefer other sources?
    Short distance 1
    Availability 2
    Better quality 3
    Other 9, specify.....

17. Would it be possible for you to reduce your price by R 50/ drum?
    No 0 → Question 19
    Yes 1 → Question 18

18. Would it be possible for you to reduce your price by R 100/ drum?
    No 0
    Yes 1 → Question 20

19. Why not?
    . . ..
    ....
    . ...

20. Which constraints do you face in selling water?
    None 0
    Water not always available 1
    Water quality not good 2
    3
    4
    other 9, specify .....

21 Could you suggest some measures that would increase your sales?
    .. ..
    . . ..
    . .. .
    .. ..

QUESTION FOR WATER WORKS DIRECTOR

TOWN· ....

DATE: ....

Could you gıve us the followıng ınformatın on the WW WSP:

WW WSP	Month	Monthly Sales (m^3)	Prıce paıd to Water Works (R/m^3)	Price receıved by sellor for hıs sales (R/m^3)
. .				
. . .				
.. ..				
. .....				

How do you feel that the sales of these WW WSP may be increased?

. .. .
. ...
....
....

Appendix 2; Variables examined in the study:

A) Households

Factor	Variable	Specification
Characteristics household members	Age	Age of household head
	Education	Type of school completed by most educated member
	Occupation	Dummy; 0 for agricultural; 1-6 for otherwise
	Income	Income categories
Distance from water sources	Distance from WW's WSP	Meters
	Distance from other WSP, river/pond., well etc	Meters
Need for water	Household size	# of persons living in household
	Consumption of water	Litres pc per day
	Presence of animals	Number of cattle owned and kept near homestead
Existing arrangement for water	Sources available	Code for every source
	Sources used	Codes for every source
	Purchased	Riels paid per drum (220 litres)
Perception of quality of water used	Opinion on water quality of WW WSP and competing source	Dummy; 1 if respondent considers water safe for health; 0 otherwise
Household attitudes	External exposure	Dummy; 1 if any male member has had exposure to life outside village for a period exceeding 3 months; 0 if no exposure
Relative Cost	Price of water from WW's WSP	R/drum
	Price of alternative	R/drum

	sources Changed choice in case of price reductions	 What if WW's WSP 50, 100, 150 Riel cheaper than present price.
Health Awareness	Definition of safe water Knowledge of importance safe water	Codes for various answers Codes for various answers

B) From WW WSP's operator

Factor	Variable	Specification
Characteristics seller	Operator's sex Operator's age Experience seller at WW WSP Training received	Dummy Years No of months
Performance	Average No of clients per day per season Water sales per season Price	Number Cubic meter Riel
Explanations	Constraints faced Seller's perception of clients' preference Reasons for price setting	Code for every answer

Appendix 3: Respondent's income distribution (household's income)

household's income

		Frequency	Valid Percent	Cumulative Percent
Valid	1 - 50,000	7	5.5	5 5
	50,001 - 100,000	46	35 9	41.4
	100,001 - 150,000	53	41.4	82.8
	150,001- 200,000	15	11.7	94.5
	200,001 - 250,000	1	.8	95.3
	250,001 - 300,000	4	3.1	98.4
	> 300,000	2	1.6	100.0
	Total	128	100.0	

Appendix 4: Reasons for preference for WW WSP in dry season

Reason for pref in dry season

		Frequency	Valid Percent	Cumulative Percent
Valid	1 quantity available	87	84.5	84.5
	2 quality	14	13.6	98 1
	3 distance from house	1	1.0	99 0
	8 no other source available	1	1.0	100.0
	Total	103	100.0	

2nd reason pref dry season

		Frequency	Valid Percent	Cumulative Percent
Valid	2. quality of water	13	54.2	54.2
	3. distance from house	6	25.0	79.2
	4. tastes better	2	8.3	87.5
	9. other	3	12.5	100 0
	Total	24	100.0	

Appendix 5: Average values and their 90 % confidenmce intervals for Svey Rieng and Kg Cham

One-Sample Test

	Test Value = 0		
	Mean Difference	90% Confidence Interval of the Difference	
		Lower	Upper
Respondent's age	35 45	32 54	38 37
Number of Years of School completed	6 42	5 31	7 54
Total number of hh members	5 52	4 84	6 19
any member 3 months or more outside village	19	6 86E-02	31
Volume of water used in dry season (l/day)	258 18	201 10	315 26
Volume of water used in rainy season (l/day)	276 06	216 25	335 88
Consumption of drinking water (l/day)	8 48	6 94	10 03
why does one need safe water	1 15	95	1 35
2nd reason for need safe water00	2 20	1 96	2 44
WW WSP water always available when needed?	28	14	42
Distance to WW WSP (meters)	66 48	47 30	85 66
Distance to non- WW WSP (meters)	400 00	257 33	542 67
distance to pond (meters)	55 50	43 09	67 91
distance to river (meters)	232 86	81 70	384 01
Distance to well (meters)	17 29	9 16	25 43
look good?	9 09E-02	4 83E-03	18
taste good?	9 09E-02	4 83E-03	18
smell good?	3 03E-02	-2 1E-02	8 16E-02
price water from WW WSP (riel/litre)	763	.240	1 287
price water from non WW WSP (riel/litre)	1 545	846	2 245

Appendix 6: Average values and their 90 % confidence intervals for Pursat and Kampot

One-Sample Test

	Test Value = 0		
	Mean Difference	90% Confidence Interval of the Difference	
		Lower	Upper
Respondent's age	39 23	36 25	42 21
Number of Years of School completed	5 68	4 89	6 47
Total number of hh members	6 18	5 75	6 60
any member 3 months or more outside village	25	15	35
Volume of water used in dry season (l/day)	292 28	249 85	334 71
Volume of water used in rainy season (l/day)	155 37	116 25	194 49
Consumption of drinking water (l/day)	9 21	8 16	10 26
why does one need safe water	1 28	1 14	1 42
2nd reason for need safe water00	3 00	1 58	4 42
WW WSP water always available when needed?	47	36	59
Distance to WW WSP (meters)	150 05	121 76	178 35
Distance to non- WW WSP (meters)	178 06	120 71	235 40
distance to pond (meters)	76 54	41 63	111 45
distance to river (meters)	278 54	176 96	380 12
Distance to well (meters)	145 00	-3 29	293 29
look good?	51	40	62
taste good?	51	40	62
smell good?	47	36	59
price water from WW WSP (riel/litre)	2 805	2 643	2 968
price water from non WW WSP (riel/litre)	709	434	985

Appendix 7: Average values of a number of variables and their 90 % confidence limit in Kg Chnang, unsuccesful WSP

One-Sample Test

	Test Value = 0		
	Mean Difference	90% Confidence Interval of the Difference	
		Lower	Upper
Respondent's age	43 92	41 36	46 47
Number of Years of School completed	5 50	4 04	6 96
Total number of hh members	5 92	5.27	6 56
any member 3 months or more outside village	.42	15	.68
Volume of water used in dry season (l/day)	175 00	83.95	266 05
Volume of water used in rainy season (l/day)	102.50	28 45	176.55
Consumption of drinking water (l/day)	7.00	5 26	8 74
why does one need safe water	.92	65	1 18
WW WSP water always available when needed?	.50	23	77
Distance to WW WSP (meters)	609 17	293 52	924 82
Distance to non- WW WSP (meters)	275 00	224 62	325 38
distance to pond (meters)	60 00	41 98	78.02
distance to river (meters)	720 00	423 07	1016 93
Distance to well (meters)	36 27	10 38	62 17
price water from non WW WSP (riel/litre)	3 409	1 563	5 255

Appendix 8: Average values of a number of variables and their 90 % confidence limit in Kg Chnang, succesful WSP

One-Sample Test

	Test Value = 0		
	Mean Difference	90% Confidence Interval of the Difference	
		Lower	Upper
Respondent's age	38 42	32 75	44 08
Number of Years of School completed	4 42	2 88	5 96
Total number of hh members	6 33	5 50	7 17
any member 3 months or more outside village	67	41	92
Volume of water used in dry season (l/day)	161 67	128 67	194 67
Volume of water used in rainy season (l/day)	94 17	67 14	121 19
Consumption of drinking water (l/day)	8 67	6 44	10 89
why does one need safe water	92	57	1 26
Distance to WW WSP (meters)	77 92	57 25	98 58
Distance to non- WW WSP (meters)	100 00	-215 69	415 69
distance to river (meters)	92 22	36 95	147 49
Distance to well (meters)	58 75	-13 85	131 35
look good?	50	23	77
taste good?	50	23	77
smell good?	50	23	77
price water from WW WSP (riel/litre)	3 178	2 865	3 492
price water from non WW WSP (riel/litre)	390	- 367	1 147

Appendix 9: A note on regression analysis used

The technique used for our analysis was Ordinary Least Square regression analysis, with the preference as the dependent variable. Since this technique requires variables at ratio level, or dichotmous variables (dummies – yes or no), the variable on water source prefered had to be recoded. If a respondent prefered the WW WSP (s)he was given code 1. If any other source was prefered, the code was 0.

Regression models were developed while using the "backward estimation method": an initial model was built comprising all variables (in the database) that could possible be of any significance. Often this model comprised some 20 independent variables. The initial regression equation was computed and consequently the least significant variables were deleted (based on estimated probabilities of the F value), after which the model was re-run.

After 20 odd iterations, a model usually appeared with a reasonable R (at least larger than 0.40, preferably larger than 0.50) and F values (at least larger than 4.0, preferably larger than 6), and regression coefficients that were significantly non-zero (at the 5 or 10 % level). We selected the model comprising most variables with significantly non-zero coefficients.

Appendix 10: Results of regression analysis – all functioning WW WSP Dry Season

Method: Ordinary Least Square

Dependent variable: WW WSP prefered during **dry season**- yes or no

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.909	.057		15.893	.000
	look good?	2 6E-02	.046	.066	.580	.564
	Consumption of drinking water (l/day)	2 8E-04	.004	.008	.072	.943
	Distance to non- WW WSP (meters)	3 5E-04	.000	143	1.240	.218
	price water from non WW WSP (riel/litre)	-4.2E-02	.025	-.198	-1.706	.091
	Distance to WW WSP (meters)	9.9E-05	.000	.055	.471	.639

a. Dependent Variable: WW WSP prefered in dry season

R = 0.245
R^2 = 0.06
R^2 adj = 0.08
F = 1,15
Sign = 0 339

Appendix 11: Results of regression analysis – all functioning WW WSP rainy Season

Method: Ordinary Least Square
Dependent variable: WW WSP prefered during **rainy season**- yes or no

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	608	.086		7.042	.000
	FARMER2	508	.237	.207	2.145	.035
	taste good?	-.301	.095	-.307	-3.179	.002
	distance to river (meters)	5.8E-04	000	.195	2 031	.045

a. Dependent Variable: WW WSP prefered in rainy season

R = 0.39
R^2 = 0.16
R^2 adj = .13
F = 5.6
Sign = 0.00

Appendix12. Simple financial Cost Benefit Analysis

		COST		Revenues	Revenues- Cost
	Investment + maintenance	Salaries	Total		
1	8,140,000	222,000	8,362,000	660,000	(7,702,000)
2	8,140	444,000	452,140	1,320,000	867,860
3	8,140	444,000	452,140	1,320,000	867,860
4	8,140	444,000	452,140	1,320,000	867,860
5	8,140	444,000	452,140	1,320,000	867,860
6	8,140	444,000	452,140	1,320,000	867,860
7	8,140	444,000	452,140	1,320,000	867,860
8	8,140	444,000	452,140	1,320,000	867,860
9	8,140	444,000	452,140	1,320,000	867,860
10	8,140	444,000	452,140	1,320,000	867,860
11	8,140	444,000	452,140	1,320,000	867,860
12	8,140	444,000	452,140	1,320,000	867,860
13	8,140	444,000	452,140	1,320,000	867,860
14	8,140	444,000	452,140	1,320,000	867,860
15	8,140	444,000	452,140	1,320,000	867,860
16	8,140	444,000	452,140	1,320,000	867,860
17	8,140	444,000	452,140	1,320,000	867,860
18	8,140	444,000	452,140	1,320,000	867,860
19	8,140	444,000	452,140	1,320,000	867,860
20	8,140	444,000	452,140	1,320,000	867,860
21	8,140	444,000	452,140	1,320,000	867,860
22	8,140	444,000	452,140	1,320,000	867,860
23	8,140	444,000	452,140	1,320,000	867,860
24	8,140	444,000	452,140	1,320,000	867,860
25	8,140	444,000	452,140	1,320,000	867,860
26	8,140	444,000	452,140	1,320,000	867,860
27	8,140	444,000	452,140	1,320,000	867,860
28	8,140	444,000	452,140	1,320,000	867,860
29	8,140	444,000	452,140	1,320,000	867,860
30	8,140	444,000	452,140	1,320,000	867,860
Present Value (Riels)			11,453,067	11,843,527	390,460

Discount rate 10%

Basic assumptions:

- Cost of WW WSP (US $) 2200
- Exchange rate Riels/US $ 3700
- Price of water sold at WW WSP (Riels/m3) 2000
- Price paid to WW (Riels/m3) 1000
- Margin for WW WSP (Riels/m3) 1000
- Volume sold per month (m3) 110