ABSTRACT

JEFFREY A. HUGHES. The Use of Willingness to Pay Information in Sanitation Planning: A Case Study in Kumasi, Ghana. (Under the Direction of Dr. Donald T. Lauria)

Two models that predicted sanitation coverage in Kumasi were developed using household willingness to pay (WTP) information. Most (90%) households in Kumasi live in apartment buildings. It was unclear how to use household WTP information to predict building decisions. The Household Decision Model (HDM) used the WTP frequency distribution to estimate the number of individual households that would decide to use Kumasi Ventilated Improved Pit Latrines (KVIPs). The Building Decision Model (BDM) aggregated household WTP information to predict the number of apartment building owners that would choose to construct KVIPs. Both models estimated the subsidy cost and capital cost of providing Kumasi households with KVIPs. A sensitivity analysis was performed on the BDM showed it to be highly sensitive to key assumptions concerning the aggregation of household WTP information. This sensitivity suggested that improving the accuracy and usefulness of models such as the HDM and BDM requires a more complete understanding of group decision behavior in Kumasi than is presently available.

TABLE OF CONTENTS

ACKNOWLEDGEMENTS

I would like to thank Dr. Donald T. Lauria and Dr. Dale Whittington for their guidance and friendship during my time at Chapel Hill. I would especially like to thank Dr. Lauria for all of the constructive feedback he patiently gave me. I am also grateful to Dr. Michael Aitken for his assistance during the preparation of this report.

LIST OF FIGURES

LIST OF TABLES

CHAPTER ONE:
INTRODUCTION

1.1 The Need for Improved Sanitation in Developing Countries

In 1990, an estimated 1.7 billion people throughout the world did not have a hygienic method of disposing of their human waste within or near their homes (Table 1.1). In urban areas, 0.4 million people had no access to adequate sanitation systems, while in rural areas, 1.3 billion were depending on sub-standard sanitation.

In response to this problem, the United Nations General Assembly proclaimed the 1980's as the International Drinking Water Supply and Sanitation Decade. Ambitious goals were established and a global effort was launched to improve water supply and sanitation coverage throughout the world. Unfortunately, although gains were made in terms of the percentage of the population served with improved sanitation, during this decade the absolute number of unserved people rose due to population growth.

Many obstacles to planning sanitation projects exist, and many past planning mistakes have led to expensive failures. Future progress in addressing the current deficits in sanitation coverage will depend to a large degree on the ability of sanitation planners and designers to propose and implement successful new sanitation projects.

Table 1.1

Water and Sanitation Services in Developing World
(millions)

		1980		1990		Change	
Total Population		3246		3990		+754	+23%
Water:	Served	1411	44%	2758	69%	+1347	+95%
	Unserved	1825	56%	1232	31%	- 593	- 32%
Sanitation:	Served	1502	46%	2250	56%	+ 748	+ 50%
	Unserved	1734	54%	1740	44%	+ 6	0%
Urban Population		963		1332		+399	+41%
Water:	Served	720	77%	1008	82%	+368	+51%
	Unserved	213	23%	244	18%	+ 31	+15%
Sanitation:	Served	641	69%	955	72%	+314	+49%
	Unserved	292	31%	377	28%	+ 85	+29%
Rural Population		2303		2659		+356	+15%
Water:	Served	690	30%	1670	63%	+980	+142%
	Unserved	1613	70%	989	37%	- 624	- 39%
Sanitation:	Served	861	37%	1295	49%	+434	+50%
	Unserved	1442	63%	1364	51%	- 78	- 5%

1.2 The Use of Demand Information in Sanitation Planning

Conventional sanitation planning for both *on* and *off-site* systems in developing countries has traditionally involved planners designing projects based on their judgement and supposition. For example, a typical planning approach for an off-site sanitation system such as piped sewerage might involve calculating the per capita or per household costs for a range of different network options. The planner decides if the calculated costs are "affordable" to the population based on experience, judgement, and "rules of thumb." Inherent in the choice is the supposition that because it is judged to be "affordable" it will be embraced by the population.

Efforts are rarely made to formally assess demand for sanitation systems before deciding to promote and construct them. The Central Accra Sewerage Project, the only large sewerage system in Ghana, was designed with 500 junctions for private house connections. It was assumed that private households would be willing to provide their own internal plumbing and pay the required connection cost. The project was completed in 1973. By 1989, less than 100 households had decided to connect to the system. The lower than expected connection rate has led to a low level of cost recovery (less than 12 percent) as well as operation problems (Akosa et *al.* 1990). As a result of these types of planning practices, in far too many cases substantial resources are devoted to projects that attract few users and provide few benefits.

The lessons learned from past mistakes have led to widespread recognition among water and sanitation specialists that planning practices need to be more demand-driven (New Delhi WSS Conference 1990; WASH 1990; World Bank 1990). A demand-driven approach requires choosing, designing, and implementing projects in accordance with what beneficiaries want and are willing to pay for rather than what planners think beneficiaries need and would find affordable.

One of the keys to demand driven planning is the inclusion of information concerning beneficiaries' willingness to pay (WTP) into all phases of the planning process. WTP information can in principle be used to help select appropriate technologies and appropriate levels of service. Once planners have an idea which technologies are viable candidates, WTP information can be incorporated into the establishment of specific implementation policies.

As is the case with any information, WTP data can be misused in the planning process, thus resulting in policy decisions that are no better or even worse than if WTP data had not been used. Assessing the willingness to pay of households for improved sanitation is difficult and has rarely been done in the past. Even if some type of WTP information is available, it may be unclear how to incorporate the information into specific planning methodologies. The development of methodologies that rely on WTP information is an important issue that requires further investigation.

1.3 Use of Household WTP Information for Planning Subsidy Programs in Kumasi, Ghana

A WTP sanitation study recently completed in Ghana presents an opportunity to explore some of the difficulties associated with using WTP information in the planning process. Kumasi, the second largest city in Ghana, has many existing sanitation problems. Almost 40 percent of the population rely on an old unhygienic system of public latrines. Another 25 percent of the population use semi-private bucket latrines whose contents are often emptied directly into the urban environment.

The United Nations Development Programme (UNDP) is funding the development of a strategic sanitation plan with the World Bank as the executing agency in an effort to improve the city's sanitation situation. One of the guiding principles behind the plan is that it be driven by user demand (UNDP 1991). As part of the project, an extensive household survey was conducted to assess the WTP of individual households for different sanitation improvement alternatives (Whittington, Lauria, Wright, Choe, Hughes, and Swarna 1991).

One of the essential issues facing planners in Kumasi is the use of subsidies. The existence of externalities involved in improving the present sanitation situation in

Kumasi justifies considering some type of subsidy program. The method of distributing subsidies to provide Kumasi households with improved sanitation will depend on the particular technology that is being considered. For example, the method of subsidizing the construction of a city wide piped sewerage system will be different than the method of subsidizing the construction of private pit latrines. Ideally, in order to use subsidy funds as efficiently as possible, WTP information should be used to determine which households and buildings require subsidies, and the minimum required amount that they require to provide them with improved sanitation technology.

The Kumasi Ventilated Improved Pit latrine (KVIP) is an on-site sanitation technology that presently has limited use in Kumasi but is being promoted as a potential solution to some of the city's sanitation problems. The KVIP is a type of pit latrine equipped with a ventilation pipe to reduce odor and the number of flies, and with a system of alternating solids collection pits designed to make emptying the pits easier and safer (see Appendix A for description). The provision of KVIP service on a massive scale in Kumasi would require constructing latrine systems in buildings throughout the city.

1.4 Scope of Technical Paper

Most of Kumasi's inhabitants are renters in multi-household apartment buildings. Individual households have little control over the management of their building and would gain access to KVIPs only if their landlords decided to construct them. Unfortunately, although a household WTP study has been completed in Kumasi, it provides no direct information regarding the collective WTP of all households living in individual buildings.

This report addresses the problem of how to use information from a household WTP study to examine KVIP subsidy programs in a situation where the decision to construct KVIP latrines is most likely not made by individual households. The report examines the situation in Kumasi and develops and applies alternative methods of using data from the household WTP study to estimate the amount of subsidies required to provide KVIP service to households in Kumasi. Through the development and application of these predictive methods, the paper shows some of the typical difficulties and limitations of using information from a WTP study of the type conducted in Kumasi to guide the formation of sanitation policy.

Chapter Two describes the present situation in Kumasi. It presents information regarding the existing housing, water and sanitation conditions in the city. The chapter concludes with a description of the existing demand for improved sanitation services based on the recently conducted WTP study.

Chapter Three describes the development and application of two predictive models for estimating the subsidy cost of providing different numbers of households with KVIPs. The chapter details the steps and procedures behind the development and application of the models. Each of the models is applied under a set of basic assumptions.

Chapter Four examines the models developed in Chapter Three more closely. The results of applying the two models are compared and discussed. New estimates of KVIP coverage and required subsidies are obtained by reapplying the models using different assumptions regarding the distribution of subsidies and the estimation of the collective WTP of all the households living in a multi-family building. The significance of the models' sensitivity to key assumptions is discussed as a basis for evaluating their usefulness as a planning tool.

Finally, Chapter Five makes conclusions and recommendations regarding the use and development of the demand-driven planning techniques presented in the paper.

CHAPTER TWO:
BACKGROUND INFORMATION ON KUMASI

One limiting factor in sanitation planning in developing countries is often the lack of adequate information on existing sanitation practices. Knowledge of the sanitation systems people have relied on in the past can provide valuable insight as to how they might react to alternative systems in the future. Detailed information on housing and other services can also be helpful in the planning process. Accordingly, as part of a project to prepare a strategic sanitation plan for Kumasi, a comprehensive two-phase information gathering survey was performed in the fall of 1989 (Whittington *et al.* 1991).

The first phase was designed to obtain information regarding the operation of the 400 existing public latrines and the city's 6 desludging trucks. As part of the field work, observers were placed at public latrines and on desludging trucks throughout the city. Interviews were conducted with public latrine managers, operators and cleaners.

The second phase of the project consisted of the design and implementation of a large survey, the purpose of which was to collect household information on existing sanitation practices and willingness to pay for improved sanitation services. A two-stage stratified sampling procedure was used to select a random sample of 1633 households. Useable interviews were obtained from 1224 respondents.

The survey instrument had four sections. Section one included questions on demographic characteristics of the household. Section two included questions about the existing water and sanitation systems and practices. Section three solicited information on the households' willingness to pay for improved water and sanitation services. Finally, section four contained questions regarding the socioeconomic characteristics of the household.

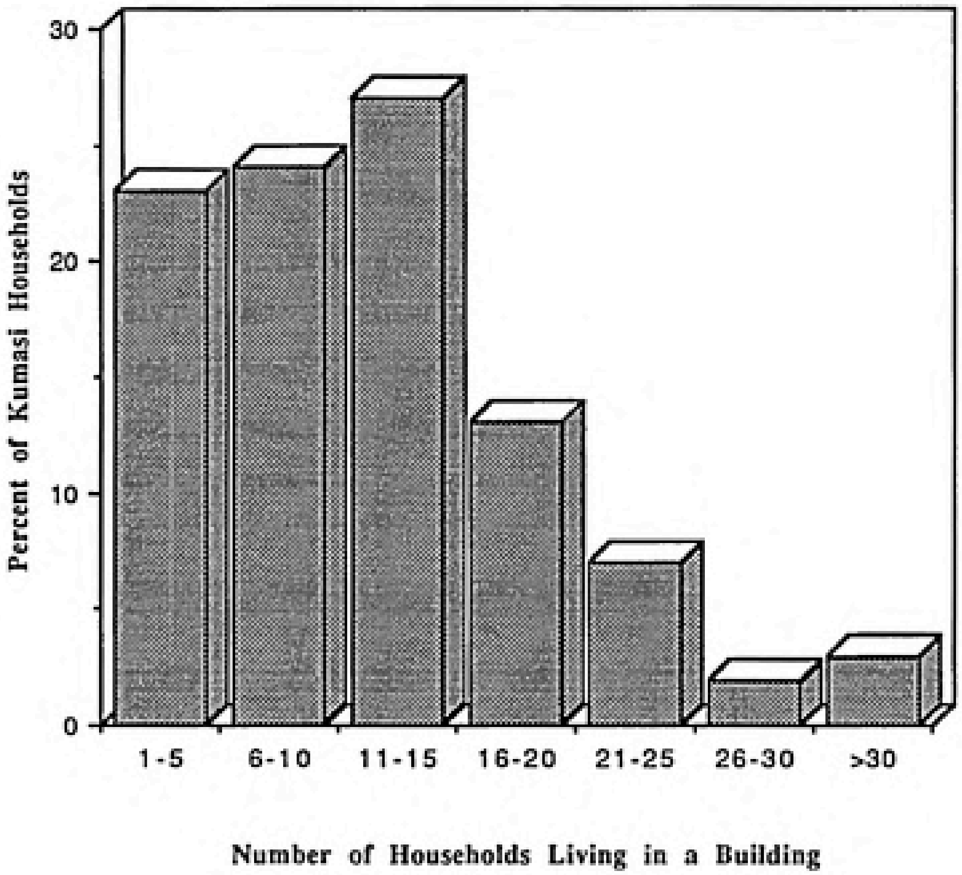
2.1 Basic Conditions in Kumasi

2.1.1 Housing

The population of Kumasi is estimated at 600,000 inhabitants and is increasing at a rapid rate. The average size of a household in Kumasi is 4.6 persons. The majority (95 percent) of Kumasi's population live in crowded multi-family apartment buildings. Although the average number of rooms inhabited by each household is 1.5, 90 percent of the households live in a single room.

Most households (70 percent) live in single story buildings. The average number of households in an apartment building is 11. About 55 percent of the buildings have more than 10 households (Figure 2.1).

Figure 2.1 Distribution of Households in a Building



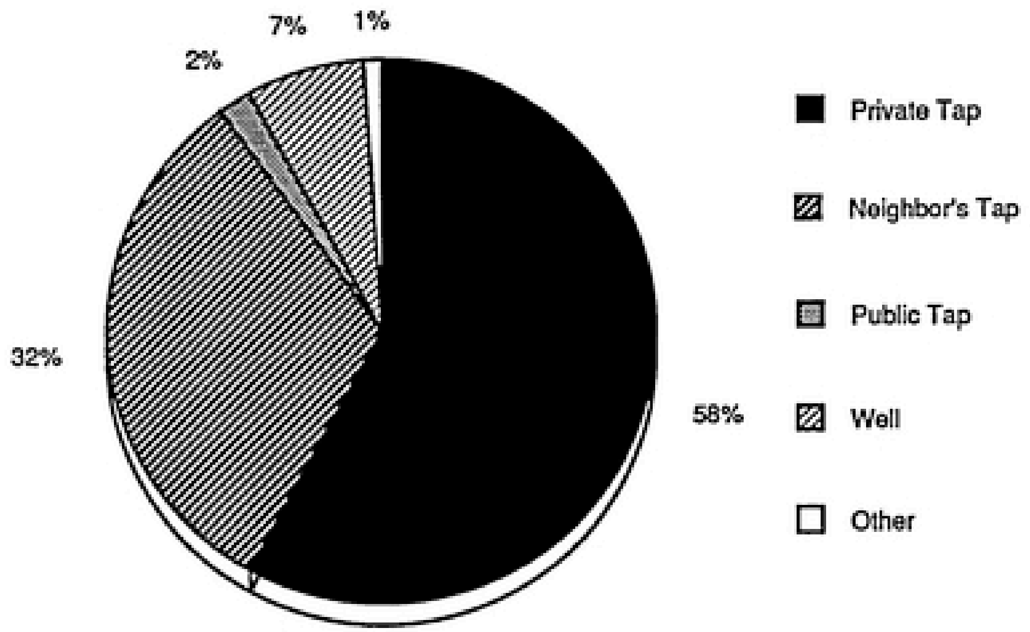
Most (89 percent) of the households in Kumasi rent their rooms. Over 55 percent of the households live in buildings with their landlord. Strict rent controls in Kumasi result in rental rates that are much lower than the market value (Malpezzi 1990). Because of the inability to charge higher rents, landlords have little incentive to make building improvements. The average monthly household rent in 1989 was $1.50, 2.2 percent of the average household income. (Households spend approximately the same amount for monthly rent as they do for electricity or six loaves of bread.)

2.1.2 Household Water Supply

Kumasi has a reliable municipal water supply that meets most of the city's needs. Water is available to most households more than eight hours a day. A majority of households (58 percent) have access to a metered private connection in their apartment building. Use of and payment for water is normally shared among all the households in apartment buildings that have their own tap (Figure 2.2). Nearly one-third of Kumasi's households purchase water from taps in neighboring buildings. Remaining households are supplied by public taps and wells.

Households with access to private connections pay an average of $1.13 a month for their share of the water bill. Households that purchase water by the bucket from taps in other buildings pay an average of $1.71 per month.

Figure 2.2 Percentage of Households Using Different Water Sources



2.1.3 Existing Sanitation

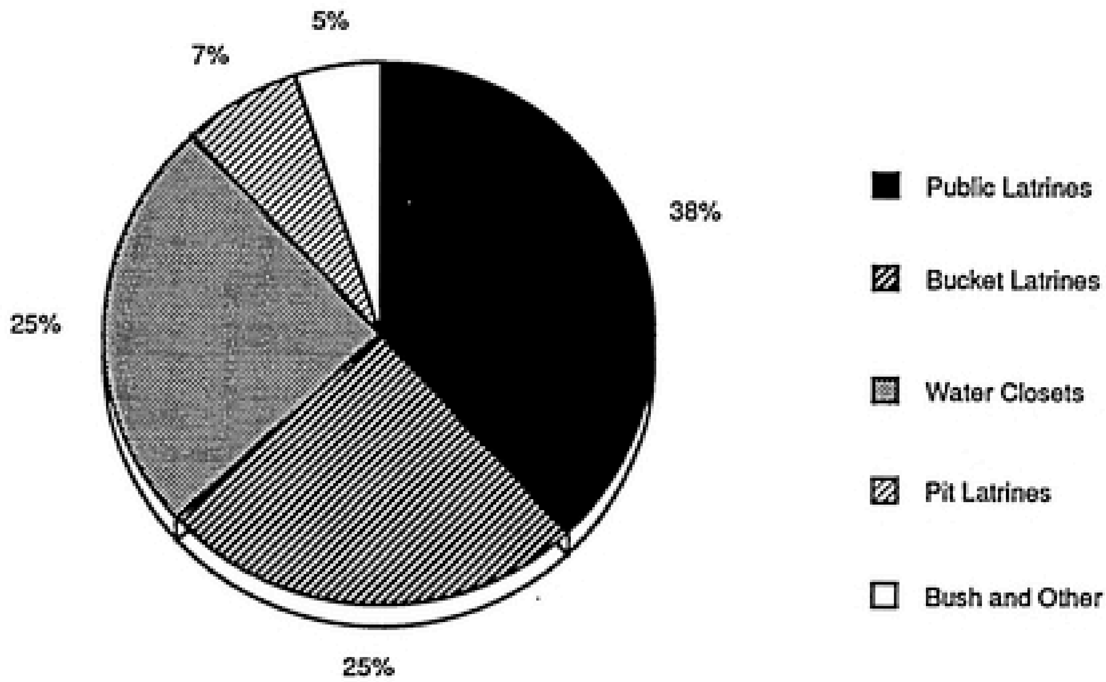
Several buildings at the university and the hospital are connected to a piped sewerage system. An additional five percent of the population does not have access to any sanitation facilities and relies on open public areas. The remaining 94 percent of the population is served by a variety of public and private on-site systems.

Figure 2.3 shows the current usage of different sanitation systems in Kumasi. Four hundred public latrines serve approximately 40 percent of the households. Approximately 25 percent of the households have access to water closets (WCs) connected to septic tanks. Another 25 percent live in buildings with bucket latrine systems (see Appendix A for a brief description of different on-site sanitation technologies). The remaining households use traditional pit latrines or "the bush."

The city has 10 heavily used public latrines in the downtown market area. The remainder of the public latrines are in neighborhood areas. Most of the public latrines (60 percent) are aqua privies. About 25 percent of the public latrines are bucket latrines. A small number of the public facilities are equipped with KVIP latrines. Most of the public latrines are 30 years old and in poor condition.

At one time, the public latrines were owned and operated by the city. The conditions at the latrines became so unsanitary that responsibility for their management was

Figure 2.3 Percentage of Households Using Different Sanitation Systems



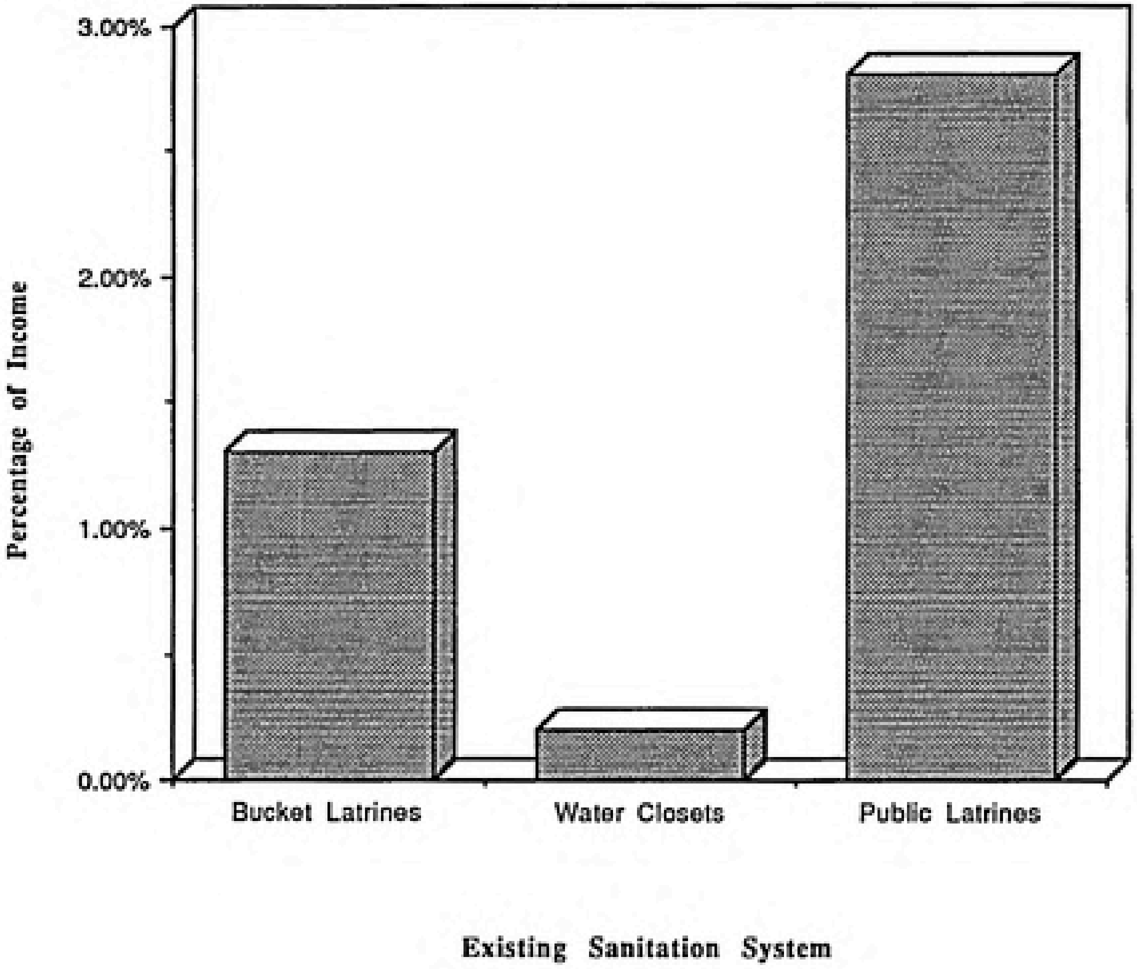
taken over by local political party organizations called "Committees for the Defense of the Revolution" (CDRs). The latrines are typically open from 4:30 A.M to 10:00 P.M. About half of the public latrines charge adults $0.015 per visit. Children and the elderly are admitted without payment.

The bucket latrines within apartment buildings are cleaned and emptied, on average, twice a week by private cleaners. The cost of emptying is shared by the users. Most of the WCs empty into concrete septic tanks which are not connected to drainage fields. Only 60 percent of the septic tanks are emptied on a regular basis, approximately once every 10 months. The $7 cost of desludging a tank is shared by the building's residents.

Households using public latrines are spending about $1.14 per month on sanitation, households using bucket latrines pay approximately $0.49, and households using WCs pay only $0.06 per month. Figure 2.4 shows these sums as percentages of household income. Households using public latrines spend 2.8 percent of their income on sanitation; households with bucket latrines, 1.3 percent; and WC users, 0.2 percent. These sanitation expenses only consider operation and maintenance costs and do not include the initial capital cost of system construction.

Figure 2.5 shows the monthly flow of human waste and money in Kumasi. Much of the waste from the existing sanitation systems does not leave the city. The waste that

Figure 2.4 Average Income Spent on Sanitation by Users of Different Systems



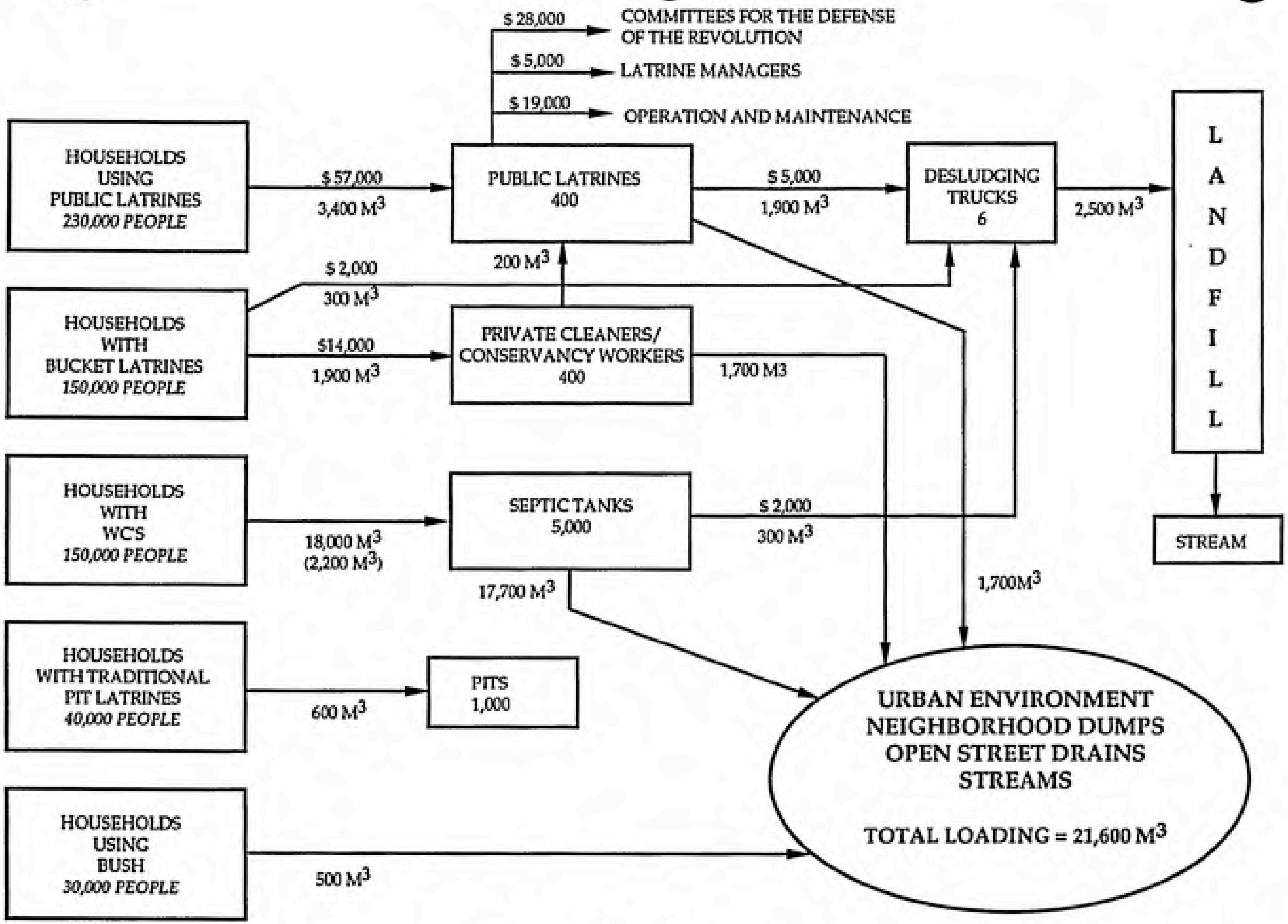


Figure 2.5
Monthly Flows of Money and Waste in Kumasi

does leave is transported by one of the desludging trucks to a landfill 10 kilometers outside of town. Most of the contents from the trucks run straight into a small stream adjacent to the landfill.

2.2 The Demand for Improved Sanitation

The demand for improved sanitation services such as KVIPs in Kumasi was assessed through the use of the contingent valuation (CV) method. This method has been used in the past by environmental and resource economists attempting to measure the benefits of environmental improvements (Freeman 1979, Mitchell 1989). A methodology for applying the contingent valuation method has been developed for use in planning water projects (Whittington et *al*. 1987). Only recently have CV studies been conducted to assess the demand for improved sanitation (Velasco 1990, Whittington *et al*. 1991).

2.2.1 Kumasi WTP Questionnaire

The Kumasi WTP questionnaire was designed to obtain information on the monthly willingness to pay for several different water and sanitation technologies and service levels. An effort was made to assess the willingness to pay of an entire apartment building by collectively interviewing all the household heads in a single building. The process proved extremely difficult and produced inconclusive results. Consequently, it was decided to obtain WTP information only at the individual household level through questions asked of heads of households or their spouses. All of the willingness to pay information from this survey is therefore a measure of the WTP of individual households for improved sanitation.

The survey included willingness to pay questions for five different technologies or levels of service: KVIP, WC with sewer, sewer connection, private water connection, and private water connection along with a WC with sewer connection. The questionnaire was designed to estimate demand for sanitation. Because certain technologies require water, some respondents were questioned about their WTP for water connections. Depending on the existing service level, households were asked their willingness to pay for one to three of the service packages (Table 2.1).

The willingness to pay questions were asked in the form of a bidding game -- a method of asking questions that resembles the process that occurs during an auction. Households were asked if they would pay a certain amount, and depending on their answer they were asked whether they would pay a lower or higher amount. The bidding questions were concluded with an open ended question that asked for the maximum amount households would pay for the different services. The details of how the respondents would be required to actually pay for the services was presented at the beginning of the bidding game (see Appendix B for a copy of bidding game description and questions).

Table 2.1
Different Types of Respondents and WTP Questions

1. Households with water and without a WC (406 respondents)

    WTP for KVIP
    WTP for WC connected to a sewer

2. Households with water and with a WC (295 respondents)

    WTP for a connection to a sewer

3. Households without water and without a WC (523 respondents)

    WTP for KVIP
    WTP for water connection
    WTP for water connection and WC connected to sewer

2.2.2 Willingness to Pay for KVIPs in Kumasi

The results of the WTP survey can be presented two different ways -- as a distribution of WTP bids or as mean WTP amounts calculated by averaging the bids from entire survey sample or from sub-samples of households with similar household characteristics.

Mean WTP

Figure 2.6 shows the mean monthly bids for various services. Respondents bidding for KVIP service had a mean monthly willingness to pay of $1.47. The mean WTP for WC service was $1.43.

Mean willingness to pay figures can also be presented to show the influence of factors such as housing type or tenancy status on the WTP of a household for improved sanitation. Table 2.2 shows the mean household WTP bids based on existing sanitation and water service. Public latrine users with water were willing, on average, to pay $1.57 for KVIP and $1.67 for WC service. Public latrine users without water have a mean WTP of $1.51 for KVIPs and $1.90 for WC and water.

Figure 2.7 shows the effect of tenancy status on the willingness to pay of a household for KVIPs. The households that are renters had an average monthly household WTP of $1.37 for KVIPs. Households who own their buildings were on average willing to pay $2.31 to provide <u>their household</u> with KVIP service.

Figure 2.6 Mean Monthly WTP Bids for Water and Sanitation Services

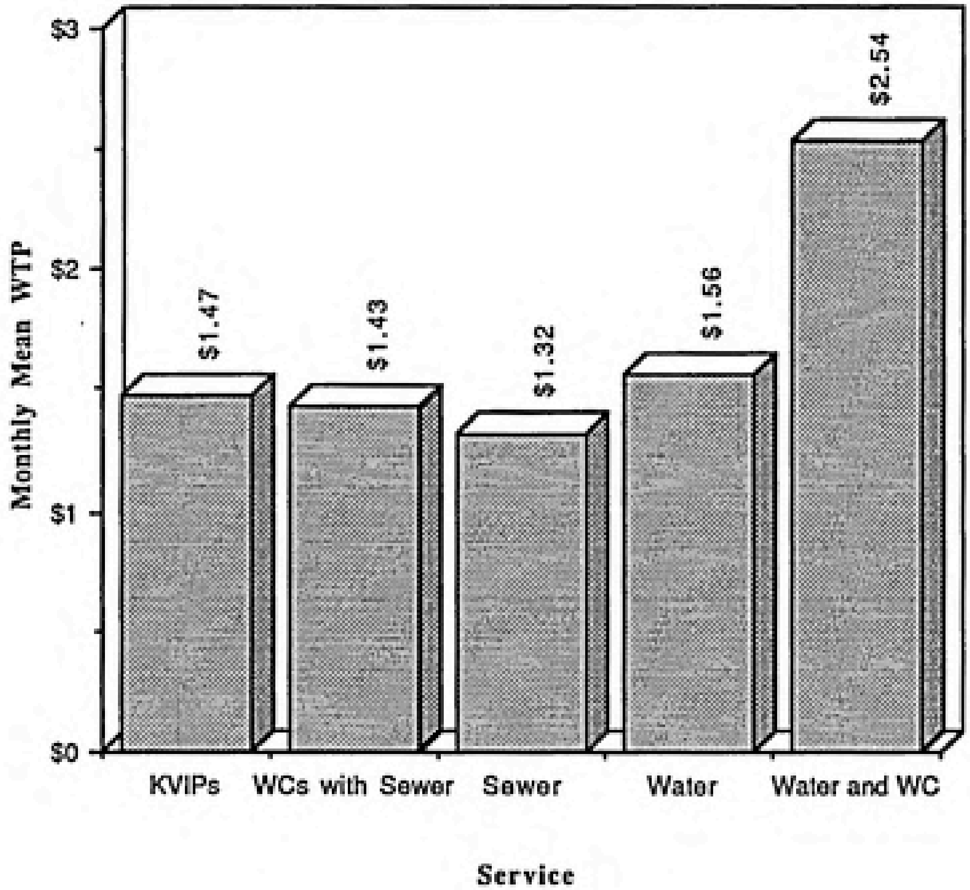
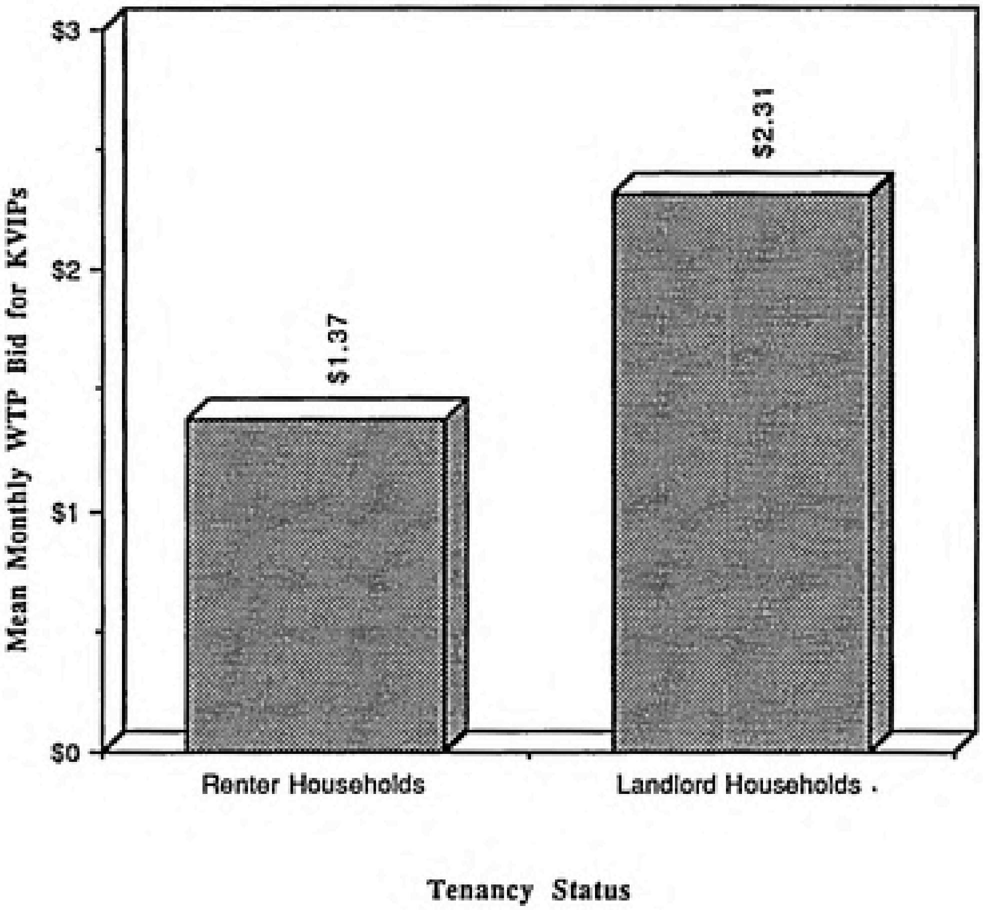


Table 2.2
Average Houshold WTP Based on Existing Sanitation

Existing Sanitation	Willingness to Pay (US $/month) For				
	KVIP	WC & Sewer	Sewer Connection	Water	WC & Water
			Households with Water		
Bucket Latrine	1.17	1.25	—	—	—
Public Latrine	1.57	1.67	—	—	—
Pit Latrine	1.26	1.33	—	—	—
WC	—	—	1.32	—	—
Other	1.25	1.27	—	—	—
			Households without Water		
Bucket Latrine	1.07	—	—	1.71	2.60
Public Latrine	1.51	—	—	1.12	1.90
Pit Latrine	1.72	—	—	1.61	2.72
Other	1.35	—	—	1.33	2.08
Mean	1.47	1.43	1.32	1.56	2.54

Figure 2.7 Mean Monthly WTP KVIP Bids of Renters and Landlords



Distribution of WTP Bids

The mean willingness to pay values presented in the last section are, by definition, the average amounts that the questioned households were willing to pay. Some households were willing to pay substantially less than the mean for sanitation service, and some households were willing to pay much more than the mean. The distribution of the WTP bids is very important and presents a clearer view of demand than do simple means.

Figure 2.8 shows the distribution of monthly household bids for KVIP service. Figure 2.9 shows the cumulative distribution. About 30 percent of the households questioned said they would be willing to pay at least $2.00 for monthly KVIP service. Fifty five percent were willing to pay an amount at least as large as the mean WTP bid, $1.47.

Figure 2.8 Distribution of Monthly KVIP WTP Bids

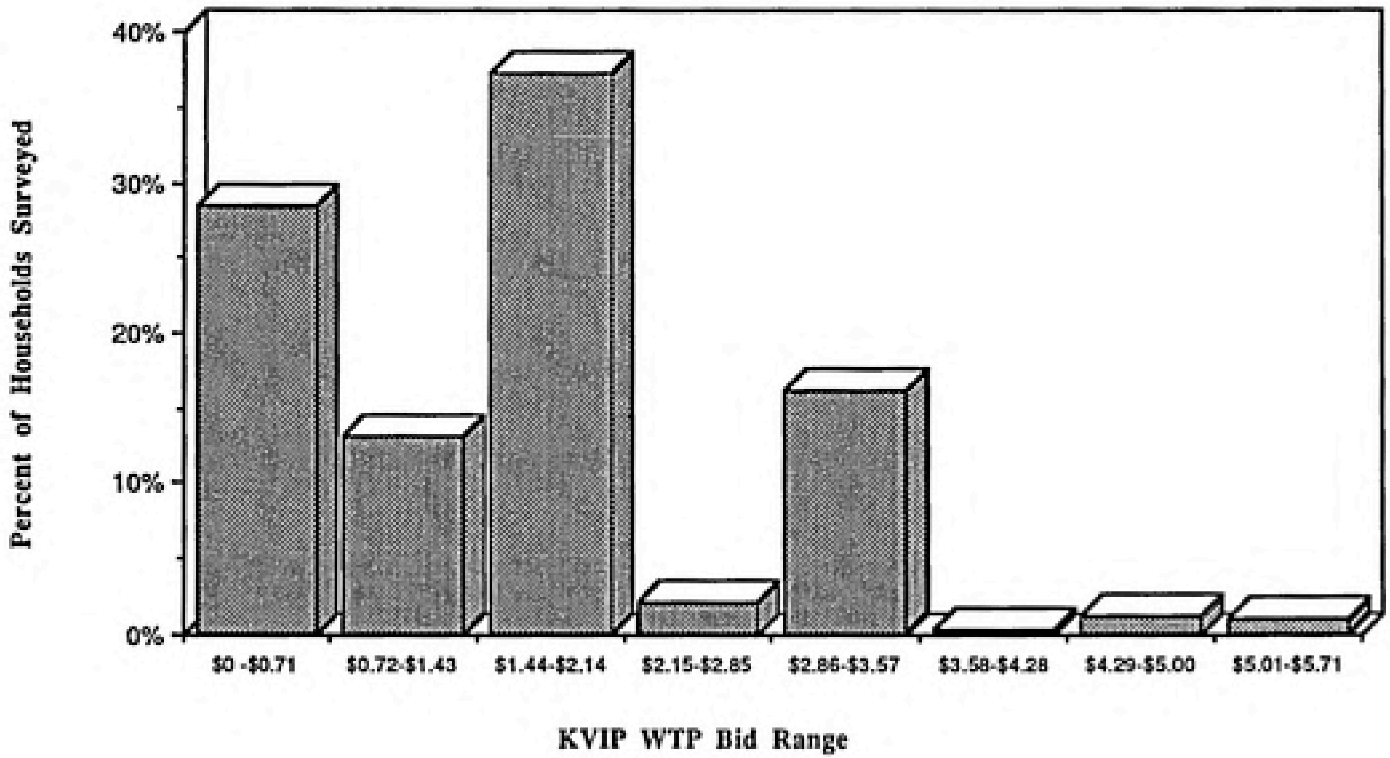
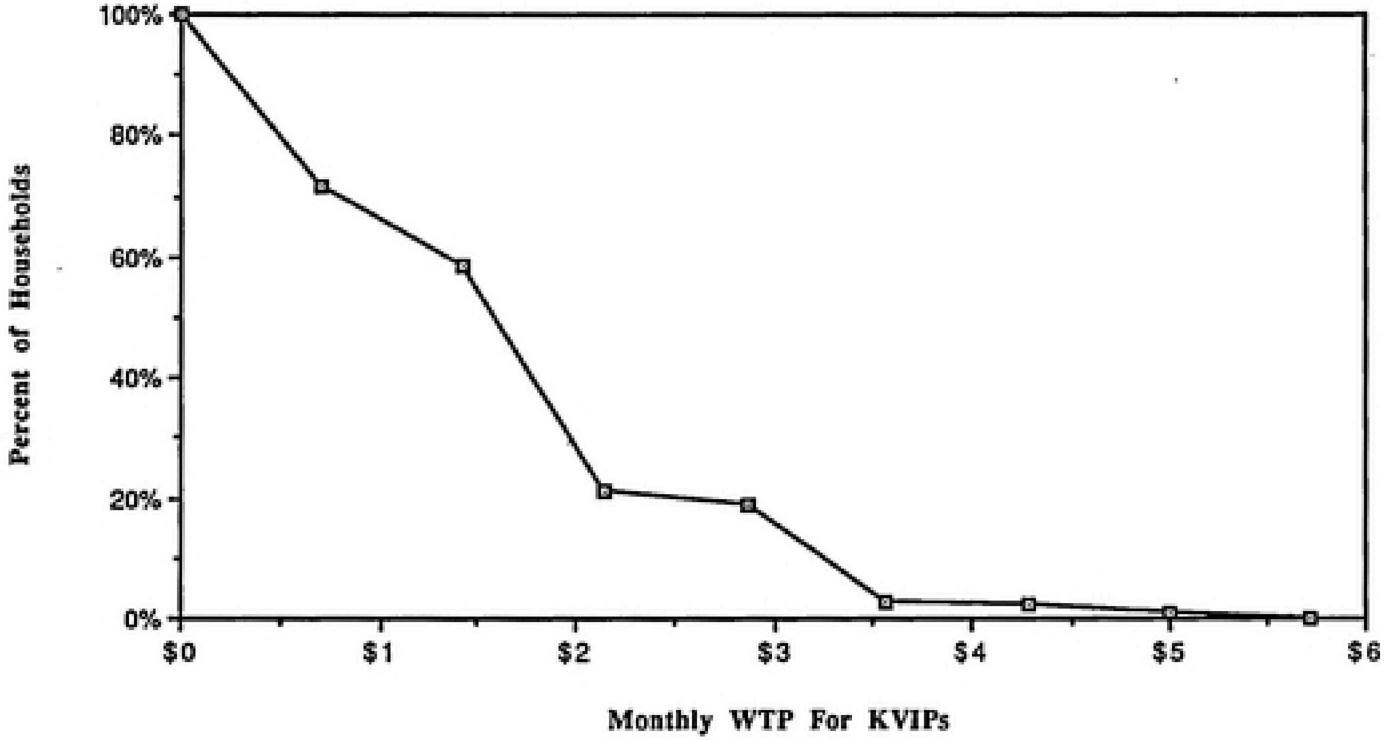


Figure 2.9 KVIP WTP Bid Cumulative Frequency Distribution



CHAPTER THREE: TWO MODELS THAT USE HOUSEHOLD WTP INFORMATION TO ESTIMATE THE SUBSIDIES REQUIRED TO PROVIDE KVIP SERVICE TO KUMASI HOUSEHOLDS

The question of this chapter is how to incorporate the results of the WTP study into sanitation planning. The process of using WTP information to improve the design and implementation of improved sanitation systems in Kumasi must begin by identifying specific questions which can be addressed using information from the WTP study. The answers to these questions can then help planners and engineers establish appropriate policies and design new systems. One such question presently facing planners in Kumasi concerns the use of subsidies to increase the number of KVIP latrines that are constructed in the city.

In order to improve Kumasi's existing sanitation situation, planners are recommending phasing out existing bucket latrines in private houses and apartment buildings and replacing most of them with KVIPs; those not targeted for KVIPs will be replaced with some form of piped sewerage systems (UNDP 1991). Many of the buildings currently relying on public latrines will also be targeted for private KVIP service. Will it require, for example, $3 million or, say, $10 million in subsidies to provide KVIPs to these households in Kumasi? If only, say, $2 million in subsidies are available, how should they be distributed to provide the most people with KVIPs? These are the types of questions of concern in this chapter.

The WTP information can be used in different ways to estimate different subsidies. This chapter presents two models for predicting the subsidy cost of providing KVIP coverage in Kumasi. The models differ in the manner in which they use information from the WTP study and the method in their assumptions about how the decisions are made to adopt KVIPs. The Household Decision Model (HDM) uses the distribution of household WTP bids to predict how many households will decide to adopt KVIP systems. Alternatively, the Building Decision Model (BDM) follows a different approach using mean WTP values from the WTP survey to predict the number of buildings that will construct KVIPs.

3.1 Household Decision Model

In various projects, information from household WTP studies has been used to estimate the number of households that would choose improved water and sanitation services at different prices or fees. Whittington *et al.* (1989) used this approach to estimate the number of households in Onitsha, Nigeria that would connect to a proposed piped water system at different water prices. Similar efforts have been made to predict the percentage of households that would adopt KVIP service at different flat monthly fees (Macoun 1990; World Bank 1991b).

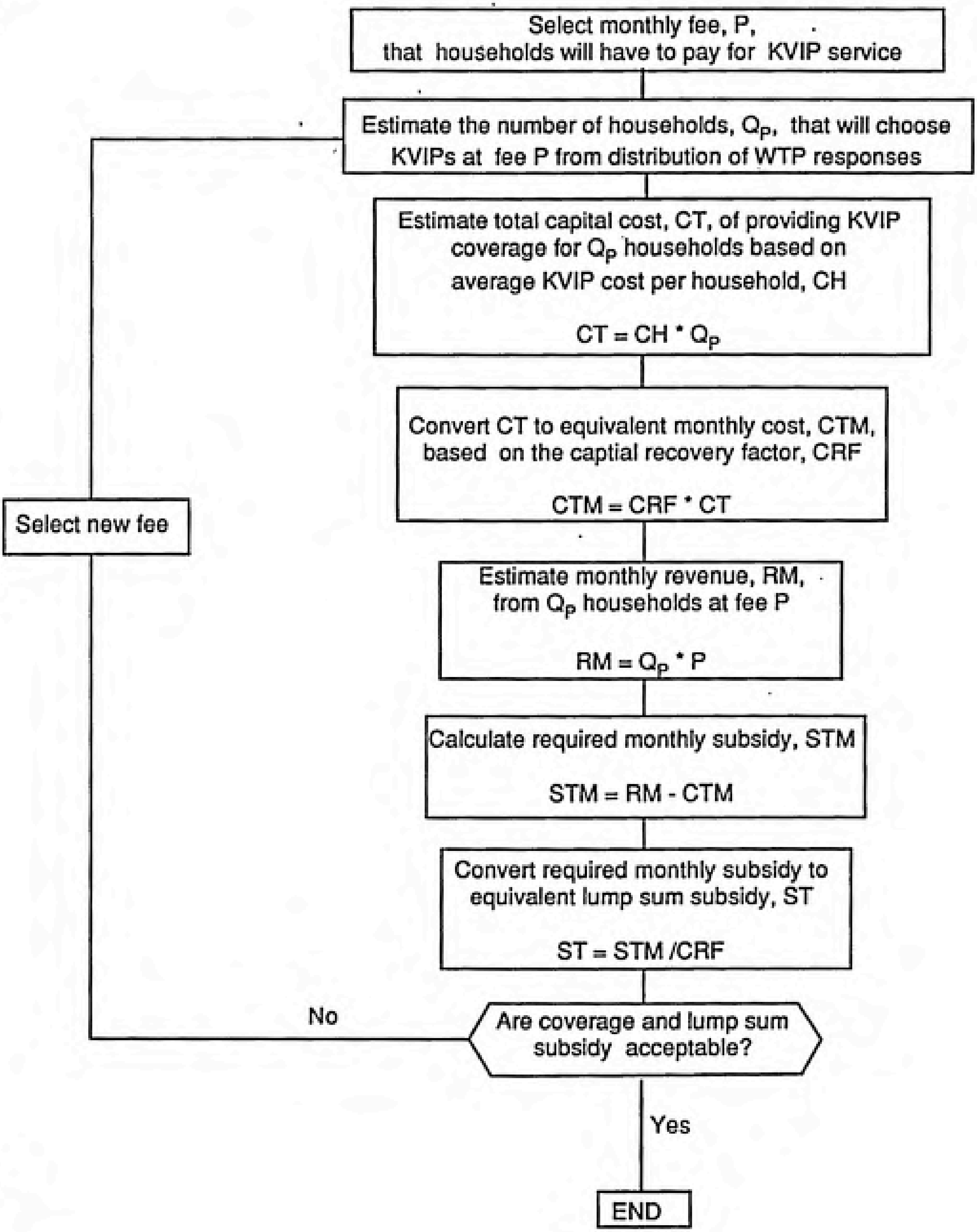
One of the fundamental assumptions behind previous methods of using household WTP information in coverage prediction models is that individual households have the power to decide whether or not to adopt a particular water or sanitation service. A model following this assumption can be developed to predict the costs and revenues of providing KVIP coverage in Kumasi. This model is referred to in this report as the Household Decision Model. The steps and procedure of applying this model are shown in figure 3.1 and described in the following sections.

If the results from the application of this model are to be used for policy decisions, it is important to consider the conditions and assumptions under which the approach accurately represents the situation in Kumasi. It is assumed that the municipal government/sanitation authority would finance the construction of KVIP latrines in buildings throughout the city. It is assumed that the city would borrow money to pay the initial cost. The city would repay the loan with revenues collected by charging households fixed monthly usage fees similar to those collected for water or electricity. Depending on their willingness to pay, individual households would choose whether or not to subscribe to the service at the fee set by the municipality.

3.1.1 Estimating the Number of Households that Would Adopt KVIPs

Of the 600,000 people in Kumasi, 150,000 have access to water closets and most likely would not consider switching

Figure 3.1 Household Decision Model



to latrines. Consequently, this group was not questioned about their WTP for KVIP latrines and is not represented in the cumulative frequency distribution describing KVIP demand. Given that 450,000 people are living in households without water closets and the average number of people per household is 4.6, approximately 98,000 households are candidates for KVIP service.

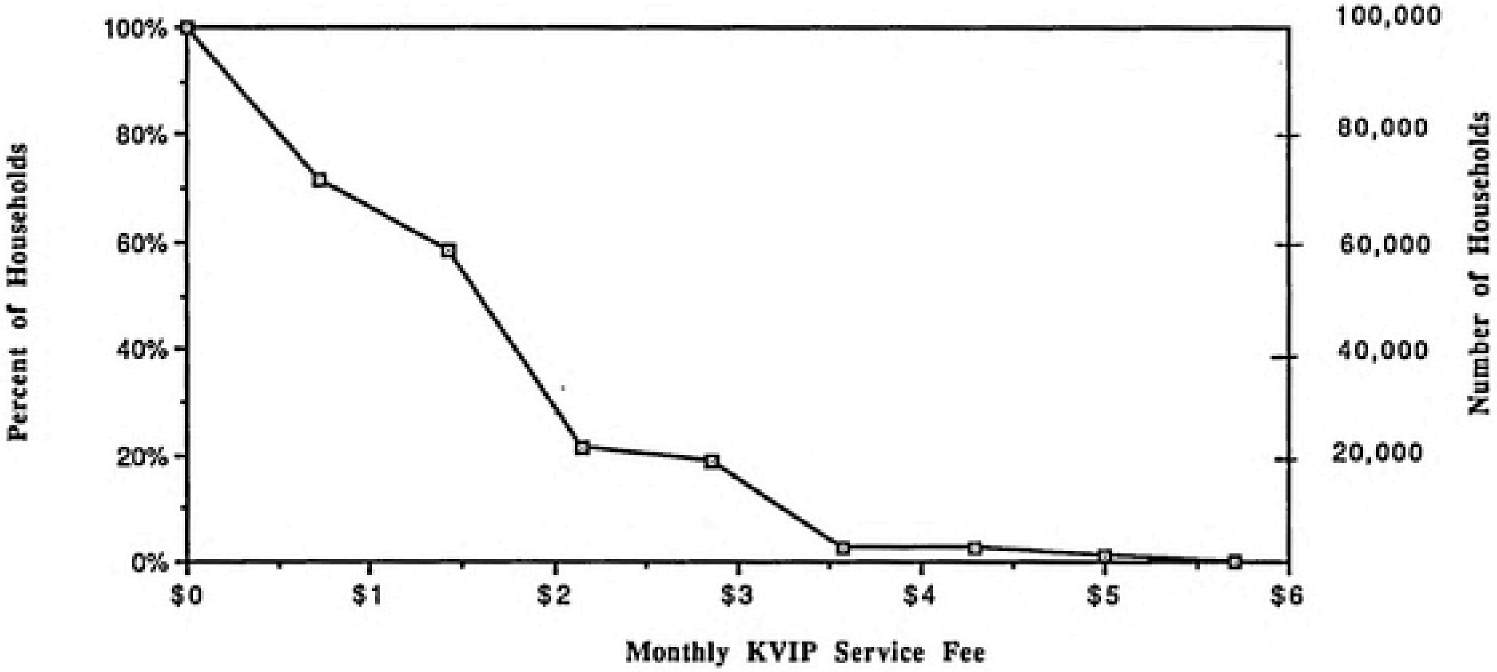
The number of households, Q_P, that would choose to be served by KVIPs at a monthly fee of P dollars can be calculated by multiplying 98,000 by the percent of households willing to pay the fee from Figure 2.9. If the monthly fee were set at $1.50, approximately 60 percent (59,000) of the households would adopt KVIPs (Figure 3.2). Only 30 percent of the candidate households (i.e. 29,000 households) would choose to be served if the fee were raised to $2.00. About 95 percent coverage (93,000 households) could be achieved with a fee of $0.30.

3.1.2 Approximating the Cost of KVIP Construction

Capital Cost

The provision of KVIP service to Kumasi's predominantly tenant population will require constructing latrines in apartment buildings. These latrines would be shared by different numbers of households depending on the size of the building. Calculating the exact cost of these systems requires information on the number of users that each

Figure 3.2 Percent and Number of Households*
that Would Choose KVIP Service at Different Fees



* Only Households with Existing Bucket Latrines or No Existing Sanitation Facilities are Candidates for KVIP Service

latrine will be designed for. It is impossible to discern from Figure 3.2, what size KVIPs will be required to provide KVIP service to the "served households." For example, serving the 30,000 households willing to pay at least $2.00 could require 15,000 latrines designed for two households or 6,000 latrines designed for five households. Under these conditions it is impossible to calculate the exact cost of providing KVIP coverage solely from the information from Figure 3.2.

An approximate estimate of the total capital cost of constructing KVIPS for a given number of households can be calculated using an assumed average household cost. Several alternative methods can be used to estimate the average cost of providing each household with KVIP service.

The simplest method of calculating average household cost is to divide the average cost of constructing a latrine by the number of households that it will serve. This method will have limited accuracy because the cost of a latrine will vary depending on the number of households it is designed for. The advantage of this method is that it requires very little information other than a few KVIP cost estimates.

A more precise estimate can be obtained by calculating the cost of constructing all the different sized latrines that would be necessary to serve all of the candidate households and dividing that number by the total number of candidate households. The disadvantage of this method is that it requires detailed information on the cost of constructing different sized latrines as well the number of different sized latrines that will be needed throughout the city.

Calculations based on the number of different sized KVIP systems that would need to be built throughout the city to serve all the buildings presently relying on public latrines or private bucket latrines lead to a total city wide cost of $5.1 million. Dividing this figure by 98,000 households leads to an approximate average cost per household of $52. The cost functions and calculations used to determine this estimate are presented in section 3.2.1 in connection with the BDM.

The approximate total capital cost of providing KVIP coverage to Q_p households is

$$\$52 * Q_p \qquad (3.1)$$

Monthly Cost After Financing

It is common practice for municipal governments to borrow money to finance the construction of water and sanitation projects. The financing terms vary depending on the funding source. The terms presently available from commercial banks in Kumasi are 30 percent over three years. It may be possible for the government to borrow money from international lending sources such as the World Bank at more favorable rates such as 10 percent over 20 years.

The monthly loan payments that Kumasi would be required to make to repay the construction loan of \$52 * Q_P is

$$\$52 * Q_P * CRF \quad (3.2)$$

where CRF is the monthly capital recovery factor based on the financing terms.

3.1.3 Calculating Required Subsidies

Monthly Subsidy

The city will use the revenue from the collection of the monthly KVIP service fees to pay the debt service for KVIP construction. It is unclear who will be responsible for paying the operation and maintenance costs of KVIPs. The description of the terms of payment in the bidding game section of the WTP questionnaire did not explicitly mention who would be responsible for operation and maintenance of the KVIPs. Some households may have assumed that the WTP bid they provided in the survey included the cost of maintaining the KVIPs, while others may have assumed they were only bidding for access to KVIPs and would still be responsible for any upkeep costs.

KVIPs must be desludged once every two years either by KVIP users or private cleaners resulting in minimum operation and maintenance costs. Because the operation and maintenance costs are low compared to the cost of repaying the construction loan, and uncertainty exists as to whether the bids include O&M costs, it is assumed that the city will use the revenue from the collection of the monthly KVIP service fees only to repay the KVIP construction loans and not for operation and maintenance costs. If the city offers KVIP service at a fee P, the monthly revenue it will collect is

$$\$P * Q_P \qquad (3.3)$$

For some levels of the fee, the revenue will not be sufficient to cover the monthly cost of repaying the loan, and subsidies will therefore be required. Subtracting the monthly revenue (Eq. 3.3) from the monthly cost of repaying the loan (Eq. 3.2) leads to a monthly required subsidy of

$$\$Q_P * (52 * CRF - P) \qquad (3.4)$$

Required Initial Lump Subsidy

The funds for subsidizing the construction of KVIPs could come from the general revenue fund of the city or they could be provided by an external donor. If an external organization was the source of subsidies, it may be more practical for that organization to contribute an initial lump sum subsidy at the beginning of the project rather than a stream of monthly or annual subsidies.

The required monthly subsidy can be converted to an initial lump sum subsidy using the monthly capital recovery factor. The required initial lump subsidy for a KVIP system provided to Q_P households at a monthly fee of P dollars is

$$\$Q_P * (52 - P/CRF) \qquad (3.5)$$

3.1.4 Applications of the Household Decision Model

Using the predictions from Figure 3.2 and Equations 3.1 and 3.5, it is possible to estimate the capital cost and subsidy cost of providing KVIP service to different percentages of the households at alternative fees.

Figure 3.3 shows the costs of KVIPs if the government pays for their construction with money borrowed from commercial banks at a rate of 30 percent over three years. For example, at a fee ($2.00/month) 30 percent of the population would choose KVIPs requiring an initial lump sum subsidy of approximately $250,000 in order to cover the $1.6 million total capital cost of construction. Alternatively, the provision of KVIPs to 50 percent of the households (at a fee of $1.55/month) would have a capital cost of $2.5 million, $1.0 million of which would need to be subsidized.

If Kumasi's government funded KVIP construction with money borrowed from an organization such as the World Bank at the more favorable rates of 10 percent over 20 years, the required monthly loan payments would be much lower. Under these financing terms, very little subsidization would be required because at most fees, the monthly collected revenue would more than cover the lower monthly loan payments (Figure 3.4). Without any subsidies, coverage could be provided to 80 percent of the households.

Figure 3.3 Captital Costs and Subsidy Costs of Providing KVIP Service
(Houshold Decision Model, i=30%, n=3 years)

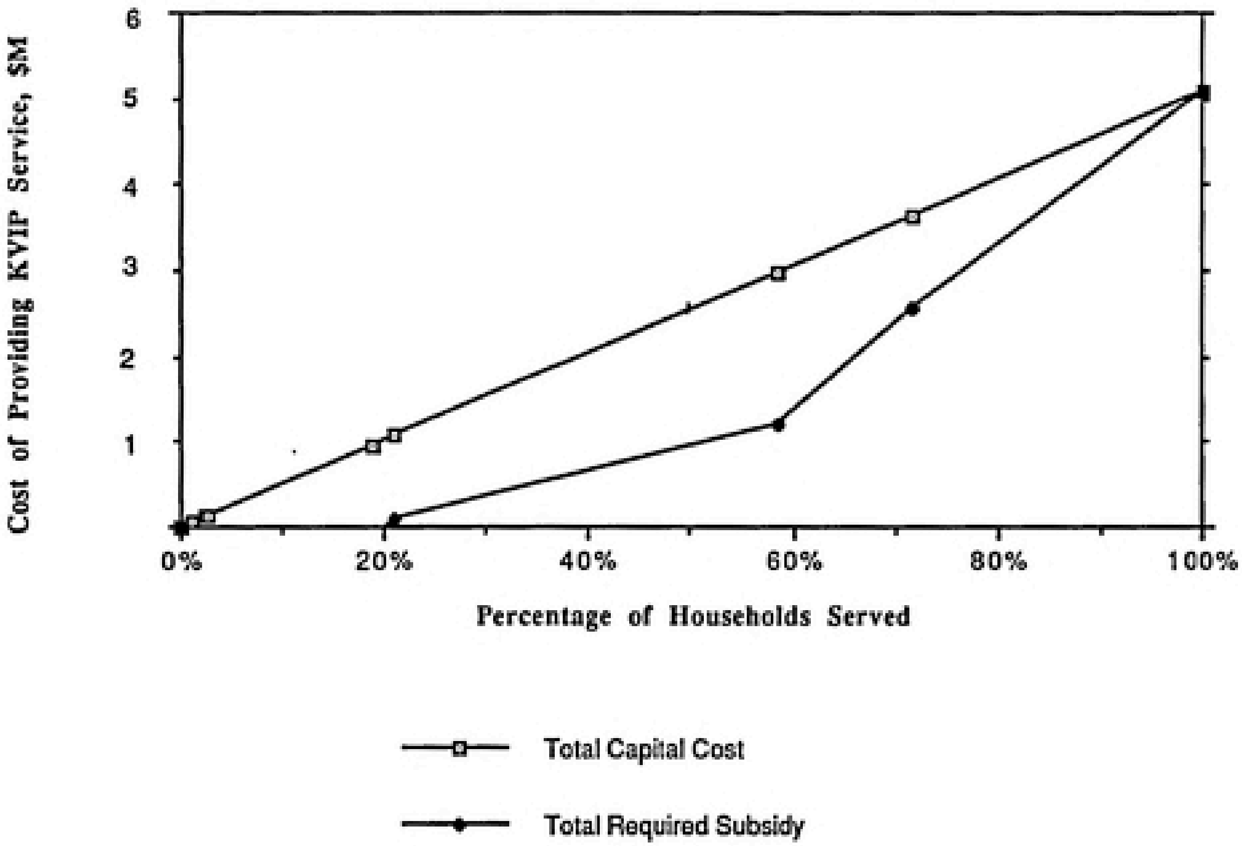
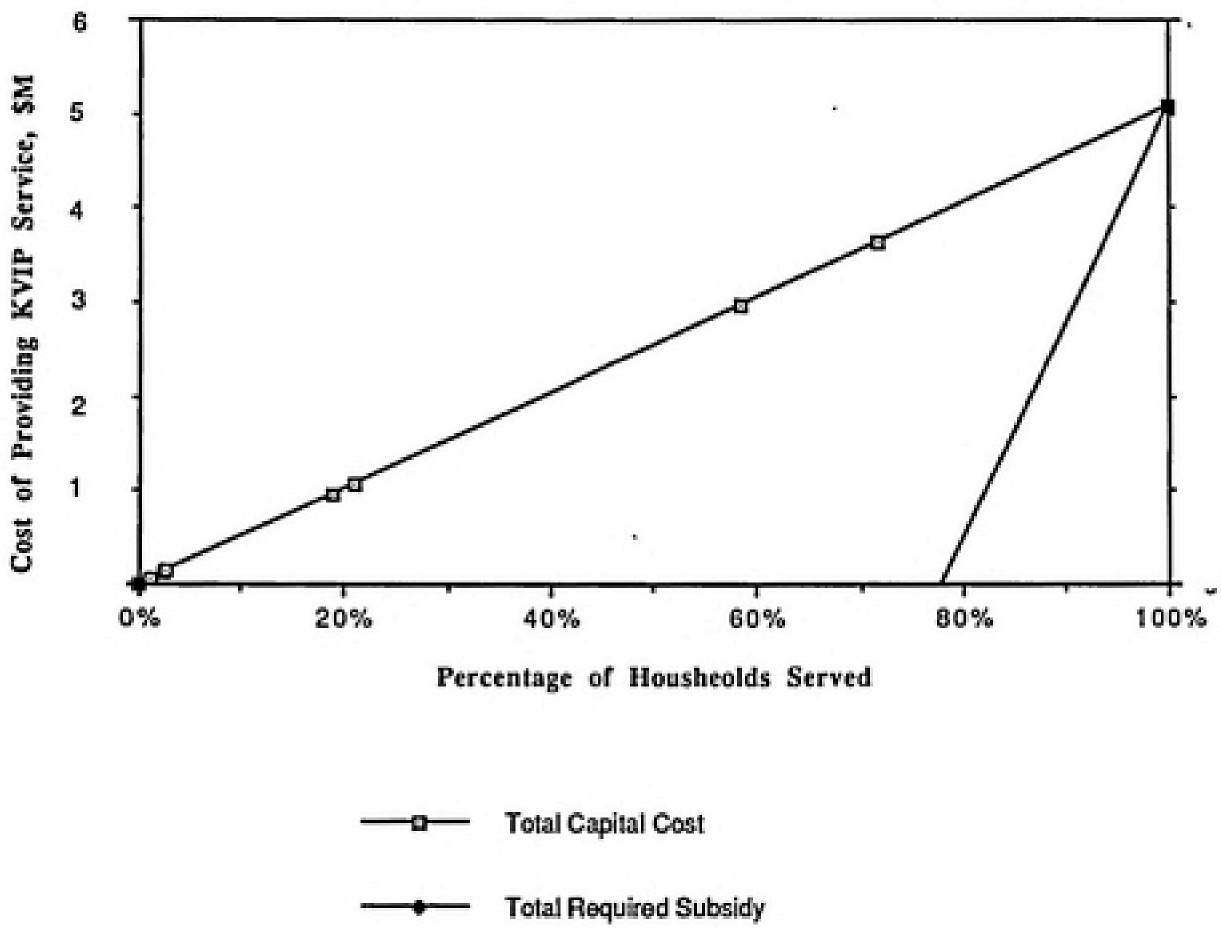


Figure 3.4 Capital Costs and Subsidy Costs of Providing KVIP Service (Household Decision Model, i=10%, n=20 years)



3.2 The Building Decision Model (BDM)

Little evidence exists to validate the assumption that individual households will control the decision whether or not to adopt KVIP service in Kumasi. The majority of Kumasi households are renters living in multi-family apartment buildings. In most cases, building owners, not the city or individual households, will probably decide whether or not to construct latrines in their buildings.

A more realistic scenario describing the potential provision of KVIP service in Kumasi than the one in the previous sections is to assume that building owners will borrow money to construct KVIP systems in their buildings. Some form of lump sum subsidy may be available to lower the amount that the landlords need to borrow. The landlords, presumably rational, will choose to construct KVIP latrines if the collective amount that the households living in the building are willing to pay on a monthly basis for KVIPs is greater than the monthly amount of money necessary to repay the building's KVIP construction loan.

The required monthly loan payments will vary from building to building based on the financing terms, initial construction costs, and level of subsidization. The number of households that will be served by the KVIP systems will depend on the number of buildings that have a WTP greater than their required monthly loan payments.

A methodology for estimating the capital cost and subsidization cost of providing KVIP coverage to different types of buildings is shown in Figure 3.5. This method is referred herein as the Building Decision Model.

3.2.1 Estimating the Cost of Constructing a Building KVIP System

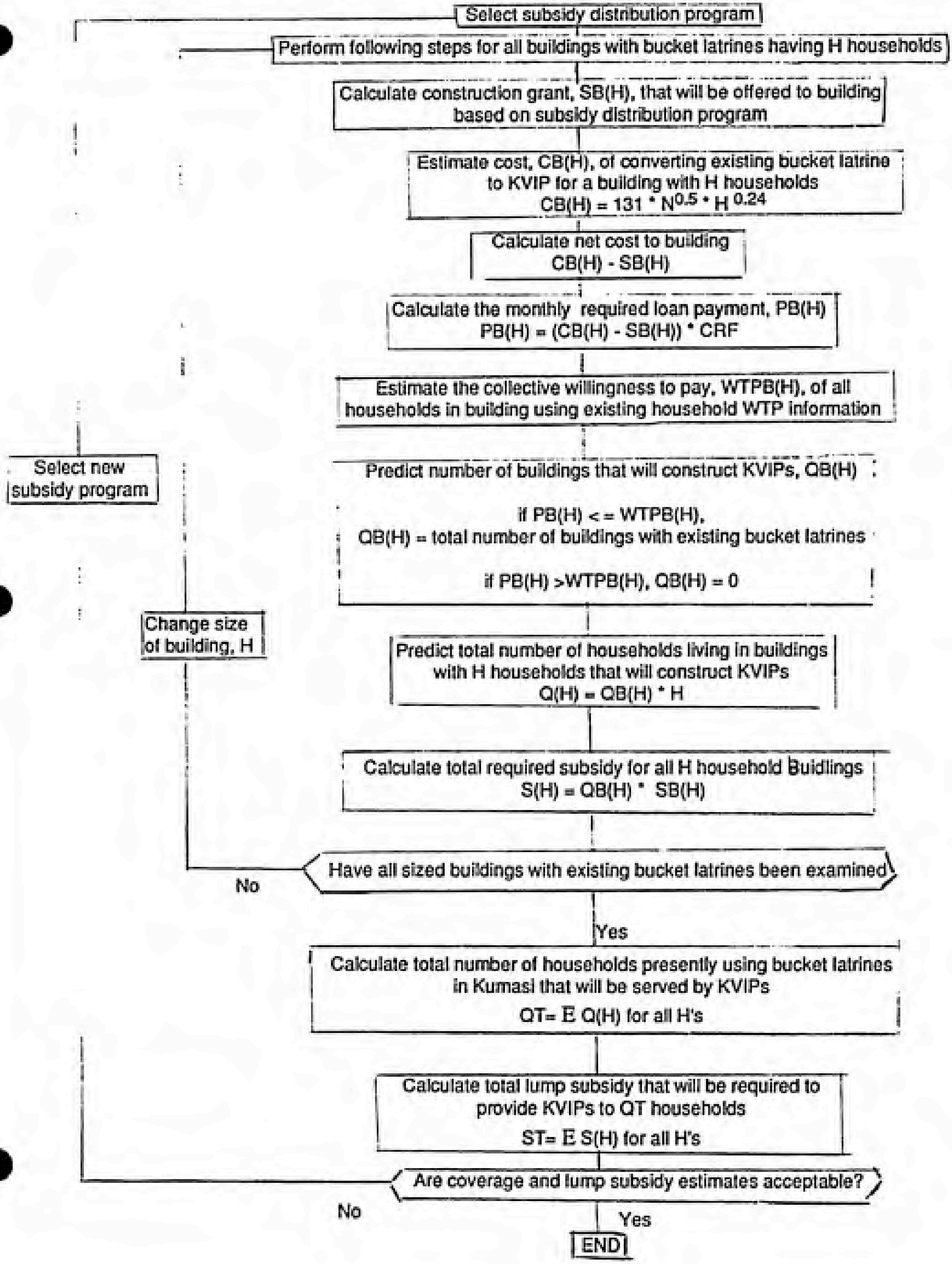
KVIP latrines consist of squatting or sitting compartments placed over a dual pit substructure. Generally one person can use a compartment at a time. Based on queuing considerations, a single compartment can serve up to 30 people or 6 households, seven to twelve households require a two-compartment system, and buildings with thirteen to eighteen households require three compartments. The size of the pit substructure under each compartment is based on the number of users.

New KVIP Systems

The World Bank has developed cost functions for KVIP latrines based on the unit prices of the material and labor required to construct different sized KVIPs (World Bank 1990). The cost in dollars, CB(H), of a KVIP system with N compartments serving a building with H households can be estimated from the following equation:

$$CB(H) = 218 * N^{0.5} * H^{0.24} \quad (3.6)$$

Figure 3.5 Building Decision Model (Buildings with Existing Bucket Latrines)



Upgrading Existing Bucket Latrines

Buildings with existing bucket latrines have latrine superstructures that can be converted for use in KVIP latrines. The cost of constructing KVIPs by upgrading bucket latrines is therefore less than the cost of constructing new KVIP latrines. Cost information from Kumasi shows that the cost of upgrading an existing bucket latrine is approximately 60 percent of the cost of constructing a new latrine such that

$$CBU(H) = 131 * N^{0.5} * H^{0.24} \qquad (3.7)$$

Using this equation to calculate the cost of upgrading a bucket latrine system presently serving a 10-household apartment building results in a predicted building cost of $322.

The Number of Buildings Requiring Different Types of KVIPs

Information was obtained from the sanitation study to estimate the number of different sized buildings in Kumasi that would require new KVIP systems and upgraded bucket latrine KVIP systems; the findings are shown in Table 3.1. Using the housing distribution in Table 3.1 and Equations 3.6 and 3.7, the total cost of constructing KVIPs in all buildings is calculated at $5.1 million (See Appendix C for complete calculations).

Table 3.1 The Number of Kumasi Buildings* Requiring Different Types of KVIP Latrines

Building Size (Number of HH living in Building)	Number of Buildings that Require New KVIPs (No existing latrines)	Number of Buildings that Require Upgrades (Existing bucket latrines)
1	807	1194
2	346	418
3	307	597
4	403	1344
5	184	836
6	230	597
7	99	580
8	274	627
9	166	438
10	369	597
11	220	445
12	230	179
13	106	248
14	107	273
15	69	231
16	79	105
17	68	56
18	90	66
19	30	94
20	46	66
21	5	51
22	58	54
23	10	5
24	29	5
25	14	0
26	0	28
27	9	0
30	4	0
31	0	4
32	14	7
34	0	4
35	0	3
37	0	16
44	3	3
45	0	5

* Does not inclule Kumasi buildings with existing WCs.

3.2.2 Calculating KVIP Subsidies Offered to Buildings

The method of calculating the total subsidy costs of KVIP coverage using the BDM depends on an assumption regarding how subsidies will be distributed. In the case of the Household Decision Model, it was assumed that subsidies would be provided to a central authority in order to offset the capital cost of constructing a city wide system of KVIPs. The Building Decision Model assumes that subsidies will be distributed to the owners of individual buildings.

One method for distributing subsidies to building owners is a program of lump sum construction grants based on the number of KVIP compartments built. This method would be fairly equitable and could be verified by visual inspection of the facilities during or after construction. Landlords of buildings requiring large multi-compartment KVIP systems would qualify for significantly higher subsidies than owners of relatively small buildings. Under this scheme, a building owner would receive SB(H) dollars after constructing a N-compartment KVIP system for H households such that:

$$SB(H) = SK * N \qquad (3.8)$$

where SK is a fixed subsidy per compartment ($ per compartment), and N is the required number of compartments to serve H households ($1 \leq H \leq 6, N=1$; if $7 \leq H \leq 12$, $N=2$, etc.). The fixed per compartment subsidy rate would be established by planners. If the subsidy level were set at, say, $60 per compartment, a landlord constructing a two-compartment latrine for a 10 household building would qualify for a $120 grant.

Some of the problems associated with a per compartment subsidy program are addressed in the next chapter wherein the Building Decision Model is used to evaluate other subsidy plans.

3.2.3 Calculating Net Monthly KVIP Cost After Subsidization

Due to the limited availability of capital in Kumasi, it is likely that building owners will borrow to pay for the construction of KVIP latrines in their buildings. The terms of the loan will depend on the funding source. It can be assumed that the sanitation authority could borrow money from an organization such as the World Bank at rates more favorable than those available at commercial banks. It can further be assumed that the sanitation authority would lend money directly to building owners or have a local bank administer a KVIP lending program. In either case, the government or participating banks would probably lend the money at higher rates than they acquired it in order to cover their operating costs and/or profit needs. Consequently, it is unlikely that individual building owners would qualify for rates much more favorable than the 30 percent over 3 years presently offered by Kumasi's commercial banks.

The monthly payment in dollars that a building owner would be required to make to repay a KVIP construction loan would depend on the initial construction cost, subsidy amount and financing terms as follows:

$$PB(H) = (CB(H) - SB(H)) * CRF \qquad (3.10)$$

where PB(H) is the monthly loan payment for a building with H households; CB(H) - SB(H) is the KVIP cost after subsidization that a building owner would need to borrow, and CRF is the capital recovery factor based on the financing terms.

3.2.4 Calculating Collective WTP of an Entire Apartment Building

A building with H households will probably construct a KVIP system if the collective monthly WTP of all households within the building is greater than the monthly cost of paying back the KVIP construction loan. Unfortunately, information on the WTP of individual buildings is unavailable. However, household WTP information from Kumasi's WTP study can be used to estimate the collective WTP of buildings by making certain assumptions regarding the behavior of households within a building.

One of the simplest methods of estimating the WTP of a building is to assume that each household within the building would be willing to pay an amount equal to an "average household WTP" calculated by averaging what all households in Kumasi said they would be willing to pay for KVIPs:

$$WTPB(H) = WTPH_{mean} * H \qquad (3.11)$$

where WTPB(H) is an estimate of what, collectively, the H households in an apartment building would be willing to pay for monthly KVIP service, and $WTPH_{mean}$ ($1.47) is the average amount all the households questioned in the WTP survey were willing to pay for monthly KVIP service. For example, a building with 10 households can be assumed to be willing to pay $14.70 a month for access to KVIP service. Unfortunately, no evidence exists to suggest that this method of calculating the collective WTP of households in an apartment building is valid. Accordingly, alternative assumptions leading to alternative methods of calculating building WTP are presented in the next chapter.

3.2.5 Estimating Number of Buildings that Choose to Construct KVIPs

The number of different sized buildings that will be able to construct KVIPs can be predicted by comparing the monthly collective amount that all the households in an apartment building would be willing to pay for KVIP service with the required monthly building loan payment. If the WTP of a building with H households is less than the required building loan payment, then it can be assumed that no owners of buildings with H households would decide to borrow money to construct KVIPs. If the WTP of a building is greater than the monthly required loan payment, all of the building of that type and size will build KVIPs. In mathematical terms,

$$\text{if } PB(H) > WTPB(H), \text{ then } QB(H) = 0 \qquad (3.12)$$

or if

$$PB(H) < = WTPB(H), \text{ then } QB(H) = B(H) \qquad (3.13)$$

where WTPB(H) is the WTP of a building with H households; PB(H) is the amount the building would have to pay each month to retire the initial loan; QB(H) is the number of H household buildings that would choose to construct KVIPs, and B(H) is the number of buildings with H households in Kumasi that are candidates for KVIP service (Table 3.1).

3.2.6 Aggregating Cost and Coverage Estimate for Entire City

Household KVIP Coverage

Calculating the total number of households that would gain access to KVIPs under different subsidy plans requires applying equations 3.6 to 3.13 to each group of similarly sized buildings that are candidates for new KVIPs and upgraded bucket latrine KVIPs. The total number of households that would gain access to KVIPs is the sum of all of the households living in buildings that decide to construct KVIPs as follows:

$$QT = {}_{H}\,[QB(H) * H] \qquad (3.14)$$

where QT is the total number of households that would be served by KVIPs, and QB(H) is the number of buildings with H households that decide to construct KVIPs.

City Wide Subsidy Cost

The calculation of the total lump sum subsidy cost of providing KVIPs throughout the city under a particular subsidy plan will depend on the number of buildings throughout Kumasi choosing to construct KVIPs such that:

$$ST = {}_{H} [QB(H) * SB(H)] \qquad (3.15)$$

where ST is the total lump sum subsidy in dollars distributed to all buildings deciding to construct KVIPs; QB(H) is the number of buildings with H households that decide to construct KVIPs, and SB(H) is the subsidy($) offered to an individual building with H households.

3.2.7 Applications of Building Decision Model

Example: Subsidy of $30 per Compartment

Table 3.2 shows the results of using the Building Decision Model to predict KVIP costs and coverage if a $30 per compartment subsidy is offered to landlords for constructing KVIP systems. The results are based on the assumption that money to build KVIPs will be available at terms of 30 percent over 3 years.

Groups of buildings with the same number of households requiring a specific type of KVIPs are analyzed individually. The results of all of the analyses are aggregated to estimate total city cost and coverage figures. For example, 307 buildings in Kumasi have three households that presently rely on existing bucket latrines. Serving

Table 5.2
Analysis: Building Decision Model
Subsidy Plan: $30 per KVIP Compartment
Financing Terms (i=30%, n=3 years)

Buildings with Existing Bucket Latrines (KVIP will be an Upgrade)

Building Size H	Number of Compartments N	# of Kum Buildings B	Bldg Cap. Cost CB	Building Subsidy SB	Required Min. Bldg. Pay. PB	Building WTP WTPB	Buildings w KVIPS CB	HH's Covered (CB*H) Q	City Cap Cost (CB*CB) C	Lump Sum City Sub. (CB*SB) S
1	1	807	$131	$30	$4.83	$1.47	0	0	0	0
2	1	348	$155	$30	$5.72	$2.93	0	0	0	0
3	1	307	$170	$30	$6.46	$4.40	0	0	0	0
4	1	403	$183	$30	$7.00	$5.86	0	0	0	0
5	1	184	$185	$30	$7.47	$7.33	0	0	0	0
6	1	230	$201	$30	$7.86	$8.79	230	1383	$46,298	$6,914
7	2	98	$298	$60	$10.80	$10.26	0	0	$0	$0
8	2	274	$305	$60	$11.25	$11.73	274	2188	$83,465	$16,420
9	2	166	$314	$60	$11.65	$13.19	166	1496	$52,230	$9,966
10	2	368	$322	$60	$12.02	$14.66	368	3687	$118,874	$22,125
11	2	220	$329	$60	$12.36	$16.12	220	2420	$72,436	$13,199
12	2	230	$336	$60	$12.66	$17.59	230	2765	$77,469	$13,827
13	3	106	$420	$90	$15.13	$19.05	106	1383	$44,651	$9,575
14	3	107	$427	$90	$15.46	$20.52	107	1496	$45,723	$9,630
15	3	69	$434	$90	$15.81	$21.99	69	1037	$30,037	$6,222
16	3	79	$441	$90	$16.12	$23.45	79	1267	$34,853	$7,130
17	3	68	$448	$90	$16.41	$24.92	68	1152	$30,347	$6,100
18	3	90	$454	$90	$16.70	$26.38	90	1613	$40,879	$8,064
19	4	30	$531	$120	$18.86	$27.85	30	576	$16,100	$3,629
20	4	46	$538	$120	$19.18	$29.31	46	922	$24,776	$5,531
21	4	5	$544	$120	$19.45	$30.78	5	115	$2,064	$658
22	4	58	$550	$120	$19.73	$32.25	58	1267	$31,886	$6,914
23	4	10	$558	$120	$20.00	$33.71	10	230	$5,579	$1,202
24	4	29	$562	$120	$20.26	$35.18	29	691	$16,177	$3,457
25	5	14	$634	$150	$22.21	$36.64	14	348	$8,767	$2,074
27	5	9	$648	$150	$22.75	$39.57	9	230	$5,513	$1,290
30	5	4	$662	$150	$23.51	$43.97	4	115	$2,544	$576
32	6	14	$757	$180	$25.56	$46.90	14	461	$10,615	$2,583
44	8	3	$918	$240	$31.14	$64.49	3	115	$2,406	$629
						Totals:	2230	26963	$804,243	$157,740

Buildings Without Existing Latrines (New KVIPs Required)

Building Size H	Number of Compartments N	# of Kum Buildings B	Bldg Cap. Cost CB	Building Subsidy SB	Required Min. Bldg. Pay. PB	Building WTP WTPB	Buildings w KVIPS CB	HH's Covered (CB*H) Q	City Cap Cost (CB*CB) C	Lump Sum City Sub. (CB*SB) S
1	1	1184	$218	$30	$8.62	$1.47	0	0	0	0
2	1	418	$257	$30	$10.42	$2.93	0	0	0	0
3	1	597	$283	$30	$11.83	$4.40	0	0	0	0
4	1	1344	$304	$30	$12.56	$5.86	0	0	0	0
5	1	836	$320	$30	$13.33	$7.33	0	0	0	0
6	1	597	$335	$30	$13.99	$8.79	0	0	0	0
7	2	580	$491	$60	$19.79	$10.26	0	0	0	0
8	2	627	$507	$60	$20.52	$11.73	0	0	0	0
9	2	436	$522	$60	$21.18	$13.19	0	0	0	0
10	2	587	$535	$60	$21.81	$14.66	0	0	0	0
11	2	445	$548	$60	$22.37	$16.12	0	0	0	0
12	2	179	$558	$60	$22.90	$17.59	0	0	0	0
13	3	248	$698	$90	$27.90	$19.05	0	0	0	0
14	3	273	$711	$90	$28.48	$20.52	0	0	0	0
15	3	231	$722	$90	$29.02	$21.99	0	0	0	0
16	3	105	$734	$90	$29.54	$23.45	0	0	0	0
17	3	56	$745	$90	$30.03	$24.92	0	0	0	0
18	3	66	$755	$90	$30.51	$26.38	0	0	0	0
19	4	94	$883	$120	$35.01	$27.85	0	0	0	0
20	4	66	$894	$120	$35.51	$29.31	0	0	0	0
21	4	51	$904	$120	$35.99	$30.78	0	0	0	0
22	4	54	$915	$120	$36.46	$32.25	0	0	0	0
23	4	5	$924	$120	$36.91	$33.71	0	0	0	0
24	4	5	$934	$120	$37.35	$35.18	0	0	0	0
28	5	29	$1,084	$150	$41.96	$36.11	0	0	0	0
31	6	4	$1,218	$180	$47.55	$45.44	0	0	0	0
32	6	7	$1,226	$180	$47.87	$46.90	0	0	0	0
34	6	4	$1,243	$180	$48.60	$49.83	4	115	$4,369	$632
35	6	3	$1,252	$180	$48.20	$51.30	3	115	$4,273	$614
37	7	16	$1,371	$210	$53.26	$54.23	16	587	$22,124	$3,360
44	8	3	$1,526	$240	$58.08	$64.49	3	115	$4,147	$652
45	8	5	$1,536	$240	$58.46	$65.96	5	230	$6,153	$1,274
						Totals:	31	1194	$43,066	$6,562

City Wide Totals

Total Households Covered:	QHT = 26,963 + 1,194 = 28,157
Total Capital Cost:	CT = $804,243 + $43,066 = $847,309
Total Subsidy Cost:	ST = $157,740 + $6,562 = $164,302

each of these buildings would require a one-compartment upgraded bucket latrine KVIP system costing $170. Each building would qualify for a lump sum subsidy of $30 dollars. Borrowing the remaining $140 necessary to upgrade to a KVIP would result in monthly required loan payments of $6.45 for each building. Since the buildings of this type only have an estimated aggregate WTP of $4.40, it follows that none of these type buildings would construct KVIP systems.

Both the capital cost and building WTP for KVIPs increases as the number of households within a building increases. Because of the economies of scale of KVIP construction, the cost of construction rises slower than the aggregate WTP of a building, resulting in smaller buildings being less likely to construct latrines than larger ones.

The method of calculating the aggregate WTP of all households in a building leads to the same WTP for KVIP service in buildings that require new KVIPs as in buildings of the same size with existing bucket latrines that require cheaper upgrades. Buildings requiring upgrades need at least 6 households to have a collective WTP greater than the required monthly loan payment. Only very large buildings (at least 34 households) requiring new KVIPs will have a aggregate WTP high enough to cover the required monthly loan payments. The significance of the predictions concerning what type of building will and will not be served under a given subsidy plan will be discussed in the next chapter.

If a $30 per compartment subsidy plan were offered, the model predicts that 27,000 Kumasi households living in buildings with bucket latrines will be served by KVIPs at a capital cost of $800,000 and a subsidy cost of $158,000. The same plan will lead to 1,200 households living in buildings without latrines gaining access to KVIP systems at a total capital cost of $43,066 and a total subsidy cost of $6,562. In total, a $30 per compartment subsidy plan would provide coverage to approximately 30 percent of the households that are candidates for KVIPs at a total subsidy cost of $164,000.

Coverage Estimates Using Different Per Compartment Subsidy Rates

Figure 3.6 shows the effects of different per compartment subsidy rates on the percent of Kumasi households presently relying on public latrines or private bucket latrines that would be served by KVIPs. Fifty percent coverage would require subsidies to be set at $80 per compartment. A $180.00 subsidy would lead to 95 percent coverage.

The provision of KVIP latrines for 95 percent of the city would cost $4.8 million, $3.8 million of which would need to be subsidized (Figure 3.7). A total city subsidy of one million ($100/compartment) would lead to coverage of 55 percent of the households. Without subsidies, 18 percent of the population would be covered.

Figure 3.6 Expected KVIP Coverage Under Different Per Compartment Subsidy Rates (Building Decision Model, i=30%, n=3 years)

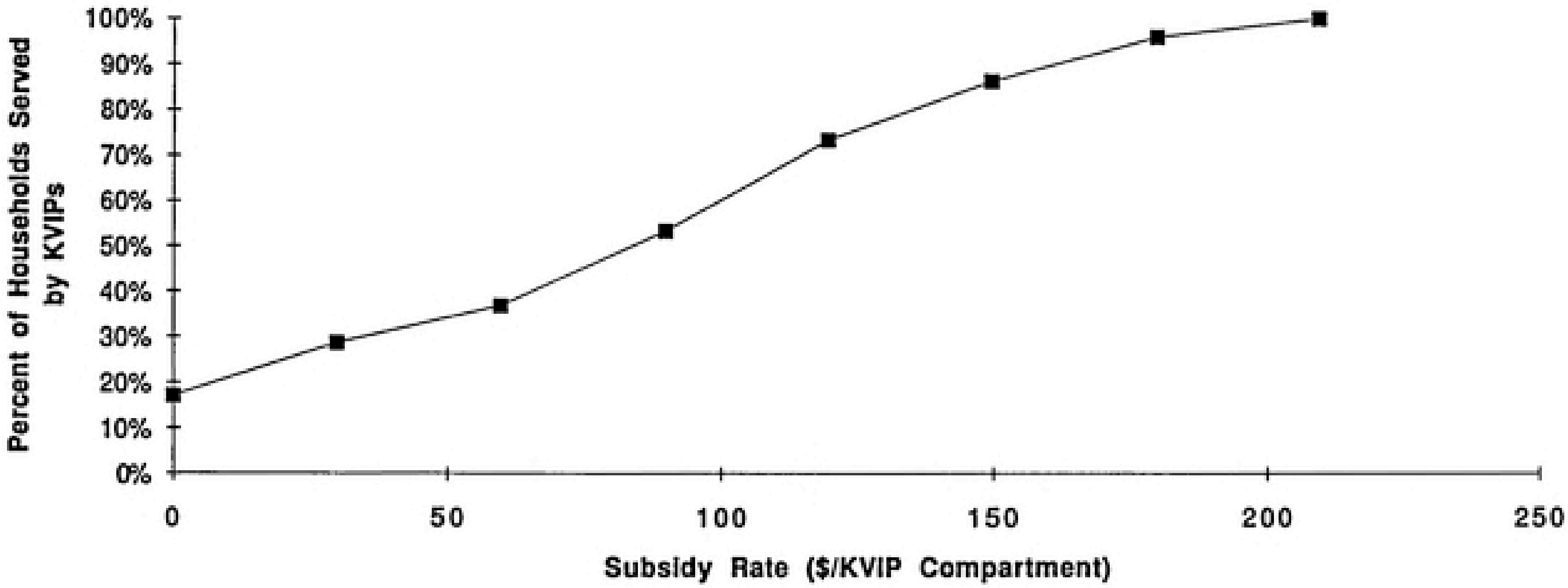
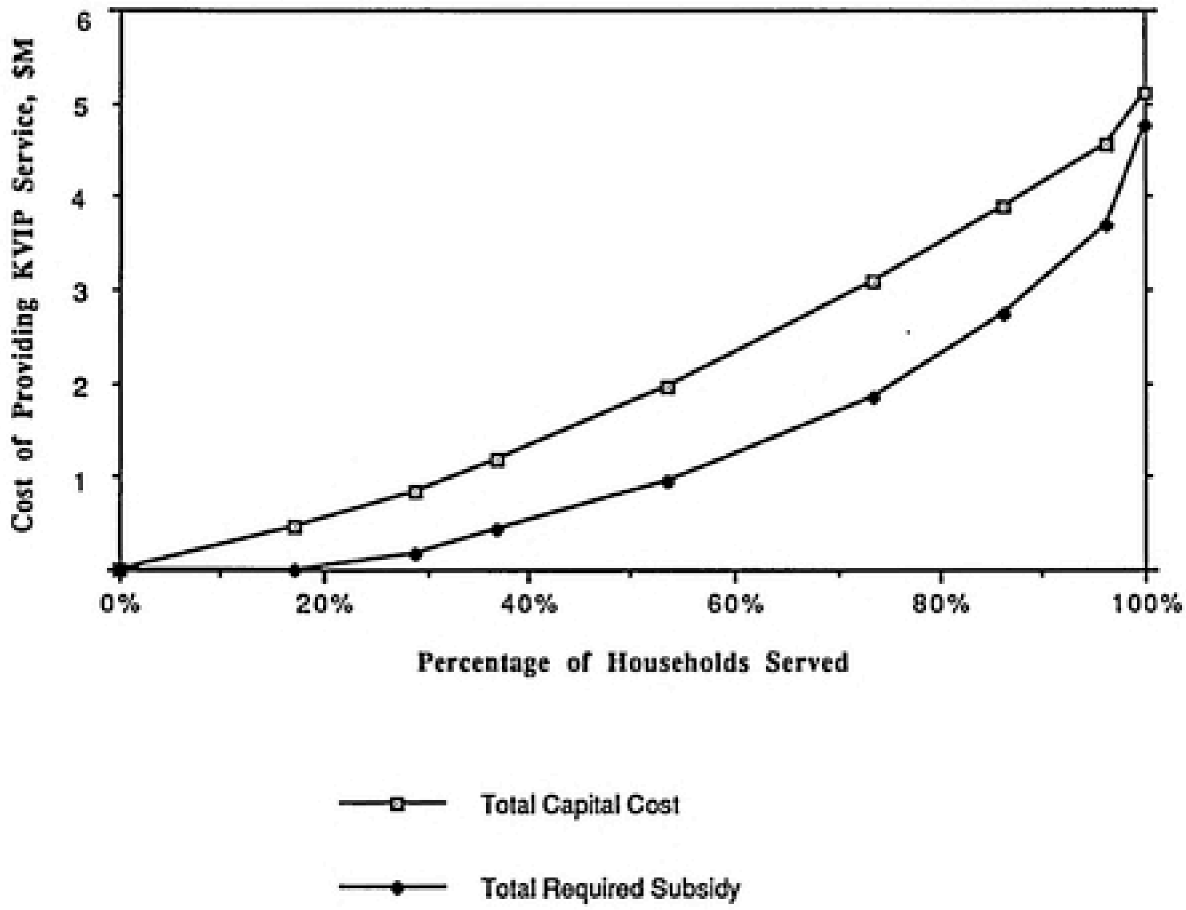


Figure 3.7 Captital Costs and Subsidy Costs of Providing KVIP Service (Building Decision Model, Per Compartment Subsidy Plan, i=30%, n=3 years)



CHAPTER FOUR:
EXAMINATION AND DISCUSSION OF THE BUILDING DECISION MODEL AND THE HOUSEHOLD DECISION MODEL

The models presented in Chapter Three are capable of generating numerous sets of predictions describing the potential outcome of various KVIP subsidy plans and policies. The ability to produce estimates does not necessarily guarantee that the models are accurate planning tools. Therefore, before planners base policy decisions on the predictions generated though the application of these models, the validity of the approaches must be examined more closely.

A common method of "testing" a model is to compare its predictions with data describing the actual outcome that the model is attempting to predict. Performing this type of test on the models presented in this paper would require actual data on the number of households and buildings that have chosen to adopt KVIP service at different fees and under different subsidy programs. Unfortunately, this type of data is presently unavailable because KVIPs have only recently been introduced in Kumasi.

Although it is impossible to formally test the accuracy of the models' predictive abilities, policy makers can gain a better understanding of the strengths and limitations of the models by examining the assumptions behind their development and the sensitivity of the model predictions to changes in the assumptions. An understanding of the models' underlying assumptions will guide planners in deciding when and how to use the models' predictions and in some cases how much confidence to place in them.

4.1 Use of the Household Decision Model and the Building Decision Model

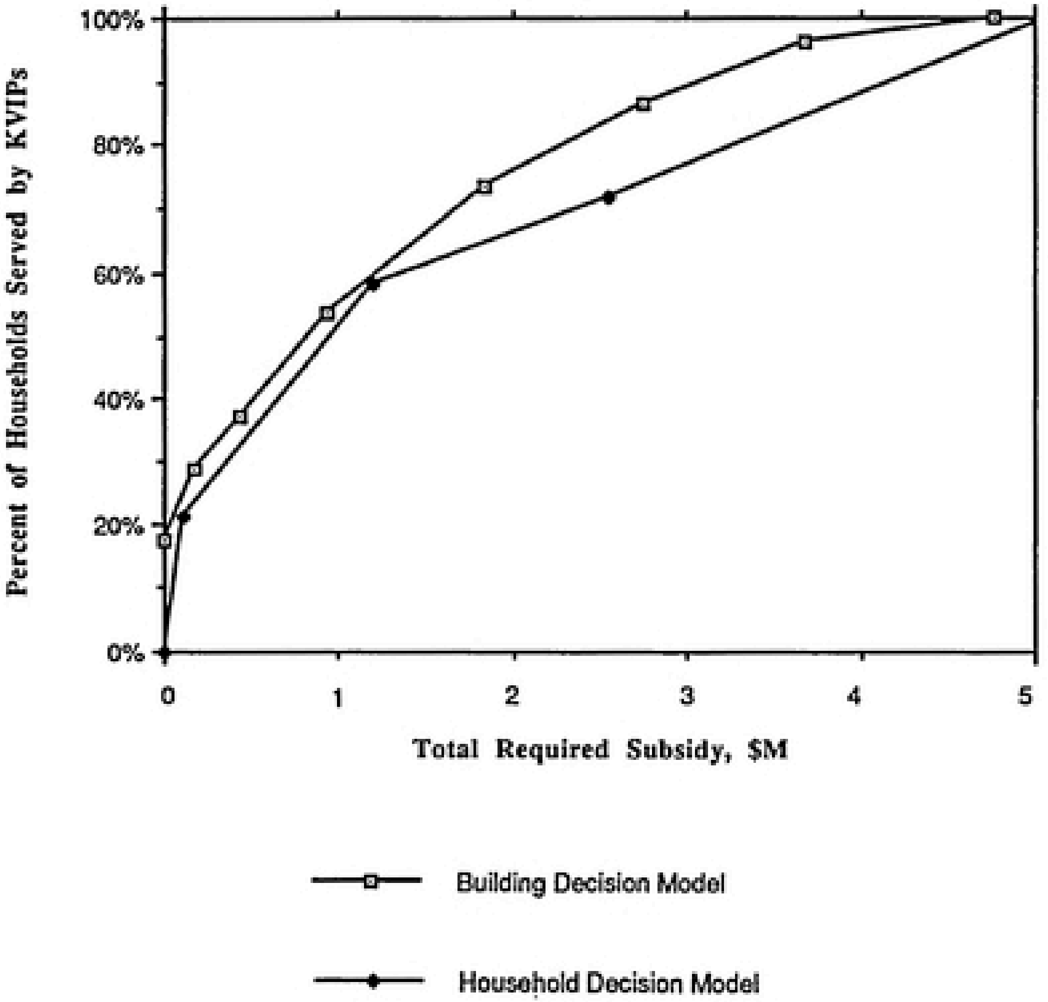
4.1.1 Results of Applying the Two Models

Figure 4.1 shows the predicted KVIP coverage rates using the Household Decision Model and the Building Decision Model. The subsidy calculations for the Building Decision Model are based on a per KVIP compartment subsidization plan. The financing terms are 30% over 3 years.

The predicted required subsidy cost of providing KVIP coverage for up to 60 percent of the households is very similar for both models. For example, both models predict KVIP service could be provided to 50 percent of the households for a total subsidy of about $900,000.

The two models' predictions of the subsidies required for providing higher than 60 percent coverage rates are significantly different. The HDM predicts a total required subsidy cost of $4.8 million to obtain 95 percent coverage while the BDM predicts the same level of coverage would require only $3.6 million. One of the reasons for this difference is that the Building Decision Model assumes the decision to adopt KVIPs is a function of the aggregated WTP

Figure 4.1 Application of Household Decision Model and Building Decision Model (i=30%, n=3 years)



of multiple households within a building. By aggregating households in a building, the influence of households with very low WTP is diminished because the other households in the building with a greater WTP for KVIP service prevent the collective WTP of the building from being unusually low. Assumptions regarding the actual collective behavior of households within a building are discussed later in this chapter.

4.1.2 Use of the Two Models in the Planning Process

Which model should be considered in making policy decisions? The underlying assumptions of the BDM are believed to more accurately represent the situation in Kumasi. The Household Decision Model would be more appropriate in a situation where, rather than in multi-family apartment buildings, individual households would have the power to decide whether or not to construct KVIPs. Although not the case in Kumasi, this type of housing situation is very common in many parts of Africa.

The BDM can provide more specific information regarding the actual implementation of KVIPs. For example, both models can predict the percentage of households that would be covered at different total subsidies, but only the BDM can predict which types of buildings will and will not be able to construct KVIPs at different total subsidies.

Information concerning partial coverage can be very useful to planners, since in many cases providing specific groups of households with KVIPs may be more important than simply providing the largest number of households with KVIPs. For example, providing new KVIPs to households in Kumasi without existing facilities may be given priority over providing upgraded KVIPs to households with existing bucket latrines. If this is the case, the BDM can be used to test the effectiveness of alternative subsidy plans designed to favor the construction of KVIPs in buildings without existing latrines.

Despite its limitations in modeling the actual situation in Kumasi, the HDM does have some advantages over the BDM. The BDM methodology is complex and its application requires making more assumptions than are required for the application of the HDM. Unlike the BDM, the HDM can use WTP information to generate coverage estimates quickly without the need to obtain additional information such as the distribution of buildings with different numbers of households and different types of sanitation systems. Overall, the HDM provides a fairly simple method of generating rough subsidy estimates quickly, while the BDM provides a more complex method of generating estimates that are presumably more precise.

4.2 Two Subsidy Distribution Plans for Use in the Building Decision Model

Use of the Building Decision Model requires making an assumption as to how subsidies will be distributed to individual buildings. In order to use the BDM to produce estimates of the total required subsidy, it is necessary to model the distribution of subsidies in a realistic manner.

The actual subsidy plan to be offered in Kumasi will be chosen based on several criteria. First, subsidies will need to be distributed in a way that insures that the subsidy a building receives is proportional to the number of households living in it. A large apartment building with 20 households should get a larger subsidy than a building with two households.

Another important concern in choosing a subsidy plan is that it should be easy to implement. The plan should be designed in a manner that allows authorities to easily and honestly calculate the amount of subsidy to which a building is entitled. Once calculated, it should be easy for the subsidy provider to distribute the subsidies to the proper beneficiaries.

Alternative subsidy plans meeting the above criteria can be evaluated by using the BDM to predict the number of households gaining access to KVIPs for a given total subsidy amount distributed under different plans.

4.2.1 Per Compartment Subsidy

The BDM results presented in the previous sections are based on the assumption that the subsidy given to a building depends on the required number of KVIP compartments in the building (Eq. 3.8). One of the justifications for this scheme is that the number of compartments can be easily verified by inspection to insure that the subsidies are distributed properly. An alternative method of distributing subsidies such as the use of a fixed per household or per user subsidy amount, would be more difficult to implement. It is much easier to see and count the number of KVIP compartments in a building than it is to count the number of households or individuals "served" in the building.

Although it may be easy to count the number of compartments built, a per compartment subsidy scheme could still pose implementation problems. It may not be feasible to inspect every KVIP system constructed, and dishonest landlords might claim to have constructed more compartments than were actually built. Another disadvantage is that the number of compartments constructed and therefore the amount of subsidy offered does not increase directly with the number of households served. For example a seven household building requiring a two compartment KVIP would be entitled to the same subsidy as a 12 household building requiring a two compartment KVIP with much larger and more expensive pits.

4.2.2 Subsidizing a Percentage of KVIP Capital Cost

One alternative to a plan based on the number of compartments is to subsidize a percentage of the capital cost of KVIP construction. Instead of setting a per compartment subsidy rate, planners would need to establish a percentage of the capital cost that the government or an external aid organization was willing to cover. For example, if it were decided to subsidize 50 percent of the cost of KVIP construction in buildings throughout the city, a landlord constructing a new KVIP system for 10 households costing $565 would only be responsible for paying $282. In mathematical terms,

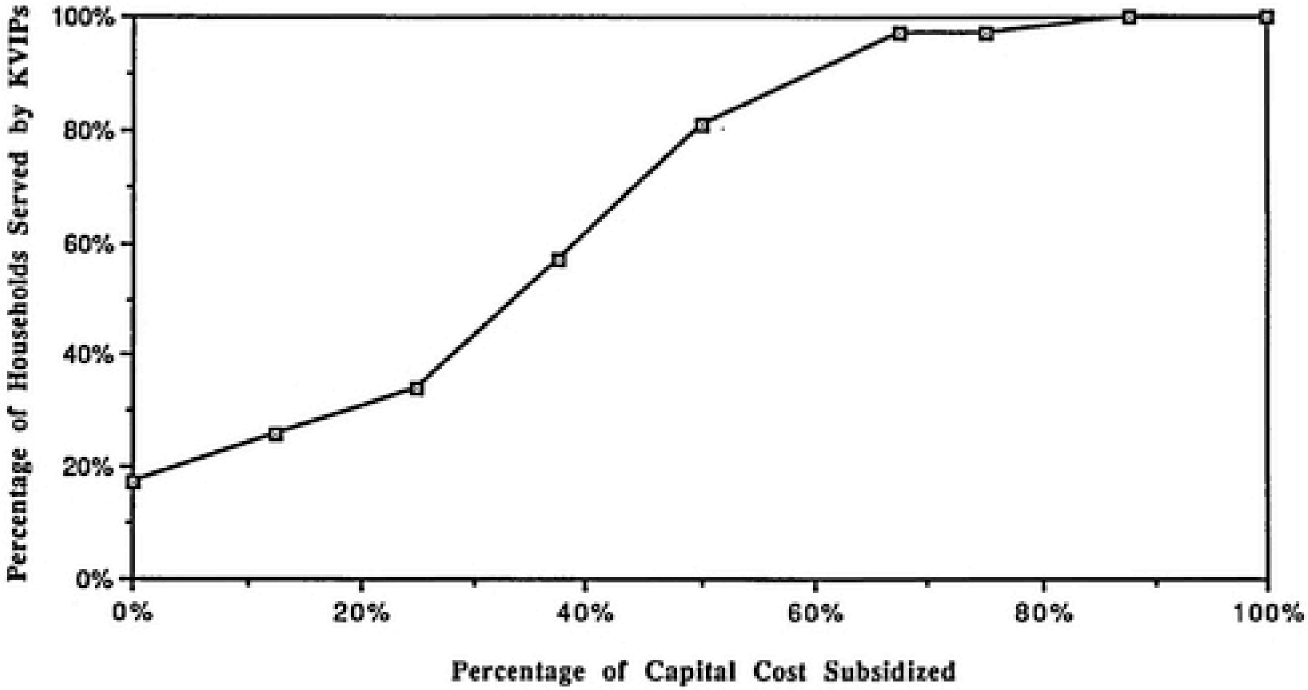
$$SB(H) = f * CB(H) \tag{4.1}$$

where SB(H) is the lump sum building subsidy($), f represents the percent of the cost that is to be subsidized, and CB(H) is the unsubsidized capital cost of constructing a KVIP system for the building.

Figure 4.2 shows the percentage of households that would be served by KVIPs based on the percentage of the capital cost that is covered by subsidies. For example, if building owners are offered subsidies equal to 35 percent of the cost of KVIP construction, the BDM predicts that 55 percent of the households that are candidates for KVIPs would use them. The prediction is based on the assumption that money for the construction of the latrines could be borrowed at terms of 30 percent over 3 years. Subsidizing 70 percent of the capital cost would lead to 95 percent KVIP coverage.

This method of subsidization is also not immune to corruption as landlords or dishonest building contractors could over report the construction cost. Under either a

Figure 4.2 Percentage of Households Served if Subsidies are Distributed as a Percentage of KVIP Capital Cost



subsidy plan based on compartments or a percentage of capital cost, it may be necessary to enact regulations governing the maximum number of compartments and the maximum allowable construction cost that could be subsidized for a given sized apartment building.

4.2.3 Subsidy Cost of Providing KVIPs under Two Subsidy Plans

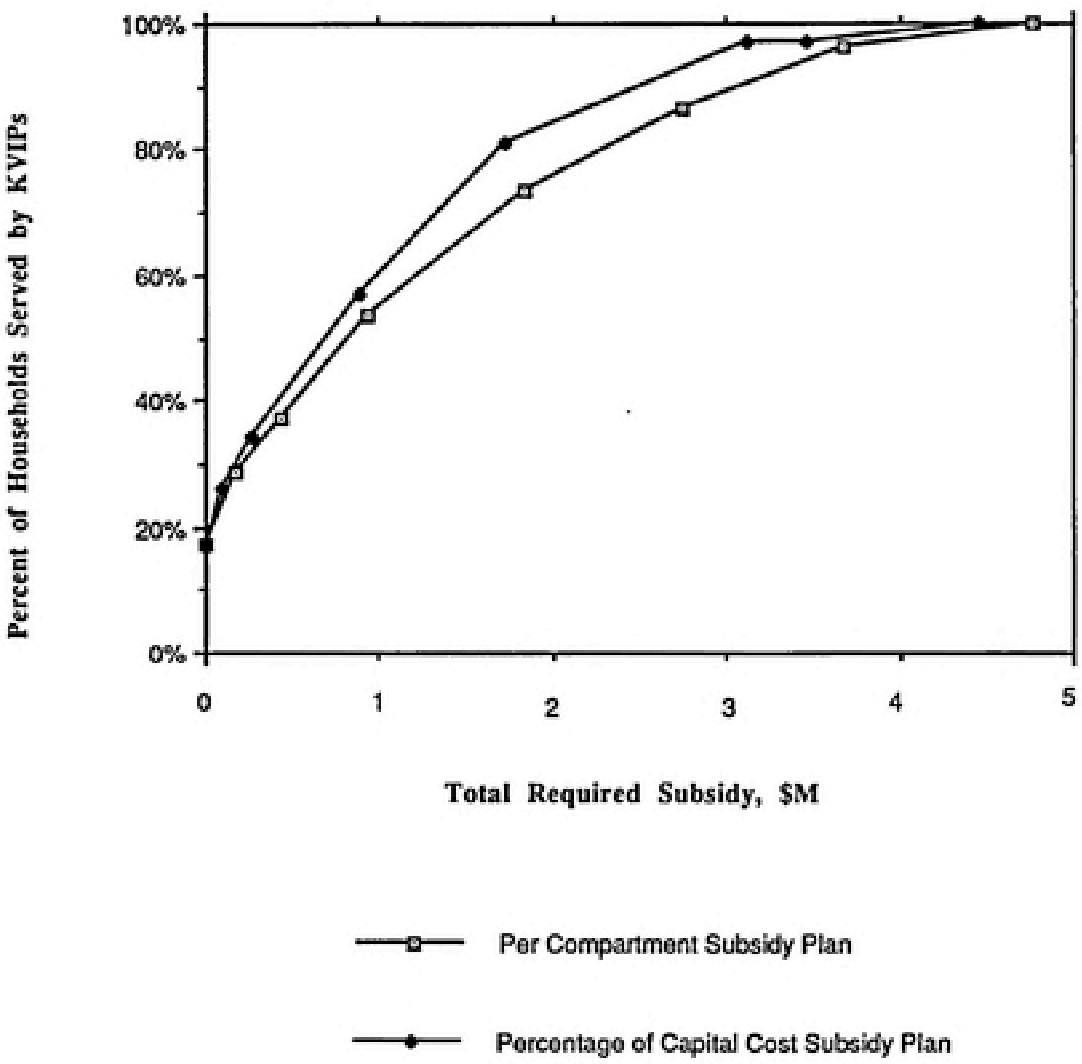
The results of applying the BDM using a per compartment subsidy plan and a percentage of capital cost subsidy plan are shown in Figure 4.3. Both sets of cost estimates are generated assuming that money to fund the construction of KVIPs is available at terms of 30 percent over three years.

Two and a half million dollars in subsidies distributed under a percent of capital cost subsidy plan leads to 90 percent coverage. The same amount of money distributed under a per compartment subsidy plan would provide approximately 85 percent coverage. In general, a fixed city wide subsidy amount distributed under a per compartment subsidy plan results in slightly less coverage than if the same amount were distributed under a percentage of capital cost subsidy plan. The difference in coverage predictions in most cases is less than five percent.

4.3 Predicting the Collective WTP of All the Households Living in a Building

The application of the BDM requires having an estimate of what all the households in a individual building would be collectively willing to pay to share a KVIP system. The

Figure 4.3 The Subsidy Costs for Two Subsidiztion Plans
(Building Decision Model, i=30%, n=3 years)



method of calculating this collective WTP from individual household WTP information depends on assumptions regarding the collective behavior of households living together in a building.

Little research has been done in Kumasi to examine the psychological and behavioral factors guiding the collective behavior of households in an apartment building. As a result of this lack of information, it is difficult to predict the relationship between the WTP of individual households and the WTP of groups of households living together.

Consider, for example, a building in Kumasi with four households. Each of the households is asked individually what they would be willing to pay each month for KVIP service. Each household bids an amount without knowing what the other three households in the building bid. No effort is made to ask all four households what they would be willing to pay as a group to share a common KVIP system (the example is hypothetical; the Kumasi WTP survey did not, collectively or individually, assess the WTP of all households in one building).

The landlord in the example says his household would be willing to pay $2.25 a month to provide his household with KVIP service. The other three tenant households would be willing to pay $.75, $1.25, and $1.75 to provide their households with KVIP service. What would be the collective WTP of all the households living in the building to provide the entire building with a KVIP system?

In the above example, would one household be willing to pay \$2.25 a month to share a KVIP system with other households that were paying \$.75 or \$1.25 for the same service? It is realistic to assume that if a KVIP system were shared, all households in the building would probably insist on paying the same monthly amount as is normally done in Kumasi with water bills. Under this assumption, the collective WTP of all households in a building with H households can be expressed as follows:

$$WTPB(H) = WTPH * H \qquad (4.1)$$

where WTPB(H) is an estimate of the amount all the households in a building acting together would be willing to pay for a shared KVIP system, and WTPH is the fixed uniform amount that each household in the building would agree to pay to share a common KVIP system.

The value of WTPH can be approximated with information from the Kumasi household survey by making certain assumptions; three alternatives are discussed below.

4.3.1 WTPH equal to Mean WTP Bid for all Households

In the above example, it could be assumed that acting collectively, each of the households would be willing to pay an amount equal to the average of what all four households said they would be willing to pay when asked individually. This average for the above example equals

$$(\$.75 + \$1.25 + \$1.75 + \$2.25)/4 = \$1.50$$

Setting WTPH in Equation 4.1 equal to $1.50 results in a collective building WTP of $6.00. One reason for choosing the mean WTP bid as an estimate of WTPH is that using it in Equation 4.1 results in the same collective WTP as would result from aggregating all the individual bids.

Since it is not possible to calculate the average bid of all the households in different size buildings using the Kumasi data, WTPH can be approximated as the mean WTP bid of all the households questioned in the survey. Substituting this value for WTPH in Equation 4.1 results in the following equation:

$$WTPB(H) = WTPH_{mean} * H \qquad (4.2)$$

As mentioned in chapter two, this mean WTP KVIP bid for Kumasi is $1.47.

4.3.2 WTPH equal to WTP Bid 75th Percentile

There is little evidence to suggest that each of the four households in the above example would indeed be willing to pay the average bid of $1.50; only two of the households in the example said they would individually be willing to pay at least that amount. While the four household average WTP bid of $1.50 is probably too high an estimate of what all the households would be willing to pay, it may be that some of the households with low bids would be persuaded into paying a higher amount by the households with high WTP bids. For example, the three households willing to pay at least $1.25 might persuade the fourth household to pay $1.25

instead of the \$.75 amount the household bid when asked individually. If all households paid \$1.25, the total building WTP would be \$5.00. The assumption leading to this outcome can be expressed mathematically as follows:

$$WTPB(H) = WTPH_{75\%} * H \qquad (4.3)$$

where WTPB(H) is the collective WTP of the H households in a building, and $WTPH_{75\%}$ is the 75 percent percentile of the WTP bid distribution.

Based on the results of the Kumasi study, $WTPH_{75\%}$ for the entire sample is \$.73. There is no particularly good reason for selecting the 75 percentile; the figure could just as easily be set at 70 percent or 80 percent.

4.3.3 WTPH equal to the mean of WTP Bids for Landlords

It is conceivable that a landlord choosing to construct a KVIP system will insist that all the households in his building pay an amount equal to the amount the he is willing to pay regardless of their own individual household WTP bid. The landlord in the example above could insist that each of his tenants pay \$2.25 resulting in a total collective building WTP of \$9.00.

Evidence from Kumasi suggests that this is a realistic assumption. Many tenants when asked for their WTP bid for services told interviewers they would pay whatever the landlord requested they pay. Under this assumption, the collective WTP of a building with H households in Kumasi can be approximated as:

$$WTPB(H) = WTPL_{mean} * H \qquad (4.4)$$

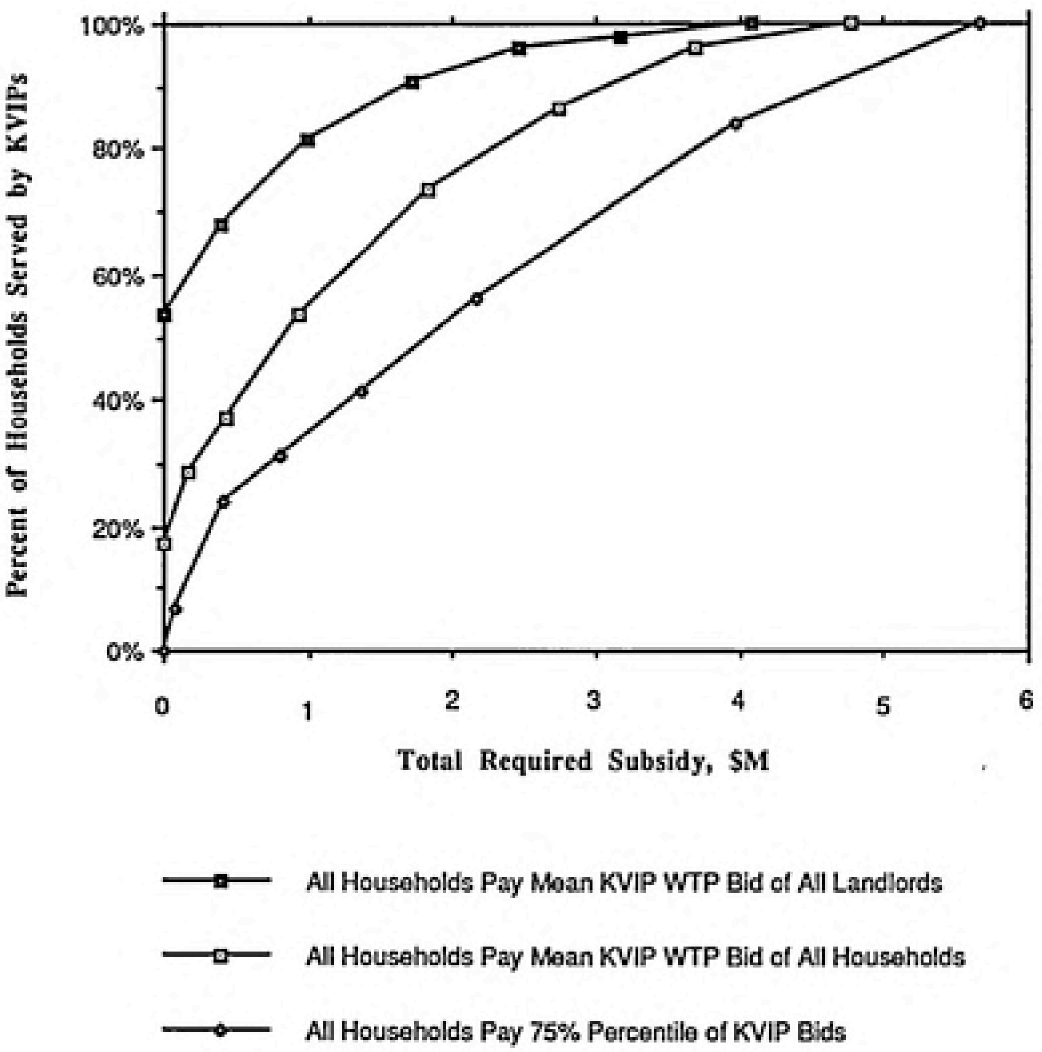
where WTPB(H) is the collective WTP of the H households in a building, and WTPLmean is the average amount that all of the landlords questioned in Kumasi said they would be willing to pay for KVIP service ($2.31).

4.3.4 BDM Coverage Predictions Following Different Assumptions Regarding the Calculation of the Collective WTP of Households in a Building

Figure 4.4 shows the results of applying the Building Decision Model using different assumptions to estimate the amount that each of the households in a building would pay for KVIP service if they all had to pay the same amount. Subsidies are assumed to be distributed under a per compartment subsidy plan. Financing terms are assumed to be 30 percent over three years. The results show that the method of calculating the WTP of a building has a significant effect on subsidy predictions.

Assuming that households in buildings would be willing to pay an amount equal to the 75 percentile of the KVIP WTP bid distribution, the BDM predicts that without subsidies, none of the households would have access to KVIPs. If households in buildings were all willing to pay the mean WTP bid, 18 percent would adopt KVIPs without any subsidies. The model predicts that 52 percent of the

Figure 4.4 Alternative Assumptions of the Fixed Monthly Amount that All Households in a Building can be Expected to Pay for KVIP Service (Building Decision Model)



households would be covered without subsidies if households were willing to pay the mean WTP bid of landlords. The BDM predicts that $3 million in total subsidies would lead either to 60 percent, 80 percent, or 95 percent coverage depending on whether WTPH in Equation 4.1 is estimated as $WTPH_{75\%}$, $WTPH_{mean}$, or $WTPL_{mean}$, respectively.

The Building Decision Model's sensitivity to the assumptions concerning the calculation of the collective building WTP will depend on the distribution of WTP bids. If there is little variation in the bids, the difference between $WTPH_{mean}$ and $WTPH_{75\%}$ will not be that significant. Alternatively, if there is a wide distribution with a large standard deviation, the variation between $WTPH_{mean}$ and $WTPH_{75\%}$ will lead to very different estimates of collective building WTP depending on which is chosen to represent WTPH in Equation 4.1.

4.4 Summary

A summary of the results of applying the HDM and BDM under different assumptions is presented in Table 4.1. As can be seen in the table, the models' predictions are very sensitive to some of the assumptions and less sensitive to others. For example, without subsidies the models predict that anywhere from 0 to 80 percent of the households that are candidates for KVIPs will gain access to KVIP service. The estimated coverage figures resulting from a total subsidy of $2.5 million range from 50 percent to 95 percent.

Table 4.1 Summary of Coverage Predictions
Using the Household Decision Model and the Building Decision Model

Model	Financing Terms	Building Subsidy Plan	Collective WTP of All Households in a Building	Estimated Coverage Without Subsidies	Estimated Coverage for $2.5 million in Subsidies	Estimated Coverage for $5 million in Subsidies
HDM	30%, 3 years	NA	NA	0%	70%	100%
HDM	10%, 20 years	NA	NA	80%	90%	100%
BDM	30%, 3 years	Percent of Capital Cost	WTPHmean * H ($1.47*H)	18%	90%	100%
BDM	30%, 3 years	Per KVIP Compartment	WTPH75% * H ($0.73*H)	0%	60%	95%
BDM	30%, 3 years	Per KVIP Compartment	WTPHmean * H ($1.47*H)	17%	83%	100%
BDM	30%, 3 years	Per KVIP Compartment	WTPLmean * H ($2.31*H)	52%	95%	100%

The models are most sensitive to changes in the assumptions that are the least certain such as the assumption as to how to calculate the collective WTP of households in a building. For this reason, it is imperative that the predictions of the models be presented with the underlying assumptions in order to qualify them.

Improving the reliability and usefulness of the models requires reducing the uncertainty behind some of the underlying assumptions. For example, the usefulness of the BDM could be greatly improved by obtaining better information on the collective WTP of households within buildings. Obtaining this type of information requires a significantly different WTP questionnaire then was used in Kumasi. Rather than focusing on individual households, the study needs to question the renters and landlord within a particular building on what the group as a whole would be willing to pay for KVIPs.

This "group" questioning can occur in several ways. All the heads of households in a building can be questioned together in an effort to identify a fee that all the households would be willing to pay. Alternatively, all the households in a particular building could be interviewed individually after explaining that all the households will be asked to pay the same amount for KVIPs.

In general, whenever possible, WTP questionnaires should be conducted in a way that accurately models the actual decision process. For example, if sanitation decisions are made by landlords independent of tenant households, than the focus of the questionnaire should be on what the landlord says his building will pay. Alternatively, if decisions are made by a tenant association, then the questionnaire should be designed to assess the tenant association's willingness to pay. Designing questionnaires to model the actual decision process leads to inevitable logistical problems as was discovered in Kumasi during attempts to interview groups of heads of households.

In situations where designing a WTP questionnaire to simulate actual decision behavior is not feasible, other techniques can be used to gain a better understanding of how groups of households will behave. WTP questionnaires can include more questions on group behavior. Individual households can be asked whether they believe if the WTP bids of other households in their building would be greater, less or the same as their own bids for KVIPs. Households can be asked whether they would pay more for KVIPs if other households in their building were willing to pay more, or if their landlord was willing to pay more.

Most buildings already have certain services which are shared among households. WTP questionnaires can include questions on how the current services are shared and more importantly, how the initial decisions to share the services were made. Were households given a choice to connect to a piped water connection, or did the landlord require everyone to connect? Were some households persuaded to pay more than they wanted to by other households? Insight into questions like this can help planners better predict collective choice behavior and consequently improve the accuracy of using WTP information.

CHAPTER FIVE:
CONCLUSIONS AND RECOMMENDATIONS

This case study shows that although WTP information from a contingent valuation survey can help planners establish sanitation policy in cities such as Kumasi, the method in which WTP information is effectively incorporated into the planning process is complex and must be done carefully.

Through the description of different methodologies designed to address the issue of KVIP subsidization, this paper highlights the typical process that should occur before using household WTP information to answer specific sanitation policy questions. Identifying and developing effective models to use WTP information in the KVIP planning process requires examining the factors controlling the provision of KVIPs including cost, distribution of subsidies, and the identification of the important decision makers (i.e. landlords). The assumptions that are made concerning these factors and the resulting conceptual framework behind the models directly influence their versatility and usefulness.

This paper examined two predictive models based on fundamentally different sets of assumptions. The Household

Decision Model uses simplified assumptions and as a result provides limited information. In contrast, the Building Decision Model more closely models the actual provision of KVIPs in Kumasi. As as a result, it is more complex, requires more background information and assumptions, and provides planners with more specific guidance in planning subsidy programs.

In order to more closely examine the strengths and limitations of the BDM, the model was reapplied after changing certain assumptions. The results of the sensitivity analysis of the Building Decision Model reveal that the model's predictions are very dependent on the method used to calculate the collective WTP of all the households in a given building. The highly sensitive nature of the model indicates its predictions should always be presented concurrently with the underlying assumptions behind its application. Policy decisions based on the predictions of the model without a concern for the nature of the underlying assumptions are as insupportable as decisions made without using WTP data.

This report presented two possible scenarios describing the sanitation decision process in Kumasi. These scenarios were chosen to highlight the difficulty of using household WTP information to predict complex landlord sanitation decisions. In the absence of more information concerning landlord sanitation decision behavior, it impossible to know which, if either of the scenarios and resulting models are accurate.

In a situation like Kumasi, it is essential to clarify the role of building owners in providing sanitation service to their tenants. To begin with, do building owners perceive the provision of sanitation as their responsibility? If not, do they perceive the provision of technologies like KVIPs as the responsibility of the city or the responsibility of individual households?

What are the factors that building owners consider when making sanitation decisions? Do they see KVIPs primarily as an investment opportunity, a method of improving their family's sanitation, or an altruistic method of improving the quality of their tenants' lives? If improved sanitation is seen primarily as an investment, information should be collected on the factors controlling investments in Kumasi. The relationship between housing markets and sanitation is also important. Do building owners believe KVIPs will significantly increase the value of their property? Would landlords insist on charging higher rents if their buildings were equipped with KVIPs?

Building owners should also be asked to what extent they will consult their tenant households when making sanitation decisions. What type of group decision making processes occur in their building? Majority rule? Unanimity rule? Is their a formal or informal tenant association in their buildings? How have past decisions been made for similar services such as water or electricity?

What is the role of individual households in the sanitation decision making process? Information on household perceptions of the sanitation decision making process must be considered along with landlord perceptions. Individual households should be asked their opinion on the level of the control they have over the sanitation decisions in their building. How have other service decisions been made in their building? Were they consulted? What options do they have if they do not like the landlord's decision? Can they somehow reverse the decision? Will they move to another building? Will they have access to an alternative sanitation option outside of the building?

The answers to the questions posed above should influence the methodology used in WTP questionnaires. This report assumed that the answers to the above questions would lead to the BDM scenario (KVIPs perceived more as a service than an investment). Under this assumption, the effectiveness of using WTP information in demand-driven planning could be greatly improved by obtaining better information on the collective WTP of households within buildings.

Another topic that requires further research involves the use of actual data to evaluate the usefulness of demand driven planning techniques such as the models discussed in this paper. Wherever WTP studies have been conducted and demand-driven planning has been attempted, planners should collect information on the actual implementation of sanitation programs and policies. This data should then be compared with the predicted outcomes using models such as those developed in this paper. The city of Kumasi provides an ideal opportunity for this type of implementation research.

APPENDIX A

DESCRIPTION OF ON-SITE SANITATION SYSTEMS

Kumasi Ventilated Improved Pit Latrine (Source: Whittington et al. 1991)

A "Kumasi ventilated improved pit latrine" is a private, sanitary means of waste disposal that does not use any water. A KVIP can be built in different sizes to accommodate various numbers of households (Figure A1). Each compartment has two holes (only one of which is in use at a time) and can serve about six households. The KVIP can be built as a free-standing structure with its own roof, or it can be built into an existing room in a building. The excrement falls into one of two adjacent pits. When one pit is full, the users switch to the other. A pit is not emptied immediately after it becomes full. Rather the users wait for about two years until the excreta is decomposed and is fully safe to handle. At this point the dry waste can be safely used for fertilizer.

The KVIP is a permanent structure. The pits are of masonry and can be easily emptied and reused. The pits may be constructed to protrude into the street so that they can be emptied from outside the house, even though the KVIP itself is entered from inside the house or courtyard. The KVIP has a vent pipe, which eliminates odors. Flies are effectively controlled by a fly screen at the top of the vent pipe. The air flow through the latrine draws flies to the top of the vent pipe where they are trapped and die. Properly designed and maintained, the KVIP is a safe, hygienic means of excreta disposal.

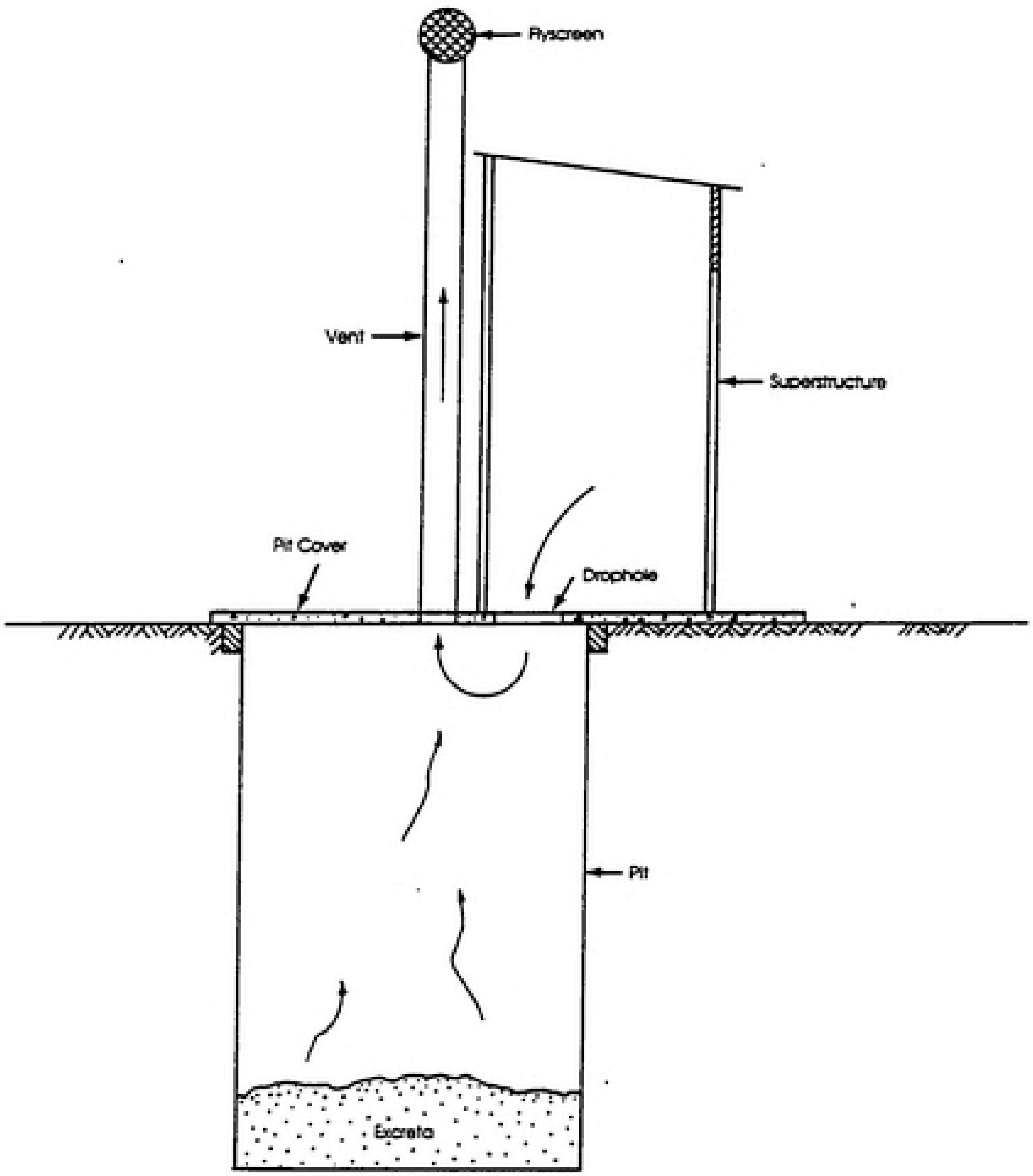
Aquaprivies (Kalbermatten et al. 1980)

An aquaprivy consists of a compartment equipped with a squatting plate above a septic tank connected to an adjacent soakaway pit. The squatting plate has a drop pipe which runs directly into the septic tank so that a water seal is formed. As long as the water level in the tank does not fall below the drop pipe, odor and flies will not be a serious problem. In practice, maintaining the water level has generally been a problem resulting in intense odor and insect problems. In order to maintain the water level, the tank must be airtight and the users must flush water into the tank to replace any losses due to evaporation.

Bucket/Pan Latrines (Kalbermatten et al. 1980)

The bucket or pan latrine consists of squatting plate above some type of pan or bucket. The container is routinely manually emptied by the user or by paid nightsoil laborers. The nightsoil from each latrine is either disposed of directly into the surrounding environment or collected in a central holding area. Tanker trucks commonly take the collected nightsoil away for treatment. If nightsoil is not disposed of properly, these latrines can pose a serious health threat to both the people who empty the latrines and general population.

Figure A-1 VIP Latrine: Basic Components (Section View)



APPENDIX 1.B

EXAMPLE OF AN OPENING STATEMENT AND WILLINGNESS-TO-PAY QUESTIONS FOR

A KVIP LATRINE (Version for tenants with a piped water connection in their dwelling)

Now I would like to ask you some questions about how much your household would be willing to pay for an improved sanitation system. I would like to ask you about two possible types of improved sanitation systems.

The first type of improved sanitation system is called a KVIP latrine, which is a ventilated pit latrine. This KVIP latrine would be private and each toilet room would have two holes (only one of which is in use at a time). It does not use water, but it could be built inside the house (on the ground floor). It can also be entered from inside the house. The excrement falls into one of two adjacent pits. When one pit is full, you switch to the other. The pit is not emptied immediately after it becomes full. You wait to empty the pit until the excreta is turned into manure which is safe to use in a garden. This takes about 2 years. The pit can then be emptied from outside the house.

This kind of latrine is specially designed so that if it is kept clean, it will not smell. It has a vent pipe to eliminate odors, and a fly screen to eliminate flies. The KVIP--a ventilated improved pit latrine--is not like an ordinary latrine. it is a permanent facility. What makes it permanent is that the two pits are lined and can be easily emptied and reused. Because the KVIP latrine has two pits, it does not have to be emptied very often and is thus very inexpensive to operate. It is a safe, sanitary means of excreta disposal.

I would now like to answer any questions you have about the KVIP latrine.

1. Were you familiar with a KVIP latrine before I came here? YES / NO

The second type of improved sanitation system is a WC in the house which you would share with other tenants. The WC would be private and there would be only one in the house (OR ONE ON EACH FLOOR IF THIS IS A MULTI-STORY BUILDING]. It would be the responsibility of the tenants and the landlord to keep the WC clean. If it were kept clean, it would not smell.

The WC would be connected to a pipe outside the house. This type of pipe is known as a sewer. The waste from the WC would flow into the sewer. The waste would not flow into a septic tank or holding pit, so it should not overflow or clog up. Therefore the household would not have the expense of emptying a septic tank or holding pit. In order to have a WC, a house must be connected to the water system.

I would now like to answer any questions you have about the WC and the sewer system.

2. Were you familiar with a WC before I came here? YES / NO
3. Were you familiar with a sewer system before I came here? YES / NO

BIDDING GAME FOR A KVIP LATRINE (HIGH STARTING POINT)

Suppose that the landlord was willing to install a KVIP latrine in this house for the use of the tenants if the costs could be recovered in a separate payment from the tenants. If the landlord installed a KVIP latrine, the excreta disposal system would be improved. There would be no initial charge or fee to have the KVIP latrine installed, only the monthly payment. You would have to pay this monthly payment as long as you lived in this house.

(a) If the landlord asked you to pay 1000 cedis per month toward the KVIP latrine, would you want the landlord to install a KVIP latrine or would you prefer not to have a KVIP latrine?

YES - have landlord install a KVIP ——— GO TO (c)

NO - rather not have a KVIP ——— GO TO (b)

(b) Suppose that instead of 1000 cedis that the monthly payment for the KVIP latrine was 500 cedis. Would you want the landlord to install a KVIP latrine or would you prefer not to have a KVIP?

YES - have landlord install a KVIP ——— GO TO (c)

NO - rather not have a KVIP ——— GO TO (c)

(c) What is the most you would be willing to pay per month to have a KVIP latrine in the house which members of your household could share with the other tenants?

MAXIMUM MONTHLY PAYMENT ________ cedis per month

[ENUMERATOR: NOW WRITE DOWN THE AMOUNT OF MONEY THE HOUSEHOLD IS SPENDING PER MONTH ON ITS PRESENT EXCRETA DISPOSAL SYSTEM FROM THE INFORMATION IN PART II OF THE QUESTIONNAIRE ON HOUSEHOLD SANITATION PRACTICES]

(d) Respondent's current monthly expenditure on sanitation from Part II: ___ cedis per month
(e) Is the respondent's current expenditure higher than his answer to (c)?

YES —— GO TO (f)
NO —— FINISHED

IF THE PRESENT EXPENDITURE IN (d) IS HIGHER THAN THE BID IN (c) ABOVE, ASK WHY THE RESPONDENT IS WILLING TO PAY LESS FOR A KVIP THAN FOR HIS EXISTING SANITATION SYSTEM. GIVE THE RESPONDENT AN OPPORTUNITY TO CHANGE HIS BID IN (c) ABOVE.

(f) Reasons given: ______________________________

(g) Respondent's revised bid: ________ cedis per month

Appendix C

Table C1 Calculation of KVIP Capital Costs (Buildings with Bucket Latrines)

Number of Households in Building	Number of Required KVIP Compartments	Number of Buildings in Kumasi	KVIP Capital Cost Each Building	KVIP Capital Cost All Buildings
1	1	807	$131	$105,630
2	1	346	$155	$53,464
3	1	307	$170	$52,380
4	1	403	$183	$73,663
5	1	184	$193	$35,527
6	1	230	$201	$46,396
7	2	99	$295	$29,180
8	2	274	$305	$83,485
9	2	166	$314	$52,230
10	2	369	$322	$118,674
11	2	220	$329	$72,438
12	2	230	$336	$77,489
13	3	106	$420	$44,651
14	3	107	$427	$45,723
15	3	69	$434	$30,037
16	3	79	$441	$34,955
17	3	68	$448	$30,347
18	3	90	$454	$40,679
19	4	30	$531	$16,100
20	4	46	$538	$24,776
21	4	5	$544	$2,984
22	4	58	$550	$31,686
23	4	10	$556	$5,570
24	4	29	$562	$16,177
25	5	14	$634	$8,767
27	5	9	$646	$5,513
30	5	4	$662	$2,544
32	6	14	$737	$10,615
44	8	3	$919	$2,406
			TOTAL:	$1,154,088

Table C2 Calculation of KVIP Capital Costs (Buildings without Existing Latrines)

Number of Households in Building	Number of Required KVIP Compartments	Number of Buildings in Kumasi	KVIP Capital Cost Each Building	KVIP Capital Cost All Buildings
1	1	1194	$218	$260,127
2	1	418	$257	$107,523
3	1	597	$283	$169,303
4	1	1344	$304	$408,162
5	1	836	$320	$267,939
6	1	597	$335	$199,945
7	2	580	$491	$285,039
8	2	627	$507	$318,127
9	2	438	$522	$228,555
10	2	597	$535	$319,647
11	2	445	$548	$243,796
12	2	179	$559	$100,183
13	3	248	$698	$173,186
14	3	273	$711	$194,016
15	3	231	$722	$166,846
16	3	105	$734	$76,691
17	3	56	$745	$41,850
18	3	66	$755	$50,089
19	4	94	$883	$83,263
20	4	66	$894	$58,725
21	4	51	$904	$46,299
22	4	54	$915	$49,656
23	4	5	$924	$4,801
24	4	5	$934	$4,648
26	5	28	$1,064	$29,339
31	6	4	$1,216	$4,686
32	6	7	$1,226	$9,149
34	6	4	$1,243	$4,369
35	6	3	$1,252	$4,273
37	7	16	$1,371	$22,124
44	8	3	$1,528	$4,147
45	8	5	$1,536	$8,153
			TOTAL:	$3,944,655

Total Capital Cost for All of Kumasi = $3,944,655 + $1,154,088 = $5,148,743

REFERENCES

Akosa, G.,and Barker, P. "Project Appraisal and Evaluation Procedures," Developing World Water, Vol. 4., 1990.

Freeman, A.M., The Benefits of Environmental Improvement Theory and Practice. Johns Hopkins University Press, 1979.

Global Consultation on Safe Water and Sanitation for the 1990's, "Conference Background Paper", New Delhi, September, 1990.

Kalbermatten, J., Julius,D.S.,Gunnerson, C.G., Mara, D.D, Appropriate Sanitation Alternatives: A Planning and Design Manual, World Bank Studies in Water and Sanitation V1 and V2, Washington, D.C., 1982.

Macoun, A., "Extending Sustainable Services in a Resource Scarce World (Draft)," World Bank, July, 1990.

Malpezzi, S., Tipple, A.G., Willis, K.G., "Costs and Benefits of Rent Control," World Bank Disscussion Paper 74, World Bank, Washington, D.C., 1990.

Mitchell, R.C., and Carson R.T., Using Surveys to Value Public Goods: The Contingent Valuation Method., 1989.

Okun, D., and Lauria, D., "A Strategy for Water Resources Capacity Building (Draft)," United Nation Development Programme Report, 1990.

United Nations Development Program (UNDP), "Strategic Sanitation Plan for Kumasi (Draft)," Kumasi, Ghana, November, 1991.

UNDP-World Bank Water and Sanitation Program, "Annual Report 1989-90," Washington, D.C., 1990.

Velasco, J. and Infante, J., "Technical Plan for the Municipal Water and Sewer System Sectors (Equador)," WASH Field Report No. 316., Water and Sanitation for Health (WASH) Project, Arlington, Virginia, 1990.

Water and Sanitation for Health (WASH) Project , Lessons Learned From the WASH Project: Ten Years of Water and Sanitation Experience in Developing Countries, Water and Sanitation for Health (WASH) Project, Arlington, Virginia, 1990.

Whittington, D., Lauria, D.T., Wright, A.M., Choe, K., Hughes, J.A., Venkateswarlu, S., "Willingness to Pay for Improved Sanitation in Kumasi: A Contingent Valuation Study (Third Draft)," World Bank, March, 1991.

Whittington, D.; Briscoe, J.; and Mu, X. 1987. Willingness to Pay for Water in Rural Area: Methodological Approaches and an Application in Haiti. Wash Field Report No. 213. Arlington, Virginia; Water and Sanitation for Health Project.

Whittington, D., Lauria, D.T., Mu,X., "A Study of Water Vending and Willingness to Pay for Water in Onitsha, Nigeria," World Development, Vol. 19, No. 2/3, pp.179-198, February, 1991b.

World Bank, "Cost Functions for On-Site Sanitation Technologies (Draft)," July, 1990.