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POVERTY DIMENSIONS OF WATER, SANITATION, AND HYGIENE IN SOUTHWEST SRI LANKA

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SUMMARY

Halving the number of people without sustainable access to safe drinking water by 2015 is an important Millennium Development Goal. How do we design policies and projects that will efficiently and equitably help meet this goal? How do we accurately monitor and systematically evaluate progress towards attaining this target? By characterizing the current needs and constraints of households and service providers, the data from baseline surveys define the starting point in quantifiable terms. Collectively such information can be deployed in generating hypotheses and explanations about the behaviors of households and providers, designing incentives and directives, setting targets, defining indicators, monitoring progress toward goals, and evaluating specific programs and projects for desired outcomes. We illustrate these features through a case study of water, sanitation, hygiene, and poverty from coastal towns of southwest Sri Lanka.

In the early 2000s, the government of Sri Lanka considered engaging private operators to manage water and sewerage services for two separate service areas that spanned the districts of Gampaha, Kalutara, and Galle.¹ To better inform the design of these private sector transactions, we surveyed 1,800 households in southwest Sri Lanka and created spatial maps of poverty and network services. Our maps and models lead us to four conclusions. First, poor and non-poor households have different behaviors regarding water and sanitation, which affects the distributional impacts of the proposed private sector participation (PSP) transactions. Second, although the three localities are close geographically, they are sufficiently heterogeneous in terms of consumption patterns and preferences to ensure that details of the design of the transactions have to be adapted to the specific service areas. Third, affordability of connection charges for network services can be a constraint in the service areas, which is evident from comparing poor and unconnected households to non-poor and connected households. Fourth, the existing tariff structure and its inherent consumption subsidies are an ineffective mechanism for targeting the poor; this is because the existing tariff structure mainly benefits non-poor households.

¹ The government of Sri Lanka abandoned its plans for private sector participation in these two specific areas in 2004.

1 INTRODUCTION

Halving the number of people without sustainable access to safe drinking water by 2015 is an important Millennium Development Goal (MDG). This MDG goal has compelled many countries to reevaluate their policies for providing comprehensive access to water supply and sanitation (WSS) services. Given the limited effectiveness of public utilities, policy makers are increasingly looking at introducing private sector participation (PSP) to improve efficiency and expand WSS services (World Bank 2004). Simultaneously, the development discourse has focused on monitoring targets and evaluating policies that are supposed to improve WSS services. Can we design contracts with private providers to maximize efficiency and ensure that WSS services reach poor households? How will we know if PSP helps meet these goals? How do we ensure accurate monitoring and systematic evaluation of outcomes under PSP arrangements? Baseline surveys provide a starting point for answering these types of questions. By characterizing the current needs and constraints of households, communities, and service providers, the data from the surveys define a starting point from which to measure progress in quantifiable terms. In addition, these data can be used to generate hypotheses and explanations about the behaviors of households and providers and the potential effectiveness of policy instruments. Collectively such information can be deployed in setting targets, defining indicators, monitoring progress towards goals, and evaluating specific programs and projects for desired outcomes (Bosch et al. 2000; Prenusshi et al. 2000).

A major concern for infrastructure reform is that at present the poor are inadequately served and that private sector operators would have little incentive to improve WSS for the poor (Estache et al. 2002; World Bank 2004). The 2004 *World Development Report* finds that poor households bear a disproportionate share of the impact of inefficient WSS services (World Bank 2004). Bosch et al. (2000) suggest that fewer poor households than non-poor households are connected to water networks; and if they are connected, many poor households have access to lower-quality services. They also suggest that poor households end up paying more than non-poor households for services because of inequitable subsidizing, extortion, and a lack of economies of scale. In addition, poor households often incur higher coping costs, measured through time, health, and energy, than non-poor households.

What types of data are helpful in ensuring that infrastructure reforms address the welfare of poor households? Estache et al. (2002) suggest that inputs from microeconomic studies are critical to the reform process, particularly for the development of policy instruments to address accessibility and affordability of WSS services. Furthermore, dissemination of information to households is also argued to be important for broadening participation by creating awareness of policy initiatives and about health risks associated with poor WSS services (Jalan et al. 2003). Baseline survey data on the needs and constraints of poor households (before project implementation) can help support initiatives of this nature.

The government of Sri Lanka considered the possibility of inviting the private sector to operate WSS services and proposed two contracts: one for the service area comprising the town of Negombo, north of Colombo, and one for the service area in the coastal strip from Kalutara to Galle. The basic assumption underlying the PSP transactions was that at the end of the contract, 95 percent of the households in the two service areas would be connected to the pipe network by private taps. The sharp increase in access rates would require large investments over the contract period, which in turn would require significant tariff increases.

The government shares the concern that the poor in the PSP area are inadequately served and wants to ensure access and affordability to WSS services for poor households. The government proposes to address these issues through a combination of incentives (financial and non-financial) for households and contract obligations for the providers. We conducted a study of the water and sanitation situation in southwest Sri Lanka to support the information needs of such transactions. By conducting and analyzing data from a rigorous, quantitative study of the urban poor in the PSP area, our study helps establish the baseline and evaluate policy instruments for the study area. This paper summarizes the findings.²

Specifically, this paper illustrates the types of information generated by household and community surveys for the purposes of establishing baselines. If the PSP transaction were to be implemented in this

² A detailed discussion of the information presented in this paper is reported in Pattanayak et al. (2004).

region, our data could be used to monitor and evaluate the performance of such a transaction in for instance delivering WSS services to the poor.³ We also evaluate various “pro-poor” design issues such as service level, tariff, and subsidy options.

Thus, we develop the baseline scenario in terms of four modules and their corresponding products:

1. A socioeconomic profile of households in the PSP region in terms of demographics, WSS services, and health and hygiene behaviors
2. A profile of the poor in the PSP region through descriptive statistics, poverty mapping, and a regression model that explores the link between poverty and connection to the piped network
3. An analysis of the subsidy mechanisms in the PSP region and their effectiveness in targeting poor households
4. A description of household attitudes, preferences, and potential demand (willingness to pay [WTP]) for improved network services

At the core of this study is a socioeconomic survey and spatial mapping of 1,800 households in approximately 10 towns in the PSP region. We based our survey instrument on a review of previous WSS and poverty studies; a series of focus groups, pretests, and key informant discussions; and technical peer reviews. In addition, we used handheld global positioning system (GPS) units to map households and community infrastructure in the PSP area. In order to uncover broad correlations, we disaggregated our population into poor and non-poor households based on monthly consumption expenditure. Overlay of household and infrastructure maps allowed us to investigate spatial patterns and the potential for zonal subsidies and geographic targeting (see Annex A).

Econometric analysis and spatial mapping of the survey data and secondary statistics allowed us to develop several descriptive and analytical statistics relating to the socioeconomic and demographic profile, environmental and infrastructural priorities, water sources and uses, sanitation services, hygiene and health behaviors, demand for improved network water services, and subsidy distribution.

In order to better explain our results and their implications, we discuss in Section 2 how the study was designed. Then in Section 3, we discuss our conceptual framework, sample and survey instrument, and implementation. In Section 4 we present our characterization of the current WSS situation, a detailed analysis of the poor and water connections, household WTP for improved services, and distribution of water sector subsidies. Section 5 concludes with a brief summary of the findings and the role of baseline surveys in WSS sector reform.

³ At the time this paper was written, the government had abandoned its PSP plans due to a change in the political environment.

2 STUDY DESIGN

2.1 Defining, surveying, and mapping the poor

Poverty means different things to different people. For this reason, having a clear, unambiguous definition of poverty was essential to ensure that WSS policies could be targeted to the correct poor population and to allow for findings to be interpreted within the broader development policy discussions. The development economics literature traditionally relies on income- and expenditure-based measures. The Sri Lanka Department of Census and Statistics (DCS), for example, uses the household food ratio (food expenditures as a percentage of total expenditures) and per capita caloric intake to define poverty (Sri Lanka Department of Census and Statistics 2002). We apply similar techniques to identify poor households in our sample.

While sampling only poor households was feasible, it would have severely restricted the descriptive, analytical, and interpretive significance of the data. For example, without non-poor households serving as benchmarks we would not have been able to evaluate whether the needs or the situations of the poor are somehow different and therefore recommend modifications or clauses to PSP contracts to address these differences. Therefore, data was collected through a general survey of the population in the study area. Data was also collected on other government welfare programs occurring in the PSP region to capture the full extent of poverty reduction efforts.

Location of the poor is considered to be an important criterion in designing poverty alleviation policies that can use geographic targeting. Furthermore, water supply planning is an inherently spatial process and decisions need to be made regarding the location and expansion of the network. Therefore, handheld GPS units were used to map households and community infrastructure in the PSP area.

2.2 Characterizing the current water and sanitation situation

In characterizing current WSS conditions, it is necessary to understand not just water sources the household currently uses, but also potential new water sources; and a key element of this use is the quantity of consumption by source. Our survey collected details on all available water sources and consumption quantities for that source, along with similar details on the types and extent of sanitation alternatives. For each of these services and uses we collected information on the direct monetary costs, including utility bills and operational costs. The literature suggests that households also incur significant "coping" costs because of inadequate infrastructure services. Therefore we collected information on time investments and investments in capital equipment, including the depreciation rates and replacement cycles of this equipment. To evaluate improvements in public health as a result of WSS, we collected data on three sets of interrelated factors: (1) recent illnesses of the household, including water-borne diseases; (2) information on household sanitation and hygiene such as boiling, chlorination, filtering, and hand washing; and (3) measurements of existing water quality through household perceptions of color, taste, reliability, and health risk.

2.2.1 Measuring benefits of improved water and sanitation services

We used contingent valuation (CV) to elicit WTP for improved water and sanitation services. CV uses survey questions to elicit people's maximum willingness (and ability) to pay for a good by presenting consumers with a hypothetical scenario in which they have the opportunity to pay for the good. It is a technique originally and most widely used in the area of environmental economics to estimate the public's WTP for improvements in environmental quality (Cummings et al. 1986; Mitchell and Carson 1989). Over the last decade CV has been used increasingly in developing countries to estimate WTP for improvements in WSS services (Whittington 1988). Several design issues and options need to be considered in any application of CV. Defining the commodity to be valued and the payment scenario requires a thorough understanding of current options and local conditions. In this study such understanding was achieved by a careful review of existing services and preliminary data. Detailed consideration of the payment method, survey method, and elicitation method to be used in the CV analysis were also a part of this study's design. For more detail on design issues and caveats of WTP estimates, see Pattanayak et al. (2004).

2.2.2 Sample design

A survey size of 1,800 households from the PSP area was used in order to extrapolate our survey findings to the general population. The Water Sector Reform Unit (WSRU) in the Ministry of Housing and Plantation Infrastructure and the National Water Supply and Drainage Board (NWSDB) defined the PSP areas for us in terms of a list of 595 *Grama Niladhari* (GN) divisions. This list was verified by the Sri Lanka Department of Census and Statistics (DCS) to rule out any typographic errors in GN labels. The PSP areas stretched across three districts—Gampaha, Kalutara, and Galle—covering 17 Divisional Secretariat (DS) divisions.

A 3-stage stratified random sampling approach was used to select our sample. In stage 1, we determined the strata to be the GN division so that we would have sufficient geographical coverage and spatial representation of the project area. In stage 2, we calculated number of households we wanted to survey from each GN based on its population. To determine the number of households per GN, we calculated the ratio of each GN population to the total population in the PSP area multiplied by the total number of surveys we needed for each study area (800 surveys for the Greater Negombo and 1,000 for the Kalutara-Galle belt). In stage 3 we randomly picked the specified number of households from a pre-listing of households in every GN. The random selection of these households ensured that our sample was representative and allowed us to generalize our findings.

We obtained household listings by GN from the DCS. The DCS maintains the pre-listing forms (also called F1 forms) for the 2001 Census of Population and Housing. These selected households constituted our survey sample and were contacted by our enumerators by using their names and addresses. We devised a geographical replacement rule for situations in which it was impossible to interview the selected household after repeat attempts. In addition to this rule, each enumerator was given a guideline document providing further suggestions for using judgment to maintain the random sampling process.

2.2.3 Questionnaire development and implementation

The survey instrument was developed through a series of focus groups in Kandy, Galle, and Kalutara; several purposive discussions with households, NWSDB officials, and WSRU staff; and 120 pretests in Negombo, Kalutara, and Peradeniya. The final survey comprised of seven modules, with a split-sample design on the contingent valuation and conjoint questions to gauge household demand.⁴ Enumerators were selected from a pool of recent university graduates and trained using a combination of lectures, role plays, and field trials in the final survey area. Two field directors and three field coordinators supervised the implementation of the survey by 15 enumerators, divided into three five-member teams including male and female interviewers. Negombo, Wadduwa, and Hikkaduwa served as the three staging areas for the survey. Each survey was conducted as an in-person interview. At the end of each field day, field coordinators checked the returned questionnaires for completeness and accuracy according to a quality checklist. During the field work, field directors periodically monitored interviews for quality purposes, ensured targeting of the appropriate population, discussed complications regarding the survey instrument with enumerators, recorded enumerator opinions regarding the quality of the interviews, maintained a list of sample household addresses for follow-up surveys, and maintained a log of sample returned surveys. The survey process was completed in two months. Household survey data was supplemented with GN-level data on the location of amenities using GPS, prices of market commodities, and administrative data on poverty alleviation programs (such as the government's flagship welfare program, Samurdhi).

2.3 Survey results

Statistics reported in this section are based on the overall sample and are not disaggregated by study region.⁵ Note that (i) unless specified otherwise, we use medians to refer to the average or typical and thus exclude the influence of outliers, and (ii) our percentages may not always add up to 100 percent because of rounding.

⁴ The seven modules included: location and policy priorities; water sources; water treatment, storage and hygiene; sanitation and sewerage; contingent valuation; family roster and health; and a socioeconomic profile.

⁵ Results by study region are reported in Pattanayak et al. (2004).

Before presenting our findings, we first use our collected data to define “the poor.” As discussed in the study design section, having a valid and usable definition of poverty was critical to this study. The Sri Lanka DCS relies on household expenditure data from the Household Income and Expenditure Survey (HIES) to identify poor households (Sri Lanka Department of Census and Statistics 2002). To be able to compare our results to the census data and to ensure that our findings can be interpreted within the broader development policy discussions, we also used monthly consumption expenditures to identify the poor households in our sample. Recognizing that our survey module of consumption focused on the major items and omitted some of the micro details covered in the HIES, we made three adjustments to the consumption data: we calibrated our food expenditure, imputed our housing expenditure, and adjusted our ‘other expenditure’ category. These adjustments allowed us to define poverty in a manner that was comparable to the Sri Lankan government’s official statistics.

After performing these adjustments, we were able to classify our sample based on monthly per capita consumption deciles. We then defined poor households as those households in the bottom two deciles, or quintile, of the distribution; in other words, poor households are those that spend less than or equal to SL Rs 3,356 per capita per month. By this definition, 365 of our sample households are classified as poor, of which 124 live in the Greater Negombo and 241 live in the Kalutara-Galle strip. On the other end of the spectrum, households in the top quintile can be classified as rich; in other words, rich households spend more than SL Rs 8,065 per month per person. By this definition, 362 sample households are classified as rich, of which 204 live in the Greater Negombo and 158 live in the Kalutara-Galle strip. This definition of the poor not only allows us to explore poverty relative to the overall socioeconomic distribution, but also enables us to directly compare our results with other regions and countries if necessary. In the tables below, descriptive statistics are reported for the poor and rich sub-samples, and for the overall sample. We summarize the differences between poor households and the overall sample under ‘Poverty Profile’.

2.3.1 Profile of current water supply and sanitation behavior

A baseline of current water and sanitation conditions can be created for the PSP region by looking at descriptive statistics calculated for the overall sample. These results provide information on demographics, environmental and infrastructural priorities, water sources, water consumption, water supply, water quality, sanitation coverage, hygiene behaviors, and health in the study region.

Demographics and socioeconomics

Table 1 shows that 89 percent of the sample is Sinhalese and 62 percent is Buddhist. The average family size is 4.8 members, with 1.3 children under 18 years of age. The typical household head is 52 years old and has 10 years of education. Over 90 percent of households have adults who have completed primary education and almost all households send their school-aged girls to school. The typical household spends SL Rs 21,615 per month, of which 38 percent is spent on food.

Table 1. Demographics and socioeconomics

<i>Demographics and socioeconomics</i>	<i>First quintile (n=365)</i>	<i>Fifth quintile (n=362)</i>	<i>Overall (n=1818)</i>
% Sinhalese	85	91	89
% Buddhist	65	56	62
Family size	5.8	3.7	4.8
Adult equivalent	5	3	3.5
% have children under 5	31	21	26
Household head's education attainment (years)	8	10	10
% have adults who have completed primary school	86	97	93
% have girls attending school	98	99	99
Monthly consumption (SL Rs)	11,883	32,308	21,615
Monthly per capita consumption (SL Rs)	2,614	10,310	5,294
% Food expenditure	49	31	38
Monthly per capita food expenditure (SL Rs)	1,214	3,236	1,953
% living on less than US\$1 a day	67	0	13
Primary occupation			
Government	10	33	22
Business	9	21	17
Private sector	10	20	16
Manual labor	27	1	11
% received Samurdhi	47	4	19
% can borrow SL Rs 3,000–5,000 relatively easily	47	60	58
Housing conditions			
% single family and single story	79	90	86
% have cement floor	91	86	92
% have red brick/cement walls	81	99	94
% have tiled roof	66	79	76
Amortized monthly housing rent (SL Rs)	1,423	9,489	4,744
Distance to infrastructure			
Piped water network (kilometers)*	0.25	0.1	0.2
Main road (kilometers)	0.2	0.1	0.1

Source: Own elaboration

Note: All statistics are presented in either the percentage term or the median value.

* This "median" statistic masks the fact that distance to the network essentially falls into three broad classes: 52 percent of the dwellings which are less than 250 meters from network, 17 percent which are less than 1,000 meters from the network, and 31 percent which are greater than 1 kilometer from the network and as much as 15 kilometers from the network. Thus, the median is 0.25 kilometers whereas the mean is about 3.25 kilometers.

About 60 percent of the households believe it is relatively easy to borrow money up to SL Rs 5,000. The average household owns at least one of the following assets: gas oven, bicycle, radio, television, sewing machine, electric fan, and refrigerator. Eighty-six percent live in single-story single-family houses that have cement floors, brick walls, and tiled roofs. The value of the average house is about SL Rs 4,750 in terms of imputed monthly rent. Households indicated that their dwellings are close to the piped water network, main road, and bus stops, but at least 3 kilometers from a hospital and 1.5 kilometers from a college.

Table 2. Environmental and infrastructural priorities

<i>Environmental and infrastructural priorities</i>	<i>First quintile (n=365)</i>	<i>Fifth quintile (n=362)</i>	<i>Overall (n=1,818)</i>
% who believe that there are no serious environmental problems	32	23	27
% who believe that 24-hour service is most important water supply problem	21	23	24
% who believe that government should focus on public health impacts	52	51	53

Source: Own elaboration

Note: All statistics are presented in either the percentage term or the median value.

Environmental and infrastructure priorities

In response to questions regarding environmental priorities, about 30 percent of the households say that there were no environmental problems in their locality (Table 2). Only 7 percent believe that “contamination of drinking water” is the most important environmental problem. Households have a very favorable impression of the quality of their existing water source, judged in terms of taste, color, smell, safety, and reliability. These results clearly suggest that water supply is viewed as a quantity issue at best and certainly is not a quality issue for the majority of the population. In stark contrast, sanitation problems are clearly associated with contamination and public health risks.

Water sources, conditions, and uses

Major sources of water for our sample households were private connections to the piped water network, private wells, and water from neighbors (Table 3). A typical household can access at least three sources and approximately 54 percent of households claim that they could get their water from a private piped connection if they wanted. Most households feel that water from private connections, private wells, and neighbors is clean, tastes fine, does not smell bad, and poses no serious health problems. However, water from private network connections is deemed to be irregular and unreliable by 58 percent of those with piped network connections. Typically, a household uses just one source of water. Only about 4 percent of the sample relies exclusively on a combination of community sources, including neighbors, public taps, and public wells.

Thirty-eight percent of the sample households use water from a private connection to the piped network. Almost all of them have a functional water meter and receive a monthly bill that averages about SL Rs 100. On average, water is available from private connections about 17 hours per day in the rainy season and 15 hours in the dry season. The main complaint of respondents with access to a piped network is that water service is not available 24 hours per day.

Table 3. Water sources, conditions, and uses

<i>Water sources, conditions and uses</i>	<i>First quintile (n=365)</i>	<i>Fifth quintile (n=362)</i>	<i>Overall (n=1,818)</i>
Total water consumption per household (m ³)	19	27	22
% have a private tap	28	43	37
Private tap water consumption per household (m ³)	16	20	19
% have a private well	59	69	66
Private well water consumption (m ³)	14	15	15
% of neighbors that give water away	36	9	20

Source: Own elaboration

Note: All statistics are presented in either the percentage term or the median value.

Overall, households consume 22 cubic meters of water per month from all available sources (or about 148 liters per capita per day). Poor households use an average of 4 cubic meters per capita (133 liters per capita per day).⁶ In general, the non-poor consume 23 cubic meters per household per month compared to 19 cubic meters for the poor. In per capita terms, the consumption per month averages 4 cubic meters for poor consumers compared to 6 cubic meters for non-poor consumers.

The results show that “self-provision” through private wells is a substantive and realistic alternative to tap water, even for poor households. This finding was also confirmed by opinions of households that are currently not connected to the piped water network. In general, households are satisfied with their existing sources. By choice or through compulsion, private wells appear to be the dominant form of self-provision, primarily because of favorable hydrogeological conditions that make it easy to construct dug wells in the two service areas.

Sanitation services

In terms of sanitation services, about 95 percent of the sampled households have at least one water-sealed toilet in their home (Table 4). While about 24 percent have a cistern flush, a majority of the households use hand-pour flushes. The waste from the toilets is typically discharged into a single-chamber septic tank. About 65 percent of the households are “very satisfied” and 27 percent are “somewhat satisfied” with their sanitation arrangements.

Table 4. Sanitation services

<i>Sanitation services</i>	<i>First quintile (n=365)</i>	<i>Fifth quintile (n=362)</i>	<i>Overall (n=1,818)</i>
% use water-sealed toilet	90	99	96
% use pit latrine	3	0	1
% use public latrine	1	—	0
% use neighbor's toilet	6	0	3

Source: Own elaboration

— Not available.

Note: All statistics are presented in either the percentage term or the median value.

Hygiene and health behaviors

Table 5 shows that over 40 percent of households treat their water before drinking and cooking by boiling and/or filtering. Forty-three percent of households have one or more storage tanks at a cost of SL Rs 5,000 each. Over 80 percent of the households have protected containers for water used in drinking and cooking and an equally large percentage of households handle and transfer water without dipping into the storage container. Almost everyone washes their hands before eating and after defecating but only about 75 percent wash their hands before preparing food. While eighty percent of the households have soap near toilets for washing hands, about 65 percent have water, 25 percent have basins, and only about 10 percent have towels.

In evaluating the health status of our sample we find that 1 percent of the households have experienced a case of diarrhea in the month prior to the survey. Only about 2 percent of the entire sample of households has experienced a morbidity event related to water-borne or water-washed diseases in the past year. About 3 percent have experienced a mortality event in the past year, with only about 1 percent reporting mortality of a child. Since diarrhea is the primary public health disease of concern with respect to WSS interventions, we developed a profile of households that have had diarrhea cases and compare them to households that have not suffered from diarrhea in the month prior to the survey. On average, the households with cases of diarrhea are poorer, more likely to have children under 5, and less educated. In general, they are less likely to be connected to the piped water network and consume about 30 percent less water per month. They are less likely to store the water in overhead tanks, transfer water by pouring or using spigots, and wash their hands before eating and preparing food. In terms of toilet behaviors, these households are less likely to wash their

⁶ Conversion from cubic meters per capita to liters per capita per day is based on the conversion factor: 1 cubic meter = 1,000 liters, divided by 30 days.

hands in or just outside the toilet, use appropriate technologies for hand washing, and sanitarily handle and dispose children’s feces.

Table 5. Hygiene and health behaviors

<i>Hygiene and health behaviors</i>	<i>First quintile (n=365)</i>	<i>Fifth quintile (n=362)</i>	<i>Overall (n=1,818)</i>
% treat/filter water before drinking	31	59	42
% have a storage tank(s)	13	73	43
% have water storage containers for cooking and drinking are covered	65	51	60
% have water storage containers for cooking and drinking are not covered	7	21	14
% have sufficient hand washing technology *	10	35	20
% have a morbidity case **	2.7	1.9	1.9
% have at least one diarrhea case	1.9	0.8	1.0
# of diarrhea cases	10	5	25
% have a mortality case	3.6	3	2.9

Source: Own elaboration

Note: All statistics are presented in either the percentage term or the median value.

* Sufficient technology is if the household has more than 2 of the following: water from tap or container, soap or detergent, towel or cloth, and basin or sink at the place for hand washing.

** This number is the sum of diarrhea, malaria, typhoid, cholera, dengue, hepatitis, and trachoma cases.

2.3.2 Poverty profile

We created a “profile of the poor” in the PSP region using descriptive statistics for poor households, spatial maps to investigate the correlation of poverty and network connections, and by characterizing connected households through a discrete-choice regression model.

Descriptive profile of the poor

As explained above, we define poor households as all households with monthly per capita consumption less than or equal to SL Rs 3,356 or those in the bottom quintile of the monthly per capita monetary consumption. The typical poor household in this study can only afford to spend SL Rs 11,883 per month, of which 49 percent is spent on food. Heads of poor households have completed 8 years of schooling on average and mostly work as manual laborers. Forty-seven percent receive Samurdhi welfare payments and 5 percent also receive monetary and non-monetary assistance from other programs. Only about 25 percent say that they can borrow money from a money lender, a self-help group, or a microfinance program.

The poor are more likely to live in single-story housing that is shared with other households and in houses with mud floors. They are also less likely to be living in houses with brick walls and tiled roofs. These differences are reflected in the value of their house; the imputed monthly rent for houses owned by the poor is 30 percent of the overall sample. The poor live somewhat farther from networked infrastructure such as main roads and piped water. They are predominantly Sinhalese and Buddhist. Nevertheless, they include disproportionately larger shares of the Tamils and Muslims than the overall sample. On average, poor households have larger families, more children who are under 5 years of age, and fewer household members who have finished high school education. However, they are just as likely to send their school-aged girls to school, with 98 percent of their girls in school.

About one-third of the poor households do not believe that the environment or water supply pose serious policy problems—that is, they do not think that the government should be focused on these problems. Nevertheless, in comparison to the non-poor, fewer poor households judge the color, safety, smell, and reliability of water from commonly available sources to be of high quality. While most of the poor can access three water sources, most use just one source. Twenty-eight percent of the poor are currently connected to the network (compared to 38 percent of the overall sample) and about 60 percent obtain water from a private well. On average, they consume 4 cubic meters of water per capita per month (or 130 liters per capita per day). While 90 percent of the poor have a private water-

sealed toilet, in general they are more likely to use a neighbor's toilet (6 percent), a pit latrine (3 percent), or public latrines (1 percent). Thirty percent of the poor treat their water before drinking and only 13 percent own overhead tanks to store water. They are less likely to have adequate technologies for hand washing. In contrast to the overall sample and the rich, poor households experience significantly higher morbidity (2.7 percent incidence rate) and mortality (3.6 percent rate). For example, the poor reported 10 cases of diarrhea (40 percent of all the cases) in the month prior to the survey and 4 cases of child mortality (36 percent of all the cases), even though they constitute only 20 percent of the overall sample.

These statistics suggest that poverty clearly plays a role in water uses and needs. Poorer households consume less water per capita and are less likely to be connected to the network or to own a well; treat their drinking water; own tanks to store water; wash hands or have access to safe hand washing technology; use and operate a water sealed toilet; be protected from water-washed diseases such as diarrhea, including among their children. They are also less willing and able to pay for improved water supply. All the reported differences between the poor and the rich are statistically significant at the 5 percent level.

Spatial mapping of poverty and network connections

One important question for the objective of this study was whether there were any obvious spatial dimensions to the differences between the poor households and the rest of the sample in southwest Sri Lanka. Economic theory suggests that households will sort themselves across the region such that households that can afford urban amenities, such as water from networked connections and schools, will pay higher rents and live in more convenient and desirable neighborhoods and communities. If households are mobile and the housing market is functional, the value of public services will be capitalized in the value of housing. Indeed, our calculations of monthly rent (imputed for owners, and reported for renters) suggest that a connection to the piped network adds about SL Rs 1,000 to monthly rents.

With costless mobility and efficient markets, we might expect perfect sorting such that the poor and the rich sort into neighborhoods with bad- and good-quality public service. The empirical reality is more subtle and complex: sorting is far from perfect and there is considerable income mixing and heterogeneity across and within neighborhoods. Factors such as peer effects and preferences for location, and a variety of non-economic considerations such as race, can complicate the sorting process (Epple 2003; Sethi and Somanathan 2004). The overlay of maps for poverty and water source provides some evidence of this complication in our study area. For sake of brevity, maps presented here are for the poor in the greater Negombo area only (figures 1A and 1B).⁷ When the poverty and water source maps are overlaid, we see that poverty is neither a necessary nor sufficient condition for a household not to have a tap that is connected to the network. Some poor households have taps that are connected to the network, whereas many non-poor households do not have taps connected to the piped network. While it is clear that location is a necessary condition for whether a household has a private tap connection, proximity to the network is not a sufficient condition for a tap—that is, some households close to the network have chosen not to be connected to the piped water network. In fact, economic theory and empirical evidence, including our previous research in South Asia (see Pattanayak et al. 2001; Whittington et al. 2002) suggest that access and use of alternatives to piped water as well as household perceptions and attitudes are critical determinants of whether a household decides to connect to the network.

Poverty and household access to network connections

We conducted multivariate regression analyses of the choice to connect to the improved network because it serves as a powerful tool to (1) test joint hypotheses based on the statistical significance of the estimated coefficients, (2) estimate the contribution of individual factors to the variable of concern, and (3) generate a function for out-of-sample predictions. For our study, each of these uses is relevant for identifying the current choice to connect to the piped water network. A detailed description of the regression modeling is reported in Pattanayak et al. (2004).

Data on whether the household has a connection to the piped water network can be recorded as a dichotomous choice (1 = has a piped water connection, 0 = does not have a connection) and analyzed using a multivariate probit model. The list of variables included in these regression models was based on intuition and practicality. While the primary criterion for inclusion of a variable was the

⁷ See Pattanayak et al. (2004) for spatial maps for Kalutara and Galle.

potential influence on household preferences, the choice was also conditioned by the availability of sufficient observations in our data set for the particular variable. Our final regression analysis included variables measuring the attributes of poverty, location, distance to network, provision of services, and household perceptions and characteristics.

The regression analysis confirms many of the findings discussed previously. The negative coefficient on the dummy variable measuring poor households (that is, those in the poorest quintile) confirms that the poor households are less likely to have a tap connection. Given that the co-variation of economic and water poverty is the outcome of a complicated and multidimensional process, it would be inappropriate to claim that economic poverty “causes” problems of water access for these households. We find that location has a significant impact on the likelihood of a household having a tap connection. As the maps suggest (See Annex B, figures B1 and B2), and the negative coefficients on these variables in the regression analysis confirm, households further from the network and further from the road are less likely to have a tap connection. Accounting for these two “distance” variables, we also find that households in Negombo region are less likely to have a private tap connection. Turning to private tap water substitutes, the model confirms that options and alternatives matter. The negative coefficient found for this variable means that households that own a private well, can access other sources, and that do use these other sources are much less likely to have a private tap connection.

Finally, we consider perceptions and household characteristics. We find that households with child diarrhea cases are no more likely to have a connection than households without child diarrhea cases.⁸ We find that households that believe the water supply is a serious problem because of water pressure, leaks, delays with new connections, water quality, or insufficient hours of supply are more likely to have a tap connection. This result may reflect the fact that households that have connections are more aware of these problems. We also find that households with more educated household heads are much more likely to have a tap connection, reflecting a combination of income and information effects. In general, the regression analysis confirms that economic wealth (or lack thereof) is not a sufficient condition for a private water connection. While wealth is highly correlated with the probability of a household having connections, location, household perceptions, and self-provision through substitutes all confound the spatial correlation of poverty and piped water connections.

2.3.3 Household demand and WTP for improved water sources

Stated preference methods such as CV surveys were used to gauge household demand for improved network water and sanitation services by presenting consumers with a contingent scenario in which they had the opportunity to obtain the described service. Households were also asked separately to consider attributes of the service, including costs, and to choose between scenarios that present different combinations of service levels and costs (usually expressed as a monthly consumption charge). WTP data from CV surveys measure the amount of monthly income that the household could give up after obtaining the improved network service and be just as well off as in a situation without an improvement in water supply or sanitation. Thus, the CV survey is a measure of the households’ economic value (Pattanayak et al. 2005). This data is related but not equivalent to demand or the revenues earned from households. Maximum WTP and CV response data define household values that underlie their demand for service improvements and therefore, may be used to inform tariff design.

Improved or new piped water supply

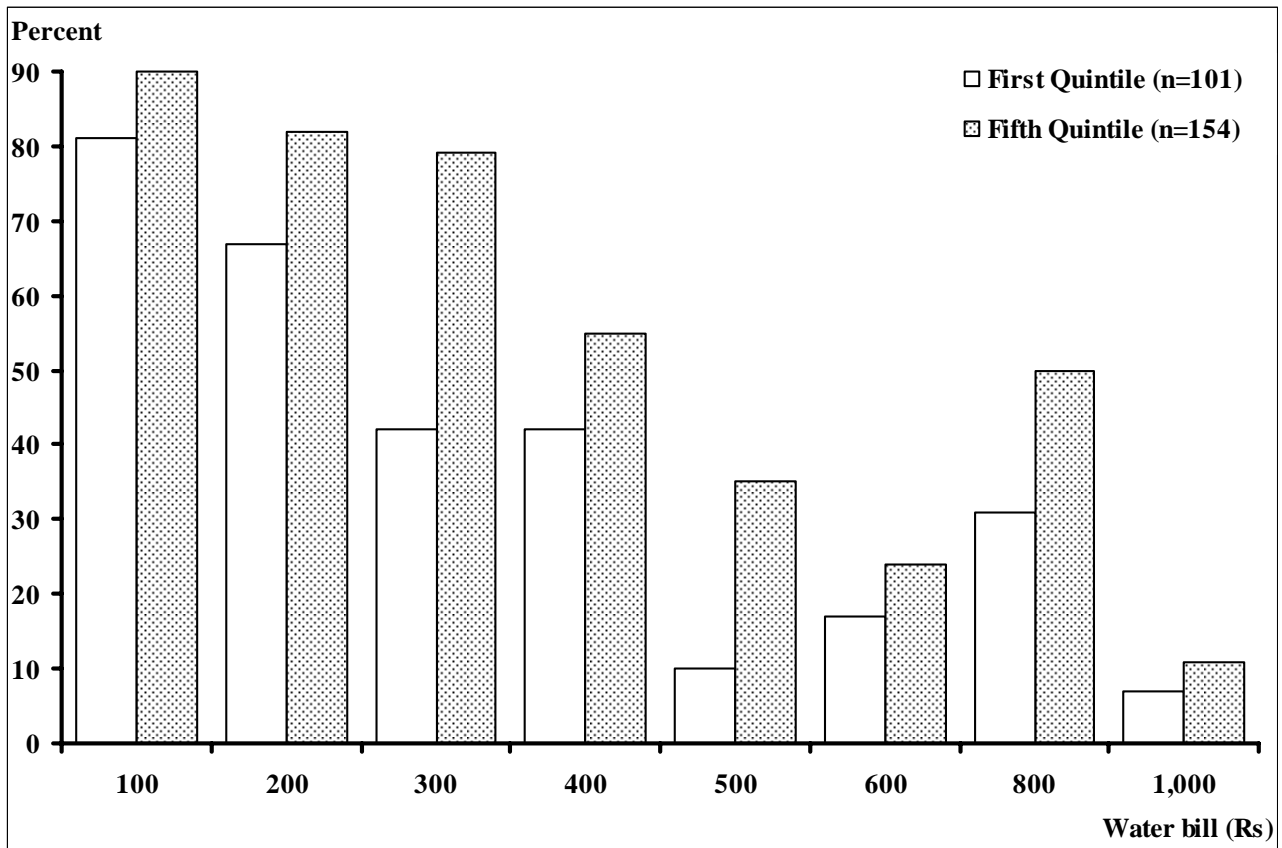
Households that are currently connected to the piped water network were asked to consider increases in monthly consumption charges for a service that would provide 15 cubic meters of clean and safe water, 24 hours a day, with regular and fair billing based on metered use, and prompt and efficient repairing and customer service.⁹ The number of households who want such a service at

⁸ High incidence of diarrhea might increase water demand and the desire to hook up to the network, all else being equal. However, current diarrhea incidence may not be correlated with historical diarrhea rates. Moreover, the causality could flow in the opposite direction: lower diarrhea rates could be the outcome of access to piped water.

⁹ While 15 cubic meters per month is lower than the current average water consumption, it is sufficiently greater than the basic requirements for health and hygiene. The unofficial standard is 40 liters per capita per day, which in this context is about 6 cubic meters per month. Thus, improvements proposed in our survey relate to the quality of the service—clean and safe water, 24 hours a day, with regular and fair billing based on metered use, and prompt and efficient repairing and customer service.

different levels of monthly consumption charge is presented in figure 1. As shown in the figure and predicted by economic theory, demand for the improved service declines with increases in monthly consumption charges. Based on this unconditional distribution, the median WTP for the improved service is about SL Rs 320 for households that are currently connected to the piped network. The sub-sample has a WTP of SL Rs 230. Overall, the median WTP among the connected is about three times more than what a typical connected household is currently paying, at between SL Rs 80 and SL Rs 100 per month.

Figure 1. Connected households that want improved service at different levels of proposed monthly water bills

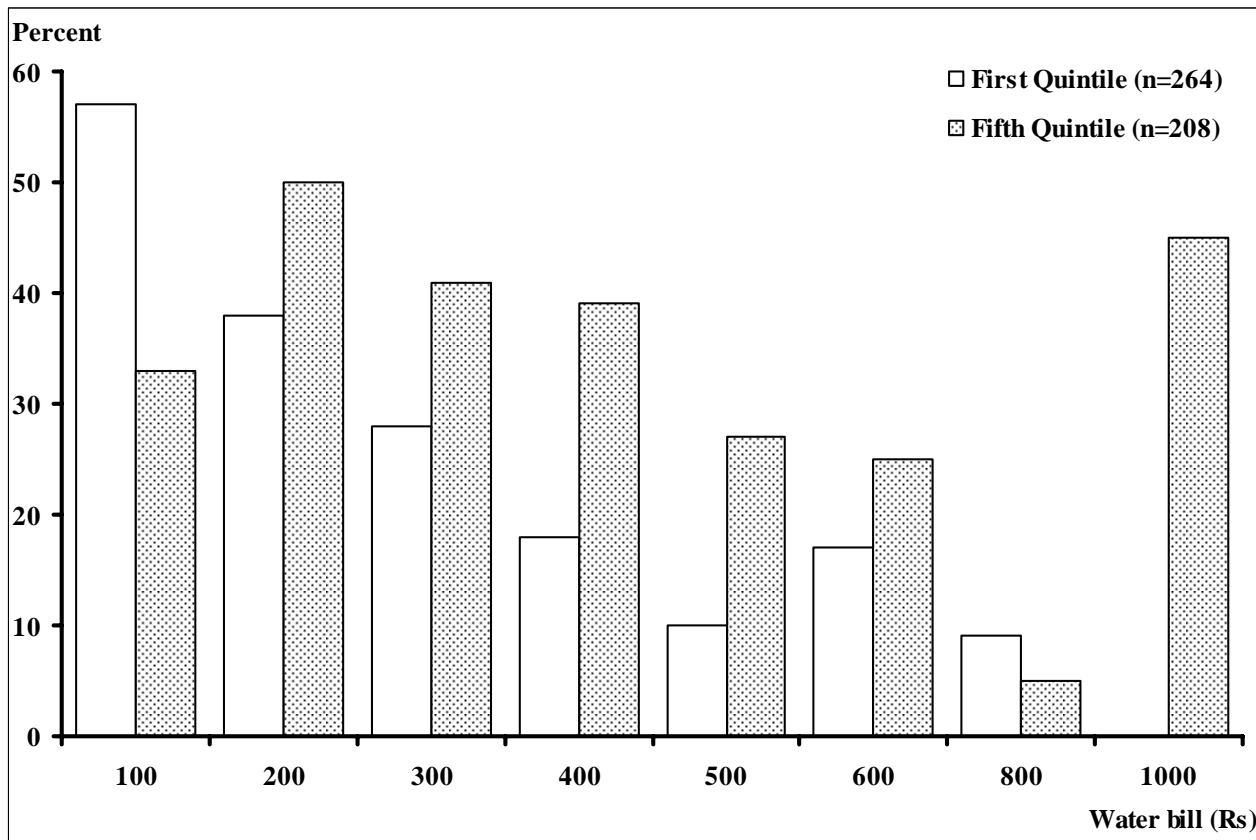


Source: Own elaboration

Households currently not connected to the network were also asked to consider a new piped water service that would provide 15 cubic meters of clean and safe water, 24 hours a day, with regular and fair billing based on metered use, and prompt and efficient repairing and customer service. In addition to monthly consumption charges for this service, they were also asked to consider a one-time connection cost.¹⁰ Using the raw data, the median WTP for the new service for unconnected households is about SL Rs 140. The distribution of responses to the WTP questions show how many people would connect at different levels of the proposed monthly bills and exhibit the expected downward sloping property that is consistent with demand theory. The distribution has an abnormality at two points—at the SL Rs 800 offer amount for connected households (figure 1) and at the SL Rs 1,000 offer amount for unconnected households (figure 2). It is possible that confounding factors such as income, perceptions, and availability substitutes are not balanced across these distributions (that is, we do not know household characteristics for the respondents at each price level). Additional regression modeling confirmed that all things considered, households were less likely to want the service as the price rose (see paragraph at the end of this section). Looking across sub-samples, WTP is lower for the poor and lower among unconnected households.

¹⁰ Eight levels of monthly consumption bills and four levels of a one-time connection cost were combined orthogonally and assigned randomly to the approximately 1,100 households in this subsample.

Figure 2. Unconnected households that want new service at different levels of proposed monthly water bills



Source: Own elaboration

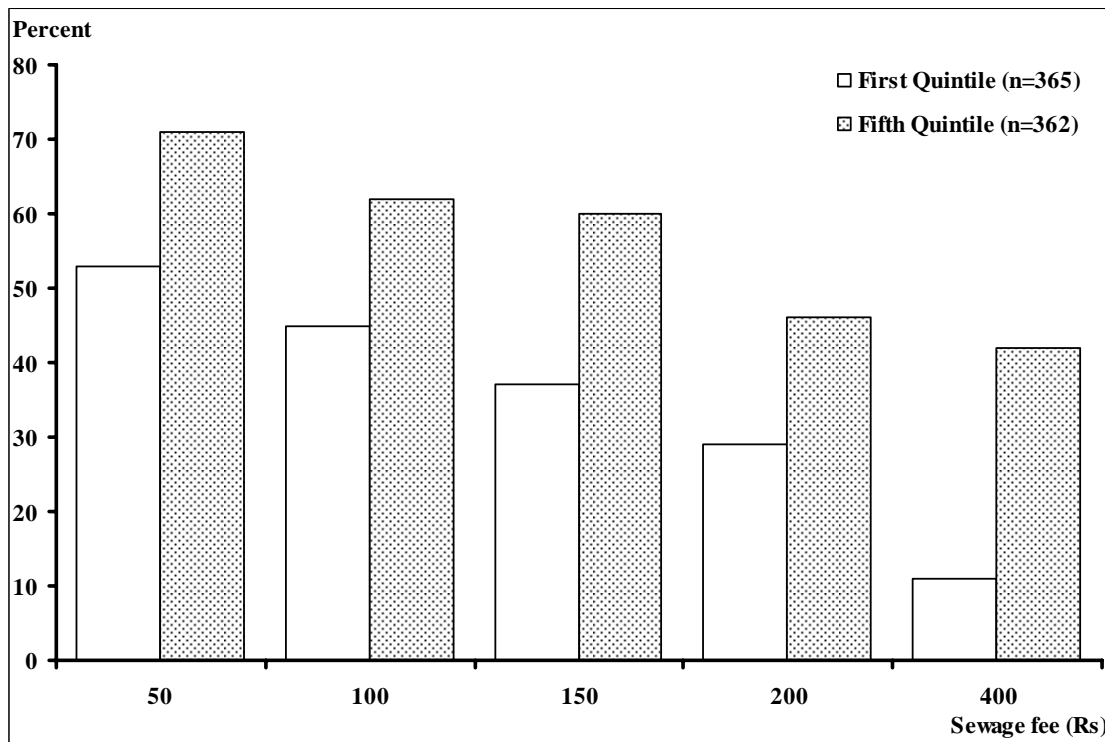
Although we find considerable demand for improved network water services, it should be noted that piped water services are seriously under priced. Yet, WTP for piped water services is lower than the rates that would be needed for cost recovery. The gap between WTP and the rates needed to implement an ambitious investment program that would make it possible to reach universal coverage is very significant. Under such an investment scenario, matching demand and supply will be difficult as it is likely that cost recovery will not be possible in the short to medium term.

We also asked unconnected households if a financing scheme, which would allow the consumers to pay off the one-time connection cost through a stream of monthly payments collected along with their monthly consumption charge, would convince the naysayers to change their mind. In general, only 60 of the 1,138 households (including about 18 poor households) would change their minds and connect to the new service if a financing scheme was available.

Piped sewage and improved sanitation systems

Analysis of household responses to CV questions on sanitation services suggests that households are willing to pay for such services in terms of monthly sewage fees (figure 3). The median WTP for the overall sample is SL Rs 150. Poor households, however, are only willing to pay SL Rs 75 for sanitation improvements. Currently, households do not pay for sanitation services in these communities.

Figure 3. Households that want improved sanitation service at different levels of proposed monthly sewage fees



Source: Own elaboration

We conducted multivariate regression modeling of the WTP responses for our subsamples of poor and non-poor households (details are reported in Chapter 5 of Pattanayak et al. [2004]). These models suggest that poor households are more influenced by the proposed monthly bill and have a higher marginal disutility of income. We see that household attitudes towards the private sector providers can have a significant impact on demand. We also find that health perceptions, water quality, institutions, and safety nets affect poor households' WTP differently than non-poor. Overall we find that affordability, measured specifically in terms of disposable income and related closely to factors such as education and economic well-being, is a prominent underlying cause for low demand. Therefore, policies that would increase income and education levels of poor households and expand the safety net would raise the demand for improved piped water services. Uptake rates under the current tariff structure and connection fees are relatively low and simulations show that a reduction in the connection fees has a significant impact on uptake rates. The options for stimulating demand are explored in greater detail through a set of simulations in a companion paper that will be made available in the near future.

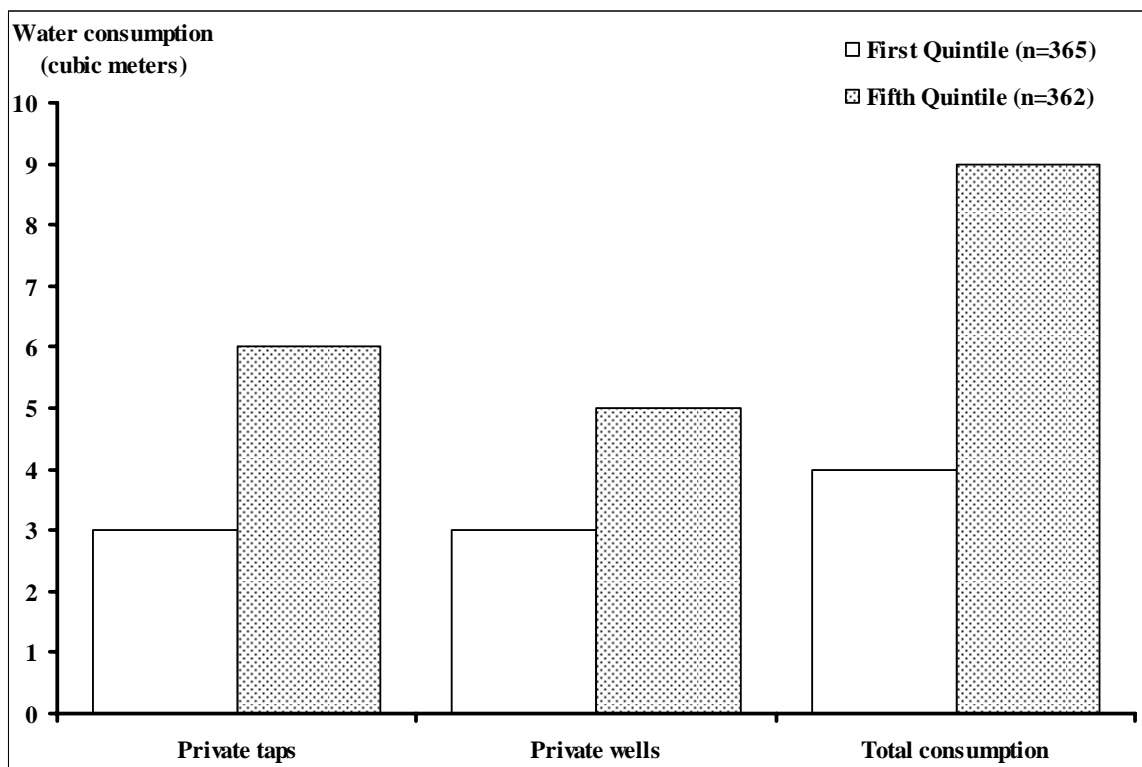
2.3.4 Subsidies

Large-scale subsidization of the water sector is typical in south Asian countries, that is, households pay for water at rates that are less than costs (defined in greater detail below). These subsidies are typically justified in terms of the need to ensure that essential water services remain affordable to the poorest in society. However, Foster et al. (2003a) identify a number of reasons for questioning whether these subsidies really benefit the poor. Tariff structures typically used in the water sector in South Asia do not discriminate between rich and poor, so that every residential customer benefits from the general subsidy to water consumption. Furthermore, a high proportion of poor people in South Asia do not have private connections and as a result they are unable to benefit from the widespread subsidization of this service. Even though this group may benefit from subsidies to public taps and tanker deliveries, these services tend to deliver such small quantities of water that the overall value of the subsidy is quite small compared with that going to users of private taps.

As was shown in table 3, 40 percent of non-poor households are supplied through private taps, compared to only 28 percent of poor households. Consumption for the overall sample of households with private taps is estimated to be about 19 cubic meters per month. Poor households consume 16 cubic meters per month and non-poor households consume 19 cubic meters per month. On a per capita basis, poor households consume an estimated 3 cubic meters per month from private taps and non-poor households consume an estimated 6 cubic meters per month (Figure 4). These differences are statistically significant.

Both poor and non-poor households receive subsidies under the Increasing Block Tariff (IBT) structure (figure 6). Under IBT, monthly water bills increase significantly if a household consumes more than 20 cubic meters per month. This drastic increase might explain why total consumption from private taps averages 19 cubic meters. More importantly, both groups fall within the third block of the IBT structure.¹¹ Average monthly household expenditure on water is also similar, at SL Rs 80 to SL Rs 100 per month for poor and non-poor households respectively.

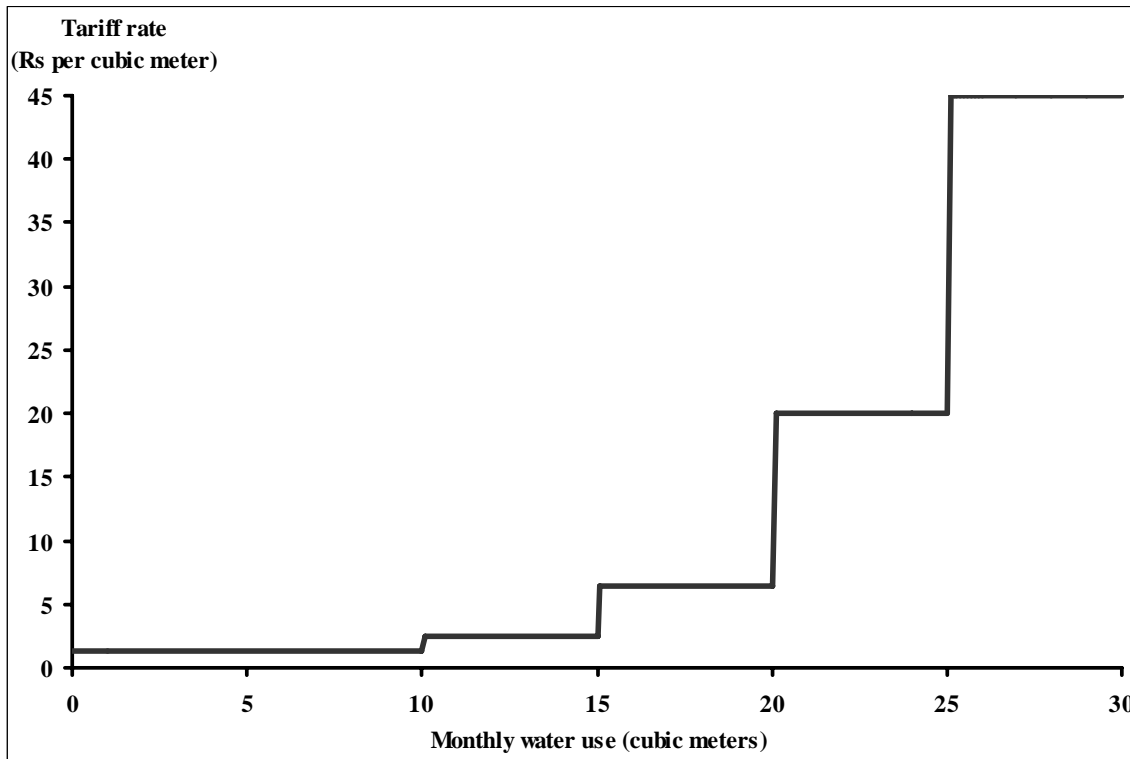
Figure 4. Per capita consumption patterns



Source: Own elaboration

¹¹ There are, however, differences between the poor (first quintile) and the rich (those in the fifth quintile of expenditure distributions). On average, the rich consume about twice the amount of total water and water from private taps as poor households.

Figure 5. Increasing block tariff structure



Source: Own elaboration

The amount of subsidy received by poor and non-poor households can be calculated as the difference between the full economic cost of producing the water that the household actually consumes and the monthly charge that the household actually pays to the utility. The larger this gap, the larger the subsidy that the household implicitly receives from the government. Three pieces of information were used from this survey to calculate the amount of subsidy that each household received: (i) monthly household expenditure on water, (ii) monthly household consumption of water, and (iii) the average cost of producing and distributing water in the city where the household lives.

Looking at the overall distribution, the percent of the subsidy received by the richest 20 percent (fifth quintile) of the population is higher than the percent of subsidy received by the bottom 20 percent (first quintile) of the population. (This can be seen in figure 6, which shows that the subsidy received increases as the income quintiles increase, from the poorest 20 percent at the left of the graph to the richest 20 percent at the right.) An analysis of the subsidy distribution in Negombo, Kalutara, and Galle shows that more than four-fifths of the subsidies available to private water networks are delivered in a way that fails to reach the poor. The vast majority of subsidy resources are spent on lowering tariffs for private connections through the IBT (figure 5), directing the distribution of subsidies towards smaller consumers on the assumption that these are more likely to be poor. Due to the fact that poor and non-poor households are captured under the same tariff block (figure 5), the IBT is a poor mechanism for targeting the poor. In particular, as much as 85 percent of subsidy resources fail to reach the poor. Meanwhile, the undercoverage rate is 72 percent given that only 28 percent of poor households are connected to the piped water network.¹² Even though the IBT is a bad instrument for targeting, the subsidies for the poor that do receive them (that is, those who are hooked up to the network) can be significant. Some calculations suggest that the subsidies make up 2.4 percent of a poor household's monthly expenditure.

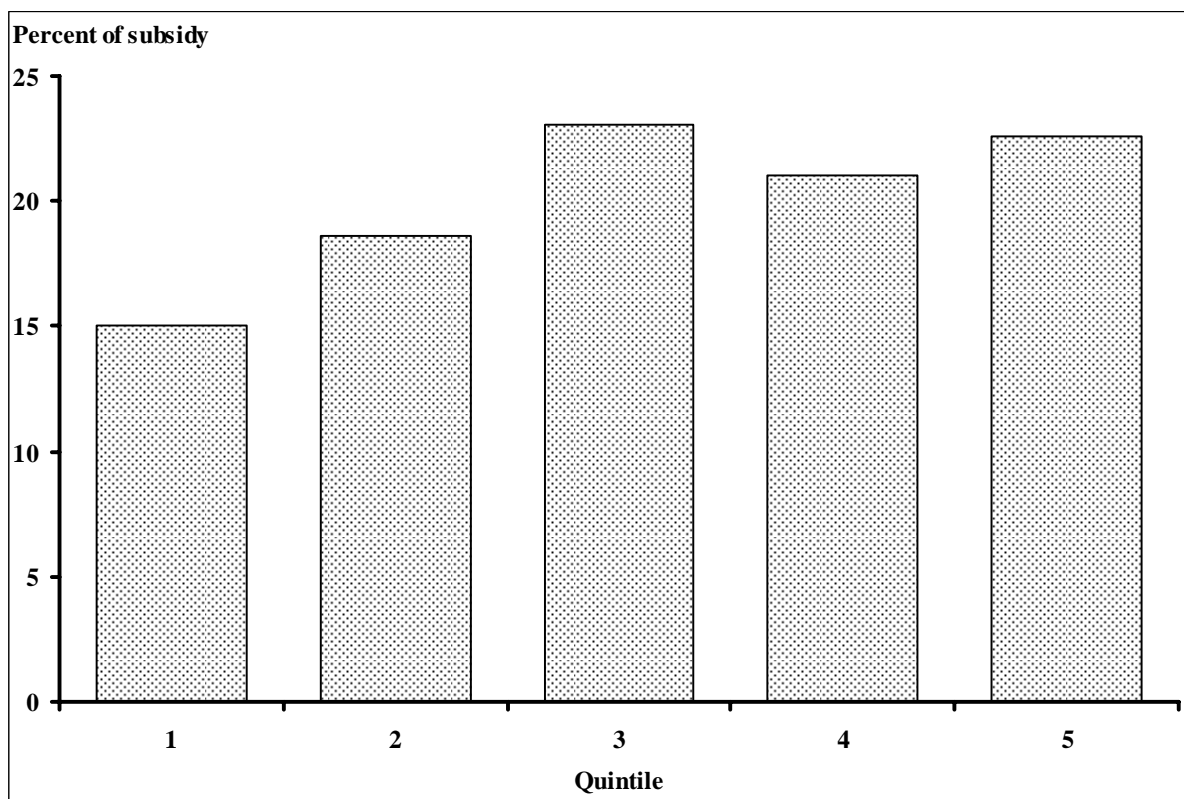
¹² Undercoverage rate or error of inclusion is defined as the ratio of non-poor households receiving subsidies to total households subsidized. Error of exclusion is calculated as the proportion of poor households that do not receive subsidies (Pattanayak and Yang 2002).

Recent literature suggests that targeting effectiveness can be improved by providing connection subsidies to unconnected households instead of consumption subsidies to connected households, particularly in areas characterized by low access to piped water (Foster et al. 2003b; Komives et al. 2005). The results in the previous section show that reducing the connection cost for unconnected households has a positive impact on WTP for a given monthly water bill and hence for uptake rates. Thus, connection subsidies could reduce the errors of exclusion in southwestern Sri Lanka. However, the poor live farther away from the piped network (particularly in Negombo) and will therefore be more expensive to serve.

Self targeting—that is, offering lower-quality service such as public taps or public wells to the poor—could also be considered. The tariff for public taps could be viewed as regressive (if not discriminatory) because it provides lower-quality service at an official tariff rate that is not significantly different than for private taps. In reality, the utility neither charges for public tap water nor provides good-quality or sufficient quantity of water. Moreover, this form of self-targeting is unlikely to work because the poor rarely use public taps but rely instead on the many other water sources in this part of Sri Lanka. We probed these issues through a survey-based conjoint methodology and found that the poor do not necessarily prefer private taps to public taps. However they do prefer small-diameter minigrids over public taps, suggesting that there is room for alternative service provision for the poor (Yang et al. 2005).

Piggybacking on the government's flagship welfare program, Samurdhi, provides another option for improved targeting because it can reduce administrative costs related to setting up and running the program. Under the current system, Samurdhi beneficiaries can receive a private connection at a lower connection cost, which can be paid through installments over time. Unfortunately, Samurdhi's effectiveness for this purpose is limited by the fact that the program is not very well targeted: it is guided often by political considerations that are not need based and more than 50 percent of the beneficiaries are non-poor households.

Figure 6. Percent of subsidy received by quintile



Source: Own elaboration

3 CONCLUSIONS

We have characterized the WSS situation in the study area through a cross-sectional survey of 1,800 households and spatial mapping. By comparing poor and non-poor households, we evaluate the extent to which poor households have been reached through traditional infrastructure services. This baseline characterization of WSS conditions in the study area can be used to monitor and evaluate water sector policies such as the possible involvement of the private sector. This would not be possible without a thorough knowledge of the current WSS situation and the concerns and constraints of the communities. Future studies can utilize this knowledge base as a starting point in impact analysis. Furthermore, the information reported in the previous section can be used to design water sector reforms in a manner that is more responsive to and targeted at the poor. This information base can also be used to conduct more sophisticated analyses for water sector policies and examples of such analyses are previewed at the end of this section.

In general, we find that both poor and non-poor households treat private connections to the piped water network as a normal economic good that is chosen by weighing the relative costs and benefits. Thus, economic growth, income redistribution, or targeted poverty alleviation programs in the region would also enhance household demand for networked water services in the long run. In the interim, if inadequate access to and use of network water imposes significant social costs, governments could consider a variety of targeted subsidy policies to stimulate demand for piped water services.

Four conclusions can be drawn from this paper regarding water sector reform issues. First, the poor are less likely to use safe water sources (they also consume less water per capita), treat water, own storage tanks, wash hands, use water-sealed toilets, and be free of water-washed diseases. Yet, poverty is neither a necessary nor sufficient condition for a household to have access to a private tap that is connected to the piped water network. We find that location, household perceptions, and self-provision through substitutes all confound the correlation of poverty and piped water connections.

Second, although the three localities are close to each other geographically and clustered around the national capital (Colombo), they are different in terms of consumption patterns and preferences as reflected in WTP for private piped water connections and household perceptions. Hence, one-size-fit-all solutions might backfire if these differences are not sufficiently captured in the transaction design to ensure that the poor are being served. The maxim that water supply is a local service is particularly true in this region and hence requires that the local context is sufficiently understood to ensure that proposed solutions can be adapted where necessary.

Third, affordability of connection charges for network services can be a constraint in the PSP area, as is evident from comparing poor and unconnected households to the non-poor and connected households. The poor have significantly lower WTP for improved services. Similarly unconnected households have significantly lower WTP than connected households, presumably due to the significant charges for connecting to the service and the availability of good-quality alternative water sources in the area. Connection subsidies could therefore be an effective mechanism to target the poor. Yet, the design of these connection subsidies should be carefully crafted depending on location and perceptions, especially as the service area is located in a region that is disease free, relatively water abundant (mainly dependent on private wells), and that has limited water quality problems. Connection subsidies would be less effective in Negombo, where the private tap access rates between poor and non-poor households barely differ in contrast to those in the Kalatura and Galle areas.

Fourth, the existing tariff structure with its inherent consumption subsidies is an ineffective mechanism for targeting the poor. Although the subsidies are large, only a small proportion of the poor benefit from them. Piped water, especially residential piped water, is seriously underpriced. In view of households' perceptions that water supply is a subsidized commodity, reducing the level of underpricing will take time. A rapid increase in water tariffs will be difficult to implement in an environment where alternative sources are easily and cheaply available (most households prefer their current option to piped water supply service alternatives) and where households perceive subsidies as part and parcel of piped water service delivery.

These findings show that conducting ex ante baseline surveys to investigate the demand for service is a useful tool to improve the design of the PSP transactions, including the design of subsidies, the

provision of service levels and other attributes of service, the application of technical standards, and so forth. Better-designed PSP transactions will have a stronger pro-poor impact and enhanced political acceptability and sustainability. Often the cost of such surveys is mentioned as an impediment to undertaken the analysis. The costs of such baseline surveys are not negligible but they tend to be small compared to the proposed investment programs in the Sri Lanka transactions, and also relatively small compared to the costs of the financial and technical advisors that design the transaction and prepare the bidding documents. In the case of Sri Lanka, the total costs of the baseline surveys would have added no more than 20 percent to the costs of the financial and technical advisors.

Consider three ways in which the data described in this paper can be used to examine additional policy questions. First, simulations with the estimated WTP regression model can determine the relative impacts of different policy variables (such as connection subsidies and IEC [information and education campaigns] on the demand for improved water services). Second, given the spatial homogeneity of the study area, the question arises whether geography is a critical determinant of poverty and water access. If geography is important, then spatial targeting could be used to target WSS investments. Third, surveys can show whether the population cares about aspects of service quality (such as service level, hours of supply, volume of water, and safety) and how consumer preferences differ by the household type (for example, poor versus non-poor). Information of this nature can be used in the transaction design process to adjust service levels to consumer preferences. These three ideas will be explored in three follow-up papers on demand simulation, economic geography, and demand for service quality.¹³

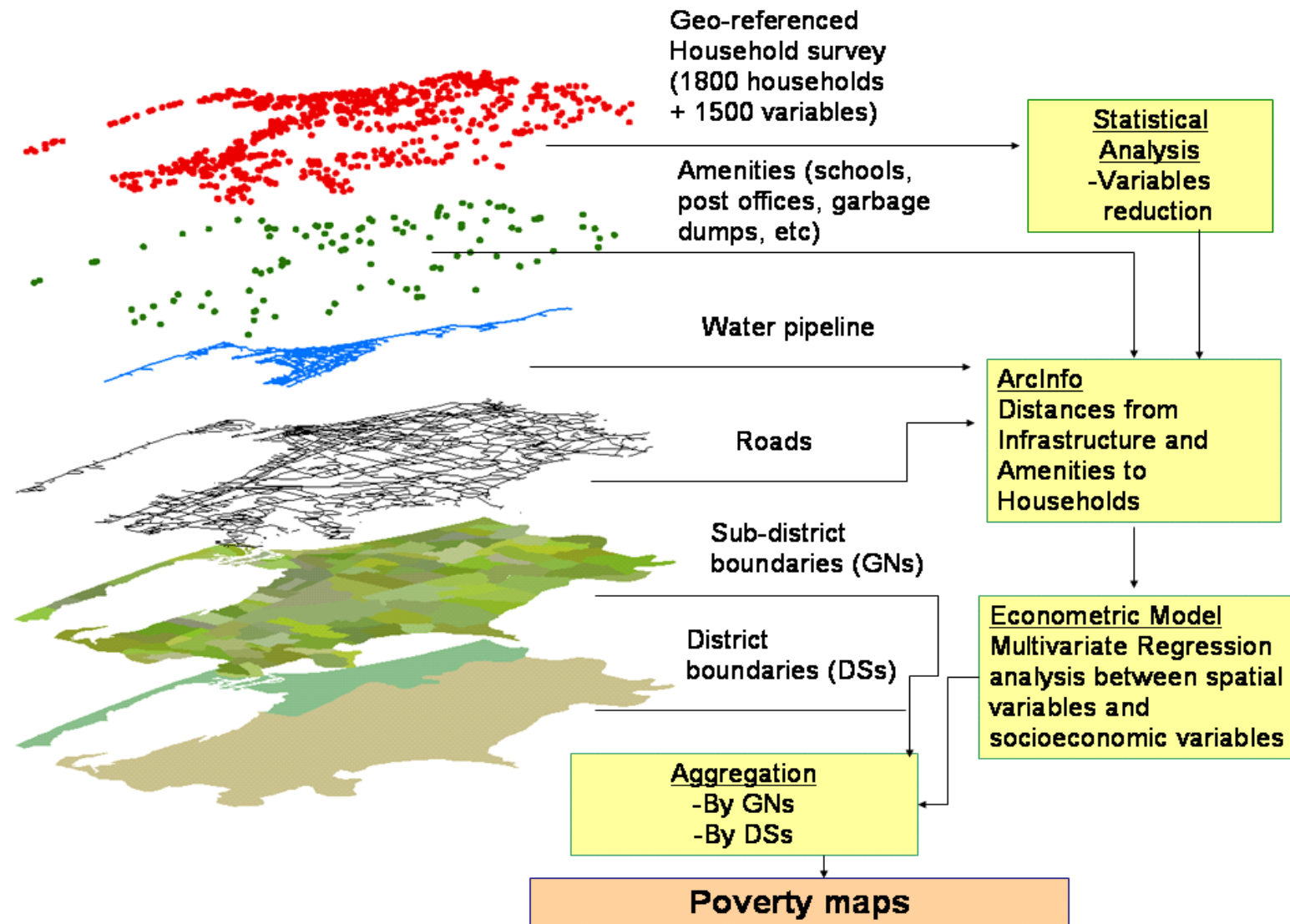
¹³ These papers are available in the Policy Research Working Paper series or with the authors (subhrendu@rti.org or cvandenberg@worldbank.org) on request.

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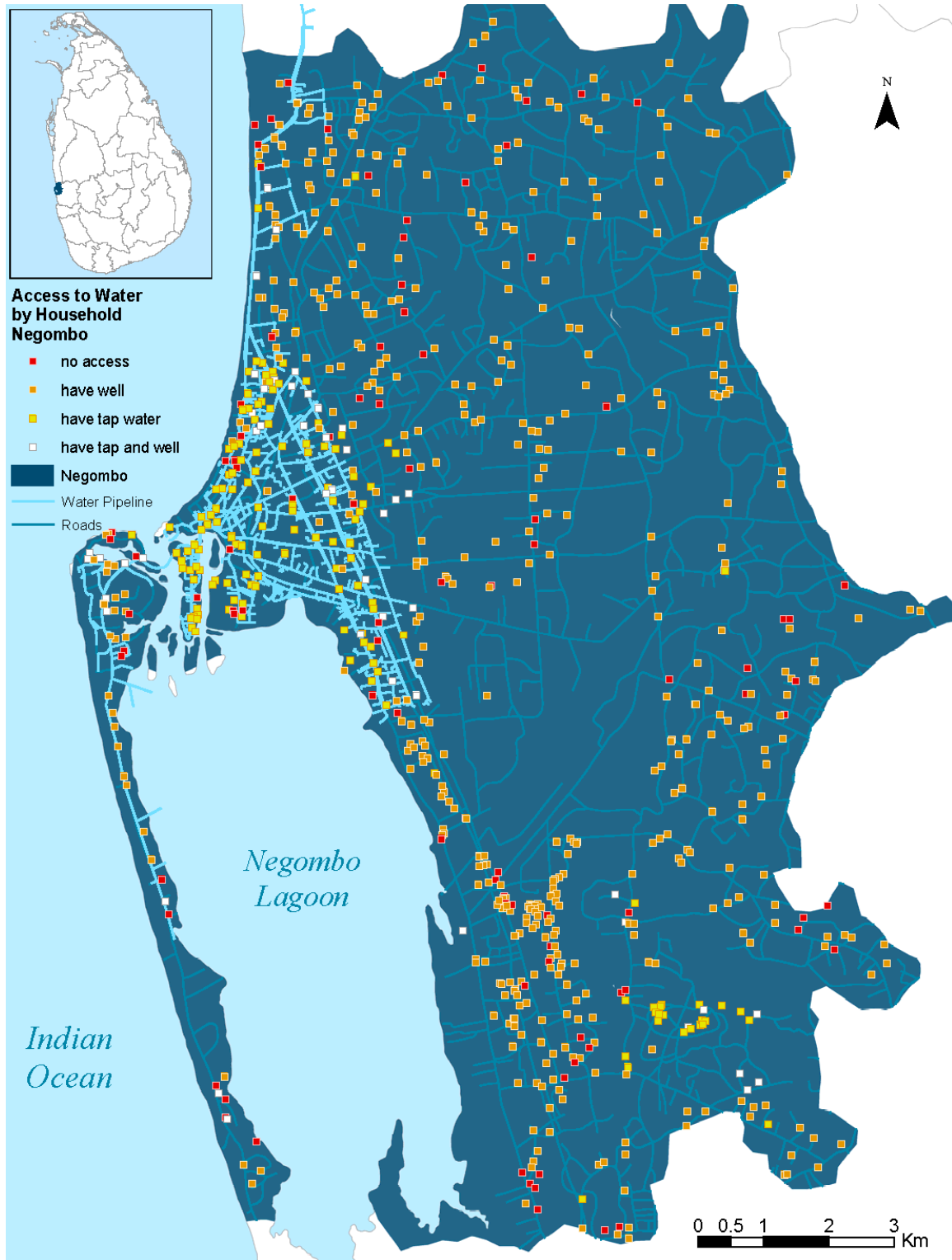
ANNEX A DATA COMPILATION IN GIS



Source: Own elaboration

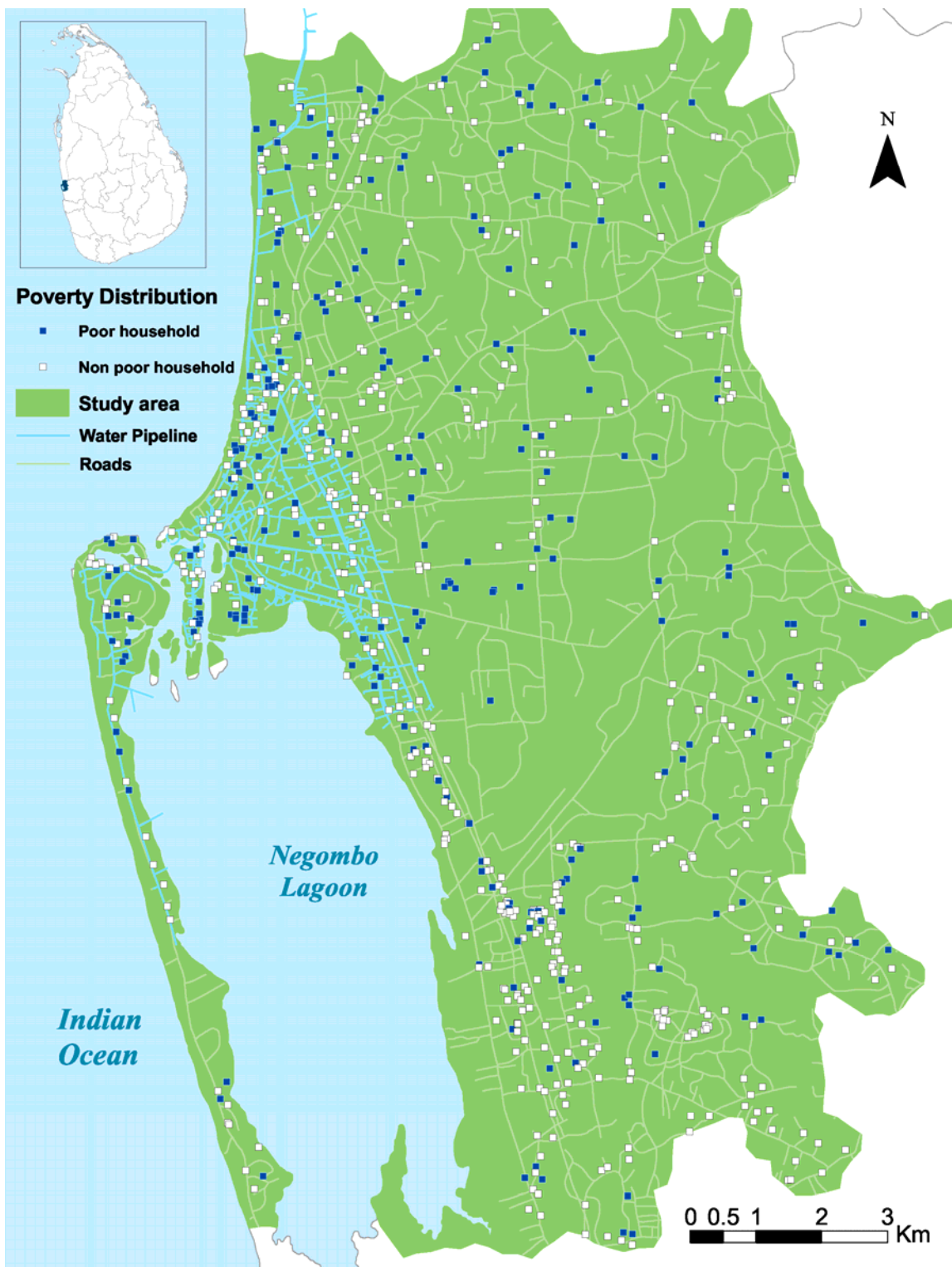
ANNEX B

Figure B1 Distribution of private tap and well uses in the Greater Negombo



Source: Own elaboration

Figure B2 Distribution of the poor in the Greater Negombo



Source: Own elaboration

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