ASSESSING THE EFFECTIVE DEMAND FOR IMPROVED WATER SUPPLY SERVICE IN MALAYSIA: FOCUSING ON JOHOR WATER COMPANY

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ABSTRACT

In Malaysia, the water management system was restructured in January 2005 by the transfer of water supplies and services from the State List to the Concurrent List. The National Water Services Commission or Suruhanjaya Perkhidmatan Air Negara (SPAN) was established in July 2006 as the technical and economic regulator for the improvement of water supply quality and the efficiency of the water industry. This study focuses on SAJ Holdings (SAJH). This water supply company provides a fully integrated service, i.e. it is involved in the all the processes of drinking water supply; these range from raw water acquisition, treatment and purification, and the subsequent distribution of purified water to customers, plus billing and payment collection.

This study attempts to assess the residential customers' preferences of different attributes of water supply. The water attributes are divided into two categories: Water Infrastructure (WI) and Residential Customers (RC). WI attributes are leakage, pipe bursts, and reservoirs; RC attributes are water quality, pressure, connections, and disruptions. Choice modelling (CM) was applied as a tool for the assessment of effective demand for improved water supplies, particularly by residential customers. There are two econometric models employed: Conditional Logit (CL) and Mixed Logit (MXL). Face-to-face interviews were conducted with residential customers and Statistical Analysis Software (SAS) was used in order to analyse the data.

The model consists of a basic model and an interaction model with socioeconomic characteristics. The findings show that the significant variables affecting demand are pipe bursts, (BUR), water quality (QUA), disruption (DIS) and connection (CON), as well as price (PRI). Among the socioeconomic characteristics that interact with the main attributes are gender, age, number of children, type of house, number of persons in the household, education, work, and income. This information is very useful for the water provider when upgrading the water service for valuable customers.

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LIST OF ABBREVIATIONS

AAS	Atomic Adsorption Spectrometer
ASC	Alternative Specific Constants
BCR	Net Benefit-Cost Ratio
BOT	Build Operate Transfer
CAPEX	Capital Expenditure
CBA	Cost-Benefit Analysis
CE	Choice Experiment
CF	Certificate of Fitness
CL	Logit Model
CM	Choice Modelling
CREAM	Centre of Research Appraisal Management
CVM	Contingent Valuation Method
DWB	Biological and Chemical
EV	Economic Valuation
FEP	Fakulti Ekonomi & Pengurusan/Faculty of Economics and Management
FFD	Fractional Factorial Design
FV	Future Value
GC-MS	Gas Chromatography-Mass Spectrophotometer
GDP	Gross Domestic Product
GM	Genetically Modified
HEV	Heteroskedastic Extreme Value
HPM	Hedonic Pricing Method
IIA	Independent of Irrelevant Alternatives
INSEE	National Institute for Statistics and Economic Studies
ISO	International Organization for Standardization
JMS	Job Management System
LC	Latent Class Models
MDC	Model of Discrete Choice
ML	Million Litres
MNL	Multinomial Logit
MOH	Ministry of Health (Malaysia)
MRS	Marginal Rates of Substitution
MWIG	Malaysia Water Industry Guide
MWTP	Marginal Willingness to Pay
MXL	Mixed Logit
MYR	Malaysia Ringgit
NL	Nested Logit
NOAA	National Oceanic and Atmospheric Administration (US Department of Commerce)
NPV	Net Present Value
NRW	Non-Revenue Water
OLS	Ordinary Least Squares
OPEX	Operational Expenditure
PAAB	Pengurusan Aset Air Berhad
PRVs	Pressure-Reducing Valves
PUAS	Perbadanan Urus Air Selangor
PV	Present Value
RC	Residential Customers
RMK9	Ninth Plan (Malaysia)

RPL	Random Parameter Logit
RUB	Ranhill Utilities Berhad
RUT	Random Utility Theory
SAJH	Johor Water Company
SAS	Statistical Analysis Software
SATU	Syarikat Air Terengganu
SC	Stated Choice
SE	Socioeconomics
SHE	Safety, Health and Environment
SIRIM	Department of Standards of Malaysia
SOS	Security of Supply
SPAN	Suruhanjaya Perkhidmatan Air Negara/National Water Services Commission
TCM	Travel Cost Method
TECHNEAU	Integrated Project Funded by the European Commission
THM	Trihalomethane
UEM	United Engineering Malaysia
USD	US Dollar
USEPA	US Environmental Protection Agency
WaQIS	Water Quality Information System
WEDC	Water Engineering and Development Centre
WI	Water Infrastructure
WSIA	Water Service Industry Act
WTP	Willingness to Pay

LIST OF STATISTICAL VARIABLES USED

BOI	Boil
BUR	Pipe Burst
BUR2	Pipe Burst Level 2
BUR3	Pipe Burst Level 3
CHI	Children
CON	Connection
CON1	Connection Level 1
CON2	Connection Level 2
DIS	Disruption
DIS1	Disruption Level 1
DIS2	Disruption Level 2
EDU	Education
ETH	Ethnicity
FIL	Filter
GEN	Gender
HOU	House
INC	Income
LEA	Leakage
LEA1	Leakage Level 1
LEA2	Leakage Level 2
LON	Long
MIN	Mineral
PER	Person
PRE	Pressure
PRE2	Pressure Level 2
PRE3	Pressure Level 3
PRI	Price
QUA	Quality
QUA2	Quality Level 2
QUA3	Quality Level 3
RES	Reservoirs
RES2	Reservoirs Level 2
RES3	Reservoirs Level 3
TAN	Tank
WOR	Work

Interaction variables relating to WI attributes

id2e	Interaction between RES2 and customers' education level
id3w	Interaction between RES2 and customers' current work
ida2	Interaction between RES and customers aged 20 to 30 years
ida3	Interaction between RES and customers aged 31 to 40 years
idc5	Interaction between RES and customers with 2 children or fewer
idc7	Interaction between RES and customers with 6 to 8 children
il2c	Interaction between LEA2 and number of children in household
il2c5	Interaction between LEA2 and customers with 2 children or fewer
il2c6	Interaction between LEA2 and customers with 3 to 5 children
il2c7	Interaction between LEA2 and customers with 6 to 8 children
il2h	Interaction between LEA2 and customers' type of house
il2h11	Interaction between LEA2 with customers living in terraced houses
il2h12	Interaction between LEA2 with customers living in two-storey houses
ilc	Interaction between LEA and number of children in household
ilh	Interaction between LEA and customers' type of house
ip2e	Interaction between BUR2 and customers' education level
ip3w	Interaction between BUR3 and customers' current work
ipc5	Interaction between BUR and customers with 2 children or fewer
ipc6	Interaction between BUR and customers with 3 to 5 children
ipc7	Interaction between BUR and customers with 6 to 8 children
iph11	Interaction between BUR and customers living in terraced houses
iph12	Interaction between BUR and customers living in two-storey houses

Interaction variables relating to RC attributes

ica4	Interaction between CON and customers' age
icg	Interaction between CON and customers' gender
id2a4	Interaction between DIS2 and customers' age
id2g	Interaction between DIS2 and customers' gender
ida	Interaction between DIS and customers' age
idi	Interaction between DIS and customers' income
ip2c	Interaction between PRE2 and number of children in household
ip2e	Interaction between PRE2 and customers' education level
ip2g	Interaction between PRE2 and customers' gender
ip3c	Interaction between PRE2 and number of children in household
ip3g	Interaction between PRE3 and customers' gender
ip3h	Interaction between PRE3 and customers' type of house
ipa4	Interaction between PRE and customers' age
ipg	Interaction between PRE and customers' gender
iq2g	Interaction between QUA2 and customers' gender
iq2c	Interaction between QUA2 and number of children in household
iq2w	Interaction between QUA2 and customers' current work
iq3e	Interaction between QUA3 and customers' education level
iq3g	Interaction between QUA3 and customers' gender
iqa4	Interaction between QUA and customers' age
iqg	Interaction between QUA and customers' gender

Interaction variables relating to PRI attribute

ire16	Interaction between PRI and customers in the lower education group
ire17	Interaction between PRI and customers in the higher education group
iri21	Interaction between PRI and customers with a monthly income between MYR500 and MYR1500
iri22	Interaction between PRI and customers with a monthly income between MYR1501 and MYR2500
irp10	Interaction between PRI and customers with 6 to 8 persons in the household
irp8	Interaction between PRI and customers with 2 persons or fewer in the household
irp9	Interaction between PRI and customers with 3 to 5 persons in the household
irw19	Interaction between PRI and customers in the professional group

CHAPTER 1: INTRODUCTION

1.1 Background of Study

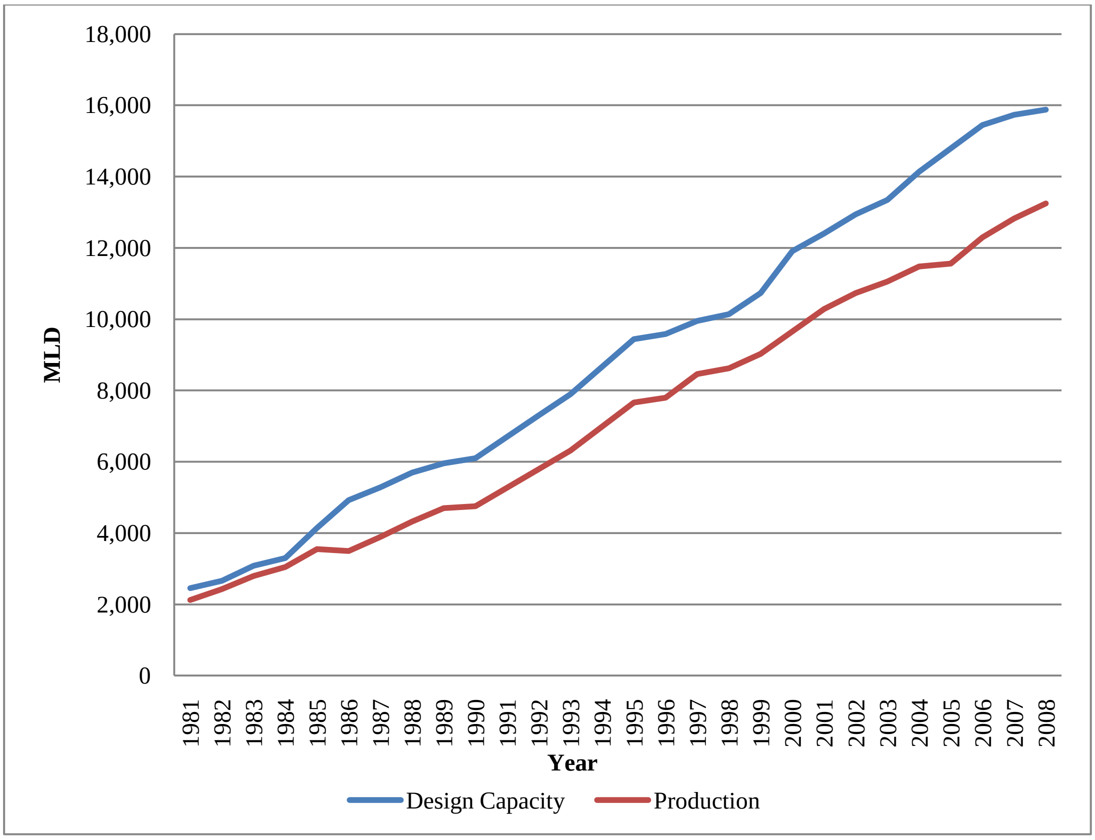
In the 21st century, water is predicted to be the leading issue, because this vital resource might be a scarce commodity, and increasingly polluted (Chan, 2001). In developing countries, because of rising population and increased development, the escalation in demand for water doubles every twenty years, but the growth in supply is far lower and is currently trailing far behind demand. As a result, it is expected that development will be significantly checked due to water demand (Bouguerra, 1997). Currently, there is a water crisis caused by poor water management in developing countries such as Nigeria and India. As a result, one in five of the world population do not have access to safe and affordable drinking water. In fact, three to four million people die each year of diseases carried via water; this includes over two million young children dying of diarrhoea (Cosgrove et al., 2000).

According to the Global Water Supply and Sanitation Assessment, 1.1 billion people do not have the use of an appropriate water supply for domestic purposes, and about two-thirds of them – nearly 670 million people – are in Asia. This comes to about 18% of the population of the continent, according to the World Health Organization (WHO) and the United Nations Children’s Fund (UNICEF).

According to Lee (2007), the position of Malaysia, close to the equator, ensures that it is supplied with a fairly copious amount of water resources. During the monsoon season, average monthly rainfall varies between 190mm and 450mm in a few areas. The total annual volume of rainfall is estimated as 990km^3, but 36% of this is lost because of evapotranspiration. The total quantity of internal water resources within the country is estimated to be 580 km^3.

The design capacity and production of the water supply in Malaysia has expanded significantly over the past 20 years. Design capacity has increased at a yearly average amount of 7.9%; whilst production of water over this period has also grown, by 7.6% per year. By 2008, the water supply design capacity and production reached 15,877 and 13,243 million litres per day (MLD) respectively (Figure 1.1).

Figure 1.1: Water Supply Design Capacity and Production in Malaysia (1981–2008)



Note: MLD = million litres per day
Source: Malaysia Water Industry Guide 2009

Furthermore, Table 1.1 shows the coverage of water supply in rural and urban area. Overall, a regular water supply is available to 90.9% of the population of Malaysia. Access of domestic water is higher in urban areas, at about 96.5% of the population; this drops to 85.25% of the population in rural areas. Consumption of water is also highest (per capita) in the most developed states, such as Selangor, Melaka, N. Sembilan and Pulau Pinang. On the other hand, the lowest levels of access to domestic water are noted in a few less developed states, such as Sabah and Kelantan: about 52% and 53.2% of the rural population respectively. This is followed by Terengganu with 82% and Pahang at about 89% of the rural population.

Table 1.1: Percentage of Urban & Rural Population Served (2008)

State	Population Served	% Population Served		
		Urban	Rural	Total
Johor	3,310,173	100.0	99.5	99.8
Kedah	1,993,642	100.0	94.8	97.0
Kelantan	862,160	56.3	53.2	54.0
Labuan	86,251	100.0	-	100.0
Melaka	753,500	100.0	-	100.0
N.Sembilan	993,541	100.0	99.5	99.8
Pulau Pinang	1,545,836	100.0	99.6	99.9
Pahang	1,406,659	98.0	89.0	93.0
Perak	2,340,261	100.0	98.9	99.5
Perlis	234,736	100.0	99.0	99.0
Sabah	2,380,000	99.0	52.0	76.0
Sarawak	3,185,679	99.0	56.5	78.0
Selangor	6,694,775	100.0	99.0	99.9
Terengganu	1,007,973	98.5	82.0	90.0
National Total/Average	**26,795,186**	**96.5**	**85.25**	**90.9**

Source: Malaysia Water Industry Guide (2009)

Due to the increasing population, industrialisation and urbanisation, the water demand is projected to increase at the rate of 12% per year throughout Malaysia. The current water demand of 12 billion m^3/year will increase to 20 billion m^3/year in 2020 (Ti et al., 2001). Although the total water availability exceeds the demand, water shortages do occur due to the variability and uneven distribution of rainfall, especially in a protracted drought period.

Also, because the requirement for clean water has increased, certain sectors of the population are having to compete for the use of their water, and. due to the rising growth in the economy this situation will be exacerbated even more markedly. The transfer of water between river basins, and even states, has had to be comtemplated, as some areas of high water demand have reached the realistic limits of developing their surface water resources.

Approaches to water supply in urban areas are demand-driven: the development of new resources takes place if there are water shortages. However, as the requirement for water keeps increasing, this approach becomes infeasible. It would be more realistic to adopt a method that could exploit restricted water supplies by giving attention to possible means of conserving them.

Therefore, the federal government is becoming more involved in managing water services and resources across the whole country, so that development of sustainable water resources is carried out and supply services remain efficient.

1.2 Research Questions

Drinkable water is a resource which is both at risk and in short supply, yet fundamental to maintain life and development, together with the environment itself. To preserve a supply of safe water in sufficient quantities, together with unpolluted rivers and the minimum amount of flooding, a National Water Policy has been drawn up to provide a framework for water conservation and management. The water service providers therefore need to follow this framework in order to ensure that customers receive a much better service.

1.2.1 Statement of the Problem

There has been a severely increased demand for water a as consequence of the rise in population and GDP over the past few decades. Population growth has become a big issue in the urban areas; this is due to rural-urban migration and increasing urbanisation. The rapid growth of the urban population has placed heavy demands on the government's capabilities to deal with the population's needs for infrastructure and services and provide environmental conditions necessary for a better quality of life. Naturally, the per capita amount available for each person of water decreases with a rise in population.

In Malaysia, the responsibility for state water supply services is that of the Public Works Department, the Water Supply Department, the Water Supply Board and the Water Supply Corporation or Company in each state, but also of private companies. In order to achieve financial sustainability and an efficient service to customers, the Federal Government set up PAAB (Water Asset Management Company) under the Ministry of Finance to take over the responsibility to finance and develop new water infrastructure. Therefore, water operators lease the water infrastructure for operation and maintenance purposes.

SAJ Holdings is a fully integrated water supply company in Johor state. It is involved in the all the processes of drinking water supply; these range from raw water acquisition, treatment and purification, and the subsequent distribution of purified water to customers, plus billing and payment collection. Therefore, SAJH needs to meet customers' demands. They should all receive the same level of service; customer quality includes water quality compliance to Ministry of Health (MOH) standards, continuous supply, and pressure. Furthermore, the customer charter relates to pipe bursts, pipe leakage and connection. Residential customers have complained about leakages, pipe bursts, reservoir capacity, low water pressure, water quality, disruption to the water supply, and connection times. In order to deliver a better service to residential customers, SAJH has stated its targets through quality objectives and the customer charter.

This research has been carried out to determine the value of universal access to an improved water service using a willingness to pay approach (WTP) in the area of study; specifically, to examine the socioeconomic factors that influence residential customers' willingness to pay for an improved water supply. This study concentrates on the water supply service to residential customers. Aspects of this service which could be improved are leakage, burst pipes, reservoir capacity, water quality standards, disruption to the water supply, pressure, and connection times. The customers' preferences for improvements to these water service attributes will allow SAJH to ensure that customers receive a better service in the future.

Therefore, this research focuses on certain issues relevant to water resource management that has been operated by private companies. It will try to answer the following specific research questions:

1. What do residential customers experience in terms of the service quality provided by SAJH?
2. What are customers' perceptions of the current preferences and choices of service factors or attributes of SAJH in order to improve the quality of service?
3. What do customers perceive the current service performance to be, according to the service factors?
4. What can be done to deliver a better service from source to tap?

1.3 Research Objectives

The general purpose of this study is to assess customers' preferences for different aspects of improvements in service to residential customers of SAJH. The specific objectives are:

1. To determine customers' willingness to pay (WTP) for a particular water supply service level.
2. To examine the socioeconomic factors that influence residential customers' willingness to pay for an improved water supply.
3. To assess the value of WTP as a planning tool for better service delivery and potential capability of generating funds.
4. To suggest recommendations to the relevant authorities and agencies for the planning and managing of effective methods of water supply service.

1.4 Significance of the Research

As a consequence of ever-increasing consumption of water, the management of water supplies has become more and more wide-ranging and complex. Also, conservationists and environmentalists are heavily involved in the painstaking examination of any proposed water resource development which is necessary to fulfil the escalating demand for water. There are three particular challenges in the Ninth Malaysia Plan (RMK9) which are being addressed by government, as follows: excellent quality water services to be provided; natural resources to be made best use of through a water delivery system which is effective and efficient and will enable people's rising aspirations; and to defend the context of the environment, in order to enhance the quality of people's lifestyles. Therefore, these findings about people's WTP are necessary so that federal and state authorities have the information to employ methods which are effective to improve the water service.

Additionally, this research's originality and innovative nature provides a fundamental basis for any future research. It adds to the information about and proficiency of water resource management and also approaches to economic valuation, especially in Malaysia and other developing countries.

1.5 Overview of the Thesis

This thesis is divided into ten chapters as follows:

Chapter 1: Introduction

This chapter briefly deals with an overview of water management in Malaysia. There is also a focus on the current situation and issues that the water companies have faced. The chapter also sets out the objectives and significance of the research.

Chapter 2: Literature Review

This section reviews on environmental valuation and economic theories related to valuation and non-market valuation methods. The chapter also describes the Choice Modelling (CM) methods which have been applied in environmental economics, particularly in water resource management. This is followed by a discussion of the factors which influence willingness to pay (WTP) and Cost Benefit Analysis (CBA).

Chapter 3: Study Description

This chapter presents Syarikat Air Johor Holdings (SAJH) as the area of study. It focuses on Johor state. Water supply operations include customer service, the water network, water quality, and asset replacement. There are three districts which were chosen for conducting the survey, namely Johor Bahru, Batu Pahat and Kluang.

Chapter 4: Methods and Procedures

This chapter discusses the research design and the methodology employed. The procedures of choice modelling design are also discussed. This starts with the design of choice experiment, construction of the questionnaire, and continues with the fieldwork study. The questionnaire was designed and translated into a Malay version to ensure good understanding by the respondent.

Chapter 5: Descriptive Analysis

This section discusses the findings of the research including socioeconomic characteristics; age, number of children, number of persons in household, type of house, education, current work, and income per month. This is followed by customers' experience with and attitudes to SAJH, its service performance and efficiency. Moreover, further analysis is also conducted in the form of cross-tabulations and correlations between water attributes and socioeconomic characteristics.

Chapter 6: Choice Experiment Results

This chapter presents the overall results of the choice experiment on SAJH's water supply service. This is followed by the results for the first choice experiment: Water Infrastructure (WI). These models are then extended to include CL models with interaction terms with socioeconomic characteristics. This chapter then presents the results of the second choice experiment: Residential Customers (RC).

Chapter 7: Mixed Logit Results

This chapter describes two stages of the MXL process. Firstly, the basic MXL models for both WI and RC are constructed and analysed. Next, the market share estimation of mean and standard deviation of the distribution of each test parameter is calculated, in order to determine the total number or proportion of respondents who preferred or did not prefer each variable.

Chapter 8: Cost Benefit Analysis Results

This chapter presents the Cost Benefit Analysis (CBA) which applies to the projects or investments of SAJH in 2008. The purpose of CBA is to identify the viability of each project or investment.

Chapter 9: Implications of Results

This chapter provides the impacts of the findings in order to improve water resource management, particularly within SAJH, and to deliver a better service to residential customers.

Chapter 10: Conclusions

This chapter presents the final conclusions of the research. It also outlines suggestions and recommendations in order to improve water management efficiency and effectively. Then, it suggests aspects of future research that might be undertaken to further advance research on water management in Malaysia.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter reviews the relevant literature on non-market valuation methods, choice experiments for valuing the water supply and non-market goods, economic valuation work in Malaysia, factors affecting WTP for water services and cost-benefit analysis for water improvement.

2.2 Review of Non-Market Valuation Methods

Environmental economists have recommended a number of market- and non-market-based methods to value the environment. Non-market goods may be environmentally valued via one of two methods: revealed preference methods and stated preference methods. The former suggests a particular non-market good's value by following actual behaviour in markets which are closely related, e.g. hedonic pricing method (HPM) and travel cost method (TCM).

These methods have been applied to estimate the benefits of non-market valuation, for instance in ecotourism and recreational opportunities (Hanley, 2001). Basically, TCM is employed to estimate the economic benefits or costs associated with environment, tourism or ecotourism sites. The travel cost expenses and time that visitors incur to visit a certain site are considered the basic premises for TCM and correspond to the 'price' of access to the location or site. Therefore, the WTP to visit the site may be determined through the number of journeys that visitors may make to the site at varying travel costs.

Meanwhile, the stated preference method measures non-market goods' value by utilising respondents' stated behaviour in a hypothetical situation, which includes contingent valuation method (CVM) and choice modelling (CM).

2.2.1 Contingent Valuation Methods (CVM)

CVM has been employed widely in order to estimate non-market value: the first study was done by Davis (1963) which was focused on hunters in Maine. Since then, one of the approaches utilised most often for the valuation of non-market goods is the CVM survey. The most common approach is the closed-ended survey: individuals are asked if they would be content to improve the level of a certain non-market good by paying a particular amount (Bateman and Willis, 1999). In addition, other stated preference methods – choice experiments, for example – occurred in marketing and transport economics studies at a similar time (Louviere, 1993).

Hammack and Brown (1974) performed the first CVM relating to water valuation study in 1969. This estimated the consumer surplus in a study on wildlife hunting in the US West Pacific Flyway wetlands.. Following this, a study was carried out which looked at enhancements to water quality in the Monongahela River, Pennsylvania and calculated option price bids for the consequent improved recreation possibilities (Desvousges et al., 1987). The possible advantages of improved water quality consistent with the US Clean Water Act were considered by Carson and Mitchell (1993), who established the WTP for better water quality for all rivers across the country. The results confirmed that for enhancements from a totally unusable state to a navigable state, the per capita WTP was €118.50 per annum, followed by €175.60 for further improvements to a state at which swimming was possible. The stage-by-stage enhancement value was €32.40 for improvements from a navigable to a fishable state, followed by €23.90 for those from a fishable state to a swimmable one.

Cho et al. (2005) used contingent valuation to estimate WTP for drinking water quality improvement in Minnesota. The results presented an average household WTP of US$4.33 per month in order to lower the sulphate levels and US$5.25 per month to lower the iron levels to the secondary standards set by the US Environmental Protection Agency (USEPA). In addition, individuals who had a low perception of drinking water were willing to pay more in order to have better water quality.

Hanley et al. (2002) applied CVM to test whether such a price level effect can be detected, once one allows for possible differences in the scale parameter between different samples. The result showed that once differences in the underlying scale parameter have been allowed for, estimates of preferences and welfare effects are insignificantly impacted by the prices used in the design.

Briscoe (1990) employed CVM to evaluate water supply issues in Brazil. Choe et al. (1996) used CVM and TCM in order to assess improvements in the quality of surface water in the rivers of and sea around the Philippines. The results of the CVM showed that the household WTP for environmental amenities was €0.90 per month.

However, CVM has several drawbacks for the estimation of values. Firstly, only one quality attribute may be presented for valuation to the respondent sample. Secondly, CVM is a weak method for the calculation of consumer values, because individuals are not likely to be accurate in their responses when they are asked about a hypothetical situation. Hypothetical bias may be problematic for the valuation of changes to attribute which the respondents find unfamiliar, or for changes which have no natural market method to bring them about. This is not as likely to happen when considering gas, electricity and water services, because consumers are already used to having to pay for the base service level. Thirdly, CVM may give rise to strategic behaviour in some individuals, particularly concerning certain public benefits; for instance, the environment (CIE, 2001).

2.2.2 Choice Modelling (CM)

Choice modelling has its origin in conjoint analysis (Adamowicz et al., 1998a). Its basis is that any good may be illustrated in terms of its attributes or characteristics, and the levels these take (Bateman et al., 2002). In other words, environmental goods may be valued with regard to their attributes. This is done via the application of probability models to the choices between the different sets of these attributes. A river may be described with regards to its ecological or water quality, or its appearance. In many ways, CM is also comparable to the discrete choice version of CVM; both methods have similar survey design processes and the same theoretical basis (i.e. random utility theory) (Blamey et al., 1999). Both techniques may provide surplus estimates for a change from the status quo to an alternative.

In CM, respondents are given a set of questions, each of which asks them to pick their preferred option from various different alternatives that is known as a choice set. These options are offered to the respondents as the results of distinct management policies, which are portrayed in terms of a standard attribute set. The alternatives are made distinct by permitting the various attribute levels to differ in accordance with an experimental design using orthogonal arrays. Correlations must not be present between attributes. This is so that the significance of each separate attribute within the model may be ascertained.

One of the alternatives within each set of choices must be the status quo or ‘no change’ position (Bueren et al., 2004).

In general, the selection of the choice set attributes took place after reviewing the published literature and via the use of four focus groups a survey of experts (Bennett et al., 2000). Another important characteristic to take into account when devising a choice modelling questionnaire is the choice of the various levels of the attributes. These are qualitative or quantitative descriptions for each individual attribute. The identification of levels which are suitable may be more difficult than choosing the attributes themselves, as it may often be possible to describe a particular attribute in various different ways. Also, those who participated in the initial focus group found appropriate descriptions for each of the attributes somewhat complex to decide upon. Because of this, a list of various descriptions was given to those participating in the other focus groups, who were then asked to specify which ones they favoured most. These descriptions were taken from the experts’ survey results and after reviewing the published literature. The questionnaires then incorporated these selections into the choice of levels (Morrison and Bennett, 2004).

Finally, when designing CE, the researcher must also think about the possibility of multi-colinearity, which will influence parameter estimation within the model and may produce choice options which are unrealistic. However, this may be overcome through the use super-attributes, consisting of a number of attributes; however, this would add to the complexity of the CE (Gujarati, 1998).

In order to measure welfare economics, the conditional logit (CL) model is employed because it is relatively simple, and due to its specification as a closed-form model, its estimation speed and its strength with regard to accuracy of prediction to violation of the significant behavioural assumptions which are required for model estimation. It is assumed that the Independence of Irrelevant Alternatives (IIA) property – stating that the relative probability of any two particular options being chosen is unchanged when other alternatives are introduced or removed – must not be violate. If this is not met, then other more complex statistical methods must be utilised (Hanley et al., 2006).

Therefore, to simplify the CM model, there are six steps developed by Hanley et al. (2001) as shown in Table 2.1.

Table 2.1: Steps of Choice Modelling

Steps	Description
Selection of attributes	Identification of relevant attributes of the good to be valued. Literature reviews and focus groups are used to select attributes that are relevant to people, while expert consultations help to identify the attributes that will be impacted by the policy. A monetary cost is typically one of the attributes to allow the estimation of WTP.
Assignment of levels	The attribute levels should be feasible, realistic, non-linearly spaced, and span the range of respondents' preference maps. Focus groups, pilot surveys, literature reviews and consultations with experts are instrumental in selecting appropriate attribute levels. A baseline 'status quo' level is usually included.
Choice of experimental design	Statistical design theory is used to combine the levels of the attributes into a number of alternative scenarios or profiles to be presented to respondents. Complete factorial design allows the estimation of the full effects of the attributes upon choices: that includes the effects of each of the individual attributes presented (main effects) and the extent to which behaviour is connected with variations in the combination of different attributes offered (interactions). These designs often produce an impractically large number of combinations to be evaluated: for example, 27 options would be generated by a full factorial design of 3 attributes with 3 levels each. Fractional factorial designs are able to reduce the number of scenario combinations presented with a concomitant loss in estimating power (i.e. some or all of the interactions will not be detected). For example, the 27 options can be reduced to 9 using a fractional factorial. These designs are available through specialised software.
Construction of choice sets	The profiles identified by the experimental design are then grouped into choice sets to be presented to respondents. Profiles can be presented individually, in pairs or in groups. For example, the 9 options identified by the fractional factorial design can be grouped into 3 sets of 4-way comparisons.
Measurement of preferences	Choice of survey procedure to measure individual preference: ratings, rankings or choices.
Estimation procedure	OLS regression or maximum likelihood estimation procedures (logit, probit, ordered logit, conditional logit, nested logit, panel data models, etc). Variables that do not vary across alternatives must interact with choice-specific attributes.

Source: Hanley, Mourato and Wright (2001)

In addition, CM includes choice experiments, contingent ranking, contingent rating and paired comparisons. These categories are described as follows:

(a) Choice Experiments (CE)

Recently, CE has been the most popular technique of economic valuation, rather than CVM. In a choice experiment, individuals are given a set of alternatives that differ with regard to attributes and levels, and asked to select the one they favour most (Hanley et al., 2002). The status quo situation is also included in each choice set. For instance, an example of a choice set in this study is presented in Table 2.2.

Table 2.2: Choice Set

If you wish to see leakage reduced, all burst pipes repaired within 24 hours, some increase in reservoir capacity and you are happy to pay a 20% increase in your water bill then you should choose Option A.

	Option A	**Option B**	**Option C**
Leakage	**20%**	**30%**	30%
Burst pipes	100% of repairs within 24 hours	100% of repairs within 24 hours	98.5% of repairs within 24 hours
Reservoirs	**125%** achieved against demand	**130%** achieved against demand	119% achieved against demand
Price	increase by **20%**	increase by **10%**	no change
PREFERENCE CHOICE	✓		

Moreover, there are some advantages of CE, as follows:

(i) CE may be used in the estimation of economic values for any particular environmental resource, and may also be employed to estimate non-use. In addition, CE allows estimation not only of the total value of such a resource, but also of the implied value and ranking of its attributes, and the value of altering two or more attributes at once (Hanley et al., 1998; Bateman et al., 2003).

(ii) Individuals find the choice approach more familiar than the CVM payment approach.

(iii) CE may solve some of the biases which occur in CVM; the strategic bias is minimised in CE, because prices of resources are already defined within the choice sets.

(iv) CE also prevents yea-saying bias, since the individual is not permitted to express a value for a particular resource if they do not actually prefer it. The possibility of a lack of scope sensitivity (‘embedding effect’) is diminished. If the choice sets presented to individuals are carefully designed and comprehensive, they will not confuse the scale of the resource or its attributes with something else in which it could be embedded (Bateman et al., 2003).

(v) The approach utilised in CE of repeated sampling has the ability to carry out tests for internal consistency, and the model can be fitted to various subsets of the data.

(vi) CE also allows for the identification of marginal values of the attributes. Therefore, in terms of benefit transfer, CE has advantages over CVM, if environmental resources can be separated into quantifiable attributes with monetary values and the model includes socioeconomic factors.

(b) Contingent Ranking

In a contingent ranking survey, respondents are given three or more alternatives within one question, then asked to rank the various alternatives from most to least preferred. Georgiou et al. (2000) utilised contingent ranking to estimate possible benefits of water quality improvement in the River Tame in Birmingham. Other studies have employed contingent ranking to estimate the value of environmental goods; these have included recreational hunting (Mackenzie, 1993), the reduction of hazardous waste risk (Smith et al., 1985) improved air quality (Rae, 1983), and electric cars (Beggs et al., 1981).

(c) Contingent Rating

In a contingent rating survey, respondents are asked to assess a set of alternatives, one at a time, by using a numerical rating scale. These ratings are then regressed against the attributes and the Ordinary Least Squares (OLS) method is used to estimate the regression parameters (Adamowicz et al., 1998a).

This method has been widely employed in marketing and psychology. It has recently been utilised in agricultural and environmental economics, e.g. in the analysis of waterfowl hunting (Gan and Luzar, 1993), recreational fishing preferences (Roe et al., 1996), and Spanish wind farms (Alvarez-Farizo and Hanley, 2002).

However, contingent rating is often criticised. Firstly, there are concerns about a rating score for utility equivalents: the scale’s cardinality assumes that unit differences are the same, but without considering that scale’s numerical value, or the comparability of the rating among alternatives. Roe et al. (1996) therefore proposed employing centring points, such as the status quo, and then building up an independent variable of differences from the status quo.

This method also suffers from a metric bias, which occurs due to the use of rating scales. This bias is associated with the difficulty of the cardinal measurement of utility and the problem of interpersonal comparison of this measurement. Metric bias could skew parameter estimates leading to increased variance (Morrison et al., 1996). Also, it suffers from estimation bias, because OLS procedures are biased and inefficient when they are used with discrete data. Moreover, the estimates of value derived by this method are only relative, because individuals are unable to express their opposition to payment (Mackenzie, 1993).

(d) Paired Comparison

In a paired comparison, respondents are shown two alternatives to choose between. They are then asked to rate their preference for the alternatives on a five- or ten-point scale. This method has been employed to estimate the value of various environmental goods, including the use of electric cars (Segal, 1995) and recreation (Sinden, 1974). Also, Johnston and Desvouges (1997) applied a paired comparison technique to estimate values and public preferences for a number of electricity generation scenarios. The effects of alternative scenarios were described in terms of employment, health and environmental attributes.

Data from paired comparison has been analysed using OLS (Krupnick and Cropper, 1992; Viscusi et al., 1991; Magat et al., 1988) and ordered logit and probit procedures (Johnson et al., 1997). The paired comparison method results in estimates of the value of individual attribute changes as well as estimates of the total value of environmental quality changes. A disadvantage of paired comparison is that it results in unconditional estimates of value, because respondents are unable to oppose payment.

CM has therefore been employed widely in various areas of environmental and resource economics, e.g. in the valuation of cultural and heritage goods and monuments (Navrud and Ready, 2002), and environmental attributes of rivers (Bennett and Morrison, 2001); and in the prediction of user fees at public recreation sites (Schroeder and Louviere, 1999). Furthermore, CM is used both for measuring e values (Adamowicz et al., 1994) and passive use values (Adamowicz et al., 1998a). Also, the CM method has been further extended to estimate the effects on economic welfare by changes to provision of public goods in the US and Europe (Viscusi et al., 1991, Opaluch et al., 1993 and Garrod and Willis, 1998). In addition, CM has also been used in psychology since the 1960s, and in transport economics and market research since the early 1970s by Louviere (1996; 1998b), Batsell and Louviere (1991), and Louviere et al. (2000).

2.3 Choice Experiment for Valuing Water Supply

Several studies have used the applied choice experiment (CE) method to estimate the value of improved water quality and water services. According to previous research, Hensher et al. (2005) employed CE in order to estimate householders' WTP to avoid water service interruptions and wastewater overflows, which were differentiated by their timing, duration and frequency, in Canberra, Australia. The results showed that when there were two interruptions a year, householders were willing to pay approximately A$41.51 in order to cut the number of interruptions. When there was one interruption per month, however, the figure was reduced to only A$9.58. This was because of two reasons: reducing the number of interruptions from 12 to 11 does not seem as psychologically important as reducing them from two to one; and householders are more inclined to act differently in order to diminish the effects of a greater number of interruptions to the supply – for example, by keeping water in storage tanks. In addition, householders' MWTP to reduce the length of interruptions in the water supply ranged from A$36.50 for interruptions of two hours to A$4.38 for those of 24 hours.

In contrast to the above study, MacDonald et al. (2005) included a status quo level in applied multinomial logit (MNL) models, in order to estimate the implicit prices which were associated with the attributes of urban water supply. The most important attributes were the frequency of future interruptions and increases in annual water bills. Furthermore, implicit price confidence intervals which were based on a random parameter logit (RPL) model imply that consumers are willing to pay significant amounts in order to have a less frequently interrupted water supply. These models were enhanced when the connections between socioeconomic characteristics, e.g. income and age, were included.

Moreover, Cooper et al. (2006) employed choice modelling to examine householder preferences for an improved wastewater service in Victoria, Australia. In addition, Hurlimann and McKay (2007) applied conjoint analysis to assess attitudes within an urban community in South Australia to the use of recycled water for non-potable domestic purposes. The results showed that, having a ‘low salt level’ was the most important attribute for watering the garden, whereas ‘colourless’ was considered as the most important attribute for washing of clothes, and a ‘low price’ for flushing the toilet. The amount of WTP differed depending on the attributes and uses applied.

Another study in Australia (Gordon et al., 2001) applied choice modelling to estimate householders’ WTP to avoid the urban and environmental damage which would be caused by the construction of a new dam, and examined their WTP to avoid the status quo supply option: this involved a greater use of water restrictions. The results showed that residents’ WTP to prevent a reduction in water use by 10% was A$10. However, they also suggested that they were willing to pay A$18 per annum in order to improve the general urban appearance of Canberra. Similar results were obtained by Blamey et al. (1999), demonstrating that consumers were willing to pay for an improved water supply. Both studies emphasise the significance of interventions by government to conserve the environment and upgrade the water supply.

Willis et al. (2002) applied CE to examine the tradeoffs in the preferences of water company customers between a rise in water supply security and the possible effect this might have locally on river and wetland biodiversity, in Sussex, UK. The results demonstrated that consumers’ valuation of higher water supply security was insignificant. However, they also valued the conservation of rivers and wetland habitats; WTP values were €6.30 for a unit increase in the former and €2.10 for the latter.

Another study, carried out in Bradford, UK (Willis et al., 2005), used a stated choice (SC) to estimate the benefit to water company customers of 14 attributes of the water supply. Conditional logit (CL), conditional logit quadratic and nested logit (NL) models were employed to estimate values of marginal rates of substitution (MRS) for each attribute and for householders’ WTP. Meanwhile, SC allowed inferences of their WTP to be made for a whole range of attributes. These had to be organised into ‘blocks’ with three or four attributes in each one; instance. e.g. water supply and quality factors; drinking water and security of supply (SOS); biological and chemical (DWB).Furthermore, SC model coefficients permitted MRS to ascertain each attribute’s implicit price or value.

The findings revealed that a residential customer's WTP was £0.03 for every drop in the number of water samples failing to reach required levels of chemical and biological purity, and £0.317 for each rise of a percentage point in water supply security during a period of drought. They also demonstrated a WTP of £2.27 per year for every thousand fewer properties subject to an interruption of the water supply for 7−12 hours per year, and £0.78 per year for complaints about discolouration of drinking water. Customers disliked wastage of water; their WTP was £0.69 for every percentage point reduction of water lost via leakages in supply pipes; and their WTP for reduction of discoloured water was £0.78, despite it being biologically and chemically safe to drink. The authors claimed that the WTP for each change to an attribute was much simpler to calculate using CE. Yorkshire Water was able to ascertain the most crucial area of their water service in order to improve it effectively. Finally, the Office of Water Services (OFWAT) allowed Yorkshire Water to raise customers' bills to improve water services by an average of £45: from £243 in 2004 to £288 in 2010. These findings are similar to Australian studies (Hensher et al., 2005 and MacDonald et al., 2005) that estimated what customers were willing to pay to reduce the number and frequency of interruptions to supply. However the amount of WTP varied, depending on the frequency of interruptions.

The studies by Accent and CREAM (2002) and Scarpa et al. (2004) used choice modelling for Yorkshire Water, UK. The study included four service levels: the status quo service level (where the expected frequency of an interruption to service was once every 500 years); two levels where service was enhanced (once every 750 and 1000 years, respectively), and a reduction in the service level (once every 250 years). The results revealed that residential customers' WTP was only £0.20 for an improvement in reliability of one level. However, business customers suggested that they were willing to pay £1.74 for such an improvement.

Powe et al. (2004) concentrated on the water supply in the south-east of England, employing CE. There were two evaluations of the possible water supply options: the current level of reliability, and to a lesser extent to ascertain the environmental effects. Even qualitative analysis may support the information required, but this also gives rise to difficulties when valuing environmental goods which are unfamiliar. These become crucial factors when constructing and analysing future research.

Another study by Haider and Rashid (2002) illustrated customer preferences concerning two attributes – water taste and water pressure – while applying conditional logit, in Thunder Bay, Ontario, Canada. Discrete choice experiment is considered to be a formal method to evaluate public preferences and trade-off behaviour in municipal water supply situations.

Furthermore, there are several studies which have applied CE to the valuation of water services in developing countries. Nam and Son (2005) applied CE and CVM to identify residents' preferences and to determine the WTP for an improved water service in Ho Chi Minh City, Vietnam. CVM had two attributes: water quality and pressure; however, the attributes used in CM were water quality, water pressure and price. In CVM, the sample was split into two groups: piped and non-piped. The Results showed that households' WTP to enhance the attributes was noteworthy, as water bills included other costs such as the collection and storing of water in addition to buying it directly. Moreover, householders who used non-piped water acknowledged that water quality was more important to them than water pressure. Although the WTP estimate of WTP within CE was actually slightly higher than that from a single, dichotomous CVM question, the difference was not significant.

However, Snowball et al. (2007) utilised some different attributes such as water discoloration, bacteria, and frequency of water meter problems. Similar attributes were the price of water and water pressure. This study used CM to ascertain the WTP for the improvement of such attributes for the middle-income group in South Africa. The econometric analysis employed was the Conditional Logit model and the Heteroscedastic Extreme Value model. The findings revealed that all attributes included had the expected sign, though meter problems and water pressure were not significant. The most important attributes were supply interruptions and water quality.

In contrast to the above study, Yang et al. (2006) used CE to determine the issues affecting the demand of water and sanitation in Negombo, Sri Lanka. Four possible alternatives of water service were given. Most attributes chosen were all different, except for the price of the monthly water bill. These were: usage of water, water sources, safety, and quantity. Conditional and Mixed Logit models were utilised. Households included those denoted as 'poor' and 'non-poor': this was calculated from monthly per capita consumption. The results suggested that the monthly bill, usage of water, safety and quantity were the most important attributes affecting the choice of water source. Most of the households favoured the status quo (non-piped) level. Meanwhile, the interactions findings demonstrated that 'poor' households had a significant connection with a change in price.

Another research study by Mu et al. (1990) utilised a discrete choice model of households' decisions on the choice of water source in Uganda and Kenya. The findings showed that such decisions depended on the time it took to collect water from different sources, the number of women in a household, and the price of water. On the other hand, household income did not have a significant effect. Similarly, Persson (2002) attempted to examine households' choice of drinking water source in Cebu, Philippines, applying a discrete choice approach. The findings suggested that the cost in time is an important factor in household choice, whereas taste has uncertain effects.

In addition to the time required to collect water, the price and the number of people in the household have been suggested as important attributes in choice decisions by Asthana (1997), who employed a multinomial logit (MNL) model to forecast people's choice of water supply systems in Bhopal, India. This study concentrated on bathing and drinking activities as it had different attributes, such as water pressure and reliability of supply for bathing and water quality for drinking. In addition, the choice model included both source and household characteristics.

Similarly, a study by Madanat and Humplick (1993) used a discrete choice approach to investigate household water demand in Faisalabad, Pakistan; the size of the sample was 588 households. Moreover, two kinds of model were used: the binary-logit model for the decision about connection to the piped network, and a number of multinomial logit (MNL) models for the water supply source choice. The results revealed different models of the choice of supply source for bathing and for drinking. These two choice models included two kinds of explanatory variables: choice characteristics and household characteristics. The findings demonstrated that households with better education and higher incomes preferred piped water, and motor pumps to hand pumps.

Abou-Ali and Carlsson (2004) utilised CE to examine the welfare consequences of an improved health status resulting from better water quality in Cairo, Egypt. The attributes used were short-term and long-term health effects, and the price of the water bill. The findings demonstrated that the mean WTP to deal with health problems brought about by poor water quality was €1.10 per household per month. However, this WTP figure was fairly low, compared to what a programme which would achieve such improvements would cost.

2.4 Choice Experiment Used in Non-Market Goods

Numerous studies employed CE in fields other than improvements to water supplies. Xu et al. (2007) applied the CM method to estimate the benefits which would arise from a change in natural resource management strategies in the Ejina region, China. The results found that the most emphasised attributes were improving water quality and increasing abundance of animal species. In addition, James and Burton (2003) used CM to investigate the conditions under which Australian consumers would be willing to buy genetically-modified (GM) foods. The results suggested that consumers would require a discount to the weekly shopping bill before doing so. Age seemed to influence preferences for a particular kind of food, with the older generation being more willing to accept GM foods. Boxall et al. (1996) also used CM to determine the influences on recreational moose hunting values of various environmental quality changes to the practices of forest management in Alberta, Canada. The attributes were distances from home to hunting area, access within hunting area, forestry management operations in the area, encounters with other hunters, quality of road access, and moose population. The results found that all attributes, excluding road quality and forestry management operations, were significant.

Bueren et al. (2004) reported on household values concerning the effects of land and water deterioration in Australia using choice modelling. Bergmann et al. (2006) used choice modelling to estimate the scale of external benefits and costs for renewable energy technologies in Scotland. Furthermore, Hensher (2001b) applied a discrete choice model to study empirical valuations of the saving of travel time for car drivers in New Zealand. Multinomial logit and alternative specifications of mixed logit models were used to obtain these values. The results demonstrated that choice model specifications which were less restrictive tended to generate higher estimates of time savings than did the multinomial logit model. In addition, the study by Ewing and Sarigollu (1998) in Montreal used a discrete choice experiment model to investigate the issues affecting consumer demand for zero-emission (or low-emission) vehicles. Three different vehicle types – electric, fuel-efficient and conventional – were investigated through the model. A greater consumer preference for electric and fuel-efficient vehicles rather than conventional ones, with regard to both performance and price, was revealed by the results.

Garrod et al. (2002) applied choice modelling to examine WTP for traffic calming in the UK. The results suggested that people had a positive WTP in order to decrease the negative effects of road traffic, and also for an enhanced design of traffic calming measures, rather than a basic one. Moreover, Alberini et al. (2005) applied conjoint choice to assess real estate developers' attitudes to incentives such as decreases in the number of regulations, relief from responsibility for cleanups in the future, and various subsidies. Models and random-coefficient logit models revealed that developers found sites which had contamination problems not as attractive as those which did not, and conditional logit showed that they did appreciate liability relief. Also, a stated preference model was used by Layton and Brown (2000) to investigate a framework of preferences to mitigate the effects of global climate change. The findings suggested substantial heterogeneity in the preferences of respondents; WTP was highly significant and passed the scope test.

Other research by Beggs et al. (1981) used an ordered logit model to examine survey information on the possible demand for electric cars. Also, Oppewal and Timmermans (1999) employed conjoint analysis to investigate the impacts of a number of shopping centre designs, and also the attributes of managing the public appearance of shopping centres. Another study by Willis and Garrod (1999) applied stated preference methods in order to estimate the value to residents of avoiding various levels of externality caused by a local quarry. The findings showed that respondents trade off reductions in tax against the change in the amount of time that they have to deal with inconvenience in the environment. Nechyba and Strauss (1998) suggested a discrete choice to estimate the impact of local finances and variables on individual community choices.

Adamowicz et al. (1994) used CE to examine the preferences of recreationalists for various river scenarios in Alberta, Canada. Eight attributes were used, including and water quality and fish size. The results indicated that the water quality and fish catch attributes significantly determined the journey destination and the consumer surplus or use value per journey was between approximately C$4.33 and C$8.06.

2.5 Overview of Economic Valuation in Malaysia

Based on the literature review, there is a wide range of economic valuation (EV) studies in Malaysia. It has been used in several sectors, particularly in forestry and tourism; for instance, forests including wetlands such as peat swamps and mangrove forests, coastal ecosystems and marine environments (DANIDA-CEMD, 2005). The majority of studies which attempted to estimate nature-based recreation benefits have applied the Travel Cost Method (TCM) (Othman, 2000; Othman and Othman, 1998; Willis et al., 1998; Shuib, 1991). A few recent studies have utilised Contingent Valuation (CV): Alias and Ruhana (2003), Alias et al. (2002), Othman (2001), and Nik Mustapha (1993) employed dichotomous choice and open-ended CV in order to estimate the non-use values of lake recreation benefits and resources.

Othman et al. (2004) employed choice modelling in order to produce estimates for non-market values which arose from various possible management options in Matang Mangrove Wetlands, Perak state, Malaysia. Implicit prices for environmental attributes were estimated, such as the recreational use of the area and the number of bird species and areas of environmental forest which would be protected. Othman (1999) also used CM in the first attempt in Malaysia to estimate non-use values in forest resource management. The results suggested that individual WTP was MYR0.625 for a 1% increase in environmental forest area (about 70 ha) and MYR0.825 for an additional migratory species.

Othman (2002) applied CM and CV to assess consumer WTP for different service options of solid waste (SW) in Malaysia. Another aim was to establish the frequency of generation and magnitude of SW and to examine households' knowledge of, attitude to, and behaviour towards the SW strategies. Othman and Asmuni (2004) employed CR to estimate the economic benefits of forest recreational attributes in Selangor, Malaysia. The consumer surplus was between US$3.84 and US$4.68 in the Forest Research Institute Malaysia (FRIM), Kanching Recreational Forest (KRF) and Kuala Selangor Nature Park (KSNP). Moreover, Willis et al. (1996) used CV and TCM to estimate recreation value in Forest Recreational Areas (FRAs) in Malaysia.

A different study by Kassim (2003) applied Total Economic Valuation (TEV), in studying the economic valuation ecosystem at Pulau Payar, Langkawi, Malaysia, using market prices and transfers of benefit to estimate the economic value for fisheries resources and the value of resources with other uses and non-use resources. Furthermore, Raziah (2002) focused on theoretical CV to assess the economic value for indigenous fruit conservation. Kumari (1997) used incremental cost in a study on biodiversity. Another study by Mohd Shawahid (1997) also applied incremental cost, to estimate use values of conservation of biodiversity in wetlands. In addition, Nik Mustapha (1993) used a dichotomous choice of CV to measure the use value of recreational parks in Tasik Perdana, Malaysia. The findings revealed that the mean WTP was MYR84 to MYR106 and the median was MYR109 to MYR136. Afizah and Siti Baizura (2006) also applied dichotomous choice CV to estimate the WTP for conservation of outdoor recreational places in Bako National Park, Sarawak, Malaysia. The median value of WTP was MYR7.76 per person. Also, a study by Alias and Ruhana (2003) was carried out at the Malaysian Agricultural Park, Bukit Cahaya Sri Alam, Selangor using CV. The results revealed that visitors' WTP was higher than present fees charged.

In conclusion, most EV studies focus on use value, particularly in the forestry sector, to evaluate timber, forestry management options, tourism and recreation, non-timber forest products, wildlife, agriculture and fisheries, minerals and water. Furthermore, benefit transfer has been used in marine and coastal ecosystems. Meanwhile, EV studies also cover use values in tourism and recreation sectors. However, there has been no study on water management in Malaysia which has applied EV. As a result, this research attempts to use CM to estimate the WTP in order to improve water planning in Malaysia.

2.6 Factors Affecting WTP for Water Services

Financing is a necessity for a new project, and consumers are the main resource from which to obtain the capital via their monthly water bills. Therefore, the water provider management must make efforts to identify the factors which influence the WTP for improved water service conditions.

Numerous studies have attempted to examine the factors influencing WTP for water services. The factors affecting domestic demand for enhanced water services in particular parts of South Asia, Africa and Latin America were investigated by the World Bank Water Demand Research Team. This study demonstrated that households' willingness to pay (WTP) was influenced by socioeconomic characteristics. Highly educated households were willing to pay more than lower educated ones, as they were more concerned about improvements in health connected to a better quality of water service. Female respondents were willing to pay more for an improved water service than male respondents (World Bank, 1993).

Similar results concerning education levels were reported by Whittington et al. (1990), Kaliba et al. (2003), Farolfi et al. (2006), Mbata (2006), Alaba (2001) and Pattanayak et al. (2006). They found that the relationship between educated households, particularly women, and improvements to the water service, was positive.

In Haiti, respondents who worked in the farming sector were willing to pay less than non-farming families. Unfortunately, this was not applicable for households in Pakistan and Nigeria. But, in Brazil, respondents who work in the government sector were willing to pay more approximately 15% than those in the private sector. However, there was no statistically significant relationship between households' size and composition and their WTP for an improved water service. Similar findings showed that other socioeconomic factors, such as the number of people in the household, the number of adult women, the number of children, and the age of the respondent, did not influence the WTP for an improved water service.

Furthermore, households in rural areas were willing to pay very little for an improved water supply; the percentage of income which they were willing to pay varied widely. For instance, in Zimbabwe, households were willing to pay less than 0.5% of their income, whereas in Ukunda, Kenya people were willing to pay approximately 9% of income for improvements such as water vendors and kiosks (World Bank, 1993; Alaba et al., 2002). Similar results were obtained in a study conducted by Alaba (2001) in Nigeria. This study employed CVM to identify factors for the demand for water. Households' income level was significant, and also had a positive relationship with WTP.

Previous research findings claimed age and WTP were inconsistent and contradictory. For instance, some older households were not willing to pay for changing to a new water source, because they preferred to use the traditional one (Davis, 2004). Others were willing to pay because they had sufficient assets to do so, and had to travel long distances to collect water from public sources (Farolfi et al., 2006).

Based on consumer demand, households would pay more for improved water services (Raje et al., 2002; Yang et al., 2006; Snowball et al., 2007). Similarly, a study by Nam and Son (2005) applied CVM and CM to examine consumers' preferences and WTP to improve the water service level. There is a negative relationship between WTP and the monthly water bill. For instance, in Haiti, households were willing to pay an estimated 40% of their income for a private connection if the existing water source was far away from their home; whilst households in Kenya were willing to pay an increase of about 10% if they bought water from a vendor or found it time-consuming to collect water, and an increase of approximately 2% if they bought water from a kiosk (World Bank, 1993).

Several studies have revealed that attributes of the water itself also influence WTP for improved water services. In 1999, the Asian Development Bank found that the water quality was the most important factor in determining effective demand for water services. In this research, water quality included chemical and biological composition, water pressure, reliability, taste and smell, and accessibility and convenience. Similarly, a study carried out by Altaf et al. (1993) in Punjab, Pakistan indicated that reliability and water quality were identified as the main attributes influencing WTP. Other studies found that households which experienced low water quality were willing to pay more than households which already received a high quality of water (Hope and Garrod, 2004; Banda, 2004). They were concerned about the water quality due to the positive relationship between WTP and health problems (Whittington et al., 1990; Mbata, 2006). Indeed, a study by Choe et al. (1996) to measure WTP in Davao City in the Philippines revealed that improvement in the water quality of rivers and the sea would benefit recreational users and public health in general.

Other research findings revealed that reliability of service is an important factor. Households were willing to pay more if there is an improved, reliable source. For instance, a study in India reported that about 17% of households who were already connected and 62% of those without piped water were willing to pay for improvements to the water system (World Bank, 1993). Furthermore, households were willing to pay more for a private connection than for access to a public tap. The percentages in Nigeria and Punjab were estimated at 100% and 130%, respectively (World Bank, 1993). Studies conducted by Whittington et al. (1996), and Altaf et al. (1993) showed similar results.

Additionally, there have been some studies in a number of developing countries in order to determine the issues affecting people's WTP for water supply and services. Most of these studies applied CVM. However, the study by Kayaga et al. (2003) used the regression method to determine the relationship between household characteristics and the WTP for water services in 11 large cities in Uganda. There were three aspects, consisting of customer satisfaction, customer loyalty and socioeconomic characteristics. The study found that gender, job, education level, income and property tenure status have affect the WTP. For instance, female heads of household were willing to pay more than male heads, because they had the responsibility to provide for the basic needs of their family, such as food. Moreover, there was also a relationship between satisfaction and loyalty for educated customers, because they were better at decision-making, particularly concerning the water supply achieving quality standards. Consequently, management of water services in low-income countries need to recover costs to be able to operate the water companies.

Similarly, the study by Raje et al. (2002) used logistic regression analysis to determine the factors affecting WTP in Mumbai, India. The results found that certain variables influenced WTP, namely customers' belief in the system for those customers who live in flats and bungalows, and affordability towards increase the water rates for slump group. For example, they are unable to pay more because the prices of basic needs increase continuously.

Other findings in this study claimed that variable affordability also affected WTP. Due to a continuous rise in the prices of basic needs, households were not ready for an increase in the monthly water bill. The type of house being lived in did not influence WTP for an improved water service. However, variable belief contributed to the majority of households' WTP.

Recently, Echenique et al. (2009) applied choice modelling in Hyderabad, India. The population of the city was 5.85 million, with 50% of the residents connected to piped water. The selected attributes consisted of quantity, pressure, frequency of service, quality, quantum of summer apply, choice of service, and cost of service. The findings revealed that household size and literacy, garden size, number of kitchens and toilets, plot size, quantity of water, water quality, and income all influenced households' WTP for improved water services. Surprisingly, the number of years of education did not affect

WTP. Overall, households' WTP is more than the costs of provision in Asian countries as well as other developing countries, and on a par with the monthly water bill in developed countries. Similarly, a study by Olajuyigbe (2010) in Ado-Ekiti, Nigeria, employed logistic linear regression. The results revealed that the determinants of WTP for an improved water supply consisted of the following: the main domestic water supply utilised, distance to that supply, time taken to collect water, access to a better water supply, water consumption per day, quantity purchased per day, impact of waterborne diseases, performance of the water company, and amount of expenditure on water during seasons of drought.

Another study by Kanyoka et al. (2008) also employed CM to identify the gap by examining the demand of multiple uses in Sekororo-Letsoalo, Limpopo Province, South Africa. The findings revealed that customers who lived in rural areas were willing to pay for water service improvements. Similarly, a study was carried out by Mbata (2006) in southern Botswana, which employed CVM to assess the relationship between selected socioeconomic variables and WTP for a private water connection. The results demonstrated that education, income, employment status and awareness level were determinants of WTP. Additionally, a study carried out by Adenike et al. (2009) applied descriptive analysis and logistic regression to examine the factors behind WTP for an improved water service in Nigeria. The outcome was that income and connection charges influenced WTP for an upgrade to water services.

2.7 Cost Benefit Analysis for Water Improvement

Cost-benefit analysis (CBA) can be defined as an economic tool to assess a project or investment through the comparison of economic benefits with the costs of carrying out the activity (Baffoe-Bonnie et al., 2008). Recently, CBA has been applied in the water industry to justify water quality improvements and investment needs. Predo and James (2006) used Microsoft Excel to analyse CBA for the project or investment.

Several studies have revealed the implementation of CBA to evaluate water projects. Cho and Kim (2004) employed the CVM to calculate the monetary value of the water quality improvement in the Paldang reservoir, Korea from third to first-class, by investigating the economic benefits and costs of enhancing water quality. The results enabled local policymakers to discover the level of decrease in water pollution which was the most acceptable to the public.

A similar study by Soto Montes de Oca and Bateman (2005) focused on the measurement of benefits and costs for two water supply situations in Mexico City, namely offers of maintenance of current supply conditions and offers of improvement to the current level of service. In order to evaluate the projects, the benefits were estimated using the customer’s WTP. Most of the findings indicated that WTP to improve water services varied. For instance, poor households were willing to pay a high proportion of income for improvement to the service. The WTP for the urban water supply was estimated by CV; then, the CBA approach was also employed to evaluate policy alternatives to upgrade the service performance.

Another piece of research attempted to examine the costs and benefits of clean coastal water in Greece. Improving coastal water quality could be measured by the improvements to urban waste water treatment. Another objective was to estimate the public WTP for an increase in four-monthly water rates in order to provide a higher standard of clean water. Then, costs and benefits were compared to investigate the economic efficiency of new capital investment (Kontogianni et al., 2005).

Furthermore, Georgiou et al. (2005) used CVM to measure economic benefits. They also estimated the public’s WTP in order for the water company to comply with legislation, and the implications for the health of individuals and society in general. The economic benefits were compared with the costs of improvement of bathing water in the UK based on the European Bathing Water Directive of 1976.

In contrast to the above study, Poirier and Fleuret (2010) applied CE to access local residents’ preferences for water quality management in France. Two models were estimated, namely a conditional logit and random parameter logit. The findings revealed that people were willing to pay for improvements. Next, a CBA was conducted. However, the NPV was negative, which means that it could take a long time to achieve good ecological status in the river basins.

2.8 Conclusions

Briefly, the stated preference methods are divided into Contingent Valuation Methods (CVM) and Choice Modelling (CM), including Choice Experiment (CE), Contingent Ranking, Contingent Rating, and Paired Comparison (PC). Recently, research has applied CM rather than CVM, due to the stability of CM in measuring welfare economics. Previously, CE was employed in marketing and transport. It was followed by environmental economics in such areas as wetlands, water supply and recreation.

Based on the literature review, many studies have been conducted on water supplies, particularly in the US and European countries since the 1970s. However, studies using CM (and particularly CE) are still new in developing countries such as Malaysia, focusing on forestry and tourism. Therefore, this study will employ CE when looking at the attempts of the water supply company (SAJH) to achieve efficiency in the delivery of water. Furthermore, WTP is a technique to measure the willingness and ability of consumers to pay for improvements to the water supply. This benefit to consumers can then be compared against the cost of capital needed to invest in water infrastructure, to deliver these benefits. The socioeconomic characteristics and attributes of the water service have been identified as factors influencing households' WTP for an improved water service. The most significant factors included age, gender, education, income, and water quality.

Additionally, CBA analysis is one tool to evaluate the benefit and cost in water projects. It has been applied widely in developed countries. The purpose is to determine the variability of the project for future investment. If the project is viable, the water provider can proceed with the investment, e.g. delivering safe drinking water to consumers.

CHAPTER 3: STUDY DESCRIPTION

3.1 Introduction

This chapter describes Johor state, the study site for this project, and the socioeconomic characteristics of the population of Johor. Then, it describes the water process, water infrastructure, water tariffs, revenue and expenditure, and water management, planning and monitoring as well as an appraisal of SAJH. This appraisal is based on the Customer Perception Studies in 2007 and 2008 which focused on Service Quality and the Customer Charter. Other important aspects also discussed are non-revenue water (NRW), water quality, the water network, and asset replacement.

3.2 Background of Study Site

This study was carried out in Johor, which is one of the most developed states in Peninsular Malaysia and is the fifth largest (19,062 km^2) state in Peninsular Malaysia (Encyclopedia, 2011). It is situated to the south of Melaka, N. Sembilan and Pahang, and is thus the southernmost state of Peninsular Malaysia. It is also immediately north of Singapore, which is separated from Malaysia by the Straits of Johor. There are eight districts in Johor, namely Johor Bahru, Pontian, Kota Tinggi, Kluang, Segamat, Muar, Batu Pahat and Mersing.

Economic activities in Johor consist of a mix of agriculture, commercial manufacturing, and tourism. For instance, the main products comprise palm oil, rubber, pineapples, and bananas. Johor is also an industrial state, producing electrical appliances, furniture, textiles and petrochemical products.

It experiences wet equatorial weather, and monsoon rain blows in from the South China Sea between November and February. The average temperature is between 25.5°C and 27.8°C; average annual rainfall is 1778 mm, and humidity is 82% to 86% (Malaysia Site). Based on the National Water Resources Study 2000-2050, Johor has adequate water resources for fifty years. There are five major river basins: Sungai Endau, Sungai Sedili Besar, Sungai Johor, Sungai Muar, and Sungai Batu Pahat. However, due to continuous heavy rain, many towns face a flood risk. The flood between December 2006 and January 2007 was particularly serious, affecting Muar, Kota Tinggi, Segamat, and Batu Pahat. There were estimated to be more than 100,000 victims who had to be transferred to flood relief centres. As a result, this situation affected the delivery of water supply to customers.

3.3 Socioeconomic Characteristics of Study Site

In 2008, the population of Johor state was 3,312,400. Johor Bharu has the highest population approximately 1,462,500. It was followed by Batu Pahat and Muar districts. The lowest population is Mersing. This population will influence the number of active customer in both categories namely domestic and non domestic customers. The breakdown of the population is reported in Table 3.1.

Table 3.1: Population in Johor State (2008)

Districts	Population
Batu Pahat	411,800
Johor Bharu	1,462,500
Kluang	318,900
Kota Tinggi	243,500
Mersing	85,300
Muar	401,500
Pontian	174,600
Segamat	214,200
Total	**3,312,400**

Source: Census 2000, Department of Statistics, Malaysia

This study was conducted in three districts, namely Johor Bharu, Batu Pahat and Kluang. The choice of these areas was based on the problems faced by customers (discussed in Chapter 4). The socioeconomic characteristics of Johor State are described in Table 3.2. The 2000 census showed that 51.61% of the population was male. Malays comprised about 55.46% of the population. The majority of the population was less than 30 years old. Households with between 3 and 5 persons were the most common (51.90%), followed by those with more than 8 persons (44.26%). The majority of the population lived in terraced and/or two-storey houses: the percentage was approximately 44.12%. The percentage of those who worked as support staff was estimated at 81.65%, the professional group at 9.6% and others at 8.1%. This pattern of socioeconomic characteristics is meaningful in order to identify water usage behaviour. Hence, water providers can use this information for planning investment in the future as well as marketing purposes.

Table 3.2: Socioeconomic Characteristics of Johor State in 2008

Item	Total	Percentage
Gender	**2,584,997**	
Male	1,334,242	51.61
Female	1,250,755	48.38
Ethnic	**2,584,997**	
Malaysian	2,462,784	-
Bumiputra	1,459,580	-
Malay	1,433,713	55.46
Non Bumiputra	25,867	-
Chinese	825,002	31.91
Indian	166,749	6.45
Others	122,213	0.44
Non-Malaysian	11,453	4.7
Age	**1,501,533**	
20 < 30	462,993	30.83
30 < 40	400,506	26.67
40 < 49	299,093	19.91
50 < 60	173,356	11.54
60 < 70	104,044	6.9
70 < 80	45,087	3.0
80++	16,454	1.1
Person in Household	**571,113**	
2 person and fewer	113,340	19.84
3-5 persons	296,441	51.90
6-8 persons	136,049	23.82
More than 8 persons	25,283	44.26
Type of House	**571,113**	
Terraced/ two-storey	251,989	44.12
Semi-detached	57,919	10.14
Bungalow	201,652	35.3
Other	59,553	10.43
Education	**1,961,064**	
Primary school	752,270	38.36
Secondary school	1,047,867	53.43
College	33,143	1.69
University	127,784	6.51
Current work	**1,022,361**	
Support staff	834,854	81.65
Professional	98,174	9.6
Others	89,333	8.7

Note:
No data for children and income per month
No percentage for Malaysian, Bumiputra & Non Bumiputra
Source: Census 2000, Department of Statistics Malaysia

3.4 Transformation of Johor Water Supply

SAJ Holdings (SAJH) is a subsidiary of Ranhill Utilities Berhad, which is Malaysia's first "source to tap" water solution provider, offering holistic water services from engineering and construction to treatment, distribution and services. It provides a fully integrated service, i.e. it is involved in the all the processes of drinking water supply; these range from raw water acquisition, treatment and purification, and the subsequent distribution of purified water to customers, plus billing and payment collection.

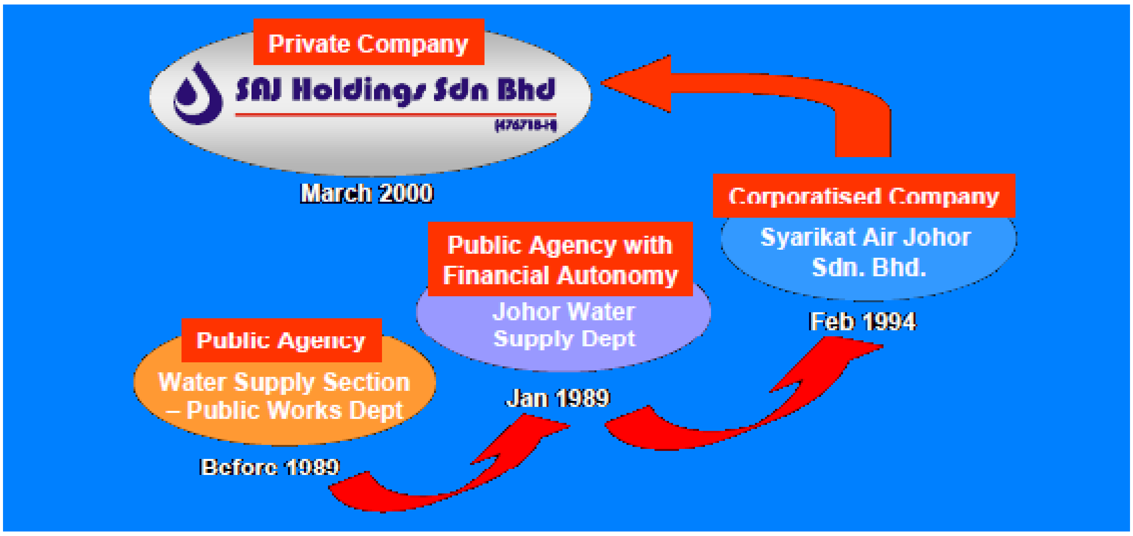
SAJH was granted a concession for 30 years' potable water supply in Johor state, from 1 March 2000 until 2029 (Figure 3.1).

Figure 3.1: SAJH Operational Area

Source: SAJH (2006)

The Water Supply Department of Johor was originally formed in 1989 under the Public Works Department. In February 1994, it became a corporate company, Syarikat Air Johor Sdn. Bhd. In March 2000, it was transformed into a fully privatised company known as SAJ Holdings Sdn. Bhd. (SAJH). This sequence of events is as shown in Figure 3.2. Then, Runhill Utilities Berhad (RUB) was listed as a public listed company in June 2002.

Figure 3.2: Transformation of Johor Water Supply



Source: SAJH (2008)

Specifically, SAJH has put in place an operation and maintenance model, the purpose of which is to plan and deliver enhancements to water service operations, manage and improve the water distribution system and also maintain assets and optimise company operations. This is in order to achieve the lowest possible costs through an effective maintenance programme. In addition, effective management systems to regulate the quantity and quality of water have been established.

There is also an initiative to create strategies to deal with various aspects of measurement data and operating records, and also to carry out the management and development of the entire programme of works. This includes items such as quality management, programme and cost control, asset management and planning, procedure and contract strategies, and monitoring construction (SAJH, 2008).

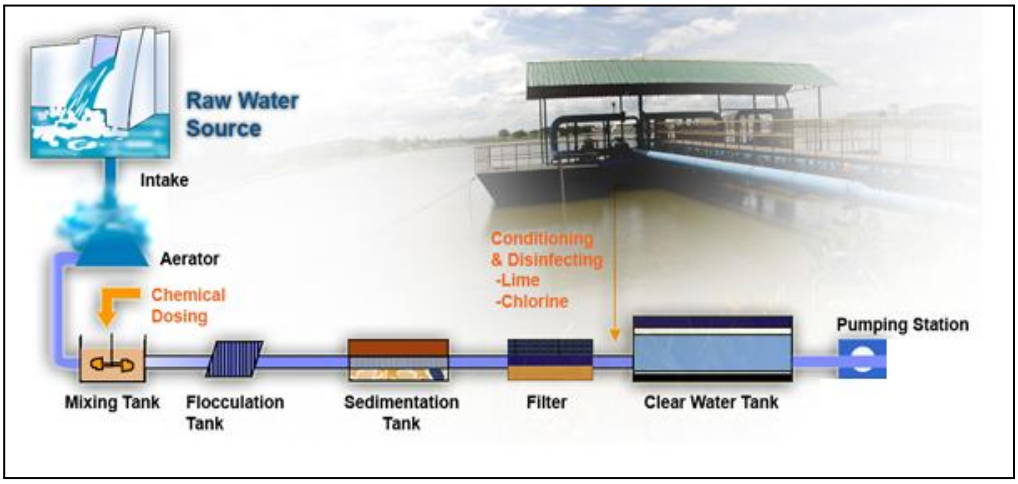
3.5 Water Treatment Process

There are two steps to the water treatment process as follows:

(a) Water Treatment

Water treatment is a process of removing impurities from untreated water, in order to supply water which is good enough for human consumption. Among substances removed are bacteria, algae, iron, sulphur and other chemical pollutants. The conventional treatment plant comprises the following processes:

Diagram 3.1: Water Treatment Process



Source: SAJH (2008)

(i) Screening

Physical material such as wood, leaves, silt and others are screened at intake.

(ii) Aeration

Water pumped from the intake is oxidised for removal of taste and odour.

(iii) Coagulation / Flocculation

The chemical alum is added to allow small particles in the water to combine and become bigger. They grow in size by knocking against each other. These particles are called flocs.

(iv) Sedimentation

In sedimentation, heavy flocs are allowed to settle. Clarified water is then collected from the top of the tank. If, however, the flocs are lighter, bubbles are introduced. The flocs then stick to the bubbles and remain at the top of the tank. Clarified water is then collected from the bottom. This process is called Dissolved Air Flotation.

(v) Filtration

Filters are then used to trap fine particles in the water. The clean water then goes to the clear water tank.

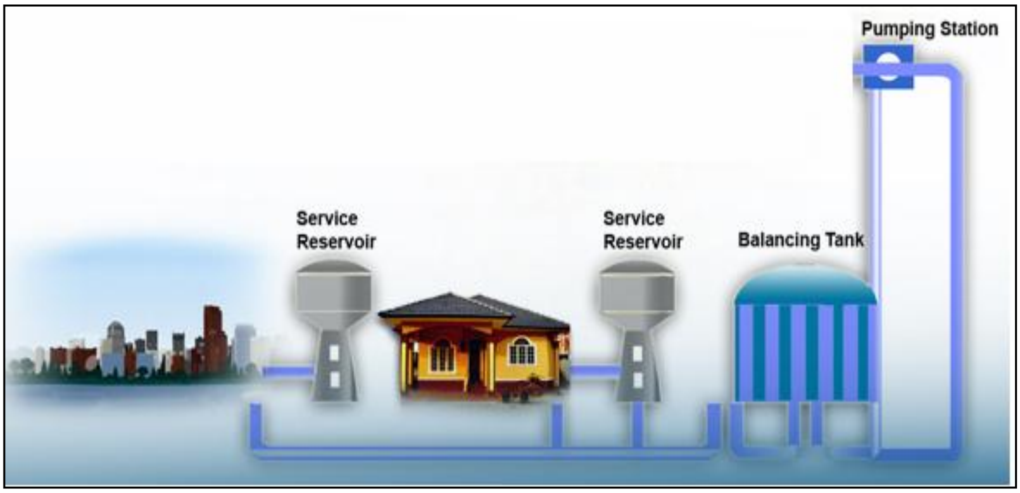
(vi) Disinfection/pH Adjustment

In the clear water tank, the water is disinfected to get rid of dangerous microbes. The pH is also adjusted using lime or soda ash. Acidic water could cause corrosion in pipelines.

(vii) Clear Water Tank

Water will be kept in the clear water tank before distribution. Here, water samples are collected every two hours for testing to ensure that they meet with WHO standards and that the water is safe for usage. The water treatment plant would stop its operations if pollutants were discovered in any of the tests conducted. This is, however, very rare, and most of the treatment plants in operation have never experienced this.

Diagram 3.2: Water Supply Distribution



Source: SAJH (2008)

(b) Water Supply Distribution

After the process, water from the water treatment plant is distributed to consumers, using huge diameter pipe mains. Water is distributed by gravity, or pumped to the tank and then distributed by gravity to customers.

3.6 Water Infrastructure

3.6.1 Water Demand

In 2008, SAJH had 888,756 registered customers, consisting of 777,338 domestic and 111,418 non-domestic customers. This number was an increase of 3.04% compared with active customers in 2007. There is also an uptrend of customers for each district. In 2007 and 2008, the majority of the customers were from Johor Bharu district. This was followed by Batu Pahat and Muar districts. Water demand has a positive correlation with the population. The breakdown of customers was as follows:

Table 3.3: Consumers by Districts and Categories in 2007 and 2008

District	2007			2008		
	Domestic	Non-Domestic	Total	Domestic	Non-Domestic	Total
Johor Bharu	358,534	52,667	411,201	370,376	56,766	427,142
Kota Tinggi	44,097	4,768	48,865	44,550	4,957	49,507
Pontian	37,131	4,949	42,080	38,083	5,163	43,246
Batu Pahat	95,713	13,794	109,507	97,959	14,478	112,437
Segamat	51,477	6,302	57,779	52,582	6,653	59,235
Kluang	66,022	9,165	75,187	67,286	9,508	76,794
Muar	88,008	11,468	99,476	90,445	11,890	102,335
Mersing	15,740	1,863	17,603	16,057	2,003	18,060
Johor	**756,722**	**104,976**	**861,698**	**777,338**	**111,418**	**888,756**

Source: SAJH (2008)

3.6.2 Pipelines and Reservoirs

Pipelines are the most important aspect of the water infrastructure because water needs to pass through them before reaching the customer's tap. The water quality is affected by the material and age of the pipelines. There are many types of pipe. Pipes can consist of asbestos cement, mild steel, ductile iron, cast iron, polyethelene, and uPVC. In total, the length of distribution pipelines in 2007 and 2008 respectively was approximately 16,971km and 17,802 km, as shown below:

Table 3.4: Types of Pipe and Total Length (km)

Material	Length of Pipes (km) 2007	Length of Pipes (km) 2008
Asbestos Cement	7,808	8,074
Mild Steel	2,918	3,067
Ductile Iron	1,273	1,314
Cast Iron	154	156
Polyethelene	607	630
uPVC	4,097	4,480
Other	113	80
Total	**16,971**	**17,802**

Source: Malaysia Water Industry Guide (2009)

Furthermore, there are 535 reservoirs in Johor, with a total capacity of 1,818.54 million litres (Ml). Essentially, the number of reservoirs required is dependent on population numbers, because each reservoir has a limited capacity of water that may be supplied to residential customers. Reservoirs' main purposes include the following: providing a store of treated water in order to minimise any stoppages caused by malfunctions of pumps, mains, or any other equipment; acting as a release valve for a system which is kept supplied via pumps; and sustaining a uniform water pressure across the system (Vipin Bhardwaj et al., 2001). The breakdown of reservoirs by district is reported in Table 3.5.

Table 3.5: Number of Reservoirs in 2008

District	No. of Reservoirs	Total Capacity (Ml)
Johor Bharu	235	1,052.81
Kota Tinggi	53	107.01
Batu Pahat	48	197.34
Pontian	26	70.86
Kluang	59	153.32
Muar	48	120.31
Segamat	49	86.53
Mersing	17	30.36
Johor	**535**	**1,818.54**

Source: SAJH (2009)

3.7 Water Tariffs, Revenue and Expenditure

Johor has the highest average water tariff among states in Malaysia: approximately RM0.98 per m^3 for residential customers. This price has influenced by the cost of water treatment. Moreover, changes in the price must be approved by SPAN. The price per m^3 increases with domestic consumption based on the rate consumed in order to encourage customers to use water wisely for water sustainability reasons, as it is a scarce resource. The breakdown of the price per m^3 is reported in Table 3.6.

Table 3.6: Water Tariff

Usage Category	Rate (m^3)	Price Per m^3 (RM)	Minimum Payment (RM)
Domestic	0–15	0.38	4.00
	16–30	1.31	
	31–45	1.82	
	46–100	2.20	
	>100	2.23	

Source: SAJH (2008)

Additionally, the water tariff will determine the revenue of the water company as well as the percentage of payment of water bills. The company will achieve a profit if the revenue exceeds the expenditure. Expenditure can be divided into two categories, namely capital expenditure (OPEX) and operation expenditure (CAPEX). The expenditure and revenue have shown a year-on-year increase until 2008, as shown in Table 3.7. In 2006, the percentage for revenue over expenditure was approximately 61.2%, which was the highest as compared with previous years, as well as with 2007 and 2008. These fluctuations might be due to the increase of the cost of water treatment and maintenance which occurred during those years.

Table 3.7: Expenditure and Revenue (MYR)

Year	Expenditure	Revenue	+/-
2002	270,722,202	293,531,212	**8.4%**
2003	382,373,342	428,919,218	**12.2%**
2004	390,658,719	497,620,817	**27.4%**
2005	460,719,155	610,068,473	**32.4%**
2006	440,038,670	709,357,518	**61.2%**
2007	288,146,000	716,403,000	**59.78%**
2008	336,114,000	733,073,000	**54.15%**
Total	**2,568,772,088**	**3,988,973,238**	

Source: Malaysia Water Industry Guide (2009)

3.8 Water Management, Planning and Monitoring

The aim of SAJH is to achieve efficiency and effectiveness in delivering a service to customers. Therefore, SAJH developed measurable targets as below:

3.8.1 Setting of Measurable Targets

This target involves the quality objective and customer charter. The quality objective includes the water quality (meeting the Ministry of Health Standards), continuous supply, good water pressure, a safe working environment, environmental compliance, water supply approval, the billing cycle, and Non-Revenue Water (Table 3.8). The customer charter comprises water quality, pipe burst repairs, billing, pipe leakage, interruption, and water supply connection (Table 3.9).

Table 3.8: Quality Objectives

Customer Quality	Quality Targets	Achievement 2007
Water Quality (MOH Standard)	99% compliance	99.5%
Continuous Supply	No more than one scheduled disruption of 24 hours per customer per 90 days	100%
Adequate Pressure	≥ 10 metres residual pressure at any point in reticulation	99.4%
Water Quantity	(i) Min.120% supply capacity against demand (ii) Min.12 hours storage capacity at reservoir	(i) 100% (ii) 100%
Safe Working Environment	(i) Zero penalties (ii) Zero hospitalisations (iii) 100% PPEs compliance (iv) 1/1000 person/year time lost through injury	(i) 0 cases (ii) 8 cases (iii) 28 cases (iv) 100%
Environmental Compliance	Provide sludge treatment for all plants if required	Effluent discharge continuously monitored for compliance
Water Supply Approval/CF Support	(i) New connection for developer 7 days (ii) Water supply approval 14 days after contribution payment (iii) 30 days CF support	(i) 99.79% (ii) 78.22% (iii) 91.76%
Billing cycle	Average of 30 days	30.65 days
Non-Revenue Water	NRW target set at 28% in June 2008 (concession target 20% by 2010)	31.5% as at June 2007

Source: SAJH (2008)

Table 3.9: Customer Charter

Criteria	Target	Achievement
Water shall be supplied in compliance with MOH Standards:		
(i) Residual chlorine;	< 2.8%	2.76%
(ii) Aluminium;	< 10.2%	4.59%
(iii) E. Coli;	< 0.4%	0.0%
(iv) Turbidity;	< 0.2%	0.08%
(v) E. Coli & residual chlorine.	< 0.3%	0.0%
Customers shall be informed of all planned interruptions more than 24 hours in advance.	100%	94.23%
Pipe bursts shall be repaired within 18 hours of receipt of complaint.	100%	99.35%
Pipe leaks shall be repaired within 2 working days of receipt of complaint.	100%	99.42%
Bill queries at the counter shall be attended to within ½ hour.	100%	99.91%
Queries & complaints requiring a visit to the premises shall be attended as follows:		
(i) Visit to the premises within 3 days of receipt of complaint;	100%	94.00%
(ii) Complaint resolved within 10 days of receipt of complaint.	100%	97.96%
New water meters shall be installed at premises as follows:		
(i) 2 working days after deposit paid for individual household;	100%	98.98%
(ii) 7 working days after deposit paid for housing developer.	100%	99.75%
Disconnected water supply shall be reconnected within 3 working days after the related payment is received.	100%	99.57%
Deposits shall be returned within 3 weeks of receipt of application to terminate supply together with related documents.	100%	80.65%
Application for approval of reticulation plans and internal plumbing shall be responded to within 3 weeks of receipt of application.	100%	95.45%

Source: SAJH (2008)

3.9 Appraisal of SAJH

In order to achieve the goal and fulfil customers' expectations, SAJH has conducted customers' perception studies every year. These studies used personal interviews carried by well-trained research assistants. The findings of the customer perception surveys can be reported based on two aspects for 2007 and 2008 as follows:

3.9.1 Service Quality

In 2007, the majority of respondents (estimated at 93%) did not know the quality of the water they received. Approximately 79.6% of respondents were satisfied with water quality and 13% were dissatisfied. Meanwhile, findings in 2008 showed that the majority of the respondents were satisfied that the water supplied complied with Ministry of Health requirements. However, half of the respondents did not know the standard water quality they received. Approximately 91% of respondents were satisfied overall with water quality. In terms of current colour, odour, and taste, only 75% of them were satisfied and 22% were dissatisfied. All the respondents agreed the importance of having better quality tap water which was safe to drink, clear and odourless.

Furthermore, the percentages of respondents who received advance notification for planned water disruptions were 76.2% in 2007 and 68% in 2008, respectively. The most effective channel of communication was through flyers. In 2007, about 93% of respondents experienced interruptions to the water supply over the previous 6 months. The main causes were pipe bursts and leakage at 27.90%, water rationing, estimated at 26.90%, and maintenance work, at about 28.40%. In 2008, half of the respondents have experienced water supply interruption in the previous 6 months because of leakage and pipe burst (42%) and maintenance by contractors/SAJH (estimated at 43%). Approximately 91% of respondents were also satisfied with the water pressure.

There were slight differences in the level of customer concern in 2007 compared with 2008. For the year 2007, where having tap water that is safe to drink, clear and odourless was the highest priority for approximately 66% of respondents; having a water supply which was adequate, with no interruptions except in emergencies was the priority for 33%; while only 0.2% of respondents were concerned with having information about SAJH and service provided. However, in 2008, the percentage of customers concerned that tap water is safe to drink, clear and odourless was 79.26%; those who required information about SAJH and services provided were estimated at 67.04%; those whose priority concern was that the water supply was adequate, with excellent customer service were about 59.52%; and those who wished never to have any interruption in service except during emergency cases were 56.55%.

In 2007, 87% of customers believed that the current status of the water supply infrastructure was in good condition and there was a need to invest for minimum improvement; approximately 12.4% thought it was in bad condition in a few aspects and needed to improve in those aspects; and 0.3% thought it was in very bad condition and needed to improve. 86.2% were also satisfied with the services provided. Their feelings with regard to the standard services of SAJH were that 47% thought they needed improvement, and 53% thought services should remain as they were. The majority of respondents (51.8%) were not willing to pay more for the water services provided; approximately 43.3% agreed with paying more.

However, in 2008, 75% of customers agreed that the overall service provided was excellent, and those 'satisfied' were about 20%. Their feelings on the standard of service can be classified as follows: an estimated 52% were in favour of making improvements to the level of service, and about 43% wished the current standard of service to remain. As far as willingness to pay in order to improve the level of service was concerned, 64% of respondents disagreed and only 18% agreed.

In conclusion, the majority of respondents were not willing to pay for improvements to the level of the water supply service. Surprisingly, the percentage of respondents who preferred to improve the level of service rather than maintain the current standard increased from 47% in 2007 to 52% in 2008. This situation might arise because they assume that water is a basic need, therefore, the water tariff should not be raised. At the same time, the cost of living continuously increased.

3.9.2 Customer Charter

The main objective of an organisation's Customer Charter is to increase customer access to services and encourage the quality of those services. It does so by informing the customers of the standards of service which they should expect, how to contact the organisation, and what they should do if they are dissatisfied with the service provided. From the employees' point of view, such a charter is a benefit, as it ensures that the services offered by the organisation are clearly laid out (Paternoste, 2010). The SAJH customer charter comparison study for 2007 against 2008 is reported in Table 3.10.

Table 3.10: Customers' Perception on Customer Charter for 2007 and 2008

	Very Satisfied	Satisfied	Dissatisfied	Year
Complaints will be settled within 10 days from date of receipt of complaint.	-	48.5%	38.8%	2007
	28%	65%	5%	2008
Disconnected water supplies will be reconnected within 2 working days of receiving payment of arrears.	-	62%	24%	2007
	30%	58%	4%	2008
Water meters for individual households will be installed within 2 working days of receiving deposit.	-	85%	8.9%	2007
	41%	52%	5%	2008
A visit by a customer to the water company's premises will be responded to within 3 working days from date of receipt of complaint.	-	69.7%	24%	2007
	34%	61%	3%	2008
Leakages will be repaired within 2-3 days of notification within working hours.	-	65.5%	28%	2007
	33%	60%	5%	2008
Burst pipes will be repaired within 18 hours of notification.	-	77%	12.5%	2007
	31%	61%	6%	2008

Note: No data for very satisfied in 2007
Source: Customer Perception Survey in 2007 and 2008

There were dramatic changes of customers' perception of all aspects of the customer charter between 2007 and 2008. The highest percentage of 'very satisfied' or 'satisfied' customers in 2008 was an estimated 95% for a response within three working days of a visit by the customer to the company's premises. This was followed by complaints being settled within 10 days (approximately 48.5% and 93% in 2007 and 2008, respectively). Similar results occurred for the installation of water meters and leakages repaired within 2-3 days of notification (approximately 93% in 2008). Surprisingly, there was an increase in customer satisfaction concerning the repair of burst pipes within 18 hours from 77% to 92% between the 2007 and 2008 surveys. In addition, 12.5% of customers were very dissatisfied about the repair of burst pipes in 2007. These situations showed the improvement of the water service provided by SAJH. Nowadays, customers are more concerned about the level of service provided by the water operator (Goett et al, 2000), particularly water quality, which has a direct impact on health problems.

In summary, the feedback from these surveys is important to SAJH in setting a benchmark and the need for continuous improvement and further development to meet customers' perceptions and satisfaction. For instance, SAJH should educate the public on the priority of investing in the water supply.

3.10 Non-Revenue Water (NRW)

According to Asian Development Bank (2010), non-revenue water (NRW) can be defined as the difference in volume between the amount of water leaving the treatment plants and that for which customers are billed. There are three components of NRW as follows:

(a) Physical (i.e. real) loss of water consists of leaks throughout the system and reservoirs overflowing. This is caused by failure to actively control leakage, the poor quality of assets underground, and poor operations and maintenance procedures.

(b) Commercial (i.e. apparent) loss of water is caused by consumption being under-recorded by faulty meters, errors in data handling, and water being stolen by various means.

(c) Also, certain authorised consumption of water is unbilled. This includes that used by firefighters, that used by the company itself in its operations, and that made available free to particular consumer groups.

At the moment, NRW is estimated at 24.9%, which is reduced from 30%. NRW is the crucial factor influencing water revenue. As previously mentioned, SAJH has invested more capital for delivery of safe, high quality water to customers. Therefore, SAJH has to reduce NRW to ensure that revenue exceeds capital and operating expenditure. In 2004, SAJH implemented the NRW Strategy and Action Plan, which focused on improvements in addressing, managing and monitoring various NRW issues. The response strategy includes the following:

(a) *Awareness*: elements causing NRW are bursts, leaks, reservoirs and meter malfunctions. These can be encountered at any time, and will influence NRW levels. If reservoir levels, system flows and pressure are monitored at significant points, this will result in quicker action to resolve problems.

(b) *Location*: NRW levels will also be affected by the time taken to discover the exact reasons for loss. For instance, a loss caused by a reservoir overflowing can be easy to determine, whilst others such as a small buried leakage need a longer time to investigate.

(c) *Repair*: when the exact cause of the loss has been identified, repairs will be carried out with better quality materials in order to avoid repetition of the problem.

Other initiative tools also used include the Job Management System (JMS), Remote Monitoring System Installation, District Metering Zones Establishment, Customer Meter Management, and Production Meter Management.

3.11 Water Quality

According to National Water Quality Handbook (2003) a working definition of water quality is its biological, chemical, and physical makeup in relation to the uses for which it is intended (such as drinking, irrigation, fishing and recreation).

Water quality is the most important attribute to be considered when attempting to improve the water supply service. Therefore, SAJH water quality should comply with the Ministry of Health’s Drinking Water Quality Guidelines (MOH Guidelines) in physical, chemical and microbiology aspects. Currently, 29,036 water samples have been tested and 234,928 tests have been carried out on these.

The strategic plan was put into practice to ensure that the MOH Guidelines were complied with. The guidelines include levels of pipework scouring and reservoir cleaning procedures, in order to enhance consumer water quality (Summerill, 2010). Within the network system, there are five secondary chlorine closing systems installed.

Sampling activities were affected because the plants were shut down due to the floods of December 2006 to January 2007. In order to solve this issue, SAJH increased water quality monitoring, consisting of treatment plants, tankers and static tanks. SAJH developed the Central Laboratory located in Sri Gading, Batu Pahat to test water samples of water for compliance with the MOH Standards (SAJH, 2008).

The objectives of the Central Laboratory are:

(i) to co-ordinate the associate district laboratories and suppliers as well as private laboratories where samples of water from each plant are sent;
(ii) to troubleshoot, should the district laboratory assistant be unable to diagnose or manage a water quality problem;
(iii) to arrange training of operators and laboratory assistants;
(iv) to communicate with MOH officers concerning any water quality violations;
(v) to contribute to the monitoring of trends in water quality;
(vi) to maintain a database of historic results;
(vii) to purchase glassware and reagents for use in the plant laboratory.

Whereas the roles of the District Laboratories are:

(i) to monitor the water quality in the district plant and troubleshoot any problems;
(ii) to carry out water quality spot checks in the plants;
(iii) to monitor and control measurements to ensure water quality and record-keeping targets are met;
(iv) to calibrate and check the accuracy of instruments in a planned manner, to ensure instrumentation is fully functional;
(v) to deal with the plant concerning the laboratory’s glassware and chemical reagents requirements.

At the moment, there are 975 sampling points throughout the water supply system. New sampling points will be installed in order to fulfil the increasing number of connections (Eighth Malaysia Plan, 2001). The Water Quality Information System (WaQIS) software system is employed to consolidate the water quality test results and interpret the water quality performance for the entire state of Johor.

In addition, the Central Laboratory utilises the latest technology instruments, such as the Atomic Adsorption Spectrometer (AAS) and Gas Chromatography–Mass Spectrophotometer (GC–MS), to identify heavy metals, trihalomethane (THM), and other pesticide content in raw and treated water, as well as other organic pollutants for short periods. Then, the formulation of the strategic Water Quality Action plan includes preventative measures and remedial action procedures that consist of reservoir cleaning and an air-scouring programme, to upgrade water quality.

SAJH has also hired 40 reliable and well-trained staff for the Water Quality Department to perform analysis and sample and test the physical, chemical and microbiological characteristics of more than 35,000 water samples per year, on which 300,000 water tests per year are conducted.

Approximately 99.5% of the water quality samples tested passed the required standard as outlined in the MOH Standards. In September 2005, SAJH’s Central Laboratory was awarded ISO/IEC:17025 certification by the Department of Standards of Malaysia (SIRIM). SAJH also introduced water tank cleaning: the first scheduled tank cleaning programme in Malaysia.

3.12 Network

In 2000, SAJH developed a customer call centre, which operates 24 hours, 7 days a week. This is the first such technology adopted in the Malaysian water industry. It serves as a nerve centre to receive feedback and complaints from customers. The Job Management System (JMS) is a database to receive customer feedback, turning it into job assignments and job status reports. This information is meaningful for evaluation, planning, decision-making, and management action. Currently, the SAJ Info Centre receives an average of 2275 calls per week about a variety of issues, for example damage enquiries, meter problems, water quality, billing enquiries, water theft, leakages, lack of water supply, tanker requests, pipe bursts, and poor water pressure. The number of calls has increased by 8.8% since 2006. This shows that customers are more concerned about water wastage and have taken action to conserve water.

In 2006, there was an average of 666 pipe bursts per month. This decreased to an average of 615 cases per month in 2007. This was due to the Asset Replacement Department and Pressure Management Programme completing the replacement of pipes. Pressure-reducing valves (PRVs) were inserted into the network at certain critical positions under the Pressure Management Programme, in order to lower the number of occurrences of burst pipes. At present, approximately 98.1% of burst pipes are repaired within 18 hours.

Furthermore, due to improved detection of leaks and better customer feedback, 1850 repairs of minor leaks per week have been achieved: an increase of approximately 25% from 2008. The performance standard for the time to repair pipe leaks was decreased in September 2006 from three to two days. It is estimated that about 95% of minor leakages have been repaired within two days since then.

The Network Department and the NRW Department collaborate closely together in order to achieve the NRW target levels by managing the implementation of the NRW Strategy and Action Plan. The Network Department was responsible for monitoring and controlling the water crisis in Segamat, Muar, Johor Bahru and Kota Tinggi during the major floods which affected Johor state of Johor in December 2006 and January 2007 (SAJH, 2008).

3.13 Asset Replacement

In the Second Operating Period programme (from 30 June 2007), 668 km of asbestos cement pipes were replaced by the Asset Replacement Department. Also, under the Rehab programme in 2006 and 2007, 77 km of asbestos cement pipes were replaced.

Major pipe repair and replacement work took place following the two floods in December 2006 and January 2007. In total, MYR9.3 million was assigned for work to prevent landslides and conduct repairs, and a further MYR4.4 million in order to replace damaged pipes. Also, because of various upgrading and development works by the authorities, some relocation of pipes by SAJH was required. In all, during the Second Operating

Period, MYR12.0 million was spent on such works requested by the authorities. Another MYR1.8 million was spent for works requested since 2006 that marked the beginning of the Third Operating Period (SAJH, 2008).

3.14 Conclusions

SAJ Holdings Sdn. Bhd. was fully privatised in March 2000. It functions as a structured water system supply company dealing with the total cycle of the drinking water supply system. The process starts sourcing of raw water, treatment and deliver of treated water to consumers, issuing of bills and collection of payments.

Johor state was chosen as a case study. The survey was be conducted in three districts included Johor Bharu, Kluang, and Batu Pahat. These areas were chosen to represent problematic areas in Johor that experience issues such as water quality, pipe burst and leakage, interruption, and water pressure. The main demographic characteristics of the state are as follows: an estimated 55.46% of the population are Malay and 51.61% are male (based on the 2000 census). Meanwhile, the majority of the population has a primary and secondary school education (approximately 91.79%).

The number of customers continually increased approximately 3.04% between 2007 and 2008. Currently, SAJH have 888,756 registered customers. The water infrastructure, including pipelines and reservoirs, was considered as the main attribute influencing the water supply service. Additionally, water tariffs, revenue and expenditure are the most important aspects to determine the viability of project investment.

Johor has the highest water tariff in Peninsular Malaysia: about RM0.98 per m^3 for residential customers. Basically, water tariffs increased when consumption rises, in order to achieve water sustainability. The tariff is the primary determinant of SAJH’s revenue, rather than other income such as the connection and installation fees.

The appraisal of SAJH concentrated on the customer charter as the basis for the main attributes of this research, such as leakages and burst pipes. The analysis referred to the customer survey that is conducted every year to evaluate the level of service provided to the residential customer in particular. The results demonstrated that the service level has improved in certain aspects, while other aspects need to be improved. One of the critical aspects is NRW, which is still high: this needs to be resolved by SAJH.

Other categories such as water quality, asset replacement and water network also influence the overall service level. The integration of all aspects is very important to achieve efficiency and effectiveness in delivering safe drinking water. Therefore, SAJH should invest for the future.

CHAPTER 4: METHODS AND PROCEDURES

4.1 Introduction

This chapter describes the methodology applied in this research. It starts with the properties of discrete choice models and the specification of Conditional Logit (CL) and Mixed Logit (MXL) models. This study will employ a CE to measure customers' WTP to improve water supply for residential customers in Malaysia, particularly in Johor state. Then, the detailed stages of CE are also presented. It also mentions the process of fieldwork data collection, including the pilot test, sampling design, and the justification of selecting three districts in Johor state.

4.2 Properties of Discrete Choice Models

4.2.1 Choice Set

In discrete choice models, decision-makers include households, people and other units of decision-making. They choose amongst alternatives such as water attributes, product attributes and so on. The set of options within the choice set must accomplish three features. First, the options must be mutually exclusive: this means that selecting one option equals not being allowed to choose any of the others. The person making the decision has to select one option only from the set of choices. Second, this set has to be exhaustive, i.e. it must comprise all possible options. The decision-maker is asked to choose one of the options. Third, the number of options must be limited (i.e. not infinite). The alternatives may be listed and one eventually reaches the end of the list (Train, 2000). This is what makes the distinction between discrete choice analysis and regression analysis, which in theory allows for an infinite number of options.

To take an example, there can be a number of alternatives forming the choice set for a person deciding how to get to work: driving on one's own, car sharing, using the bus or train. However, the options may become more complicated because one could use multiple modes of transport for a particular trip, e.g. driving one's car to a railway station and taking the train from there. Therefore, the choice set can include every possible combination of transport modes. As an alternative, the choice may be defined as that of the "primary" mode: in this case the set comprises only bus, car, train and "other" (encompassing all other possibilities such as walking or using a bicycle; "other" is used to ensure the choice set is exhaustive).

4.2.2 Identification of Choice Models

The specification and estimation of the discrete choice model are affected by the behavioural decision process. There are two parts as follows:

(a) Differences in Utility

The actual degree of utility is immaterial, both to the decision-maker's behaviour as well as to the researcher's model. If one were to add a constant to the utility of all the possible alternatives, the one with the highest utility would remain the same (Train, 2000).

The choice probability is $P_{ni} = \text{Prob}(U_{ni} > U_{nj} \forall j \neq i) = \text{Prob}(U_{ni} - U_{nj} > 0 \forall j \neq i)$, which depends upon the differences in utility. However, if the utility consists of observed and unobserved parts, the choice probability becomes $P_{ni} = \text{Pr ob}(\varepsilon_{nj} - \varepsilon_{ni} < V_{ni} - V_{nj} \forall j \neq i)$ which is based on the differences. This indicates that only variations in utility matter, which has implications regarding the recognition and specification of discrete choice models (Train, 2003). Basically, it will take several forms, as below:

(i) Alternative Specific Constants (ASC)

It is satisfactory to assign the observed part of the utility to represent a linear parameter, including the constant (Train, 2000). The equation is written as:

$$V_{nj} = x'_{nj} \beta + k_j \forall j$$

where:

x_{nj} = vector of variables that relate to alternative j as faced by decision-maker n

β = coefficient

k_j = constant specific to alternative j

The alternative specific constants (ASC) have a similar role with the constant in the regression model (Train, 2003) because they capture whatever orderly variations in the choice observations which are related with an option that is explained neither by the observed socioeconomic characteristics of the respondents nor by the attribute variation (Othman et al., 2004).

When alternative specific constants are present, the unobserved portion of utility, ε_{nj}, then possesses zero mean by construction. However, since only the variations in utility are relevant, so are only the variations in the alternative specific constants, not their absolute values. To reflect this, the researcher must set their overall level (Train, 2003).

(ii) Socioeconomic Variables

Entering socioeconomic variables will affect the model. Generally, the main attributes vary among alternatives. However, the attributes of the decision-maker do not vary amongst alternatives. For instance, the person's income will affect the willingness to pay a price rise for every cubic metre of water if the water provider improves the water service in terms of water quality or pressure. This result indicates that a person's utility service depends on higher income. The socioeconomic variables affect the differences in the utility service through their interaction with the attributes of the alternatives.

(b) The Scale of Utility is Irrelevant

In the same way that adding a constant to all the alternatives' utility will not change the choice of the decision-maker, neither will multiplying each alternative's utility by a constant. The choice which possesses the highest utility remains the same, regardless how utility is increased (or reduced). This means that it is not an issue how utility is scaled. However, the standard process to normalise the scale of utility is by links between the variance of the error terms (Train, 2003). As a result, normalising the variance of the error terms is equivalent to normalising the scale of utility (Train, 2003).

4.2.3 Statistical Significant of Model Estimates

An outcome in statistics is considered to be 'statistically significant' if the likelihood is that it has not occurred by chance. Moreover, this is different from the use of the term significance. Significance is a statistical term that states how certain we are that a difference or relationship exists. The relationship of significance can be strong or weak. Significant differences can be large or small.

The amount of evidence necessary to show that an event is not likely to have occurred by chance is called the level of significance or critical p-value. The level of significance is usually represented by the Greek symbol α (alpha). The most common levels are 5% (0.05), 1% (0.01) and 0.1% (0.001). If a significance test produces a p-value lower than the level of significance level, the null hypothesis is then discounted (Hill et al., 2007).

In order to analyse the panel data, this study will be an applied SAS program. The procedure, which is called MDC (Model of Discrete Choice), will perform calculations on a variety of multivariate random utility models, consisting of conditional logit, nested logit, HEV (Heteroskedastic Extreme Value) and multinomial probit models. However, this research will focus on only two models, multinomial logit (MNL) and mixed logit (MXL).

Normally, the SAS results reveal information under the headings “Model Fit Summary”, “Discrete Response Profile”, “Goodness of Fit Measures” and “Parameter Estimates”. However, the statement algorithm converged at the beginning of the model. The most important analysis is to evaluate whether to consider the estimated parameters in the model as representing real effects. If the p-value of the parameter is high, it is considered non-significant, since there is a high probability that a parameter estimate of the same size can be generated, even when the true model parameter is zero; whilst if it is low, then it is considered to be significant, and one can be more certain that the parameter estimate represents a true effect. This is very practical data in assessing the parameters of the model (Lívia Madureira et al., 2007). Those insignificant parameters can be ignored when trying to judge whether the parameters that are significant correspond to the beliefs about the relationship between the effects in the question and the behaviour (Markley, 2007).

4.2.4 Limitations of the MNL Model

(a) Taste Variation

Generally, the importance or value that decision-makers confer on each attribute of the options differs among themselves (Train, 2003). For instance, water quality is probably more important to households with a higher income level than those with a lower income. Different respondents will choose different options depending on their individual preferences and concerns, even they have the same education, income, job and so on.

As a result, MNL can represent systematic taste variation, but not random taste variation. It can capture taste variations, but only in a very limited fashion. More precisely, tastes that are consistent with reference to observed variables can be covered, but those that vary with unobserved variables or strictly randomly cannot be handled (Train, 2003).

(b) Substitution Patterns

If representative utility is required by the research, MNL must utilise proportional substitution throughout all the options. This means that altering the attributes of one option, e.g. price, increases or decreases the probability of its being decided (Train, 2003). For example, when the water provider increases the water tariff for each cubic metre, customers will decrease the quantity of daily usage and use water wisely. Instead of using potable water, they will change to rainwater or well water.

Therefore, MNL employs a certain pattern of substitution across alternatives. MNL is also appropriate, whenever replacement occurs in this way, given the researcher's specification of representative utility (Train, 2003).

(c) Repeated Choice over Time

In research, there are numerous choices between various alternatives made by each decision-maker. Typically, respondents are faced with a series of hypothetical choice enquiries, called "*stated preference*" experiments. A set of alternative options with different attributes will be presented to respondents (Train, 2003). Respondents are required to decide how their choice will change when the attributes change (Yohei Mitani, 2008). Consequently, the researcher indicates the sequence of choices by each respondent. Data that represent restated choices like these are addressed in panel data (Train, 2003).

MNL can be applied to examine the panel data, if the unobserved factors that impact decision-makers are independent across the repeated options. However, dynamics- related factors with unobserved factors cannot be managed, because the unobserved factors are assumed to be unrelated over options (Train, 2003).

4.2.5 Panel Nature of Data

As mentioned above, in stated preference experiments, respondents are faced with a series of hypothetical choice enquiries and are asked how their choices would alter when the attributes do. Information collected in this way, that represents a series of different choices by the same individual, is called panel data. In other words, panel data refers to a set of data on the same individual over several periods of time (Maddala, 2001).

4.2.6 Taste Heterogeneity

The options chosen by the respondent constitute differences in utility, according to the decision rules. In order to describe the type of heterogeneity in the population, direct measures of taste are employed to capture the psychological factors affecting decisions. For instance, the respondent will be faced with a series of options about their preferences of attributes of non-market goods and ask them to determine their preferences between the alternatives presented.

In addition, heterogeneity can be separated into observed and unobserved categories. In terms of observed heterogeneity, the preference heterogeneity among individuals can for instance be captured when using the interaction between attributes and individual-specific variables (i.e., socioeconomics) (Pollack and Wales, 1992). In the random parameter framework, by contrast, coefficients of attributes are broken down into a mean value that presents the average attitude over the whole sample. Meanwhile, a deviation from the mean is specific to each person in the sample. Based on this pattern, heterogeneity is summarised applying a parametric density function for the coefficients in the model. Hence, the proportion of the sample which prefers an attribute and that which does not can be estimated (Train, 1998).

Mixed logit is extensively used in the random parameter discrete choice model that represents preference heterogeneity in many fields, such as marketing (Louviere et al., 2002; Ben-Akiva et al., 1999b) and non-market valuation (Train, 1998; Von Haefen et al., 2004).

4.3 Theoretical Framework

The choice experiment[1] method derives from random utility theory (Luce, 1959; McFadden, 1974; Thurstone, 1927) and the characteristics theory of value (Lancaster, 1966). Random utility theory (RUT) is an example of a discrete choice econometric model. It makes the assumption that the individual is perfectly able to make choices which are fully informed; but also assumes that the researcher does not have all the information and consequently must take uncertainty into consideration (Manski, 1977). In choice experiment, individuals choose between different sets of (environmental) goods; these are depicted in terms of their characteristics (or “attributes”) and attribute levels. One of these attributes is usually price (Hanley et al., 1998); estimates of marginal utility relating to changes in attribute level may be translated into monetary terms (Hanley et al., 2002).

In order to identify the choice of the water supply attributes which is preferred by most people, choice experiment (CE) has been employed. Essentially, the choice experiment method consists of characteristics theory of value and random utility theory (Rolfe et al., 2004).

Basically, RUT comprises two components, namely representative utility (observable) and random components (unobservable). An individual will evaluate each alternative from $Uj; j = 1..., J$ possible alternatives. The decision-maker must compare $U_1, U_2, ...U_j ....,UJ$ and choose the alternative with the maximum utility. In other words, RUT assumes that the probability of decision-maker n choosing alternative j is the difference between random components of alternatives j and i less than the difference between the representative utilities of alternatives i and j for all alternatives in the choice set (van Bueren et al., 2004; Ryan et al., 2009). Decision-maker n chooses alternative i if and only if $U_{ni} > U_{nj}$, $i \neq j$ (Train, 2003). Furthermore, the analyst will observe the attributes of alternatives x_{nj} and socioeconomic characteristics of decision-maker s_n. Therefore, the utility function is denoted as $V_{nj} = V(x_{nj,} s_n)$ and known as *representative utility* (Train, 2003).

1 The choice experiment method has been referred to in the literature by a range of names, especially more recently: “stated choice”, “attribute-based stated choice”, “choice-based conjoint”, and “choice modelling”. This study uses the terms “choice modelling” and “choice experiment” interchangeably.

Normally, the equation of the utility is represented as $U_{nj} = V_{nj} + \varepsilon_{nj}$, where ε_{nj} is the random factor. The joint density of the random factors vector $\varepsilon_n = < \varepsilon_{ni} ... \varepsilon_{nj} >$ is denoted as $f(\varepsilon_n)$. Then the probability of decision-maker n choosing alternative i can be expressed as:

$$
\begin{aligned}
P_{ni} &= \text{Prob } (U_{ni} > U_{nj}) \\
&= \text{Prob } (V_{ni} + \varepsilon_{ni} > V_{nj} + \varepsilon_{nj}) \\
&= \text{Prob } (\varepsilon_{nj} - \varepsilon_{ni} < V_{ni} - V_{nj}) \qquad (4.1)
\end{aligned}
$$

This probability is a cumulative distribution; the probability that each random term $\varepsilon_{ni} .... \varepsilon_{nj}$ is below the observed quantity $V_{ni} - V_{nj}$. Then, using the density $f(\varepsilon_n)$, this equation can be rewritten as:

$$
\begin{aligned}
P_{ni} &= \text{Prob } (\varepsilon_{nj} - \varepsilon ni < V_{ni} - V_{nj}) \\
&= \int_{\varepsilon} I(\varepsilon_{nj} - \varepsilon_{ni} < V_{ni} - V_{nj}) f(\varepsilon_n) d\varepsilon_n, \; j \neq i \qquad (4.2)
\end{aligned}
$$

where I (.) is the indicator function, which is 1 when the expression in the parentheses is true, and 0 otherwise (Train, 2003).

It is complex to predict respondents' preferences because of the random component's influence. This component allows the modelling of the choice of options in a probabilistic form: the probability that individual n will choose option i from the choice set over the other options j may be expressed as:

$$
\text{Prob } (i \mid C) = \text{Prob } \left\{ V_{in} + \varepsilon_{in} > V_{jn} + \varepsilon_{jn}, \text{all } \; j \in C \right\} \qquad (4.3)
$$

where:

C = complete choice set

To estimate an equation (4.3), it is presumed that random elements are independent and identically distributed (McFadden,1974) and Type 1 extreme value distribution or Gumbel-distribution (Weibull). Then, the probability of choosing i can be given by:

$$
\text{Prob } (i) = \frac{\exp^{\mu vi}}{\sum_{j \in C} \exp^{\mu vj}} \qquad (4.4)
$$

where:

μ = scale parameter. This is inversely proportional to the standard deviation of the error distribution, and is generally assumed have a value of 1.

Equation (4.4) can be calculated by means of a multinomial logit or conditional logit model (CL) that has to obey the IIA property. This means that the relative probabilities of two choices are unaffected when they are either inserted into or taken away from the list of alternatives (Ben-Akiva and Lerman, 1985).

Therefore, the probability of an individual's choice, where they are facing two alternatives *i* or *j*, can be expressed as (Boxall et al., 1996):

$$\text{Prob }(i) = \text{Prob}(\varepsilon_i - \varepsilon_j < V_j - V_i)$$

or

$$\text{Prob }(j) = \text{Prob}(\varepsilon_j - \varepsilon_i < V_i - V_j) \quad (4.5)$$

Then, to estimate the linear-in-parameters utility function for the j^{th} alternative as follows (Blamey et al., 1999):

$$V_j = ASC_j + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + ... + \beta_k X_k + \gamma_1(S_1 * ASC_j) + ... + \gamma_p(S_p * ASC_j) \quad (4.6)$$

where:

β = vector of coefficients

X = vector of observable characteristics of alternative i or j

p = socioeconomic characteristics

j = alternatives in the choice set

k = attributes or factors

γ = vector of utility values associated with vector of individual respondent differences

Moreover, ASCs capture the unexplainable factors which can explain choice mean effect in the error terms for each alternative (Ben-Akiva and Lerman, 1985). Socioeconomic characteristics can be included in the model interactively with ASCs (Swallow et al., 1994). ASCs also relieve inaccuracies caused by the assumption that IIA is violated (Train, 1986).

When the parameter estimates have been obtained, the estimation of welfare can be derived from WTP, according to Hanemann (1984); Parsons and Kealy (1992), Alvarez-Farizo and Hanley (2002), Hurlimann and McKay (2007); and also the method used by van der Pol and Ryan (1996), which can be derived as follows:

$$WTP = b_y^{-1} In \left\{ \frac{\sum_i \exp(V_i^1}{\sum_i \exp(V_i^0} \right\} \tag{4.7}$$

Equation (4.7) can be simplified as follows:

$$WTP = \frac{-b_c}{b_y}$$

where:

b_c = coefficient of any of the attributes in the model

b_y = coefficient on price

However, if the IIA is not violated, the standard random utility model can no longer
water quality (Train, 1998); consumers' choices of efficiency level of household appliances (Revelt and Train, 1998); be employed. There are more complex statistical models, including the random parameters logit (Train, 1998), the nested logit (McFadden, 1981) and also the multinomial probit (Hausman and Wise, 1978). IIA may be tested via Hausman and McFadden's method (1984).

4.4 The Mixed Logit Model (MXL)

Mixed logit[2] models have been applied to numerous examples of environmental analysis, e.g. householders' WTP for various attributes of water services (Hensher et al., 2005); WTP for an upgrade to fish stock, affected by anglers' choices of fishing sites and the individuals' choices of vehicle based on emissions and fuel consumption (Train and

[2] Mixed logit is also known as logit kernel probit or logit kernel, and random parameter logit or random coefficient logit. This research prefers to use mixed logit due to it composed of mixture of logit models.

Sonnier, 2004) and demand for generation of renewable energy, for instance water and wind power (Goett et al., 2000);

There are advantages of mixed logit specification, as follows: the model may be obtained via utility-maximisation, and the IIA property is not revealed; it explains possible correlations between recurring selections by each respondent. The model is also able to portray circumstances in which the coefficients have a distribution pattern different from the normal distribution (Brownstone and Train, 1996; Revelt and Train 1996). Consequently, if a normal distribution is imposed in such cases, it is possible to obtain results which may be improbable or counter-intuitive when utilising the estimates from the model.

The specification adopts the mixed logit developed by Revelt and Train (1998) and Train (1997). Individual n faces a choice among J alternatives in each of T time periods. J can be as small as 2, and T can be small as 1. Hence, the person's utility from alternative j in the period t can be written as follows:

$$U_{njt} = \beta'_n X_{njt} + \varepsilon_{njt} \tag{4.8}$$

where:

ε_{njt} is assumed to be an extreme value of IID independent of β_n

Individual n chooses alternative i in period t if $U_{njt} \forall_j \neq i$. Moreover, the coefficient vector β_n is unexplained, for each n diversifies among the population with density $f(\beta \mid \theta)$ where θ represents the parameters of this distribution. If β_n is specified to be the same for all respondents, then θ is its value for all respondents; however, if β_n is specified to be normally distributed in the population, θ represents the mean b and covariance W.

Normally, the respondent chooses the situations that provide the maximum utility. Therefore, the person's chosen alternative in period t is denoted as y_{nt}, the person's sequence of choices over T time periods as $y_n = \langle y_{n1},..., y_n T \rangle$, and the set of $y_n \forall_n$ as Y. The probability is conditional on β_n, then respondent i choosing alternative j in situation t is standard logit (McFadden, 1974):

$$L_n(i,t \mid \beta_n) = \frac{e^{\beta'_n X_{nit}}}{\sum_j e^{\beta'_n X_{njt}}} \tag{4.9}$$

where e_{nti} is independent over choice experiments. The conditional probability of the respondent's n sequence of choices – the product of the logit – is:

$$P(y_n \mid \beta_n) = L(y_{n1},1 \mid \beta_n)....L(y_{nT,}T \mid \beta_n) \tag{4.10}$$

If the researcher does not observe β_n, these conditional probabilities are integrated over all possible values of β_n, using the density of β_n:

$$P(y_n \mid \theta) = \int P(y_n \mid \beta) f(\beta \mid \theta) d\beta \tag{4.11}$$

where $P(y_n \mid \theta)$ is the probability of the sequences of choices by the respondent, conditional on the parameters of the distribution $f(\beta \mid \theta)$. According to McFadden and Train (2000), any choice model may be closely approximated in an arbitrary manner by a mixed logit which has a suitable specification of $f(\beta \mid \theta)$.

Generally, the integration of mixed logit probability has no closed form. Therefore, it has to be approximated numerically via simulation. Practically, *R* draws of β are taken from density $f(\beta \mid \theta)$. The product in Equation (4.10) is calculated for each draw. The results are then averaged over all draws. Then, the simulated probability, denoted $\tilde{P}(y_n \mid \theta)$ for this average, is:

$$\tilde{P}(y_n \mid \theta) = \frac{1}{R} \sum_r P(y_n \mid \beta^r) \tag{4.12}$$

The population parameter θ is calculated by introducing $\tilde{P}(y_n \mid \theta)$ for each individual into the log-likelihood function and function over θ. The estimator is consistent if *R* is considered to increase with the size of the sample, and is asymptotically equivalent to the estimator of the maximum likelihood on the (infeasible) exact probabilities, and asymptotically normal and efficient if *R* increases faster than the square root of the size of the sample (Lee, 1995; Hajivassiliou and Ruud, 1994). Halton draws are utilised to carry out the simulation, as the results will be more accurate when estimating mixed logits than random independent draws (Bhat, 2001; Train, 2000; Hensher, 2001a).

4.5 Design Stages in the Choice Experiment

In order to construct the CE questionnaire, there are five steps (Louviere et al., 2000, Rolfe et al., 2004). These are: the definition of attributes, the assigning of attribute levels, the creation of scenarios, the determination of choice sets and acquisition of preference data, and the estimation of model parameters. Similarly, studies by Bateman et al. (2002), and Mohd Rusli Yacob and Ahmad Shuib (2009) suggested that CE has five stages, including the selection of attributes, the determination of levels, the choice of experimental design, choice sets construction, and the of measuring preferences. However, the experimental design and constructing the questionnaire were identified as the most important stages in CE.

4.5.1 Defining Attributes

Definition of attributes is the most crucial stage in CE. Environmental goods or services can be characterised by a number of component attributes, and the choice among these is a key issue for the researcher (Astrid, 2000). Attributes determined must be familiar and relevant to respondents (Garrod et al., 1999). These characteristics include those thought to be part of people’s preferences for the environmental change being considered, and attributes which can be impacted by policy, project/management option choice (Bateman et al., 2002). Identifying attributes can be taken from relevant sources, for instance literature, report documents, brochures and expertise in water resources.

This study has selected attributes from the customer charter and quality objectives of SAJH. There are many criteria listed in these documents, such as water quality, continuous supply, adequate pressure, water quantity, a safe working environment, environmental compliance, water supply approval, the billing cycle, and Non-Revenue Water (NRW). However, only seven attributes have been selected for this research, which are: leakage, burst pipes, reservoirs, water quantity, connections, pressure, and disruption. These attributes were selected because they are the priorities, as far as residential customers are concerned, in order to achieve a higher level of service. They are divided into two blocks: water infrastructure (WI) and residential customers (RC). The detailed attributes are listed below:

Table 4.1: List of Attributes

Attributes	Definitions
Water Infrastructure	
1. Leakage	Water is lost through leakage (cracks) in old pipes. Currently 30% of all water supplied by SAJH is 'lost' in the system through leakage before it reaches customers. With investment in new pipes, and better maintenance of existing pipes, this leakage could be reduced to only 20% by 2010.
2. Burst pipes	Currently, SAJH repairs 98.5% of all burst pipes within 24 hours of receipt of a complaint. With further investment, this rate could be increased to 99% or even 100% in the future.
3. Water Quantity/Reservoirs	Daily production must be sufficient to meet customer demand. At the moment, the supply capacity achieved against demand is 119%. With new investment in plant treatment and reservoirs, this capacity could be increased. This would reduce the likelihood any supply disruption during periods of drought.
Residential Customers	
1. Water quality standard	More than 35,000 samples of water are tested each year to check the purity of tap water. Currently, SAJH water achieves 99.7% compliance to the MOH Guidelines. With new investment in water treatment and distribution this compliance could be increased to 99.8% or even 99.9%.
2. Disruption	Disruption to water supply can occur for a number of reasons such as leakage in main pipes, drought, etc. Currently, customers experience loss of water for 2 hours per day for 4 days per year on average. With improved investment in pipe maintenance and reservoirs, this disruption could be reduced.

Table 4.1 (continued): List of Attributes

Attributes	Definitions
3. Connections	Customers must apply for new connections (and any reconnection because of non-payment of water bills). SAJH will install a connection within 3 days (including reconnections after outstanding payments are received). With further investment this period could be reduced to 2 days or with more investment to just 1 day.
4. Pressure	Some customers experience low water pressure due to geographical and physical factors, replacement of pipes, and upgrades to treatment plants. Currently, SAJH provides normal pressure to around 93% of residential customers. With planned investment, good water pressure could be supplied to 95% of customers, and further investment would mean 98% of customers always had good pressure.

Source: Quality Objectives and Customer Charter of SAJH

4.5.2 Attribute Levels

In this study, most of the attributes' levels are measured by percentage descriptions. There are three levels of attribute: level 1 is the status quo, level 2 and level 3 represent improvements. Table 4.2 presents the details of attribute levels.

Table 4.2: Attributes and Levels

Attributes	Levels	Current Situation
Water Infrastructure		
Leakage	1. 30% 2. 25% 3. 20%	30%
Burst pipes	1. 98.5% of repairs within 24 hours 2. 99% of repairs within 24 hours 3. 100% of repairs within 24 hours	98.5% of repairs within 24 hours
Reservoirs	1. 119% achieved against demand 2. 125% achieved against demand 3. 130% achieved against demand	119% achieved against demand
Residential customers		
Water quality standard	1. 99.7% compliance 2. 99.8% compliance 3. 99.9% compliance	99.7% compliance
Disruption	1. 2 hours per day for 4 days per year 2. 1 hour per day for 3 days per year 3. 1 hour per day for 2 days per year	2 hours per day for 4 days per year
Connections	1. 3 days 2. 2 days 3. 1 day	3 days
Pressure	1. 93% of households 2. 95% of households 3. 98% of households	93% of households
Price	1. no change 2. increase by 10% 3. increase by 20%	no change

4.5.3 Choice Options

This study implemented a series of multiple choices (Mohd Rusli Yacob and Ahmad Shuib, 2009). The attributes were split into two blocks, namely water infrastructure (WI) in part A and residential customers (RC) in part B. This is because it is easier to manage the attributes based on the concern of consumers to the level of service provided. Moreover, the number of alternatives can be reduced, rather than combined into seven attributes in one block.

For each attribute, there are three choices or alternatives which include option A, option B and option C (the status quo or current situation), which implies that the respondent does not require any improvement of the water supply.

4.5.4 Experimental Design

A design experiment can be defined as a method of manipulating attributes and their levels in order to allow the rigorous testing of particular hypotheses of interest (Louviere et al, 2000). In other words, experimental designs present the means to select subsets of the total set of possible alternatives for use in the questionnaire. This study used Statistical Analysis Software (SAS) to set the attributes and levels.

This study has two blocks, encompassing water infrastructure (WI) and residential customers (RC). Water infrastructure contains four attributes (leakage, burst pipes, reservoirs and price) and three levels (3 x 3 x 3 x 3) = 81 alternatives that are considered a complete factorial design, i.e. all the possible combinations. Moreover, residential customers comprises five attributes (water quality, disruption, connection, pressure and price) and three levels (3 x 3 x 3 x 3 x 3) = 243 alternatives. In this case, the total of the full factorials for both blocks is 324 alternatives (81 + 243). Practically, it is difficult to ask each respondent to evaluate and respond to too many alternatives. Therefore, for 324 choice sets, a complete factorial design would have 162 alternative pairs plus the current situation. This became 54 choice sets of three alternatives for each set. However, in the survey, the choice sets are still difficult to manage.

As a result, another option is needed: either use of a fractional factorial design, or blocking of the experimental design. In fractional factorial design (FFD), only a certain portion of all the possible combinations of attribute levels is implemented. It is then possible for the design to lower the number of alternatives between which the respondent must decide, and still permits the unknown parameters sought by the researcher to be estimated.

Moreover, a special condition requires that fractional factorial design must fulfil the property of orthogonality. This means that there is no correlation with other attributes. With this condition, the effect of any changes to these attributes on individuals' choices may be ascertained and measured. In other words, parameter estimates are uncorrelated and satisfied when any two levels of different attributes in the profile occur jointly, and their frequencies amount to the product of their marginal frequencies (Huber and Zwerina, 1996).

To ensure participation from respondents, choice sets should be accepted by the respondent in order to avoid survey dropouts, reducing the respondents' burden for data quality concerns. Therefore, with the factional factorial design in this study of 3^4 for block 1(WI) and 3^5 for block 2 (RC), the total number of choices in the choice sets is four for each block; so, in total, there are eight choice cards. According to Carson et al. (1994), in most research, subjects assess between one and sixteen choice sets, with an average of eight choice alternatives per person.

After the choice sets have been created by using the experimental design, the next step is to review each choice set for the presence of implausible or dominated alternatives. Implausible alternatives are defined as those where the attribute levels move in ways that most respondents would find counter-intuitive, traced by the experimental design. Dominated alternatives are those which are combined with other alternatives: the latter are universally superior on account of their experimental design-driven attribute levels. The strategy of dropping choice sets with implausible or dominated alternatives can avoid the problem, but it also can cause departures from the orthogonal character of the fractional factorial used. The process of trade-off associated with the dropping of implausible or dominated alternatives due to the importance of an orthogonal design means that the attributes may be frustrated and that the resulting parameter estimates will not isolate the effects of each attribute (Bernett et al, 1999).

4.5.5 Choice Sets

Once an experimental design has been selected, alternatives should be packaged to present them to the respondent. The number of alternatives must be reasonable. It is impractical to burden the respondent with too complex and difficult a task because they may not give reliable answers, and they may become tired and may not complete the questionnaire.

Moreover, there are options when there are too many attributes and levels: 1) try to reduce the number of attributes and levels offered; 2) group the attributes into subsets, with a common theme to each set, and construct a smaller design for each set; and 3) construct large designs, then split them into "blocks" and offer respondents each block only once. The last two options have implications for the sample size needed. For example, if the design is divided into several sub-tasks then it will almost certainly not be possible for each respondent to complete all the tasks, which will therefore need to be allocated to different groups of respondents. Similarly, if the design is split into blocks, the sample size will automatically be increased: for instance, 500 respondents become 1500 respondents when the design is split into three blocks (Bateman et al., 2002).

In addition, Smith and Desvousges (1987) suggested that ranking sets of between 4 to 6 elements are suitable for getting consistent answers, compared with sets of more than 8, which are too complicated for most respondents.

However, in paired comparisons up to 26 profile-pair ratings were presented to respondents (Johnson and Desvousges, 1997). This was because the individuals became involved in a learning process and later ratings scored better than previous rating outcomes. Moreover, in their CE study, Adamowicz et al. (1995) applied 16 pairs for each respondent and Hanley (1997) used eight pairs. Meanwhile, Kroes and Sheldon (1988) implemented 9 to 16 pairs in their study.

Another possibility is to construct smaller sets of alternatives to be proposed to the respondents. Therefore, respondents can be asked to choose, rank or rate their most preferred options from those provided in the choice set.

Therefore, this study implemented four choice cards, chosen in Part A (Water Infrastructure – WI) of Section B. This was followed by another four choice cards in Part B (Residential Customers – RC).

4.6 Questionnaire Design

In order to design the questionnaire and the choices or alternatives in the choice card, this study followed the experiment design applying SAS, as mentioned in section 4.5.4. Hence, the first part contains background information such as the topic of the research. This is then followed by detailed information regarding the respondent that must be completed, including the date, starting and ending time, location and serial number. The interviewer should introduce himself/herself, briefly explain what the research is about, and explain that all responses will be treated as confidential and for research purposes.

The second part presents general information on Johor Water Company (SAJH), the issue and purpose of this research. The briefing is very important in order to portray the current situation correctly, and also the study being undertaken. Then, the details about attributes in SAJH follow, such as Water Infrastructure (WI) including leakage, burst pipes, reservoirs; and Residential Customer (RC) consisting of water quality, disruption, connections, and pressure. The summary of the current attributes are also mentioned so that the respondent keeps them in mind and to make it easier for him/her to answer the following questions, particularly in the choice sets of Section B.

This questionnaire has three sections. Section A consists of Water Experience with SAJH, including the length of time the customer has been with SAJH, the monthly water bill and customer satisfaction on the water service provided by SAJH since privatisation in March 2000. These items are leakage, burst pipes, reservoirs, water quality, disruption, connections, pressure, and price. The questionnaire used the Likert scale: very satisfied (5), fairly satisfied (4), neither satisfied or nor dissatisfied (3), fairly dissatisfied (2), and very dissatisfied (1). In addition, respondents were also asked about use of water filters, purchase of bottled water for drinking, and boiling of water while at home.

Section B is the choice experiment, including Quality Service and Quality Objective. There are a total of eight choice cards, consisting of attributes from Water Infrastructure (WI), and Residential Customers (RC). The attributes of WI include leakage, burst pipes, and reservoirs, while RC includes water quality standard, disruption, connections, and pressure. Initially, each choice card has a brief explanation on the three alternatives comprising options A, B and C (option C is the status quo). Respondents are asked to choose their preferred options for all choice sets with different attributes and levels. The price is also included, for instance as shown below in Figure 4.1.

Figure 4.1: Example of Choice Card

The card below presents three alternatives. Please state which alternative you prefer the most. Option C is the current situation, Options A and B are alternatives.

If you would like to see leakage reduced, and all burst pipes repaired with 24 hours, and some increase in reservoir capacity and you are happy to pay a 20% increase in your water bill then you should choose Option A.

If you are not concerned about reducing leakage but would like to see all burst pipes repaired within 24 hours, and you would like to see a bigger increase in reservoir capacity, and you are willing to pay 10% more for your water bill then you should choose Option B.

Alternatively, if you are happy with the current levels of service from SAJH and you do not want to pay any more for your water, then you should choose Option C.

There is no right or wrong answer. We are just interested in your preference for the service factors.

You will now be presented with 4 cards and asked to choose on each card which option you prefer most.

If you would like to see leakage reduced, and all burst pipes repaired with 24 hours, and some increase in reservoir capacity and you are happy to pay 20% increase in your water bill then you should choose Option A.

	Option A	**Option B**	**Option C**
Leakage	**20%**	**30%**	30%
Burst pipes	100% of repairs within 24 hours	100% of repairs within 24 hours	98.5% of repairs within 24 hours
Reservoirs	**125%** achieved against demand	**130%** achieved against demand	119% achieved against demand
Price	increase by **20%**	increase by **10%**	no change
PREFERRED CHOICE	✓		

Section C contains socioeconomic characteristics, including gender, age, level of education, income, type of house, number of children and number of people in the households, and current work.

4.6.1 Focus Group

Basically, there were four steps in the focus group included introduction, important discussion, testing the draft of questionnaire and closure. Coordinators of focus group will be introduced by facilitator in the introduction session. Important discussion focuses on the issue of the study and the attributes of the environmental goods which chosen for this study. It was followed by testing the draft of questionnaire and participants could evaluate and comments on it. At the end of session, they were allowed to point out their opinion and make a clarification on the issue.

Focus groups were conducted with the residential customers and top management of SAJH in May 2008. Four focus groups were conducted with 24 participants. The discussion to collect the qualitative data took approximately 90 to 120 minutes (Krueger, 1994, Rolfe and Bennett, 1996). This method was employed due to affordability, immediate feedback and reduction of complex sampling and statistical analysis (Desvousges and Frey, 1989).

Certain issues were explored in the focus group, including crucial issues of water improvement in order to deliver safe water and sustainability of water preservation, and also, customers' WTP for water improvement, the payment collection mechanism and management of the WTP for various projects which are beneficial to them. The most important parts of discussion were identified the problem of water management and water attributes as well as their level for both aspects, namely Water Infrastructure (WI) and Residential Customers (RC). Selection of attributes was based on elements of the service quality and customer charter, while also referring to journals and documents from SPAN.

The outcome of the focus group was slightly similar among residents from three districts. They agreed with the attributes chosen, comprising leakage, burst pipes, reservoir capacity, water quality, disruption, connection, pressure and price. These attributes could be measured as indicator of water service performance. However, there was a detailed discussion about the determination of the level of selection attributes. Most of the attributes were measured as percentages.

The majority of participants claimed that the choice sets were confusing because of the levels and they had to choose the level they most preferred. Therefore, a few amendments were made following the suggestion in the focus group in terms of sentence structure and frames or formats in the choice card. The status quo column (option C) was made slightly bolder to make it easier for respondents to compare it with the improvement levels, option A and option B. It is most important that the respondent makes the right decision on the choice card. They also comment on the order of the questions, and in particular that the questions on the choice card and the language used must be simple and easy to understand (fewer technical terms).

Powe et al. (2005) looked at the issue of post-questionnaire focus group analysis, and examined the flexibility of CE, because respondents were asking to choose among a variety of attributes and levels that they preferred most for particular environmental goods. Whilst qualitative analysis is a crucial method to gain a true picture, this is difficult when using the questionnaire method. These results present useful indicators for improving future studies and the implementation of methods.

Powe et al. (2004b) employed a mixture of questionnaire surveys and focus groups to examine customers' willingness to pay expensive water bills for funding. The purpose is to manage biodiversity preservation in England and Wales. The findings reveal that customers are willing to forgo a proportion of the potential reduction of the bill in order to pay for biodiversity. However, they are not willing to pay increases in the bill for the same benefits.

In conclusion, the management and customers of SAJH agreed with the attributes and levels presented in the choice card as well as the issues of the study. Lastly, the questionnaire was translated into a Malay version.

4.7 Fieldwork Data Collection

4.7.1 Pilot Test

The pilot test was conducted in March 2008. Each respondent was presented with the series of four choice cards relating to Water Infrastructure (WI) and four for Residential Customers (RC). This pilot test was conducted with 20 respondents in order to discover the understanding of the terms used as well as the questionnaire, particularly on choice sets. The respondents were all residential customers in Johor Bharu.

The results indicated that most of the questions were well managed and all sections were clear to understand. However, Section B, which presents the series of choice cards, was found to be a quite complicated task to complete due to the variety of attributes and the choices to be answered to show the respondents' highest preference. Options A and B present the improvement of attributes and option C is the current situation. Overall, the questionnaire was understood by respondents. It took about 30 minutes to complete all 27 questions, including respondents' experience with SAJH, the choice cards and the socioeconomic profile.

Furthermore, the reliability analysis has been conducted to assess and improve the reliability of variables used. The Cronbach's alpha of the internal consistency or average correlation of variables is used in a survey instrument to gauge its reliability. This research employs the ALPHA option of the PROC CORR procedure using SAS (Joe, 1999).

There are three questions using the Likert scales consisting of Q4 (1 = very dissatisfied; 5 very satisfied); Q17 (1 = completely unimportant; 5 = very important) and Q18 (1 = Disagree strongly; 5 = agree strongly). The results of the reliability analysis are presented in Table 4.3.

Table 4.3 Reliability Analysis

(a) Cronbach Coefficient Alpha – Question 4: Experience

Variables	*Alpha*
Raw	0.789004
Standardized	0.856219

Cronbach Coefficient Alpha with Deleted Variable

	Raw Variables		*Standardized Variables*	
Deleted Variable	*Correlation with Total*	*Alpha*	*Correlation with Total*	*Alpha*
Leakage	0.223677	0.802676	0.249382	0.877541
Burst	0.830021	0.739322	0.922721	0.798822
Reservoirs	0.830021	0.739322	0.922721	0.798822
Quality	0.544392	0.762910	0.463164	0.854474
Disruption	0.545022	0.767332	0.626026	0.835726
Connections	0.538487	0.759804	0.558858	0.843584
Pressure	0.507808	0.771110	0.613721	0.837179
Price	0.557684	0.784560	0.498185	0.850530

(b) Cronbach Coefficient Alpha – Question 17: Service Performance

Variables	*Alpha*
Raw	0.755696
Standardized	0.803623

Cronbach Coefficient Alpha with Deleted Variable

	Raw Variables		*Standardized Variables*	
Deleted Variable	*Correlation with Total*	*Alpha*	*Correlation with Total*	*Alpha*
Reduce leakage	0.663465	0.700310	0.670438	0.757531
Improve bursts	0.680725	0.717620	0.700888	0.752655
Increase reservoirs	0.643524	0.688132	0.720307	0.749517
Improve quality				
Reduce disruption	0.491291	0.737981	0.450272	0.791213
Improve	0.414420	0.737922	0.393309	0.799489
connections	0.570515	0.708821	0.538326	0.778070
Increase pressure				
Increase price	0.267680	0.758265	0.278389	0.815652
	0.354335	0.786289	0.401529	0.798305

(c) Cronbach Coefficient Alpha – Question 18: Strategy

Variables	*Alpha*
Raw	0.823077
Standardized	0.823087

Raw Variables			*Standardized Variables*	
Deleted Variable	***Correlation with Total***	***Alpha***	***Correlation with Total***	***Alpha***
Strategic plan	0.756000	0.725389	0.756105	0.725215
Staff training	0.552025	0.819423	0.552303	0.819429
Increasing funding	0.747409	0.729310	0.747322	0.729503
Education				
	0.544949	0.822727	0.544688	0.822739

(d) Cronbach Coefficient Alpha – Overall Variables

Variables	*Alpha*
Raw	0.852752
Standardized	0.898765

Cronbach Coefficient Alpha with Deleted Variable

Raw Variables			*Standardized Variables*	
Deleted Variable	***Correlation with Total***	***Alpha***	***Correlation with Total***	***Alpha***
Leakage	0.375375	0.848501	0.385518	0.897800
Burst	0.863449	0.836620	0.862243	0.884372
Reservoirs	0.863449	0.836620	0.862243	0.884372
Quality	0.275485	0.856507	0.251575	0.901384
Disruption	0.572471	0.843983	0.586805	0.892260
Connections	0.470575	0.844966	0.435237	0.896449
Pressure	0.674674	0.841367	0.714100	0.888660
Price	0.299192	0.861325	0.272259	0.900835
Reduce leakage	0.754575	0.834015	0.737774	0.887982
Improve burst	0.766555	0.839154	0.770502	0.887040
Increase reservoirs	0.659187	0.834933	0.675669	0.889755
Improve quality				
Reduce disruption	0.459167	0.847343	0.473959	0.895389
Improve	0.254418	0.852758	0.281574	0.900588
connections	0.550686	0.841067	0.557574	0.893077
Increase pressure				
Increase price	0.391796	0.847914	0.359876	0.898492
	0.298755	0.864658	0.354336	0.898642
Strategic plan				
Staff training	0.397764	0.848490	0.498111	0.894724
Increasing funding	0.322928	0.850374	0.334333	0.899179
Education	0.612123	0.842951	0.666716	0.890009
	0.389976	0.848671	0.469498	0.895512

The Cronbach's alpha values of experience, service performance and strategy were 0.789004, 0.755696 and 0.823077, respectively. Furthermore, the overall variable value was 0.852752. The values indicated that Cronbach's alpha is acceptable, due to the recommended value exceeding 0.70.

4.7.2 Data Sources and Techniques of Data Collection

This research used both primary and secondary data. Primary data was collected through the survey and focus group discussions. Meanwhile, secondary data included annual reports and publication from Malaysian Water Association (MWA), documents from Johor Water Company (SAJH) and government publications.

There are many survey methods for handling fieldwork. These are mail surveys, telephone interviews, and personnel interviews. These methods are different in terms of cost, time to collect data, quality of data, quantity of data, response rate, and the degree of complexity and versatility allowed. Practically, the design of the questionnaire must take into account and be consistent with the chosen data collection technique. Table 4.4 presents the advantages and disadvantages of each survey method.

Personal interviews were used to collect the data. The sample comprised residential customers at the SAJH office counters in three districts: Kluang, Batu Pahat and Johor Bahru. There are several advantages of personal interviews: they are very flexible, larger quantities of data may be collected, they allow for further probing of answers and clarification of questions, it is possible to create more complicated questionnaire structures, the potential exists for the use of visual helps, and there are high response rates and control of the sample. In addition, the interviewer can assist the respondents by explaining in detail the structure of the questionnaire and the response needed, particularly for CE questions. They can also correct the respondents if they overlook a question and monitor the behaviour of respondents if they feel it is not convenient for them to complete the questionnaire. Furthermore, the CE technique is a new approach in Malaysia, and the personal interview was the best method for gaining customer feedback in this field of study.

Table 4.4: Survey Methods

Method	Advantages	Disadvantages
Mail survey	Relatively inexpensive Lack of interview bias Easier to answer sensitive questions Can be completed at respondent's own pace	Low response rates (25–50%) Self-selection bias Time-consuming Little control over who fills in the questionnaire Fixed question order No clarification or probing possible Restricts the use of visual aids Respondent can alter earlier responses
Telephone interviews	Complex questionnaire structures are possible Cheaper than personal interviews Permits probing and clarification Relatively quick to administer Easy to monitor 60-75% response rates	No use of visual aids Restricts use the lengthy scales Respondent may get tired Respondents may not answer sensitive questions Non-telephone or non-listed respondents not sampled
Personal interviews	Highly flexible Complex questions and questionnaire structures are possible Permits probing and clarification Larger quantity of data can be collected Potential for extensive use of visual and demonstration aids High response rates 70%+ Greatest sample control	Relatively expensive Interviewer bias Intercept surveys: samples normally not representative and self-selection bias Intercept surveys: questionnaires have to be short
Mixed modes: **Drop off survey (mail + personnel)**	Initial personal contact gives survey a 'human face'	Survey may be lost in interval before calling back Expensive

Table 4.4 (continued): Survey Methods

Method	Advantages	Disadvantages
Mail + telephone surveys	Respondent telephoned for interview time, gives personal touch Can complete mailed questionnaire in own time	Shares some of the limitations of mail surveys Relatively expensive
Computer-assisted interviews	Interviewer records responses directly on computer and/or respondent may respond to questions on computer screen, speeding up analysis Permits more complex interviews Permits use of email and Internet	Possible rejection of 'computer technology' Email/internet may preclude random sample unless wide coverage of PCs

Source: Bateman et al. (2002)

4.7.3 Sampling Design

This study applied cluster sampling for collecting the data. A characteristic of cluster sampling is heterogeneity among the elements within each group. Hence, there are several groups with intragroup heterogeneity and intergroup homogeneity. It is possible to carry out random sampling of the clusters or groups and obtain information from each member (Sekaran, 2003). Additionally, the most important properties of cluster sampling include the fact that the population is divided into N groups called clusters and samples are randomly selected from n clusters by the researcher. Due to budget constraints, cluster sampling is the best method (Zelin et al., 2005). However, the drawbacks of cluster sampling are that it is exposed to the greatest biases and is also the least generalisable of all probability sampling designs. This is because most of the clusters which occur naturally in the organisational context have no elements which are heterogeneous (Sekaran, 2003). Furthermore, the justification of the best time to conduct cluster sampling is exactly when the researcher experiences the difficult task of gathering the full and complete list of population elements. Also, the population is concentrated in 'natural' clusters. In this study, sampling took place in the urban areas in three districts in Johor state: Johor Bharu, Kluang and Batu Pahat.

Furthermore, the sample design encompasses deciding both which types of people to interview and how many of them; in principle, to select a subset of the target population in order to achieve accurate and reliable data. Moreover, from a statistical point of view, this consideration of bias is taken into account in the statistical analysis and the variance as well. From the survey side, there are aspects of reliability and quality (Bateman et al., 2002).

It is assumed in this case that every residential customer has experience with SAJH as the privatised water company in Johor, which has a guarantee of the concession for 30 years (2000-2030). Therefore, stage 2 of the cluster sampling survey was used for residential customers within a city (urban area). The personal interview could be conducted with a random sample of customers who pay the water bill at SAJH counters at Johor Bahru, Kluang and Batu Pahat, as opposed to customers in the rural areas who prefer to pay their bill at the post office. As a result, each section of the sample frame had the same opportunity to be chosen. At the SAJH counter, the personal interviews were conducted from 9am until 4pm in the start and end of month periods (March to May 2008). This is because this is the peak time to pay the water bill.

4.7.4 Sample Size Requirements

Practically, the sample sizes for conjoint studies range between 150 and 1200 respondents. Additionally, if the quantitative research does not intend to compare analysis, the sample size should be 300 respondents (Orme, 2010). By using Sawtooth Software's CBC System, the sample size should be calculated in accordance with the formula below (Johnson and Orme, 2003).

$$\frac{nta}{c} \geq 500$$

where; n = the number of respondents

t = number of choice tasks

a = number of alternatives per choice tasks (exclude *none* or *status quo* alternative)

c = level of attribute

Therefore, the study has 392 usable respondents (detailed discussion in 5.2: Residential Customers Survey). It shows that the sample is representative to present the population of active water customers in Johor.

4.7.5 Justification of Interview Site

In general, based on the water quality status for the river basins of Peninsular Malaysia reported by the Department of Environment (2007), most of the rivers in Johor are slightly polluted, and a few rivers in Johor Bahru are categorised as polluted because of waste and sewage from construction sites, squatter areas and factories. The state government has spent MYR94 million to clean up garbage in these rivers (*Star*, 10 May 2008). Therefore, three districts have been chosen as the study area, namely Johor Bahru, Kluang, and Batu Pahat, due to water problems, limited budget and time constraints.

Johor Bahru is the capital of Johor state. The population was approximately 1,370,738 in 2005. The city is an important commercial, industrial and tourism and hub for southern Malaysia. Johor Bahru also has a highly developed industrial base; this has resulted in it becoming one of the biggest industrial centres in Malaysia.

There are three rivers, namely the Segget, Tebrau and Skudai, which have been classified as the most polluted. A mechanical system will be installed to trap solid garbage along the Tebrau (32.5km), Skudai (35km) and Segget (4km). Also, MYR45 million has been allocated to carry out research at several river basins in Johor including the Muar, Batu Pahat, Kluang-Mengkibol, Pontian and Mersing (*Star*, 10 May 2008).

In Kluang district, the source of water comes from the Sembrong dam. The dam was completed in 1981 and cost MYR26 million; its primary purposes were to deal with flooding in low-lying parts of Sungai Batu Pahat, and also to provide water in the Kluang and Batu Pahat districts for both domestic and industrial uses. Normally, problems are faced here during periods of drought, because the water level at the dam drops to a dangerous level due to the lack of rainfall. This problem is expected to be solved with the transfer between the rivers Sembrong Timur and the Sembrong Barat of 50 million litres of raw water via 10km of pipelines.

Moreover, a 718 hectare area near Sembrong Dam has been transformed to palm oil production, which contributes to water pollution, for instance there is a high manganese and iron content in the raw water pumped to Sembrong Water Treatment Plant. In addition, 10% out of 20,000 residents face the low water pressure due to the high terrain.

Most of the mains water pipes in Batu Pahat district have been in use for between30 and 50 years. They need to be replaced in order to reduce the NRW level which is due to pipe bursts and leakage. Moreover, more than 5800km of these pipes are made of a type of asbestos cement which has a tendency to corrode.

Also, the river Bekok is one of the large streams in Batu Pahat, with a length of approximately 20km from its source at Bekok Dam. The Bekok flows through various types of land use – agricultural, urban and residential – before extraction for the water supply. This river supplies raw water directly to two water treatment plants, namely Yong Peng nos. 2 and 3 plants. Another two treatment plants, Sri Gading and Sembrong, get raw water resources from an artificial lagoon which is also supplied by the Bekok.

However, the Bekok faces severe water quality problems, with concentrations of iron and aluminium as high as 110mg/1 and 290 mg/1 respectively. The pH values are as low as 2.5, which exceeds the limits set out by the Interim National Water Quality Standards for Class II Rivers (SAJH, 2005). This situation has caused significant interruptions in the operation of water treatment plants nos. 2 and 3 at Yong Peng, as well as Sri Gading and Parit Raja, to produce sufficient potable water for the district of Batu Pahat. Furthermore, critical problems occurred during the long drought from mid-January to 23 March 2005. Meanwhile, during periods of heavy rainfall, the operation of Parit Raja plant was forced to be shut down due to substantial amounts of ammonia, aluminium, iron, and manganese found in the raw water.

Johor also experienced major floods in December 2006 and January 2007, particularly in Johor Bahru, Segamat, Muar, and Kota Tinggi. These floods disrupted the operation of 15 water treatment plants. At the same time, sampling activities were affected because of the plants being shut down and the inaccessibility factor.

There were also complaints from customers during the survey. These included: the impact of replacement of water meters causing increases in water bills, even though there was no leakage found at home; poor quality of water in terms of taste, colour and odour during the flood and drought seasons, because the water treatment plan does not function well; sometimes customers have to make a complaint more than once about a particular water problem; the "customer-friendly" roadshows (Mesra Pelanggan) are also limited in number and only rarely held in the customers' area; some staff are not friendly; and notice of water disruption does not cover the whole area affected, especially in rural areas.

To summarise, the most crucial issue of the three sites selected is polluted water from the river, particularly at Johor Bahru, Batu Pahat and Kluang. Another problem is the critical water level at Sembrong Dam during the drought season. SAJH should take into account these highlighted problems in order to achieve efficiency and better delivery to the residential customer, particularly in the sample areas of this study, and Johor state as a whole.

4.8 Conclusions

This chapter discussed the properties of discrete choice models. It included choice sets, identification of choice models, the statistical significance of model estimates, limitations of the MNL model, the panel nature of data, and taste heterogeneity as well as the latent class model. The specifications of choice modelling and the mixed logit model have been explained in detail. Basically, both models are based on random utility theory (RUT). However, the mixed logit model does not present the IIA property and can be derived from utility maximising behaviour.

Furthermore, there are five steps in designing the choice experiment, and the most important parts are experimental design and questionnaire design. The focus group was conducted among residential customers and the top management of SAJH. The main discussion was about the crucial issue of water supply improvement, in order to deliver safe water, and the sustainability of water preservation, as well as the water attributes and their levels. Before a field survey is conducted, the sample framework should be determined to achieve reliable data based on reliability analysis. The results found that the overall variable value was 0.852752. This means that Cronbach's alpha is acceptable, as the minimum recommended value is 0.70.

This study applies Stage 2 of cluster sampling and a personal interview with the respondents, due to the complexity of choice sets that need to be clarified in detail and the alternatives presented in the choice set. Additionally, the preferred choices of respondents are very important to decision-makers to determine policy and further investment in the future.

CHAPTER 5: DESCRIPTIVE ANALYSIS

5.1 Introduction

This chapter presents some descriptive statistics, which is the first step of analysis. It describes the basic features of the data in the study and provides simple summaries about the sample. This research attempts to reveal the true picture of the sample of study: residential customers of SAJH. The analysis begins with the residential customers' survey and socioeconomic characteristics of the sample, followed by customers' experience of service quality performance, improvement of water service and improvement of strategies. This is followed by a cross tabulation analysis and correlation analysis also conducted towards the three aspects mentioned with socioeconomics characteristics.

5.2 Residential Customers Survey

Face-to- face interviews were utilised to collect the data on customers' experience and their perception of service quality, CE questions, and socioeconomic characteristics. The survey was conducted in three districts in Johor: Johor Bharu, Batu Pahat and Kluang. These urban areas were selected because serious problems with the water service had occurred there and customers had not been satisfied (detailed discussion in section 4.7.4).

In total, 430 respondents were interviewed by the researcher; however, only 392 respondents have been used in the data analysis. The discarded sample was 8.83% (38 respondents) from total sampling. This was done to avoid selection bias. These respondents excluded from analysis because of the following:

(a) Failed to complete the perceptions and experience questions
(b) Failed to complete the CE questions
(c) Failed to complete the socioeconomics questions

At the initial stage, each respondent was informed about this study and asked whether they were willing or not to participate. However, many factors can influence the respondent during the process of the interview. These are detailed as follows:

(a) Time constraints. Individuals often have a lot of work to do. Therefore, time was considered as the main reason for completion (or non-completion) of the questionnaire. For instance, if the respondent was waiting for their turn to pay their bill, and during the interview process, their turn suddenly came up, the respondent needed to stop the interview and pay the bill. A few respondents failed to continue the interview after this and went to work or went home.

(b) Loss of interest. Interest is a very important attitude for the completion of the questionnaire. However, if there were confusing and difficult questions, the respondent might ask to omit that question. This might occur, for instance, with CE questions in which the respondent was asked to choose their most preferred attribute among three levels – the status quo, a small improvement and a larger improvement; it might also happen if the questions were too personal or intrusive.

Table 5.1: Total Number of Samples

Description	**Interview Location**		
	Johor Bharu	**Batu Pahat**	**Kluang**
Number of respondents interviewed	**176 (100%)**	**119 (100%)**	**135 (100%)**
Number of samples missing			
a. Failed to complete the perceptions and experience questions	5 (2.84%)	3 (2.52%)	4 (2.96%)
b. Failed to complete the CE questions	6 (3.40%)	7 (5.88%)	5 (3.70%)
c. Failed to complete the socioeconomics questions	3 (1.70%)	2 (1.68%)	3 (2.22%)
Number of samples used	**162(92.04%)**	**107 (89.9%)**	**123 (91.11%)**

5.3 Socioeconomic Profile

The sample consisted of 392 respondents for three districts in Johor, namely Johor Bharu, Kluang and Batu Pahat. Face-to-face interviews were conducted at each SAJH counter, which is the place where customers pay their bill, for each district as organised by SAJH.

Table 5.2: Socioeconomic Characteristics Profile of Respondents (n=392)

Variables	Items	Frequency	Percentage (%)
GEN	**Gender**		
	Male	235	59.95
	Female	157	40.05
ETH	**Ethnic group**		
	Malay	329	83.93
	Chinese	48	12.24
	Indian	11	2.81
	Other	4	1.02
AGE	**Age**		
	20-30 years	151	38.52
	31-40 years	75	19.13
	41-50 years	83	21.17
	More than 51 years	83	21.17
CHI	**Children**		
	2 children or fewer	214	55.15
	3-5 children	122	31.44
	6-8 children	41	10.57
	More than 9 children	11	2.84
PER	**Persons in household**		
	2 persons or fewer	67	17.14
	3-5 persons	180	46.04
	6-8 persons	113	28.90
	More than 8 persons	31	7.93
HOU	**Type of house**		
	Terraced	145	36.99
	Double-storey	107	27.30
	Semi-detached	29	7.40
	Bungalow	31	7.91
	Other	80	20.41
EDU	**Education**		
	Primary school	39	9.97
	Secondary school	122	31.20
	College	112	28.64
	University	118	30.18
WOR	**Current work**		
	Support staff group	106	27.11
	Professional group	106	27.11
	Others	179	45.78
INC	**Income per month**		
	MYR500 or less	42	10.71
	MYR501-1,500	105	26.79
	MYR1,501-2,500	133	33.93
	More than MYR2,501	112	28.57

The socioeconomic pattern will influence WTP for improvements to the water supply. In this study, the socioeconomic characteristics included gender, ethnic, age, number of children, number of persons in the household, type of house, education, current work, and income, as reported in Table 5.2.

Male respondents comprised 59.95% of the sample and female ones 40.05%. This shows that males, as the heads of their families, are responsible to pay the monthly bill more than females, who concentrate more on looking after the children at home.

The majority of respondents were Malay (83.93%). Most respondents were aged between 20 and 30 years (38.52%) followed by those 30 to 40 years old (19.13%), and the rest were above 40 years old. The result is parallel with the overall socioeconomic characteristics of Johor state, where an estimated 55.46% of the population was Malay, which is the highest percentage among ethnic groups. This was followed by Chinese (31.91%) and Indian (6.45%).

Most respondents had two children or fewer (55.15%), and the percentages of households with three to five persons and two persons or fewer were 46.04% and 17.14%, respectively. The majority of respondents lived in terraced and two-storey houses (36.99% and 27.30%, respectively). Lifestyle may influence water usage patterns and attitudes towards water improvement.

Education was identified as the most important socioeconomic factor that influences WTP for the upgrading of service quality. Most respondents had college or university degrees (28.64% and 30.14%, respectively); this was followed by 31.20% of respondents with secondary school education only. The results have been proven in World Bank (1993), Whittington et al. (1990), Kaliba et al. (2003), Farolfi et al. (2006), Mbata (2006), Alaba (2001), Kayaga et al. (2003) and Pattanayak et al. (2006) found that higher educated respondents willing to pay more to improve water service rather than lower educated.

The majority of respondents have a qualification at either college or university level according to their socioeconomic profile. This is not reflected in the general population of Johor, of which about only 8.2% have such a qualification. The interviews' location, which took place at the Nusajaya property project being built by United Engineering Malaysia (UEM) Land (The Star Online, 2012) may be the reason behind this result. Nusajaya, 9,308 ha in area, is a major development zones in Iskandar, which is designed to be Malaysia's first 'corridor' for economic growth (The Star, 2011). Several university and college graduates are resident in Nusajaya and use the local SAJH agency office to pay their monthly water bills. In contrast, respondents without any higher education tend to use post offices instead of SAJH agency offices to pay their bills. Also, cluster sampling was utilised by this research in Batu Pahat, Johor Bharu and Kluang districts (4.7.3 Sampling Design).

Basically, the employment status has a relationship with the level of education as well as the income level. For instance, an individual who has been through higher education should be employed in the professional group and earn a higher income.

This study revealed that professional staffs were 27.11% of the respondents, whereas support staff and others were 27.11% and 45.78%, respectively. This means that the majority of respondents were self-employed. The majority of respondents had an income of either between MYR1,501 and MYR2,500 per month (33.93%) or more than MYR2,501 per month (28.57%). Income level also determines WTP for service quality improvements.

The rest of the socioeconomic characteristics of the sample are also similar to the socioeconomics profile of Johor state in 2008. Even though there is the small percentage of the sample, it is more than enough because the sample size is more than 300, which fulfils the sample size requirement (4.7.4 pg. 86).

5.4 Respondents' Experience with SAJH

Table 5.3 shows the respondents' experience with SAJH. The results indicate that the majority of respondents have been with SAJH for more than 8 years. Since privatisation in March 2000, SAJH has the water supply concession in Johor state for 30 years and a monopoly of the water resources. The fieldwork was conducted at SAJH counters in three districts: therefore, 100% of the respondents pay their water bill at SAJH counters.

Table 5.3: Respondents' Experience with SAJH (n=392)

Variables	Questions	Frequency	Percentage (%)
LON	**Q1. How long have you been with SAJH?**		
	2 years and below	41	10.46
	3-5 years	20	5.10
	5-7 years	8	2.04
	More than 8 years	323	82.40
BIL	**Q2. How much is your monthly water bill?**		
	MYR4–MYR10	51	13.01
	MYR11–MYR20	78	19.90
	MYR21–MYR30	84	21.43
	More than MYR31	179	45.66
PAY	**Q3. How do you pay the water bill?**		
	Through SAJH counters	392	100.00
	Through online payment e.g. Maybank2u	-	-
	Through the post office	-	-
	Other	-	-
FIL	**Q5. Do you use a water filter in your home?**		
	Yes	175	44.64
	No	217	55.36
TAN	**Q6. Do you use a tank to store water?**		
	Yes	296	75.51
	No	96	24.49
MIN	**Q7. Do you buy mineral water or bottled water to drink?**		
	Yes	208	53.06
	No	184	46.94
BOI	**Q8. Do you boil water for drinking?**		
	Yes	370	94.39
	No	22	5.61

The majority had a water bill of more than MYR31 per month because Johor has the highest water tariff among the states in Malaysia. This is due to the cost of water treatment, as otherwise the water from source to the household tap would be polluted by industrial waste and waste from agricultural activities.

Treatment of water results in improvement of water quality such that it achieves 98% compliance with the MOH Standards. But despite this, almost half of the respondents (44.64%) used a water filter at home because of the colour and taste of the water. Discolouration of water and complaints about taste arise because the mains pipes are more than 20 years old, and rusting. This influences the water quality from the dam to the customer's house. Moreover, respondents also believe in the benefits of water filtration, for instance: providing better tasting and smelling mineral water by the removal of chlorine and bacterial contaminants; reducing the potential risk of cancer; and protecting against disease, leading to overall greater health.

In order to alleviate this situation, a high percentage of respondents bought mineral water or bottled water to drink at home (53.06%). The majority of respondents boiled water for drinking: some 94.3%. Also, most respondents (75.51%) had a water tank at home. This tank was useful for storing water for daily activities during drought situations.

5.5 Perceptions of Service Quality Performance

In this section of the questionnaire, each respondent was required to state their perceptions for the eight attributes of service quality performance, rating each from 1 (very satisfied) to 5 (very dissatisfied). Table 5.4 presents respondents' perception of various aspects including leakage, burst pipes, reservoirs, water quality, connections, disruption, pressure and price. Leakage, or Non-Revenue Water (NRW), occurs in old pipes, and currently 24.5% of water supplied by SAJH is 'lost' in the system before it reaches customers. Normally, leakage is experienced outside customers' houses, for instance in the road. This does not affect the water pressure very much, and immediate action is taken by SAJH to repair the leakage as they use sophisticated tools to identify the problem area. Therefore, the majority of respondents were either very satisfied or fairly satisfied (22.51% and 52.69% respectively).

As far as burst pipes are concerned, SAJH repairs 98.5% of them within 24 hours of receiving a complaint. Therefore, more than 77% of respondents were satisfied with this. However, a few respondents still complain about the poor performance of SAJH, such as late repair of burst pipes and the need to make the same complaint more than once.

Currently, water quantity is more than sufficient (i.e. more than 100%) to supply and meet customer demand. The majority of respondents (approximately 79.08%) were normally satisfied with reservoir levels because there is sufficient water in Malaysia as a whole, as well as in Johor. However, there have been water crises during drought periods or the dry season. As a result, SAJH needs to increase the available water quantity to solve this problem.

Furthermore, the water quality achieved 98% compliance to MOH Standards. At the moment, more than 35,000 samples of water are tested for purity of tap water every year. Most of the respondents were satisfied with water quality (approximately 65.56%). However, 29.85% of respondents were not satisfied with water quality in terms of taste, colour and odour. This is because their pipes are between 20 and 50 years old and need to be replaced by PVC pipes. Their water must flow through old pipes that have rusted and this influences the quality of the drinking water.

Normally, disruptions happen during the drought season and are unpredictable. They will affect the level of water above the dam until critical levels are reached. More than 70% of respondents were satisfied with this variable. Disruptions are allowed to be up to two hours, four times per year, and very rare. SAJH will notify customers through its website, newspapers, and pamphlets. Sometimes, there are upgrading works at treatment plants, cleaning of the reservoir, or replacement of an old pipeline in a particular area that causes disruption. A minority of respondents (17.60%) indicated they were dissatisfied because information about disruptions did not reach them.

The majority of respondents (81.84%) were satisfied with their water connection because most of them have not had any problems. A small percentage of respondents (9.46%) were dissatisfied with this attribute, because they had to wait more than a week for reconnection of their water supply – even though, according to the customer charter, it is only supposed to take three days to reconnect it. More than 70% of those who were interviewed indicated that they were satisfied with the water pressure. However, 15.05% of respondents were dissatisfied because they experienced low pressure, particularly in the Kluang area, due to the high terrain.

During the survey, the price of fuel increased in Malaysia and other goods rose in price as well. As a result, most of the respondents were very concerned about price. However, 65.25% of them agreed with the current price, and 31.89% were not satisfied with it. They also suggested that the price of water should remain unchanged or be reduced because the current bill indicated that the price had doubled compared to the previous price. Moreover, Johor has the highest water tariff among all the states in Malaysia. Some respondents complained that when their meter was replaced, the new meter ran faster than the old one, and a lot of air rather than water came out of the pipe. They had to wait until the water began to flow properly.

Table 5.4: Perceptions of Service Quality (n=392)

Questions	Frequency	Percentage (%)
Q4. Thinking about your experience with SAJH, how satisfied are you with the following aspects of the company's service performance?		
(a) Leakage		
Very satisfied	88	22.51
Fairly satisfied	206	52.69
Neither satisfied nor dissatisfied	28	7.16
Fairly dissatisfied	47	12.02
Very dissatisfied	22	5.63
(b) Burst pipes		
Very satisfied	94	23.98
Fairly satisfied	208	53.06
Neither satisfied nor dissatisfied	31	7.91
Fairly dissatisfied	36	9.18
Very dissatisfied	23	5.87
(c) Reservoirs		
Very satisfied	116	29.59
Fairly satisfied	194	49.49
Neither satisfied nor dissatisfied	42	10.71
Fairly dissatisfied	29	7.40
Very dissatisfied	11	2.81
(d) Water quality standard		
Very satisfied	92	23.47
Fairly satisfied	165	42.09
Neither satisfied nor dissatisfied	18	4.59
Fairly dissatisfied	74	18.88
Very dissatisfied	43	10.97
(e) Disruption		
Very satisfied	93	23.72
Fairly satisfied	207	52.81
Neither satisfied nor dissatisfied	23	5.87
Fairly dissatisfied	53	13.52
Very dissatisfied	16	4.08
(f) Connections		
Very satisfied	103	26.34
Fairly satisfied	217	55.50
Neither satisfied nor dissatisfied	34	8.70
Fairly dissatisfied	28	7.16
Very dissatisfied	9	2.30
(g) Pressure		
Very satisfied	107	27.30
Fairly satisfied	203	51.79
Neither satisfied nor dissatisfied	23	5.87
Fairly dissatisfied	40	10.20
Very dissatisfied	19	4.85

Table 5.4 (continued): Perceptions of Service Quality (n=392)

Questions	Frequency	Percentage (%)
(h) Price		
Very satisfied	78	19.90
Fairly satisfied	166	42.35
Neither satisfied nor dissatisfied	23	5.87
Fairly dissatisfied	84	21.43
Very dissatisfied	41	10.46

5.6 Perceptions of Improvement of Service Quality

In this section of the questionnaire, the respondents were asked to determine the importance of various criteria in order to improve the water supply, such as reducing the level of leakage, improvement in repairing burst pipes, increase in reservoir capacity, improvement in water quality, reduction in water disruption, reduction of the time taken for connections, increases in the water pressure level, and increases in price. The measurement of their perception is based on the Likert scale; 1 = completely unimportant to 5 = very important. The results indicated that more than 80% of respondents agreed the importance of all these factors, excluding increases in the level of pressure and increases in price (64.03% and 33.42% respectively). Over half of respondents (55.61%) disagreed with the importance of a rise in the price of water. They suggested that SAJH should keep the price of water at its current level and improve the water quality of service as well.

Table 5.5: Perceptions of Improvement of Service Quality (n=392)

Questions	Frequency	Percentage (%)
Q20. If the current situation of service provided by SAJH were changed, and service performance were improved, please indicate how important each service factor improvement is to you based on the 5-point scale as follows:		
(a) Reduction in the level of leakage		
Very important	194	49.49
Important	180	45.92
Neither important nor not important	10	2.55
Not important	5	1.28
Completely unimportant	3	0.77
(b) Improvement in repairing burst pipes		
Very important	188	47.96
Important	194	49.49
Neither important nor not important	6	1.53
Not important	2	0.51
Completely unimportant	2	0.51
(c) Increase in reservoirs' capacity		
Very important	191	48.72
Important	169	43.11
Neither important nor not important	11	2.81
Not important	19	4.85
Completely unimportant	2	0.51
(d) Improvement in the Ministry of Health water quality standards		
Very important	309	78.83
Important	72	18.37
Neither important nor not important	5	1.28
Not important	2	0.51
Completely unimportant	4	1.02
(e) Reduction in service quality disruptions		
Very important	196	50.00
Important	172	43.88
Neither important nor not important	17	4.34
Not important	3	0.77
Completely unimportant	4	1.02

Table 5.5 (continued): Perceptions of Improvement of Service Quality (n=392)

Questions	Frequency	Percentage (%)
(f) Improvement in the time taken to connect the water supply		
Very important	188	47.96
Important	179	45.66
Neither important nor not important	17	4.34
Not important	4	1.02
Completely unimportant	4	1.02
(g) Increase in the level of water pressure		
Very important	177	45.15
Important	184	46.94
Neither important nor not important	13	3.32
Not important	14	3.57
Completely unimportant	4	1.02
(h) Increase in the price		
Very important	57	14.54
Important	74	18.88
Neither important nor not important	43	10.97
Not important	140	35.71
Completely unimportant	78	19.90

5.7 Perception on Improvement of Strategy

In this section, respondents determined their perception of SAJH strategies based on the scale from 1 (disagree strongly) to 5 (agree strongly). Table 5.6 presents the strategies to be taken by SAJH in order to improve service quality. There are strategies encompassing: creating an integrated strategic plan; providing good quality training to all staff; increasing funding for new investment; and encouraging education and awareness. Over 90% of those interviewed indicated that they agreed with these strategies. This shows that SAJH should implement them to achieve efficiency and effectiveness of service performance.

Table 5.6: SAJH Strategies (n=392)

Questions	Frequency	Percentage (%)
Q21. The main issue in SAJH is the efficiency and effectiveness in service performance, in order to convince their customers and to maintain the sustainability of water as a natural resource. Please indicate whether you agree or disagree with improvement of these strategies based on the 5-point scale as follows:		
(a) Creating an integrated strategic plan		
Agree strongly	166	42.46
Agree	215	54.99
Neither agree or disagree	5	1.28
Disagree	5	1.28
Disagree strongly	-	-
(b) Providing good quality training to all staff		
Agree strongly	204	52.04
Agree	178	45.41
Neither agree or disagree	6	1.53
Disagree	3	0.77
Disagree strongly	1	0.26
(c) Increasing the funding for new investment e.g. sophisticated tools or instruments, and upgrades to reservoirs		
Agree strongly	179	45.66
Agree	198	50.51
Neither agree or disagree	10	2.55
Disagree	5	1.28
Disagree strongly	-	-
(d) Encouraging education and awareness e.g. roadshow "*Mesra Pelanggan*" (customer-friendly)		
Agree strongly	202	51.53
Agree	176	44.90
Neither agree or disagree	9	2.30
Disagree	5	1.28
Disagree strongly	-	-

5.8 Cross Tabulation Analysis of Perceptions and Socioeconomic Characteristics

The cross tabulation analysis has been conducted in order to see the cross tabulation between the perception of service quality performance, improvement of water service and improvement of strategies with socioeconomic characteristics. Current service quality performance included leakage, repair of burst pipes, reservoir capacity, water quality, disruption, connection, pressure, and price; whilst there were eight aspects of improvement of water service, namely reduction in the level of leakage, improvement in repairing burst pipes, increase in reservoirs' capacity, improvement of water quality against MOH Standards, reduction in service quality disruptions, improvement in the time taken to connect the water supply, increase in the level of water pressure, and increase in price.

Additionally, improvement of strategies by SAJH consisted of setting up an integrated strategic plan, providing good quality training to all staff, increasing funding for new investments, e.g. sophisticated tools or instruments and upgrades to reservoirs, and encouraging education and awareness, e.g. the "*Mesra Pelanggan*" (customer-friendly) roadshow. These strategies were very important in order to achieve efficiency and effectiveness in service performance to convince their customers and to maintain the sustainability of water as a natural resource.

5.8.1 Cross Tabulation Analysis Perceptions of Service Quality Performance and Socioeconomics

The cross tabulation analysis between perceptions of service quality performance and socioeconomics is reported in Appendix B1.

(a) Leakage

The results revealed that 75.20% of respondents were satisfied with the leakage situation. Approximately 56.89% of the respondents were male and 80.10% were Malay. The age group between 20 to 30 years old is estimated at 27.11% of all respondents. About 39.80% of respondents had two children or fewer. This was followed by those respondents with three to five children, at approximately 25.06%. 32.82% of the respondents had six to eight persons in their households and 32.30% of the households consisted of three to five persons. Most respondents lived in terraced or two-storey houses; the percentages were 27.62% and 20.20%, respectively. Most respondents had qualifications from college or university; the percentages were 21.28% and 18.97%, respectively. 25.36% of the respondents worked as self-employed, followed by the professional group at about 20%. The most common income groups were those between MYR1,501 to MYR2,500 and more than MYR2,501, for which the percentages were approximately 17.37% and 20.2%, respectively.

(b) Burst pipes

It was estimated that 77.04% of respondents were satisfied with the repair of burst pipes. It was approximately 58.67% were male. About 81.63% were Malay. There were 27.55% of respondents who were in the age group between 20 and 30 years old. It was estimated that 40.98% of respondents had two children or fewer. Those households with three to five people and those with six to eight people were 35.04% and 32.25%, respectively. Most respondents lived in terraced or two-storey houses, approximately 28.57% and 19.90% respectively. Most respondents had graduated from college or university and the percentages of these were 22.51% and 18.92%, respectively. Approximately 35.30% of respondents worked as self-employed; this was followed by the professional group. The most common income groups were those between MYR1,501 and MYR2,500 and over MYR2,501 per month, and the percentages of these were 27.82% and 19.89%, respectively.

(c) Reservoir capacity

It was estimated that 55.11% of the respondents were male. The majority of respondents were Malay – about 76.28%. The most common age group was that between 20 and 30 years. This was followed by the group aged over 51 years and that aged between 41 and 50 years, the percentages were 18.37% and 17.86%, respectively. Approximately 41.50% of the respondents had two children or fewer. About 34.78% of the respondents had three to five persons in their household. This was followed by those who had six to eight persons in their household, at 23.79%. Most lived in terraced and two-storey houses; the percentages were 29.08% and 22.70%, respectively. Most respondents had qualifications from college or university. The percentages were 24.30% and 19.18%, respectively. Most of the respondents worked as self-employed. The most common income group was that between MYR1,501 and MYR2,500; the percentage was 28.60%.

(d) Water Quality

The majority of respondents were male: approximately 58.16%. The percentage of females was 39.03%. 81.89% of the respondents were Malay. The most common age group was 20 to 30 years old, estimated at 22.96%. This was followed by the age groups between 41 and 50 years old and more than 51 years old, at approximately 15.31% and 15.05%, respectively. About 35.05% of respondents had two children or fewer. There were 20.61% of respondents with three to five children. Approximately 27.88% of respondents had three to five persons in their households. Most respondents lived in terraced or two-storey houses, and the percentages for these were 23.72% and 17.60% respectively. Most also had higher education qualifications from college or university, estimated at 16.63% and 19.19%, respectively. Most of the respondents worked in the ‘others’ group (such as self-employment). The percentage of these was 29.66%. This was followed by the professional group at 18.67%. The most common income group was MYR1,501 to MYR2,500, estimated at 23.98%.

(e) Disruption

Approximately 57.66% of the respondents were male. 78.57% were Malay. 27.80% of the respondents were aged between 20 and 30 years old. This was followed by groups aged more than 51 years old and 41 to 50 years old; the percentages were 17.35% and 16.33% respectively. Most respondents had two children or fewer (40.47%). This was then followed by those who had three to five children (25%). About 34.28% of respondents had three to five persons in their households. This was followed by 22.51% of respondents with six to eight persons in their households. Most respondents lived in terraced or two-storey houses; the percentages were 27.55% and 21.18% respectively. It was estimated that 23.53% of respondents had graduated from college and 18.16% from university. Most respondents worked as self-employed; the percentage was 35.04%. 28.57% of the respondents worked in the professional group. The most common income group was MYR1,501 to MYR2,500, estimated at 19.13% of all respondents.

(f) Connection

It was estimated that 56.63% of respondents were male and 78.32% were Malay. The most common age group was that between 20 to 30 years old (approximately 29.93%). This was followed by those more than 51 years old, estimated at 17.65%. About 36.67%

of respondents had three to five persons in their households. This was followed by 24.11% of respondents having six to eight persons in their households. The majority of respondents lived in terraced or two-storey houses; the percentages were 29.41% and 23.27%, respectively. Most respondents had a higher education qualification from college or university: the percentages were 24.61% and 21.28%, respectively. Most respondents worked as self-employed, estimated at 37.7%. This was followed by 21.02% who worked in the professional group. Most respondents had an income of between MYR1,501 to MYR2,500 or more than MYR2,501 (29.67% and 21.74% respectively).

(g) Pressure

Approximately 55.63% of respondents were male and 76.52% were Malay. Most respondents were in the age group between 20 and 30 years old, estimated at 27.55%. This was followed by the group aged between 41 to 50 years and those more than 51 years old; the percentages for these were 16.84% and 18.8%, respectively. There were an estimated 42.53% of respondents who had two children or fewer. This was followed by 24.74% of respondents who have three to five children. Most respondents had three to five persons in their households (34.53%) this was followed by 24.56% of respondents with six to eight persons in their households. Most respondents lived in terraced or two-storey houses; the percentages for these were 29.08% and 22.96%, respectively. Most had a higher education qualification from college or university, estimated at 23.27% and 20.51%, respectively. Most respondents worked as self-employed (approximately 35.81%). This was followed by the professional group at 20.98%. The most common income group was MYR1,501 to MYR2,500; the percentage for this was 29.08%.

(h) Price

The results indicate that 62.25% of respondents agreed with the current price of water. Only 18.88% of respondents were male and 14.54% were female. It was estimated that 29.85% of the respondents were Malay. The most common age group was that between 20 and 30 years old (approximately 25.25%). Most respondents had two children or fewer; the percentage was 37.37%. Moreover, most respondents had three to five persons in their households (estimated at 27.37%). Most respondents lived in terraced or two-storey houses (23.21% and 17.35%, respectively). Most of them had qualifications from college or university; the percentages were 16.37% and 17.64%, respectively. Most respondents worked as self-employed (about 29.15%). This was followed by 17.14% of respondents in the professional group. The most common income group was that between MYR1,501 to MYR2,500, estimated at 20.66%.

5.8.2 Cross Tabulation Analysis Perceptions of Water Service Improvement and Socioeconomics

The cross tabulation analysis between perception of water service improvement and socioeconomics is presented in Appendix B2.

(a) Reduction in the level of leakage

The results demonstrated that 95.41% of respondents determine reducing the level of leakage as important. Approximately 57.98% of respondents were male, and 80.15% were Malay. Furthermore, 36.74% were in the age group between 20 and 30 years old. This was followed by those who were aged between 41 and 50 years old; the percentage was 20.41%. The majority of respondents had two children or fewer, estimated at 53.09%. Also, 44.5% of respondents had three to five persons in their households. In total, 34.95% of respondents lived in terrace houses. Most of the respondents have a higher education qualification including college and university degrees, the percentages were 27.11% and 28.64%, respectively. The majority of respondents were in the "others" employment category, such as self-employed (approximately 42.71%). This was followed by the professional group at 27.11%. About 23.16% of respondents from income group between MYR1,501 to MYR2,500 per month.

(b) Improvement in repairing burst pipes

Approximately 97.45% of respondents identified the importance of improvements in repairing burst pipes. About 59.80% of them were male and 81.63% were Malay. Most of the respondents were aged between 20 to 30 years old (37.50%). There were 53.61% who had two children or fewer and 44.50% who had three to five persons in their households. Also, it was estimated that 36.22% of respondents lived in terraced houses and 26.27% lived in two-storey houses. The majority of respondents had a higher education qualification from college or university (27.88% and 29.16% respectively). Approximately 43.99% were from the "others" employment category (such as businessmen or self-employed). These were followed by the professional group at 27.11%. The most common income was between MYR1,501 and MYR2,500 per month.

(c) Increase in reservoirs' capacity

The findings showed that 91.83% of respondents recognised the importance of an increase in reservoirs' capacity. The majority of respondents were male and Malay; the percentages were 55.61% and 76.28%, respectively. The most common age group was that between 20 and 30 years old, at 35.46%. This was followed by those aged over 51 years old, at 19.64%. Approximately 51.03% of respondents had two children or fewer and 28.61% had three to five children. About 42.20% of respondents have three to five persons in their households and 26.59% of respondents have six to eight persons. Most respondents lived in terraced houses or two-storey houses; the percentages were 35.21% and 25%, respectively. The majority of respondents had a higher education qualification: 26.60% from college and 27.61% from university. However, most respondents (approximately 42.20%) were self-employed (such as businessmen). The most common income range was that between MYR1,501 and MYR2,500 per month, estimated at 31.89%.

(d) Improvements to water quality against Ministry of Health Standards

The results demonstrated that 97.20% of respondents considered important the improvement of water quality in order to comply with Ministry of Health Standards. It was estimated that 58.16% of respondents were male and 81.89% were Malay. About 36.99% of respondents were aged between 20 and 30 years old. They were followed by those aged between 41 and 50 years old and between 31 to 40 years old, at 20.41% and 18.88%, respectively. The majority of respondents (approximately 53.60%) had two children or fewer. Most respondents had three to five persons in their households; the percentage was 45.02%. About 35.97% of respondents were college graduates and 20.41% were university graduates. Most respondents worked as self-employed, estimated at 43.99%. The most common income range was between MYR1,501 and MYR2,500 per month; the percentage was 33.42%. This was followed by those with an income of more than MYR2,501 per month.

(e) Reduction in service quality disruptions

The results indicated that 93.88% of respondents chose the reduction in service quality disruptions as important. It was estimated that 57.66% of respondents were male and 36.22% were female. Approximately 78.57% were Malay. The age group between 20 and

30 years old was estimated 35.46%. The majority of respondents had two children or fewer, estimated at 51.51%. This was followed by those who had three to five children. Approximately 42.45% of respondents had three to five persons in their households. 54.73% of respondents had a higher education qualification. This was followed by those who had a secondary school qualification, at 29.67%. The majority of respondents were self-employed; 26.24% were in the professional group. The most common income group was between MYR1,501 and MYR2,500 per month, estimated at 31.63%. This was followed by the group who had an income of more than MYR2,501 per month.

(f) Improvements to the time taken to connect the water supply

The findings presented that 93.62% of respondents identified the importance of improvements in the time taken to connect the water supply. The gender breakdown was estimated at 56.63% male and 36.99% female, respectively. 78.32% of the respondents were Malay. The most common age group was that between 20 and 30 years old (34.95%). This was followed by the age groups between 41 and 50 years old and more than 51 years old; the percentages were 20.41% and 20.40%, respectively. The majority of respondents had two children or fewer, estimated at 50.77%. 29.64% had three to five children. About 42.75% of respondents had three to five persons in their households. The majority of respondents lived in terraced houses or two-storey houses (34.95% and 24.74%, respectively). About 26.34% of respondents had graduated from college and 27.37% had a university degree. Most respondents were self-employed (estimated at 42.71%) and 26.60% were in the professional group. The most common income group was that between MYR1,501 and MYR2,500 per month, estimated at 31.89%.

(g) Increase in the level of water pressure

The results showed that 92.09% of respondents believed that an increase in the level of water pressure was important. The majority of respondents were male (approximately 55.62%). About 76.53% were Malay. 34.19% were in the age group between 20 and 30 years old. The majority of respondents had two children or fewer; the percentage was 50.52%. This was followed by those who had three to five children (29.12%). About 41.69% of respondents had three to five persons in their households, and 27.37% had six to eight persons in their households. Most respondents lived in terraced or two-storey houses; the percentages were 34.19% and 23.98%, respectively. The majority of respondents had a higher education qualification from college or university (estimated at

25.07% and 28.11%, respectively). Most respondents were self-employed; this was followed by those in the professional group (the percentages was 41.43% and 26.09%, respectively). The most common income group was those who earned MYR1,501 to MYR2,500 per month (estimated at 30.87%).

(h) Increase in the price

Approximately 55.61% of respondents disagreed about a rise in the price of water. The cross tabulation between gender and price increase shows that 34.44% of the respondents were male and 21.17% were female. 43.88% of the respondents were Malay. The majority of the respondents were aged between 20 and 30 years old. About 29.12% of respondents had two children or fewer. This was followed by those who had three to five children. It is estimated that 29.12% of respondents were from households consisting of three to five persons. Moreover, an estimated 20.15% of respondents lived in terraced houses. Most respondents had a higher education qualification; the percentages of college and university graduates were 24.8% and 16.37%, respectively. The most common employment group were the “others” at 15.35% and the most common income group were those who earned MYR1,501 to MYR2,500 per month.

5.8.3 Cross Tabulation Analysis: Perceptions of Improvement of Strategies and Socioeconomics

The findings of the cross tabulation analysis between improvement of strategies and socioeconomics were reported in Appendix B3.

(a) Setting up an integrated strategic plan

Approximately 97.45% of respondents agreed with creating an integrated strategic plan. More than 50% of the respondents were male and approximately 82.10% were Malay. The age group between 20 and 30 years old was estimated 37.09%. The majority of respondents had two children or fewer; the percentage was 53.75%. Furthermore, an estimated 44.36% of respondents had three to five persons in their households. Most of the respondents lived in terraced houses or two-storey houses; the percentages were 36.32% and 26.60%, respectively. The majority of respondents had a qualification from college or university; the percentages were 27.18% and 29.47%, respectively. Approximately 44.36% of respondents were self-employed. The most common income groups were MYR1,500 to RM2,500 and more than MYR2,501 per month; the percentages were 23% and 27.87%, respectively.

(b) Providing good quality training to all staff

The vast majority of respondents (an estimated 97.45%) agreed with the strategy of providing good quality training to all staff. About 58.68% were male and 82.39% were Malay. The age group between 20 to 30 years old was estimated at 37.5%. This was followed by those aged more than 51 years old, estimated at 20.91%. The majority of respondents had two children or fewer; the percentage was 53.35%. 30.67% of respondents had three to five children, whilst an estimated 44.75% and 27.88%, respectively, had three to five persons and six to eight persons in their households. Approximately 36.48% of respondents lived in terraced houses. The majority of respondents have a higher education qualification from college or university (27.38% and 44.59%, respectively). Most respondents worked as self- employed (estimated at 44.50%). The most common income range was that between MYR1,501 and MYR2,500 per month. This was followed by those who had an income of more than MYR2,501 per month; the percentage was 27.81%.

(c) Increasing funding for new investment

96.17% of respondents agreed with increasing funding for new investment. Approximately 57.40% were female and 81.13% were Malay. There were 37.25% of respondents who were in the age group between 20 and 30 years old. The majority of respondents had two children or fewer, estimated at 53.10%. This was followed by 30.16% of respondents who had three to five children. Most respondents had three to five or six to eight persons in their households, estimated at 43.99% and 27.62%, respectively. Most respondents lived in terraced or two-storey houses (36.48% and 27.28%, respectively). The majority of respondents had higher education qualifications from college or university. About 43.48% of respondents worked as self-employed. Most respondents had an income between MYR1,501 to MYR2,500 per month (estimated at 32.66%). This was followed by those who had an income of more than MYR2,501 per month.

(d) Encouraging education and awareness

The results indicate that 96.43% of respondents agreed with encouraging education and awareness. It was estimated that 57.66% of the respondents were male and 38.77% were female. The majority were Malay (approximately 81.12%). The most common age group was that between 20 and 30 years old; the percentage was 36.99%. This was followed by the age group between 41 and 50 years old, estimated at 20.66%. The majority of respondents had two children or fewer; the percentage was 52.84%. Most respondents had three to five persons in their households (approximately 43.73%), whilst about 28.14% of respondents had six to eight persons in their households. Most respondents lived in terraced and two-storey houses; the percentages were 36.48% and 16.27%, respectively. The majority of respondents had qualifications from college and university. Most respondents worked as self-employed (such as businessmen). The most common income groups were those between MYR1,501 to MYR2,500 per month (estimated at 27.62%) and more than MYR2,501 per month (28.13%).

5.9 Correlation Analysis of Customers Perception and Socioeconomics

This study applied correlation analysis between customers' perception of service quality performance, improvements to the water service and to strategies, and socioeconomic characteristics. However, only selected characteristics, consisting of gender, education level, work and income, which identify the most important factors that influence WTP, were explained. The purpose of correlation is to see the linear relationship between variables.

5.9.1 Correlation Perceptions of Service Quality Performance and Socioeconomics

The results of the correlation between perception of service quality performance and socioeconomics are shown as follows:-

Table 5.7 (a): Correlation of Service Quality Performance with Male

Pearson Correlation Coefficients, n = 235 Prob > |r| under H0: Rho=0								
	Leakage	**Burst Pipes**	**Reservoir**	**Water Quality**	**Disrup-tion**	**Connec-tion**	**Pressure**	**Price**
Leakage	1.00000	**0.82812 (<.0001)***	**0.49950 (<.0001)***	**0.41718 (<.0001)***	**0.57224 (<.0001)***	**0.46088 (<.0001)***	**0.46339 (<.0001)***	**0.36338 (<.0001)***
Burst Pipes	**0.82812 (<.0001)***	1.00000	**0.55303 (<.0001)***	**0.46435 (<.0001)***	**0.60505 (<.0001)***	**0.52066 (<.0001)***	**0.47243 (<.0001)***	**0.30764 (<.0001)***
Reser-voir	**0.49950 (<.0001)***	**0.55303 (<.0001)***	1.00000	**0.40237 (<.0001)***	**0.60734 (<.0001)***	**0.58773 (<.0001)***	**0.56436 (<.0001)***	**0.21088 (<.0001)***
Water Quality	**0.41718 (<.0001)***	**0.46435 (<.0001)***	**0.40237 (<.0001)***	1.00000	**0.50509 (<.0001)***	**0.42916 (<.0001)***	**0.28591 (<.0001)***	**0.20824 (<.0001)***
Disrup-tion	**0.57224 (<.0001)***	**0.60505 (<.0001)***	**0.60734 (<.0001)***	**0.50509 (<.0001)***	1.00000	**0.67506 (<.0001)***	**0.55320 (<.0001)***	**0.27878 (<.0001)***
Connec-tion	**0.46088 (<.0001)***	**0.52066 (<.0001)***	**0.58773 (<.0001)***	**0.42916 (<.0001)***	**0.67506 (<.0001)***	1.00000	**0.56146 (<.0001)***	**0.30182 (<.0001)***
Pressure	**0.46339 (<.0001)***	**0.47243 (<.0001)***	**0.56436 (<.0001)***	**0.28591 (<.0001)***	**0.55320 (<.0001)***	**0.56146 (<.0001)***	1.00000	**0.28143 (<.0001)***
Price	**0.36338 (<.0001)***	**0.30764 (<.0001)***	**0.21088 (0.0013)***	**0.20824 (<.0001)***	**0.27878 (<.0001)***	**0.30182 (<.0001)***	**0.28143 (<.0001)***	1.00000

* Significant at 1%

Table 5.7 (b): Correlation of Service Quality Performance with Female

Pearson Correlation Coefficients, n = 157 Prob > |r| under H0: Rho=0								
	Leakage	**Burst Pipes**	**Reservoir**	**Water Quality**	**Disrup-tion**	**Connec-tion**	**Pressure**	**Price**
Leakage	1.00000	**0.83299 (<.0001)***	**0.46367 (<.0001)***	**0.39490 (<.0001)***	**0.64508 (<.0001)***	**0.57993 (<.0001)***	**0.42609 (<.0001)***	0.11533 0.1503
Burst Pipes	**0.83299 (<.0001)***	1.00000	**0.48784 (<.0001)***	**0.40225 (<.0001)***	**0.68964 (<.0001)***	**0.54349 (<.0001)***	**0.41137 (<.0001)***	0.10297 0.1994
Reser-voir	**0.46367 (<.0001)***	**0.48784 (<.0001)***	1.00000	**0.49036 (<.0001)***	**0.64613 (<.0001)***	**0.54237 (<.0001)***	**0.42568 (<.0001)***	**0.20890 (0.0086)***
Water Quality	**0.39490 (<.0001)***	**0.40225 (<.0001)***	**0.49036 (<.0001)***	1.00000	**0.52747 (<.0001)***	**0.44076 (<.0001)***	**0.46746 (<.0001)***	**0.25205 (0.0014)***
Disrup-tion	**0.64508 (<.0001)***	**0.68964 (<.0001)***	**0.64613 (<.0001)***	**0.52747 (<.0001)***	1.00000	**0.56339 (<.0001)***	**0.47960 (<.0001)***	**0.19989 (0.0121)****
Connec-tion	**0.57993 (<.0001)***	**0.54349 (<.0001)***	**0.54237 (<.0001)***	**0.44076 (<.0001)***	**0.56339 (<.0001)***	1.00000	**0.57005 (<.0001)***	0.10797 0.1783
Pressure	**0.42609 (<.0001)***	**0.41137 (<.0001)***	**0.42568 (<.0001)***	**0.46746 (<.0001)***	**0.47960 (<.0001)***	**0.57005 (<.0001)***	1.00000	**0.18151 (0.0229)****
Price	0.11533 0.1503	0.10297 0.1994	**0.20890 (0.0086)***	**0.25205 (0.0014)***	**0.19989 (0.0121)****	0.10797 0.1783	**0.18151 (0.0229)****	1.00000

* Significant at 1% ** Significant at 5%

(a) Service Quality Performance and Gender

Table 5.7 (a) - (b) demonstrated that female respondents had a positive correlation with all the water attributes except leakage and price, burst pipe and price, as well as connection and price. Male respondents had a positive interaction with all the water attributes. The strongest relationships were between leakage and burst pipe and both genders, and the coefficients were 0.83299 and 0.82812, respectively. Both were significant at the 1% level. Leakage shared approximately 64% of its variability with burst pipe. Surprisingly, only price had a weak correlation with reservoir, water quality, disruption and pressure. The coefficient range was between 0.18151 and 0.36338 and significant at the 5% and 1% levels respectively.

Table 5.8 (a): Correlation of Service Quality Performance with Primary School

Pearson Correlation Coefficients, n = 39 Prob > |r| under H0: Rho=0								
	Leakage	**Burst Pipes**	**Reservoir**	**Water quality**	**Disruption**	**Connection**	**Pressure**	**Price**
Leakage	1.00000	**0.74094 (<.0001)***	**0.38171 (0.0165)****	**0.34673 (0.0306)****	**0.63793 (<.0001)***	**0.65588 (<.0001)***	**0.66464 (<.0001)***	-0.04033 0.8074
Burst Pipes	0.74094 (<.0001)*	1.00000	0.50667 **0.0010**	0.17903 0.2755	**0.77611** (<.0001)*	**0.81058 (<.0001)***	**0.74026 (<.0001)***	0.17659 0.2822
Reser-voir	**0.38171 (0.0165)****	**0.50667 (0.0010)***	1.00000	**0.38640 (0.0151)****	**0.54471 (0.0003)***	**0.63321** (<.0001)*	**0.52588 (0.0006)***	**0.35215 (0.0279)****
Water quality	**0.34673 (0.0306)****	0.17903 0.2755	**0.38640 (0.0151)****	1.00000	0.19762 0.2278	0.30000 0.0635	0.15729 0.3389	0.16219 0.3239
Disrup-tion	**0.63793 (<.0001)***	**0.77611 (<.0001)***	**0.54471 (0.0003)***	0.19762 0.2278	1.00000	**0.86023 (<.0001)***	**0.88734 (<.0001)***	0.11288 0.4939
Connec-tion	**0.65588 (<.0001)***	**0.81058 (<.0001)***	**0.63321 (<.0001)***	0.30000 0.0635	**0.86023 (<.0001)***	1.00000	**0.84130 (<.0001)***	0.13122 0.4259
Pressure	**0.66464 (<.0001)***	**0.74026 (<.0001)***	**0.52588 (0.0006)***	0.15729 0.3389	**0.88734 (<.0001)***	**0.84130 (<.0001)***	1.00000	0.07246 0.6611
Price	-0.04033 0.8074	0.17659 0.2822	0.35215 0.0279	0.16219 0.3239	0.11288 0.4939	0.13122 0.4259	0.07246 0.6611	1.00000

* Significant at 1%   ** Significant at 5%

Table 5.8 (b): Correlation of Service Quality Performance with Secondary School

Pearson Correlation Coefficients, n = 122 Prob > |r| under H0: Rho=0								
	Leakage	**Burst Pipes**	**Reservoir**	**Water Quality**	**Disruption**	**Connection**	**Pressure**	**Price**
Leakage	1.00000	**0.85671 (<.0001)***	**0.64330 (<.0001)***	**0.41975 (<.0001)***	**0.60260 (<.0001)***	**0.46199 (<.0001)***	**0.36414 (<.0001)***	**0.25921 (0.0039)***
Burst Pipes	**0.85671 (<.0001)***	1.00000	**0.63704 (<.0001)***	**0.42899 (<.0001)***	**0.67457 (<.0001)***	**0.49260 (<.0001)***	**0.37448 (<.0001)***	**0.20708 (0.0221)****
Reser-voir	**0.64330 (<.0001)***	**0.63704 (<.0001)***	1.00000	**0.40452 (<.0001)***	**0.66296 (<.0001)***	**0.46741 (<.0001)***	**0.45918 (<.0001)***	**0.17583 (0.0527)*****
Water Quality	**0.41975 (<.0001)***	**0.42899 (<.0001)***	**0.40452 (<.0001)***	1.00000	**0.50411 (<.0001)***	**0.44829 (<.0001)***	**0.46324 (<.0001)***	0.17030 0.0607
Disrup-tion	**0.60260 (<.0001)***	**0.67457 (<.0001)***	**0.66296 (<.0001)***	**0.50411 (<.0001)***	1.00000	**0.57992 (<.0001)***	**0.39768 (<.0001)***	**0.26135 (0.0036)***
Connec-tion	**0.46199 (<.0001)***	**0.49260 (<.0001)***	**0.46741 (<.0001)***	**0.44829 (<.0001)***	**0.57992 (<.0001)***	1.00000	**0.48105 (<.0001)***	**0.22563 (0.0125)****
Pressure	**0.36414 (<.0001)***	**0.37448 (<.0001)***	**0.45918 (<.0001)***	**0.46324 (<.0001)***	**0.39768 (<.0001)***	**0.48105 (<.0001)***	1.00000	0.05980 0.5129
Price	**0.25921 (0.0039)***	**0.20708 (0.0221)****	**0.17583 (0.0527)*****	**0.17030 0.0607**	**0.26135 (0.0036)***	**0.22563 (0.0125)****	0.05980 0.5129	1.00000

* Significant at 1% ** Significant at 5% *** Significant at 10%

Table 5.8 (c): Correlation of Service Quality Performance with College

Pearson Correlation Coefficients, n = 112 Prob > |r| under H0: Rho=0								
	Leakage	**Burst Pipes**	**Reservoir**	**Water Quality**	**Disruption**	**Connection**	**Pressure**	**Price**
Leakage	1.00000	**0.85602 (<.0001)***	**0.52107 (<.0001)***	**0.41548 (<.0001)***	**0.57377 (<.0001)***	**0.53443 (<.0001)***	**0.49780 (<.0001)***	**0.25733 (0.0062)***
Burst Pipes	**0.85602 (<.0001)***	1.00000	**0.52169 (<.0001)***	**0.44957 (<.0001)***	**0.65859 (<.0001)***	**0.59120 (<.0001)***	**0.52502 (<.0001)***	**0.21836 (0.0207)****
Reser-voir	**0.64330 (<.0001)***	**0.63704 (<.0001)***	1.00000	**0.40452 (<.0001)***	**0.66296 (<.0001)***	**0.46741 (<.0001)***	**0.45918 (<.0001)***	**0.17583 (0.0324)****
Water Quality	**0.52107 (<.0001)***	**0.52169 (<.0001)***	**0.36935 (<.0001)***	1.00000	**0.57175 (<.0001)***	**0.66833 (<.0001)***	**0.52945 (<.0001)***	**0.20230 (0.0140)****
Disrup-tion	**0.57377 (<.0001)***	**0.65859 (<.0001)***	**0.57175 (<.0001)***	**0.54994 (<.0001)***	1.00000	**0.75175 (<.0001)***	**0.59000 (<.0001)***	**0.21511 (0.0227)****
Connec-tion	**0.53443 (<.0001)***	**0.59120 (<.0001)***	**0.66833 (<.0001)***	**0.45645 (<.0001)***	**0.75175 (<.0001)***	1.00000	**0.67583 (<.0001)***	**0.22563 (0.0035)***
Pressure	**0.49780 (<.0001)***	**0.52502 (<.0001)***	**0.52945 (<.0001)***	**0.27886 (0.0029)***	**0.59000 (<.0001)***	**0.67583 (<.0001)***	1.00000	**0.34028 (0.0002)***
Price	**0.25733 (0.0062)***	**0.21836 (0.0207)****	**0.17583 (0.0324)****	**0.20230 (0.0140)****	**0.21511 (0.0227)****	**0.22563 (0.0035)***	**0.34028 (0.0002)***	1.00000

* Significant at 1% ** Significant at 5%

Table 5.8 (d): Correlation of Service Quality Performance with University

Pearson Correlation Coefficients, n = 112 Prob > |r| under H0: Rho=0								
	Leakage	**Burst Pipes**	**Reservoir**	**Water Quality**	**Disruption**	**Connection**	**Pressure**	**Price**
Leakage	1.00000	**0.78851 (<.0001)***	**0.32844 (<.0001)***	**0.35981 (<.0001)***	**0.58732 (<.0001)***	**0.48133 (<.0001)***	**0.39494 (<.0001)***	**0.35949 (<.0001)***
Burst Pipes	**0.78851 (<.0001)***	1.00000	**0.39561 (<.0001)***	**0.43716 (<.0001)***	**0.52899 (<.0001)***	**0.43411 (<.0001)***	**0.34115 (0.0002)***	**0.27684 (0.0024)***
Reservoir	**0.64330 (<.0001)***	**0.63704 (<.0001)***	1.00000	**0.40452 (<.0001)***	**0.66296 (<.0001)***	**0.46741 (<.0001)***	**0.45918 (<.0001)***	**0.17583 (0.0039)***
Water Quality	**0.32844 (<.0001)***	**0.39561 (<.0001)***	**0.50172 (<.0001)***	1.00000	**0.60013 (<.0001)***	**0.52710 (<.0001)***	**0.48726 (<.0001)***	**0.26408 (0.0009)***
Disrup-tion	**0.58732 (<.0001)***	**0.52899 (<.0001)***	**0.60013 (<.0001)***	**0.50071 (<.0001)***	1.00000	**0.50400 (<.0001)***	**0.46903 (<.0001)***	**0.33074 (0.0003)***
Connec-tion	**0.48133 (<.0001)***	**0.43411 (<.0001)***	**0.52710 (<.0001)***	**0.39014 (<.0001)***	**0.50400 (<.0001)***	1.00000	**0.48474 (<.0001)***	**0.22540 (0.0141)***
Pressure	**0.39494 (<.0001)***	**0.34115 (<.0001)***	**0.48726 (<.0001)***	**0.35336 (0.0029)***	**0.46903 (<.0001)***	**0.48474 (<.0001)***	1.00000	**0.34638 (0.0001)***
Price	**0.35949 (<.0001)***	**0.27684 (0.0024)***	**0.26408 (0.0039)***	**0.30132 (0.0009)***	**0.33074 (0.0003)***	**0.22540 (0.0141)****	**0.34638 (0.0001)***	1.00000

***** Significant at 1% ****** Significant at 5%

(b) Service Quality Performance and Education

Referring to Table 5.8 (a) - (d) showed that respondents who studied at primary and secondary level had a positive correlation between some of the water attributes. The strong relationships for both groups were disruption and pressure as well as leakage and burst pipe, and the coefficients were 0.88734 and 0.84671, respectively. Both were significant at the 1% level. Disruption shared about 64% of its variability with pressure. Furthermore, leakage shared about 64% of its variability with burst pipe. Additionally, the weakest correlation between leakage and water quality was 0.34673 for primary level education. It shared about 9% of its variability with water quality. There was no correlation between most of the water attributes except reservoir capacity. Moreover, for secondary level education, the weakest correlation was between burst pipe and price at 0.20708 and was significant at the 5% level. It shared about 4% of its variability with price.

Additionally, those educated at college and university had a positive correlation between all water attributes. The strongest relationship was leakage and burst pipe for both groups and the coefficients were approximately 0.85602 and 0.7885, respectively. Both were significant at the 1% level. It shared about 64% of its variability with burst pipe. Furthermore, for the college group, the weakest correlation between reservoir capacity and price was 0.17583 and was significant at the 5% level. It shared about 4% of its variability with price. Additionally, for university level education, the weakest correlation was between connection and price was 0.22540 and was significant at the 5% level. It shared about 4% of its variability with price.

Table 5.9 (a): Correlation of Service Quality Performance with Support Staff

Spearman Correlation Coefficients, n = 145 Prob > |r| under H0: Rho=0								
	Leakage	**Burst Pipes**	**Reservoir**	**Water Quality**	**Disruption**	**Connection**	**Pressure**	**Price**
Leakage	1.00000	**0.78953 (<.0001)***	**0.65494 (<.0001)***	**0.47442 (<.0001)***	**0.59688 (<.0001)***	**0.56980 (<.0001)***	**0.57422 (<.0001)***	**0.38423 (<.0001)***
Burst Pipes	**0.78953 (<.0001)***	1.00000	**0.68039 (<.0001)***	**0.46472 (<.0001)***	**0.68605 (<.0001)***	**0.67358 (<.0001)***	**0.58697 (0.0001)***	**0.33877 (0.0004)***
Reser-voir	**0.65494 (<.0001)***	**0.68039 (<.0001)***	1.00000	**0.54655 (<.0001)***	**0.67899 (<.0001)***	**0.66908 (<.0001)***	**0.60804 (<.0001)***	**0.18769 (0.0540)*****
Water Quality	**0.47442 (<.0001)***	**0.46472 (<.0001)***	**0.54655 (<.0001)***	1.00000	**0.65989 (<.0001)***	**0.60568 (<.0001)***	**0.42857 (<.0001)***	0.16670 0.0877
Disrup-tion	**0.59688 (<.0001)***	**0.68605 (<.0001)***	**0.67899 (<.0001)***	0.65989 **(<.0001)***	1.00000	**0.79931 (<.0001)***	**0.58581 (<.0001)***	**0.24703 0.0107****
Connec-tion	**0.56980 (<.0001)***	**0.67358 (<.0001)***	**0.66908 (<.0001)***	**0.60568 (<.0001)***	**0.79931 (<.0001)***	1.00000	**0.55270 (<.0001)***	**0.27551 (0.0043)***
Pressure	**0.57422 (<.0001)***	**0.58697 (<.0001)***	**0.60804 (<.0001)***	**0.42857 (<.0001)***	**0.58581 (<.0001)***	**0.55270 (<.0001)***	1.00000	**0.38098 (<.0001)***
Price	**0.38423 (<.0001)***	**0.33877 (0.0004)***	**0.18769 (0.0540)*****	0.16670 0.0877	**0.24703 (0.0107)****	**0.27551 (0.0043)***	**0.38098 (<.0001)***	1.00000

***** Significant at 1% ****** Significant at 5%

Table 5.9 (b): Correlation of Service Quality Performance with Professional

Spearman Correlation Coefficients, n = 145 Prob > |r| under H0: Rho=0								
	Leakage	**Burst Pipes**	**Reservoir**	**Water Quality**	**Disruption**	**Connection**	**Pressure**	**Price**
Leakage	1.00000	**0.87235 (<.0001)***	**0.40600 (<.0001)***	**0.48962 (<.0001)***	**0.73540 (<.0001)***	**0.56878 (<.0001)***	**0.52103 (<.0001)***	**0.33018 (0.0005)***
Burst Pipes	**0.87235 (<.0001)***	1.00000	**0.45050 (<.0001)***	**0.54433 (<.0001)***	**0.68609 (<.0001)***	**0.55720 (<.0001)***	**0.54205 (0.0001)***	**0.24334 (0.0120)****
Reser-voir	**0.40600 (<.0001)***	**0.45050 (<.0001)***	1.00000	**0.52188 (<.0001)***	**0.61580 (<.0001)***	**0.58615 (<.0001)***	**0.68058 (<.0001)***	**0.32865 (0.0006)***
Water Quality	**0.48962 (<.0001)***	**0.54433 (<.0001)***	**0.52188 (<.0001)***	1.00000	**0.54282 (<.0001)***	**0.44526 (<.0001)***	**0.45574 (<.0001)***	**0.39728 (<.0001)***
Disrup-tion	**0.73540 (<.0001)***	**0.68609 (<.0001)***	**0.61580 (<.0001)***	**0.54282 (<.0001)***	1.00000	**0.59798 (<.0001)***	**0.61051 (<.0001)***	**0.35413 (0.0002)***
Connec-tion	**0.56878 (<.0001)***	**0.55720 (<.0001)***	**0.58615 (<.0001)***	**0.44526 (<.0001)***	**0.59798 (<.0001)***	1.00000	**0.76208 (<.0001)***	**0.30968 (0.0013)***
Pressure	**0.52103 (<.0001)***	**0.54205 (<.0001)***	**0.68058 (<.0001)***	**0.45574 (<.0001)***	**0.61051 (<.0001)***	**0.55270 (<.0001)***	1.00000	**0.39844 (<.0001)***
Price	**0.33018 (0.0005)***	**0.24334 (0.0120)****	**0.32865 (0.0006)***	**0.39728 (<.0001)***	**0.35413 (0.0002)***	**0.30968 (0.0013)***	**0.39844 (<.0001)***	1.00000

***** Significant at 1% ****** Significant at 5%

Table 5.9 (c): Correlation of Service Quality Performance with Others

Spearman Correlation Coefficients, n = 106 Prob > |r| under H0: Rho=0								
	Leakage	**Burst Pipes**	**Reservoir**	**Water Quality**	**Disruption**	**Connection**	**Pressure**	**Price**
Leakage	1.00000	**0.83029 (<.0001)***	**0.60226 (<.0001)***	**0.46126 (<.0001)***	**0.64009 (<.0001)***	**0.56648 (<.0001)***	**0.54865 (<.0001)***	**0.29149 (<.0001)***
Burst Pipes	**0.83029 (<.0001)***	1.00000	**0.63028 (<.0001)***	**0.48701 (<.0001)***	**0.70592 (<.0001)***	**0.57798 (<.0001)***	**0.54044 (0.0001)***	**0.30373 (<.0001)***
Reser-voir	**0.60226 (<.0001)***	**0.63028 (<.0001)***	1.00000	**0.42402 (<.0001)***	**0.67761 (<.0001)***	**0.62022 (<.0001)***	**0.53698 (<.0001)***	**0.30462 (<.0001)***
Water Quality	**0.46126 (<.0001)***	**0.48701 (<.0001)***	**0.42402 (<.0001)***	1.00000	**0.50905 (<.0001)***	**0.44010 (<.0001)***	**0.39489 (<.0001)***	**0.22619 (0.0023)***
Disrup-tion	**0.64009 (<.0001)***	**0.70592 (<.0001)***	**0.67761 (<.0001)***	**0.50905 (<.0001)***	1.00000	**0.66652 (<.0001)***	**0.57020 (<.0001)***	**0.30279 (<.0001)***
Connec-tion	**0.56648 (<.0001)***	**0.57798 (<.0001)***	**0.62022 (<.0001)***	**0.44010 (<.0001)***	**0.66652 (<.0001)***	1.00000	**0.63671 (<.0001)***	**0.30505 (<.0001)***
Pressure	**0.54865 (<.0001)***	**0.54044 (<.0001)***	**0.53698 (<.0001)***	**0.39489 (<.0001)***	**0.57020 (<.0001)***	**0.63671 (<.0001)***	1.00000	**0.23118 (0.0018)***
Price	**0.29149 (<.0001)***	**0.30373 (<.0001)***	**0.30462 (<.0001)***	**0.22619 (0.0023)***	**0.30279 (<.0001)***	**0.30505 (<.0001)***	**0.23118 (0.0018)***	1.00000

***** Significant at 1%

(c) Service Quality Performance and Work

Table 5.9 (a) - (c) demonstrated that the professional and “others” employment groups had a positive correlation between all water attributes. The strongest correlations were between leakage and burst pipe for both groups, and the coefficients were 0.87235 and

0.83029, respectively. Both were significant at the 1% level. It shared approximately 64% of its variability with burst pipe. Moreover, for the professional group, there was a weak correlation between burst pipe and price, which was 0.24334, and was significant at the 5% level. In addition, for the "others" group, the weakest correlation was between water quality and price at 0.22619 and was significant at the 5% level as well.

Meanwhile, there was a positive correlation between all water attributes except price with reservoir capacity and water quality for the support staff group. The strongest correlation was between disruption and connection at 0.79931 and was significant at the 1% level. It shared approximately 64% of its variability with connection. Furthermore, there was a weak correlation between disruption and price, with a value of 0.24703, and was significant at the 5% level.

Table 5.10 (a): Correlation of Service Quality Performance with Income (MYR500 or less per month)

Pearson Correlation Coefficients, n = 42 Prob > |r| under H0: Rho=0								
	Leakage	**Burst Pipes**	**Reservoir**	**Water Quality**	**Disruption**	**Connection**	**Pressure**	**Price**
Leakage	1.00000	**0.91575 (<.0001)***	**0.73402 (<.0001)***	**0.62978 (<.0001)***	**0.68036 (<.0001)***	**0.70108 (<.0001)***	**0.47879 (0.0013)****	0.25219 0.1071
Burst Pipes	**0.91575 (<.0001)***	1.00000	**0.68053 (<.0001)***	**0.70301 (<.0001)***	**0.70691 (<.0001)***	**0.69470 (<.0001)***	**0.45108 0.0027***	0.28555 0.0668
Reser-voir	**0.73402 (<.0001)***	**0.68053 (<.0001)***	1.00000	**0.51067 (<.0001)***	**0.63732 (<.0001)***	**0.86514 (<.0001)***	**0.43150 (0.0043)***	0.21616 0.1692
Water Quality	**0.62978 (<.0001)***	**0.70301 (<.0001)***	**0.51067 (<.0001)***	1.00000	**0.66730 (<.0001)***	**0.56549 (<.0001)***	0.28486 0.0675	0.27609 0.0768
Disrup-tion	**0.68036 (<.0001)***	**0.70691 (<.0001)***	**0.63732 (<.0001)***	**0.66730 (<.0001)***	1.00000	**0.73743 (<.0001)***	**0.43181 (0.0043)***	**0.35120 (0.0226)****
Connec-tion	**0.70108 (<.0001)***	**0.69470 (<.0001)***	**0.86514 (<.0001)***	**0.56549 (<.0001)***	**0.73743 (<.0001)***	1.00000	**0.46814 (0.0018)***	0.18110 0.2511
Pressure	**0.47879 (0.0013)****	**0.45108 (0.0027)***	**0.43150 (0.0043)***	0.28486 0.0675	**0.43181 (0.0043)***	**0.46814 (0.0018)***	1.00000	0.20978 0.1824
Price	0.25219 0.1071	0.28555 0.0668	0.21616 0.1692	0.27609 0.0768	**0.35120 (0.0226)****	0.18110 0.2511	0.20978 0.1824	1.00000

***** Significant at 1%   ****** Significant at 5%

Table 5.10 (b): Correlation of Service Quality Performance with Income (MYR501–MYR1,500 per month)

Pearson Correlation Coefficients, n= 105 Prob > |r| under H0: Rho=0								
	Leakage	Burst Pipes	Reservoir	Water Quality	Disruption	Connection	Pressure	Price
Leakage	1.00000	0.82590 (<.0001)*	0.53774 (<.0001)*	0.31780 (<.0001)*	0.50763 (<.0001)*	0.42278 (<.0001)*	0.48088 (0.0013)*	0.15862 0.1061
Burst Pipes	0.82590 (<.0001)*	1.00000	0.59795 (<.0001)*	0.27443 (0.0046)*	0.59936 (<.0001)*	0.50486 (<.0001)*	0.47377 (0.0027)*	0.19482 (0.0464)**
Reservoir	0.53774 (<.0001)*	0.59795 (<.0001)*	1.00000	0.31843 (0.0009)*	0.57318 (<.0001)*	0.47262 (<.0001)*	0.50822 (0.0043)*	0.23851 (0.0143)**
Water Quality	0.31780 (<.0001)*	0.27443 (<.0001)*	0.31843 (<.0001)*	1.00000	0.45810 (<.0001)*	0.44065 (<.0001)*	0.42399 0.0675	0.09355 0.3425
Disrup-tion	0.50763 (<.0001)*	0.59936 (<.0001)*	0.57318 (<.0001)*	0.45810 (<.0001)*	1.00000	0.58679 (<.0001)*	0.46992 (0.0043)*	0.13265 0.1774
Connec-tion	0.42278 (<.0001)*	0.50486 (<.0001)*	0.47262 (<.0001)*	0.44065 (<.0001)*	0.58679 (<.0001)*	1.00000	0.59454 (<.0001)*	0.13910 0.1570
Pressure	0.48088 (<.0001)*	0.47377 (<.0001)*	0.50822 (<.0001)*	0.42399 (<.0001)*	0.46992 (<.0001)*	0.59454 (<.0001)*	1.00000	0.08135 0.1824
Price	0.15862 0.1061	0.19482 (0.0464)**	0.23851 (0.0143)**	0.09355 0.3425	0.13265 0.1774	0.13910 0.1570	0.08135 0.4094	1.00000

* Significant at 1% ** Significant at 5%

Table 5.10 (c): Correlation of Service Quality Performance with Income (MYR1,501–MYR2,500 per month)

Spearman Correlation Coefficients, n = 106 Prob > |r| under H0: Rho=0								
	Leakage	Burst Pipes	Reservoir	Water Quality	Disruption	Connection	Pressure	Price
Leakage	1.00000	0.82336 (<.0001)*	0.35991 (<.0001)*	0.46273 (<.0001)*	0.58275 (<.0001)*	0.56887 (<.0001)*	0.37424 (<.0001)*	0.32997 (0.0001)*
Burst Pipes	0.82336 (<.0001)*	1.00000	0.29524 (0.0006)*	0.52078 (<.0001)*	0.58686 (<.0001)*	0.49228 (<.0001)*	0.38289 (<.0001)*	0.28540 0.0009*
Reser-voir	0.35991 (<.0001)*	0.29524 (0.0006)*	1.00000	0.40614 (<.0001)*	0.55492 (<.0001)*	0.45360 (<.0001)*	0.45921 (<.0001)*	0.11594 0.1839
Water Quality	0.46273 (<.0001)*	0.52078 (<.0001)*	0.40614 (<.0001)*	1.00000	0.51412 (<.0001)*	0.36930 (<.0001)*	0.31378 (0.0002)*	0.25095 (0.0036)*
Disrup-tion	0.58275 (<.0001)*	0.58686 (<.0001)*	0.55492 (<.0001)*	0.51412 (<.0001)*	1.00000	0.61673 (<.0001)*	0.60621 (<.0001)*	0.23823 (0.0058)*
Connec-tion	0.56887 (<.0001)*	0.49228 (<.0001)*	0.45360 (<.0001)*	0.36930 (<.0001)*	0.61673 (<.0001)*	1.00000	0.48015 (0.0018)*	0.22303 (0.0102)**
Pressure	0.37424 (<.0001)*	0.38289 (<.0001)*	0.45921 (0.0002)*	0.31378 (<.0001)*	0.60621 (<.0001)*	0.48015 (<.0001)*	1.00000	0.28238 (0.0010)*
Price	0.32997 (0.0001)*	0.28540 (0.0009)*	0.11594 0.1839	0.25095 (0.0036)*	0.23823 (0.0058)*	0.22303 (0.0102)**	0.28238 (0.0010)*	1.00000

* Significant at 1% ** Significant at 5%

Table 5.10 (d): Correlation Between Service Quality Performance with Income (more than MYR2,501 per month)

Pearson Correlation Coefficients, n = 112 Prob > |r| under H0: Rho=0								
	Leakage	**Burst Pipes**	**Reservoir**	**Water Quality**	**Disruption**	**Connection**	**Pressure**	**Price**
Leakage	1.00000	**0.80955 (<.0001)***	**0.43651 (<.0001)***	**0.33880 (0.0003)***	**0.66208 (<.0001)***	**0.45019 (<.0001)***	**0.47426 (<.0001)***	**0.29893 (0.0014)***
Burst Pipes	**0.80955 (<.0001)***	1.00000	**0.56906 (<.0001)***	**0.38340 (<.0001)***	**0.67282 (<.0001)***	**0.51772 (<.0001)***	**0.45490 (<.0001)***	0.17417 0.0663
Reser-voir	**0.43651 (<.0001)***	**0.56906 (<.0001)***	1.00000	**0.53252 (<.0001)***	**0.67996 (<.0001)***	**0.61722 (<.0001)***	**0.54858 (<.0001)***	**0.29367 (0.0017)***
Water Quality	**0.33880 (<.0001)***	**0.38340 (<.0001)***	**0.53252 (<.0001)***	1.00000	**0.49379 (<.0001)***	**0.43290 (<.0001)***	**0.39776 (<.0001)***	**0.30403 (0.0011)***
Disrup-tion	**0.66208 (<.0001)***	**0.67282 (<.0001)***	**0.67996 (<.0001)***	**0.49379 (<.0001)***	1.00000	**0.62571 (<.0001)***	**0.50014 (<.0001)***	**0.33407 (0.0003)***
Connec-tion	**0.45019 (<.0001)***	**0.51772 (<.0001)***	**0.61722 (<.0001)***	**0.43290 (<.0001)***	**0.62571 (<.0001)***	1.00000	**0.64421 (<.0001)***	**0.32452 (0.0005)***
Pressure	**0.47426 (<.0001)***	**0.45490 (<.0001)***	**0.54858 (<.0001)***	**0.39776 (<.0001)***	**0.50014 (<.0001)***	**0.64421 (<.0001)***	1.00000	**0.34849 (0.0002)***
Price	**0.29893 (0.0014)***	0.17417 0.0663	**0.29367 (0.0017)***	**0.30403 (0.0011)***	**0.33407 (0.0003)***	**0.32452 (0.0005)***	**0.34849 (0.0002)***	1.00000

* Significant at 1%

(d) Service Quality Performance and Income

Table 5.10 (a) - (d) showed that for those respondents with an income of MYR500 or less per month, there was a positive correlation between all water attributes except pressure with water quality as well as price with leakage, burst pipe, reservoir capacity, connection, and pressure. The strongest correlation was between leakage and burst pipe at 0.91575 and was significant at the 1% level. It shared approximately 81% of its variability with burst pipe. This was followed by a correlation between leakage and burst pipe, which was 0.82590, for respondents who have an income of MYR501 to MYR1,500 per month and was significant at the 1% level. It shared approximately 64% of its variability with burst pipe.

Meanwhile, for the group with income MYR1,501 to MYR2,500 per month, there was a positive correlation between all water attributes except reservoir capacity and price. The strongest correlation was between leakage and burst pipe at 0.82336 and was significant at the 1% level. It shared approximately 64% of its variability with burst pipe. The lowest coefficient was 0.19482 of correlation between burst pipe and price, for the group whose income was between MYR501 and MYR1,500 per month. This correlation was significant at the 5% level. Surprisingly, the majority of the water attributes did not have a relationship with price, in addition to not being statistically significant.

5.9.2 Correlation Perceptions of Service Factors and Socioeconomics

The results of the correlation between the perception of service quality performance and socioeconomics are reported as follows:-

Table 5.11 (a): Correlation of Water Service with Male

Pearson Correlation Coefficients, n = 235 Prob > |r| under H0: Rho=0								
	Leakage	**Burst Pipes**	**Reservoir**	**Water Quality**	**Disruption**	**Connection**	**Pressure**	**Price**
Leakage	1.00000	**0.73421 (<.0001)***	**0.61379 (<.0001)***	**0.41724 (<.0001)***	**0.65577 (<.0001)***	**0.64075 (<.0001)***	**0.47793 (<.0001)***	**0.15703 (0.0160)****
Burst Pipes	**0.73421 (<.0001)***	1.00000 (<.0001)*	**0.65889 (<.0001)***	**0.50903 (<.0001)***	**0.68085 (<.0001)***	**0.64651 (<.0001)***	**0.49400 (<.0001)***	0.12773 0.0505
Reservoir	**0.61379 (<.0001)***	**0.65889 (<.0001)***	1.00000	**0.38407 (<.0001)***	**0.62155 (<.0001)***	**0.58616 (<.0001)***	**0.45043 (<.0001)***	**0.18475 (0.0045)***
Water Quality	**0.41724 (<.0001)***	**0.50903 (<.0001)***	**0.38407 (<.0001)***	1.00000	**0.45902 (<.0001)***	**0.44450 (<.0001)***	**0.36739 (<.0001)***	0.05352 0.4141
Disrup-tion	**0.65577 (<.0001)***	**0.68085 (<.0001)***	**0.62155 (<.0001)***	**0.45902 (<.0001)***	1.00000	**0.76825 (<.0001)***	**0.49385 (<.0001)***	**0.20336 (0.0017)****
Connec-tion	**0.64075 (<.0001)***	**0.64651 (<.0001)***	**0.58616 (<.0001)***	**0.44450 (<.0001)***	**0.76825 (<.0001)***	1.00000	**0.55511 (<.0001)***	**0.21598 (0.0009)***
Pressure	**0.47793 (<.0001)***	**0.49400 (<.0001)***	**0.45043 (<.0001)***	**0.36739 (<.0001)***	**0.49385 (<.0001)***	**0.55511 (<.0001)***	1.00000	**0.22745 (0.0004)***
Price	**0.15703 (0.0160)****	0.12773 0.0505	**0.18475 (0.0045)****	0.05352 0.4141	**0.20336 (0.0017)****	**0.21598 0.0009)***	**0.22745 (0.0004)***	1.00000

Table 5.11 (b): Correlation of Water Service with Female

Pearson Correlation Coefficients, n = 157 Prob > |r| under H0: Rho=0								
	Leakage	**Burst Pipes**	**Reservoir**	**Water Quality**	**Disruption**	**Connection**	**Pressure**	**Price**
Leakage	1.00000	**0.84381 (<.0001)***	**0.60398 (<.0001)***	**0.56035 (<.0001)***	**0.51793 (<.0001)***	**0.54196 (<.0001)***	**0.30483 (<.0001)***	0.08330 0.2997
Burst Pipes	**0.84381 (<.0001)***	1.00000	**0.65182 (<.0001)***	**0.53603 (<.0001)***	**0.53858 (<.0001)***	**0.57582 (<.0001)***	**0.34657 (<.0001)***	0.12732 0.1120
Reservoir	**0.60398 (<.0001)***	**0.65182 (<.0001)***	1.00000	**0.43389 (<.0001)***	**0.46763 (<.0001)***	**0.48572 (<.0001)***	**0.34462 (<.0001)***	**0.16124 (0.0437)****
Water Quality	**0.56035 (<.0001)***	**0.53603 (<.0001)***	**0.43389 (<.0001)***	1.00000	**0.45709 (<.0001)***	**0.46627 (<.0001)***	**0.35011 (<.0001)***	0.06735 0.4020
Disrup-tion	**0.51793 (<.0001)***	**0.53858 (<.0001)***	**0.46763 (<.0001)***	**0.45709 (<.0001)***	1.00000	**0.69655 (<.0001)***	**0.40813 (<.0001)***	**0.17169 (0.0316)****
Connec-tion	**0.54196 (<.0001)***	**0.57582 (<.0001)***	**0.48572 (<.0001)***	**0.46627 (<.0001)***	**0.69655 (<.0001)***	1.00000	**0.38404 (<.0001)***	**0.15838 (0.0476)****
Pressure	**0.30483 (0.0028)****	**0.34657 (0.0028)****	**0.34462 (0.0028)****	**0.35011 (0.0028)****	**0.40813 (0.0028)****	**0.38404 (0.0028)****	1.00000	**0.23687 (0.0028)****
Price	0.08330 0.2997	0.12732 0.1120	**0.16124 (0.0437)****	0.06735 0.4020	**0.17169 (0.0316)****	**0.15838 (0.0476)****	**0.23687 (0.0028)****	1.00000

* Significant at 1% ** Significant at 5%

(a) Service Factors and Gender

Table 5.11 (a) - (b) reported that female respondents had a positive correlation between all water attributes except reduction in the level of leakage and increase in price, burst pipe and increase in price, as well as water quality and increase the price. The strongest correlation was between leakage and burst pipe was 0.84381 and was significant at the 1% level. It shared approximately 64% of its variability with burst pipe. However, there was a weak correlation between reservoir capacity and increase in price, which was 0.15838 and was significant at the 5% level. It shared only 1% of its variability with reservoir capacity.

Male respondents had a positive correlation between all water attributes. The strongest correlation was between time taken for connection and water supply disruption at 0.76825 and was significant at the 1% level. It shared approximately 49% of its variability with disruption. Additionally, there was a weak correlation between burst pipe and increase in price, which was 0.12773 and was significant at the 5% level. It shared only 1% of its variability with reservoir capacity.

Table 5.12 (a): Correlation of Water Service with Primary School

Spearman Correlation Coefficients, n = 39 Prob > |r| under H0: Rho=0								
	Leakage	**Burst Pipes**	**Reservoir**	**Water Quality**	**Disruption**	**Connection**	**Pressure**	**Price**
Leakage	1.00000	**0.95166 (<.0001)***	**0.70504 (<.0001)***	**0.59194 (<.0001)***	**0.65792 (<.0001)***	**0.48563 (0.0017)***	**0.61839 (<.0001)***	0.16103 0.3274
Burst Pipes	**0.95166 (<.0001)***	1.00000	**0.65388 (<.0001)***	**0.55784 (0.0002)***	**0.69592 (<.0001)***	**0.52493 (0.0006)***	**0.55819 (0.0002)****	0.12602 0.4446
Reservoir	**0.70504 (<.0001)***	**0.65388 (<.0001)***	1.00000	**0.66200 (<.0001)***	**0.65388 (<.0001)***	**0.75651 (<.0001)***	**0.70504 (<.0001)***	0.26469 0.1034
Water Quality	**0.59194 (<.0001)***	**0.55784 (0.0002)****	**0.66200 (<.0001)***	1.00000	**0.55784 (0.0002)****	**0.53119 (0.0005)****	**0.49503 (0.0014)***	**0.33383 (0.0378)****
Disrup-tion	**0.65792 (<.0001)***	**0.69592 (<.0001)***	**0.65388 (<.0001)***	**0.55784 (0.0002)****	1.00000	**0.80953 (<.0001)***	**0.85193 (<.0001)***	**0.40131 (0.0113)****
Connec-tion	**0.48563 (0.0017)***	**0.52493 (0.0006)***	**0.75651 (<.0001)***	**0.53119 (0.0005)****	**0.80953 (<.0001)***	1.00000	**0.85690 (<.0001)***	0.30838 0.0561
Pressure	**0.61839 (<.0001)***	**0.55819 (0.0002)***	**0.70504 (<.0001)***	**0.49503 (0.0014)***	**0.85193 (<.0001)***	**0.85690 (<.0001)***	1.00000	0.31273 0.0526
Price	0.16103 0.3274	0.12602 0.4446	0.26469 0.1034	**0.33383 (0.0378)****	**0.40131 (0.0113)****	0.30838 0.0561	0.31273 0.0526	1.00000

* Significant at 1%   ** Significant at 5%

Table 5.12 (b): Correlation of Water Service with Secondary School

Spearman Correlation Coefficients, n = 122 Prob > |r| under H0: Rho=0								
	Leakage	**Burst Pipes**	**Reservoir**	**Water Quality**	**Disruption**	**Connection**	**Pressure**	**Price**
Leakage	1.00000	**0.72401 (<.0001)***	**0.68742 (<.0001)***	**0.27501 (0.0022)***	**0.53104 (<.0001)***	**0.55621 (<.0001)***	**0.39877 (<.0001)***	-0.03340 0.7150
Burst Pipes	**0.72401 (<.0001)***	1.00000	**0.70766 (<.0001)***	**0.30120 (0.0007)***	**0.52254 (<.0001)***	**0.54373 (<.0001)***	**0.42476 (<.0001)***	0.01653 0.8566
Reservoir	**0.68742 (<.0001)***	**0.70766 (<.0001)***	1.00000	**0.41478 (<.0001)***	**0.58570 (<.0001)***	**0.57517 (<.0001)***	**0.44608 (<.0001)***	0.00633 0.9448
Water Quality	**0.27501 (0.0022)***	**0.30120 (0.0007)***	**0.41478 (<.0001)***	1.00000	**0.32539 (0.0003)****	**0.28455 (0.0015)***	**0.31146 (0.0005)***	-0.06985 0.4445
Disrup-tion	**0.53104 (<.0001)***	**0.52254 (<.0001)***	**0.58570 (<.0001)***	**0.32539 (0.0003)****	1.00000	**0.66165 (<.0001)***	**0.46544 (<.0001)***	0.09225 0.3122
Connec-tion	**0.55621 (<.0001)***	**0.54373 (<.0001)***	**0.57517 (<.0001)***	0.28455 0.0015	**0.66165 (<.0001)***	1.00000	**0.59825 (<.0001)***	0.09450 0.3005
Pressure	**0.39877 (<.0001)***	**0.42476 (<.0001)***	**0.44608 (<.0001)***	0.31146 0.0005	**0.46544 (<.0001)***	**0.59825 (<.0001)***	1.00000	**0.19966 (0.0275)****
Price	-0.03340 0.7150	0.01653 0.8566	0.00633 0.9448	-0.06985 0.4445	0.09225 0.3122	0.09450 0.3005	**0.19966 (0.0275)****	1.00000

* Significant at 1%   ** Significant at 5%

Table 5.12 (c): Correlation of Water Service with College

Spearman Correlation Coefficients, n = 112 Prob > |r| under H0: Rho=0								
	Leakage	Burst Pipes	Reservoir	Water Quality	Disruption	Connection	Pressure	Price
Leakage	1.00000	0.82124 (<.0001)*	0.76377 (<.0001)*	0.47450 (<.0001)*	0.76295 (<.0001)*	0.75613 (<.0001)*	0.50664 (<.0001)*	0.18765 (0.0476)**
Burst Pipes	0.82124 (<.0001)*	1.00000	0.78804 (<.0001)*	0.45332 (<.0001)*	0.78977 (<.0001)*	0.74334 (<.0001)*	0.55517 (<.0001)*	0.12516 0.1886
Reser-voir	0.76377 (<.0001)*	0.78804 (<.0001)*	1.00000	0.40949 (<.0001)*	0.73677 (<.0001)*	0.69702 (<.0001)*	0.58112 (<.0001)*	0.19303 (0.0414)**
Water Quality	0.47450 (<.0001)*	0.45332 (<.0001)*	0.40949 (<.0001)*	1.00000	0.35605 (<.0001)*	0.47057 (<.0001)*	0.31702 (0.0007)*	0.01622 0.8652
Disrup-tion	0.76295 (<.0001)*	0.78977 (<.0001)*	0.73677 (<.0001)*	0.35605 (<.0001)*	1.00000	0.78998 (<.0001)*	0.56475 (<.0001)*	0.14400 0.1298
Connec-tion	0.75613 (<.0001)*	0.74334 (<.0001)*	0.69702 (<.0001)*	0.47057 (<.0001)*	0.78998 (<.0001)*	1.00000	0.60470 (<.0001)*	0.14248 0.1340
Pressure	0.50664 (<.0001)*	0.55517 (<.0001)*	0.58112 (<.0001)*	0.31702 (0.0007)*	0.56475 (<.0001)*	0.60470 (<.0001)*	1.00000	0.25874 (0.0059)*
Price	0.18765 (0.0476)**	0.12516 0.1886	0.19303 (0.0414)*	0.01622 0.8652	0.14400 0.1298	0.14248 0.1340	0.25874 (0.0059)*	1.00000

* Significant at 1% ** Significant at 5%

Table 5.12 (d): Correlation of Water Service with University

Spearman Correlation Coefficients, n = 118 Prob > |r| under H0: Rho=0								
	Leakage	Burst Pipes	Reservoir	Water Quality	Disruption	Connection	Pressure	Price
Leakage	1.00000	0.82871 (<.0001)*	0.67227 (<.0001)*	0.42274 (<.0001)*	0.52262 (<.0001)*	0.55870 (<.0001)*	0.52982 (<.0001)*	0.03872 0.6772
Burst Pipes	0.82871 (<.0001)*	1.00000	0.74769 (<.0001)*	0.36321 (<.0001)*	0.51872 (<.0001)*	0.63078 (<.0001)*	0.52830 (<.0001)*	0.08874 0.3393
Reser-voir	0.67227 (<.0001)*	0.74769 (<.0001)*	1.00000	0.35812 (<.0001)*	0.56053 (<.0001)*	0.63095 (<.0001)*	0.55159 (<.0001)*	0.16263 0.0785
Water Quality	0.42274	0.36321 (<.0001)*	0.35812 (<.0001)*	1.00000	0.45511 (<.0001)*	0.42162 (<.0001)*	0.45219 (<.0001)*	-0.06941 0.4552
Disrup-tion	0.52262 (<.0001)*	0.51872 (<.0001)*	0.56053 (<.0001)*	0.45511 (<.0001)*	1.00000	0.72035 (<.0001)*	0.60800 (<.0001)*	0.08680 0.3500
Connec-tion	0.55870 (<.0001)*	0.63078 (<.0001)*	0.63095 (<.0001)*	0.42162 (<.0001)	0.72035 (<.0001)	1.00000	0.61871 (<.0001)*	0.17557 0.0572
Pressure	0.52982 (<.0001)*	0.52830 (<.0001)*	0.55159 (<.0001)*	0.45219 (<.0001)*	0.60800 (<.0001)*	0.61871 (<.0001)*	1.00000	0.06413 0.4903
Price	0.03872 0.6772	0.08874 0.3393	0.16263 0.0785	-0.06941 0.4552	0.08680 0.3500	0.17557 0.0572	0.06413 0.4903	1.00000

* Significant at 1% ** Significant at 5%

(b) Service Factors and Education

Table 5.12 (a) - (d) demonstrated that there was a positive correlation between some of the water attributes for all levels of education. The strongest correlation was between leakage and burst pipe at 0.95166 and was significant at the 1% level for those who only went to primary school. It shared about 81% of its variability with burst pipe. Additionally, it was followed by disruption and pressure, which was 0.85193 and was significant at the 1% level. It shared approximately 64% of its variability with pressure.

Moreover, respondents who graduated from college and university had a strong correlation between leakage and burst pipe, which were 0.82124 and 0.82871, respectively. Both were significant at the 1% level. These attributes shared approximately 64% of their variability with burst pipe. For those educated to university level, there was no correlation between an increase in the price and other attributes. Furthermore, the weakest correlation was between an increase in the price and leakage for those who studied at college. The coefficient was 0.18765 and was significant at the 5% level.

Table 5.13 (a): Correlation of Water Service with Support Staff

Spearman Correlation Coefficients, n =106 Prob > |r| under H0: Rho=0								
	Leakage	**Burst Pipes**	**Reservoir**	**Water Quality**	**Disruption**	**Connection**	**Pressure**	**Price**
Leakage	1.00000	**0.68925 (<.0001)***	**0.61298 (<.0001)***	**0.44998 (<.0001)***	**0.52140 (<.0001)***	**0.47984 (<.0001)***	**0.22633 (0.0197)****	0.02425 0.8051
Burst Pipes	**0.68925 (<.0001)***	1.00000	**0.62724 (<.0001)***	**0.40668 (<.0001)***	**0.54681 (<.0001)***	**0.54965 (<.0001)***	**0.25088 (0.0095)***	-0.06643 0.4987
Reservoir	**0.61298 (<.0001)***	**0.74769 (<.0001)***	1.00000	**0.40784 (<.0001)***	**0.58385 (<.0001)***	**0.46914 (<.0001)***	**0.33442 (0.0005)***	0.06839 0.4860
Water Quality	**0.44998 (<.0001)***	**0.40668 (<.0001)***	**0.40784 (<.0001)***	1.00000	**0.39934 (<.0001)***	**0.42331 (<.0001)***	**0.25403 (0.0086)***	0.00021 0.9983
Disrup-tion	**0.52140 (<.0001)***	**0.54681 (<.0001)***	**0.58385 (<.0001)***	**0.39934 (<.0001)***	1.00000	**0.69388 (<.0001)***	**0.50279 (<.0001)***	0.11672 0.2334
Connec-tion	**0.47984 (<.0001)***	**0.54965 (<.0001)***	**0.46914 (<.0001)***	**0.42331 (<.0001)**	**0.69388 (<.0001)**	1.00000	**0.51358 (<.0001)***	0.18051 0.0641
Pressure	**0.22633 (0.0197)****	**0.25088 (0.0095)***	**0.33442 (0.0005)***	**0.25403 (0.0086)***	**0.50279 (<.0001)***	**0.51358 (<.0001)***	1.00000	**0.33143 (0.0005)***
Price	0.02425 0.8051	-0.06643 0.4987	0.06839 0.4860	0.00021 0.9983	0.11672 0.2334	0.18051 0.0641	**0.33143 (0.0005)***	1.00000

* Significant at 1%   ** Significant at 5%

Table 5.13 (b): Correlation of Water Service with Professional Staff

Spearman Correlation Coefficients, n = 106 Prob > |r| under H0: Rho=0								
	Leakage	**Burst Pipes**	**Reservoir**	**Water Quality**	**Disruption**	**Connection**	**Pressure**	**Price**
Leakage	1.00000	**0.90532 (<.0001)***	**0.79976 (<.0001)***	**0.29625 (0.0020)***	**0.69708 (<.0001)***	**0.73462 (<.0001)***	**0.68184 (<.0001)***	0.13681 0.1620
Burst Pipes	**0.90532 (<.0001)***	1.00000	**0.82466 (<.0001)***	**0.21668 (0.0257)****	**0.60368 (<.0001)***	**0.75263 (<.0001)***	**0.62612 (<.0001)***	**0.23335 (0.0161)****
Reservoir	**0.79976 (<.0001)***	**0.82466 (<.0001)***	1.00000	**0.31828 (0.0009)***	**0.62062 (<.0001)***	**0.74384 (<.0001)***	**0.70019 (<.0001)***	**0.20787 (0.0325)****
Water Quality	**0.29625 (0.0020)****	**0.21668 (0.0257)****	**0.31828 (0.0009)***	1.00000	**0.38938 (<.0001)***	**0.30952 (0.0012)***	**0.39818 (<.0001)***	-0.02713 0.7825
Disrup-tion	**0.69708 (<.0001)***	**0.60368 (<.0001)***	**0.62062 (<.0001)***	**0.38938 (<.0001)***	1.00000	**0.70239 (<.0001)***	**0.66852 (<.0001)***	0.11716 0.2317
Connec-tion	**0.73462 (<.0001)***	**0.75263 (<.0001)***	**0.74384 (<.0001)***	**0.30952 (0.0012)***	**0.70239 (<.0001)**	1.00000	**0.72755 (<.0001)***	**0.25541 (0.0082)***
Pressure	**0.68184 (<.0001)***	**0.62612 (<.0001)***	**0.70019 (<.0001)***	**0.39818 (<.0001)***	**0.66852 (<.0001)***	**0.72755 (<.0001)***	1.00000	0.14231 0.1456
Price	0.13681 0.1620	**0.23335 (0.0161)****	**0.20787 (0.0325)****	-0.02713 0.7825	0.11716 0.2317	**0.25541 (0.0082)***	0.14231 0.1456	1.00000

* Significant at 1%   ** Significant at 5%

Table 5.13 (c): Correlation of Water Service with Others

Spearman Correlation Coefficients, n = 179 Prob > |r| under H0: Rho=0								
	Leakage	**Burst Pipes**	**Reservoir**	**Water Quality**	**Disruption**	**Connection**	**Pressure**	**Price**
Leakage	1.00000	**0.81947 (<.0001)***	**0.71088 (<.0001)***	**0.61312 (<.0001)***	**0.62338 (<.0001)***	**0.62338 (<.0001)***	**0.54379 (<.0001)***	0.05335 0.4781
Burst Pipes	**0.82871 (<.0001)***	1.00000	**0.74498 (<.0001)***	**0.47696 (<.0001)***	**0.66145 (<.0001)***	**0.60522 (<.0001)***	**0.59559 (<.0001)***	0.07431 0.3228
Reservoir	**0.71088 (<.0001)***	**0.74498 (<.0001)***	1.00000	**0.48517 (<.0001)***	**0.65289 (<.0001)***	**0.69822 (<.0001)***	**0.57145 (<.0001)***	0.12195 0.1039
Water Quality	**0.44167 (<.0001)***	**0.47696 (<.0001)***	**0.48517 (<.0001)***	1.00000	**0.42632 (<.0001)***	**0.43320 (<.0001)***	**0.41754 (<.0001)***	-0.00146 0.9846
Disrup-tion	**0.61312 (<.0001)***	**0.66145 (<.0001)***	**0.65289 (<.0001)***	**0.42632 (<.0001)***	1.00000	**0.75457 (<.0001)***	**0.54772 (<.0001)***	0.12960 0.0838
Connec-tion	**0.62338 (<.0001)***	**0.60522 (<.0001)***	**0.69822 (<.0001)***	**0.43320 (<.0001)**	**0.75457 (<.0001)**	1.00000	**0.62241 (<.0001)***	0.07153 0.3413
Pressure	**0.54379 (<.0001)***	**0.59559 (<.0001)***	**0.57145 (<.0001)***	**0.41754 (<.0001)***	**0.54772 (<.0001)***	**0.62241 (<.0001)***	1.00000	0.13337 0.0751
Price	0.05335 0.4781	0.07431 0.3228	0.12195 0.1039	-0.00146 0.9846	0.12960 0.0838	0.07153 0.3413	0.13337 0.0751	1.00000

* Significant at 1%   ** Significant at 5%

(c) Service Factors and Work

Table 5.13 (a) - (c) revealed that professional respondents have a positive correlation between some of the water attributes. The strongest correlation was between leakage and burst pipe, which was 0.90532 and was significant at the 1% level. It shared approximately 64% of its variability with burst pipe. The weakest correlation was between increase in price and reservoir capacity, which was 0.20787 and was significant at the 5% level.

Furthermore, for the "others" group, there were correlations with all water attributes except increase in price. Similarly, the strongest correlation was between leakage and burst pipe, which was 0.81947 and was significant at the 1% level. It shared approximately 64% of its variability with improve repairs to burst pipe. Meanwhile, in the support staff group, the strongest correlation was between disruption and time taken for connection. The coefficient was 0.69388 and was significant at the 1% level. It shared approximately 49% of its variability with time taken for connection.

Table 5.14 (a): Correlation of Water Service with Income (MYR500 or less per month)

Pearson Correlation Coefficients, n = 42 Prob > |r| under H0: Rho=0								
	Leakage	**Burst Pipes**	**Reservoir**	**Water Quality**	**Disruption**	**Connection**	**Pressure**	**Price**
Leakage	1.00000	**0.77071 (<.0001)***	**0.55392 (<.0001)***	**0.57826 (<.0001)***	**0.58780 (<.0001)***	**0.54220 (0.0002)***	**0.65458 (<.0001)***	0.29255 0.0601
Burst Pipes	**0.77071 (<.0001)***	1.00000	**0.72731 (<.0001)***	**0.61497 (<.0001)***	**0.66560 (<.0001)***	**0.67361 (<.0001)***	**0.70159 (<.0001)***	**0.41747 (0.0059)***
Reser-voir	**0.55392 (<.0001)***	**0.72731 (<.0001)***	1.00000	**0.60228 (<.0001)***	**0.63539 (<.0001)***	**0.72749 (<.0001)***	**0.70605 (<.0001)***	0.17411 0.2701
Water Quality	**0.57826 (<.0001)***	**0.61497 (<.0001)***	**0.60228 (<.0001)***	1.00000	**0.67008 (<.0001)***	**0.59249 (<.0001)***	**0.60384 (<.0001)***	0.18789 0.2334
Disrup-tion	**0.58780 (<.0001)***	**0.66560 (<.0001)***	**0.63539 (<.0001)***	**0.67008 (<.0001)***	1.00000	**0.82263 (<.0001)***	**0.75190 (<.0001)***	0.27164 0.0818
Connec-tion	**0.54220 (0.0002)***	**0.67361 (<.0001)***	**0.72749 (<.0001)***	**0.59249 (<.0001)**	**0.82263 (<.0001)**	1.00000	**0.79483 (<.0001)***	0.25243 0.1068
Pressure	**0.65458 (<.0001)***	**0.70159 (<.0001)***	**0.70605 (<.0001)***	**0.60384 (<.0001)***	**0.75190 (<.0001)***	**0.79483 (<.0001)***	1.00000	0.27968 0.0728
Price	0.29255 0.0601	**0.41747 (0.0059)***	0.17411 0.2701	0.18789 0.2334	0.27164 0.0818	0.25243 0.1068	0.27968 0.0728	1.00000

*Significant at 1% **Significant at 5%

Table 5.14 (b): Correlation of Water Service with Income (MYR500–MYR1,500 per month)

Pearson Correlation Coefficients, n = 105
Prob > |r| under H0: Rho=0

	Leakage	Burst Pipes	Reservoir	Water Quality	Disruption	Connection	Pressure	Price
Leakage	1.00000	**0.77144 (<.0001)***	**0.73444 (<.0001)***	**0.54859 (<.0001)***	**0.59595 (<.0001)***	**0.58676 (0.0002)***	**0.47135 (<.0001)***	0.09823 0.3188
Burst Pipes	**0.77144 (<.0001)***	1.00000	**0.65464 (<.0001)***	**0.59943 (<.0001)***	**0.61290 (<.0001)***	**0.54370 (<.0001)***	**0.50300 (<.0001)***	0.04241 0.6675
Reservoir	**0.73444 (<.0001)***	**0.65464 (<.0001)***	1.00000	**0.48705 (<.0001)***	**0.65747 (<.0001)***	**0.59436 (<.0001)***	**0.49947 (<.0001)***	**0.20434 (0.0365)****
Water Quality	**0.54859 (<.0001)***	**0.59943 (<.0001)***	**0.48705 (<.0001)***	1.00000	**0.49665 (<.0001)***	**0.56323 (<.0001)***	**0.41059 (<.0001)***	0.10726 0.2761
Disrup-tion	**0.59595 (<.0001)***	**0.61290 (<.0001)***	**0.65747 (<.0001)***	**0.49665 (<.0001)***	1.00000	**0.79224 (<.0001)***	**0.42756 (<.0001)***	0.1506 0.1250
Connec-tion	**0.58676 (0.0001)***	**0.54370 (<.0001)***	**0.59436 (<.0001)***	**0.56323 (<.0001)**	**0.79224 (<.0001)**	1.00000	**0.43258 (<.0001)***	0.1615 0.1068
Pressure	**0.47135 (<.0001)***	**0.50300 (<.0001)***	**0.49947 (<.0001)***	**0.41059 (<.0001)***	**0.42756 (<.0001)***	**0.43258 (<.0001)***	1.00000	**0.23612 (0.0153)****
Price	0.09823 0.3188	0.04241 0.6675	0.20434 0.0365	0.10726 0.2761	0.15067 0.1250	0.16157 0.0996	**0.23612 (0.0153)****	1.00000

*Significant at 1%   **Significant at 5%

Table 5.14 (c): Correlation of Water Service with Income (MYR1501–MYR2,500 per month)

Pearson Correlation Coefficients, n = 133
Prob > |r| under H0: Rho=0

	Leakage	Burst Pipes	Capacity	Water Quality	Disruption	Connection	Pressure	Price
Leakage	1.00000	**0.73043 (<.0001)***	**0.58004 (<.0001)***	**0.46440 (<.0001)***	**0.61969 (<.0001)***	**0.63736 (<.0001)***	**0.34470 (<.0001)***	0.14291 0.1008
Burst pipe	**0.73043 (<.0001)***	1.00000	**0.69735 (<.0001)***	**0.52041 (<.0001)***	**0.61906 (<.0001)***	**0.66151 (<.0001)***	**0.33174 (<.0001)***	0.16440 0.0586
Reservoir	**0.58004 (<.0001)***	**0.69735 (<.0001)***	1.00000	**0.47556 (<.0001)***	**0.61130 (<.0001)***	**0.50210 (<.0001)***	**0.29290 (0.0006)***	**0.20150 (0.0200)****
Water Quality	**0.46440 (<.0001)***	**0.52041 (<.0001)***	**0.47556 (<.0001)***	1.00000	**0.45700 (<.0001)***	**0.46416 (<.0001)***	**0.31412 (0.0002)***	0.08014 0.3592
Disrup-tion	**0.61969 (<.0001)***	**0.61906 (<.0001)***	**0.61130 (<.0001)***	**0.45700 (<.0001)***	1.00000	**0.69490 (<.0001)***	**0.41037 (<.0001)***	**0.21356 (0.0136)****
Connec-tion	**0.63736 (<.0001)***	**0.66151 (<.0001)***	**0.50210 (<.0001)***	**0.46416 (<.0001)***	**0.69490 (<.0001)***	1.00000	**0.40074 (<.0001)***	**0.20974 (0.0154)****
Pressure	**0.34470 (<.0001)***	**0.33174 (<.0001)***	**0.29290 (0.0006)***	**0.31412 (0.0002)***	**0.41037 (<.0001)***	**0.40074 (<.0001)***	1.00000	**0.35454 (<.0001)***
Price	0.14291 0.1008	0.16440 0.0586	**0.20150 (0.0200)****	0.08014 0.3592	**0.21356 (0.0136)****	**0.20974 (0.0154)****	**0.35454 (<.0001)***	1.00000

*Significant at 1%   **Significant at 5%

Table 5.14 (d): Correlation of Water Service with Income (more than MYR2,501 per month)

Pearson Correlation Coefficients, n = 112 Prob > |r| under H0: Rho=0								
	Leakage	**Burst Pipes**	**Reservoir**	**Water Quality**	**Disruption**	**Connection**	**Pressure**	**Price**
Leakage	1.00000	**0.84172 (<.0001)***	**0.55968 (<.0001)***	**0.30846 (0.0009)***	**0.59595 (<.0001)***	**0.54720 (<.0001)***	**0.30807 (0.0010)***	0.08301 0.3842
Burst Pipes	**0.84172 (<.0001)***	1.00000	**0.59291 (<.0001)***	**0.34610 (<.0002)***	**0.61290 (<.0001)***	**0.59435 (<.0001)***	**0.35427 (<.0001)***	0.07185 0.4515
Reservoir	**0.55968 (<.0001)***	**0.59291 (<.0001)***	1.00000	0.14106 0.1379	**0.30792 (<.0010)***	**0.45908 (<.0001)***	**0.34281 (<.0002)***	0.12628 0.1846
Water Quality	**0.30846 (0.0009)***	**0.34610 (<.0002)***	0.14106 0.1379	1.00000	**0.26471 (0.0048)***	**0.18990 (0.0449)****	**0.20815 (0.0276)****	-0.07945 0.4050
Disrup-tion	**0.52343 (<.0001)***	**0.56720 (<.0001)***	**0.30792 (<.0010)***	**0.26471 (0.0048)****	1.00000	**0.65855 (<.0001)***	**0.40741 (<.0001)***	0.17795 0.0605
Connec-tion	**0.54720 (0.0001)***	**0.59435 (<.0001)***	**0.45908 (<.0001)***	**0.18990 (0.0449)****	**0.65855 (<.0001)**	1.00000	**0.51415 (<.0001)***	**0.18708 (0.0483)****
Pressure	**0.30807 (<.0010)***	**0.35427 (<.0001)***	**0.34281 (<.0002)***	**0.20815 (0.0276)****	**0.40741 (<.0001)***	**0.51415 (<.0001)***	1.00000	0.04943 0.6048
Price	0.08301 0.3842	0.07185 0.4515	0.12628 0.1846	-0.07945 0.4050	0.17795 0.0605	**0.18708 (0.0483)****	0.04943 0.6048	1.00000

*Significant at 1% **Significant at 5%

(d) Service Factors and Income

Table 5.14 (a) - (d) revealed that there was a positive correlation between some of the water attributes. The strongest correlation was between leakage and burst pipe at 0.84172 and was significant at the 1% level. It shared approximately 64% of its variability with burst pipe for those with an income of more than MYR2,501 per month. It was followed by those with an income of MYR500 or less per month; the strongest relationship was between disruption and time taken for connection, which was 0.82263 and was significant at the 1% level. It shared approximately 64% of its variability with time taken for connection. Similarly, the coefficient for respondents who had an income of MYR501 to MYR1,500 was 0.79224. The weakest correlation was between increase in price and burst pipe, which was 0.41747 and was significant at the 1% level.

5.9.3 Correlation Perceptions of Improvement of Strategies and Socioeconomics

The results of the correlation between perception of improvement of strategies and socioeconomics have been presented as follows:

Table 5.15 (a): Correlation of Strategies with Male

Pearson Correlation Coefficients, n = 235 Prob > |r| under H0: Rho=0				
	Integrated	**Training**	**Funding**	**Education**
Integrated	1.00000	**0.74319 (<.0001)***	**0.71881 (<.0001)***	**0.70575 (<.0001)***
Training	**0.74319 (<.0001)***	1.00000	**0.73084 (<.0001)***	**0.77722 (<.0001)***
Funding	**0.71881 (<.0001)***	**0.73084 (<.0001)***	1.00000	**0.74902 (<.0001)***
Education	**0.70575 (<.0001)***	**0.77722 (<.0001)***	**0.74902 (<.0001)***	1.00000

* Significant at 1%

Table 5.15 (b): Correlation of Strategies with Female

Pearson Correlation Coefficients, n = 157 Prob > |r| under H0: Rho=0				
	Integrated	**Training**	**Funding**	**Education**
Integrated	1.00000	**0.55820 (<.0001)***	**0.57841 (<.0001)***	**0.62713 (<.0001)***
Training	**0.55820 (<.0001)***	1.00000	**0.60585 (<.0001)***	**0.47806 (<.0001)***
Funding	**0.57841 (<.0001)***	**0.60585 (<.0001)***	1.00000	**0.67854 (<.0001)***
Education	**0.62713 (<.0001)***	**0.47806 (<.0001)***	**0.67854 (<.0001)***	1.00000

* Significant at 1%

(a) Improvement of Strategies and Gender

Table 5.15 (a) - (b) showed that there was a positive correlation between all improvement strategies. For male respondents, the strongest relation was between providing good quality training to all staff and encouraging education and awareness, which was 0.77722 and was significant at the 1% level. It shared approximately 49% of its variability with encouraging education and awareness. It was followed by the correlation between funding for new investment and encouraging education and awareness. The coefficient was 0.74902 and was significant at the 1% level. It shared approximately 49% of its variability with encouraging education and awareness. With female respondents, there was a correlation between funding for new investment and encouraging education and awareness, which was 0.67854 and was significant at the 1% level. It shared approximately 36% of its variability with encouraging education and awareness.

Table 5.16 (a): Correlation of Strategies with Primary School

Spearman Correlation Coefficients, n = 39 Prob > |r| under H0: Rho=0				
	Integrated	**Training**	**Funding**	**Education**
Integrated	1.00000	**0.69629 (<.0001)***	**0.74363 (<.0001)***	**0.80829 (<.0001)***
Training	**0.69629 (<.0001)***	1.00000	**0.95004 (<.0001)***	**0.73458 (<.0001)***
Funding	**0.74363 (<.0001)***	**0.95004 (<.0001)***	1.00000	**0.68825 (<.0001)***
Education	**0.80829 (<.0001)***	**0.73458 (<.0001)***	**0.68825 (<.0001)***	1.00000

*Significant at 1%

Table 5.16 (b): Correlation of Strategies with Secondary School

Spearman Correlation Coefficients, n = 122 Prob > |r| under H0: Rho=0				
	Integrated	**Training**	**Funding**	**Education**
Integrated	1.00000	**0.73965 (<.0001)***	**0.79292 (<.0001)***	**0.73965 (<.0001)***
Training	**0.73965 (<.0001)***	1.00000	**0.74485 (<.0001)***	**0.62500 (<.0001)***
Funding	**0.79292 (<.0001)***	**0.74485 (<.0001)***	1.00000	**0.74589 (<.0001)***
Education	**0.73965 (<.0001)***	**0.62500 (<.0001)***	**0.74589 (<.0001)***	1.00000

*Significant at 1%

Table 5.16 (c): Correlation of Strategies with College

Spearman Correlation Coefficients, n = 112 Prob > |r| under H0: Rho=0				
	Integrated	**Training**	**Funding**	**Education**
Integrated	1.00000	**0.75219 (<.0001)***	**0.75996 (<.0001)***	**0.78132 (<.0001)***
Training	**0.75219 (<.0001)***	1.00000	**0.74239 (<.0001)***	**0.78145 (<.0001)***
Funding	**0.75996 (<.0001)***	**0.74239 (<.0001)***	1.00000	**0.85655 (<.0001)***
Education	**0.78132 (<.0001)***	**0.78145 (<.0001)***	**0.85655 (<.0001)***	1.00000

*Significant at 1%

Table 5.16 (d): Correlation of Strategies with University

Spearman Correlation Coefficients, n = 118 Prob > |r| under H0: Rho=0				
	Integrated	**Training**	**Funding**	**Education**
Integrated	1.00000	**0.65294 (<.0001)***	**0.65908 (<.0001)***	**0.59097 (<.0001)***
Training	**0.65294 (<.0001)***	1.00000	**0.57213 (<.0001)***	**0.71851 (<.0001)***
Funding	**0.65908 (<.0001)***	**0.57213 (<.0001)***	1.00000	**0.65513 (<.0001)***
Education	**0.59097 (<.0001)***	**0.71851 (<.0001)***	**0.65513 (<.0001)***	1.00000

*Significant at 1%

(b) Improvement of Strategies and Education

Table 5.16 (a) - (d) demonstrated that there was a positive correlation between all improvement strategies. The strongest correlation was between providing good quality training to all staff and increasing funding for new investment, which was 0.95004 and was significant at the 1% level for those who only studied in primary school. It shared approximately 81% of its variability with funding for new investment. Furthermore, it was followed by funding for new investment and encouraging education and awareness at 0.85655, which was significant at the 1% level for those who graduated from college. It shared approximately 64% of its variability with encouraging education and awareness. Surprisingly, for respondents who had graduated from university, there was a low correlation between providing good quality training to all staff and encouraging education and awareness, which was 0.71851 and significant at the 1% level. It shared approximately 49% of its variability with encouraging education and awareness.

Table 5.17 (a): Correlation of Strategies with Support Staff

Spearman Correlation Coefficients, n = 106 Prob > |r| under H0: Rho=0				
	Integrated	**Training**	**Funding**	**Education**
Integrated	1.00000	**0.78621 (<.0001)***	**0.69904 (<.0001)***	**0.67835 (<.0001)***
Training	**0.78621 (<.0001)***	1.00000	**0.71429 (<.0001)***	**0.66172 (<.0001)***
Funding	**0.69904 (<.0001)***	**0.71429 (<.0001)***	1.00000	**0.76800 (<.0001)***
Education	**0.67835 (<.0001)***	**0.66172 (<.0001)***	**0.76800 (<.0001)***	1.00000

*Significant at 1%

Table 5.17 (b): Correlation of Strategies with Professional

Spearman Correlation Coefficients, n = 106 Prob > |r| under H0: Rho=0				
	Integrated	**Training**	**Funding**	**Education**
Integrated	1.00000	**0.69778 (<.0001)***	**0.82800 (<.0001)***	**0.75446 (<.0001)***
Training	**0.69778 (<.0001)***	1.00000	**0.69438 (<.0001)***	**0.74935 (<.0001)***
Funding	**0.82800 (<.0001)***	**0.69438 (<.0001)***	1.00000	**0.78304 (<.0001)***
Education	**0.75446 (<.0001)***	**0.74935 (<.0001)***	**0.78304 (<.0001)***	1.00000

*Significant at 1%

Table 5.17 (c): Correlation of Strategies with Others

Spearman Correlation Coefficients, n = 179 Prob > |r| under H0: Rho=0				
	Integrated	**Training**	**Funding**	**Education**
Integrated	1.00000	**0.67920 (<.0001)***	**0.69952 (<.0001)***	**0.70052 (<.0001)***
Training	**0.67920 (<.0001)***	1.00000	**0.71970 (<.0001)***	**0.71483 (<.0001)***
Funding	**0.69952 (<.0001)***	**0.71970 (<.0001)***	1.00000	**0.70003 (<.0001)***
Education	**0.70052 (<.0001)***	**0.71483 (<.0001)***	**0.70003 (<.0001)***	1.00000

*Significant at 1%

(c) Improvement of Strategies and Work

Table 5.17 (a) - (c) showed that there was a positive correlation between all improvement strategies. For respondents who work as professional staff, the strongest correlation was between an integrated strategic plan and funding for new investment, which was 0.82800 and was significant at the 1% level. It shared about 64% of its variability with increase funding for new investment. This was followed, by a correlation between an integrated strategic plan and providing good quality training to all staff for those who worked as support staff. The coefficient was 0.78621 and was significant at the 1% level. It shared approximately 64% of its variability with providing good quality training to all staff.

Table 5.18 (a): Correlation of Strategies and Income (MYR500 or less per month)

Pearson Correlation Coefficients, n = 42 Prob > |r| under H0: Rho=0				
	Integrated	**Training**	**Funding**	**Education**
Integrated	1.00000	**0.67797 (<.0001)***	**0.62573 (<.0001)***	**0.69039 (<.0001)***
Training	**0.67797 (<.0001)***	1.00000	**0.67904 (<.0001)***	**0.69952 (<.0001)***
Funding	**0.62573 (<.0001)***	**0.67904 (<.0001)***	1.00000	**0.67864 (<.0001)***
Education	**0.69039 (<.0001)***	**0.69952 (<.0001)***	**0.67864 (<.0001)***	1.00000

*Significant at 1%

Table 5.18 (b): Correlation of Strategies and Work (MYR501–MYR1,500 per month)

Pearson Correlation Coefficients, n = 105 Prob > |r| under H0: Rho=0				
	Integrated	**Training**	**Funding**	**Education**
Integrated	1.00000	**0.55875 (<.0001)***	**0.58454 (<.0001)***	**0.69784 (<.0001)***
Training	**0.55875 (<.0001)***	1.00000	**0.62461 (<.0001)***	**0.52755 (<.0001)***
Funding	**0.58454 (<.0001)***	**0.62461 (<.0001)***	1.00000	**0.62631 (<.0001)***
Education	**0.69784 (<.0001)***	**0.52755 (<.0001)***	**0.62631 (<.0001)***	1.00000

*Significant at 1%

Table 5.18 (c): Correlation of Strategies and Work (MYR1,501–MYR2,500 per month)

Pearson Correlation Coefficients, n = 132 Prob > |r| under H0: Rho=0				
	Integrated	**Training**	**Funding**	**Education**
Integrated	1.00000	**0.56723 (<.0001)***	**0.65603 (<.0001)***	**0.61697 (<.0001)***
Training	**0.56723 (<.0001)***	1.00000	**0.66622 (<.0001)***	**0.63809 (<.0001)***
Funding	**0.65603 (<.0001)***	**0.66622 (<.0001)***	1.00000	**0.64881 (<.0001)***
Education	**0.61697 (<.0001)***	**0.63809 (<.0001)***	**0.64881 (<.0001)***	1.00000

*Significant at 1%

Table 5.18 (d): Correlation of Strategies and Work (More than MYR2,501 per month)

Pearson Correlation Coefficients, n = 122 Prob > |r| under H0: Rho=0				
	Integrated	**Training**	**Funding**	**Education**
Integrated	1.00000	**0.84675 (<.0001)***	**0.75261 (<.0001)***	**0.70406 (<.0001)***
Training	**0.84675 (<.0001)***	1.00000	**0.74382 (<.0001)***	**0.75550 (<.0001)***
Funding	**0.75261 (<.0001)***	**0.74382 (<.0001)***	1.00000	**0.88501 (<.0001)***
Education	**0.70406 (<.0001)***	**0.75550 (<.0001)***	**0.88501 (<.0001)***	1.00000

*Significant at 1%

(d) Improvement of Strategies and Income

Table 5.18 (a) - (d) revealed that there was a positive correlation between all improvement strategies. The strongest correlation was between funding for new investment and encouraging education and awareness, which was 0.88501 and was significant at the 1% level. It shared approximately 64% of its variability with encouraging education and awareness for those who had an income of more than MYR2,501 per month. This was followed by the correlation between providing good quality training to all staff and an integrated strategic plan. The coefficient was 0.84675 and shared approximately 64% of its variability with an integrated strategic plan.

Additionally, for those who had an income of MYR501 to MYR1,500 per month, the strongest relationship was between an integrated strategic plan and encouraging education and awareness, which was 0.69784 and was significant at the 1% level. It shared approximately 49% of its variability with encouraging education and awareness. The weakest correlation was between encouraging education and awareness and providing good quality training to all staff, which was 0.52755 and was significant at the 1% level.

5.10 Conclusions

The sample size was 392 respondents. It covered three districts in Johor: Kluang, Batu Pahat and Johor Bahru. The majority of respondents have been with SAJH since privatisation (March 2000) to the present day. Socioeconomics are considered one of the factors which influence WTP for improvements to service quality.

Water quality achieved 98% compliance to MOH Standards. Due to old water pipes and customer concern about the safety of drinking water, the results showed that most of the respondents used a water filter at home (44.64%) and bought mineral or bottled water for drinking at home (53.06%).

Performance of service quality measured leakage, pipe bursts, reservoirs, water quality standards, disruption, connections, pressure, and price. The results indicated that more that 50% of respondents were satisfied with service quality. However, the service needs to be upgraded and improved because certain attributes did not achieve 100% of satisfied respondents.

In order to improve the service quality, the results showed that a majority of respondents agreed the importance of strategies consisting of reducing leakage, improving the repairing of burst pipes, increasing reservoirs' capacity, improving the water quality, reducing water supply disruptions, improving the time taken for connections to the water supply, and increasing the water pressure level.

Furthermore, more than 90% of respondents agreed with the strategies that included setting up an integrated strategic plan, providing good quality training to staff, increasing funding for new investment, and encouraging education and awareness about upgrading the service quality to achieve excellence in the future.

The cross tabulation findings between the perception on service quality performance, improvement of water service and improvement of strategies, and socioeconomic characteristics demonstrated that most of the respondents were satisfied with those aspects. The majority of respondents (approximately 50%) were male and the majority were Malay. The most common age group was between 20 to 30 years old. About 40% of respondents had two children or fewer. This was followed by respondents with three to five children (approximately 25%). 30% of respondents had six to eight persons in their households. The majority of respondents lived in terraced or two-storey houses. Furthermore, most of the respondents had qualifications from college or university. The majority of respondents worked as self-employed, followed by the professional group at about 20%. The most common income groups were those who earned between MYR1,501 and MYR2,500 per month and those who earned more than MYR2,501 per month. It is interesting to observe preferences for certain attributes based on the socioeconomic characteristics of the consumer. Therefore, the water company should consider customer preferences with regard to the water attributes and socioeconomics in order to better satisfy and fulfil the customers' wishes.

Furthermore, the results of the correlation analysis revealed that there was a positive relationship between the majority of attributes of service quality performance. There was also a strong correlation among attributes as well as the attributes of the improvement of the water service. Only the attribute price has a weak correlation with the other water attributes. Furthermore, the results showed that there was a positive and strong correlation between all improvement strategies. For instance, the level of education was the most important variable that influenced the WTP. Therefore, the respondents who have a higher level of education are more likely to satisfy the more reduction of leakage for upgrading the water service. Therefore, this pattern of relationships is meaningful to determine the priority of water attributes and socioeconomic characteristics in order to deliver an excellent water service.

In conclusion, the descriptive analysis, including cross tabulation and correlation analysis, found that there were priority aspects of the service quality and the pattern of socioeconomics which should be considered and improved by SAJH.

CHAPTER 6: CHOICE EXPERIMENT RESULTS

6.1 Introduction

This chapter reports the results of the choice experiment for the water supply service of Johor Water Company (SAJH). It begins by documenting the responses to the choice experiment cards. The chapter then presents results for the first choice experiment: Water Infrastructure (WI). A number of different models are used, namely: (i) the basic conditional logit (CL) model; (ii) CL with an alternative specific constant for the status quo or current position (asc0); (iii) CL with non-linear terms, (iv) CL with non-linear terms and asc0; and (v) CL incorporating levels. These models are then extended to include CL models with interaction terms with socioeconomic characteristics, and the mixed logit model (in Chapter7). This chapter also reports on a second choice experiment: Residential Customers (RC), comprising a similar series to the models already mentioned, except for CL with asc0, CL with non-linear terms and asc0, and CL incorporating levels.

6.2 Pattern of Responses

Both of the choice experiments, Water Infrastructure (WI) and Residential Customers (RC), comprised a number of attributes. The four attributes of the WI choice experiment were leakage (LEA), burst pipe (BUR), reservoirs (RES), and price (PRI). The five attributes of the RC choice experiment consisted of water quality standard (QUA), disruption (DIS), connection (CON), pressure (PRE) and price (PRI). Table 6.1 reports the pattern of attribute levels on the choice cards that were presented to respondents.

Most choice cards showed a preferred leakage level of a decrease by 20%. This occurred on 41.65% of the cards. This was followed by the current situation, estimated at 33.35%. The choices for BUR – the current situation and an improvement of repairing 100% of bursts within 24 hours – were approximately 50% and 41.67%, respectively. A small percentage chose an increase to 99.9%. In terms of reservoir capacity (RES), most respondents chose the current situation, i.e. ‘no change’: this appeared on 66.67% of the cards. This was followed by 25.02% of customers choosing a RES increase to 125%.

Table 6.1: Descriptions and Descriptive Statistics of the Main Attributes for the Choice Experiment

Attributes	Description (unit)	Descriptive Statistics					
		Freq	(%)	Mean	St. Dev	Min	Max
Water Infrastructure (WI): N = 4704							
LEA	***Leakage** (% change)*			25.41	4.31	20.00	30.00
	a) 30%	1569	(33.35)				
	b) decrease to 25%	1176	(25.00)				
	c) decrease to 20%	1959	(41.65)				
BUR	***Burst Pipe** (% change)*			99.16	0.71	98.50	100.00
	a) 98.5%	2352	(50.00)				
	b) increase to 99.0%	392	(8.33)				
	c) increase to 100%	1960	(41.67)				
RES	***Reservoir** (% change)*			121.41	9.24	119.00	130.00
	a) 119%	3136	(66.67)				
	b) increase to 125%	1177	(25.02)				
	c) increase to 130%	391	(8.31)				
PRI	***Price** (% change)*			7.50	9.24	0.00	20.00
	a) no change	2744	(58.33)				
	b) increase of 10%	391	(8.31)				
	c) increase of 20%	1569	(33.35)				
Residential Customers (RC): N = 4704							
QUA	***Water Quality** (% change)*			99.75	0.07	99.70	99.90
	a) 99.7%	2744	(58.33)				
	b) increase to 99.8%	1176	(25.00)				
	c) increase to 99.9%	786	(16.67)				
DIS	***Disruption***			1.82	0.57	1.20	2.40
	a) 2 hours per day for 4 days a year	1176	(25.00)				
	b) 2 hours per day for 3 days a year	1176	(25.00)				
	c) 1 hour per day for 2 days a year	2352	(50.00)				
CON	***Connection***			2.58	0.64	1.00	3.00
	a) 3 days	392	(8.33)				
	b) decrease to 2 days	1176	(25.00)				
	c) decrease to 1 day	3136	(66.67)				
PRE	***Pressure** (% change)*			94.91	1.97	93.00	98.00
	a) 93%	1960	(41.67)				
	b) increase to 95%	1568	(33.33)				
	c) increase to 98%	1176	(25.00)				
PRI	***Price** (% change)*			6.66	7.45	0.00	20.00
	a) no change	2352	(50.00)				
	b) increase by 10%	1568	(33.33)				
	c) increase by 20%	784	(16.67)				

Most of the choice cards expressed a preference for the current situation of water quality (QUA) (58.33%). Obviously, where the quality level choice was increased to 99.9%, the number of choice cards selected was decreased: the percentage was approximately 16.67% of responses for this alternative. Both disruption (DIS) and connection (CON) saw most of the choice cards selected improving the disruption period to one hour per day for two days a year and decreasing the connection time to one day: 50% and 66.67%, respectively. In terms of pressure (PRE), the preferred option was the current situation: the percentage was 41.67%. When the percentage of PRE increased, the number of choice cards declined, so that a PRE increase to 98% only scored 25%.

In terms of price (PRI) it is apparent that most preferred the selection of the current price, i.e.. ‘no change’. In the WI experiment, approximately 58% of all choices were for ‘no change’ in price; and in the RC experiment this percentage was 50%. In the RC experiment it was clear that as price increased, the number of times respondents selected this option decreased, so that a 20% price increase only attracted 16.6% of responses.

In order to further explain the CL model, the theoretical expectation of the attributes of WI and RC are stated in Table 6.2. Basically, the customer chooses the alternative that provides the greatest utility. In Part 1, BUR and RES are expected to be positive signs; whilst LEA and PRI are expected to have negative signs. It means that customers will gain more utility with a decrease in the percentage of LEA and PRI. Meanwhile, customers will entertain more utility with an increase in the percentage of BUR and RES.

Furthermore, QUA and PRE will be expected to be positive signs; DIS, CON and PRI, negative signs. Customers’ utility will increase with a decrease in the percentage of DIS, CON, and PRI. However, increasing the percentage of QUA and PRE will cause a rise of customers’ utility as well.

Table 6.2: Theoretical Expectation of Explanatory Variables

Variables	Expected Sign	Explanation
Water Infrastructure (WI)		
Leakage (LEA)	-	Expectation that utility will increase with reduction of leakage. The relationship is negative. Customers will be happy with the reduction of leakage in order to use water wisely.
Burst Pipe (BUR)	+	Expectation of utility will positively increase with repairs immediately after reporting of bursts. Normally, burst pipes will influence the water pressure.
Reservoir (RES)	+	Expectation of utility will be positive with the increase of reservoir capacity, particularly during drought. Customers will be happy if they can receive water at all times.
Residential Customers (RC)		
Water Quality (QUA)	+	Improvement in water quality is expected to have a positive relationship with utility. Customers will be happy with good water quality.
Disruption (DIS)	-	Reduction in disruption to supply is expected to increase the utility. The sign is negative. Customers are less inconvenienced when the duration of disruption declines.
Connections (CON)	-	Reduction in period of time waiting for a connection to water supply will increase the utility. The sign is negative.
Pressure (PRE)	+	Improving the pressure will increase the utility. Customers will regularly receive water at the normal pressure. The sign is positive.
Price (PRI)	-	An increase in price is expected to have a negative impact on utility. The customer's WTP will decrease because of the reduction of disposable income for other goods.

6.3 Results for the Basic CL Model

(a) Choice 1: Water Infrastructure (WI)

The Water Infrastructure (WI) Choice Experiment comprised leakage (LEA), pipe burst (BUR), reservoir (RES) and price (PRI). The results of the basic CL are reported as follows:

Table 6.3: Basic CL Model, Choice 1 (WI)

	Model 1			**Model 2**		
Parameter	*Estimate*	*Approx Pr > |t|*	*Marginal WTP*	*Estimate*	*Approx Pr > |t|*	*Marginal WTP*
asc0				0.6494	0.0079	
LEA	0.0392	0.0002		0.002922	0.8640	
BUR	0.4164	<0.0001*	0.041	0.6340	<0.0001*	0.064
RES	-0.0660	<0.0001		-0.0381	<0.0133	
PRI	-0.1005	<0.0001*		-0.0977	<0.0001*	
Number of observations	1568			1568		
Log likelihood	-1287			-1284		
McFadden's LRI	**0.2527 R/U**			**0.2547 R/U**		

	Model 3			**Model 4**		
Parameter	*Estimate*	*Approx Pr > |t|*	*Marginal WTP*	*Estimate*	*Approx Pr > |t|*	*Marginal WTP*
asc0				-0.0728	0.8788**	
LEA	-0.7120	0.0026*	0.072	-0.7689	0.0816	0.078
LEA2	0.0151	0.0015		0.0163	0.0801	
BUR	0.5266	<0.0001*	0.055	0.5111	<0.0001*	0.053
RES	-0.0821	<0.0001		-0.0865	0.0059	
PRI	-0.0944	<0.0001*		-0.0942	<0.0001*	
Number of observations	1568			1568		
Log likelihood	-1282			-1282		
McFadden's LRI	**0.2556 R/U**			**0.2556 R/U**		

Notes: *significant at 1%; **significant at 5%

Model 1 of the Water Infrastructure (WI) choice experiment contains LEA, BUR, RES, and PRI as attributes. The results show that BUR and PRI have a correct sign according to expectations and are highly significant at the 1% level. Meanwhile, LEA and RES have incorrect signs. The signs for these attributes should be negative and positive respectively. The MWTP of BUR is estimated at MYR0.041 for each percentage point increase in repairing a pipe burst within 24 hours.

Model 2 shows the Water Infrastructure (WI) choice experiment, which also includes asc0. This denotes the utility of all elements excluded from the model, and therefore has similarities with a regression model constant. It records the average impact of all elements which are not included (Train, 2003). The result indicates that BUR and PRI have signs as expected, and both attributes are highly significant at the 1% level. Both LEA and RES remain unchanged in terms of signs, and are not statistically significant. The MWTP of BUR is MYR0.064 for each percentage point increase in repairing a pipe burst within 24 hours.

Model 3 includes a non-linear term for LEA in the Water Infrastructure (WI) choice experiment, i.e. LEA2 (squared). This is because this aspect of behaviour can only be interpreted and meaningful for this model. The result for LEA is that it has the correct sign and is highly significant at the 1% level. BUR and PRI also have their correct prior expected signs and are highly significant at the 1% level as well. However, RES remains unchanged with an incorrect sign; it should be positive rather than negative. The MWTP for both LEA and BUR are estimated to be MYR0.072 and MYR0.055 respectively for each percentage point of leakage reduction and each percentage point increase in repairs to pipe bursts within 24 hours.

Model 4 also includes a non-linear term of the Water Infrastructure (WI) choice experiment, LEA2, and also includes asc0. The result shows that LEA has a negative sign and is significant at the 10% level. Both BUR and PRI have the correct sign and are highly significant at the 1% level, as in the previous model. RES remains unchanged with a negative rather than positive sign. The MWTP for both LEA and BUR are approximately MYR0.078 and MYR0.053 respectively for each percentage point of leakage reduction and each percentage point increase in repairing pipe bursts within 24 hours. These amounts are slightly different from Model 3 due to changes in the coefficient.

In summary, the three variables, LEA, BUR and PRI have correct signs as expected *a priori* and are highly significant. However, RES remains with a negative sign rather than a positive one as expected. This is because the reservoir capacity depends on the season; the water capacity decreases in drought situations. Both BUR and PRI have correct signs and are highly significant for all models. PRI is a very important attribute, being instrumental in measurement of WTP towards improving the water service. The McFadden LRI values for each model are 0.2527, 0.2547 and 0.2556 respectively. Model 3 is the better model due to a higher McFadden's LRI value, and the attributes LEA, BUR, and PRI have the correct sign and are significant at the 1% level.

(b) Choice 2: Residential Customers (RC)

The Residential Customers (RC) choice experiment included water quality (QUA), disruption (DIS), connections (CON), pressure (PRE) and PRI. The results of this second choice experiment are presented below in Table 6.4.

Table 6.4: Basic CL Model, Choice 2 (RC)

	Model 5			Model 6		
Parameter	*Estimate*	*Approx Pr > $\lvert t \rvert$*	*Marginal WTP*	*Estimate*	*Approx Pr > $\lvert t \rvert$*	*Marginal WTP*
QUA	-2.7056	0.0006		-1.0373	0.3214	
DIS	0.3334	0.0037		-17.8306	0.0178**	1.067
DIS2				4.9892	0.0157	
CON	-0.5993	<0.0001*	0.084	-0.6540	<0.0001*	0.054
PRE	0.008159	0.7171		0.0505	0.0745**	0.041
PRI	-0.0695	<0.0001*		-0.1179	<0.0001*	
Number of observations	1568			1568		
Log likelihood	-1402			-1400		
McFadden's LRI	**0.1858 R/U**			**0.1875 R/U**		

Notes: *significant at 1%; **significant at 5%

Model 5 presents the basic CL of this second CE. The results reveal that CON and PRI have their correct expected signs. Meanwhile, QUA and PRE have incorrect signs, but are not statistically significant. Additionally, the variable PRI is significant at the 1% level and will influence the WTP estimated or improvements in each attribute. However, PRE is not statistically significant even though it has the correct expected sign.

Model 6 presents the results of a CE that includes a non-linear term: DIS2. The result shows that DIS has its correct expected sign (negative) and QUA remains unchanged with an incorrect sign as in the previous model. Moreover, PRE has a positive sign and is statistically significant. Both CON and PRI have the correct sign and are highly significant at the 1% level.

In terms of goodness of fit statistics, the McFadden LRI values reported are approximately 0.1858 and 0.1875 for Models 5 and 6 respectively. This indicates that the best model is Model 6. This model has four variables: DIS, CON, PRE and PRI, which have correct signs and are significant at the 1% (CON and PRI) and 5% levels (DIS and PRE). The alternative specific constant (asc0) is not included in the second CE due to the fact that asc0 is equal to zero because of the linear combination of asc0 with other variables.

Surprisingly, RES and QUA have unexpected signs in the basic model. This is possible for this study based on customer experience. If customers have not experienced a water shortage, they might not place any emphasis on RES. Rather, they might have reservations about more reservoirs across the landscape: this is an issue which is somewhat confounding, and which was not addressed in the experimental design nor in the questionnaire survey information to respondents.

At the time of the flood disasters on 19th December 2006 (the first occurrence) and 12th January 2007 (the second occurrence), some of the reservoirs were submerged and had to be closed., As a result, the water company could not process water in the normal way; instead, tankers and static tanks had to be used to deliver a treated water supply to relief centres. The quality of this supply was adequate in areas where Johor Health Department did not report any major occurrences of food- and water-borne diseases, such as typhoid and cholera. It was determined that 19,670 of the flood victims had communicable diseases, whilst 34,530 had non-communicable diseases (Badrul Hisham et al., 2009).

6.4 Results of the CL Model with Levels Incorporated

(a) Choice 1: Water Infrastructure (WI)

There are six main variables of WI reported in Table 6.5. Each attribute was coded by level, for instance LEA1 and LEA2, with the omitted level being the base case or status quo position.

Table 6.5: Results for CL with Levels Incorporated, Choice 1 (WI)

	Model 7		
Parameter	*Estimate*	*Approx Pr > |t|*	*Marginal WTP*
LEA1	-0.4775	0.0426**	0.047
LEA2	-0.5703	0.0047*	0.056
BUR2	0.8609	0.0004*	0.081
BUR3	0.8199	<0.0001*	0.085
RES2	-0.5668	0.0042**	
RES3	-0.9058	<0.0001*	
PRI	-0.0988	<0.0001*	
Number of observations	1568		
Log likelihood	-1279		
McFadden's LRI	**0.2574 R/U**		

Notes: *significant at 1%; **significant at 5%

Table 6.5 presents the basic model of Water Infrastructure (WI) that consists of LEA1, LEA2, BUR2, BUR3, RES2, and RES3. All the parameters have the correct sign except RES2 and RES3. There is a higher coefficient for LEA1 and LEA2, indicating that customers prefer an improvement to the status quo (LEA3: base level, 30% leakage). Note that the marginal utility is non-linear: the coefficient for LEA1 (20% leakage) is less than that for LEA2 (25% leakage). This indicates that customers would prefer to see some reduction in leakage from 30% to 25%, but do not believe a further reduction from 25% to 20% is necessary.

Furthermore, the variables BUR2 and BUR3 also have higher coefficients, indicating that respondents preferred BUR2 and BUR3 to BUR1 (the base level, 98.5% of pipe bursts repaired within 24 hours). Both are significant at the 1% level. This means that customers would favour seeing some improvement in repairing pipe bursts to the 99% (BUR2) and 100% (BUR3) levels respectively. Moreover, the parameter coefficient for PRI is negative, which is the correct sign, and is highly significant at the 1% level. However, the coefficients for RES2 and RES3 are highly significant and have the incorrect sign to that expected *a priori*. The attribute RES has the incorrect sign for all models because water capacity is dependent on the season and is beyond human control.

The MWTP of LEA1 and LEA2 have values of MYR0.047 and MYR0.056 respectively for each percentage point of leakage reduction. Moreover, the MWTP of BUR2 and BUR3 are MYR0.081 and MYR0.085 per percentage point of improvement in repairs to burst pipes within 24 hours. In terms of goodness of fit statistics, the McFadden LRI value reported is approximately 0.2574, which indicates that this model is much better than the basic model (Table 6.3).

(b) Choice 2: Residential Customers (RC)

The results of the basic RC are presented in Table 6.6. There are eight main attributes incorporating different levels.

Table 6.6: Results for CL with Levels Incorporated, Choice 2 (RC)

	Model 8		
Parameter	*Estimate*	*Approx Pr > |t|*	*Marginal WTP*
QUA2	-0.6883	0.0867	
QUA3	-1.0408	0.0257	
DIS1	-0.7558	0.0600**	0.062
DIS2	-2.2097	0.0034**	0.183
CON1	2.6480	0.0003	
CON2	2.7364	0.0007	
PRE2	0.5178	0.1642	
PRE3	-0.1844	0.2695	
PRI	-0.1182	<0.0001*	
Number of observations	1568		
Log likelihood	-1387		
McFadden's LRI	**0.1949 R/U**		

Notes: *significant at 1%; **significant at 5%

The incorporated levels of Residential Customers (RC) consist of QUA2, QUA3, DIS1, DIS2, CON1, CON2, PRE2, PRE3, and PRI. The results demonstrate that DIS1, DIS2 and PRI have the correct sign as expected *a priori*. Both DIS1 and DIS2 are statistically significant at the 5% and 1% levels respectively. The coefficient of DIS2 is higher than DIS1, meaning that respondents favoured the reducing the disruption period from two hours to one hour per day. The variable PRE2 has the correct sign, but it is insignificant.

The MWTP for DIS1 and DIS2 are MYR0.062 and MYR0.183 respectively for each percentage point reduction in the amount of time of disruption. In terms of goodness of fit statistics, the McFadden LRI value reported is approximately 0.1949. This indicates that this model is much better than the basic Model 6 in Table 6.4.

6.5 Improving the Model Fit

The basic CL model for both choices (WI and RC) can be improved. There are several possibilities to improve the model in order to account for the heterogeneity of preferences. One method is the interaction of socioeconomic characteristics, including gender, age, children, number of persons in the household, type of house, education, work, and income, as proposed by Rolfe et al. (2000) and McConnell and Tseng (2000).

All attributes for WI and RC are discrete variables. For instance, in Table 6.3 (Model 3) the MWTP for LEA and BUR are MYR0.072 and MYR0.055 respectively for each percentage point in reducing water leakage before it reaches households and for improving repairs to pipe bursts within 24 hours. Whilst in Table 6.4 (Model 6), the MWTP for DIS, CON, and PRE are MYR1.067, MYR0.054, and MYR0.041 respectively for each percentage point for an improvement of the disruption time from two hours per day for four days per year to a lesser period. Moreover, connection time could be reduced to less than three days for connection to a new supply, or for reconnection following a cut-off because of an overdue payment. Also, water pressure should be increased.

In general, there is a little concern about attributes such as RES (WI), and QUA (RC) that have negative rather than positive signs. By the inclusion of socioeconomic variables (SE) with the main attributes, the result could be improved from the basic CL model. In order to enhance the interaction model, dummy variables will be applied for socioeconomic characteristics, using codes 1 and 0. For example, gender is either male or female, the dummy variable taking the value 1 whenever the observation in question is male, and 0 when female. In addition, the status quo level for each attribute has been selected as a base case level which is specified in bold in Table 6.7.

Table 6.7: The Base Case Level for Choice 1 (W1) and Choice 2 (RC)

Attribute	**Description**
WI attributes (Choice 1)	
LEA	***30% of water lost before it reaches households***
	decrease to 20% of water lost before it reaches households
	decrease to 10% of water lost before it reaches households
BUS	***98.5% of burst pipes repaired within 24 hours***
	increase to 99% of burst pipes repaired within 24 hours
	increase to 100% of burst pipes repaired within 24 hours
RES	***119% water capacity against demand***
	increase to 125% water capacity against demand
	increase to 130% water capacity against demand
PRI	***no change – MYR0.90 (average water tariff)***
	increase by 10%
	increase by 20%
RC attributes (Choice 2)	
QUA	***99.7% compliance with Ministry of Health standard***
	increase to 99.8% compliance with Ministry of Health standard
	increase to 99.9% compliance with Ministry of Health standard
DIS	***2 hours per day for 4 days per year***
	1 hour per day for 3 days per year
	1 hour per day for 2 days per year
CON	***3 days to connect to water supply***
	2 days to connect to water supply
	1 day to connect to water supply
PRE	***Good water pressure achieved in supply to 93% of households***
	Good water pressure achieved in supply to 95% of households
	Good water pressure achieved in supply to 98% of households
PRI	***no change – MYR0.98 (average water tariff)***
	increase by 10%
	increase by 20%

Note: the bold italic statement is the base case of each attribute

6.5.1 Results of the CL Interaction Model, Choice 1: Water Infrastructure (WI)

There are 22 interaction variables between the main attributes and socioeconomics in the CE interaction models. However, only the significant variables are reported. In addition, this analysis of the model starts with '*general to specific*' which includes all the socioeconomic variables, then drops the insignificant variables.

Table 6.8: CL Interaction Model, Choice 1 (WI)

	Model 9			**Model 10**		
Parameter	*Estimate*	*Approx Pr > |t|*	*Marginal WTP*	*Estimate*	*Approx Pr > |t|*	*Marginal WTP*
LEA	-0.6411	0.0079*		-0.7085	0.0033*	
LEA2	0.0144	0.0039		0.0150	0.0020	
BUR	0.5425	<0.0001*		0.0970	0.7647	
RES	-0.0795	<0.0001*		-0.0821	<0.0001*	
PRI	-0.1016	<0.0001*		-0.0968	<0.0001*	
il2c5	-0.003161	0.0005*	0.003			
il2c6	-0.001935	0.0351**	0.0018			
il2c7	-0.002377	0.0176**	0.0023			
il2h11	-0.001339	0.0023*	0.0012			
il2h12	-0.001615	0.0014*	0.0015			
ipc5				0.7044	0.0025*	0.071
ipc6				0.4541	0.0543**	0.045
ipc7				0.6563	0.0104**	0.066
iph11				0.3024	0.0053*	0.031
iph12				0.3630	0.0039*	0.037
Number of observations	1568			1568		
Log likelihood	-1231			-1245		
McFadden's LRI	**0.2853 R/U**			**0.2771 R/U**		
	Model 11			**Model 12**		
Parameter	*Estimate*	*Approx Pr > |t|*	*Marginal WTP*	*Estimate*	*Approx Pr > |t|*	*Marginal WTP*
LEA	-0.7354	0.0020*		-0.7505	0.0016*	
LEA2	0.0155	0.0011		0.0159	0.0008	
BUR	0.5267	<0.0001*		0.5642	<0.0001*	
RES	-0.2030	0.0459**		-0.0746	<0.0001*	
PRI	-0.0935	<0.0001*		-0.1647	0.0055*	
ida2	0.1145	0.0011*	0.012			
ida3	0.0652	0.0844***	0.0068			
idc5	0.1758	0.0297**	0.018			
idc7	0.1749	0.0445**	0.0085			
irp10				-0.0393	0.0589**	0.0023
ire16				-0.0311	0.0431**	0.0018
ire17				-0.0270	0.0838***	0.0016
irw19				-0.0575	0.0009*	0.0034
iri21				-0.0324	0.0460**	0.0019
iri22				-0.0418	0.0052*	0.0024
Number of observations	1568			1568		
Log likelihood	-1253			-1232		
McFadden's LRI	**0.2725 R/U**			**0.2848 R/U**		

Notes: *significant at 1%; **significant at 5%; ***significant at 10%

Table 6.8 presents the interaction of non-linear terms between Water Infrastructure (WI) and SE, including LEA2. Model 9 describes the interaction between LEA and SE. These three variables LEA, BUR and PRI have the correct sign and are significant at the 1% level. However, RES has an incorrect sign. The result shows LEA has a relationship with number of children and type of house (il2c5, il2c6, il2c7, il2h11, il2h12). Interaction results indicate a strong relationship exists between these variables where customers had two children or fewer (il2c5), as opposed to those who had three to five children, or more (il2c6, il2c7). These variables are significant at the 1% and 5% levels, respectively. Also, the variables for customers who lived in terraced houses (il2h11) and two-storey houses (il2h12) are highly significant at the 1% level.

In addition, Model 10 describes the interaction between BUR and SE. Both LEA and PRI remain with their correct signs and are significant at the 1% level. Additionally, BUR has the correct sign as well, but it is not statistically significant. RES remains unchanged with a negative rather than positive sign as expected. The results reveal that BUR has an interaction with number of children and type of house (ipc5, ipc6, ipc7, iph11, iph12). However, the coefficients are higher and have significant values which are also similar between the 1% and 5% levels as well.

Meanwhile, Model 11 shows the interaction between RES and SE. Three main variables, namely LEA, BUR and PRI have the correct sign; however, RES remains with an incorrect sign from that expected *a priori*. The results indicate that RES has a relationship with the age of the respondent and the number of children. The age group between 20 to 30 years (ida2) coefficient is more significant than that of the group aged between 31 to 40 years and others (ida3). Furthermore, coefficients for the groups of customers who had two children or fewer (idc5), and those who had more children (idc7), are both significant at the 5% level.

Model 12 presents the interaction between PRI and SE. The main variables including LEA, BUR, and PRI have a correct sign as expected *a priori*. RES remains unchanged with a negative rather than positive sign. The results indicate that the number of persons in the household, education, work and income (irp10, ire16, ire17, irw19, iri21, iri22) have a relationship with PRI. The coefficient for households with six to eight persons (irp10) is significant at the 5% level. The lower education group (ire16) has a greater coefficient than the higher education group (ire17), and these are significant at the 5%

and 10% levels respectively. The professional group (irw19) also has high significance at the 1% level. Meanwhile, the higher income group has high significance at the 1% level, rather than the lower income group.

In terms of goodness of fit statistics, the McFadden's LRIs for each model are 0.2853, 0.2771, 0.2725, and 0.2848 respectively, compared with the basic model at 0.2556. This indicates that the model is much better when the interaction with SE terms is included.

Marginal Willingness to Pay (MWTP)

Model 9 presents the interaction between LEA and SE. The MWTP is between MYR0.0012 to MYR0.003 for each percentage point of leakage decrease. The MWTP of the group with two children or fewer (il2c5), three to five children (il2c6) and six to eight children (il2c7) are MYR0.003, MYR0.00186, and MYR0.0023 respectively. Also, the MWTP of customers who lived in terraced houses (ilc211) and two-storey houses (ilc212) are MYR0.0015 and MYR0.0012 respectively. These patterns of MWTP show that customers' willingness to pay for reducing leakage is at the lowest value compared to other models.

Model 10 describes interaction between BUR and SE. The MWTP is between MYR0.031 to MYR0.071 for each percentage point increase of improvement in repairing pipe bursts within 24 hours. The highest WTP is MYR0.071 by customers with two children or fewer (ipc5), followed by the groups with six to eight children (ipc6), and three to five children (ipc5), with MWTP estimated at MYR0.066 and MYR0.045 respectively. Moreover, the MWTP of customers who lived in terraced houses (iph11) and two-storey houses (iph12) are MYR0.031 and MYR0.037 respectively. These trends show that WTP definitely depends on the purchasing power of customers, whether with a lower or higher monthly expenditure.

Model 11 shows the interaction between RES and SE. The MWTP of customers aged between 20 and 30 years (ida2) is higher than those aged 31 to 40 years (ida3). The values are MYR0.012 and MYR0.0068 respectively. The MWTP of customers with two children or fewer (idc5) is MYR0.018, and MYR0.0085 for those who had six to eight children (idc7). There is only a slight difference between them. These values indicate that customers' WTP for an increase in the volume of reservoirs is reasonable, as water shortages or crises during drought periods are rare in Johor.

In addition, Model 12 reveals the interaction between PRI and SE. The results indicate that the range of MWTP is MYR0.0016 to MYR0.0034 for each percentage point increase in the price of the monthly water bill. The MWTP of households with six to eight persons (irp10) is MYR0.0023. The MWTP of customers who were educated to secondary school level (ire16) and college level (ire17) are similar: MYR0.0018 and MYR0.0016 respectively. Furthermore, the MWTP of the professional group (irw19) is the highest, estimated at MYR0.0031. The MWTP of customers with an income between MYR500 and MYR1,500 per month (iri21) and those with an income between MYR1,501 and MYR2,500 per month (iri22) are MYR0.0019 and MYR0.0024 respectively. This proves that customers with a higher income are willing to pay more compared to lower income groups. These MWTP values also reveal that customers' willingness to pay is a small amount for every cubic metre, and SAJH should take this into consideration when revising the water tariff in future.

6.5.2 Results of the CL Interaction Model, Choice 2: Residential Customers (RC)

The same process has been conducted for Residential Customers (RC), with the variables water quality (QUA), disruption (DIS), connection (CON), pressure (PRE), and price (PRI). In total, there are 22 interaction variables between the main attributes and socioeconomic variables (SE). However, only the significant variables are reported. The detailed results are presented in Table 6.9.

Table 6.9: CL Interaction Model, Choice 2 (RC)

	Model 13			**Model 14**		
Parameter	*Estimate*	*Approx Pr > |t|*	*Marginal WTP*	*Estimate*	*Approx Pr > |t|*	*Marginal WTP*
QUA	-2.3027	0.7040		-2.0931	0.0608**	
DIS	-10.9807	0.1531		-7.3509	0.3401	
DIS2	3.1035	0.1415		1.5516	0.4659	
CON	-0.6496	<0.0001*		-0.6711	<0.0001*	
PRE	0.0330	0.2549		0.0342	0.2455	
PRI	-0.1095	<0.0001*		-0.1065	<0.0001*	
iqg	2.1798	0.0718**	0.195			
iqa4	8.5358	<0.0001*	0.764			
id2g				-0.0726	0.0393**	0.006
id2a4				-0.2802	<0.0001*	0.026
Number of observations	1568			1568		
Log likelihood	-1342			-1285		
McFadden's LRI	**0.221 R/U**			**0.256 R/U**		

	Model 15			**Model 16**		
Parameter	*Estimate*	*Approx Pr > |t|*	*Marginal WTP*	*Estimate*	*Approx Pr > |t|*	*Marginal WTP*
QUA	-1.0993	0.3354		-1.8201	0.0945	
DIS	-7.3755	0.3477		-7.0115	0.3580	
DIS2	2.1005	0.3301		2.0106	0.3371	
CON	-2.2784	<0.0001*		-0.6676	<0.0001*	
PRE	0.0459	0.1248		0.2793	0.1862	
PRI	-0.1173	<0.0001*		-0.1091	<0.0001*	
icg	-0.2585	0.0125***	0.056			
ica4	-0.6662	<0.0001*	0.021			
ipg				0.1280	0.0024*	0.021
ipa4				0.2310	<0.0001*	0.011
Number of observations	1568			1568		
Log likelihood	-1288			-1279		
McFadden's LRI	**0.2522 R/U**			**0.2573 R/U**		

Table 6.9 (continued): CL Interaction Model, Choice 2 (RC)

	Model 17		
Parameter	*Estimate*	*Approx Pr > |t|*	*Marginal WTP*
QUA	-1.4581	0.1866	
DIS	-6.7877	0.3773	
DIS2	1.9161	0.3643	
CON	-0.4906	<0.0001*	
PRE	0.0202	0.4943	
PRI	-0.1590	0.0349**	
irp8	-0.1871	0.0006*	0.012
irp9	-0.2017	0.0003*	0.012
irp10	-0.2265	0.0063*	0.014
iri21	-0.1282	0.0102**	0.007
iri22	-0.1514	0.0352**	0.009
Number of observations	1568		
Log likelihood	-1338		
McFadden's LRI	**0.2231 R/U**		

Notes: *significant at 1%; **significant at 5%; ***significant at 10%

Table 6.9 describes the linear term interaction between Residential Customers (RC) and socioeconomics (SE). Model 13 shows the interaction between QUA and SE. The results demonstrate that DIS, CON, PRE and PRI have the correct sign according to expectations and that CON and PRI are highly significant at the 1% level, whilst DIS and PRE are not statistically significant. QUA remains unchanged with a negative rather than positive sign, as in the basic CL (Model 6). However, QUA has a relationship with gender and age (iqg, iqa4). These variables are significant at the 5% and 1% levels respectively.

Model 14 includes a non-linear term for DIS in the RC choice experiment. The inclusion of a non-linear term for DIS, i.e. DIS2, results in DIS having the correct sign, but it is not statistically significant. Three variables, namely CON, PRE and PRI, have the correct sign as expected *a priori*. Variables CON and PRI are significant at the 1% level, whilst variable PRE is insignificant. The results show that DIS2 has interaction between gender and age (id2g, id2a4). These groups are highly statistically significant at the 5% and 1% levels respectively.

Furthermore, Model 15 reports the interaction between CON and SE. The results reveal that DIS, CON, PRE, and PRI have a correct sign as expected *a priori*. However, DIS and PRE are not statistically significant as in the previous model. CON and PRI remain constant, highly significant at the 1% level. There are interactions with the gender and age variables (icg, ica4) as well and these are significant at the 1% and 10% levels respectively.

Model 16 reports the interaction between PRE and SE. The results confirm that DIS, CON, PRE, and PRI have the correct prior expected signs. However, only CON and PRI are significant at the 1% level. PRE has interaction with gender and age (ipg, ipa4). Both groups are significant at the 1% level.

Model 17 shows the interaction between PRI and SE. All variables except QUA have the correct sign as expected *a priori*. However, DIS and PRE are not statistically significant. CON and PRI are highly significant at the 1% level. In interaction terms, PRI shows a relationship with the number of persons in the household, and income (irp8, irp9, irp10, iri21, iri22). Both groups – number of persons in the household (irp8, irp9 and irp10) and income (iri21, iri22) – are significant at the 1% and 5% levels respectively.

In terms of goodness of fit statistics, the McFadden's LRIs for each model are 0.221, 0.256, 0.2522, 0.2573 and 0.2231 respectively, compared with the basic model at 0.1875. This reveals that the model is much improved and fits better when interaction terms with SE are included.

Marginal Willingness to Pay (MWTP)

Model 13 presents the interaction between QUA and SE. The MWTP of female respondents (iqg) and customers aged 41 to 50 years old (iqa4) are MYR0.19 and MYR0.76 for each percentage point of improvement to water quality and compliance with the MOH Standards. These values are the highest MWTP amongst all the models. The results also indicate that their concern about water quality is a top priority of these customers' perception of a better service provision.

In addition, Model 14 illustrates the interaction between DIS2 and SE. The MWTP for gender (id2g) and the age group between 41 to 50 years old (id2g4) are MYR0.0066 and MYR0.026 for each percentage point in reducing disruption to the water supply. The results reveal that customers' WTP is at a certain amount in order to avoid disruption in order to ensure the daily routine runs properly.

Model 15 describes the interaction between CON and SE. The MWTP of gender (icg) and the age group between 41 to 50 years old (ica4) is approximately MYR0.056 and MYR0.021 respectively. This means that the time taken for the connection of the water supply is an important criterion for good service by SAJH. Customers are willing to pay a certain amount for each percentage point of reduction of the time taken for connection, either for a reconnection following an overdue payment or for a connection to new premises. This is because a long time taken to connect the water supply will affect daily activities.

Furthermore, Model 16 indicates the interaction between PRE and SE. The MWTP of female respondents (ipg) is MYR0.021 for each percentage point of improvement in water pressure. Meanwhile, the MWTP for age (ipa4) between 41 to 50 years is MYR0.011 for each percentage point increase in the pressure level. Good pressure is the most important criterion of delivery of a better service, in order to make sure enough water comes out of the tap regularly.

Model 17 presents the interaction between PRI and SE. The results reveal that the MWTP of customers where the number of persons in the household (irp8, irp9, irp10) range from MYR0.012 to MYR0.014 for each percentage point increase in the water tariff or monthly water bill. Moreover, the MWTP of those with an income of between MYR501 and MYR1,500 (iri21) and between MYR1,501 and MYR2,500 (iri22) are MYR0.0079 and MYR0.0093 respectively. These values indicate that customers with a higher income are willing to pay more than those with a lower one.

6.5.3 Results of the CL Interaction Incorporating Level Model, Choice 1: Water Infrastructure (WI)

In order to fit the model, socioeconomic characteristics were included. However, only the significant attributes are reported in Table 6.10.

Table 6.10: CL Interactions of Model with Levels Incorporated, Choice 1 (WI)

	Model 18			Model 19		
Parameter	*Estimate*	*Approx Pr > |t|*	*Marginal WTP*	*Estimate*	*Approx Pr > |t|*	*Marginal WTP*
LEA1	-0.0579	0.9305		-0.4769	0.0455**	
LEA2	1.3038	0.0519**		-0.5694	0.0051*	
BUR2	0.8379	0.0007*		2.0835	0.1251	
BUR3	0.7561	0.0001*		1.7278	0.0002*	
RES2	-0.6041	0.0028*		-0.5504	0.0061*	
RES3	-0.7998	0.0003*		-0.9063	<0.0001*	
PRI	-0.1023	<0.0001*		-0.0997	<0.0001*	
ilc	-0.3976	0.0019*	0.045			
ilh	-0.1465	0.0096*	0.014			
il2c	-0.4193	0.0015*	0.04			
il2h	-0.2255	0.0001*	0.022			
ip2e				0.4574	0.0525**	0.045
ip3w				0.1794	0.0152**	0.018
Number of observations	1544			1544		
Log likelihood	-1231			-1234		
McFadden's LRI	**0.2744 R/U**			**0.2728 R/U**		

	Model 20		
Parameter	*Estimate*	*Approx Pr > |t|*	*Marginal WTP*
LEA1	-0.4837	0.0423**	
LEA2	-0.5770	0.0049*	
BUR2	0.8354	0.0008*	
BUR3	0.8195	<0.0001*	
RES2	-0.6719	0.3931	
RES3	0.5033	0.5887	
PRI	-0.0983	<0.0001*	
id2e	0.3746	0.0039*	0.037
id3w	0.3228	0.0489**	0.032
Number of observations	1544		
Log likelihood	-1232		
McFadden's LRI	**0.274 R/U**		

Notes: *significant at 1%; **significant at 5%; ***significant at 10%

Table 6.10 shows the linear term interaction between Water Infrastructure (WI) and socioeconomic factors (SE). Model 18 presents the interaction between LEA and SE. The three attributes BUR2, BUR3 and PRI have the correct sign as expected *a priori*, and are highly significant at the 1% level. However, RES2 and RES3 remain unchanged with an incorrect sign. The negative sign on the level of leakage and number of children (ilc, il2c) indicates that customers with more children have a higher preference for reducing leakage to 25% or 20% than those with fewer children. The interaction between leakage and type of house (ilch, ilc2h) and the negative sign for reduction of leakage to the 25% and 20% levels indicates that customers who live in a spacious house have a higher preference for reducing leakage than customers who live in a less spacious dwelling such as a flat.

Model 19 presents the interaction between BUR and SE. There are five variables: LEA1, LEA2, BUR2, BUR3 and PRI; all have the correct sign as expected *a priori*. Furthermore, LEA1 and LEA2 are highly statistically significant at the 5% and 1% levels respectively. The attribute PRI is highly statistically significant at the 1% level. The income level variable shows a positive sign for repairing pipe bursts within 24 hours (ip2e), indicating that the higher income group would agree to support the percentage increase to 99% for repairs within 24 hours compared with the lower income group. Meanwhile, professional workers would contribute positively towards repairing 100% of pipe bursts within 24 hours (ip3w).

Model 20 reveals the interaction between RES and SE. The results demonstrate that LEA1, LEA2, BUR2, BUR3 and PRI have correct signs as expected *a priori*. All these attributes are also highly statistically significant at the 1% level, except LEA1, which is significant at the 5% level. The positive sign for education with RES2 at 125% (id2e) indicates that customers with a higher level of education have a higher preference than those with a lower level of education in supporting a water capacity of 125%. Moreover, the professional group would agree to support increasing the water capacity to 130% of consumption, compared to other groups.

In terms of goodness of fit statistics, the McFadden's LRI for each model is 0.2744, 0.2728, and 0.274 for Models 18, 19, and 20 respectively, compared to the value of 0.2574 for the basic model. This means that the model is a much better fit when interaction terms with SE are included.

Marginal Willingness to Pay (MWTP)

Model 18 presents the interaction between LEA and SE. The MWTP of the groups with children (ilc, il2c) is MYR0.045 and MYR0.040 respectively for each percentage point improvement in reducing leakage; whilst the customers who lived in terraced houses (ilh, il2h) have a WTP of MYR0.014 and MYR0.022 respectively. The value of the MWTP of customers with children is higher than that of those who lived in terraced houses, meaning that the former are willing to pay more in order to reduce leakage.

Model 19 reveals the interaction between BUR and SE. The MWTP of those customers who have been in higher education (ip2e) is MYR0.045 and that of the professional group (ip3w) is MYR0.018 per percentage point of improvement in repairing pipe bursts within 24 hours. The pattern of MWTP indicates that more educated and professional groups are willing to pay more in order to achieve a better level of service.

In addition, Model 20 describes the interaction between RES and SE. The MWTP of higher education customers (id2e) and professionals (id3w) is MYR0.037 and MYR0.032 respectively. These amounts indicate that these groups are willing to pay for an increase in the reservoir capacity, particularly in dry periods.

6.5.4 Results for the Interaction CL Incorporating Level Model, Choice 2: Residential Customers (RC)

Furthermore, the interaction between the main attributes of RC and socioeconomic variables was also studied. The results are presented in Table 6.11.

Table 6.11: CL Interactions of Model with Levels Incorporated, Choice 2 (RC)

	Model 21			**Model 22**		
Parameter	*Estimate*	*Approx Pr > |t|*	*Marginal WTP*	*Estimate*	*Approx Pr > |t|*	*Marginal WTP*
QUA2	-3.5919	<0.0001*		-0.5578	0.1691	
QUA3	-0.9369	0.2193		-1.0164	0.0321	
DIS1	-0.6998	0.0889***		-1.3720	0.0337**	
DIS2	-2.1729	0.0049**		-4.9336	<0.0001*	
CON1	2.7646	0.0002*		2.5876	0.0004*	
CON2	2.6022	0.0016*		2.6969	0.0009*	
PRE2	0.5475	0.1506		0.5031	0.1788	
PRE3	-0.0839	0.6231		-0.0756	0.6590	
PRI	-0.1269	<0.0001*		-0.1291	<0.0001*	
iq2g	0.4594	<0.0001*	0.035			
iq2c	0.5214	0.0084**	0.040			
iq2w	0.2832	0.0813***	0.022			
iq3g	0.3214	0.0570***	0.025			
iq3e	0.4893	0.0971***	0.038			
ida				-0.2965	0.0009*	0.022
idi				-0.5302	0.0167**	0.040
id2a				-0.1468	0.0021*	0.011
Number of observations	1564			1564		
Log likelihood	-1330			-1288		
McFadden's LRI	**0.226 R/U**			**0.2506 R/U**		

	Model 23		
Parameter	*Estimate*	*Approx Pr > |t|*	*Marginal WTP*
QUA2	-0.5114	0.1975	
QUA3	-1.1929	0.0118	
DIS1	-0.9016	0.0232**	
DIS2	-2.2204	0.0028*	
CON1	2.5981	0.0003*	
CON2	2.8621	0.0004	
PRE2	-1.4011	0.0076*	
PRE3	-2.6020	<0.0001*	
PRI	-0.1172	<0.0001	
ip2g	0.2836	0.0076*	0.024
ip2c	0.6734	0.0001*	0.056
ip2e	0.3718	0.0340**	0.031
ip3g	0.4162	0.0011*	0.035
ip3c	0.5238	0.0143**	0.044
ip3h	0.7241	0.0007*	0.061
Number of observations	1564		
Log likelihood	-1287		
McFadden's LRI	**0.2511 R/U**		

Notes: *significant at 1%; **significant at 5%; ***significant at 10%

Table 6.11 reports the linear term interaction between Residential Customers (RC) and socioeconomics (SE). Model 21 reveals the interaction between RC and SE. However, only the significant variables are presented, apart from the main variables. This is because this interaction model, which included socioeconomic characteristics and main attributes, had a positive influence on model fit. The interaction between CON and SE is not shown because there is no interaction between the main attributes and SE. The results show, as the McFadden value is higher compared to the simple model, that this model is more accurate.

In Model 21, there is interaction between QUA and SE. There are four attributes: DIS1, DIS2, PRE2, and PRI, and all have correct signs as expected *a priori*. DIS1 and DIS2 are statistically significant at the 10% and 5% levels respectively. PRI is highly statistically significant at the 1% level. The positive sign on water quality for the gender variable (iq2g) indicates that male respondents are more concerned than female ones with a water quality percentage increase to 99.8% compliance with the MOH Standards. Moreover, customers who had more children (iq2c) and those who were professionals (iq2w) also had a positive preference for increasing water quality compliance. Furthermore, the higher education group also had a preference for supporting an increase in water quality compliance to 99.9%, compared with the lower education group (iq3e).

Model 22 presents the interaction between DIS and SE. The results reveal that four attributes DIS1, DIS2, PRE2 and PRI have correct signs as expected *a priori*. DIS1 and DIS2 are statistically significant at the 5% and 1% levels respectively. PRI is highly statistically significant at the 1% level. The negative sign for age with DIS indicates that the older groups (ida, id2a) were more concerned about disruption times than the younger groups of customers. The income level coefficient showed a negative sign for reducing the period of disruption from three days to one day a year. This result indicates that the higher the income level group (idi), the greater the support for reducing disruption. Furthermore, Model 23 describes the interaction between PRE and SE. The results reveal that DIS1 and DIS2 have a correct sign as expected *a priori*. There are interactions between the gender (ip2g, ip3g), number of children (ip2c, ip3c), education (ip3e) and type of house (ip3h). The positive sign for the gender coefficient for pressure (ip2g) shows that females were more likely to agree to the achievement of normal water pressure. The positive sign for the number of children (ip2c) reveals that people with a larger number of children preferred to have normal pressure in order have a more settled daily routine. The positive sign for education (ipe2) indicates that the higher education group supported an increase in water pressure more than the lower education group.

In terms of goodness of fit statistics, the McFadden's LRI for each model are 0.226, 0.2506, and 0.2511 for Models 21, 22 and 23 respectively, compared with the basic model, which has a value of 0.1949. This means that the model is a much better fit when interaction terms with SE are included.

Marginal Willingness to Pay (MWTP)

Model 21 demonstrates the interaction between QUA and SE. The MWTP of gender (iq2g, iq3g) is MYR0.035 and MYR0.025 respectively, for each percentage point improvement in water quality compliance to the MOH Standards. Additionally, the MWTP of the professional group (iq2w) is MYR0.022 and the MWTP of the higher educated group (iq3e) is MYR0.038. The results reveal that females, the professional group and those who have been in higher education were more concerned about water quality as the priority factor of customers' perception for providing an excellent service.

Furthermore, Model 22 describes the interaction between DIS and SE. The MWTP of age (ida, id2a) is MYR0.022 and MYR0.011 respectively. The MWTP of the higher income level (idi) is MYR0.040. These amounts are for each percentage point decrease of disruption time. Females and higher income customers were willing to pay more in order to get a better service.

Model 23 reveals the interaction between PRE and SE. The MWTP of particular age groups (ip2g, ip3g) is MYR0.024 and MYR0.035 for each percentage point increase in pressure. Moreover, the MWTP of customers with children (ip2c, ip3c) is MYR0.056 and MYR0.044 respectively. The MWTP of the higher education group (ip2e) is MYR0.031 and that of those living in terraced houses (ip3h) is MYR0.061.

6.6 Conclusions

Based on the first choice model (WI) presented, the main attributes having interaction between socioeconomic (SE) characteristics include: number of children, type of house, age, number of persons in the household, education, type of work, and income. These models indicate that LEA and BUR have interaction with the number of children (il2c5, il2c6, il2c7, ipc5, ipc6, ipc7) and type of house (il2h11, il2h12, iph11, iph12). RES has a relationship with age (ida2, ida3) and number of children (idc5, idc7). PRI has interaction with the number of persons in household (irp10), education level (ire16, ire17), type of work (irw19), and income (iri21, iri22).

Customers' WTP is higher for repairs to pipe bursts within 24 hours rather than leakage (LEA) and reservoir capacity (RES). This means that BUR is the priority attribute of Water Infrastructure (WI) and this should be taken into consideration when upgrading residential customers' service.

The second choice model (RC) has interaction with gender, age, number of persons in the household, and income. The interaction between the main variables and SE indicates that QUA, DIS, CON and PRE have a relationship with gender (iqg, id2g, icg, ipg) and age (iqa4, id2a4, ica4, ipa4). PRI has interaction with the number of persons in the household (irp8, irp9, irp10) and income (iri21, iri22).

Additionally, male respondents had more concern about water quality, disruption, connection and pressure, due to being the head of the family and therefore responsible to pay the water bill each month. Also, the older age group were concerned about the achievement of better delivery of service to customers, particularly about water quality, disruption, connection, and pressure, because they have experienced the history of SAJH and its transformation from state water company to privatised company. Furthermore, attitudes to increases in price have been influenced by the number of persons in the household and income level.

Furthermore, the amount of MWTP varies, depending on the main attributes and socioeconomic (SE) characteristics. These demonstrate that customers' WTP is influenced directly by purchasing power. For instance, the less educated group were willing to pay more than the more educated group. Probably the most important factor is customers' income level: the group with a higher income had a greater WTP compared to those with lower income levels. These groups of customers were also more concerned about the water service and environment. The MWTP for each attribute illustrates that customers' WTP is high in order to improve the water service and enjoy safe and clean water, particularly for repairs to pipe bursts (BUR).

In the model levels incorporated, the results indicate that WI has interactions with socioeconomic (SE) characteristics. LEA has interactions between the number of children (ilc, il2c), and type of house (ilh, il2h). BUR and RES have interactions between the level of education (ip2e, id2e) and type of work (ip3w, id3w). The highest WTP is for BUR, estimated at MYR0.045 for each percentage point in repairing pipe burst within 24 hours. Also, there are indications that the higher education group and professional group were willing to pay more to increase the level of service. BUR is definitely the most important attribute with regards to improving the water service.

In addition, RC also has interaction with socioeconomics (SE), which reveal that QUA has interaction with gender (iq2g, iq3g), number of children (iq2c, iq3c), type of works (iq2w), and level of education (iq3e). DIS has interaction with age (ida, id2a), and income level (idi). Furthermore, PRE also has interaction with gender (ip2g, ip3g), level of education (ip2e), number of children (ip2c) and type of house (ip3h).

The highest customers' WTP for PRE is roughly MYR0.061 per percentage point increase in water pressure. This means that PRE is the priority attribute in the RC group, of most concern to customers for achieving a better level of service. PRE has a relationship with RES, which indicates that if reservoir capacity is sufficient, there is good water pressure for customers. Water would then be delivered to the customer's tap consistently and continuously without any obstacles or technical problems from the water provider.

There are a few features that should be highlighted in the CL model. The basic model of WI incorporating levels (Model 7) is much better than the basic CL (Models 1 and 3) in Table 6.3. It is shown that the McFadden LRI is higher, approximately 0.2574 rather than 0.2527 and 0.2556 respectively. In addition, the BUR and PRI variables have the correct signs and are highly significant at the 1% level in Model 1 and Model 3 (non-linear term).

In addition, the RC incorporating levels model (Model 8) is also much better than the basic CL model (Models 5 and 6) in Table 6.4. The McFadden LRI is higher, estimated at 0.1949, compared with 0.1858 and 0.1875 respectively. The result demonstrated that attributes CON and PRI have the correct sign and are highly significant at the 1% level in Model 5. Moreover, in Model 6, DIS, CON, PRE and PRI have the correct sign. Attributes DIS and PRE are significant at the 5% level whilst variables CON and PRI are significant at the 1% level. In Model 8, there are four attributes, DIS1, DIS2, PRE2, and PRI which have the correct signs as expected *a priori*. Variable DIS1 and DIS2 are significant at the 5% level, whilst PRE2 is insignificant. PRI is highly significant at the 1% level.

Furthermore, the results indicate that there is a slightly different interaction in the basic CL model and the CL model incorporating levels for WI. LEA has interaction both with the number of children (il2c5, il2c6, ilc7, ilc, il2c), and the type of house (il2h11, il2h12, ilh, il2h). However, BUR has interaction with the number of children (ipc5, ipc6, ipc7) and the type of house (iph11, iph12) in the CL interaction. There is interaction with the education level (ip2e, ip3e) and type of work (ip3w, id3w) for BUR and RES respectively. The McFadden values are lower for Models 18 and 19. However, it is higher in Model 20 – approximately 0.274 – compared with Model 11 in Table 6.6.

In the RC model interaction, the results indicate that QUA has interaction with gender (iqg, iq2g, iq3g) in Models 13 and 21. However, there are interactions with the number of children (iq2c), the type of work (iq2w) and the education level (iq3e) in Model 21 (interaction of levels incorporated). DIS has interaction with age (ida and id2a), similar to the CL interaction (Model 14) in Table 6.9. There is interaction between PRE and gender (ip2g, ip3g), similar to the model CL interaction (Model 16). However, the results of the interaction with the number of children (ip2c, ip3c), the education level (ip2e), and the type of house (ip3h) are different. The McFadden value is similar, estimated to be higher at 0.226 for Model 21 (Table 6.11) than in the CL interaction in Model 13 (Table 6.9), where the value is 0.221.

The results of incorporating levels, were better due to the interaction between socioeconomic variables were variety; the McFadden LRI values are slightly higher for the basic model (Models 7 and 8), and the MWTP is higher than the MWTP in the CL interaction model in Table 6.6 and Table 6.9.

The choice experiment analysis has shown that models can be developed to provide information on customer preferences for improvements to different water attributes. Such information is important in assessing the benefits of future investment projects to improve water supply and quality. It is essential that SAJH is able to ensure the benefits to customers from new projects exceed the cost of those projects. It is also important that the water company can increase the price of water to customers, to recover the costs of the project, and that customers are willing to pay this increase for the benefits that the project provides. Furthermore, SAJH should identify the most important of the socioeconomic characteristics that influence the WTP. It is because of the pattern or background of customers SAJH that can reveal their willingness to pay for water improvement. For instance, if the MWTP is greater for each percentage point increase for the main attributes, SAJH could acquire more capital to invest in various projects to achieve an effective and efficient service to residential customers, particularly in Johor state.

CHAPTER 7: MIXED LOGIT RESULTS

7.1 Introduction

Mixed Logit (MXL) models relax many of the assumptions of the CL and NML models (Revelt and Train, 1998). MXL is a flexible discrete choice model. MXL models are able to approximate random utility choice models to any desired degree of accuracy. This is done by specifying the coefficient distributions appropriately (Train et al., 2004). Moreover, MXL models relax three limitations associated with CL and NML models. Firstly, they allow the coefficient of variables to vary amongst respondents (i.e. they introduce heterogeneity into the demand function). Secondly, they fully relax the independent irrelevant alternatives (IIA) property. Thirdly, they can handle more flexible substitution patterns, e.g. in repeated choices over time, rather than assuming that unobserved factors are independent of each respondent over time (Train, 1986; McFadden, 1974, 1978). Therefore, MXL has been utilised due to the limitations of Conditional Logit, including random taste variation, unrestricted substitution, and correlation in unobserved factors over time (Train, 2003). Additionally, this analysis attempts to look at the comparison analysis between Conditional Logit and other models to discover which is the best model.

Furthermore, MXL in this research avoids IIA; MXL choice probability does not imply an IIA test. More specifically, by the use of simulation techniques, this research will reduce the IIA assumption and will examine the consequences that this might have for the results.

When estimating the random utility model, there are three different approaches. The first one is to presume the IIA assumption is correct, and then employ McFadden's conditional logit estimator. The second one utilises simulation methods in order to estimate a multinomial probit model and reduce the IIA assumption in so doing.

This is followed by the third approach: applying simulation estimation techniques to estimate a mixed logit specification. This allows the relaxation of two firm assumptions employed in the initial approach: (1) it is not necessary to assume that the alternatives are unrelated to each other (which means that the model can be estimated with flexible substitution patterns); and (2) the assumption of fixed coefficients may be relaxed (which means that estimate distribution parameters with the coefficients and individual-specific heterogeneity within the model may be introduced). If the mixed logit results and those from the first approach are compared, it is possible to examine whether the results may be sensitive to these two assumptions. By comparing them with the results from the second approach, it is possible to observe whether there are any disparities between the multinomial probit and the mixed logit model in reality (according to McFadden and Train, 2000) and decide whether any reasons exist (from a practical point of view) to pick either the multinomial probit or the mixed logit model where the application has many alternatives.

Theoretically, a useful approach to deal with the IIA property would be to allow the unobserved area of the utility function to follow. However, this process has not been as obvious in empirical applications, as multiple integrals then need to be evaluated.

Moreover, advances in the knowledge of simulation methods with estimation, and also in computer speed, have made other methods just as viable as the traditional one (Dahlberg et al., 2003).

This is true even if the assumption is made that the elements of the coefficient are statistically independent (Viton, 2011). Also, IIA is really only relevant where the alternatives are labelled. There are two non-labelled hypothetical alternatives plus the current situation (it is labelled, but needs to be included to assess the value of a change from the current situation).

In terms of water studies, attributes of water resources involve a variety of perceptions of customers. The values may be intangible and they may be unfamiliar to some customers. Price attributes may be a sensitive issue and be perceived differently amongst customers. The combination of water resource variables and monetary values has different impacts on future investment.

MXL models can take many forms of distribution, such as normal, log normal, uniform and triangular distribution. But, in practice, the most popular distributions are the normal or log normal distributions. As usual, at the initial stage of data analysis, all distributions are applied: normal, log normal and uniform distributions. Unfortunately, coefficients or goodness of fit of models are not statistically significant results, except for the normal distribution. Therefore, this study employed the normal distribution in the MXL model.

Typically, there were two stages to the MXL process in this research. Firstly, the basic MXL models for both WI and RC were constructed and analysed. Next, the market share estimation of mean and standard deviation of the distribution of each taste parameter was calculated, in order to determine the total number or proportion of respondents who preferred or did not prefer each variable.

Secondly, the main attributes and interaction attributes were entered into the indirect utility specification. The purpose here was to determine the effect of the characteristics of respondents on the distribution of preferences, and to compare these results with the CL model results.

7.2 Results for the Basic MXL Model

(a) Choice 1: Water Infrastructure (WI)

Water Infrastructure (WI) consists of LEA, BUR, RES, and PRI. The basic ML results are reported in Table 7.1.

Table 7.1: Basic MXL Model, Choice 1 (WI)

	Model 1			
Parameter	*Estimate*	*Standard Error*	*Approx Pr > |t|*	*Marginal WTP*
LEA_M	0.0399	0.0162	0.0140	
LEA_S	0.1478	0.0394	0.0002	
BUR_M	0.4640	0.0744	<0.0001*	0.039
BUR_S	0.2819	0.6949	0.6850	
RES_M	-0.1490	0.0621	0.0165	
RES_S	-0.2232	0.1017	0.0282	
PRI	-0.1163	0.0137	<0.0001*	
Number of observations	1568			
Log likelihood	-1283			
McFadden's LRI	**0.2553 R/U**			

Notes: *significant at 1%

The results indicate that each attribute comprises an estimated taste parameter value for the means (M) of preferences for the various water attributes, and an estimated standard deviation (S) of the distribution of the taste parameter for each attribute in the population. Both attributes BUR and PRI have the correct sign as expected *a priori* and are highly statistically significant at the 1% level. The variable LEA has changed to a positive sign, compared to a negative one in the CL model. However, RES remains with a negative sign, when it should really have a positive one, and the same pattern as in the CL model. The estimated standard deviations of coefficients of this model are significant at all levels except in the case of the BUR attribute. This means that preferences do vary across the population of respondents.

In terms of goodness of fit statistics, the McFadden's LRI value is presented, and this indicates that the MXL model is better than the basic CL (Model 1). The index is 0.2553 compared with the Model 1 estimate of 0.2527. However, this indicates that the explanatory power of the MXL model is only slightly different to the CL and not much improved.

Compared with the CL model, the MXL model estimates a slightly lower value for BUR: approximately MYR0.039 for each percentage point increase in repairing pipe bursts within 24 hours. This value has thus declined by MYR0.002 – from an estimated MYR0.041 to MYR0.039 – in Model 1.

Specifically, a MXL model enables the estimation of the coefficient's means and standard deviations for the percentages of the population conferring a positive or a negative value, respectively, on the WI attributes.

Moreover, customers' preferences for LEA show that 39% of respondents would prefer no further improvement, whilst 61% of them would like to reduce the level of leakage before it reaches the customer's tap. Only 25% of respondents would prefer to increase the level of reservoir capacity. Furthermore, customers' preferences on BUR show 51% of respondents would prefer an improvement in repairing pipe bursts within 24 hours of a complaint. The proportion (%) of the population for the WI attributes at each attribute distribution based on the estimated mean and standard deviation is reported in Table 7.2.

Table 7.2: Taste Heterogeneity, Proportions of Utility and Disutility (WI)

Variable	*Disutility Do Not Prefer (%)*	*Utility Prefer (%)*
LEA	39	61
BUR	49	51
RES	75	25

(b) Choice 2: Residential Customers (RC)

The residential customers (RC) model consists of QUA, DIS, CON, PRE, and PRI. The basic MXL result is reported in Table 7.3.

Table 7.3: Basic MXL Model, Choice 2 (RC)

	Model 2			
Parameter	*Estimate*	*Standard Error*	*Approx Pr > |t|*	*Marginal WTP*
QUA_M	-2.0464	5.2075	0.6943	
QUA_S	8.4413	15.8850	0.5951	
DIS_M	0.1669	0.2565	0.5153	
DIS_S	-0.3123	1.7544	0.8587	
CON_M	-0.4909	0.3840	0.2011	
CON_S	1.1031	0.5258	0.0359**	
PRE_M	0.002978	0.0708	0.9664	
PRE_S	0.3772	0.2062	0.0674***	
PRI	-0.1431	0.0308	<0.0001*	
Number of observations	1568			
Log likelihood	-1393			
McFadden's LRI	**0.1912 R/U**			

Notes: *significant at 1%; **significant at 5%; ***significant at 10%

The results indicate that variables QUA and DIS have an incorrect sign. Variables CON and PRE have the correct sign, but are not statistically significant for their estimated means. The estimated standard deviations of the coefficients for this result are not significant at all levels, except for CON and PRE which are significant at the 5% and 10% levels respectively. These results indicate that preferences do not vary in the population of respondents for QUA and DIS, although heterogeneity is a significant feature of CON and PRE. However, only for PRI is the mean coefficient highly statistically significant at the 1% level. Surprisingly, QUA and DIS, for both their mean coefficients and standard deviations, are not statistically significant. Obviously, these results contradict the basic CL model in Table 6.4 (Model 5).

In addition, in terms of goodness of fit statistics, the McFadden's LRI value indicates that this MXL model is better than the basic CL model (Model 5). The index is 0.1912, compared with the Model 5 estimate of 0.1858. However, this indicates that the explanatory power of the MXL model is slightly different to the CL model.

The same process has been conducted as in the previous model, in order to estimate the proportion of the population with positive and negative utilities. The result of the proportion of the population that prefers or does not prefer each of the attributes is reported in Table 7.4.

Table 7.4: Taste Heterogeneity, Proportions of Utility and Disutility (RC)

Variable	***Disutility Do Not Prefer (%)***	***Utility Prefer (%)***
QUA	40	60
DIS	30	70
CON	33	67
PRE	50	50

The distribution of coefficients of the DIS attribute presented indicates that 70% of respondents would prefer more action to avoid disruption. This means that DIS is the customers' highest priority attribute. This is followed by CON, as approximately 67% of respondents would prefer that connections to the water supply are achieved more quickly. Meanwhile, the results demonstrate that 60% of respondents prefer water quality (QUA) in compliance with MOH Standards. This shows that water quality is crucial, probably because it impacts on health. The water pressure (PRE) attribute achieved 50% of respondents preferring good water supply pressure. If water pressure is not sufficient or fails to achieve the normal standard, delivery would not be received at the household tap, which would influence daily household activities.

7.3 Results of the MXL Interaction Model, Choice 1: Water Infrastructure (WI)

There are 22 interactions between main attributes and socioeconomic (SE) characteristics. However, only significant variables are reported in Table 7.5.

Table 7.5: MXL Interaction Model, Choice 1 (WI)

	Model 3			**Model 4**		
Parameter	*Estimate*	*Approx Pr > |t|*	*Marginal WTP*	*Estimate*	*Approx Pr > |t|*	*Marginal WTP*
LEA_M	0.1216	<0.0001		0.0262	0.1688	
LEA_S	0.0431	0.7189		-0.2731	<0.0001	
BUR_M	0.4722	<0.0001*		-0.3138	0.2782	
BUR_S	0.004030	0.9980		0.0970	0.9353	
RES_M	-0.1399	0.0131		-0.1934	0.0075	
RES_S	-0.2050	0.0275		-0.2989	0.0052	
PRI	-0.1154	<0.0001*		-0.1376	<0.0001*	
ilc5_M	-0.0739	0.0003*	0.0062			
ilc5_S	-0.1364	0.0022*				
ilh11_M	-0.0714	0.0021*	0.006			
ilh11_S	-0.0149	0.9554				
ilh12_M	-0.0607	0.0215**	0.0051			
ilh12_S	-0.1353	0.0319**				
ipc5_M				0.7463	0.0117**	0.0531
ipc5_S				-1.1937	0.0060*	
ipc7_M				0.5321	0.0996***	0.0379
ipc7_S				0.0683	0.9790	
iph11_M				0.2785	0.0361**	0.0198
iph11_S				-0.4982	0.1995	
iph12_M				0.2681	0.0718**	0.019
iph12_S				0.0382	0.9742	
Number of observations	1568			1568		
Log likelihood	-1261			-1256		
McFadden's LRI	**0.2679 R/U**			**0.2637 R/U**		

Table 7.5 (continued): MXL Interaction Model, Choice 1 (WI)

	Model 5			**Model 6**		
Parameter	*Estimate*	*Approx Pr > |t|*	*Marginal WTP*	*Estimate*	*Approx Pr > |t|*	*Marginal WTP*
LEA_M LEA_S	0.0385 -0.1407	0.0189 0.0003		0.0511 -0.1711	0.0070 0.0016	
BUR_M BUR_S	0.4633 0.3265	<0.0001* 0.5984		0.5580 0.003736	<0.0001* 0.9978	
RES_M RES_S	-0.2786 -0.2134	0.0180 0.0980		-0.1332 -0.2333	0.0443 0.0539	
PRI	-0.1162	<0.0001*		-0.0655	<0.0001*	
ida2_M ida2_S	0.1222 0.0164	0.0179** 0.9655	0.010			
irp10_M irp10_S				0.0279 0.1539	0.0224** 0.9464	0.0041
irw19_M irw19_S				0.0448 0.0584	0.0703** 0.1613	0.0067
iri22_M iri22_S				0.0263 0.1072	0.0939*** 0.8442	0.0039
Number of observations	1568			1568		
Log likelihood	-1265			-1256		
McFadden's LRI	**0.2656 R/U**			**0.2648 R/U**		

Notes: *significant at 1%; **significant at 5%; ***significant at 10%

The interaction models between the main attributes (LEA, BUR, RES and PRI) and SE are presented in Table 7.5. This model shows the estimated result of the MXL interaction model, including the estimates for the taste parameter for both the main variables and the interaction variables. For each variable indicated, the estimated mean (M) and standard deviations (S) of the distribution of the taste parameter in the population are shown. Also presented is the MWTP of the WI attributes for the interaction MXL model.

Model 3 presents the interaction between LEA and SE. The results indicate that there are two main attributes, namely BUR and PRI, which have correct signs as expected *a priori* with mean coefficients that are highly significant at the 1% level. The attribute LEA has an incorrect sign that should be negative, but it is significant at the 1% level. The variable RES has an incorrect sign from that expected and is statistically significant. There is interaction between LEA and the number of children (ilc5) and the type of house (ilh11, ilh12). The mean for all interactions are significant at the 1% and 5% levels respectively. The significant of the standard deviation for customers who have two children or fewer (ilc5) and those who live in two-storey houses (ilh12) show that the preferences for the unobserved factors for this variable vary significantly across the population of respondents.

Model 4 reveals the interaction between BUR and SE. The results indicate that PRI has the correct sign as expected and is highly statistically significant at the 1% level. Meanwhile, LEA, BUR and RES remain with incorrect signs, which should be negative, positive and positive respectively. The standard deviations for BUR are highly insignificant. Meanwhile, those for LEA and RES are significant at the 1% level. The results indicate that BUR has an interaction with the number of children (ipc5, ipc7) and with the type of house (iph11, iph12). The mean interaction is significant at the 5% level for customers who have two children or fewer (ipc5) and for those who live in terraced or two-storey houses (iph11, iph12); and at the 10% level for those who have three to five children (ipc7).

Model 5 describes the interaction between RES and SE. The results indicate that BUR and PRI have the correct sign according to expectations as well as being highly statistically significant at the 1% level. Meanwhile, LEA and RES remain with incorrect signs that should be negative and positive respectively. The standard deviations for BUR are highly insignificant. The results indicate that RES has an interaction with age (ida2). For this group of customers the coefficient is significant at the 5% level.

Model 6 reports the interaction between PRI and SE. The results show that BUR and PRI have correct signs and are highly statistically significant at the 1% level. However, the standard deviation of BUR is highly significant as well. Elsewhere, LEA and RES are significant at the 1% and 5% levels respectively. The results presented show that PRI has interaction with the number of persons in the household (irp10), type of work (irw19), and also income (iri22). The standard deviations of these are highly insignificant. This means that preferences for the unobserved factors for this variable do not vary significantly across the population of the respondents.

In terms of goodness of fit statistics, the McFadden's LRI for each model is 0.2679, 0.2637, 0.2656 and 0.2648 respectively, while that of the basic MXL model is 0.2553. This means that each model has a better explanatory power than the basic MXL model. However, these values are definitely not much improved if compared with the CL interaction model.

Marginal Willingness to Pay

Model 3 presents the interaction between LEA and SE. The MWTP of customers who have two children or fewer (ilc5) is MYR0.0062 for each percentage point decrease in leakage. Meanwhile, the MWTP for customers who live in terraced houses (ilh11) or two-storey houses (ilh12) is MYR0.006 and MYR0.0051 respectively. These values are higher than in the CL interaction in Table 6.8 (Model 9). The range of values is MYR0.0012 to MYR0.0003 for each percentage point in leakage reduction before the water reaches customers. This pattern of MWTP indicates that customers with more income are willing to pay more, compared to those who have a large number of children and live in flats (for instance).

Model 4 reveals the interaction between BUR and SE. The MWTP of customers who have two children or fewer (ipc5) and those who have six to eight children (ipc7) are MYR0.053 and MYR0.037 respectively for each percentage point improvement in repairing pipe bursts within 24 hours. Furthermore, the MWTP for customers who live in terraced (iph11) or two-storey houses (iph12) ranges between MYR0.019 and MYR0.019. These values are lower than in the CL interaction in Table 6.8 (Model 10).

Model 5 describes the interaction between RES and SE. The MWTP of the group aged between 20 and 30 years (ida2) is MYR0.01 for each percentage point increase in reservoir capacity. This value is slightly different from that in the CL interaction model in Table 7.8 (Model 11) by approximately MYR0.012. The results presented show that customers' willingness to pay is definitely dependent on their level of income.

Model 6 shows the interaction between PRI and SE. The MWTP of customers with six to eight persons in the household (irp10), professionals (irw19) and those with an income of between MYR1501 and MYR2500 (iri22) are MYR0.0041, MYR0.0067 and MYR0.0039 respectively for each percentage point increase in the water bill. The highest MWTP is from the professional group; due to their higher income, they are willing to pay more compared to other groups.

7.4 Results of the MXL Interaction Model, Choice 2: Residential Customers (RC)

The estimation results of the MXL interaction model of Choice 2 are reported in Table 7.6. This model also comprises 22 interaction variables between the main attributes and the socioeconomic variables (SE). There are only four main attributes (QUA, DIS, CON, and PRE), and the significant variables are shown below. The variable PRI did not come out because of error; convergence was not attained in 100 iterations. The estimates produced by the software (SAS 9.2) should be interpreted with care.

Table 7.6: MXL Interaction Model, Choice 2 (RC)

	Model 7			**Model 8**		
Parameter	*Estimate*	*Approx Pr > |t|*	*Marginal WTP*	*Estimate*	*Approx Pr > |t|*	*Marginal WTP*
QUA_M	-3.1202	0.0447		-3.5585	0.0336	
QUA_S	0.0642	0.9974		0.8239	0.9598	
DIS_M	0.2017	0.2585		0.9212	0.0008	
DIS_S	0.1278	0.9524		0.1555	0.9445	
CON_M	-0.5284	0.0018*		-0.8472	<0.0001*	
CON_S	0.9155	0.0116		-0.0283	0.9872	
PRE_M	-0.003676	0.9278		0.0277	0.4648	
PRE_S	0.3212	<0.0001		-0.009008	0.9872	
PRI	-0.1250	<0.0001*		-0.1197	<0.0001*	
iqg_M	3.6696	0.0093*	0.288			
iqg_S	-0.0194	0.9993				
iqa4_M	3.9517	0.0419**	0.309			
iqa4_S	0.0243	0.9990				
idg_M				-0.9618	<0.0001*	0.0787
idg_S				0.0446	0.9868	
ida4_M				-4.6183	0.0255**	0.378
ida4_S				-9.6268	0.0281**	
Number of observations	1568			1568		
Log likelihood	-1371			-1292		
McFadden's LRI	**0.204 R/U**			**0.2498 R/U**		

Table 7.6 (continued): MXL Interaction Model, Choice 2 (RC)

	Model 9			**Model 10**		
Parameter	*Estimate*	*Approx Pr > |t|*	*Marginal WTP*	*Estimate*	*Approx Pr > |t|*	*Marginal WTP*
QUA_M QUA_S	-2.6181 0.2946	0.0653 0.9909		-1.2680 0.0433	0.3524 0.9986	
DIS_M DIS_S	0.2233 -0.0645	0.1609 0.9792		0.2257 0.0606	0.1451 0.9784	
CON_M CON_S	-0.1536 0.0467	0.3477 0.9805		-0.4819 0.9236	0.0027* 0.0045	
PRE_M PRE_S	-0.0587 -0.0159	0.0824 0.9731		-0.1959 0.1768	<0.0001 0.0717	
PRI	-0.1251	<0.0001*		-0.1248	<0.0001*	
icg_M icg_S	-0.8748 0.0334	<0.0001* 0.9870	0.0685			
ipg_M ipg_S				0.4005 -0.008980	<0.0001* 0.9901	0.0314
ipa4_M ipa4_S				0.3048 -0.1204	<0.0001* 0.6807	0.0239
Number of observations	1568			1568		
Log likelihood	-1300			-1330		
McFadden's LRI	**0.2456 R/U**			**0.2277 R/U**		

Notes: *significant at 1%; **significant at 5%

Model 7 describes the interaction between QUA and SE. The results indicate that CON and PRI have the correct expected signs, with mean coefficients that are highly significant at the 1% level. This is an improvement on the simple model for the variable CON, which had an incorrect sign and was insignificant as well. There are three main variables, QUA, DIS and PRE, that have incorrect signs to those expected *a priori* and in contrast with the basic MXL model (Model 2). In terms of the standard deviations for all the main attributes, they are not significant at any level, except for CON and PRE, which are significant at the 1% level. Additionally, the result indicates that QUA has an interaction with gender and age (iqg and iqa4). Both are highly significant at the 1% and 5% levels respectively.

Model 8 presents the interaction between DIS and SE. The results reported reveal that PRI remains with a negative sign as expected *a priori* and is highly significant at the 1% level. CON also has a correct sign, but it is not statistically significant. Moreover, QUA, DIS and PRE have incorrect signs according to *a priori* expectations. None of the mean coefficients and standard deviations are significant at any level, except for CON and PRI.

There is a relationship between DIS and gender (idg) and with the age group between 41 and 50 years old (ida4). Both are significant at the 1% and 5% level respectively.

Model 9 indicates the interaction between CON and SE. The results presented reveal that CON and PRI have the correct sign as expected *a priori*. The mean coefficient of PRI is highly significant at the 1% level. Moreover, QUA has an incorrect sign, but is statistically significant. DIS and PRE also have incorrect signs, but are not statistically significant. The standard deviations for all main variables are highly insignificant at all levels. This pattern indicates that preferences do not vary significantly across the population of respondents. CON has an interaction with gender and age (icg); both are significant at the 1% level.

Model 10 reports the interaction between PRE and SE. The results described show that CON and PRI remain with a negative sign, with the mean coefficients being highly significant at the 1% level. Furthermore, QUA, DIS and PRE have incorrect signs. None of the standard deviations are highly significant at any level, apart from CON and PRE which are significant at the 1% and 5% levels respectively. The significance of CON and PRE suggests that the preferences of the unobserved factors for these variables vary significantly across the population of respondents. There is an interaction between PRE and gender (ipg) and age (ipa4). Both groups are significant at the 1% level.

In terms of goodness of fit statistics, the McFadden's LRI for each model is 0.204, 0.2498, 0.2456, and 0.2277 respectively, as opposed to that of the basic MXL model, which is 0.1912. This means that this model has a better explanatory power than the basic MXL model. However, these values are not much of an improvement when compared with the CL interaction model.

Marginal Willingness to Pay (MWTP)

Model 7 describes the interaction between QUA and SE. The MWTP of gender (iqg) and customers aged between 41 and 50 years old (iqa4) is the highest across all models. These values are MYR0.28 and MYR0.30 respectively for each percentage point of improvement of the water quality to meet MOH Standards. Both MWTPs are increased as compared with the values in the CL interaction model (MYR0.179 and MYR0.701). This indicates that customers are willing to pay more for getting a better service from SAJH in terms of receiving good quality water.

Model 8 presents the interaction between DIS and SE. The MWTP of gender (iqg) is MYR0.28, and for customers who are aged from 41 to 50 years old (iqa4) it is MYR0.31. These values also increase for each percentage point reduction in disruption to supply. The results show that customers are also willing to pay more in order for convenience when conducting daily activities.

Model 9 indicates the interaction between CON and SE. The MWTP of female respondents (icg) is estimated at MYR0.068, which is an increase from MYR0.056. Female respondents are therefore willing to pay slightly more as compared to the CL interaction models. This is because different genders have different responsibilities; for instance, a male as a head of a family has a huge commitment, particularly for monthly expenditure.

Model 10 reports the interaction between PRE and SE. The MWTP of gender (ipg) is MYR0.031 and that for those aged between 41 and 50 years old (ipa4) is MYR0.023 for each percentage point increase in the level of water pressure. These values are slightly increased from the CL interaction models (Model 14). The results reveal that customers are concerned about good pressure as an achievement of a better level of service.

7.5 Conclusions

This chapter presents the MXL model as a flexible tool which will approximate any random utility model. There are two types of techniques that can be employed to overcome the IIA problem in McFadden’s conditional logit estimator: (1) utilizing simulation methods to estimate a multinomial probit model and (2) employing simulation estimation to estimate a mixed logit specification. By using simulation techniques, the need for an IIA test can be avoided.

In the basic MXL (WI) model, the results show that BUR and PRI have the correct signs as expected *a priori* and are highly significant. Meanwhile, the results of the basic MXL (RC) model indicate that only PRI has the correct sign and is highly statistically significant.

In the MXL interaction model of Water Infrastructure (WI), four attributes are included, namely LEA, BUR, RES and PRI. The results reveal that BUR and PRI have correct signs according to prior expectations and that they are highly significant at the 1% level, except in Model 4. There is a relationship between LEA and the number of children (ilc5) and the type of house (ilh11 and ilh12). Moreover, BUR has an interaction between the number of children and the type of house as well. RES has a relationship with age (ida2); meanwhile, PRI has a relationship with the number of persons in the household (irp10), type of work (irw19), and income (iri22).

The MXL interaction model of Residential Customers (RC) includes four attributes. Attribute PRI did not come out because of error and convergence was not attained in 100 iterations. The estimates produced by the software (SAS 9.2) should be interpreted with care. The results reveal that CON and PRI have the correct signs as expected *a priori* and are statistically significant at the 1% level, except in Model 7. The interaction results show that QUA has a relationship with gender (iqg) and age (iqa4). DIS has a relationship with gender (idg) and age (ida4) as well. Meanwhile, CON just has a relationship with gender (icg). Moreover, PRE has an interaction between gender (ipg) and age (ipa4).

Furthermore, males are more concerned about QUA, DIS and PRE, because they are the heads of their families and it is their responsibility to pay the monthly water bill. In addition, the older age group (41 to 50 years old) also have a similar view on this matter, because they have experienced the process of SAJH becoming a privatised company that should provide an excellent service to customers.

In general, the MWTP for WI is somewhat similar to the CL models. The MWTP for interaction variables (ilc5, ilh11, ilh22, irp10, irw19, irw22) is higher. This means that customers are willing to pay for better service achievements in the water supply.

In addition, the MWTP for RC increases for all interaction variables (iqg, iqa4, idg, ida4, icg, ipg, ipa4), except for CON with gender (iga4). These patterns show that customers are willing to pay more in order to get a better service from SAJH. SAJH should take this into consideration in future when revising the water tariff.

In summary, all MXL model results seem worse than those of the CL basic model. As a result, the other possible alternative that could be considered for the next process is to apply a Latent Class Model (LC). A latent class estimation of the heterogeneity in preferences might produce better results than a MXL model.

CHAPTER 8: COST BENEFIT ANALYSIS RESULTS

8.1 Introduction

This chapter presents the Cost Benefit Analysis (CBA) of investment of SAJH for the year 2008. It begins with the components of CBA for a water supply system, followed by the specific scenario of SAJH, the formula to calculate CBA, and the implementation of CBA in order to evaluate the variables of the project.

8.2 Stages of CBA for a Water Supply System

According to Baffaoe-Bonnie et al. (2008) for Integrated Project funded by the European Commission (TECHNEAU), there are six key stages of CBA, as follows:

(a) A base case representing the present service level and the current cost to the provider. This is called the "without-project" scenario; it should be compared directly with the "with-project" scenario.

(b) The planning period or horizon to the appraisal (in years).

(c) Identification and estimation of costs within this period. This should include operating expenditure (OPEX), capital expenditure (CAPEX), and social and environmental costs. The cost to the service provider of any intervening systems which will improve the features of drinking water enhancement, which would be identified by a customer focus group, also needs to be identified and quantified.

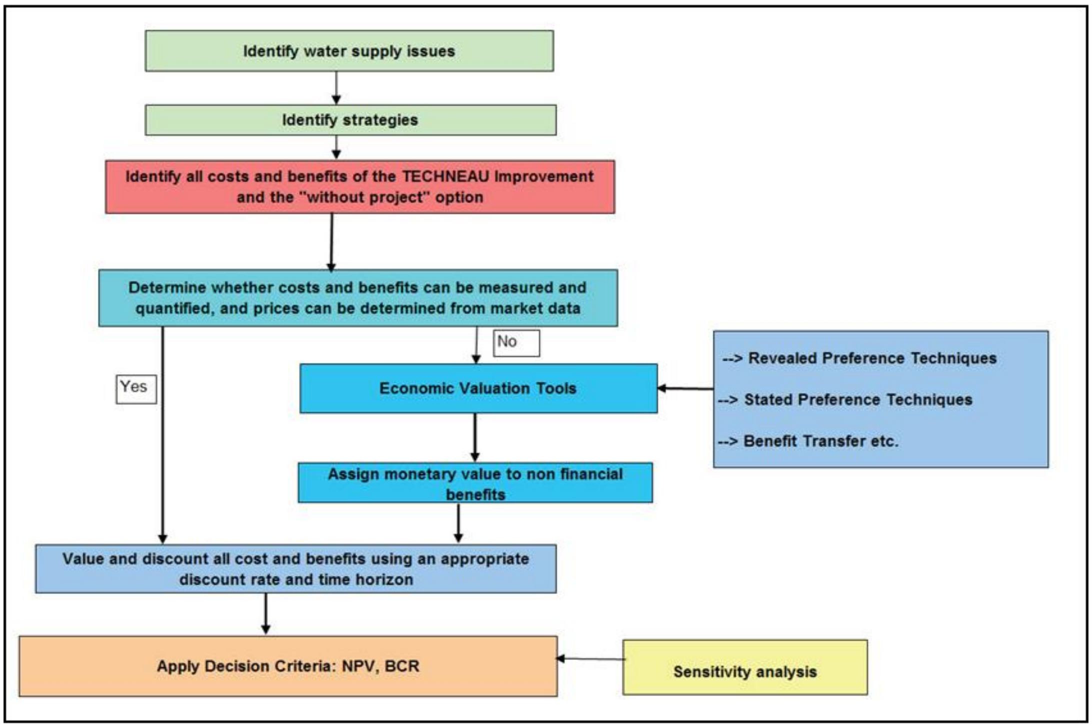
(d) Identification and estimation of benefits to the service provider, customers, and society in general within the planning horizon (with regards to monetary or cost benefits or both). This requires deriving the customer benefit, in monetary terms, of these enhancements to aesthetic service provision by means of a large-scale customer WTP survey.

(e) A discount rate, in order to modify future values to current ones.

(f) A risk and sensitivity analysis, in order to incorporate any risks and uncertainties into the CBA structure.

The stages in the development of a CBA for a TECHNEAU operational improvement are shown in Figure 8.1.

Figure 8.1: Stages in the Development of the CBA Model



Source: Baffaoe-Bonnie et al. (2008)

Briefly, the stages in developing the CBA are explained as follows:

(a) Ascertaining water supply issues

Identifying key service areas is dependent upon the type of issues that end–users experience, or have experienced previously, concerning the provision of water which is safe to drink. Also, users in different geographical areas may have different choices with regards to which service areas should be prioritised. One would expect these to include water quality, disruptions to the supply, customer satisfaction, among others. These problems are usually ascertained through customer focus groups, satisfaction surveys and complaints databases.

(b) Determining strategies and interventions

The next phase is to determine and choose applicable actions or strategies to maintain or decrease the service level of risk. This implies identifying the many technologies, developed under TECHNEAU or else, that for being executed to address the water supply problems identified.

(c) Determination of relevant costs and benefits of an intervention

All the relevant costs and benefits must be determined and estimated to create a reliable framework in order to compare possible alternatives. All of the costs of applying an intervention for service improvements and the value of the benefits that the customers and the water supplier gain must be integrated into the model to measure the project's profitability or desirability. This will (as an example), present a method to justify any capital maintenance expenditure to raise the quality of tap water.

The end-users may have different backgrounds – geographical, organisational or operational. There may also be some national variations as regards regulatory or organisational responsibilities. These differences will deliver diverse details concerning the costs along with the effects or impacts of improvements.

Both tangible and intangible effects ought to be determined and quantified. Tangible effects consider those that can be determined and quantified simply. For instance, tangible costs may include operating, maintenance and capital costs, and other overheads. In contrast, it is hard to attribute a monetary value to intangible effects, or to quantify them otherwise. As an example, intangible effects may add some worth in terms of customers' satisfaction, time, comfort or health, due to improvements in water quality – these are generally challenging to quantify.

The probable cost and benefit items for TECHNEAU improvement projects, and ways of measuring these, are shown in Tables 8.1 and 8.2.

Table 8.1: Likely Costs of Water Quality Improvement Programmes

Costs	Elements	Note on Estimation
C1: Capital expenditure	Capital costs incurred to acquire or upgrade physical assets to undertake water quality improvement schemes.	If capital costs are involved, apply the end-user's costs for the items concerned.
C2: Operating expenditure	Operating costs include additional monitoring costs, energy costs, chemical costs, labour/manpower costs, etc.	Additional annual operating costs – depends on particular intervention.
C3: Capital maintenance	This includes costs incurred on an improvement system to maintain the existing standard.	
C4: Additional costs	Any other additional costs including replacement costs, overhead costs, etc.	
C5: External costs – social and environmental costs	May include traffic congestion costs, delay to pedestrians due to repair works, noise pollution, carbon impacts of intervention, etc.	Depends on the external costs identified for the particular operational improvement in the particular location of implementation. As a general rule, externalities should be included if they can be quantified, although care must be taken to ensure any unquantifiable external impacts are not completely disregarded.

Source: Baffaoe-Bonnie et al. (2008)

Table 8.2: Likely Benefits of Improvement Programmes

Benefits	Elements	Notes on Estimation
B1: Reduction in operating costs	Could include reduced cost of customer complaints, improvements in technology that lead to reduced operating costs at treatment works, etc.	Depends on the operational improvements implemented and the knock-on effects. A comparison of the current or "without project" operating costs and "with project" scenario could give an estimate of net operating costs.
B2: Deferment of / reduction in capital expenditure		Apply the end-user's unit costs to build up an estimate of the capital expenditure deferred.
B3: Improvements to water supply service levels	Use consumer's valuations of different levels of service for each relevant supply issue, e.g. supply interruptions.	WTP surveys of customers need to be performed to establish their valuations.
B4: Health benefits	Good quality water will result in improved public health, leading to greater economic output generally and reduced health costs associated with water quality problems.	Realistically, only an estimate based on national statistics, supplemented by research information from the WHO, can be made. Cost effectiveness analysis is an ideal tool.
B5: Improved aesthetic qualities	This involves estimating the value of improved aesthetic qualities, such as taste and odour, to customers.	The value users place on improved tap water could be estimated based on customer interviews (customer surveys) or from the findings of previous studies of this type.
B6: Public goodwill of water company	Based on consumers' perception and confidence in the utility due to fewer supply interruptions, fewer complaints as a result of improve water quality.	Use record of customer complaints.

Source: Baffaoe-Bonnie et al. (2008)

(d) Valuation of costs and benefits

A key element of CBA is monetary valuation. Economic values which are communicated in monetary terms, if correctly determined, will indicate respondents' preferences, enabling them to be utilised as emphases to enlighten any policy analysis or decisions.

After determining all costs and benefits which are relevant, the next phase is to assign monetary values to each option's costs and benefits, in terms of the prices current in the year in which the project is evaluated. However, it is complicated to put monetary values on such non-financial benefits as health or aesthetic benefits. For instance, it is not necessarily possible to quantify or estimate in solid monetary terms the worth associated with the reduction of odours in the water or perhaps the value of lives possibly saved because of improvements in the water quality. This is because no market exists for these items, or market prices cannot be directly observed or are difficult to estimate. Many benefits of increased water quality are unable to be measured directly via a market system; as a result, non-market methods have been devised in order to quantify them. Consequently, there are several economic valuation techniques and tools, which may be used to estimate the worth put on non-market goods.

(e) Using economic valuation techniques to measure the benefits of water quality improvements

Economic valuation refers to assigning monetary values to non-market assets, goods or services. Monetary values for non-market goods which are reliably estimated will indicate people's WTP for, or accept, various changes. WTP reflects the payment a user is willing or prepared to pay for a particular service or product, or even a particular change in level of service or product attribute. It is the price at which they are indifferent between acquiring the service/product and keeping the money. Somebody may not wish to buy the service/product for a sum more than their WTP. In terms of water services, WTP represents the quantity which a customer would be willing to pay for proposed improvements to the water services over and above the current defined baseline.

(f) Discounting the future stream of costs and benefit

Each cost/benefit has to be assessed at current values employing an appropriate discount rate and the analysis's planning horizon. The selection of discount rate may have a major effect on the assessment of costs and benefits in the event that the planning horizon is a long one. This is because of the principle that a given sum is more valuable earlier rather than later, as this allows one to benefit from investment opportunities. Thus, more importance is put on costs and benefits that arise now than on others that may occur in the future. When it is applied to monetary values, the discount should indicate the opportunity cost of the capital or revenue.

The number of years over which the project should be discounted over is determined by the proposal. There are other factors which must be taken into account, for example, if the purchase of equipment is the main cost to the project, then one could use the expected life of that equipment. On the other hand, if costs or benefits are likely to arise at some point in the future, a longer timescale might be considered.

(g) Decision Criteria – Net Present Value, Benefit Cost Ratio

Net Present Value (NPV) is a reliable guide of a project's financial/economic performance. It measures a project's net benefit, and estimated to be the sum of the project's annual net benefit over the planning horizon. In comparing contradictory improvement options, the one that delivers the best positive net present social benefit is chosen. If we assume that the advantages are greater than the expenses, then a general benefit would be achieved through the project's implementation.

An important element in a CBA is to determine and quantify all relevant costs and benefits, as seen through private and society's opinions. The NPV is then estimated as the total of the discounted flows of costs and benefits within the expected life or horizon of the project. Without including risks and uncertainties, an NPV greater than 0 suggests that the project would lead to a potential improvement in efficiency, as benefits exceed costs. Generally, all CBAs use variables which may only be measured or predicted with a degree of imprecision. Any risk or doubt in the variables within a CBA will affect the accuracy of the estimated NPV, or any economic decision criteria such as benefit cost ratio (BCR). Hence, it is crucial to take into consideration the consequences of risks and uncertainties when undertaking CBA.

The analysis must contain a "risk assessment" in order to cater for the uncertainty that always pervades investment projects. Two main elements have to be carried out: sensitivity analysis and risk analysis.

(i) Sensitivity analysis

The object of sensitivity analysis is to determine the critical variables of the project. This will permit them to be utilised in evaluating how sensitive the expected NPV would be to any modifications in these variables. The project variables/parameters are allowed to vary in line with a particular percentage change and then any consequent changes to the economic and financial performance indicators (NPV and BCR) are monitored. Variables should be changed one at a time, while keeping the rest constant. Calculating the values as they change may deliver interesting results, by suggesting what percentage change to the parameters would make the NPV (either economic or financial) equal to zero.

(ii) Risk analysis

Measuring the impact on a project's performance indicators of a particular variable's given percentage modification does not indicate anything about the probability of this change actually occurring. Risk analysis refers to this. By allotting an appropriate probability distribution to the key variables, probability distributions for the economic and financial performance indicators may then be estimated. It is then possible to generate statistics for the performance indicators of the project; these may include expected values, coefficient of variation and standard deviation.

8.3 The Scenario of SAJH

The SAJH mission is: "*We shall continuously satisfy our customers and stakeholders, delivering quality services to become a world class water utility provider*". This study focuses on the Water Infrastructure (WI) and Residential Customers (RC) aspects, considered as crucial for water services improvements, which should be upgraded to fulfil customers' expectations and achieve their satisfaction. There are seven attributes: reduction level of leakage; repairs to pipe bursts; reservoir capacity; water quality; reduction of disruption; provision of connection in a shorter time; and increase in good water pressure. In the customer charter, the target to be achieved for these attributes is 100%. However, it is aimed to reduce leakage by 20% in 2010.

In general, the main activities of the business consist of the following: extracting raw water from catchment areas to treatment plants; distributing purified water to all categories of customers (domestic, institutional and commercial); developing, maintaining and operating the reticulation and water treatment systems, and other systems supporting these; and collecting fees and charges from the different categories of customers for supplying water.

As a result, in order to achieve the target, SAJH needs to make new investment in future. These activities include:

(a) Water Infrastructure (WI)

The water infrastructure projects consist of the following:

(i) Leakage

The Network Department and the NRW Department collaborate closely together in order to achieve the NRW target levels by managing the implementation of the NRW Strategy and Action Plan.

(ii) Pipe bursts

Pipes were replaced by the Asset Replacement Department and Pressure Management Programme: pressure-reducing valves were installed at certain critical positions in the network in order to lower the number of occurrences of burst pipes.

(iii) Reservoir

A total of 18.1 million litres capacity of new reservoirs and 85km of new mains are being constructed because of rapid growth in the Iskandar development region. The daily production of the treatment plants at Bukit Serampang and Gerisek has been raised from 4.5 to 6.5 million litres and from 44.8 to 62.2 million litres, respectively. (This project is ongoing, within the Third Operating Period, July 2008–June 2013).

(b) Residential Customers (RC)

Meanwhile, the residential customers (RC) projects are as follows:

(i) Water quality

A continuing strategic plan is in place to improve the degree of compliance to MOH Guidelines. This comprises pipe scouring and reservoir cleaning to improve water quality; also greater supervision of quality concerning static tanks, tankers and treatment plants.

(ii) Disruption

Investment in pipe maintenance and reservoirs could reduce the disruption period, particularly in festival seasons and periods of drought.

(iii) Connection

New investment will reduce the connection time to 1 day.

(iv) Pressure

With planned investment, good water pressure could be provided to 100% of customers.

8.4 Formula of Cost-Benefit Analysis

The process to calculate CBA is dealt with above in section 8.2. The present value (PV) or cost is computed based on the equation below:

$$PV = FV / (1 + i)^n$$

where:

PV = the present value of a benefit or cost

FV = its future value

i = the discount rate

n = the number of years between the present and the time when benefit or cost is expected to occur

In order to make a decision for projects, there are two indicators of financial need to be used as follows:

(a) Net Present Value (NPV)

This estimates the net benefit of the project. If the benefits exceed the costs, this means that an overall benefit is achieved with the implementation of the project.

Net Present Value (NPV) is calculated as:

$$NPV = \sum_{t=1}^{T} \frac{1}{(1+r)^t} (Benefits_t - Costs_t)$$

where:

r = discount rate (%)

t = time (years)

(b) Benefit Cost Ratio (BCR)

This is the method of determining the most attractive option (the one with the highest BCR). This may be done by placing monetary values on all costs and benefits. If the ratio is greater than 1, the benefits exceed the costs and the project would provide net present social benefit.

Benefit Cost Ratio (BCR) is calculated as:

$$BCR = NPV(B) / NPV(C)$$

where:
B = benefits
C = costs

In summary, all benefits accrue from the customers' WTP. The average WTP for a change in the level of a particular attribute may be weighed against the marginal cost of carrying out the change. If the WTP is more than the marginal cost, it is meaningful to proceed with the project (Baffoe-Bonnie et al., 2008).

8.5 Implementation of CBA in SAJH

In order to improve the water supply service, SAJH's benefit element is identified by using consumers' valuations of different levels of service for each relevant supply issue. CBA is then conducted to evaluate the future investment or project. According to Willis (2002), choice experiment (CE) is used to measure the WTP of improvements in water service. WTP can be explained as the total customers could be willing to further improve the baseline water service (the status quo). Next, benefits need to be measured at the present value (PV), setting an appropriate discount rate, and also the planning horizon of the analysis.

CBA is calculated as the aggregate WTP for the annual available cost and estimated investment needed to improve the water service to examine the potential implications for the future water policies. To evaluate the improvements to the water service by SAJH, there are assumptions as follows: the operating cost (OPEX) is MYR336,114,000 and capital expenditure (CAPEX) is MYR435,811,000. The lifespan for the new projects is 20 years, regarded as a suitable period to determine the viability of the projects. The implicit prices have been summed across all attributes of the water supply. The implicit price of an attribute is derived as the coefficient of summed across all attributes divided by the coefficient of price. This amount is estimated as MYR0.514. This means that households have a WTP of approximately MYR0.514 for improvements to the level of water service. Therefore, the total WTP, which can be considered a monthly value, is MYR1,644,800. This value could be calculated by multiplying the implicit price from the amount of SAJH customers, which is approximately 3.2 million (Johnstone et al., 2006). Therefore, the total annual benefit is MYR20,000,000: this amount is calculated by multiplying the value of the monthly WTP by 12 (months). The discount rate for the net benefit of improving the water supply is 5%. The result of the calculation is presented in Table 8.3.

Table 8.3: Cost-Benefit Analysis of SAJH (2008)

	Per Year (MYR)	***Present Value (MYR)***
Benefits	20,000,000	269,244.21
Costs	771,925,000	10,391,816.72
Net Present Value (NPV)	–10,122,572.51	
Net Benefit Cost Ratio (BCR)	0.03%	

Table 8.3 shows the cost-benefit analysis of SAJH for 2008. The result reveals that there is a negative NPV, which means that the management project is uneconomic (at a discount rate of 5%), and therefore the new project should not be invested in because the costs exceed benefits (Shively and Galopin, n.d.). Therefore, the investment is not currently viable, but it may become so in the future.

Moreover, the aggregate WTP for enhancing the water supply service was estimated to be lower than the expenses for all ranges of discount rates considered in this study. Because of this, customers are not willing to pay very much to upgrade the service. Therefore, SAJH should determine other aspects of the water infrastructure which might be identified as the crucial factors for improving the water supply service in Johor, in particular: customer complaints, water bill enquiries, installation of new meters, and applications for water reticulation plans and approval of internal plumbing systems.

8.6 Conclusions

CBA is the one tool to assess the project with two approaches, which consider Net Present Value (NPV) and Net Benefit-Cost Ratio (BCR). For the year 2008, SAJH's project was uneconomic. In order to achieve an economic project, the planning horizon needs to be more than one year. Therefore, SAJH should restructure the project or investment as well as the amount of capital to gain profit in the future. In addition, the priority attributes or aspects should be considered more in order to satisfy residential customers.

CHAPTER 9: IMPLICATIONS OF RESULTS

9.1 Introduction

This section addresses the implications of the results. It begins by describing the significance of the socioeconomic characteristics of SAJH customers. Then, it reviews customers' experiences with SAJH. Following this it reconsiders customers' perceptions of service quality and presents the implications of perceptions of improvements to the water service. The findings of this study, which have been carried out for one water company and one sample in Johor state, may be used for preliminary awareness of WTP for an improved water service, as well as in suggesting relevant policy for policymakers in respect of sustainable water management in Malaysia. At the same time, the water provider can identify the priority strategies and aspects of water management, including customer preferences and direct investment, in order to achieve the goals and vision towards efficient water management which satisfy customer preferences and provide clean and safe water.

9.2 Implications of Socioeconomic Characteristics

The results of the socioeconomic characteristics of this study are very useful to the management of SAJH, because of the potential implications for planning and marketing purposes. Socioeconomics revealed that the majority of respondents are aged between 20 and 30 years old. The management should focus on this group with effective plans; for example, educate them in using water wisely to ensure sustainable water resources.

Furthermore, most of the respondents graduated from college or university. They are more concerned about the water service, particularly water quality. They are also willing to pay more for improvements to the water service. The socioeconomic characteristics also show that most respondents have an income of greater than MYR1,501 per month. This shows the connection between education and income level. Of course, individuals who are educated will be employed in a good job. Subsequently, SAJH management can propose a pricing plan for water and other payments to enhance the water supply service and become more efficient. While doing so, the top management of SAJH should create an integrated plan to manage the water service as well as to achieve customers' satisfaction and preferences.

Moreover, the cross tabulation findings revealed that the majority of respondents were satisfied with their perception of service quality performance, improvement of water service, and improvement of strategies. Most respondents were Malay, aged between 20 to 30 years old, with two children or fewer as well as having six to eight persons in their households. Most respondents lived in terraced or two-storey houses. The majority had higher education qualifications and a good income. Additionally, the correlation findings demonstrated that socioeconomics had a positive relationship with all the water attributes except for increase in price. There were similar results for improvements to the water service, and improvement of strategies. All coefficients were strong.

Additionally, based on these findings, SAJH will get to know the pattern of behaviour of the residential customers in each area. It is important to determine the behaviour of customers towards water; either they use water wisely or not. The pattern of usage will affect the supply of water to that area, as well as the customers' attitude to water issues or problems. Identifying the customers' attitudes and behaviours makes it easier to manage the water service and settle the problems faced. Customers' educational backgrounds and levels of income are very important characteristics for determining whether the bill will be paid on time. Those with a higher level of education or income also expect a higher quality of service of water supply to be provided.

9.3 Implications of Customers' Experience with SAJH

Furthermore, customers' input concerning their experience with SAJH is useful for the water management for marketing and planning in order to provide an excellent level of service. The most crucial finding concerns water quality, which achieved 98% compliance with MOH Standards. However, customers used a water filter at home to purify the water from colour, odour and taste. They also boiled the water for drinking. Both techniques are normal practice in Malaysia. A water filter becomes a necessity to obtain better tasting water, as well as preventing disease.

Therefore, SAJH needs to focus on the management side to achieve a world-class standard of water quality. SAJH needs to provide good infrastructure in order to upgrade the service to customers, for example, pipelines, reservoirs, and treatment work, all of which influence the water quality.

9.4 Implications of Perceptions of Service Quality

The perceptions of service quality performance indicate that more than 50% of customers were satisfied with the attributes of the water service. Surprisingly, the most important attribute within the WI group was reservoirs (RES): approximately 79.08%. Water capacity is a crucial factor for the delivery of water to customers' taps. However, it is determined by nature in the rainy and drought seasons. In a drought situation, SAJH needs to ration water to customers because the water capacity is insufficient to provide normal delivery. Thus, the management of SAJH should be more concerned about reservoir capacity to provide sufficient water at all times.

In addition, the lowest percentage within the RC group is water quality: approximately 65.56%. This means that water quality is also the priority attribute that most concerns customers, because people have to consume water regularly to maintain good health. As a result, they use a water filter at home. SAJH need to increase investment to upgrade the water infrastructure, particularly to improve water quality.

9.5 Implications of Perceptions of Improvement of Water Service

The results of customers' perception of strategies for improvement of the water service are very useful in order to determine the most important strategies. In Table 6.5, the strategies are listed as follows:

(i) Encouraging education and awareness about using the water wisely. SAJH staff can also be made aware of problems directly from customers.
(ii) Creating an integrated strategic plan and providing good quality training to all the staff.
(iii) Increasing the funding in order to invest for the future.

Therefore, SAJH should have a strategy to improve service levels to the point where the marginal benefits to customers equals the marginal cost to SAJH in the current investment period. At the same time, they need to identify and implement another strategy for the future.

9.6 Implication of the Choice Experiments Results

There are two groups of water attributes (WI and RC) comprising leakage (LEA), pipe bursts (BUR), reservoir capacity (RES), water quality (QUA), disruptions (DIS), connections (CON), and water pressure (PRE). The findings indicate that BUR is the most important attribute of the WI group.

In order to reduce the incidences of pipe bursts, both the Asset Replacement Department and the Pressure Management Programme conducted pipe replacement activities. The objective of the latter was to install pressure-reducing valves (PRVs) at certain critical positions in the network, in order to lower the number of occurrences of burst pipes. The Network Department within SAJH has now brought down the standard time required to mend a burst from 24 to 18 hours. The NRW Department also collaborates very closely with this department, in order to achieve the NRW level targets by administering the NRW Strategy and Action Plan.

QUA is the most important attribute within the RC group. SAJH concentrates on compliance with the MOH Standards by collecting samples of water at certain points in the system and carrying out tests on chemical, physical and microbiological characteristics. At the time of writing, 29,036 samples had been taken in total, and 234,928 tests had been performed; 99.5% of these achieved MOH Standards. In total, there are 975 sampling points throughout the system; these allow for water quality to be carefully scrutinised, and also permit troubleshooting wherever necessary.

Based on the policies above, SAJH have moved one step ahead in improving the service's condition to achieve customers' preferences and keep improving the service to achieve their vision.

9.7 Policy Implications

The main objective of this study was to assess customers' preferences about, and WTP for, the variety of attributes of water supply and quality, namely leakage (LEA), pipe bursts (BUR), reservoir capacity (RES), water quality (QUA), disruption (DIS), connections (CON), and water pressure (PRE). The environmental economic method used is known as Choice Modelling (CM). This research comprised an analysis of choice of alternatives, and explanatory variables were presented as the attributes of the water service.

The evidence obtained from Chapters 5 to 8 provides a basis for the formulation of water policy. In Chapter 5, the socioeconomic results could be considered as an input to SAJH's Department of Quality Assurance, in order that revolutionary projects are carried out in line with policy supplied by SAJH and SPAN regulations. Simultaneously, this department provides significant facilities, such as the counter for payment and customer service, and also measurement or processes to monitor the standard of the service to valuable customers.

As a result, the information about residential customers' socioeconomic characteristics, customers' experience of attitudes to SAJH, and their perceptions of service quality, is considered meaningful data to SAJH in order to provide excellent services and achieve customer satisfaction. Specifically, in terms of strategy, SAJH needs to upgrade its strategy intensively in the areas of water quality (QUA) and price (PRI). For instance, SAJH management should provide sophisticated instruments to ensure good quality water that achieves 99.7% compliance with MOH Standards when it arrives at the tap; particularly, reservoirs should be monitored and cleaned and old pipes should be replaced to achieve this goal.

Additionally, the monthly water bill forms the main source of SAJH's revenue. Due to having the highest water tariff in Johor, SAJH has to review its tariff to become more competitive among water providers in Malaysia. SPAN is the technical and economic regulatory body for water services in Peninsular Malaysia and the Federal Territory of Labuan and has to consider the procedure of setting the water tariff. SAJH also has to ensure that the customers pay the bill on time. Moreover, the number of residential customers increases from year to year. Therefore, revenue should rise as long as there is effective enforcement to ensure the customers pay their bills. There are several methods of payment, such as payment at the SAJH agent's office located in each district, at the post office, or online. The payment systems and infrastructure need to improve in order to ensure customers' convenience when making a payment at the SAJH counter. Alternatively, SAJH could keep the current water price and increase the charge of other payments, such as the deposit for a new installation or the connection fee. Funding is a very crucial factor for new investment in the areas certain to improve the water service.

SAJH should create an integrated strategic plan consistent with customers' satisfaction and preferences because of their responsibility to fulfill customers' needs.

Staff members are a valuable asset of the company for success in business. Therefore, SAJH should provide training to all the staff in order that they become more friendly towards customers and knowledgeable about the business. This is a very important element in achieving its vision and mission as well as affecting the efficiency of the company. An estimated 97.45% of customers agreed with providing relevant training for staff.

Moreover, a programme of customer-friendly service should be held to encourage education and awareness about using water wisely, for instance. Also in this programme, the management of SAJH would discuss issues and problems directly with valued customers. They would provide the latest information, particularly on recent rules and regulations, and on services provided by the company, through a variety of channels such as electronic media, brochures, flyers, and the company websites. The findings indicate that 96.43% of customers agreed with this strategy.

Furthermore, the results from Chapter 6 and 7 shown that age, number of children, type of house, current work, and income are important factors affecting WTP for the water supply. Water management could use such information to refine and segment the market in order to deliver differentiated service levels at different prices, with benefit to all customers. In other words, customers might be offered different levels of water tariff based on the quality of water service. The segmentation of the market is also important to develop promotions and strategies that focus on customers' preferences and needs. By means of this strategy, the water operator can be customer-focused and achieve success in its water service.

The previous chapters reported that women were more loyal and willing to pay more than men to get a better quality of water service. Moreover, educated respondents were also willing to pay more because they were concerned about water quality influencing individual health. They also have a good attitude towards payment of the water bill because they know about the operation of the water supply.

Additionally, the water attributes, such as leakage (LEA), burst pipe (BUR), reservoir capacity (RES), disruption (DIS), connections (CON), and water pressure (PRE), should also be considered in integrated planning and formulating strategy, because these items are stated in the Customer Charter and Quality Objectives. All these attributes should be integrated in order to contribute to a high quality water service. They also have a positive and strong correlation with the socioeconomic characteristics of customers.

Moreover, this study applied Choice Experiment to measure households' willingness to pay to improve the water management of SAJH in Johor state. The implicit price was estimated as MYR0.514. The annual aggregate WTP was estimated to be MYR20 million. This value is insufficient to pay the full cost of water service improvement. As a result, it is recommended that SAJH should increase the fees for installation, connection and meter testing.

In Chapter 8 the CBA analysis reported that the SAJH projects in 2008 were uneconomic. As a result, SAJH's management must seek to increase the funding which could increase the capital for a new project. Alternatively, SAJH also can obtain financing from the federal government for the development of the water infrastructure. Furthermore, government has also reformed the obligation to invest in and develop new water infrastructure in Peninsular Malaysia, which has become the responsibility of the asset holding company, PAAB. PAAB is financed by using an initial equity contribution from the federal government and lease payments that are received from state water companies. PAAB is incorporated into the strategy of taking over both assets and debts from the state water companies. It can be required to contract debt at commercial rates in the capital market, obtaining favourable rates because of guarantees by the federal government (PAAB, n.d).

In principle, all companies need the capital to run the business. Therefore, the water provider needs to improve its cost recovery. This is because of the importance of sufficient capital for new projects to upgrade and enhance the water service in order to fulfill the customers' expectations. Additionally, SAJH should conduct market research and determine the WTP in assessing the financial viability of future investment programmes, and CBA appraisals of future developments and upgrades to the water supply system. There is also an equity issue: CBA is usually based on mean WTP, but median WTP might be much lower. This raises questions about lower-income households' ability to pay.

In order to support the accuracy of the results of the current CM findings, other methods of natural resource valuation, such as TCM and CVM, may be conducted. Interestingly, CM presents detailed information about customers' preferences and their WTP for different water attributes. This data is crucial for water providers to deliver a water service at a reasonable price, based on the customer's demand. The assessment of customers' preferences towards the SAJH water attributes is very important to the policymaker to ensure that water resources are managed efficiently and sustainably.

CHAPTER 10: CONCLUSIONS

10.1 Introduction

This chapter provides a summary of the thesis on the issue of water demand in Malaysia. This research has been carried out because of two objectives. The first is to estimate the economic value of the service provided by SAJH. The method applied was Choice Experiments (CE). The calculation of willingness to pay (WTP) has been done to estimate residential consumers' WTP for upgrades to the level of service. The second is also to expand the research use of the economic method in the valuation of non-market goods, particularly in water resource management. Some suggestions for future research are also discussed.

10.2 Summary of the Thesis

The initial chapters of this study were an overview of water management in Malaysia. The study concentrated on the current situation and issues that have been experienced by the water companies. The literature reviews on environmental valuation and economic theories related to valuation and non-market valuation methods were then discussed. It also presented the Choice Modelling (CM) methods which have been applied in environmental economics, particularly in water resource management, as well as factors which influence WTP and CBA analysis. This research focused on Syarikat Air Johor Holdings (SAJH) as the area of study, particularly on the customers' preferences for water attributes in three districts, namely Johor Bahru, Batu Pahat and Kluang. The research design and the methodology employed were also reported.

Furthermore, in order to achieve the main purpose of this research, the research questions need to be restated and answered. The research questions are listed below:

1. What do residential customers experience in terms of the service quality provided by SAJH?
2. What are customers' perceptions of SAJH's current preferences and choices of service factors/attributes in order to improve the quality of service?
3. What do customers perceive the current service performance to be according to the service factors?
4. What can be done to deliver a better service from source to tap?

The answers for questions 1, 3, and 4 have been detailed in descriptive analysis in Chapter 5. Furthermore, the findings for question 2 have been explained in Chapters 6 and 7. Choice experiments (CE) were conducted, consisting of CL and MXL, using the basic model, incorporation of levels, and interaction with socioeconomic characteristics such as gender, age, number of children, number of persons in the household, education, work and income.

Chapter 1 presented the background of the research. It focused on the problem statement and the objectives, as well as the significance of the research. An overview of water management in Malaysia was described. In 2005, the water services industry was restricted with the introduction of two new water-related measures: the Water Industry Services Act (WSIA) and the National Water Service Commission (SPAN). The main effect was that the federal government took over control of the water industry from the states, which, however, retain powers to determine and regulate water resources including catchment areas, water sources and river basins. The main purpose of this study was to assess customers' preferences from a variety of water service attributes; the findings then become a very important indicator for the upgrading of the level of water service in Malaysia.

Chapter 2 reviewed the literature on non-market valuation methods, Choice Modelling (CM), consisting of Choice Experiments (CE), paired comparisons, contingent ranking, and contingent rating. The overview of economic valuation work in Malaysia and the implementation of choice experiments for assessing the water supply and non-market goods were discussed. It also presented the factors affecting WTP for water services as well as Cost Benefit Analysis (CBA).

Following this, Chapter 3 described the study. It focused on detailed information about Johor state and the management of SAJH, which is an integrated water supply company in Johor state. It is involved in the all the processes of drinking water supply; these range from raw water acquisition, treatment and purification, and the subsequent distribution of purified water to customers, plus billing and payment collection. An appraisal of SAJH was also presented, based on the customer perception study in 2007 and 2008, which focused on service quality and the Customer Charter. SAJH also has a well structured organisation in place in order to deliver water effectively and efficiently. The water treatment and processes were discussed.

The research methods and procedures were explained in Chapter 4. The first topic covered was the properties of a discrete choice model and the specification of Conditional Logit (CL) and Mixed Logit (MXL) models were also explained. The methodology applied for this study was CE, to measure customers' WTP to improve the water supply for residential customers in Malaysia, particularly in Johor state. The stages of CE were explained. There are five stages, consisting of selecting attributes, determining levels, choosing experimental design, constructing choice sets, and measuring preferences. The most important stages in CE are experimental design and questionnaire construction. The focus group was selected from SAJH staff and residential customers in each district. The pilot test was successfully conducted, which resulted in some changes to the questionnaire in order to be more systematic, better organised, and better understood by respondents.

The result of the CE design was that the attributes were divided into two groups; namely Water Infrastructure (WI) and Residential Customers (RC). The first group consisted of leakage (LEA), pipe bursts (BUR), and reservoir capacity (RES), whilst the second group comprised water quality (QUA), water service disruptions (DIS), water service connections (CON), and water pressure (PRE). Face-to-face interviews were the method used to collect the data.

The descriptive analysis was presented in Chapter 5. This described the full picture of customers' profiles and their socioeconomic characteristics, followed by customers' experience with and attitudes to SAJH, its service performance and efficiency. Cross tabulation and correlation analysis was also conducted concerning customers' perception of service quality performance, improvement of water service, and improvement of strategies.

The choice experiment results were shown in Chapter 6. This chapter provided the impact of the findings to improve water resource management, particularly in SAJH, and to deliver better service to residential customers. Specifically, the CL results were presented to demonstrate customers' preferences within the water service. Three models were analysed, namely the basic model, the model incorporating levels and the interaction model. For the basic model, the CL results were shown to be insignificant. The overall McFadden values were good. In order to proceed to the model incorporating levels and the interaction model, data was recoded to dummy variables (1 and 0). The respondents' socioeconomic characteristics were included to improve the model fit.

Chapter 7 presented the MXL models for WI and RC. It began with analysis of the basic MXL model and this was followed by that of the interaction MXL model. Then, the market share estimation of the mean and standard deviation of distribution of each test parameter was calculated, to determine the proportion of respondents who favoured or did not favour each variable.

Chapter 8 reported on Cost Benefit Analysis (CBA) results. It described the steps to conduct the CBA of water supply service, the CBA formula and the implementation of CBA in SAJH projects or investments to determine whether projects are economic or uneconomic.

Chapter 9 focused on the implications of the results of this research. The results of this study will play a crucial role for relevant agencies in order to implement effective water management policies, and particularly for SAJH to achieve excellence as a water supply operator, by determining the aspects that need to be improved to deliver clean and safe water to customers. It would then become a model for other water operators in Malaysia.

Conclusions are presented in Chapter 10. This section reviews all aspects in this research from beginning to end. It starts with the introduction, follows this with a summary of the thesis, the benefits of this research, the difficulties encountered and improvements that could be made to the research. The limitations to the research are also explained, as well as suggestions for future research of economic valuation.

10.3 Conclusion of the Choice Experiments Study

This research employs CL and MXL for estimation of water resource attributes. The two groups of attributes are Water infrastructure (WI) and Residential Customers (RC). WI comprises leakage (LEA), pipe bursts (BUR), and reservoir capacity (RES). RC consists of water quality (QUA), service disruptions (DIS), service connections (CON), and water pressure (PRE).

For Choice 1 (WI), the results of the basic CL, which includes non-linear terms such as LEA2, demonstrate that LEA, BUR, and PRI have the correct sign and are significant at the 1% level. Additionally, the interaction results reveal that LEA and BUR have a relationship with the number of children in the household and the type of house. RES has interaction with age and number of children. Furthermore, PRI has a relationship with the number of persons in the household, education level, type of work, and income.

Moreover, for Choice 2 (RC), the basic CL model also includes the non-linear term DIS2. The results show that DIS, CON and PRI have the correct sign as expected *a priori*. Both CON and PRI are highly significant at the 1% level. However, DIS and PRE are significant at the 5% level. The interaction results demonstrate that QUA, DIS, CON and PRE have a relationship with gender and age. PRI has interaction with the number of persons in the household and income.

In terms of the basic CL model incorporating levels (WI), LEA2, BUR2, BUR3 and PRI have the correct sign and are statistically significant at the 1% level, and LEA1 is significant at the 5% level. This indicates that customers preferred to see improvements in the level of service. LEA has interaction with the number of children, and type of house. BUR and RES have interaction with the level of education and type of work.

Furthermore, in Choice 2 (RC), the results show that only DIS1, DIS2 and PRI have the correct sign as expected *a priori*. DIS1 and DIS2 are statistically significant at the 5% and 1% levels respectively. In terms of the interactions within the CL model incorporating levels, QUA has interaction with gender, number of children, type of work, and level of education. DIS has interaction with age, and income level. Furthermore, PRE also has interaction with gender, level of education, number of children and type of house.

The MWTP of BUR is the highest value estimated: MYR0.065 for each percentage point of improvement in repairing pipe bursts within 24 hours. This indicates that BUR is the most important attribute within WI. Therefore, SAJH must concentrate on this issue to achieve better service to residential customers. Moreover, QUA is the crucial attribute within RC, meaning that customers are most concerned about water quality. Consequently, SAJH need to monitor the water quality against the standard to ensure its safety, particularly for drinking.

However, in the model incorporating levels, RES has become the most important attribute within WI. This indicates that customers focus more on the reservoir capacity either in the rainy or the drought seasons. SAJH need to control and monitor capacity to ensure there is sufficient water at all times. Moreover, PRE has been determined as the most important of the RC attributes. This result demonstrates that customers need to have good water pressure to achieve their daily activities. Therefore, SAJH has to monitor water pressure, particularly in the highlands.

In summary: for the CL model, there are four important attributes which have been identified, namely BUR, RES, QUA, and PRE. In order to achieve an excellent water supply service, SAJH need to concentrate on these attributes when implementing relevant policy to upgrade or improve the service.

Furthermore, the MXL results are described in Chapter 7. The normal distribution was considered because the other distributions were insignificant. However, the results for both groups (WI and RC) seemed to be worse than those for the CL model. The estimated models showed a small improvement in the McFadden values.

The results show that BUR and PRI have the correct signs as expected *a priori* and are highly significant in the basic MXL (WI). Meanwhile, the results of the basic MXL (RC) indicate that only PRI has the correct sign and is highly statistically significant.
The interaction results of WI demonstrate that LEA has interaction with the number of children and type of house. Moreover, BUR has interaction between number of children and type of house. RES has a relationship with age; meanwhile, PRI has a relationship with the number of persons in the household, type of work, and income.

The interaction results show that QUA has a relationship with gender and age. DIS has a relationship with gender and age as well. Meanwhile, CON just has a relationship with gender. Moreover, PRE has interaction with gender and age.

By applying MXL when estimating customers' preferences allows for variation in their preferences. The findings show that there is only a small improvement in explanatory power and the standard deviation of random parameter distributions does not compare efficiently with the CL model. However, they still show the heterogeneity of preferences among customers. It can be concluded that these models have a lower explanatory power than the CL model. As a result, all the standard deviations of parameter distributions are highly insignificant at all levels.

The results of the MXL model are seen to be worse than those of the CL model. As a result, an alternative model such as the Latent Class Model (LC) should be used. It is a better model of random heterogeneity through segmentation, by e.g. gender, income level, etc. By using this model, the results could be improved. Recently, this method has been used widely in economic valuation.

In general, the main determining factor of the WTP for water improvement was education level. This factor was also identified in similar studies of water demand conducted by World Bank (1993), Whittington et al. (1990), Kaliba et al. (2003), Farolfi et al. (2006), Mbata (2006), Alaba (2001), Kayaga et al. (2003) and Pattanayak et al. (2006). These studies revealed that highly educated respondents were willing to pay more for improved water supply because their perceived of a good quality of water.

Meanwhile, the type of the respondents' work also influences their WTP for water improvement. The studies from the World Bank (1993) and Kayaga et al. (2003) showed similar results. The results in this study of the age factor influencing the WTP are similar to the research of Farolfi et al. (2006). However, the findings in this study are inconsistent with those of Davis (2004) because customers preferred to use the traditional type of water source. The income factor also determined the WTP, with a similar outcome to Alaba (2001), Kayaga et al. (2003) and World Bank (1993), and the gender factor showed parallels with the study by Kayaga et al. (2003). However, there were results contradicting previous studies in the literature, regarding number of persons in the household, and number of children.

In order to determine the viability of the SAJH project, CBA has been conducted. The results of the CBA show that the project is not viable at present. This has similarities to the study of Poirier and Fleuret (2010), who applied CE to discover the preferences of respondents in France regarding water quality management. The study used two models: conditional logit and random parameter logit. The results demonstrated that residents were willing to pay for improvements in water quality. However, the project revealed to be unviable by the CBA, as the costs significantly outweighed the advantages deriving from the achievement of good ecological status; indeed, they could be deemed out of proportion. The achievement of such a status in a particular basin could be a benefit overall, but a long period would be needed to recover the capital invested in the projects required. CBA is the best method to identify future projects.

10.4 Potential Improvement Areas

10.4.1 New Approach of Attributes and Levels

In this study, most of the attributes and levels concentrate on the quantitative approach. The most important suggestion in this area is to employ both qualitative and quantitative approaches, in order to obtain a truer picture and make it easier for respondents to determine their preferences for each of the attributes. For instance, a picture presentation using computer graphics could be applied, in order to be more attractive to respondents and to aid easy understanding. Furthermore, while conducting personal interviews as part of the fieldwork, the enumerator could use a laptop to present a colourful view of the questionnaire, particularly with regard to the respondent's preference of choice card.

10.4.2 Increase the Number of Attributes

Currently, this research focuses on WI and RC, consisting of leakage, pipe bursts, reservoir capacity, water quality, service connections, service disruptions and water pressure. This is because, in the CL basic model, there are few attributes which have the correct sign and are significant. The majority of the attributes have an incorrect sign and are insignificant. However, those models become much improved when there is interaction between the main attributes and the socioeconomic characteristics. In future research, new attributes or aspects such as productive use, sources of water, age of meters and length of pipelines could be included, in order to find other crucial factors within water management in Malaysia. A focus group should be organised properly to determine accurate attributes and levels within the field of study.

10.4.3 Increase the Number of Water Operators

In the future, studies that involve different water providers will exhibit different attributes and levels. Therefore, a suitable focus group between water operators as well as stakeholders should determine appropriate attributes and levels. By using this method, detailed information can be provided to achieve better results, which will be more statistically significant.

In Malaysia, water providers are controlled by SPAN as a technical and economic regulator. Therefore, water providers must follow the rules and regulations in order to carry out water supply operations. For instance, the most important example in this study is the price or monthly bill; water operators cannot make a decision to change the price immediately without getting approval from SPAN. Therefore, in the future, SPAN should cooperate in management and make effective decisions in a shorter timeframe.

10.4.4 Improvement of the Questionnaire Design

The application of CE is new in Malaysia. Therefore, the researcher should present the questionnaire clearly and attractively, particularly in the respondents' preference section which includes the attributes and levels, in order to be lucid and not confusing. The respondents need to choose their highest preference. The information on water supply, choice experiment methods and choice are very important in order to ensure data reliability and significant results. This could also reduce the complexity of CE and potential biases when conducting future CE studies in Malaysia.

10.5 Suggestions for Future Research

Focusing on particular topics in the study of water service improvement could be a good option; for instance, by concentrating on the issue of water quality for drinking, this might include perceptions concerning the acceptability of drinking water, to analyse the customers' preferences and the effects on health.

Moreover, this study is the first attempt to employ CE in assessing water management in Malaysia. It provides detailed information about customers' preferences and WTP for different characteristics of the water service. This is a crucial study for water providers who may wish to replace or upgrade their machinery or other equipment, or install new machinery, in order to safeguard the health of the public by supplying drinking water that is safe. Therefore, this technique is capable of being extended to other water operators by using different attributes and levels. Moreover, other methods of Choice Modelling (CM) should be applied, such as Contingent Ranking (CR), Contingent Rating (CRt) and Paired Comparison (PC). These findings from a variety of methods could be compared to achieve better results and assist policymakers in implementing the right policy to achieve the sustainability of natural resources.

10.6 Closing Remarks

This research allows proposals for future water policy to be prepared concerning various aspects of management; for example, NRW, water quality and water infrastructure, which would include pipe bursts, reservoir capacity and leakage. The approach utilised by this research could be usefully employed by other water suppliers so that the objectives of Vision 2020 (the achievement of developed-nation status) would be fulfilled; Malaysia would thereby manage and protect its water supplies to guarantee a sufficient quantity of safe water for all users and for the environment.

REFERENCES

Abou-Ali H. and Carlsson F. (2004). Evaluating the Welfare Effects of Improved Water Quality Using the Choice Experiment Method. Working Papers in Economics, Vol. 131. Department of Economics, Goteborg University

Accent Marketing & Research and Centre for Research in Environmental Appraisal & Management (CREAM), (2000). Yorkshire Water Services, Final Report, Prepared for Yorkshire Water, November.

Adamowicz, J. Swait, J., Louviere, J. and Williams, M. (1997). Perceptions versus Objective Measures of Environmental Quality in Combined Revealed and Stated Preference Models of Environmental Valuation. Journal of Environmental Economics and Management, **32**(1): 65-84

Adamowicz, W., Boxall, P., Williams, M., and Louviere, J.(1998a). Stated Preference Approaches for Measuring Passive Use Values: Choice Experiments and Contingent Valuation. American Journal of Agricultural Economics, **80** (1): 64-75

Adamowicz, W., P. Boxall, et al., (1995). Stated Preference Approaches for Measuring Passive Use Values: Choice Experiments Versus Contingent Valuation. Edmonton, Canada, Department of Rural Economics, University of Alberta.

Adamowicz, W., Louviere, J. and Swait, J. (1998b). Introduction to Attribute-Based Stated Choice Methods, Final Report submitted to: Resource Valuation Branch, Damage Assessment Centre NOAA (National Oceanic and Atmospheric Administration, US Department of Commerce)

Adamowicz, W.L., Louviere, J.J. and Williams, M. (1994). Combining Revealed and Stated Preference Methods for Valuing Environmental Amenities. Journal of Environmental Economics and Management, **26** (3): 271-292

Adenike, A. A. and Titus, O.B. (2009). Determinants of Willingness to Pay for Improved Water Supply in Osogbo Metropolis, Osun State, Nigeria. Research Journal of Social Sciences **4**: 1- 6

Afizah, M. and Siti Baizura, J. Z. (2006). The Economics of Recreational Park Conservation: A Case Study of Bako National Park. Staff Paper 4, Universiti Putra Malaysia

Alaba O.A. (2001) Economics of Water, Health and Households' Labour Market Participation, A final report presented at the workshop of African Economic Research Consortium (AERC), in Nairobi-Kenya.

Alaba O.A. and O. B. Alaba (2002), Determinants of Demand for Infrastructure in Rural and Urban Nigeria Presented at the WIDER/CSAE, Oxford UK

Altaf, M.A., Whinttington, D., Jamal, H., Kerry, V.K., (1993). Rethinking Rural Water Supply Policy in Punjab, Pakistan. Water Resources Research **29** (7), 1943-1954

References

Alberini, A., Longo, A., Tonin, S., Trombetta, F. and Turvani, M. (2005). The Role of Liability, Regulation and Economic Incentives in Brownfield Remediation and Redevelopment: Evidence from Surveys of Developers. Regional Science and Urban Economics **35**: 327-351

Alias, R. and Ruhana, B. (2003). Consumer Perception and Willingness to Pay Towards Facilities in Malaysian Agro Park, Bukit Cahaya Shah Alam, Selangor. In Ishak et al (eds) Seminar FEP 2001 Proceedings in Hospitality and Recreation, Faculty of Economic and Management, Universiti Putra Malaysia: 41-52

Alias, R., Shazali, A. M., Abas, S., Afizah, M. (2002). Wilingness of Local Tourists to Pay for Conservation of Tourism Sports in the Damai District Sarawak. ASEAN Journal on Hospitality and Tourism **1**: 53-63

Alpizar, F., Carlsson, F., and Martinsson, P. (2001). Using Choice Experiments for Non-Market Valuation. Working Papers in Economics, No. 52. Department of Economics, Goteborg University

Alvarez-Farizo, B. and Hanley, N. (2002). Using Conjoint Analysis to Quantify Public Preferences over the Environmental Impacts of Wind Farms. An Example from Spain. Energy Policy, **30** (2): 107-116

Amigues, J., Boulatoff, C., Desaigues, B., Gauthier, C., Keith, J. E. (2002). The Benefits and Costs of Riparian Analysis Habitat Preservation: A Willingness to Accept/Willingness to Pay Contingent Valuation Approach. Ecological Economics, **43**: 17-31

AS Badrul Hisham, MI Marzukhi, AR Daud (2009). The Worst Flood In 100 Years : Johore Experience. Malaysian Journal of Community Health. Issue Vol **15**(S)

Asthana, A.N. (1997). Household Choice of Water Supply Systems, in Water and Sanitation for All. Proceedings of the 23rd WEDC Conference, edited by J.Pickford, pp.259-262, Water, Eng. and Dev. Cent., Loughborough University, Loughborough, UK

Astrid D. A. M. Kemperman, Aloys W. J. Borgers, Harmen Oppewal, Harry J. P. Timmermans (2000). Consumer Choice of Theme Parks: A Conjoint Choice Model of Seasonality Effects and Variety Seeking Behavior. Leisure Sciences: An Interdisciplinary Journal, 22 (1): 1-18

Atkinson, G., Healey, A. and Mourato, S. (2005). Valuing the Costs of Violent Crime: A Stated Preference Approach. Oxford Economic Papers, **57**: 559-585

Baffoe-Bonnie, B. et. al (2008). Framework for Operational Cost Benefit Analysis in Water Supply. TECHNEAU (Integrated Project Funded by the European Commission)

Baffoe-Bonnie, B., Harle, T., Glennie, E., Dillon, G., Sjøvold, F., (2008).Framework for Operational Cost Benefit Analysis in Water Supply, http://www.techneau.org/fileadmin/files/Publications/Publications/Deliverables/D5.1.2.frame.pdf retrieved on 3 Feb 2012

Banda, B., Farolfi, S., Hassan, R. (2004). Determinants of Quality and Quantity Values of Water for Domestic Uses in the Steelpoort Sub-Basin: A Contingent Valuation Approach. Proceedings of the Conference : Water Management for Local Development, Loskop Dam, 8-11 November

Bateman, I. and Willis, K. G. (1999). Valuing Environmental Preferences. Oxford University Press

Bateman, I., Carson, et. al. (2002). Economic Valuation with Stated Preference Technique, Edward Elgar.

Bateman, I., Carson, R., Day, B., Hanemann, W.M., Hanley, N., Hett, T, et al. (2003). Guidelines for the Use of Stated Preference Techniques for the Valuation of Preferences for Non-Market Goods. Cheltenham: Edward Elgar.

Bateman, I.,J., Carson, R.T., Day, B., Hanemann, M., Hanley, N., Hett, T., Jones-Lee, M., Loomes, G., Mourato, S., Ozdemiroglu, E., Pearce, D. W., Sugden, R., and Swanson, J. (2002). Economic Valuation with Stated Preference Techniques: A Manual. Cheltenham: Edward Elgar

Bateman, I.J. and K.G.Willis (1999). Contingent Valuation of Environmental Preference: Assessing Theory and Practice in the USA, Europe, and Developing Countries. Oxford University Press

Bateman, J., Carson, R.T, et al. (2002). Economic Valuation with Stated Preference Techniques: A Manual. Edward Elgar.

Batsell, R. R. and Louviere, J.J. (1991). Experimental Choice Analysis. Marketing Letters 2. 199-214

Beggs, S., Cardell, S. and Hausman, J. (1981). Assessing the Potential Demand for Electrical Cars. Journal of Econometrics, **16**: 1-19

Ben-Akiva M., Lerman S. (1985). Discrete Choice Analysis, The MIT Press, Cambridge Massachusetts.

Ben-Akiva, M., D. McFadden, T. Garling, D. Gopinath, J. Walker, D. Bolduc, A. Borsch-Supan, P.Delquie, O. Larichev, T. Morikawa, A. Polydoropoulou and V. Rao (1999a). Extended Framework for Modelling Choice Behavior. Marketing Letters **10** (3):187-203

Ben-Akiva, M. E. and M. Bierlaire (1999b). Discrete Choice Methods and Their Applications to Short-Term Travel Decisions, In R. Hall (Hg.) *Handbook of Transportation Science*, 5-34, Kluwer, Dordrecht.

Bennett, J. and Blamey, R. (2001). The CM Approach to Environmental Valuation. Edward Elgar Publishing, Cheltenham, UK.

Bennett, J. and Vic Adamowicz (1999). Some Fundamentals of Environmental Choice Modelling. In Bennett, J and Blamey, R. The Choice Modelling Approach to Environmental Valuation. Edward Elgar

Bennett, J., and Morrison, M. (2001). Valuing the Environmental Attributes of NSW Rivers. Draft Report Prepared for the NSW Environment Protection Authority

Bennett, J., Morrison, M. and Harvey, R. (2000). A River Somewhere-Valuing the Environmental Attributes of Rivers. Paper Presented at the International Society for Ecological Economics 2000 Conference, Australia National University, Canberra, 5-8 July

Bergmann, A., Hanley, N. and Wright, R. (2006). Valuing the Attributes of Renewable Energy Investments. Energy Policy, **34**: 1004-1014

Bhat, C., (2001). Quasi-random Maximum Simulated Likelihood Estimation of the Mixed Multinomial Logit Model. Transportation Research, **35**, Part B 17 (1): 677-693.

Birol, E., Karousakis, K. and Koundouri, P. (2006). Using Economic Valuation Techniques to Inform Water Resources Management: A Survey and Critical Appraisal of Available Techniques and an Application. Journal of Science of the Total Environment, **365**: 105-122

Blamey, R., Gardon, J. and Chapman, R. (1999). Choice Modelling: Assessing the Environmental Values of Water Supply Options. The Australian Journal of Agricultural and Resource Economics, **43** (3): 337-357

Bohm, R.A., Essenburg, T.J., Fox, W.F., (1993). Sustainability of Potable Water Services in the Philippines. Water Resources Research **29** (7), 1955-1963

Bouguerra, L. (1997) Foreword on Water Resources in the 21st Century. In Chan N W (Editor) Proceedings of the International Conference Meeting Water Challenges in the 21st Century. Water Mobilising Programme of the Alliance for a Responsible and United World, Paris, i-ii

Boxall, P., W. Adamowicz, M. Williams, J. Swait, and J. Louviere. (1996). A Comparison of Stated Preference Approaches to the Measurement of Environmental Values. Ecological Economics, **18**: 243-253.

Briscoe, J., Paulo, F. de C., Charles, G., James, N., and Orjan, O. (1990). Toward Equitable and Sustainable Rural Water Supplies: A Contingent Valuation Study in Brazil. World Bank Economic Review **4**:115–34

Brownstone, D., and Train, *K. (1996).* Forecasting New Product Penetration *with* Flexible Substitution Patterns. Journal of Econometrics, Vol. **89**, No. 1-2: 109-129 **.**

Buckland, S. T., Macmilla, D. C., Duff, E. I., Hanley, N. (1999). Estimating Mean Willingness to Pay from Dichotomous Choice Contingent Valuation Studies. The Statistician **48**: 109-124

Bueren, M. and Bennett, J. (2004). Towards the Development of a Transferable Set of Value Estimates for Environmental Attributes. The Australian Journal of Agricultural and Resource Economics, **48** (1): 1-32

Bunch, D.S, Louviere, Jordon J, Anderson, Donald A, (1996) A Comparison of Experimental Design Strategies for Multinomial Logit Models: The Case of

Generic Attributes. Working Paper, Graduate School of Management, University of California, Davis, CA

Burton, M., Marsh, S. and Patterson, J. (2007). Community Attitudes Towards Water Management in the Moore Catchment, Western Australia. Agricultural Systems **92**: 157-178

Carlsson, F., Frykblom, P. and Liljenstolpe, C. (2003). Valuing Wetland Attributes: An Application of Choice Experiments. Journal of Ecology Economics, **47**: 95-103

Carson, R.T. and Mitchell, R.C.(1993), The Issue of Scope in Contingent Valuation Studies. American Journal of Agricultural Economics, **75**: 1263-1267.

Carson et al. (1994). Experimental Analysis of Choice. Marketing Letters. 351-368.

Centre for International Economics (CIE)(2001). Review of Willingness-To-Pay Methodologies. Report Prepared for Independent Pricing and Regulatory Tribunal of NSW.

Chan, N. W. (2001). Water Resources Management in Malaysia: NGO Perspectives. http://www.waterwatchpenang.org/upload_files/12/Water%20Resources%20Management%20in%20Malaysia-NGO%20Perspectives.pdf, retrieved on 12 March 2007

Cho and Kim (2004). The Cost-Benefit Analysis of the Improvement of Water Quality of the Paldang Reservoir in Korea. American Agricultural Economics Association Meetings in Denver Colorado

Cho, Y., Easter, W., McCann, L.M.J. and Homans, F. (2005). Are Rural Residents Willing to Pay Enough to Improve Drinking Water Quality? Journal of the American Water Resources Association **41**(3): 729-740

Choe K, Whittington D, Lauria D. (1996). The Economic Benefits of Surface Water Quality Improvements in Developing Countries: A Case Study of Davao, Philippines. Land Economics, 72(4): 519–37.

Company Profile, http://www.saj.com.my/Content.php?menu_parent_id=1&content_id=1, retrieved 2 May 2008

Cooper, B., Crase, L. and Dollery, B. (2006). Using Choice Modelling to Reveal Waste Water Preferences in Regional Victoria. Desalination, 188: 31-41

Corporate Info - SAJ Holdings (2008). www.saj.com.my/Content.php?menu_parent_id=1&content_id=1, retrieved 2 May 2008

Cosgrove W.J. and F. R. Rijsberman (2000). World Water Vision: Making Water Everybody's Business. Earthscan, London.

Dahlberg, Matz and Eklöf, Matias, (2003). Relaxing the IIA Assumption in Locational Choice Models: A Comparison Between Conditional Logit, Mixed Logit, and

Multinomial Probit Models, Working Paper Series 2003:9, Uppsala University, Department of Economics.

DANIDA-CEMD Project on Multilateral Environmental Agreement: Capacity Building and Implementation. (2005). The Use of Economic Valuation in Connection with the Implementation on Green MEAs. Draft Final Report

Davis, R. (1963). The Value of Outdoor Recreation: An Economic Study of the Maine Woods. Unpublished Ph.D. dissertation, Department of Economics, Harvard University

Davis, J. (2004). Assessing Community Preferences for Development Projects: Are Willingness to Pay Studies Robust to Mode Effects? World Development , **32** (4): 655-672

Department of Environment (2007). Malaysia Environmental Quality Report. http://www.doe.gov.my/dmdocuments/publications/eqr%2005%20n%2006%20%20pdf/EQR%202006.pdf retrieved on 20 March 2008

Department of Statistics, Malaysia (2000) *Census 2000*. Putrajaya, Malaysia: Department of Statistics.

Desvousges, W.H., Frey, J.H. (1989) Integrating Focus Groups and Surveys: Examples from Environmental Risk Studies. Journal of Official Statistics 5(4): 349-363.

Desvousges, W. H., Johnson, F.R., Ruby, M.C., Gable, A. R. (1997). Valuing Stated Preferences for Health Benefits of Improved Air Quality: Results of a Pilot Study. TER General Working Paper No. T-9702

Desvousges, W.H., Smith, V.K., Fisher, A., (1987). Option Price Estimates for Water Quality Improvements: A Contingent Valuation Study for the Monongahela River. Journal of Environmental Economics and Management, **14** (3): 248–267.

Earnhart D. (2001). Combining Revealed and Stated Preference Methods to Value Environmental Amenities at Residential Locations. Journal of Land Economics, **77** (1):12-29

Echenique M., Seshagiri R. (2009). Attribute-based Willingness to Pay for Improved Water Services: A Developing Country Application. Environment and Planning B: Planning and Design **36**(3): 384 – 397

Eighth Malaysia Plan 2001- 2005 (2001). Kuala Lumpur: Percetakan Nasional Malaysia Berhad

Ewing, G. O. and Sarigoollu, E. (1998). Car Fuel-type Choice under Travel Demand Management and Economic Incentives. Transportation Research **3** (6): 429-444

Farolfi, S, Mabugu. R. E., Ntshingila. (2006). Domestic Water Uses and Values in Swaziland: A Contingent Valuation Analysis. Agrecon.

Frauendorfer, R. and R. Liemberger (2010). *The Issues and Challenges of Reducing Non-Revenue Water*. Mandaluyong City, Philippines: Asian Development Bank

Freeman, A. M. (2003). The Measurement of Environmental and Resources Values: Theory and Method. 2nd ed. Resources for the Future. Washington DC

Gan, C., and E.J. Luzar. *(*1993). *A Conjoint* Analysis of Waterfowl Hunting in Louisiana. Journal of Agricultural and Applied Economics, **25** (2):36-45

Garrod, G. and Willis, KG. (1999). Economic Valuation of the Environment: Methods and Case Study. Edward Elgar.

Garrod, G. D. and Willis, K.G. (1998). Estimating Lost Amenity Due to Landfill Waste Disposal. Resource, Conservation and Recycling **22**: 83-95

Garrod, G. D., Scarpa, R. and Willis, K.G. (2002). Estimating the Benefits of Traffic Calming on Through Routes: A Choice Experiment Approach. Journal of Transport Economics and Policy, **36**: 211-231

Georgiou, S., Bateman, I., Cole, M., Hadley, D., (2000). Contingent Ranking and Valuation of Water Quality Improvements. CSERGE Discussion Paper 2000-18. University of East Anglia.

Goett, D., Hudson,K. and, Train, K. (2000). Customers' Choice Among Retail Energy Suppliers: The Willingness to Pay for Service Attributes. The Energy Journal, **21** (4): 1-28.

Gordon, J., Chapman, R. and Blamey, R. (2001). Assessing the Options for the Canberra Water Supply: An Application of Choice Modelling, in Bennett, J. and Blamey, R. (eds). The Choice Modelling Approach to Environmental Evaluation. Edward Elgar, Cheltenham.

Government of Malaysia/JICA, (1982). National Water Resources Study, Malaysia, Sectoral Report, Volume 18

Green, W. (2000). Econometrics Analysis. Prentice Hall. New York

Gujarati, D. (1998). Basic Econometrics. McGraw-Hill, Singapore.

Haab, T. C. and McConnell, K.E. (2002). Valuing Environmental and Natural Resources: The Econometrics of Non-Market Valuation. Edward Elgar Publishing Limited. United Kingdom

Hai, E. C. (2008). Delivering Efficiency in Johor's Water Supply. Asia Water 2008. Kuala Lumpur Convention Centre Putrajaya, 1- 3 April 2008

Haider, W., and H. Rasid (2002). Eliciting Public Preference for Municipal Water Supply Option. Environmental Impact Assessment Review, **22**: 337-360

Hajivassiliou, V.A. and Ruud, *P.A. (*1994*)* Classical Estimation Methods for LDV Models Using Simulation**.** In *Handbook* of *Econometrics*, (*eds) R.F. Engle* and D.L. *McFadden*. *Vol. 4*: 2384-2441.

Hammack J. and G. Brown (1974), Waterfowl and Wetlands: Towards Bioeconomic Analysis. Baltimore: John Hopkins University Press.

Hanemann W.M (1984). Welfare Evaluation in Contingent Evaluation Experiments with Discrete Response. American Journal of Agricultural Economics, **66**: 332-41

Hanley, N. (2001).A Benefits Analysis of the Impacts of Water Framework Directive for Scotland. A report prepared for the Scottish Executive. University of Glasgow and University of Dundee.

Hanley N., Bell D, and Alvarez-Farizo, B (2003). Valuing the Benefits of Coastal Water Quality Improvements Using Contingent and Real Behaviour. Journal of Environmental and Resource Economics, **24**: 273-285

Hanley, N. and G. Koop, et al. (2001). Go Climb a Mountain. Journal of Agricultural Economics, **52** (1):36-51

Hanley, N., Adamowicz, V., Wright, R. E. (2002). Do Choice Experiments Pass the Scope Test? A Test of Scope in a Choice Experiment Examining the Benefits of Water Quality Improvements. EAERE/AERE World Congress, Monterey.

Hanley, N., Colombo, S., Tinch D., Black A. and Aftab, A. (2006). Estimating the Benefits of Water Quality Improvements Under the Water Framework Directive: Are Benefits Transferable? European Review of Agricultural Economics, **33** (3): 391-413

Hanley, N., Mourato, S. and Wright, R. E. (2001), Choice Modelling Approaches: A Superior Alternative for Environmental Valuation? Journal of Economic Surveys, **15**: 435–462.

Hanley, N., Wright R.E. and Adamowicz W.L. (1998). Using Choice Experiments to Value the Environmental. Journal of Environmental and Resource Economics, **11**(3-4): 413-428

Hanley, N., Wright, R. E. (1997). Using Choice Experiments to Value the Environment. Journal of Environment and Resource Economics, **11** (3-4):413-428

Hanley, N., Wright, R.E., and Koop, G. (2002). Modelling Recreation Demand Using Choice Experiments: Climbing in Scotland. Journal of Environmental and Resource Economics, **22** (3): 449-466

Hausman, J. A, Wise, D.A, (1978), A Conditional Probit Model for Qualitative Choice: Discrete Decisions Recognizing Interdependence and Heterogeneous Preferences, Econometrica, Vol. **46** (2): 403-426

Hausman, J. and McFadden, D. (1984). Specification Tests for the Multinomial Logit Model. Econometrica, Econometric Society, Vol. **52** (5): 1219-40

Hensher, D. A. (2001a). The Valuation of Commuter Travel Time Savings for Car Drivers: Evaluating Alternative Model Specifications. Transportation **28**: 101-118

Hensher, D.A., (2001b). Measurement of the Valuation of Travel Time Savings. Journal of Transport Economics and Policy (JTEP). London School of Economics and University of Bath, Vol. **35** (28): 71-98

Hensher, D. A., and W. H. Greene (2003). The Mixed Logit Model: The State of Practice. Transportation **30** (2): 133-176

Hensher, D. A., Shore, N. and K. Train (2005). Households' Willingness to Pay for Water Service Attribute. Journal of Environmental and Resource Economics, **32** (4): 509-531

Hensher, D., Shore, N. and Train, K. (2006).Water Supply Security and Willingness to Pay to Avoid Drought Restrictions. The Economic Record **82** (256): 56-66

Hill, T. and Lewicki, P. (2007). Statistics: Methods and Applications. StatSoft, Tulsa, OK.

Hope, R.A., and G.D. Garrod. (2004). Is Water Policy Responding to Rural Preferences? A Choice Experiment Model Evaluating Household Domestic Water Trade-Offs in Rural South Africa. CAMP - TR 8.

Huber, J. and K. Zwerina, (1996). The Importance of Utility Balance in Efficient Choice Designs. Journal of Marketing Research, **33** (8): 307-317

Hurlimann, A. and McKay, J. (2007). Urban Australians Using Recycled Water for Domestic Non-Potable Use- An Evaluation of the Attributes Prices, Saltiness, Colour and Odour Using Conjoint Analysis. Journal of Environmental Management, **83**: 93-104

James, S. and Burton, M. (2003). Consumer Preferences for GM Food and Other Attributes of the Food System. The Australian Journal of Agricultural and Resource Economics, **47** (4): 501-518

John Loh (2012). UEM Land's Nusajaya to be Driven by New Projects in The Star Online Business, retrieved on 8 Nov 2012.

Johnson, R. and B. Orme (2003). Getting the Most from CBC, Sawtooth Software Research Paper Series, 41, http://www.sawtoothsoftware.com/education/techpap.shtml, retrieved 20 December 2011.

Johnson, F. R. and Desvousges, W.H. (1997). Estimating Stated Preferences with Rated-Pair Data: Environmental, Health, and Employment Effects of Energy Programs. Journal of Environmental Economics and Management, **34**: 79-99

Johnston, F. R. and Desvousges, W.H. and Wood, L.L. (1995). Conjoint Analysis of Individual and Aggregate Environmental Preferences. Triangle Economic Research Technical Working Paper No T-9502

Johnstone, C. and Markandya, A. (2006). Valuing River Characteristics Using Combined Site Choice and Participation Travel Cost Models. Journal of Environmental Management, **80** (3): 237-247

Johor. The Columbia Encyclopedia (2011), 6th ed., Encyclopedia.com: http://www.encyclopedia.com/doc/1E1-Johor.html, retrieved 1 April 2012

Kaliba, A. R., Norman, D. W., and Chang Y. M. (2003). Willingness to Pay To Improve Domestic Water Supply in Rural Areas of Central Tanzania: Implications for Policy. International Journal of Sustainable Development and World Ecology, Vol. 10 Issue 2: 119-32.

Kanyoka P, Farolfi S and Morardet S (2008). Households' Preferences and Willingness to Pay for Multiple Use Water Services in Rural Areas of South Africa: An Analysis Based on Choice Modelling. Water SA, **34** (6): 715-724.

Kassim, M. (2003). Economic Valuation of Pulau Payar. Fisheries Research Institute

Kayaga S., Calvert J., Sansom K.(2003). Paying for Water Services: Effects of Household Characteristics, Utilities Policy, **11** (3): 123-132.

Kontogianni, M.Skourtos, B. Zanou and I.H.Langford (2005). The costs and benefits of Implementing the European Urban Waste Water Directive in Greece. In *Cost Benefit Analysis and Water Resources Management* eds R.Brouwer and D.W. Pearce. Cheltenham: Edward Elgar.

Kroes, E.P. and Sheldon, R.J. (1988). Stated Preference Methods: An Introduction. A Journal of Transport Economics and Policy, XXII (1):11-26

Krueger, R.A. (1994). Focus Group; A Practical Guide for Applied Research, Thousand Oaks, CA: Sage Publications

Krupnick, A. J. and Cropper, M. L. (1992). The Effect of Information on Health Risk Valuations. Journal of Risk and Uncertainty, **5**: 29-48

Kumari, K. (1997). Forestry Practices in North Selangor Peat Swamp Forests, Malaysia in King, Kenneth and Giesen, Wim (Eds). Incremental Costs of Wetland Conservation: Case Studies in Asia and the Pacific. Wetlands International-Asia Pacific and Global Environmental Facility

Lancaster, K. (1966). A New Approach to Consumer Theory. Journal of Political Economy, **74**: 132-157

Layton, D. F. and Brown, G. (2000). Heterogeneous Preferences Regarding Global Climate Change. The Review of Economics and Statistics, **82** (4): 616-624

Lee, C. (2007). Social Policies and Private Sector Participation in Water Supply: the Case of Malaysia prepared for the UNRISD project on Social Policy, Regulation and Private Sector Involvement in Water Supply.

Lee, L.F., (1995). Semiparametric Maximum Likelihood Estimation of Polychotomous and Sequential Choice Model. Journal of Econometrics, **65**: 385-428.

Leon Paternoste (2010). Establishing a Customer Charter / Code of Conduct. http://www.instituteofcustomerservice.com/1849-2147/Establishing-a customer-charter--code-of-conduct.html, retrieved on 8 Nov 2012

Lockwood, M. (1997). Integrated Value Assessment Using Paired Comparisons. Ecological Economics, **25**: 73-87

Lockwood, M. (1999). Preference Structures, Property Rights, and Paired Comparisons. Environmental and Resource Economics, **13**: 107-122

Louviene, J.J. (1988a). Analyzing Decision Making: Metric Conjoint Analysis, Sage University Papers Series No. 67, Sage Publications, Inc., Newbury Park, CA

Louviene, J.J. (1988b). Conjoint Analysis Modelling of Stated Preferences: A Review of Theory, Methods, Recent Developments and External validity. Journal of Transport, Economy, Policy, **10**: 93-119

Louviene, J.J. (1992). Experimental Choice Analysis: Introduction and Overview. Journal of Business Research, **24** (2), 89 – 96

Louviene, J.J. (1996). Relating Stated Preference Measures and Models to Choices in Real Markets: Calibration of CV Responses. In D.J. Bjornstad and J.R.Kahn (eds): The Contingent Valuation of Environmental Resources. Edward Elgar, Cheltenham

Louviere, J.J. (1991). Experimental Choice Analysis: Introduction and Review. Journal of Business Research, 23, 291-297.

Louviere, J. (1993). Conjoint Analysis. In Bagozzi, R.(ed). Advanced Methods in Marketing Research. Cambridge: Blackwell Business

Louviere, J., R. Carson, A.Ainslie, J. Deshazo, T. Cameron, R. Kohn and T. Marley (2002). Dissecting the Random Component of Utility. Marketing Letters, **13** (3), 177-193

Louviere, J.J. Hensher, D.A. and Swait, J.D. (2000). Stated Choice Methods: Analysis and Application. Cambridge University Press.

Louviere, J.J. Hensher, D.A. et al. (2001). Stated Choice Methods: Analysis and Applications in Marketing, Transport and Environmental Valuation. Cambridge, Cambridge University Press.

Luce D. (1959). Individual Choice Behaviour. New York: John Wiley

MacDonald, D. H., Barnes, Mary., Bennett, J., Morrison, M. and Young, M.D. (2005). Using Choice Modelling Approach for Customer Service Standards in Urban Water. Journal of the American Water Resources Association, **41**: 719-728

Malaysia Site, Johor the Southern Gateway (n.d.), http://malaysiasite.nl/johoreng.htm, retrieved 8 April 2008

McFadden, D. (1981). Econometric Models of Probabilistic Choice, In Manski, C. and McFadden, D. (eds.) *Structural Analysis of Discrete Data with Econometric Applications*, 198-272. MIT Press, Cambridge, MA.

Mackenzie, J. (1993). A Comparison of Contingent Preference Models. American Journal of Agricultural Economics, **75**: 593-603

MacDonald, D.H., Barnes, M., Bennett, J., Morrison, M. and Young, M. D. (2005), Using A Choice Modelling Approach for Customer Service Standards in Urban Water. JAWRA Journal of the American Water Resources Association, **41**: 719-728

Macmillan, D.C., Duff, E.I. and Elston, D.A. (2000). Modelling the Non-market Environmental Costs and Benefits of Biodiversity Projects Using Contingent Valuation Data. Environmental and Resource Economics, **18**: 391- 410

Madanat, S. and F.Humplick (1993). A Model of Household Choice of Water Supply Systems in Developing Countries. Water Resources Research, **29**: 1353-1358

Maddala, G.S. (2001). Introduction to Econometrics. 3rd edition. John Wiley & Sons, Ltd.

Madureira, L., Rambonilaza, T. and Karpinski, I. (2007). Review of Methods and Evidence for Economics Valuation of Agricultural Non-Commodity Output and Suggestions to Facilitate its Application to Broader Contents. Agriculture Ecosystems and Environment, **120** (1): 5-20

Magat, W. A., Viscusi, W. K and Huber, J. (1989). Paired Comparison and Contingent Valuation Approaches to Morbility Risk Valuation. Journal of Environmental Economics and Management, **15**: 395-411

Malaysian Water Association (2009). *Malaysia Water Industry Guide 2009*. Kuala Lumpur: Malaysian Water Association.

Manski, C. F. (1977). The Structure of Random Utility Models. Theory and Decision, **8**: 229-254

Markley, S. (2007). Spatially-Oriented Discrete Choice Predictions: A Case Study of French Supermarket Preferences.

Mbata. J. N. (2006). Estimating Household Willingness to Pay for Water Services in a Rural Economy: The Case of Kanye in Southern Botswana. Development Southern Africa, **23** (1): 29-44

McFadden D. (1974). Conditional Logit Analysis of Qualitative Choice Behaviour. In: Zarembka P, editor. Frontiers in Econometrics, New York: Academic Press

McFadden, D. (1978). Modelling the Choice of Residential Location. In *Spatial Interaction Theory and Planning Models*, eds. A. Karquist et al. Amsterdam: North-Holland Press.

McFadden, (1981). Econometric Models of Probabilistic Choice, In Manski, C. and McFadden, D., (eds.) *Structural Analysis of Discrete Data with Econometric Applications*, 198-272. MIT Press, Cambridge, MA.

McFadden, D., and Train, K. (2000). Mixed MNL Models of Discrete Response. Journal of Applied Econometrics, **15**, 447-470

Md. Ghazali, Z. and Omar, J. (2007). The SAJH's Experiences on Customers Relation in Providing Adequate and Satisfactory Water Services, International Conference on Water Management and Technology Applications in Developing Countries

Mohd. Azhar, G., (2000). *Managing Malaysian Water Resources Development.* Jurnal Kesihatan Masyarakat, 6 (S): 40-58.

Mohd Rusli Yacob and Ahmad Shuib. (2009). Assessing the Preference Heterogeneity in Marine Ecotourism Attributes by Using Choice Experiment. International Journal of Economics and Management, **3** (2):367-384.

Mohd Shawahid H.O. (1997). Conservation and Land Use in Kuala Selangor Wetlands, Malaysia in King,Kenneth and Giesen, Wim (Eds). *Incremental Costs of Wetland Conservation: Case Studies in Asia and the Pacific*. Wetlands International-Asia Pacific and Global Environmental Facility

Morrison, M and Bennett, J. (2004). Valuing New South Wales Rivers for Use in Benefit Transfer. The Australian Journal of Agricultural and Resource Economics, **48** (4): 591-611

Morrison, M., Bennett, J. and Blamey, R. (1999). Valuing Improved Wetland Quality Using Choice Modelling. Journal of Water Resources Research, **35**(9): 2805-2814

Morrison, M.D., Blamey, R. K., Bennett, J. W. and Louviere, J.J. (1996). A Comparison of Stated Preference Techniques for Estimating Environmental Values. Research Report No. 1

Mu, X., D. Whittington and J. Briscoe (1990). Modelling Village Water Demand Behaviour: A Discrete Choice Approach. Water Resources Research, **26**: 521-529

N.A.Powe, G.D.Garrod, P.L.McMahon and K.G.Willis (2004). Assessing Customer Preferences for Water Supply Options Using Mixed Methodology Choice Experiments. Water Policy, **6**: 427-441

N. A. Powe, William A. Wadsworth, G.D. Garrod, P. L. McMahon (2004). Putting Action into Biodiversity Planning: Assessing Preferences Towards Funding. Journal of Environmental Planning and Management, **47**: 287-301

N.A.Powe (2007). Redesigning Environmental Valuation: Mixing Methods within Stated Preference Tecniques. Edward Elgar, USA.

N.A. Powe, G.D. Garrod, and P.L. McMahon (2005). Mixing Methods within Stated Preference Environmental Valuation: Choice Experiments and Post-Questionnaire Qualitative Analysis. Ecological Economics, **52**: 513-526

Nam, P. and Son, T. (2005). Household demand for Improved Water Services in Ho Chi Minh City: A Comparison of Contingent Valuation and Choice Modelling Estimates. Research Report #2005-RR#, Economy and Environment Program for South East Asia (EEPSEA).

National Water Quality Handbook (2003) http://www.wsi.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1044775.pdf, retrieved on 2 Nov 2012

Navrud, S., and Ready, R., (eds) (2002). Valuing Cultural Heritage: Applying Environmental Valuation Techniques to Historic Building, Monuments and Artifacts. Cheltenham: Edward Elgar

Nechyba, T. J. and Strauss, R.P. (1998). Community Choice and Local Public Services: A Discrete Choice Approach. Regional Science and Urban Economics, **28**: 51-73

Ninth Malaysia Plan (2006-2010). http://www.parlimen.gov.my/news/eng-ucapan_rmk9.pdf retrieved on 2 March 2007

Nik Mustapha, A. R. (1993). Valuing Outdoor Recreational Resources in Tasik Perdana Using Dichotomous Choice of Contingent Valuation Method. The Malaysian Journal of Agricultural Economics, **10**: 39-50

Olajuyigbe, A.E. and Fasakin, J.O. (2010).Citizens' Willingness to Pay for Improved Sustainable Water Supply in a Medium-Sized City in South Western Nigeria, Current Research Journal of Social Sciences **2** (2): 41-50

Opaluch, J. J., S. Swallow, T. Weaver, C. Wessels and D. Wichlens (1993). Evaluating Impacts form Noxious Waste Facilities, Including Public Preferences in Current Sitting Mechanism. Journal of Environmental Economics and Management, **24**: 41-59

Oppewal, H. and Timmermans, H. (1999). Modelling Consumer Perception of Public Space in Shopping Centers. Environment and Behavior, **31** (1): 45-65

Orme, B. (2010). Getting Started with Conjoint Analysis: Strategies for Product Design and Pricing Research. 2nd edn. (Madison, WI: Research Publishers).

Othman, J. (1999). Economic Valuation of Environmental Resources: Application of the TEV Framework- Choice Model. UNEP/ROAP

Othman, J. (2000) Economic Benefits of Wetlands-Based Recreation: The Case of Kuala Selangor Fireflies and Nature Park. Malaysian Journal of Environmental Management, **1**: 41-54

Othman, J. (2001). Estimating Non-Use Values of Environmental Resources Using Contingent Valuation: Case of Matang Mangroves. In Jamaluddin Jahi, et al. (eds). Environmental Management . Center for Graduate Studies, Universiti Kebangsaan Malaysia, December 2001: 214-222

Othman, J (2002). Household Preferences for Solid Waste Management. Paper Economy and Environment Program for South East Asia (EEPSEA).

Othman, J. and Asmuni, S. (2003). The Economics of Wetlands Conservation: Case of Paya Indah Wetlands, Malaysia. Paper presented at International Ecotourism Conference: Sustainability of Ecotourism Development in a Competitive Global Environment, organized by SEAMEO-SEARCA and UPM, at Bangi, Malaysia, April, 15-17

Othman, J. and Asmuni, S. (2004). Entrance Fee System for Recreational Forest in Selangor, Malaysia. ASEAN Journal on Hospitality and Tourism, **3** (2): 1-19

Othman, J. and Othman, R. (1998). Economic Benefits from Wetland Biodiversity: Case of Fireflies Recreation, Malaysia. Tropical Biodiversity, **5** (1): 65-74

Othman, J., Bennett, J. and Blamey, R. (2004). Environmental Values and Resource Management Options: a Choice Modelling Experience in Malaysia. Journal of Environmental Development Economics, **9**: 803-824

PAAB (n.d.) Changes Under The National Water Services Industry Restructuring Initiatives., http://www.paab.my/reform-in-water-services-industry/changes-under-the-national-water-services-industry-restructuring-initiatives, retrieved on 4 December 2011

Parsons, G.R., Kealy, M. J. (1992), Randomly Drawn Opportunity Sets in a Random Utility Model of Lake Recreation, Land Economics, University of Wisconsin Press, **68** (1): 93-106.

Pattanayak. S.K, Jonson. F.R, Mansfield, C, van den Berg, C., Jones. K (2006). Unpackaging Demand for Water Service Quality: Evidence from Conjoint Surveys in Sri Lanka. World Bank Policy Research Working Paper 3817, January 2006

Persson T. H. (2002). Household Choice of Drinking Water Source in the Philippines. Asian Economic Journal, **16**: 303-316

Philip A. Viton (2011). *CRP 775 – Extensions Mode Choice* – Problems and *Extensions*. http://facweb.knowlton.ohio-state.edu/pviton/courses2/crp775/mode-choice-extensions-handout.pdf retrieved on 12 Dec 2011

Poirier, J. and Fleuret, A. (2010). Using the Choice Experiment Method for Valuing Improvement in Water Quality: A Simultaneous Application to Four Recreation Sites of a River Basin. Report Prepared for the INSEE (National Institute for Statistics and Economic Studies)

Predo, C. and James, D. (2006). A User Manual for Benefit Cost Analysis Using Microsoft Excel. Economy and Environment Program for Southeast Asia

Pollack, R.A., T.J. Wales (1992). Demand System Specification and Estimation. Oxford Univ. Press, New York.

Rae, D.A., J. Hauseman, and J. Wickam, (1983). Benefits of Visual Air Quality in Cincinnati: Results of a Contingent Ranking Survey, paper presented at the AEA Meetings, Washington, D.C.

Raja Dato' Zaharaton Raja Zainal Abidin (2004). Water Resources Management in Malaysia: The Way Forward. http://www.epu.gov.my/html/themes/epu/images/common/pdf/papers/txtspeech.pdf retrieved on 13 Feb 2007

Raje, D., Dhobe, P., and Deshpande, A. (2002). Consumer's Willingness to Pay More for Municipal Supplied Water: A Case Study. Ecological Economics **42** (3):391– 400.

Raziah, M.L. (2002). Contingent Valuation Technique: Application in Natural Resource Management. Paper presented at a Regional Training Course/Workshop on Socio Economics of Conservation and Use of Native Tropical Fruit Species Biodiversity in Asia, HORDI, Peradeniya, Sri Lanka, 12-21 December

Revelt, D. and K. Train. (1996). "Incentives for Appliance Efficiency: Random Parameters Logit Model of Households' Choices, Working Paper, Department of Economics, University of California, Berkeley.

Revelt, D. and Train, K. (1998). Mixed Logit with Repeated Choices: Households' Choice of Appliance Efficiency Level. Review of Economics and Statistics, Vol. LXXX, **4**, 647-657.

Roe, B., Boyle, K. J., and Teisl, M. F. (1996). Using Conjoint Analysis to Derive Estimates of Compensating Variation. Journal of Environmental Economics and Management, **31**:145-159.

Rolfe, John and Alam, Khorshed and Windle, Jill and Whitten, Stuart (2004) Designing The Choice Modelling Survey Instrument for Establishing Riparian Buffers in The Fitzroy Basin (Establishing the Potential for Offset Trading in the Lower Fitzroy River Research Report No. 3). Project Report. Central Queensland University, Rockhampton, Australia.

Rolfe, J., Bennett, J. (1996) Valuing International Rainforests Using a Choice Modeling Approach. Vanuatu Forest Conservation Report, School of Economics nd Management UNSW.

Rolfe, J. and Bennett, J. (2000). Framing Effects. In J. Bennett, and R. Blamey (eds). The Choice Modelling Approach to Environmental Valuation. Edward. Elgar Publishing, Cheltenham, UK

Rolfe, J. Bennett, J and Louviere, J. (2000). Choice Modelling and Its Potential Application to Tropical Rainforest Preservation. Ecological Economics, **35**: 289-302

Ryan, M. and Watson, V. (2009), Comparing Welfare Estimates from Payment Card Contingent Valuation and Discrete Choice Experiments. Health Economics, **18**: 389–401

S. Georgiou, Bateman, I.J. and I.H.Langford (2005). Cost-benefit Analysis of Improved Bathing Water Quality in the United Kingdom as a Result of a Revision of the European Bathing Water Directive. In *Cost Benefit Analysis and Water Resources Management* eds R.Brouwer and D.W. Pearce. Cheltenham: Edward Elgar.

SAJ Holdings (2007). Report of Customer Perception Survey 2007. Johor Bahru, Malaysia: SAJ Holdings.

SAJ Holdings (2008). *Report of Customer Perception Survey 2008*. Johor Bahru, Malaysia: SAJ Holdings.

SAJ Holdings (2008). Review of Operations, http://www.saj.com.my/V2/Content.php?s_text=review+of+operation&content_id=8 retrieved 20 June 2008.

SAJ Holdings (2008). Water Treatment Process, http://www.saj.com.my/Content.php?menu_parent_id=1&content_id=8, retrieved 17 January 2008.

SAJ Holdings (2010). SAJ Holdings Sdn Bhd, http://www.saj.com.my/Default.php, retrieved 1 January 2010.

Scarpa, R., Willis, K.G. and Acutt, M. (2004). Individual-Specific Welfare Measures for Public Goods: A Latent Class Approach to Residential Customers of Yorkshire Water, January, forthcoming in Koundouri, P. (ed), Econometrics Informing Natural Resource Management, Edward Elgar Publisher, Aldershot.

Schroeder, H. W., and Louviere, J. (1999). Stated Choice Models for Predicting the Impact of User Fees at Public Recreation Sites. Journal of Leisure Research, **31** (3): 300-324

Segal, R. (1995). Forecasting the Market for Electric Vehicles in California Using Conjoint Analysis. The Energy Journal, **16** (3): 89-111

Shively, G., and Galopin, M. (n.d.). An Overview of Benefit-Cost Analysis. http://www.agecon.purdue.edu/staff/shively/COURSES/AGEC406/reviews/bca.htm retrieved on 27 Sept 2010

Shuib, A. (1991). Effects of Time Cost on Recreational Benefit Estimation. Malaysia Journal of Agricultural Economics, **8**: 41-51

Sinden, J. A. (1974). A Utility Approach to the Valuation of Recreational and Aesthetic Experiences. American Journal of Agricultural Economics, **56** (1): 61-72

Smith, V. K., Desvousges, W.H. and Freeman, A. M. (1985).Valuing Changes in Hazardous Waste Risks: A Contingent Valuation Analysis. Draft Interim Report prepared for the US Environmental Protection Agency in Smith, V.K. and Desvousges, W.H. (1986). Measuring Water Quality Benefits. Kluwer-Nojhoff Publishing, Boston

Smith, V.K. and Desvousges, W.H. (1987). An Empirical Analysis of the Economic Value of Risk Changes. Journal of Political Economics, **68** (2): 280-290

Snowball, D., Willis, K.G., Jeurissen, C. (2007). Willingness to Pay for Water Service Improvements in Middle-Income Urban Households in South Africa: A Stated Choice Analysis. ESSA 2007 Conference.

Soto Montes de Oca, G. and Bateman, I.J. (2005), Cost-benefit Analysis of Urban Water Supply in Mexico City. In *Cost Benefit Analysis and Water Resources Management* eds R.Brouwer and D.W. Pearce. Cheltenham: Edward Elgar.

Swallow, S.K., Weaver, T., Opaluch, J.J. and Michelman, T.S. (1994). Heterogeneous Preferences and Aggregation in Environmental Policy Analysis: A Landfill Sitting Case. American Journal Agriculture Economics, **76**: 431- 443

The Star, 10 May 2008. RM94million to Clean Up Three Rivers in Johor.

Thurstone, L. (1927). A Law of Comparative Judgement. Psychological Review **4**: 273-286

Ti, L.H. and Facon, T. (2001a). From Vision to Action: A Synthesis of Experiences in Southeast Asia, ESCAP Environment and Natural Resources Development Division, FAO Regional Office for Asia and the Pacific

Ti, L.H. and Facon, T. (2001b), Malaysia's Water Vision: The Way Forward: The Malaysian Water Partnership in From Vision to Action: A Synthesis of Experiences in Southeast Asia

Train, K. (1986). Qualitative Choice Analysis. Cambridge: MIT Press

Train, K. (1997). Mixed Logit Models for Recreation Demand. In *Valuing the Environment Using Recreation Demand Models*, eds. C. Kling and J. Herriges. Forthcoming, Elgar Press.

Train, K. (1998). Recreation Demand Models with Taste Differences Over People. Land Economics, **74** (2): 230-239

Train, K. (2000). Halton Sequences for Mixed Logit. Economics Working Papers E00-278, University of California at Berkeley.

Train, K. (2003). Discrete Choice Methods with Simulation. Cambridge, UK: Cambridge University Press.

Train, K. and Sonnier, G. (2004) Mixed Logit with Bounded Distributions of Correlated Partworths, In R. Scarpa & A. Alberini, (eds), *Applications of Simulation Methods in Environmental and Resource Economics*, Kluwer Academic Publishers, Boston, MA.

Uma Sekaran (2003). Research Methods For Business: A Skill Building Approach, 4th Edition. John Wiley & Sons, Inc.

Van Bueren, M. and Bennett, J. (2004). Towards the Development of a Transferable Set of Value Estimates for Environmental Attributes. Australian Journal of Agricultural and Resource Economics, **48**: 1-32

Van der Pol, M., Ryan, M., (1996). Using Conjoint Analysis to Establish Consumer Preferences for Fruit and Vegetables, British Food Journal, **98** (8): 5-12.

Viscusi, W. K., W. A. Megat and J. Huber (1991). Pricing Environmental Health Risks: Survey Assessments for Risk-Risk and Risk-Dollat Trade-offs for Chronic Brochitis. Journal of Environmental Economics and Management, **21**: 32-51

Vipin Bhardwaj and Chris Metzgar (2001). Reservoirs, Towers, and Tanks in Tech Brief: A National Drinking Water Clearing House Fact Sheet.

Von Haefen, R., D. Phaneuf and G. Parson (2004). Estimation and Welfare Analysis with Large Demand System. Journal of Business and Economics Statistics, **22**(2): 194-205

Whittington, D., Davis, J., McClelland (1996). Implementing a Demand-Driven Approach to Community Water Supply Planning: A Case Study of Lugazi, Uganda. Unpublished Report to the World Bank

Whittington, D., Okarafor, A., Okore, A., McPhail, A., (1990). Strategy for Cost Recovery in the Rural Water Sector: A Case study of Nsukka district, Anambra State, Nigeria. Water Resources Research, **26** (9): 1899-1913

William J. Cosgrove and Frank R. Rijsberman (2000). Making Water Everybody's Business. World Water Vision Report. Earthscan Publications Ltd

Willis, K.G. (2002). Stated Preference and the Estimation of Environmental Values, International Journal of Environmental Studies, **59** (6): 635-646

Willis, K.G, Garrod. G.D. and T. Chee (1998). Valuation and Analysis of Consumer Demand for Forest Recreation Areas in Peninsula Malaysia. In S. Lee, D. 21 May, I. Gauld and J. Bishop (eds). *Conservation, Management and Development of Forest Resources*. Proceedings of the Malaysia-UK Programme Workshop. Forest Research Institute Malaysia.

Willis, K. G. and Garrod, G.D. (1999). Externalities from Extraction of Aggregates Regulation by Tax or Land-use Controls. Resources Policy, **25**: 77-86

Willis, K. G., McMahon, P.L., Garrod, G.D. and Powe, N. A. (2002). Water Companies' Service Performance and Environmental Trade-offs. Journal of Environmental Planning and Management, **45** (3): 363-379

Willis, K. G., Scarpa, R.and Acutt, M. (2005). Assessing Water Company Customer Preference and Willingness to Pay for Service Improvement: A Stated Choice Analysis. Journal of Water Resources Research, **41**:1-11

Willis, K.G. (2002). Stated Preference and the Estimation of Environmental Values. International Journal of Environmental Studies, **59**: 635-646

Willis, K.G. and Garrod, G. D. (1996). The Non-Use Benefits of Enhancing Forest Biodiversity: A Contingent Ranking Study. Ecological Economics, **21**: 45-61

Willis, K.G., Garrod, G.D., and Yiew, C.T. (1996). Valuation and Analysis of Consumer Demand for Forest Recreation Areas in Peninsular Malaysia in Conservation, Management and Development of Forest Resources. Proceedings of the Malaysia-United Kingdom Programme Workshop, 21-24 October

World Bank (1993). The Demand for Water in Rural Areas: Determinants and Policy Implications. The World Bank Research Observer, **8** (1): 47-70

References

Xu, Z.M., Cheng G.D., Bennett, J., Zhang, Z. Q., Long, A. H. and Kunio, H.(2007). Choice Modelling and Its Application to Managing the Ejina Region, China. Journal of Arid Environment, **69**: 331-343

Yang J, Pattanayak S. Kk, Jonson F.Rr, Mansfield C, Van Den Berg C and Jones K (2006). Unpackaging Demand For Water Service Quality: Evidence From Conjoint Surveys In Sri Lanka. World Bank Policy Research. Working Paper **3817** (January Issue).

Yohei Mitani, (2008).Estimating Economic Values of Vegetation Restoration with Choice Experiments: A Case Study of an Endangered Species in Lake Kasumigaura, Japan. Landscape and Ecological Engineering, **4** (2): 103-113

Zazali Musa (2011). RM6bil invested in Nusajaya, in The Star www.iskandarmalaysia.com.my › Invest, retrieved on 8 Nov 2012

Zelin A, Stubbs R (2005). Clustered Sampling: A False Economy? International Journal of Market Research, **47** (5):501-522.

APPENDIX A: QUESTIONNAIRE

Serial No:

ASSESSING THE EFFECTIVE DEMAND FOR IMPROVED WATER SUPPLY SERVICE IN MALAYSIA: FOCUSING ON JOHOR WATER COMPANY

Date : ____________________
Start Time : ____________________
End Time : ____________________
Location : ____________________
Interviewer Name : ____________________

All your responses will be treated as confidential

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ASSESSING THE EFFECTIVE DEMAND FOR IMPROVED WATER SUPPLY SERVICE IN MALAYSIA: FOCUSING ON JOHOR WATER COMPANY

SAJ Holdings Sdn. Bhd. (SAJH)

SAJ Holdings Sdn. Bhd. is a private company which has a 30 year concession to supply water to residential and commercial customers in Johor from March 2000 until 2029. SAJH takes water from catchment areas, treats the water, and distributes it to customers. The tariff is variable depending on the class of the customer. Currently, SAJH has a total of 766,000 residential customers.

Issue

SAJH aims to deliver a better service to customers. This study focuses on the water supply service to residential customer. Aspects of this service which could be improved are leakage, burst pipes, reservoir capacity, quality of water standards, disruption, water pressure, and connections. Your preference for improvements in these water service attributes will allow SAJH to invest to ensure that customers receive a better service in the future.

Purpose of the Research

The purpose of this research is to assess customers' preferences for different aspects of service improvements for residential customers of SAJH.

Attributes Practice in SAJH

Water Infrastructure

1. **Leakage**
   Water is lost through leakage (cracks) in old pipes. Currently 30% of all water supplied by SAJH is 'lost' in the system before it reaches customers. With investment in new pipes, and better maintenance of existing pipes, this leakage could be reduced to only 20% by 2010.

2. **Burst Pipes**
   Currently, SAJH repairs 98.5% of all burst pipes within 24 hours following receipt of a complaint. With further investment, this rate could be increased to 99% or even 100% in the future.

3. **Water Quantity/Reservoirs**
   Daily production must be sufficient to meet customer demand. At the moment, the supply capacity achieved is 119% against demand. With new investment in plant treatment and reservoirs, this capacity could be increased. This would reduce the likelihood of any disruption to supplies during periods of drought.

<u>Residential Customers</u>

1. Water quality standard

More than 35,000 samples of water are tested each year to check the purity of tap water. Currently, SAJH water achieves 99.7% compliance to the MOH Standards. With new investment in water treatment and distribution this compliance could be increased to 99.8% or even 99.9%.

2. Disruption

Disruption to water supply can occur for a numbers of reasons such as leakage in main pipes, drought, etc. Currently, customers on average experience loss of water for 2 hours per day for 4 days per year on average. With improved investment in pipe maintenance and reservoirs, this disruption could be reduced.

3. Connections

Customers must apply for new connections (and any reconnection because of non-payment of water bills). SAJH will install a connection within 3 days (as well as reconnection after back payments are received). With further investment this period could be reduced to 2 days or with more investment to just 1 day.

4. Water Pressure

Some customers experience low water pressure due to geographical and physical factors, replacement of pipes, and upgrading of treatment plants. Currently, SAJH provides normal pressure to around 93% of residential customers. With planned investment, good water pressure could be supplied to 95% of customers, and further investment would mean that 98% of customers always had good pressure.

Attribute Options for SAJH in Johor

Current Attribute Practice

A Summary of the Current Attribute Practice for Improving the Water Supply Service in Johor

Water Infrastructure

Leakage	: 30% of water lost before it reaches households
Burst pipes	: 98.5% of burst pipes repaired within 24 hours
Reservoirs	: 119% of water capacity against demand

Residential Customers

Water quality standard	: 99.7% compliance with Ministry of Health standard
Disruption	: 2 hours per day for 4 days per year
Connections	: 3 days to connect water supply
Water Pressure	: 93% of households supplied with good pressure

Price

Residential Customer : MYR0.98 (average water tariff)

Type of Charge

0-15m^3	= MYR0.38/m^3
16-30m^3	= MYR1.18/m^3
31-45m^3	= MYR1.64/m^3
46-100m^3	= MYR1.98/m^3
> 100m^3	= MYR2.01/m^3

(Source: Malaysia Water Industry Guide, 2009)

SECTION A: EXPERIENCE OF SAJH

Instruction: Please tick (✓) your answer in the box provided.

Q1. How long have you been with SAJH?

☐ 2 years or less
☐ 3 – 5 years
☐ 5 – 7 years
☐ More than 8 years

Q2. How much is your monthly water bill?

☐ MYR4 – MYR10
☐ MYR11 – MYR20
☐ MYR21 – MYR30
☐ More than MYR31

Q3. How do you pay the water bill?

☐ Through SAJH counters
☐ Through online payment e.g. Maybank2u
☐ Through Post Office
☐ Other: please state ____________

Q4. Thinking about your experience of SAJH, how satisfied are you with the following aspects of the company's service performance? Please indicate how satisfied or dissatisfied you are with the company's performance based on a 5 point scale as follows:

1. **Very Dissatisfied**
2. **Fairly Dissatisfied**
3. **Neither Satisfied nor Dissatisfied**
4. **Fairly Satisfied**
5. **Very Satisfied**

	Attributes	**Scale**				
(a)	Leakage	**1**	**2**	**3**	**4**	**5**
(b)	Burst pipes	**1**	**2**	**3**	**4**	**5**
(c)	Reservoirs	**1**	**2**	**3**	**4**	**5**
(d)	Water quality standard	**1**	**2**	**3**	**4**	**5**
(e)	Disruption	**1**	**2**	**3**	**4**	**5**
(f)	Connections	**1**	**2**	**3**	**4**	**5**
(g)	Pressure	**1**	**2**	**3**	**4**	**5**
(h)	Price	**1**	**2**	**3**	**4**	**5**

Q5. Do you use a water filter in your home?

☐ Yes

☐ No

Q6. Do you use a tank to store water?

☐ Yes

☐ No

Q7. Do you buy mineral water or bottled water for drinking?

☐ Yes

☐ No

Q8. Do you boil water for drinking?

☐ Yes

☐ No

SECTION B: QUALITY SERVICES & QUALITY OBJECTIVE

Part A: Water Infrastructure

Instruction: Please choose ONE option and please tick (✓) in the box provided.

The card below presents three alternatives. Please state which alternative you prefer the most. Option C is the current situation, options A and B are alternatives.

If you would like to see leakage reduced, all burst pipes repaired with 24 hours, some increase in reservoir capacity and you are happy to pay a 20% increase in your water bill then you should choose Option A.

If you are not concerned about reducing leakage but would like to see all burst pipes repaired within 24 hours, a bigger increase in reservoir capacity, and you are willing to pay a 10% increase in your water bill then you should choose Option B.

Alternatively, if you are happy with the current level of service from SAJH and you do not want to pay any more for your water, then you should choose Option C.

There is no right or wrong answer. We are just interested in your preference of the service factors.

You will now be presented with 4 cards and asked to choose on each card which option you prefer most.

<u>EXAMPLE</u>

If you would like to see leakage reduced, all burst pipes repaired with 24 hours, some increase in reservoir capacity, and you are happy to pay a 20% increase in your water bill then you should choose <u>Option A</u>.

	Option A	**Option B**	**Option C**
Leakage	**20%**	**30%**	30%
Burst pipes	**100%** of repairs within 24 hours	**100%** of repairs within 24 hours	98.5% of repairs within 24 hours
Reservoirs	**125%** achieved against demand	**130%** achieved against demand	119% achieved against demand
Price	Increase by **20%**	Increase by **10%**	No change
PREFERENCE CHOICE	✓		

MYR0.98 (average water tariff)

Q9.

Now look at these 3 alternatives, which option do you prefer?

	Option A	**Option B**	**Option C**
Leakage	**20%**	**30%**	30%
Burst pipes	**100%** of repairs within 24 hours	**100%** of repairs within 24 hours	98.5% of repairs within 24 hours
Reservoirs	**125%** achieved against demand	**130%** achieved against demand	119% achieved against demand
Price	Increase by **20%**	Increase by **10%**	no change
PREFERENCE CHOICE			

MYR0.98 (average water tariff)

Q10.

Now look at these 3 alternatives, which option do you prefer?

	Option A	**Option B**	**Option C**
Leakage	**20%**	**20%**	30%
Burst pipes	**98.5%** of repairs within 24 hours	**100%** of repairs within 24 hours	98.5% of repairs within 24 hours
Reservoirs	**125%** achieved against demand	**119%** achieved against demand	119% achieved against demand
Price	No change	No change	No change
PREFERENCE CHOICE			

MYR0.98 (average water tariff)

Q11.

Now look at these 3 alternatives, which option do you prefer?

	Option A	**Option B**	**Option C**
Leakage	**20%**	**25%**	30%
Burst pipes	**99%** of repairs within 24 hours	**100%** of repairs within 24 hours	98.5% of repairs within 24 hours
Reservoirs	**125%** achieved against demand	**119%** achieved against demand	119% achieved against demand
Price	Increase by 20%	Increase by 20%	No change
PREFERENCE CHOICE			

MYR0.98 (average water tariff)

Q12.

Now look at these 3 alternatives, which option do you prefer?

	Option A	**Option B**	**Option C**
Leakage	25%	25%	30%
Burst pipes	**98.5%** of repairs within 24 hours	**100%** of repair within 24 hours	98.5% of repairs within 24 hours
Reservoirs	119% achieved against demand	119% achieved against demand	119% achieved against demand
Price	Increase by **20%**	No change	No change
PREFERENCE CHOICE			

MYR0.98 (average water tariff)

Part B: Residential Customers

Instruction: Please choose ONE option and please tick *(✓)* in the box provided.

The card below presents three alternatives. Please state which alternative you prefer the most. Option C is the current situation, options A and B are alternatives.

If you would like to see water quality compliance to Ministry of Health Standards, reduced disruption to the water supply throughout the year, improved time for connections, some increase in water pressure, and you are happy to pay a 10% increase in your water bill, then you should choose <u>Option A</u>.

If you would still like to see improvement in water quality, a greater reduction in disruption, reduced connection time, and a greater improvement in water pressure, and you are willing to pay a 20% increase in your water bill, then you should choose <u>Option B</u>.

Alternatively, if you are happy with the current levels of service from SAJH and you do not want to pay any more for your water, then you should choose <u>Option C</u>.

There is no right or wrong answer. We are just interested in your preference of the service factors.

You will now be presented with 4 cards and asked to choose on each card which option you prefer most.

Q13.

Now look at these 3 alternatives, which option do you prefer?

	Option A	**Option B**	**Option C**
Water quality standard	**99.9%** compliance	**99.9%** compliance	99.7% compliance
Disruption	**1** hour per day for **3** days per year	**1** hour per day for **2** days per year	2 hours per day for 4 days per year
Connections	**2** days	**2** days	3 days
Pressure	**95%** of households	**98%** of households	93% of households
Price	Increase by **10%**	Increase by **20%**	No change
PREFERENCE CHOICE			

MYR0.98 (average water tariff)

Q14.

Now look at these 3 alternatives, which option do you prefer?

	Option A	**Option B**	**Option C**
Water quality standard	**99.7%** compliance	**99.8%** compliance	99.7% compliance
Disruption	**1** hour per day for **2** days per year	**1** hour per day for **2** days per year	2 hours per day for 4 days per year
Connections	**3** days	**1** day	3 days
Pressure	**95%** of households	**93%** of households	93% of households
Price	Increase by **10%**	Increase by **20%**	No change
PREFERENCE CHOICE			

MYR0.98 (average water tariff)

Q15.

Now look at these 3 alternatives, which option do you prefer?

	Option A	**Option B**	**Option C**
Water quality standard	**99.8%** compliance	**99.7%** compliance	99.7% compliance
Disruption	**1** hour per day for **3** days per year	**2** hours per day for **4** days per year	2 hours per day for 4 days per year
Connections	**1** day	**3** days	3 days
Pressure	**95%** of households	**98%** of households	93% of households
Price	No change	Increase by **10%**	no change
PREFERENCE CHOICE			

MYR0.98 (average water tariff)

Q16.

Now look at these 3 alternatives, which option do you prefer?

	Option A	**Option B**	**Option C**
Water quality standard	**99.7%** compliance	**99.8%** compliance	99.7% compliance
Disruption	**1** hour per day for **3** days per year	**2** hours per day for **4** days per year	2 hours per day for 4 days per year
Connections	**2** days	**3** days	3 days
Pressure	**98%** of households	**95%** of households	93% of households
Price	No change	Increase by **10%**	No change
PREFERENCE CHOICE			

MYR0.98 (average water tariff)

Q17. If the current service provided by SAJH were changed, and service performance were improved, please indicate how important each service factor improvement would be to you based on the 5-point scale as follows:

1. Completely unimportant
2. Unimportant
3. Neither important nor unimportant
4. Important
5. Very important

	Attributes	Scale				
(a)	Reduce the level of leakage	**1**	**2**	**3**	**4**	**5**
(b)	Improve repairs to burst pipes	**1**	**2**	**3**	**4**	**5**
(c)	Increase in reservoir capacity	**1**	**2**	**3**	**4**	**5**
(d)	Improve the water quality against Ministry of Health standards	**1**	**2**	**3**	**4**	**5**
(e)	Reduce water supply disruption	**1**	**2**	**3**	**4**	**5**
(f)	Improve the time taken for connections	**1**	**2**	**3**	**4**	**5**
(g)	Increase the level of pressure	**1**	**2**	**3**	**4**	**5**
(h)	Increase the price	**1**	**2**	**3**	**4**	**5**

Q18. The main issue in SAJH is the efficiency and effectiveness of service performance in order to convince their customers and to maintain the sustainability of water as a natural resource. Please indicate how much you agree or disagree with the improvement of strategies based on the 5-point scale as follows:

1. **Disagree strongly**
2. **Disagree**
3. **Neither agree nor disagree**
4. **Agree**
5. **Agree strongly**

	Attributes	**Scale**				
(a)	Setting an integrated strategic plan	**1**	**2**	**3**	**4**	**5**
(b)	Providing good training to all staff	**1**	**2**	**3**	**4**	**5**
(c)	Increasing funding for new investment e.g. sophisticated tools or instruments, upgrades to reservoirs.	**1**	**2**	**3**	**4**	**5**
(d)	Encouraging education and awareness e.g. "*Mesra Pelanggan*" (customer-friendly) roadshow.	**1**	**2**	**3**	**4**	**5**

SECTION C: SOCIOECONOMIC CHARACTERISTICS

Instruction: Please tick (✓) your answer in the box provided.

Q19. Gender

- ☐ Male
- ☐ Female

Q20. What is your ethnic group?

- ☐ Malay
- ☐ Chinese
- ☐ Indian
- ☐ Other: please state ____________

Q21. What is your age group?

- ☐ 20 – 30 years
- ☐ 31 – 40 years
- ☐ 41 – 50 years
- ☐ More than 51 years

Q22. How many children are there in your family?

- ☐ 2 children or fewer
- ☐ 3 – 5 children
- ☐ 6 – 8 children
- ☐ More than 9 children

Q23. How many persons are there in your family?

- ☐ 2 persons or fewer
- ☐ 3 – 5 persons
- ☐ 6 – 8 persons
- ☐ More than 9 persons

Q24. What type of house do you live in?

- ☐ Terraced
- ☐ Two-storey
- ☐ Semi-detached
- ☐ Bungalow
- ☐ Other: please state ____________

Q25. What is your education level?

- ☐ Primary school
- ☐ Secondary school
- ☐ College
- ☐ University degree

Q26. What is your current type of work?

- ☐ Support staff
- ☐ Professional
- ☐ Other: please state ______________

Q27. What is your household income level?

- ☐ MYR500 or less per month
- ☐ MYR501 – MYR1,500 per month
- ☐ MYR1,501 – MYR2,500 per month
- ☐ More than MYR2,501 per month

– Thank you for your cooperation –

APPENDIX B: CROSS TAB AND CORRELATION

Appendix B1: Cross Tab Water Service Performance and Socioeconomics

	(a) Leakage									
	1		2		3		4		5	
Gender	***n***	***%***	***n***	***%***	***n***	***%***	***n***	***%***	***n***	***%***
Male	2	0.51	4	1.02	6	1.53	110	28.06	113	28.83
Female	1	0.26	1	0.26	4	1.02	70	17.86	81	20.66
Ethnic										
Malay	3	0.77	4	1.02	8	2.04	149	38.01	165	42.09
Chinese	-	-	1	0.26	2	0.51	20	5.10	25	6.38
Indian	-	-	-	-	-	-	7	1.79	4	1.02
Others	-	-	-	-	-	-	4	1.02	-	-
Age										
20-30 years	8	2.05	22	5.63	14	3.58	69	17.65	37	9.46
31-40 years	2	0.51	7	1.79	3	0.77	43	11.00	20	5.12
41-50 years	6	1.53	9	2.30	5	1.28	48	12.28	15	3.84
More than 51 years	6	1.53	9	2.30	6	1.53	46	11.76	16	4.09
Child										
2 children or fewer	10	2.58	28	7.24	22	5.68	109	28.17	45	11.63
3-5 children	6	1.55	14	3.62	4	1.02	68	17.57	29	7.49
6-8 children	5	1.29	5	1.29	2	0.51	21	5.43	8	2.07
More than 9 children	1	0.26	-	-	-	-	5	1.29	5	1.29
Person										
2 persons or fewer	3	0.77	2	0.51	5	1.28	34	8.72	22	5.64
3-5 persons	6	1.54	30	7.69	18	4.62	99	25.38	27	6.92
6-8 persons	8	2.05	13	3.33	3	0.77	59	15.13	30	7.69
More than 9 persons	5	1.28	2	0.51	2	0.51	14	3.59	8	2.05
House										
Terraced	10	2.56	11	2.81	16	4.09	84	21.48	24	6.14
Two-storey	7	1.79	14	3.58	7	1.79	54	13.81	25	6.39
Semi-detached	1	0.26	4	1.02	-	-	16	4.09	8	2.05
Bungalow	1	0.26	7	1.79	3	0.77	16	4.09	3	0.77
Others	3	0.77	11	2.81	2	0.51	36	9.21	28	7.16
Education										
Primary school	1	0.26	3	0.77	2	0.51	24	6.15	9	2.31
Secondary	4	1.02	12	3.08	3	0.77	74	18.97	29	7.44
College	9	2.31	10	2.56	9	2.31	52	13.33	31	7.95
University degree	8	2.05	22	5.64	14	3.59	55	14.10	19	4.87
Work										
Support staff	3	0.77	13	3.33	9	2.31	59	15.13	22	5.64
Professional	10	2.56	10	2.56	7	1.79	55	14.10	23	5.90
Others	9	2.31	24	6.15	12	3.08	92	23.59	42	1.77

Appendix B: Cross Tab and Correlation

	(a) Leakage									
	1		2		3		4		5	
Income										
MYR500 or less per month	2	0.51	6	1.53	3	0.77	22	5.63	9	2.30
MYR501 – MYR1,500 per month	4	1.02	14	3.58	9	2.30	52	13.30	25	6.39
MYR1,501 – MYR2,500 per month	9	2.30	10	2.56	7	1.79	74	18.93	33	8.44
More than MYR2,501 per month	7	1.79	17	4.35	9	2.30	58	14.83	21	5.37

	(b) Burst pipes									
	1		2		3		4		5	
Gender	***n***	***%***	***n***	***%***	***n***	***%***	***n***	***%***	***n***	***%***
Male	1	0.26	1	0.26	3	0.77	122	31.12	108	27.55
Female	1	0.26	1	0.26	3	0.77	72	18.37	80	20.41
Ethnic										
Malay	2	0.51	2	0.51	5	1.28	161	41.07	159	40.56
Chinese	-	-	-	-	1	0.26	22	5.61	25	6.38
Indian	-	-	-	-	-	-	7	1.79	4	1.02
Others	-	-	-	-	-	-	4	1.02	-	-
Age										
20-30 years	8	2.04	18	4.59	17	4.34	68	17.35	40	10.20
31-40 years	3	0.77	4	1.02	3	0.77	45	11.48	20	5.10
41-50 years	6	1.53	5	1.28	6	1.53	49	12.50	17	4.34
More than 51 years	6	1.53	9	2.30	5	1.28	46	11.73	17	4.34
Child										
2 children or fewer	9	2.32	24	6.19	22	5.67	110	28.35	49	12.63
3-5 children	9	2.32	8	2.06	7	1.80	67	17.27	31	7.99
6-8 children	4	1.03	3	0.77	2	0.51	24	6.19	8	2.06
More than 9 children	1	0.26	1	0.26	-	-	4	1.02	5	1.29
Person										
2 persons or fewer	3	0.77	3	0.77	8	2.05	33	8.44	20	5.12
3-5 persons	9	2.30	19	4.86	15	3.84	103	26.34	34	8.70
6-8 persons	9	2.30	11	2.81	6	1.53	58	14.83	29	7.42
More than 9 persons	2	0.51	3	0.77	2	0.51	14	3.58	10	2.56

	(b) Burst pipes									
	1		2		3		4		5	
House										
Terraced	8	2.04	9	2.30	16	4.08	79	20.15	33	8.42
Two-storey	7	1.79	15	3.83	7	1.79	54	13.78	24	6.12
Semi-detached	3	0.77	1	0.26	2	0.51	14	3.57	9	2.30
Bungalow	1	0.26	8	2.04	2	0.51	18	4.59	2	0.51
Others	4	1.02	3	0.77	4	1.02	43	10.97	26	6.63
Education										
Primary school	1	0.26	2	0.51	1	0.26	25	6.39	10	2.56
Secondary	5	1.28	9	2.30	4	1.02	74	18.93	30	7.67
College	8	2.05	7	1.79	9	2.30	55	14.07	33	8.44
University degree	9	2.30	18	4.60	17	4.35	53	13.55	21	5.37
Work										
Support staff	3	0.77	8	2.05	10	2.56	62	15.86	23	5.88
Professional	12	3.07	8	2.05	8	2.05	49	12.53	29	7.42
Others	8	2.05	20	5.12	13	3.32	97	24.81	41	10.49
Income										
MYR500 or less per month	2	0.51	7	1.79	3	0.77	20	5.10	10	2.53
MYR501 – MYR1,500 per month	5	1.28	7	1.79	8	2.04	56	14.28	29	7.40
MYR1,501 – MYR2,500 per month	9	2.30	6	1.53	9	2.30	76	19.38	33	8.42
More than MYR2,501 per month	7	1.79	16	4.08	11	2.81	56	14.28	22	5.61

	(c) Reservoir capacity									
	1		2		3		4		5	
Gender	***n***	***%***	***n***	***%***	***n***	***%***	***n***	***%***	***n***	***%***
Male	1	0.26	13	3.32	5	1.28	107	27.30	109	27.81
Female	1	0.26	6	1.53	6	1.53	62	15.82	82	20.92
Ethnic										
Malay	2	0.51	18	4.59	10	2.55	135	34.44	164	41.84
Chinese	-	-	1	0.26	1	0.26	24	6.12	22	5.61
Indian	-	-	-	-	-	-	6	1.53	5	1.28
Others	-	-	-	-	-	-	4	1.02	-	-
Age										
20-30 years	8	2.04	16	4.08	21	5.36	62	15.82	44	11.22
31-40 years	1	0.26	4	1.02	8	2.04	33	8.42	29	7.40
41-50 years	2	0.51	4	1.02	7	1.79	47	11.99	23	5.87
More than 51 years	-	-	5	1.28	6	1.53	52	13.27	20	5.10

	(c) Reservoir capacity									
	1		2		3		4		5	
Child										
2 children or fewer	8	2.06	19	4.90	26	6.70	102	26.29	59	15.21
3-5 children	3	0.77	9	2.32	10	2.58	62	15.98	38	9.79
6-8 children	-	-	-	-	6	1.55	23	5.98	12	3.09
More than 9 children	-	-	1	0.26	-	-	5	1.29	5	1.29
Person										
2 persons or fewer	3	0.77	3	0.77	7	1.79	34	8.70	20	5.12
3-5 persons	4	1.02	17	4.35	23	5.88	91	23.27	45	11.51
6-8 persons	3	0.77	9	2.30	8	2.05	55	14.07	38	9.72
More than 9 persons	1	0.26	-	-	4	1.02	14	3.58	12	3.07
House										
Terraced	4	1.02	13	3.32	14	3.57	77	19.64	37	9.44
Two-storey	1	0.26	8	2.04	9	2.30	51	13.01	38	9.69
Semi-detached	1	0.26	3	0.77	3	0.77	14	3.57	8	2.04
Bungalow	1	0.26	2	0.51	10	2.55	14	3.57	4	1.02
Others	4	1.02	3	0.77	6	1.53	38	9.69	29	7.40
Education										
Primary school	2	0.51	-	-	-	-	28	7.16	9	2.30
Secondary	3	0.77	12	3.07	5	1.28	68	17.36	34	8.70
College	1	0.26	5	1.28	11	2.81	50	12.79	45	11.51
University degree	5	1.28	12	3.07	26	6.65	47	12.02	28	7.16
Work										
Support staff	1	0.26	9	2.30	16	4.09	46	11.76	34	8.70
Professional	4	1.02	9	2.30	12	3.07	46	11.76	35	8.95
Others	6	1.53	11	2.81	14	3.58	102	26.09	46	11.76
Income										
MYR500 or less per month	2	0.51	3	0.77	4	1.02	23	5.87	10	2.55
MYR501 – MYR1,500 per month	4	1.02	8	2.04	8	2.04	54	13.78	31	7.91
MYR1,501 – MYR2,500 per month	2	0.51	4	1.02	11	2.81	66	16.84	50	12.76
More than MYR2,501 per month	3	0.77	14	3.57	19	4.85	51	13.01	25	6.38

	(d) Water quality against Ministry of Health Standards									
	1		**2**		**3**		**4**		**5**	
Gender	***n***	***%***	***n***	***%***	***n***	***%***	***n***	***%***	***n***	***%***
Male	2	0.51	2	0.51	3	0.77	44	11.22	184	46.94
Female	2	0.51	-	-	2	0.51	28	7.14	125	31.89
Ethnic										
Malay	3	0.77	1	0.26	4	1.02	61	15.56	260	66.33
Chinese	-	-	1	0.26	1	0.26	8	2.04	38	9.69
Indian	1	0.26	-	-	-	-	2	0.51	8	2.04
Others	-	-	-	-	-	-	1	0.26	3	0.77
Age										
20-30 years	21	5.36	27	6.89	13	3.32	56	14.29	34	8.67
31-40 years	5	1.28	21	5.36	1	0.26	28	7.14	20	5.10
41-50 years	9	2.30	13	3.32	1	0.26	41	10.46	19	4.85
More than 51 years	8	2.04	13	3.32	3	0.77	40	10.20	19	4.85
Child										
2 children or fewer	26	6.70	39	10.05	13	3.35	88	22.68	48	12.37
3-5 children	14	3.61	25	6.44	3	0.77	51	13.14	29	7.47
6-8 children	3	0.77	7	1.80	1	0.26	20	5.15	10	2.58
More than 9 children	-	-	2	0.51	1	0.26	4	1.03	4	1.02
Person										
2 persons or fewer	5	1.28	11	2.81	6	1.53	26	6.65	19	4.86
3-5 persons	24	6.14	39	9.97	8	2.05	76	19.44	33	8.44
6-8 persons	10	2.56	19	4.86	4	1.02	52	13.30	28	7.16
More than 9 persons	4	1.02	5	1.28	-	-	11	2.81	11	2.81
House										
Terraced	16	4.08	29	7.40	7	1.79	63	16.07	30	7.65
Two-storey	11	2.81	25	6.38	2	0.51	43	10.97	26	6.63
Semi-detached	7	1.79	2	0.51	1	0.26	13	3.32	6	1.53
Bungalow	4	1.02	5	1.28	5	1.28	12	3.06	5	1.28
Others	5	1.28	13	3.32	3	0.77	34	8.67	25	6.38
Education										
Primary school	3	0.77	4	1.02	-	-	25	6.39	7	1.79
Secondary	7	1.79	28	7.16	3	0.77	53	13.35	31	7.93
College	12	3.07	19	12.00	6	1.53	41	10.49	34	8.70
University degree	21	5.37	23	21.00	9	2.30	45	11.51	20	5.12
Work										
Support staff	10	2.56	19	4.86	4	1.02	46	11.76	27	6.91
Professional	17	4.35	19	4.86	3	0.77	42	10.74	25	6.39
Others	16	4.09	36	9.21	11	2.81	77	19.69	39	9.97

	(d) Water quality against Ministry of Health Standards									
	1		2		3		4		5	
Income										
MYR500 or less per month	4	1.02	5	1.28	24	6.12	24	6.12	7	1.79
MYR501 – MYR1,500 per month	10	2.55	20	5.10	43	10.97	43	10.97	24	6.12
MYR1,501 – MYR2,500 per month	13	3.32	22	5.61	54	13.78	54	13.78	40	10.20
More than MYR2,501 per month	14	4.08	27	6.89	44	11.22	44	11.22	21	5.36

	(e) Disruption									
	1		2		3		4		5	
Gender	***n***	***%***	***n***	***%***	***n***	***%***	***n***	***%***	***n***	***%***
Male	1	0.26	2	0.51	6	1.53	115	29.34	111	28.32
Female	3	0.77	1	0.26	11	2.81	57	14.54	85	21.68
Ethnic										
Malay	3	0.77	3	0.77	15	3.83	140	35.71	168	42.86
Chinese	1	0.26	-	-	2	0.51	22	5.61	23	5.87
Indian	-	-	-	-	-	-	7	1.79	4	1.02
Others	-	-	-	-	-	-	3	0.77	1	0.26
Age										
20-30 years	7	1.79	20	5.10	15	3.83	71	18.11	38	9.69
31-40 years	2	0.51	13	3.32	1	0.26	37	9.44	22	5.61
41-50 years	4	1.02	10	2.55	5	1.28	49	12.50	15	3.83
More than 51 years	3	0.77	10	2.55	2	0.51	50	12.76	18	4.59
Child										
2 children or fewer	7	1.80	33	8.51	17	4.38	108	27.84	49	12.63
3-5 children	6	1.55	13	3.35	6	1.55	66	17.01	31	7.99
6-8 children	3	0.77	4	1.02	-	-	25	6.44	9	2.32
More than 9 children	-	-	3	0.77	-	-	4	1.03	4	1.03
Person										
2 persons or fewer	3	0.77	7	1.79	4	1.02	33	8.44	20	5.12
3-5 persons	3	0.77	32	8.18	11	2.81	100	25.58	34	8.70
6-8 persons	8	2.05	10	2.56	7	1.79	60	15.35	28	7.16
More than 9 persons	2	0.51	4	1.02	1	0.26	14	3.58	10	2.56

House										
Terraced	5	1.28	20	5.10	12	3.06	79	20.15	29	7.40
Two-storey	4	1.02	17	4.34	3	0.77	58	14.80	25	6.38
Semi-detached	3	0.77	4	1.02	1	0.26	14	3.57	7	1.79
Bungalow	1	0.26	7	1.79	5	1.28	16	4.08	2	0.51
Others	3	0.77	5	1.28	2	0.51	40	10.20	30	7.65
Education										
Primary school	1	0.26	1	0.26	-	-	26	6.65	11	2.81
Secondary	3	0.77	16	4.09	4	1.02	69	17.65	30	7.67
College	5	1.28	10	2.56	5	1.28	56	14.32	36	9.21
University degree	7	1.79	26	6.65	14	3.58	55	14.07	16	4.09
Work										
Support staff	4	1.02	14	3.58	5	1.28	58	14.83	25	6.39
Professional	7	1.79	15	3.84	5	1.28	56	14.32	23	5.88
Others	5	1.28	24	6.14	13	3.32	93	23.79	44	11.25
Income										
MYR500 or less per month	2	0.51	5	1.28	3	0.77	24	6.12	8	2.04
MYR501 – MYR1,500 per month	3	0.77	12	3.06	9	2.30	49	12.50	32	8.16
MYR1,501 – MYR2,500 per month	5	1.28	10	2.55	6	1.53	77	19.64	35	8.93
More than MYR2,501 per month	6	1.53	26	6.63	5	1.28	57	14.54	18	4.59

	(f) Connections									
	1		**2**		**3**		**4**		**5**	
Gender	***n***	***%***	***n***	***%***	***n***	***%***	***n***	***%***	***n***	***%***
Male	1	0.26	2	0.51	10	2.55	114	29.08	108	27.55
Female	3	0.77	2	0.51	7	1.79	65	16.58	80	20.41
Ethnic										
Malay	4	1.02	4	1.02	14	3.57	145	36.99	162	41.33
Chinese	-	-	-	-	3	0.77	25	6.38	20	5.10
Indian	-	-	-	-	-	-	5	1.28	6	1.53
Others	-	-	-	-	-	-	4	1.02	-	-
Age										
20-30 years	5	1.28	11	2.81	18	4.60	76	19.44	41	10.49
31-40 years	2	0.51	3	0.77	5	1.28	43	11.00	22	5.63
41-50 years	2	0.51	6	1.53	6	1.53	49	12.53	20	5.12
More than 51 years	-	-	8	2.05	5	1.28	49	12.53	20	5.12

	(f) Connections									
	1		2		3		4		5	
Child										
2 children or fewer	5	1.29	14	3.62	24	6.20	118	30.49	53	13.70
3-5 children	4	1.03	10	2.58	9	2.33	66	17.05	33	8.53
6-8 children	-	-	2	0.51	1	0.26	24	6.20	13	3.36
More than 9 children	-	-	2	0.51	-	-	5	1.29	4	1.02
Person										
2 persons or fewer	1	0.26	3	0.77	7	1.79	35	8.97	21	5.38
3-5 persons	4	1.02	14	3.59	19	4.87	106	27.18	37	9.49
6-8 persons	4	1.02	9	2.31	5	1.28	62	15.90	32	8.21
More than 9 persons	-	-	2	0.51	3	0.77	14	3.59	12	3.08
House										
Terraced	2	0.51	11	2.81	16	4.09	83	21.23	32	8.18
Two-storey	1	0.26	8	2.05	7	1.79	58	14.83	33	8.44
Semi-detached	2	0.51	2	0.51	2	0.51	16	4.09	7	1.79
Bungalow	1	0.26	2	0.51	6	1.53	18	4.60	4	1.02
Others	3	0.77	5	1.28	3	0.77	42	10.74	27	6.91
Education										
Primary school	1	0.26	-	-	-	-	29	7.44	9	2.31
Secondary	3	0.77	9	2.31	8	2.05	73	18.72	29	7.44
College	2	0.51	6	1.54	7	1.79	55	14.10	41	10.51
University degree	3	0.77	13	3.33	19	4.87	59	15.13	24	6.15
Work										
Support staff	2	0.51	5	1.28	9	2.31	64	16.41	26	6.67
Professional	3	0.77	8	2.05	12	3.08	49	12.56	33	8.46
Others	4	1.02	15	3.85	13	3.33	104	26.67	43	11.03
Income										
MYR500 or less per month	1	0.26	2	0.51	5	1.28	27	6.91	7	1.79
MYR501 – MYR1,500 per month	2	0.51	10	2.56	8	2.05	55	14.07	30	7.67
MYR1,501 – MYR2,500 per month	3	0.77	5	1.28	8	2.05	73	18.67	43	11.00
More than MYR2,501 per month	3	0.77	11	2.81	13	3.32	62	15.86	23	5.88

	(g) Pressure									
	1		2		3		4		5	
Gender	***n***	***%***	***n***	***%***	***n***	***%***	***n***	***%***	***n***	***%***
Male	3	0.77	6	1.53	8	2.04	117	29.85	101	25.77
Female	1	0.26	8	2.04	5	1.28	67	17.09	76	19.39
Ethnic										
Malay	4	1.02	14	3.57	11	2.81	149	38.01	151	38.52
Chinese	-	-	-	-	2	0.51	26	6.63	20	5.10
Indian	-	-	-	-	-	-	6	1.53	5	1.28
Others	-	-	-	-	-	-	3	0.77	1	0.26
Age										
20-30 years	7	1.79	22	5.61	14	3.57	64	16.33	44	11.22
31-40 years	2	0.51	7	1.79	4	1.02	37	9.44	25	6.38
41-50 years	9	2.30	7	1.79	1	0.26	47	11.99	19	4.85
More than 51 years	1	0.26	4	1.02	4	1.02	55	14.03	19	4.85
Child										
2 children or fewer	10	2.58	24	6.19	15	3.87	106	27.32	59	15.21
3-5 children	7	1.80	13	3.35	6	1.55	61	15.72	35	9.02
6-8 children	1	0.26	3	0.77	2	0.51	26	6.70	9	2.32
More than 9 children	1	0.26	-	-	-	-	6	1.55	4	1.02
Person										
2 persons or fewer	6	1.53	3	0.77	5	1.28	34	8.70	19	4.86
3-5 persons	8	2.05	25	6.39	12	3.07	92	23.53	43	11.00
6-8 persons	5	1.28	8	2.05	4	1.02	62	15.86	34	8.70
More than 9 persons	-	-	4	1.02	2	0.51	15	3.84	10	2.56
House										
Terraced	5	1.28	18	4.59	8	2.04	80	20.41	34	8.67
Two-storey	5	1.28	8	2.04	4	1.02	59	15.05	31	7.91
Semi-detached	1	0.26	4	1.02	1	0.26	14	3.57	9	2.30
Bungalow	3	0.77	2	0.51	4	1.02	18	4.59	4	1.02
Others	5	1.28	8	2.04	6	1.53	32	8.16	29	7.40
Education										
Primary school	1	0.26	2	0.51	-	-	27	6.91	9	2.30
Secondary										
College	6	1.53	9	2.30	5	1.28	67	17.14	35	8.95
University	4	1.02	10	2.56	7	1.79	56	14.32	35	8.95
degree	8	2.05	19	4.86	11	2.81	52	13.35	28	7.16
Work										
Support staff	4	1.02	10	2.56	5	1.28	57	14.58	30	7.67
Professional	8	2.05	9	2.30	7	1.79	49	12.53	33	8.44
Others	7	1.79	21	5.37	11	2.81	97	24.81	43	11.00

	(g) Pressure									
	1		2		3		4		5	
Income										
MYR500 or less per month	3	0.77	7	1.79	3	0.77	22	5.61	7	1.79
MYR501 – MYR1,500 per month	3	0.77	11	2.81	8	2.04	49	12.50	34	8.67
MYR1,501 – MYR2,500 per month	8	2.04	6	1.53	5	1.28	73	18.62	41	10.46
More than MYR2,501 per month	5	1.28	16	4.08	7	1.79	59	15.05	25	6.38

	(h) Price									
	1		2		3		4		5	
Gender	***n***	***%***	***n***	***%***	***n***	***%***	***n***	***%***	***n***	***%***
Male	41	10.46	94	23.98	26	6.63	41	10.46	33	8.42
Female	37	9.44	46	11.73	17	4.34	33	8.42	24	6.12
Ethnic										
Malay	63	16.07	109	27.81	40	10.20	67	17.09	50	12.76
Chinese	13	3.32	22	5.61	2	0.51	5	1.28	6	1.53
Indian	2	0.51	7	1.79	1	0.26	-	-	1	0.26
Others	-	-	2	0.51	-	-	2	0.51	-	-
Age										
20-30 years	15	3.83	24	6.12	13	3.32	67	17.09	32	8.16
31-40 years	4	1.02	20	5.10	4	1.02	29	7.40	18	4.59
41-50 years	13	3.32	19	4.85	3	0.77	35	8.93	13	3.83
More than 51 years	9	2.30	21	5.36	3	0.77	35	8.93	15	3.83
Child										
2 children or fewer	15	3.87	37	9.54	17	4.38	106	27.32	39	10.05
3-5 children	17	4.38	35	9.02	5	1.29	38	9.79	27	6.96
6-8 children	7	1.80	10	2.58	1	0.26	15	3.87	8	2.06
More than 9 children	1	0.26	1	0.26	-	-	5	1.29	4	1.02
Person										
2 persons or fewer	4	1.02	9	2.30	7	1.79	33	8.44	14	3.58
3-5 persons	17	4.35	43	11.00	13	3.32	78	19.95	29	7.42
6-8 persons	14	3.58	26	6.65	2	0.51	45	11.51	26	6.65
More than 9 persons	6	1.53	6	1.53	1	0.26	10	2.56	8	2.05

	(h) Price									
	1		2		3		4		5	
House										
Terraced	16	4.08	27	6.89	11	2.81	67	17.09	24	6.12
Two-storey	8	2.04	2	7.14	3	0.77	43	10.97	25	6.38
Semi-detached	4	1.02	5	1.28	1	0.26	12	3.06	7	1.79
Bungalow	3	0.77	7	1.79	5	1.28	14	3.57	2	0.51
Others	10	2.55	17	4.34	3	0.77	30	7.65	20	5.10
Education										
Primary school	1	0.26	9	2.30	-	-	20	5.12	9	2.30
Secondary										
College	9	2.30	24	6.14	7	1.79	59	15.09	23	5.88
University	23	5.88	22	5.63	3	0.77	41	10.49	23	5.88
degree	8	2.05	28	7.16	13	3.32	46	11.76	23	5.88
Work										
Support staff	13	3.32	23	5.88	8	2.05	44	11.25	18	4.60
Professional	13	3.32	24	6.14	2	0.51	40	10.23	27	6.91
Others	15	3.84	37	9.46	13	3.32	82	20.97	32	8.18
Income										
MYR500 or less per month	3	0.77	8	2.04	4	1.02	20	5.10	7	1.79
MYR501 – MYR1,500 per month	10	2.55	21	5.36	6	1.53	46	11.73	22	5.61
MYR1,501 – MYR2,500 per month	18	4.59	27	6.89	7	1.79	53	13.52	28	7.14
More than MYR2,501 per month	10	2.55	28	7.14	6	1.53	47	11.99	21	5.36

Appendix B2: Cross Tab Service Factor Improvement and Socioeconomics

	(a) Reduce the level of leakage									
	1		2		3		4		5	
Gender	***n***	***%***	***n***	***%***	***n***	***%***	***n***	***%***	***n***	***%***
Male	2	0.51	4	1.02	6	1.56	110	28.6	113	29.38
Female	1	0.26	1	0.26	4	1.02	70	18.2	81	21.06
Ethnic										
Malay	3	0.77	4	1.02	8	2.08	149	38.01	165	42.09
Chinese	-	-	1	0.26	2	0.51	20	5.10	25	6.38
Indian	-	-	-	-	-	-	7	1.79	4	1.02
Others	-	-	-	-	-	-	4	1.02	-	-
Age										
20-30 years	-	-	2	0.51	5	1.28	56	14.29	88	22.45
31-40 years	1	0.26	1	0.26	1	0.26	34	8.67	38	9.69
41-50 years	1	0.26	-	-	2	0.51	45	11.48	35	8.93
More than 51 years	1	0.26	2	0.51	2	0.51	45	11.48	33	8.42
Child										
2 children or fewer	1	0.26	3	0.51	4	1.02	95	24.48	111	28.61
3-5 children	2	0.51	2	-	5	1.29	58	14.95	55	14.18
6-8 children	-	-	-	-	1	0.26	22	5.67	18	4.64
More than 9 children	-	-	-		-	-	3	0.77	8	2.06
Person										
2 persons or fewer	-	-	2	0.51	-	-	29	7.42	36	9.21
3-5 persons	3	0.77	2	0.51	1	0.26	85	21.74	89	22.76
6-8 persons	-	-	1	0.26	7	1.79	55	14.07	50	12.79
More than 9 persons	-	-	-	-	2	0.51	11	2.81	18	4.60
House										
Terraced	1	0.26	3	0.77	4	1.02	63	16.07	74	18.88
Two-storey	2	0.51	2	0.51	2	0.51	50	12.76	51	13.01
Semi-detached	-	-	-	-	-	-	12	3.06	17	4.34
Bungalow	-	-	-	-	3	0.77	17	4.34	11	2.81
Others	-	-	-	-	1	0.26	38	9.69	41	10.46
Education										
Primary school	1	0.26	-	-	1	0.26	25	6.39	12	3.07
Secondary	-	-	2	0.51	2	0.51	61	15.60	57	14.58
College	2	0.26	1	0.26	3	0.77	49	12.53	57	14.58
University Degree	-	-	2	0.51	4	1.02	44	11.25	68	17.39
Work										
Support staff	1	0.26	1	0.26	4	1.02	48	12.28	52	13.30
Professional	-	-	-	-	-	-	44	11.25	62	15.86
Others	2	0.51	4	1.02	6	1.53	88	22.51	79	20.20

	(a) Reduce the level of leakage									
	1		2		3		4		5	
Income										
MYR500 or less per month	-	-	2	0.51	2	0.51	21	5.36	17	4.34
MYR501 – MYR1,500 per month	1	0.26	-	-	5	1.28	46	11.73	53	13.52
MYR1,501 – MYR2,500 per month	2	0.51	1	0.26	1	0.26	65	16.58	64	16.58
More than MYR2,501 per month	-	-	2	0.51	2	0.51	48	12.24	60	15.31

	(b) Improve repairs to burst pipes									
	1		2		3		4		5	
Gender	***n***	***%***	***n***	***%***	***n***	***%***	***n***	***%***	***n***	***%***
Male	1	0.26	1	0.26	3	0.51	122	31.72	108	28.08
Female	1	0.26	1	0.26	3	0.51	72	18.72	80	20.8
Ethnic										
Malay	2	0.51	2	0.51	5	1.28	161	41.07	159	40.56
Chinese	-	-	-	-	1	0.26	22	5.61	25	6.38
Indian	-	-	-	-	-	-	7	1.82	4	1.02
Others	-	-	-	-	-	-	4	1.02	-	-
Age										
20-30 years	-	-	1	0.26	3	0.77	59	15.05	88	22.45
31-40 years	-	-	1	0.26	1	0.26	35	8.93	38	9.69
41-50 years	1	0.26	-	-	1	0.26	48	12.24	33	8.42
More than 51 years	1	0.26	-	-	1	0.26	52	13.27	29	7.40
Child										
2 children or fewer	1	0.26	2	0.51	3	0.77	101	26.03	107	27.58
3-5 children	1	0.26	-	-	3	0.77	62	15.98	56	14.43
6-8 children	-	-	-	-	-	-	24	6.19	17	4.38
More than 9 children	-	-	-	-	-	-	5	1.29	6	1.55
Person										
2 persons or fewer	-	-	-	-	-	-	29	7.42	38	9.72
3-5 persons	2	0.51	2	0.51	2	0.51	92	23.53	82	20.97
6-8 persons	-	-	-	-	3	0.77	59	15.09	51	13.04
More than 9 persons	-	-	-	-	1	0.26	14	3.58	16	4.09

	(b) Improve repairs to burst pipes									
	1		2		3		4		5	
House										
Terraced	1	0.26	1	0.26	1	0.26	67	17.09	75	19.13
Two-storey	1	0.26	1	0.26	2	0.51	59	15.05	44	11.22
Semi-detached	-	-	-	-	-	-	10	2.55	19	4.85
Bungalow	-	-	-	-	2	0.51	20	5.10	9	2.30
Others	-	-	-	-	1	0.26	38	9.69	41	10.46
Education										
Primary school	1	0.26	-	-	1	0.26	26	6.65	11	2.81
Secondary	-	-	-	-	1	0.26	72	18.41	49	12.53
College	1	0.26	-	-	2	0.51	50	12.79	59	15.09
University degree	-	-	2	0.51	2	0.51	45	11.51	69	17.65
Work										
Support staff	-	-	1	0.26	2	0.51	52	13.30	51	13.04
Professional	-	-	-	-	-	-	47	12.02	59	15.09
Others	2	0.26	1	0.26	4	1.02	95	24.30	77	19.69
Income										
MYR500 or less per month	-	-	1	0.26	1	0.26	24	6.12	16	4.08
MYR501 – MYR1,500 per month	1	0.26	-	-	3	0.77	49	12.50	52	13.27
MYR1,501 – MYR2,500 per month	1	0.26	-	-	1	0.26	69	17.60	62	15.82
More than MYR2,501 per month	-	-	1	0.26	1	0.26	52	13.27	58	14.80

	(c) Increase in reservoir capacity									
	1		2		3		4		5	
Gender	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*
Male	1	0.26	13	3.32	5	1.28	107	27.30	109	27.81
Female	1	0.26	6	1.53	6	1.53	62	15.82	82	20.92
Ethnic										
Malay	2	0.51	18	4.59	10	2.55	135	34.44	164	41.84
Chinese	-	-	1	0.26	1	0.26	24	6.12	22	5.61
Indian	-	-	-	-	-	-	6	1.53	5	1.28
Others	-	-	-	-	-	-	4	1.02	-	-
Age										
20-30 years	-	-	5	1.28	7	1.79	57	14.54	82	20.92
31-40 years	-	-	3	0.77	2	0.51	30	7.65	40	10.20
41-50 years	1	0.26	7	1.79	1	0.26	38	9.69	36	9.18
More than 51 years	1	0.26	4	1.02	1	1.26	44	11.22	33	8.42

	(c) Increase in reservoir capacity									
	1		2		3		4		5	
Child										
2 children or fewer	1	0.26	8	2.06	7	1.80	94	24.23	104	26.80
3-5 children	1	0.26	7	1.08	3	0.77	52	13.40	59	15.21
6-8 children	-	-	3	0.77	1	0.26	18	4.64	19	4.90
More than 9 children	-	-	1	0.26	-	-	3	0.77	7	1.80
Person										
2 persons or fewer	-	-	3	0.77	1	0.26	25	6.39	38	9.72
3-5 persons	2	0.51	8	2.05	5	1.28	85	21.74	80	20.46
6-8 persons	-	-	6	1.53	3	0.77	51	13.04	53	13.55
More than 9 persons	-	-	2	0.51	2	0.26	8	2.05	19	4.86
House										
Terraced	1	0.26	3	0.77	3	0.77	62	15.82	76	19.39
Two-storey	1	0.26	6	1.53	2	0.51	52	13.27	46	11.73
Semi-detached	-	-	3	0.77	1	0.26	6	1.53	19	4.85
Bungalow	-	-	4	1.02	3	0.77	16	4.08	8	2.04
Others	-	-	3	0.77	2	0.51	33	8.42	42	10.71
Education										
Primary school	1	0.26	1	0.26	-	-	23	5.88	14	3.58
Secondary	-	-	7	1.78	3	0.77	52	13.30	60	15.35
College	1	0.26	4	1.02	3	0.77	45	11.51	59	15.09
University degree	-	-	7	1.78	5	1.28	48	12.78	58	14.83
Work										
Support staff	-	-	6	1.53	3	0.77	46	11.76	51	13.04
Professional	-	-	6	1.53	3	0.77	40	10.23	57	14.58
Others	2	0.51	7	1.78	5	1.28	83	21.23	82	20.97
Income										
MYR500 or less per month	-	-	2	0.51	2	0.51	19	4.85	19	4.85
MYR501 – MYR1,500 per month	1	0.26	5	1.28	4	1.02	40	14.03	55	10.20
MYR1,501 – MYR2,500 per month	1	0.26	4	1.02	3	0.77	66	15.05	59	16.84
More than MYR2,501 per month	-	-	8	2.04	2	0.51	44	11.22	58	14.80

	(d) Improve the water quality against Ministry of Health Standards									
	1		2		3		4		5	
Gender	***n***	***%***	***n***	***%***	***n***	***%***	***n***	***%***	***n***	***%***
Male	2	0.51	2	0.51	3	0.77	44	11.22	184	46.94
Female	2	0.51	2	0.51	2	0.51	28	7.14	125	31.89
Ethnic										
Malay	3	0.77	1	0.26	4	1.02	61	15.56	260	66.33
Chinese	-	-	1	0.26	1	0.26	8	2.04	38	9.69
Indian	1	0.26	-	-	-	-	2	0.51	8	2.04
Others	-	-	-	-	-	-	1	0.26	3	0.77
Age										
20-30 years	2	0.51	1	0.26	3	0.77	27	6.89	118	30.10
31-40 years	-	-	-	-	1	0.26	11	2.81	63	16.07
41-50 years	1	0.26	1	0.26	1	0.26	13	3.32	67	17.09
More than 51 years	1	0.26	-	-	-	-	21	5.36	61	15.56
Child										
2 children or fewer	3	0.77	1	0.26	2	0.26	38	9.79	170	43.81
3-5 children	1	0.26	-	-	3	0.77	20	5.15	98	25.26
6-8 children	-	-	1	0.26	-	-	12	3.09	28	7.22
More than 9 children	-	-	-	-	-	-	1	0.26	10	2.58
Person										
2 persons or fewer	2	0.51	-	-	1	0.26	11	2.81	53	13.55
3-5 persons	2	0.51	1	0.26	1	0.26	27	6.91	149	38.11
6-8 persons	-	-	1	0.26	2	0.51	31	7.93	79	20.20
More than 9 persons	-	-	-	-	1	0.26	3	0.77	27	6.91
House										
Terraced	3	0.77	-	-	1	0.26	24	6.12	117	29.85
Two-storey	1	0.26	1	0.26	1	0.26	15	3.83	89	22.70
Semi-detached	-	-	-	-	-	-	3	0.77	26	6.63
Bungalow	-	-	1	0.26	3	0.77	9	2.30	18	4.59
Others	-	-	-	-	-	-	21	5.36	59	15.05
Education										
Primary school	1	0.26	-	-	-	-	17	4.35	21	5.37
Secondary	1	0.26	-	-	1	0.26	22	5.63	98	25.06
College	1	0.26	1	0.26	2	0.51	15	3.84	93	2.79
University degree	1	0.26	1	0.26	2	0.51	18	4.60	96	24.55
Work										
Support staff	-	-	1	0.26	1	0.26	19	4.86	85	21.74
Professional	1	0.26	-	-	1	0.26	12	3.07	92	23.53
Others	3	0.77	1	0.26	3	0.77	41	10.49	131	33.50

	(d) Improve the water quality against Ministry of Health Standards									
	1		2		3		4		5	
Income										
MYR500 or less per month	-	-	1	0.26	1	0.26	10	2.55	30	7.65
MYR501 – MYR1,500 per month	2	0.51	-	-	3	0.77	17	4.34	83	21.17
MYR1,501 – MYR2,500 per month	1	0.26	1	0.26	-	-	32	8.16	99	25.26
More than MYR2,501 per month	1	0.26	-	-	1	0.26	13	3.32	97	24.74

	(e) Reduce water supply disruption									
	1		2		3		4		5	
Gender	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*
Male	1	0.26	2	0.51	6	1.53	115	29.34	111	28.32
Female	3	0.77	1	0.26	11	2.81	57	14.54	85	21.68
Ethnic										
Malay	3	0.77	3	0.77	15	3.83	140	35.71	168	42.86
Chinese	1	0.26	-	-	2	0.51	22	5.61	23	5.87
Indian	-	-	-	-	-	-	7	1.79	4	1.02
Others	-	-	-	-	-	-	3	0.77	1	0.26
Age										
20-30 years	2	0.51	2	0.51	8	2.04	54	13.78	85	21.68
31-40 years	-	-	-	-	5	1.28	30	7.65	40	10.20
41-50 years	1	0.26	-	-	1	0.26	44	11.22	37	9.44
More than 51 years	1	0.26	1	0.26	3	0.77	44	11.22	34	8.67
Child										
2 children or fewer	3	0.77	3	0.77	12	3.09	87	22.42	109	28.09
3-5 children	1	0.26	-	-	3	0.77	62	15.98	56	14.43
6-8 children	-	-	-	-	2	0.51	18	4.64	21	5.41
More than 9 children	-	-	-	-	-	-	3	0.77	8	2.06
Person										
2 persons or fewer	-	-	-	-	3	0.77	22	5.63	42	10.74
3-5 persons	4	1.02	2	0.51	8	2.05	89	22.76	77	19.69
6-8 persons	-	-	1	0.26	4	1.02	49	12.53	59	15.09
More than 9 persons	-	-	-	-	2	0.51	12	3.07	17	4.35

	(e) Reduce water supply disruption									
	1		2		3		4		5	
House										
Terraced	1	0.26	1	0.26	7	1.79	63	16.07	73	18.62
Two-storey	2	0.51	2	0.51	5	1.28	47	11.99	51	13.01
Semi-detached	-	-	-	-	1	0.26	12	3.06	16	4.08
Bungalow	-	-	-	-	2	0.51	13	3.32	16	4.08
Others	1	0.26	-	-	2	0.51	37	9.44	40	10.20
Education										
Primary school	1	0.26	-	-	1	0.26	26	6.65	11	2.81
Secondary	-	-	2	0.51	4	1.02	55	14.07	61	15.60
College	1	0.26	-	-	6	1.53	45	11.51	60	15.35
University degree	2	0.51	1	0.26	6	1.53	46	11.76	63	16.11
Work										
Support staff	1	0.26	1	0.26	8	2.05	43	11	53	13.55
Professional	-	-	-	-	2	0.51	45	11.51	59	15.09
Others	3	0.77	2	0.51	7	1.79	84	21.48	83	21.23
Income										
MYR500 or less per month	-	-	1	0.26	3	0.77	19	4.85	19	4.85
MYR501 – MYR1,500 per month	2	0.51	1	0.26	3	0.77	40	10.20	59	15.05
MYR1,501 – MYR2,500 per month	2	0.51	-	-	7	1.79	61	15.56	63	16.07
More than MYR2,501 per month	-	-	1	0.26	4	1.02	52	13.27	55	14.03

	(f) Improve the time taken for connections									
	1		2		3		4		5	
Gender	***n***	***%***	***n***	***%***	***n***	***%***	***n***	***%***	***n***	***%***
Male	1	0.26	2	0.51	10	2.55	114	29.08	108	27.55
Female	3	0.77	2	0.51	7	1.79	65	16.58	80	20.41
Ethnic										
Malay	4	1.02	4	1.02	14	3.57	145	36.99	162	41.33
Chinese	-	-	-	-	3	0.77	25	6.38	20	5.10
Indian	-	-	-	-	-	-	5	1.28	6	1.53
Others	-	-	-	-	-	-	4	1.02	-	-
Age										
20-30 years	2	0.51	2	0.51	10	2.55	58	14.80	79	20.15
31-40 years	-	-	-	-	5	1.28	28	7.14	42	10.71
41-50 years	1	0.26	1	0.26	1	0.26	45	11.48	35	8.93
More than 51 years	1	0.26	1	0.26	1	0.26	48	12.24	32	8.16

	(f) Improve the time taken for connections									
	1		2		3		4		5	
Child										
2 children or fewer	3	0.77	3	0.77	11	2.84	93	23.97	104	26.80
3-5 children	1	0.26	1	0.26	5	0.26	58	14.95	57	14.69
6-8 children	-	-	-	-	1	-	22	5.67	18	4.64
More than 9 children	-	-	-	-	-		4	1.03	7	1.80
Person										
2 persons or fewer	-	-	-	-	4	1.02	27	6.91	36	9.21
3-5 persons	4	1.02	2	0.51	7	1.79	88	22.51	79	20.20
6-8 persons	-	-	2	0.51	4	1.02	53	13.55	54	13.81
More than 9 persons	-	-	-	-	2	0.51	11	2.81	18	4.60
House										
Terraced	1	0.26	-	-	7	1.79	64	16.33	73	18.62
Two-storey	2	0.51	3	0.77	5	1.28	49	12.50	48	12.24
Semi-detached	-	-	-	-	1	0.26	11	2.81	17	4.34
Bungalow	-	-	-	-	2	0.26	19	4.85	10	2.55
Others	1	0.26	1	0.26	2	0.51	36	9.18	40	10.20
Education										
Primary school	1	0.26	-	-	1	0.26	24	6.14	13	3.32
Secondary	-	-	2	0.51	1	0.26	60	15.35	59	15.09
College	2	0.51	1	0.26	6	1.53	47	12.02	56	14.32
University degree	1	0.26	1	0.26	9	2.30	47	12.02	60	15.35
Work										
Support staff	1	0.26	2	0.51	8	2.05	46	11.76	49	12.33
Professional	-	-	-	-	2	0.51	45	11.51	59	15.09
Others	3	0.77	2	0.51	7	1.79	88	22.51	79	20.20
Income										
MYR500 or less per month	-	-	1	0.26	4	1.02	21	5.36	16	4.08
	2	0.51	-	-	4	1.02	42	10.71	57	14.54
MYR501 – MYR1,500 per month	2	0.51	2	0.51	4	1.02	63	16.07	62	15.82
MYR1,501 – MYR2,500 per month	-	-	1	0.26	5	1.28	53	13.52	53	13.52
More than MYR2,501 per month										

	(g) Increase the level of pressure									
	1		2		3		4		5	
Gender	***n***	***%***	***n***	***%***	***n***	***%***	***n***	***%***	***n***	***%***
Male	3	0.77	6	1.53	8	2.04	117	29.85	101	25.77
Female	1	0.26	8	2.04	5	1.28	67	17.09	76	19.39
Ethnic										
Malay	4	1.02	14	3.57	11	2.81	149	38.01	151	38.52
Chinese	-	-	-	-	2	0.51	26	5.10	20	5.10
Indian	-	-	-	-	-	-	6	1.28	5	1.28
Others	-	-	-	-	-	-	3	0.77	1	0.26
Age										
20-30 years	-	-	8	2.04	9	2.30	54	13.78	80	20.41
31-40 years	2	0.51	4	1.02	2	0.51	39	9.95	28	7.14
41-50 years	1	0.26	-	-	-	-	42	10.71	40	10.20
More than 51 years	1	0.26	2	0.51	2	0.51	49	12.50	29	7.40
Child										
2 children or fewer	2	0.51	8	2.06	8	2.06	94	24.23	102	26.29
3-5 children	2	0.51	3	0.77	4	1.02	62	15.98	51	13.14
6-8 children	-	-	2	0.51	1	0.26	22	5.67	16	4.12
More than 9 children	-	-	-	-	-	-	4	1.02	7	1.80
Person										
2 persons or fewer	-	-	-	-	4	1.02	26	6.63	37	9.46
3-5 persons	4	-	10	2.55	3	0.77	92	23.53	71	18.16
6-8 persons	-	-	3	0.77	3	0.77	58	14.83	49	12.54
More than 9 persons	-		1	0.26	3	0.77	8	2.05	19	4.86
House										
Terraced	1	0.26	4	1.02	6	1.53	62	15.82	72	18.37
Two-storey	2	0.51	8	2.04	3	0.77	54	13.78	40	10.20
Semi-detached	1	0.26	-	-	1	0.26	11	2.81	16	4.08
Bungalow	-	-	-	-	2	0.51	21	5.36	8	2.04
Others	-	-	2	0.51	1	0.26	36	9.18	41	10.46
Education										
Primary school	1	0.26	-	-	1	0.26	25	6.39	12	3.07
Secondary	1	0.26	5	1.28	1	0.26	64	16.37	51	13.04
College	1	0.26	6	1.53	7	1.79	43	11.00	55	14.07
University degree	1	0.26	3	0.77	4	1.02	51	13.04	59	15.07
Work										
Support staff	1	0.26	6	1.53	4	1.02	55	14.07	41	10.49
Professional	-	-	1	0.26	2	0.51	43	11.00	59	15.09
Others	3	0.77	7	1.76	7	1.79	86	21.99	76	19.44

	(g) Increase the level of pressure									
	1		2		3		4		5	
Income										
MYR500 or less per month	-	-	1	0.26	4	1.02	20	5.10	17	4.34
MYR501 – MYR1,500 per month	2	0.51	4	1.02	4	1.02	42	10.71	53	13.52
MYR1,501 – MYR2,500 per month	1	0.26	8	2.04	3	0.77	68	17.35	53	13.52
More than MYR2,501 per month	1	0.26	1	0.26	2	0.51	54	13.78	54	13.78

	(h) Increase in price									
	1		2		3		4		5	
Gender	***n***	***%***	***n***	***%***	***n***	***%***	***n***	***%***	***n***	***%***
Male	41	10.46	94	23.98	26	6.63	41	10.46	33	8.42
Female	37	9.44	46	11.73	17	4.34	33	8.42	24	6.12
Ethnic										
Malay	63	16.07	109	27.81	40	10.20	67	17.09	50	12.76
Chinese	13	3.32	22	5.61	2	0.51	2	0.51	6	1.53
Indian	2	0.51	7	1.79	1	0.26	1	0.26	1	0.26
Others	-	-	2	0.51	-	-	-	-	-	-
Age										
20-30 years	35	8.93	41	10.46	19	4.85	28	7.14	28	7.14
31-40 years	11	2.81	30	7.65	12	3.06	13	3.32	9	2.30
41-50 years	19	4.85	32	8.16	2	0.51	19	4.85	11	2.81
More than 51 years	13	3.32	37	9.44	10	2.55	14	3.57	9	2.30
Child										
2 children or fewer	43	11.08	70	18.04	28	7.22	40	10.31	33	8.51
3-5 children	26	6.70	52	13.40	10	2.58	19	4.90	15	3.87
6-8 children										
More than 9 children	7	1.80	13	3.35	3	0.77	11	2.84	7	1.80
	2	0.51	4	1.03	2	0.51	2	0.51	1	0.26
Person										
2 persons or fewer	11	2.81	18	4.60	8	2.05	16	4.09	14	3.58
3-5 persons	35	8.95	78	19.95	22	5.63	28	7.16	17	4.35
6-8 persons	26	6.65	36	9.21	7	1.79	24	6.14	20	5.12
More than 9 persons	6	1.53	8	2.05	6	1.53	5	1.28	6	1.53

	(h) Increase in price									
	1		2		3		4		5	
House										
Terraced	31	7.91	48	12.24	17	4.34	31	7.91	18	4.59
Two-storey	26	6.63	46	11.73	8	2.04	11	2.81	16	4.08
Semi-detached	4	1.02	8	2.04	2	0.51	9	2.30	6	1.53
Bungalow	2	1.02	8	2.04	7	1.79	12	3.06	2	0.51
Others	15	0.51	30	7.65	9	2.30	11	2.81	15	3.83
Education										
Primary school	6	1.53	14	3.58	1	0.26	13	3.32	5	1.28
Secondary	26	6.65	49	12.53	9	2.30	26	6.65	12	3.07
College	19	4.86	39	9.97	15	3.84	17	4.35	22	5.63
University degree	27	6.91	37	9.46	18	4.60	18	4.60	18	4.60
Work										
Support staff	16	4.09	18	4.6	19	4.86	34	8.70	19	4.86
Professional	21	5.37	16	4.09	8	2.05	40	10.23	21	5.37
Others	20	5.12	40	10.23	16	4.09	66	16.88	37	9.46
Income										
MYR500 or less per month	8	2.04	11	2.81	6	1.53	14	3.37	3	0.77
MYR501 – MYR1,500 per month	27	6.89	33	8.42	13	3.32	18	4.59	14	3.57
MYR1,501 – MYR2,500 per month	21	5.36	55	14.03	12	3.06	22	5.61	23	5.87
More than MYR2,501 per month	22	5.61	41	10.46	12	3.06	20	5.10	17	4.34

Appendix B3: Cross Tab Improvement of Strategies and Socioeconomics

	(a) Setting up an integrated strategic plan									
	1		2		3		4		5	
Gender	***n***	**%**	***n***	**%**	***n***	**%**	***n***	**%**	***n***	**%**
Male	-	-	3	0.77	2	0.51	133	34.02	97	24.81
Female	-	-	2	0.51	3	0.77	82	20.97	69	17.65
Ethnic										
Malay	-	-	3	0.77	4	1.02	179	45.78	142	36.32
Chinese	-	-	1	0.26	1	0.26	25	6.39	21	5.37
Indian	-	-	-	-	-	-	8	2.05	3	0.77
Others	-	-	-	-	-	-	-	-	-	-
Age										
20-30 years	3	0.77	3	0.77	3	0.77	71	18.16	74	18.93
31-40 years	-	-	-	-	1	0.26	43	11.00	31	7.93
41-50 years	2	0.51	2	0.51	-	-	46	11.76	34	8.70
More than 51 years	-	-	-	-	1	0.26	55	14.07	27	6.91
Child										
2 children or fewer	-	-	3	0.77	3	0.77	114	29.46	94	24.29
3-5 children	-	-	2	0.51	2	0.51	67	17.31	50	12.92
6-8 children	-	-	-	-	-	-	26	6.72	15	3.88
More than 9 children	-	-	-	-	-	-	5	1.29	6	1.55
Person										
2 persons or fewer	-	-	-	-	2	0.51	32	8.21	33	8.46
3-5 persons	-	-	5	1.28	1	0.26	106	27.18	67	17.18
6-8 persons	-	-	-	-	2	0.51	62	15.90	49	12.56
More than 9 persons	-	-	-	-	-	-	15	3.85	16	4.10
House										
Terraced	-	-	2	0.51	1	0.26	75	19.18	67	17.14
Two-storey	-	-	1	0.26	1	0.26	67	17.14	37	9.46
Semi-detached	-	-	2	0.51	-	-	17	4.35	10	2.56
Bungalow	-	-	-	-	1	0.26	20	5.12	10	2.56
Others	-	-	-	-	2	0.51	36	9.21	42	10.74
Education										
Primary school	-	-	-	-	-	-	25	6.41	14	3.59
Secondary	-	-	-	-	2	0.51	72	18.46	48	12.31
College	-	-	3	0.77	2	0.51	51	13.08	55	14.10
University degree	-	-	2	0.51	1	0.26	66	16.92	49	12.56
Work										
Support staff	-	-	1	0.26	1	0.26	56	14.36	48	12.31
Professional	-	-	2	0.51	1	0.26	55	14.10	48	12.31
Others	-	-	2	0.51	3	0.77	104	26.67	69	17.69

	(a) Setting up an integrated strategic plan									
	1		2		3		4		5	
Income										
MYR500 or less per month	-	-	-	-	1	0.26	26	6.65	15	3.84
MYR501 – MYR1,500 per month	-	-	-	-	3	0.77	52	13.30	50	12.79
MYR1,501 – MYR2,500 per month	-	-	2	0.51	1	0.26	74	18.93	55	14.07
More than MYR2,501 per month	-	-	3	0.77	-	-	63	16.11	46	11.76

	(b) Providing good quality training to all staff									
	1		2		3		4		5	
Gender	***n***	***%***	***n***	***%***	***n***	***%***	***n***	***%***	***n***	***%***
Male	-	-	2	0.51	3	0.77	115	29.34	115	29.34
Female	1	0.26	1	0.26	3	0.77	63	16.07	89	16.07
Ethnic										
Malay	1	0.26	-	-	5	1.28	146	37.24	177	45.15
Chinese	-	-	2	0.51	1	0.26	22	5.61	23	5.87
Indian	-	-	-	-	-	-	8	2.04	3	0.77
Others	1	0.26	1	0.26	-	-	2	0.51	1	0.26
Age										
20-30 years	1	0.26	2	0.51	1	0.26	56	14.29	91	23.21
31-40 years	-	-	-	-	1	0.26	38	9.69	36	9.18
41-50 years	-	-	1	0.26	3	0.77	38	9.69	41	10.46
More than 51 years	-	-	-	-	1	0.26	46	11.73	36	9.18
Child										
2 children or fewer	1	0.26	3	0.77	3	0.77	92	23.71	115	29.64
3-5 children	-	-	-	-	3	0.77	61	15.72	58	14.95
6-8 children	-	-	-	-	-	-	19	4.90	2	5.67
More than 9 children	-	-	-	-	-	-	4	1.03	7	1.80
Person										
2 persons or fewer	-	-	-	-	1	0.26	30	7.67	36	9.21
3-5 persons	-	-	3	0.77	2	0.51	84	21.48	91	23.27
6-8 persons	1	0.26	-	-	3	0.77	52	13.30	57	14.58
More than 9 persons	-	-	-	-	-	-	12	3.07	19	4.86

	(b) Providing good quality training to all staff									
	1		2		3		4		5	
House										
Terraced	-	-	-	-	2	0.51	63	16.07	80	20.41
Two-storey	-	-	2	0.51	1	0.26	54	13.78	50	1.76
Semi-detached	-	-	1	0.26	-	-	12	3.06	16	4.08
Bungalow	-	-	-	-	1	0.26	21	5.36	9	2.30
Others	-	-	-	-	2	0.51	28	7.14	49	12.50
Education										
Primary school	1	0.26	-	-	-	-	24	6.14	14	3.58
Secondary	-	-	-	-	2	0.56	58	14.83	62	15.86
College	-	-	1	0.16	4	1.02	40	10.23	67	17.14
University degree	-	-	2	0.51	-	-	55	14.07	61	15.60
Work										
Support staff	-	-	1	0.26	1	0.26	48	12.28	56	14.32
Professional	-	-	1	0.26	2	0.51	44	11.25	59	15.09
Others	1	0.26	1	0.26	3	0.77	86	21.99	88	22.51
Income										
MYR500 or less per month	-	-	-	-	1	0.26	22	5.61	19	4.85
MYR501 – MYR1,500 per month	1	0.26	1	0.26	2	0.51	40	10.20	62	15.82
MYR1,501 – MYR2,500 per month	-	-	1	0.26	2	0.51	62	15.82	68	17.35
More than MYR2,501 per month	-	-	2	0.51	1	0.26	54	13.78	55	14.03

	(c) Increasing funding for new investment e.g. sophisticated tools or instruments, upgrades to reservoirs									
	1		2		3		4		5	
Gender	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*
Male	-	-	4	1.02	6	1.53	120	30.61	105	26.79
Female	-	-	1	0.26	4	1.02	78	19.90	74	18.88
Ethnic										
Malay	-	-	3	0.77	8	2.04	164	41.84	154	39.29
Chinese	-	-	1	0.26	1	0.26	24	6.12	22	5.61
Indian	-	-	-	-	-	-	8	2.04	3	0.77
Others	-	-	1	0.26	1	0.26	2	0.51	-	-

	(c) Increasing funding for new investment e.g. sophisticated tools or instruments, upgrades to reservoirs									
	1		2		3		4		5	
Age										
20-30 years	-	-	1	0.26	4	1.02	68	17.35	78	19.90
31-40 years	-	-	-	-	2	0.51	37	9.44	36	9.18
41-50 years	-	-	2	0.51	2	0.51	43	10.97	36	9.18
More than 51 years	-	-	2	0.51	2	0.51	50	12.76	29	7.40
Child										
2 children or fewer	-	-	3	0.77	5	1.29	107	27.58	99	25.52
3-5 children	-	-	2	0.51	3	0.77	62	15.98	55	14.18
6-8 children	-	-	-	-	1	0.26	22	5.67	18	4.64
More than 9 children	-	-	-	-	1	0.26	4	1.03	6	1.55
Person										
2 persons or fewer	-	-	-	-	1	0.26	33	8.44	33	8.44
3-5 persons	-	-	4	1.02	4	1.02	97	24.81	75	19.18
6-8 persons	-	-	1	0.26	4	1.02	54	13.81	54	13.81
More than 9 persons	-	-	-	-	1	0.26	14	3.58	16	4.09
House										
Terraced	-	-	-	-	2	0.51	73	18.62	70	17.86
Two-storey	-	-	3	0.77	1	0.26	54	13.78	49	12.50
Semi-detached	-	-	1	0.26	-	-	15	3.83	13	3.32
Bungalow	-	-	-	-	3	0.77	20	5.10	8	2.04
Others	-	-	1	0.26	4	1.02	36	9.18	39	9.95
Education										
Primary school	-	-	-	-	1	0.26	25	6.39	13	3.32
Secondary	-	-	1	0.26	3	0.77	68	17.39	50	12.79
College	-	-	2	0.51	1	0.26	46	11.76	63	16.11
University degree	-	-	2	0.51	3	0.77	58	14.83	53	13.55
Work										
Support staff	-	-	1	0.26	2	0.51	48	12.28	55	14.07
Professional	-	-	2	0.51	1	0.26	50	12.79	53	13.53
Others	-	-	2	0.51	7	1.79	100	25.58	70	17.90

	(c) Increasing funding for new investment e.g. sophisticated tools or instruments, upgrades to reservoirs									
	1		**2**		**3**		**4**		**5**	
Income										
MYR500 or less per month	-	-	-	-	2	0.51	27	6.89	13	3.32
MYR501 – MYR1,500 per month	-	-	2	0.51	2	0.51	51	13.01	50	12.76
MYR1,501 – MYR2,500 per month	-	-	-	-	5	1.28	66	16.84	62	15.82
More than MYR2,501 per month	-	-	3	0.77	1	0.26	54	13.78	54	13.78

	(d) Encouraging education and awareness e.g. "*Mesra Pelanggan*" (customer-friendly) roadshow									
	1		**2**		**3**		**4**		**5**	
Gender	***n***	***%***	***n***	***%***	***n***	***%***	***n***	***%***	***n***	***%***
Male	-	-	3	0.77	6	1.53	109	27.81	117	29.85
Female	-	-	2	0.51	3	0.77	67	17.09	85	21.68
Ethnic										
Malay	-	-	3	0.77	8	2.04	144	36.73	174	44.39
Chinese	-	-	1	0.26	1	0.26	23	5.87	23	5.87
Indian	-	-	-	-	-	-	7	1.79	4	1.02
Others	-	-	1	0.26	-	-	2	0.51	1	0.26
Age										
20-30 years	-	-	2	0.51	4	1.02	57	14.54	88	22.45
31-40 years	-	-	-	-	2	0.51	33	8.42	40	10.20
41-50 years	-	-	1	0.26	1	0.26	41	10.46	40	10.20
More than 51 years	-	-	2	0.51	2	0.51	45	11.48	34	8.67
Child										
2 children or fewer	-	-	5	1.29	4	1.03	89	22.94	116	29.90
3-5 children	-	-	-	-	4	1.03	59	15.21	59	15.21
6-8 children	-	-	-	-	-	-	22	5.67	19	4.90
More than 9 children	-	-	-	-	1	0.26	4	1.03	6	1.55
Person										
2 persons or fewer	-	-	1	0.26	1	0.26	26	6.65	39	9.97
3-5 persons	-	-	4	1.02	5	1.28	87	22.25	84	21.48
6-8 persons	-	-	-	-	3	0.77	50	12.79	60	15.35
More than 9 persons	-	-	-	-	-	-	13	3.32	18	4.60

	(d) Encouraging education and awareness e.g. "*Mesra Pelanggan*" (customer-friendly) roadshow									
	1		**2**		**3**		**4**		**5**	
House										
Terraced	-	-	1	0.26	1	0.26	65	16.58	78	19.90
Two-storey	-	-	3	0.77	1	0.26	55	14.03	48	12.24
Semi-detached	-	-	1	0.26	-	-	11	2.81	17	4.34
Bungalow	-	-	-	-	4	1.02	16	4.08	11	2.81
Others	-	-	-	-	3	0.77	29	7.40	48	12.24
Education										
Primary school	-	-	-	-	-	-	21	5.37	18	4.60
Secondary	-	-	-	-	2	0.51	58	14.83	62	15.86
College	-	-	2	0.51	2	0.51	45	11.51	63	16.11
University degree	-	-	3	0.77	5	1.28	51	13.04	59	15.09
Work										
Support staff	-	-	-	-	3	0.77	44	11.25	59	15.09
Professional	-	-	3	0.77	1	0.26	46	11.76	56	14.32
Others	-	-	2	0.51	5	1.28	86	21.99	86	21.99
Income										
MYR500 or less per month	-	-	-	-	2	0.51	22	5.61	18	4.59
MYR501 – MYR1,500 per month	-	-	1	0.26	3	0.77	41	10.46	60	15.31
MYR1,501 – MYR2,500 per month	-	-	1	0.26	3	0.77	62	15.82	67	17.09
More than MYR2,501 per month	-	-	3	0.77	1	0.26	51	13.01	57	14.54

Appendix B4

Appendix B4.1 (a): Correlation of Service Quality Performance with Malay

Spearman Correlation Coefficients, n = 329
Prob > |r| under H0: Rho=0

	Leakage	Burst Pipes	Reservoir	Water Quality	Disruption	Connection	Pressure	Price
Leakage	1.00000	0.81343 (<.0001)*	0.50859 (<.0001)*	0.45047 (<.0001)*	0.64890 (<.0001)*	0.54019 (<.0001)*	0.52930 (<.0001)*	0.26410 (<.0001)*
Burst Pipes	0.81343 (<.0001)*	1.00000	0.53834 (<.0001)*	0.46955 (<.0001)*	0.68564 (<.0001)*	0.58344 (<.0001)*	0.54467 (<.0001)*	0.21771 (<.0001)*
Reservoir	0.50859 (<.0001)*	0.53834 (<.0001)*	1.00000	0.42760 (<.0001)*	0.61447 (<.0001)*	0.58685 (<.0001)*	0.58342 (<.0001)*	0.22223 (<.0001)*
Water Quality	0.45047 (<.0001)*	0.46955 (<.0001)*	0.42760 (<.0001)*	1.00000	0.53652 (<.0001)*	0.46456 (<.0001)*	0.39188 (<.0001)*	0.21771 (<.0001)*
Disruption	0.64890 (<.0001)*	0.68564 (<.0001)*	0.61447 (<.0001)*	0.53652 (<.0001)*	1.00000	0.66299 (<.0001)*	0.58593 (<.0001)*	0.26232 (<.0001)*
Connection	0.54019 (<.0001)*	0.58344 (<.0001)*	0.58685 (<.0001)*	0.46456 (<.0001)*	0.66299 (<.0001)*	1.00000	0.64974 (<.0001)*	0.27382 (<.0001)*
Pressure	0.52930 (<.0001)*	0.54467 (<.0001)*	0.58342 (<.0001)*	0.39188 (<.0001)*	0.58593 (<.0001)*	0.64974 (<.0001)*	1.00000	0.27349 (<.0001)*
Price	0.26410 (<.0001)*	0.21771 (<.0001)*	0.22223 (<.0001)*	0.21771 (<.0001)*	0.26232 (<.0001)*	0.27382 (<.0001)*	0.27349 (<.0001)*	1.00000

***** Significant at 1%

Appendix B4.1 (b): Correlation of Service Quality Performance with Chinese

Spearman Correlation Coefficients, n = 48 Prob > |r| under H0: Rho=0								
	Leakage	**Burst Pipes**	**Reservoir**	**Water Quality**	**Disruption**	**Connection**	**Pressure**	**Price**
Leakage	1.00000	0.93423 (<.0001)*	0.79404 (<.0001)*	0.57247 (<.0001)*	0.73342 (<.0001)*	0.73246 (<.0001)*	0.61692 (<.0001)*	0.73078 (<.0001)*
Burst Pipes	0.93423 (<.0001)*	1.00000	0.81862 (<.0001)*	0.64037 (<.0001)*	0.75073 (<.0001)*	0.67850 (<.0001)*	0.57615 (<.0001)*	0.77010 (<.0001)*
Reservoir	0.79404 (<.0001)*	0.81862 (<.0001)*	1.00000	0.79555 (<.0001)*	0.89704 (<.0001)*	0.82564 (<.0001)*	0.67033 (<.0001)*	0.60980 (<.0001)*
Water Quality	0.57247 (<.0001)*	0.64037 (<.0001)*	0.79555 (<.0001)*	1.00000	0.67748 (<.0001)*	0.58727 (<.0001)*	0.63481 (<.0001)*	0.56845 (<.0001)*
Disruption	0.73342 (<.0001)*	0.75073 (<.0001)*	0.89704 (<.0001)*	0.67748 (<.0001)*	1.00000	0.79042 (<.0001)*	0.58940 (<.0001)*	0.59532 (<.0001)*
Connection	0.73246 (<.0001)*	0.67850 (<.0001)*	0.82564 (<.0001)*	0.58727 (<.0001)*	0.79042 (<.0001)*	1.00000	0.72393 (<.0001)*	0.48633 (<.0005)*
Pressure	0.61692 (<.0001)*	0.57615 (<.0001)*	0.67033 (<.0001)*	0.63481 (<.0001)*	0.58940 (<.0001)*	0.72393 (<.0001)*	1.00000	0.57573 (<.0001)*
Price	0.73078 (<.0001)*	0.77010 (<.0001)*	0.60980 (<.0001)*	0.56845 (<.0001)*	0.59532 (<.0001)*	0.48633 (<.0005)*	0.57573 (<.0001)*	1.00000

* Significant at 1%

Appendix B4.1 (c): Correlation of Service Quality Performance with Indian

Spearman Correlation Coefficients, n = 11 Prob > |r| under H0: Rho=0								
	Leakage	**Burst Pipes**	**Reservoir**	**Water Quality**	**Disruption**	**Connection**	**Pressure**	**Price**
Leakage	1.00000	**0.90830 (0.0001)***	**0.90830 (0.0001)***	**0.73068 (0.0106)****	0.49054 0.1255	**0.72866 (0.0110)****	**0.69921 (0.0166)****	0.13587 0.6904
Burst Pipes	**0.90830 (0.0001)***	1.00000	**1.00000 (<.0001)***	**0.85635 (0.0008)***	**0.81009 (0.0025)***	**0.85398 (0.0008)***	**0.75993 (0.0066)***	0.27425 0.4144
Reservoir	**0.90830 (0.0001)***	**1.00000 (<.0001)***	1.00000	**0.85635 (0.0008)***	**0.81009 (0.0025)***	**0.85398 (0.0008)***	**0.75993 (0.0066)***	0.27425 0.4144
Water Quality	**0.73068 (0.0106)****	**0.85635 (0.0008)***	**0.85635 (0.0008)***	1.00000	**0.75979 (0.0067)***	**0.64266 (0.0330)****	0.44230 0.1731	0.02135 0.9503
Disruption	0.49054 0.1255	**0.68564 (0.0025)***	**0.81009 (0.0025)***	**0.75979 (0.0067)***	1.00000	**0.75769 (0.0069)***	**0.60305 (0.0495)****	0.38086 0.2478
Connection	**0.72866 (0.0110)****	**0.85398 (0.0008)***	**0.85398 (0.0008)***	**0.64266 (0.0330)****	**0.75769 (0.0069)***	1.00000	**0.80348 (0.0029)***	0.36195 0.2740
Pressure	**0.69921 (0.0166)****	**0.75993 (0.0066)***	**0.75993 (0.0066)***	0.44230 0.1731	**0.60305 (0.0495)****	**0.80348 (0.0029)***	1.00000	0.40059 0.2221
Price	0.13587 0.6904	0.27425 0.4144	0.27425 0.4144	0.02135 0.9503	0.38086 0.2478	0.36195 0.2740	0.40059 0.2221	1.00000

***** Significant at 1% ****** Significant at 1%

Appendix B4.2 (a): Correlation of Service Quality Performance with Age (20 to 30 years old)

Pearson Correlation Coefficients, n = 151 Prob > |r| under H0: Rho=0								
	Leakage	**Burst Pipes**	**Reservoir**	**Water Quality**	**Disruption**	**Connection**	**Pressure**	**Price**
Leakage	1.00000	**0.81835 (<.0001)***	**0.51118 (<.0001)***	**0.43307 (<.0001)***	**0.62176 (<.0001)***	**0.51702 (<.0001)***	**0.45909 (<.0001)***	**0.25536 (0.0016)***
Burst Pipes	**0.81835 (<.0001)***	1.00000	**0.55436 (<.0001)***	**0.50838 (<.0001)***	**0.70144 (<.0001)***	**0.52783 (<.0001)***	**0.45032 (<.0001)***	**0.28842 (0.0003)***
Reservoir	**0.51118 (<.0001)***	**0.55436 (<.0001)***	1.00000	**0.47410 (<.0001)***	**0.67707 (<.0001)***	**0.43853 (<.0001)***	**0.45286 (<.0001)***	**0.27293 (0.0007)***
Water Quality	**0.43307 (<.0001)***	**0.50838 (<.0001)***	**0.47410 (<.0001)***	1.00000	**0.58707 (<.0001)***	**0.45203 (<.0001)***	**0.39740 (<.0001)***	**0.28010 (0.0005)***
Disruption	**0.62176 (<.0001)***	**0.70144 (<.0001)***	**0.67707 (<.0001)***	**0.58707 (<.0001)***	1.00000	**0.54708 (<.0001)***	**0.56422 (<.0001)***	**0.29032 (0.0003)***
Connection	**0.51702 (<.0001)***	**0.52783 (<.0001)***	**0.43853 (<.0001)***	**0.45203 (<.0001)***	**0.54708 (<.0001)***	1.00000	**0.54031 (<.0001)***	**0.18737 (0.0212)****
Pressure	**0.45909 (<.0001)***	**0.45032 (<.0001)***	**0.45286 (<.0001)***	**0.39740 (<.0001)***	**0.56422 (<.0001)***	**0.54031 (<.0001)***	1.00000	**0.21347 (0.0085)***
Price	**0.25536 (0.0016)***	**0.28842 (0.0003)***	**0.27293 (0.0007)***	**0.28010 (0.0005)***	**0.29032 (0.0003)***	**0.18737 (0.0212)****	**0.21347 (0.0085)***	1.00000

***** Significant at 1%   ****** Significant at 5%

Appendix B4.2 (b): Correlation of Service Quality Performance with Age (31 to 40 years old)

Pearson Correlation Coefficients, n = 75
Prob > |r| under H0: Rho=0

	Leakage	Burst Pipes	Reservoir	Water Quality	Disruption	Connection	Pressure	Price
Leakage	1.00000	**0.91955 (<.0001)***	**0.68685 (<.0001)***	**0.51086 (<.0001)***	**0.82633 (<.0001)***	**0.77150 (<.0001)***	**0.64061 (<.0001)***	**0.32596 (0.0043)***
Burst Pipes	**0.91955 (<.0001)***	1.00000	**0.69535 (<.0001)***	**0.46289 (<.0001)***	**0.82407 (<.0001)***	**0.81759 (<.0001)***	**0.68230 (<.0001)***	**0.31628 (0.0057)***
Reservoir	**0.68685 (<.0001)***	**0.69535 (<.0001)***	1.00000	**0.55093 (<.0001)***	**0.65092 (<.0001)***	**0.75612 (<.0001)***	**0.63555 (<.0001)***	**0.30711 (0.0074)***
Water Quality	**0.51086 (<.0001)***	**0.46289 (<.0001)***	**0.55093 (<.0001)***	1.00000	**0.52536 (<.0001)***	**0.52899 (<.0001)***	**0.52018 (<.0001)***	**0.45542 (<.0001)***
Disruption	**0.82633 (<.0001)***	**0.82407 (<.0001)***	**0.65092 (<.0001)***	**0.52536 (<.0001)***	1.00000	**0.77448 (<.0001)***	**0.65409 (<.0001)***	**0.28248 (0.0141)****
Connection	**0.77150 (<.0001)***	**0.81759 (<.0001)***	**0.75612 (<.0001)***	**0.52899 (<.0001)***	**0.77448 (<.0001)***	1.00000	**0.67397 (<.0001)***	**0.40879 (0.0003)***
Pressure	**0.64061 (<.0001)***	**0.68230 (<.0001)***	**0.63555 (<.0001)***	**0.52018 (<.0001)***	**0.65409 (<.0001)***	**0.67397 (<.0001)***	1.00000	**0.28090 (0.0146)****
Price	**0.32596 (0.0043)***	**0.31628 (0.0057)***	**0.30711 (0.0074)***	**0.45542 (<.0001)***	**0.28248 (0.0141)****	**0.40879 (0.0003)***	**0.28090 (0.0146)****	1.00000

***** Significant at 1% ****** Significant at 5%

Appendix B4.2 (c): Correlation of Service Quality Performance and Age (41 to 50 years old)

Pearson Correlation Coefficients, n = 83 Prob > |r| under H0: Rho=0								
	Leakage	**Burst Pipes**	**Reservoir**	**Water Quality**	**Disruption**	**Connection**	**Pressure**	**Price**
Leakage	1.00000	**0.92907 (<.0001)***	**0.56533 (<.0001)***	**0.36268 0.0008**	**0.52287 (<.0001)***	**0.57453 (<.0001)***	**0.40082 (0.0002)***	0.09563 0.3898
Burst Pipes	**0.92907 <.0001***	1.00000	**0.58718 (<.0001)***	**0.35911 0.0009**	**0.51721 (<.0001)***	**0.54226 (<.0001)***	**0.39490 0.0002**	0.04384 0.6939
Reservoir	**0.56533 (<.0001)***	**0.58718 (<.0001)***	1.00000	**0.46629 (<.0001)***	**0.71810 (<.0001)***	**0.73038 (<.0001)***	**0.61604 (<.0001)***	0.12673 0.2536
Water Quality	**0.36268 (0.0008)***	**0.35911 (0.0009)***	**0.46629 (<.0001)***	1.00000	**0.60658 (<.0001)***	**0.49901 (<.0001)***	**0.37098 (0.0006)***	0.08710 0.4336
Disruption	**0.52287 (<.0001)***	**0.51721 (<.0001)***	**0.71810 (<.0001)***	**0.60658 (<.0001)***	1.00000	**0.70262 (<.0001)***	**0.39850 (0.0002)***	0.10357 0.3515
Connection	**0.57453 (<.0001)***	**0.54226 (<.0001)***	**0.73038 (<.0001)***	**0.49901 (<.0001)***	**0.70262 (<.0001)***	1.00000	**0.56907 (<.0001)***	0.17339 0.1170
Pressure	**0.40082 (0.0002)***	**0.39490 (0.0002)***	**0.61604 (<.0001)***	**0.37098 (0.0006)***	**0.39850 (0.0002)***	**0.56907 (<.0001)***	1.00000	0.15551 0.1604
Price	0.09563 0.3898	0.04384 0.6939	0.12673 0.2536	0.08710 0.4336	0.10357 0.3515	0.17339 0.1170	0.15551 0.1604	1.00000

***** Significant at 1%   ****** Significant at 5%

Appendix B4.2 (d): Correlation of Service Quality Performance and Age (More than 51 years old)

Pearson Correlation Coefficients, n = 83 Prob > |r| under H0: Rho=0								
	Leakage	**Burst Pipes**	**Reservoir**	**Water Quality**	**Disruption**	**Connection**	**Pressure**	**Price**
Leakage	1.00000	**0.69390 (<.0001)***	0.11966 0.2813	**0.33598 (0.0019)***	**0.45699 (<.0001)***	0.18496 0.0962	**0.31581 (0.0036)***	**0.41843 (<.0001)***
Burst Pipes	**0.69390 (<.0001)***	1.00000	0.20407 0.0642	**0.37496 (0.0005)***	**0.48943 (<.0001)***	**0.27812 (0.0114)****	**0.31264 (0.0040)***	**0.24011 (0.0288)****
Reservoir	0.11966 0.2813	0.20407 0.0642	1.00000	0.18820 0.0884	**0.34666 (0.0013)***	**0.55432 (<.0001)***	**0.31642 (0.0036)***	**0.10775 0.3322**
Water Quality	**0.33598 (0.0019)***	**0.37496 (0.0005)***	0.18820 0.0884	1.00000	**0.25181 (0.0216)****	**0.22039 (0.0466)****	0.09613 0.3873	0.10629 0.3389
Disruption	**0.45699 (<.0001)***	**0.48943 (<.0001)***	**0.34666 (0.0013)***	**0.25181 (0.0216)****	1.00000	**0.58774 (<.0001)***	**0.44916 (<.0001)***	**0.29010 (0.0078)***
Connection	0.18496 0.0962	**0.27812 (0.0114)****	**0.55432 (<.0001)***	**0.22039 (0.0466)****	**0.58774 (<.0001)***	1.00000	**0.52459 (<.0001)***	0.19256 0.0831
Pressure	**0.31581 (0.0036)***	**0.31264 (0.0040)***	**0.31642 (0.0036)***	0.09613 0.3873	**0.44916 (<.0001)***	**0.52459 (<.0001)***	1.00000	**0.41899 (<.0001)***
Price	**0.41843 (<.0001)***	**0.24011 (0.0288)****	0.10775 0.3322	0.10629 0.3389	**0.29010 (0.0078)***	0.19256 0.0831	**0.41899 (<.0001)***	1.00000

***** Significant at 1% ****** Significant at 5%

Appendix B4.3 (a): Correlation of Service Quality Performance with Child (2 children and fewer)

Pearson Correlation Coefficients, n = 214 Prob > |r| under H0: Rho=0								
	Leakage	**Burst Pipes**	**Reservoir**	**Water Quality**	**Disruption**	**Connection**	**Pressure**	**Price**
Leakage	1.00000	**0.81176 (<.0001)***	**0.51545 (<.0001)***	**0.41150 (<.0001)***	**0.63063 (<.0001)***	**0.49800 (<.0001)***	**0.44746 (<.0001)***	**0.17086 (0.0123)****
Burst Pipes	**0.81176 (<.0001)***	1.00000	**0.57695 (<.0001)***	**0.45096 (<.0001)***	**0.68869 (<.0001)***	**0.50184 (<.0001)***	**0.42876 (<.0001)***	**0.20503 (0.0026)***
Reservoir	**0.51545 (<.0001)***	**0.57695 (<.0001)***	1.00000	**0.46144 (<.0001)***	**0.62046 (<.0001)***	**0.47219 (<.0001)***	**0.50681 (<.0001)***	**0.24178 (0.0004)***
Water Quality	**0.41150 (<.0001)***	**0.45096 (<.0001)***	**0.46144 (<.0001)***	1.00000	**0.49428 (<.0001)***	**0.37683 (<.0001)***	**0.37096 (<.0001)***	**0.20286 (0.0029)***
Disruption	**0.63063 (<.0001)***	**0.68869 (<.0001)***	**0.62046 (<.0001)***	**0.49428 (<.0001)***	1.00000	**0.54238 (<.0001)***	**0.57144 (0.0046)***	**0.19294 (0.0046)***
Connection	**0.49800 (<.0001)***	**0.50184 (<.0001)***	**0.47219 (<.0001)***	**0.37683 (<.0001)***	**0.54238 (<.0001)***	1.00000	**0.53584 (<.0001)***	**0.17786 (0.0091)***
Pressure	**0.44746 (<.0001)***	**0.42876 (<.0001)***	**0.50681 (<.0001)***	**0.37096 (<.0001)***	**0.57144 (<.0001)***	**0.53584 (<.0001)***	1.00000	**0.16999 (0.0128)****
Price	**0.17086 (0.0123)****	**0.20503 (0.0026)***	**0.24178 (0.0004)***	**0.20286 (0.0029)***	**0.19294 (0.0046)***	**0.17786 (0.0091)***	**0.16999 (0.0128)****	1.00000

***** Significant at 1%   ****** Significant at 5%

Appendix B4.3 (b): Correlation of Service Quality Performance with Child (3–5 children)

Pearson Correlation Coefficients, n = 122 Prob > |r| under H0: Rho=0								
	Leakage	**Burst Pipes**	**Reservoir**	**Water Quality**	**Disruption**	**Connection**	**Pressure**	**Price**
Leakage	1.00000	**0.86988 (<.0001)***	**0.54983 (<.0001)***	**0.38497 (<.0001)***	**0.56894 (<.0001)***	**0.61403 (<.0001)***	**0.49089 (<.0001)***	**0.37112 (<.0001)***
Burst Pipes	**0.86988 (<.0001)***	1.00000	**0.52390 (<.0001)***	**0.36780 (<.0001)***	**0.60451 (<.0001)***	**0.58960 (<.0001)***	**0.47254 (<.0001)***	**0.27629 (0.0021)***
Reservoir	**0.54983 (<.0001)***	**0.52390 (<.0001)***	1.00000	**0.42999 (<.0001)***	**0.74720 (<.0001)***	**0.73621 (<.0001)***	**0.55302 (<.0001)***	**0.21125 (0.0195)****
Water Quality	**0.38497 (<.0001)***	**0.36780 (<.0001)***	**0.42999 (<.0001)***	1.00000	**0.55386 (<.0001)***	**0.51159 (<.0001)***	**0.41847 (0.0062)***	**0.24631 (0.0062)***
Disruption	**0.56894 (<.0001)***	**0.60451 (<.0001)***	**0.74720 (<.0001)***	**0.55386 (<.0001)***	1.00000	**0.78553 (<.0001)***	**0.51997 (0.0029)***	**0.26786 (0.0029)***
Connection	**0.61403 (<.0001)***	**0.58960 (<.0001)***	**0.73621 (<.0001)***	**0.51159 (<.0001)***	**0.78553 (<.0001)***	1.00000	**0.63196 (<.0001)***	**0.28613 (0.0014)***
Pressure	**0.49089 (<.0001)***	**0.47254 (<.0001)***	**0.55302 (<.0001)***	**0.41847 (<.0001)***	**0.51997 (<.0001)***	**0.63196 (<.0001)***	1.00000	**0.28082 (0.0017)***
Price	**0.37112 (<.0001)***	**0.27629 (0.0021)***	**0.21125 (0.0195)****	**0.24631 (0.0062)***	**0.26786 (0.0029)***	**0.28613 (0.0014)***	**0.28082 (0.0017)***	1.00000

* Significant at 1% ****** Significant at 5%

Appendix B4.3 (c): Correlation of Service Quality Performance with Child (6–8 children)

Pearson Correlation Coefficients, n = 41
Prob > |r| under H0: Rho=0

	Leakage	Burst Pipes	Reservoir	Water Quality	Disruption	Connection	Pressure	Price
Leakage	1.00000	**0.78990 (<.0001)***	0.23111 0.1460	**0.46360 (0.0023)***	**0.54156 (0.0003)***	0.20649 0.2011	0.19744 0.2160	**0.31208 (0.0470)****
Burst Pipes	**0.78990 (<.0001)***	1.00000 0.2380	**0.18845 (0.0002)***	**0.55237 (0.0048)***	**0.43221 (0.0466)****	0.31658 0.0587	0.29776 0.4039	0.13391 0.4039
Reservoir	0.23111 0.1460	0.18845 0.2380	1.00000	0.27949 0.0768	0.20998 0.1876	**0.54713 (0.0003)***	**0.39761 (0.0100)***	0.23695 0.1358
Water Quality	**0.46360 (0.0023)***	**0.55237 (0.0002)***	0.27949 0.0768	1.00000	**0.41873 (0.0064)***	**0.36766 (0.0196)****	0.05243 0.7448	0.20090 0.2078
Disruption	**0.54156 (0.0003)***	**0.43221 (0.0048)***	0.20998 0.1876	**0.41873 (0.0064)***	1.00000	**0.47617 (0.0019)***	0.16477 0.3032	**0.35939 (0.0210)****
Connection	0.20649 0.2011	**0.31658 (0.0466)****	**0.54713 (0.0003)***	**0.36766 (0.0196)****	**0.47617 (0.0019)***	1.00000	**0.32621 (0.0400)****	0.15610 0.3361
Pressure	0.19744 0.2160	0.29776 0.0587	**0.39761 (0.0100)***	0.05243 0.7448	0.16477 0.3032	**0.32621 (0.0400)****	1.00000	**0.31604 (0.0441)****
Price	**0.31208 (0.0470)****	0.13391 0.4039	0.23695 0.1358	0.20090 0.2078	**0.35939 (0.0210)****	0.15610 0.3361	**0.31604 (0.0441)****	1.00000

***** Significant at 1%   ****** Significant at 5%

Appendix B4.3 (d): Correlation of Service Quality Performance with Child (More than 9 children)

Pearson Correlation Coefficients, n = 11 Prob > |r| under H0: Rho=0								
	Leakage	**Burst Pipes**	**Reservoir**	**Water Quality**	**Disruption**	**Connection**	**Pressure**	**Price**
Leakage	1.00000	**0.89360 (0.0002)***	0.04303 0.9000	0.54130 0.0855	**0.70973 (0.0144)***	**0.78174 (0.0045)***	**0.96612 (<.0001)***	**0.86809 (0.0005)***
Burst Pipes	**0.89360 (0.0002)***	1.00000	0.41201 0.2080	**0.72162 (0.0122)****	**0.83450 (0.0014)***	**0.95258 (<.0001)***	**0.85282 (0.0008)***	**0.74516 (0.0085)***
Reservoir	0.04303 0.9000	0.41201 0.2080	1.00000	**0.70766 (0.0148)****	0.57869 0.0622	**0.60553 (0.0484)****	0.07077 0.8362	0.10821 0.7515
Water Quality	0.54130 0.0855	**0.72162 (0.0122)****	**0.70766 (0.0148)****	1.00000	**0.97260 (<.0001)***	**0.80345 (0.0029)***	0.54930 0.0801	**0.73838 (0.0095)***
Disruption	**0.70973 (0.0144)****	**0.83450 (0.0014)****	0.57869 0.0622	**0.97260 (<.0001)***	1.00000	**0.87604 (0.0004)***	**0.71665 (0.0131)****	**0.84981 (0.0009)***
Connection	**0.78174 (0.0045)***	**0.95258 (<.0001)***	**0.60553 (0.0484)****	**0.80345 (0.0029)***	**0.87604 (0.0004)***	1.00000	**0.80345 (0.0029)***	**0.70202 (0.0160)****
Pressure	**0.96612 (<.0001)***	**0.85282 (0.0008)***	0.07077 0.8362	0.54930 0.0801	**0.71665 (0.0131)****	**0.80345 (0.0029)****	1.00000	**0.88606 (0.0003)***
Price	**0.86809 (0.0005)***	**0.74516 (0.0085)***	0.10821 0.7515	**0.73838 (0.0095)***	**0.84981 (0.0009)***	**0.70202 (0.0160)****	**0.88606 (0.0003)***	1.00000

***** Significant at 1%   ****** Significant at 5%

Appendix B4.4 (a): Correlation of Service Quality Performance with Person (2 persons or fewer)

Pearson Correlation Coefficients, n = 67 Prob > |r| under H0: Rho=0								
	Leakage	**Burst Pipes**	**Reservoir**	**Water Quality**	**Disruption**	**Connection**	**Pressure**	**Price**
Leakage	1.00000	**0.85976 (<.0001)***	**0.59235 (<.0001)***	**0.45241 (0.0001)***	**0.74065 (<.0001)***	**0.82738 (<.0001)***	**0.54059 (<.0001)***	**0.27614 (0.0237)****
Burst Pipes	**0.85976 (<.0001)***	1.00000	**0.55587 (<.0001)***	**0.47558 (<.0001)***	**0.67300 (<.0001)***	**0.79310 (<.0001)***	**0.43614 (0.0002)****	**0.29124 (0.0168)****
Reservoir	**0.59235 (<.0001)***	**0.55587 (<.0001)***	1.00000	**0.50719 (<.0001)***	**0.72092 (<.0001)***	**0.60307 (<.0001)***	**0.48042 (<.0001)***	0.04423 0.7223
Water Quality	**0.45241 (0.0001)***	**0.47558 (<.0001)***	**0.50719 (<.0001)***	1.00000	**0.53389 (<.0001)***	**0.49993 (<.0001)***	**0.57376 (<.0001)***	**0.24032 (0.0501)****
Disruption	**0.74065 (<.0001)***	**0.67300 (<.0001)***	**0.72092 (<.0001)***	**0.53389 (<.0001)***	1.00000	**0.70547 (<.0001)***	**0.64826 (<.0001)***	**0.30138 (0.0132)****
Connection	**0.82738 (<.0001)***	**0.79310 (<.0001)***	**0.60307 (<.0001)***	**0.49993 (<.0001)***	**0.70547 (<.0001)***	1.00000	**0.52964 (<.0001)***	**0.33758 (0.0052)***
Pressure	**0.54059 (<.0001)***	**0.43614 (0.0002)****	**0.48042 (<.0001)***	**0.57376 (<.0001)***	**0.64826 (<.0001)***	**0.52964 (<.0001)***	1.00000	0.19089 0.1218
Price	**0.27614 (0.0237)****	**0.29124 (0.0168)****	0.04423 0.7223	0.24032 0.0501	**0.30138 (0.0132)****	**0.33758 (0.0052)***	0.19089 0.1218	1.00000

***** Significant at 1%   ****** Significant at 5%

Appendix B4.4 (b): Correlation of Service Quality Performance with Person (3 to 5 persons)

Pearson Correlation Coefficients, n = 180
Prob > |r| under H0: Rho=0

	Leakage	Burst Pipes	Reservoir	Water Quality	Disruption	Connection	Pressure	Price
Leakage	1.00000	**0.78785 (<.0001)***	**0.38717 (<.0001)***	**0.34748 (<.0001)***	**0.52209 (<.0001)***	**0.39796 (<.0001)***	**0.37946 (<.0001)***	**0.29684 (<.0001)***
Burst Pipes	**0.78785 (<.0001)***	1.00000	**0.40793 (<.0001)***	**0.36571 (<.0001)***	**0.57445 (<.0001)***	**0.37724 (<.0001)***	**0.36559 (<.0001)***	**0.23382 (0.0016)***
Reservoir	**0.38717 (<.0001)***	**0.40793 (<.0001)***	1.00000	**0.34661 (<.0001)***	**0.57172 (<.0001)***	**0.52400 (<.0001)***	**0.47717 (<.0001)***	**0.29540 (<.0001)***
Water Quality	**0.34748 (<.0001)***	**0.36571 (<.0001)***	**0.34661 (<.0001)***	1.00000	**0.40699 (<.0001)***	**0.31106 (<.0001)***	**0.24499 (0.0009)***	**0.22595 (0.0023)***
Disruption	**0.52209 (<.0001)***	**0.57445 (<.0001)***	**0.57172 (<.0001)***	**0.40699 (<.0001)***	1.00000	**0.60133 (<.0001)***	**0.52309 (<.0001)***	**0.23155 (0.0018)***
Connection	**0.39796 (<.0001)***	**0.37724 (<.0001)***	**0.52400 (<.0001)***	**0.31106 (<.0001)***	**0.60133 (<.0001)***	1.00000	**0.50007 (<.0001)***	**0.23172 (0.0017)***
Pressure	**0.37946 (<.0001)***	**0.36559 (<.0001)***	**0.47717 (<.0001)***	**0.24499 (0.0009)***	**0.52309 (<.0001)***	**0.50007 (<.0001)***	1.00000	**0.33396 (<.0001)***
Price	**0.29684 (<.0001)***	**0.23382 (0.0016)***	**0.29540 (<.0001)***	**0.22595 (0.0023)****	**0.23155 (0.0018)***	**0.23172 (0.0017)***	**0.33396 (<.0001)***	1.00000

***** Significant at 1%   ****** Significant at 5%

Appendix B4.4 (c): Correlation of Service Quality Performance with Person (6 to 8 persons)

Pearson Correlation Coefficients, n = 113
Prob > |r| under H0: Rho=0

	Leakage	**Burst Pipes**	**Reservoir**	**Water Quality**	**Disruption**	**Connection**	**Pressure**	**Price**
Leakage	1.00000	**0.89908 (<.0001)***	**0.64913 (<.0001)***	**0.44008 (<.0001)***	**0.64060 (<.0001)***	**0.54586 (<.0001)***	**0.55761 (<.0001)***	**0.20326 (0.0308)****
Burst Pipes	**0.89908 (<.0001)***	1.00000	**0.71564 (<.0001)***	**0.47259 (<.0001)***	**0.73425 (<.0001)***	**0.57346 (<.0001)***	**0.54681 (<.0001)***	**0.20292 (0.0311)****
Reservoir	**0.64913 (<.0001)***	**0.71564 (<.0001)***	1.00000	**0.52842 (<.0001)***	**0.70367 (<.0001)***	**0.66445 (<.0001)***	**0.62571 (<.0001)***	0.11026 0.2450
Water Quality	**0.44008 (<.0001)***	**0.47259 (<.0001)***	**0.52842 (<.0001)***	1.00000	**0.68589 (<.0001)***	**0.58768 (<.0001)***	**0.43415 (<.0001)***	0.18141 0.0545
Disruption	**0.64060 (<.0001)***	**0.73425 (<.0001)***	**0.70367 (<.0001)***	**0.68589 (<.0001)***	1.00000	**0.66497 (<.0001)***	**0.52996 (<.0001)***	**0.18739 (0.0469)****
Connection	**0.54586 (<.0001)***	**0.57346 (<.0001)***	**0.66445 (<.0001)***	**0.58768 (<.0001)***	**0.66497 (<.0001)***	1.00000	**0.73588 (<.0001)***	**0.21141 (0.0253)****
Pressure	**0.55761 (<.0001)***	**0.54681 (<.0001)***	**0.62571 (<.0001)***	**0.43415 (<.0001)***	**0.52996 (<.0001)***	**0.73588 (<.0001)***	1.00000	0.11700 0.2172
Price	**0.20326 (0.0308)****	**0.20292 (0.0311)****	0.11026 0.2450	0.18141 0.0545	**0.18739 (0.0469)****	**0.21141 (0.0253)****	0.11700 0.2172	1.00000

* Significant at 1%   ** Significant at 5%

Appendix B4.4 (d): Correlation of Service Quality Performance with Person (More than 9 persons)

Pearson Correlation Coefficients, n = 31 **Prob > |r| under H0: Rho=0**								
	Leakage	**Burst Pipes**	**Reservoir**	**Water Quality**	**Disruption**	**Connection**	**Pressure**	**Price**
Leakage	1.00000	**0.76386** **(<.0001)***	0.19019 0.3054	**0.45449** **(0.0102)****	**0.57313** **(0.0008)***	**0.39445** **(0.0281)****	0.29894 0.1023	0.22627 0.2209
Burst Pipes	**0.76386** **(<.0001)***	1.00000	0.24132 0.1909	**0.59773** **(0.0004)***	**0.49874** **(0.0043)***	**0.64744** **(<.0001)***	**0.55749** **(0.0011)***	0.13056 0.4839
Reservoir	0.19019 0.3054	0.24132 0.1909	1.00000	**0.48052** **(0.0062)***	**0.36107** **(0.0460)****	0.22413 0.2255	0.15368 0.4091	**0.38192** **(0.0340)****
Water Quality	**0.45449** **(0.0102)****	**0.59773** **(0.0004)***	**0.48052** **(0.0062)***	1.00000	**0.43983** **(0.0133)****	**0.39481** **(0.0279)****	0.33308 0.0671	0.28360 0.1221
Disruption	**0.57313** **(0.0008)***	**0.49874** **(0.0043)***	**0.36107** **(0.0460)****	**0.43983** **(0.0133)****	1.00000	**0.47278** **(0.0072)***	0.19899 0.2832	**0.36497** **(0.0435)****
Connection	**0.39445** **(0.0281)****	**0.64744** **(<.0001)***	0.22413 0.2255	**0.39481** **(0.0279)****	**0.47278** **(0.0072)***	1.00000	**0.36104** **(0.0460)****	-0.03275 0.8612
Pressure	0.29894 0.1023	**0.55749** **(0.0011)***	0.15368 0.4091	0.33308 0.0671	0.19899 0.2832	**0.36104** **(0.0460)****	1.00000	0.22598 0.2216
Price	0.22627 0.2209	0.13056 0.4839	**0.38192** **(0.0340)****	0.28360 0.1221	**0.36497** **(0.0435)****	-0.03275 0.8612	0.22598 0.2216	1.00000

***** Significant at 1%   ****** Significant at 5%

Appendix B4.5 (a): Correlation of Service Quality Performance with Terraced House

Spearman Correlation Coefficients, n = 145
Prob > |r| under H0: Rho=0

	Leakage	Burst Pipes	Reservoir	Water Quality	Disruption	Connection	Pressure	Price
Leakage	1.00000	**0.76058 (<.0001)***	**0.50318 (<.0001)***	**0.54623 (<.0001)***	**0.61656 (<.0001)***	**0.54924 (<.0001)***	**0.51803 (<.0001)***	**0.20306 (0.0143)****
Burst Pipes	**0.76058 (<.0001)***	1.00000	**1.00000 (<.0001)***	**0.53060 (<.0001)***	**0.44012 (<.0001)***	**0.62664 (<.0001)***	**0.56697 (<.0001)***	0.13727 0.0997
Reservoir	**0.50318 (<.0001)***	**0.53060 (<.0001)***	1.00000	**0.29288 (0.0004)***	**0.56220 (<.0001)***	**0.59926 (<.0001)***	**0.49799 (<.0001)***	0.09281 0.2669
Water Quality	**0.54623 (<.0001)***	**0.44012 (<.0001)***	**0.29288 (0.0004)***	1.00000	**0.40092 (<.0001)***	**0.32711 (<.0001)***	**0.39475 (<.0001)***	0.12811 0.1246
Disruption	**0.61656 (<.0001)***	**0.71575 (<.0001)***	**0.56220 (<.0001)***	**0.40092 (<.0001*)**	1.00000	**0.64341 (<.0001)***	**0.59739 (<.0001)***	**0.20209 (0.0148)****
Connection	**0.54924 (<.0001)***	**0.62664 (<.0001)***	**0.59926 (<.0001)***	**0.32711 (<.0001)***	**0.64341 (<.0001)***	1.00000	**0.66082 (<.0001)***	**0.19924 (0.0167)****
Pressure	**0.51803 (<.0001)***	**0.56697 (<.0001)***	**0.49799 (<.0001)***	**0.39475 (<.0001)***	**0.59739 (<.0001)***	**0.66082 (<.0001)***	1.00000	**0.29795 (0.0003)***
Price	**0.20306 (0.0143)****	0.13727 0.0997	0.09281 0.2669	0.12811 0.1246	**0.20209 (0.0148)****	**0.19924 (0.0167)****	**0.29795 (0.0003)***	1.00000

***** Significant at 1% ****** Significant at 5%

Appendix B4.5 (b): Correlation of Service Quality Performance with Two-Storey House

Spearman Correlation Coefficients, n = 107 Prob > |r| under H0: Rho=0								
	Leakage	**Burst Pipes**	**Reservoir**	**Water Quality**	**Disruption**	**Connection**	**Pressure**	**Price**
Leakage	1.00000	**0.83899 (<.0001)***	**0.54640 (<.0001)***	**0.45495 (<.0001)***	**0.70745 (<.0001)***	**0.51745 (<.0001)***	**0.49354 (<.0001)***	**0.33319 (0.0005)***
Burst Pipes	**0.83899 (<.0001)***	1.00000	**0.51593 (<.0001)***	**0.56088 (<.0001)***	**0.62242 (<.0001)***	**0.48593 (<.0001)***	**0.44763 (<.0001)***	**0.27306 (0.0044)***
Reservoir	**0.54640 (<.0001)***	**0.51593 (<.0001)***	1.00000	**0.55754 (<.0001)***	**0.67437 (<.0001)***	**0.70767 (<.0001)***	**0.66116 (<.0001)***	**0.35460 (0.0002)***
Water Quality	**0.45495 (<.0001)***	**0.56088 (<.0001)***	**0.55754 (<.0001)***	1.00000	**0.59165 (<.0001)***	**0.51736 (<.0001)***	**0.41236 (<.0001)***	**0.31970 (0.0008)***
Disruption	**0.70745 (<.0001)***	**0.62242 (<.0001)***	**0.67437 (<.0001)***	**0.59165 (<.0001)***	1.00000	**0.66030 (<.0001)***	**0.55882 (<.0001)***	**0.31945 (0.0008)***
Connection	**0.51745 (<.0001)***	**0.48593 (<.0001)***	**0.70767 (<.0001)***	**0.51736 (<.0001)***	**0.66030 (<.0001)***	1.00000	**0.70094 (<.0001)***	**0.38995 (<.0001)***
Pressure	**0.49354 (<.0001)***	**0.44763 (<.0001)***	**0.66116 (<.0001)***	**0.41236 (<.0001)***	**0.55882 (<.0001)***	**0.70094 (<.0001)***	1.00000	**0.39626 (<.0001)***
Price	**0.33319 (0.0005)***	**0.27306 (0.0044)***	**0.35460 (0.0002)***	**0.31970 (0.0008)***	**0.31945 (0.0008)***	**0.38995 (<.0001)***	**0.39626 (<.0001)***	1.00000

***** Significant at 1%

Appendix B4.5 (c): Correlation of Service Quality Performance with Semi-Detached House

Spearman Correlation Coefficients, n = 29 Prob > |r| under H0: Rho=0								
	Leakage	**Burst Pipes**	**Reservoir**	**Water Quality**	**Disruption**	**Connection**	**Pressure**	**Price**
Leakage	1.00000	**0.93890 (<.0001)***	**0.63883 (0.0002)***	**0.40479 (0.0294)****	**0.74614 (<.0001)***	**0.58227 (0.0009)***	**0.54865 (0.0021)***	**0.51893 (0.0039)***
Burst Pipes	**0.93890 (<.0001)***	1.00000	**0.73031 (<.0001)***	**0.49655 (<.0001)***	**0.78278 (0.0061)***	**0.58154 (0.0009)***	**0.54925 (0.0020)***	**0.59554 (0.0007)***
Reservoir	**0.63883 (0.0002)***	**0.73031 (<.0001*)**	1.00000	**0.62517 (<.0001)***	**0.82932 (0.0003)***	**0.37811 (0.0431)****	**0.40842 (0.0278)****	**0.63288 (0.0002)***
Water Quality	**0.40479 (0.0294)****	**0.49655 (0.0061)***	**0.62517 (0.0003)***	1.00000	**0.73095 (<.0001)***	**0.59588 (0.0006)***	**0.27466 0.1495**	**0.70164 (<.0001)***
Disruption	**0.74614 (<.0001)***	**0.78278 (<.0001)***	**0.82932 (<.0001)***	**0.73095 (<.0001*)**	1.00000	**0.52053 (0.0038)***	**0.44096 (0.0167)***	**0.75498 (<.0001)***
Connection	**0.58227 (0.0009)***	**0.58154 (0.0009)***	**0.37811 (0.0431)****	**0.59588 (0.0006)***	**0.52053 (0.0038)***	1.00000	**0.64481 (0.0002)***	**0.43390 (0.0187)****
Pressure	**0.54865 (0.0021)***	**0.54925 (0.0020)***	**0.40842 (0.0278)****	**0.27466 0.1493**	**0.44096 (0.0167)****	**0.64481 (0.0002)***	1.00000	0.33185 0.0786
Price	**0.51893 (0.0039)***	**0.59554 (0.0007)***	**0.63288 (0.0002)***	**0.70164 (<.0001)***	**0.75498 (<.0001)***	**0.43390 (0.0187)****	0.33185 0.0786	1.00000

***** Significant at 1%   ****** Significant at 5%

Appendix B4.5 (d): Correlation of Service Quality Performance with Bungalow

Spearman Correlation Coefficients, n = 31 Prob > |r| under H0: Rho=0								
	Leakage	**Burst Pipes**	**Reservoir**	**Water Quality**	**Disruption**	**Connection**	**Pressure**	**Price**
Leakage	1.00000	**0.83086 (<.0001)***	**0.71443 (<.0001)***	**0.52254 (0.0026)***	**0.58062 (0.0006)***	**0.55798 (0.0011)***	**0.70703 (<.0001)***	**0.65201 (<.0001)***
Burst Pipes	**0.83086 (<.0001)***	1.00000	**0.78438 (<.0001)***	**0.66897 (<.0001)***	**0.61092 (0.0003)***	**0.53631 (0.0019)***	**0.63806 (0.0001)***	**0.51655 (0.0029)***
Reservoir	**0.71443 (<.0001)***	**0.78438 (<.0001)***	1.00000	**0.68576 (<.0001)***	**0.57672 (0.0007)***	**0.61052 (0.0003)***	**0.68927 (<.0001)***	**0.53676 (0.0019)***
Water Quality	**0.52254 (0.0026)***	**0.66897 (<.0001)***	**0.68576 (<.0001)***	1.00000	**0.74814 (<.0001*)**	**0.53182 (0.0021)***	**0.43329 (0.0149)****	**0.42986 (0.0158)****
Disruption	**0.58062 (0.0006)***	**0.61092 (0.0003)***	**0.57672 (0.0007)***	**0.74814 (<.0001)***	1.00000	**0.76548 (<.0001*)**	**0.42165 (0.0182)****	**0.51170 (0.0033)****
Connection	**0.55798 (0.0011)***	**0.53631 (0.0019)***	**0.61052 (0.0003)***	**0.53182 (0.0021)***	**0.76548 (<.0001)***	1.00000	**0.58400 (0.0006)***	**0.39185 (0.0293)****
Pressure	**0.70703 (<.0001)***	**0.63806 (0.0001)***	**0.68927 (<.0001)***	**0.43329 (0.0149)****	**0.42165 (0.0182)****	**0.58400 (0.0006)***	1.00000	**0.53978 (0.0017)***
Price	**0.65201 (<.0001*)**	**0.51655 (0.0029)***	**0.53676 (0.0019)***	**0.42986 (0.0158)****	**0.51170 (0.0033)***	**0.39185 (0.0293)****	**0.53978 (0.0017)***	1.00000

***** Significant at 1%   ****** Significant at 5%

Appendix B4.5 (e): Correlation of Service Quality Performance with Others

Spearman Correlation Coefficients, n = 80 Prob > |r| under H0: Rho=0								
	Leakage	**Burst Pipes**	**Reservoir**	**Water Quality**	**Disruption**	**Connection**	**Pressure**	**Price**
Leakage	1.00000	**0.90591 (<.0001)***	**0.56218 (<.0001)***	**0.38499 (0.0004)***	**0.62019 (<.0001)***	**0.63906 (<.0001)***	**0.62491 (<.0001)***	**0.32277 (0.0035)***
Burst Pipes	**0.90591 (<.0001)***	1.00000	**0.65003 (<.0001)***	**0.44151 (<.0001)***	**0.69863 (<.0001)***	**0.70402 (<.0001)***	**0.64830 (0.0001)***	**0.35091 (0.0014)***
Reservoir	**0.56218 (<.0001)***	**0.65003 (<.0001)***	1.00000	**0.61029 (<.0001*)**	**0.71726 (0.0007)***	**0.62400 (0.0003)***	**0.71432 (<.0001*)**	**0.24880 (0.0261)****
Water Quality	**0.38499 (<.0001)***	**0.44151 (<.0001)***	**0.61029 (<.0001*)**	1.00000	**0.64438 (<.0001*)**	**0.62990 (0.0021)***	**0.53733 (0.0149)****	0.17896 0.1122
Disruption	**0.62019 (0.0006)***	**0.69863 (<.0001)***	**0.71726 (<.0001)***	**0.64438 (0.0003)***	1.00000	**0.79292 (<.0001*)**	**0.70034 (0.0182)****	0.20460 0.0687
Connection	**0.63906 (<.0001)***	**0.70402 (<.0001)***	**0.62400 (<.0001)***	**0.62990 (<.0001)***	**0.79292 (<.0001*)**	1.00000	**0.65700 (0.0006)***	**0.25962 (0.0200)****
Pressure	**0.62491 (<.0001)***	**0.64830 (<.0001)***	**0.71432 (<.0001)***	**0.53733 (<.0001)***	**0.70034 (<.0001)***	**0.65700 (<.0001)***	1.00000	**0.22409 (0.0457)****
Price	**0.32277 (0.0035)***	**0.35091 (0.0014)***	**0.24880 (0.0261)****	0.17896 0.1122	0.20460 0.0687	**0.25962 (0.0200)****	**0.22409 (0.0457)****	1.00000

***** Significant at 1%   ****** Significant at 5%

Appendix B5

Appendix B5.1 (a): Correlation of Water Service with Malay

Spearman Correlation Coefficients, n = 329 Prob > |r| under H0: Rho=0								
	Leakage	**Burst Pipes**	**Reservoir**	**Water Quality**	**Disruption**	**Connection**	**Pressure**	**Price**
Leakage	1.00000	**0.80243 (<.0001)***	**0.68936 (<.0001)***	**0.45057 (<.0001)***	**0.58250 (<.0001)***	**0.59206 (<.0001)***	**0.46942 (<.0001)***	0.09530 0.0843
Burst Pipes	**0.80243 (<.0001)***	1.00000	**0.71077 (<.0001)***	**0.41254 (<.0001)***	**0.58047 (<.0001)***	**0.60513 (<.0001)***	**0.48357 (<.0001)***	0.10656 0.0535
Reservoir	**0.68936 (<.0001)***	**0.71077 (<.0001)***	1.00000	**0.43192 (<.0001)***	**0.58237 (<.0001)***	**0.60856 (<.0001)***	**0.50828 (<.0001)***	**0.15234 (0.0056)***
Water Quality	**0.45057 (<.0001)***	**0.41254 (<.0001)***	**0.43192 (<.0001)***	1.00000	**0.42618 (<.0001)***	**0.42522 (<.0001)***	**0.36576 (<.0001)***	-0.01886 0.7332
Disruption	**0.58250 (<.0001)***	**0.58047 (<.0001)***	**0.58237 (<.0001)***	**0.42618 (<.0001)***	1.00000	**0.71172 (<.0001)***	**0.53309 (<.0001)***	**0.13373 (0.0152)****
Connection	**0.59206 (<.0001)***	**0.60513 (<.0001)***	**0.60856 (<.0001)***	**0.42522 (<.0001)***	**0.71172 (<.0001)***	1.00000	**0.60183 (<.0001)***	**0.15551 (0.0047)****
Pressure	**0.46942 (<.0001)***	**0.48357 (<.0001)***	**0.50828 (<.0001)***	**0.36576 (<.0001)***	**0.53309 (<.0001)***	**0.60183 (<.0001)***	1.00000	**0.19531 (0.0004)***
Price	0.09530 0.0843	0.10656 0.0535	**0.15234 (0.0056)***	-0.01886 0.7332	**0.13373 (0.0152)****	**0.15551 (0.0047)****	**0.19531 (0.0004)***	1.00000

***** Significant at 1% ****** Significant at 5%

Appendix B5.1 (b): Correlation of Water Service with Chinese

Spearman Correlation Coefficients, n= 48 Prob > |r| under H0: Rho=0								
	Leakage	**Burst Pipes**	**Reservoir**	**Water Quality**	**Disruption**	**Connection**	**Pressure**	**Price**
Leakage	1.00000	**0.87196 (<.0001)***	**0.86564 (<.0001)***	**0.33037 (0.0218)****	**0.82271 (<.0001)***	**0.75575 (<.0001)***	**0.75501 (<.0001)***	-0.12723 0.3888
Burst Pipes	**0.87196 (<.0001)***	1.00000	**0.88363 (<.0001)***	**0.37204 0.0092**	**0.83842 (<.0001)***	**0.81851 (<.0001)***	**0.74364 (<.0001)***	-0.08051 0.5865
Reservoir	**0.86564 (<.0001)***	**0.88363 (<.0001)***	1.00000	**0.38545 (0.0068)****	**0.92962 (<.0001)***	**0.89381 (<.0001)***	**0.82832 (<.0001)***	-0.02719 0.8545
Water Quality	**0.33037 (0.0218)****	**0.37204 (0.0092)****	**0.38545 (0.0068)****	1.00000	**0.32440 (0.0245)****	**0.38618 (0.0067)****	**0.44581 (0.0015)****	0.07773 0.5995
Disruption	**0.82271 (<.0001)***	**0.83842 (<.0001)***	**0.92962 (<.0001)***	**0.32440 (0.0245)****	1.00000	**0.87947 (<.0001)***	**0.78917 (<.0001)***	0.00467 0.9749
Connection	**0.75575 (<.0001)***	**0.81851 (<.0001)***	**0.89381 (<.0001)***	**0.38618 (0.0067)****	**0.87947 (<.0001)***	1.00000	**0.88728 (<.0001)***	0.08600 0.5611
Pressure	**0.75501 (<.0001)***	**0.74364 (<.0001)***	**0.82832 (<.0001)***	**0.44581 (0.0015)****	**0.78917 (<.0001)***	**0.88728 (<.0001)***	1.00000	0.07642 0.6057
Price	-0.12723 0.3888	-0.08051 0.5865	-0.02719 0.8545	0.07773 0.5995	0.00467 0.9749	0.08600 0.5611	0.07642 0.6057	1.00000

***** Significant at 1% ****** Significant at 5%

Appendix B5.1 (c): Correlation of Water Service with Indian

Spearman Correlation Coefficients, n = 11 Prob > |r| under H0: Rho=0								
	Leakage	**Burst Pipes**	**Reservoir**	**Water Quality**	**Disruption**	**Connection**	**Pressure**	**Price**
Leakage	1.00000	**0.60714 (0.0476)****	0.44854 0.1664	0.07629 0.8236	**0.60714 (0.0476)****	**0.69007 (0.0188)****	0.44854 0.1664	-0.27771 0.4083
Burst Pipes	**0.60714 (0.0476)****	1.00000	**0.82808 (0.0016)****	0.45774 0.1569	**1.00000 (<.0001)***	**0.69007 (0.0188)****	**0.82808 (0.0016)****	-0.27771 0.4083
Reservoir	0.44854 0.1664	**0.82808 (0.0016)****	1.00000	0.55277 0.0778	**0.82808 (0.0016)****	**0.83333 (0.0014)****	**0.63333 (0.0364)****	0.00000 1.0000
Water Quality	0.07629 0.8236	0.45774 0.1569	0.55277 0.0778	1.00000	0.45774 0.1569	0.29481 0.3788	0.55277 0.0778	0.00000 1.0000
Disruption	**0.60714 (0.0476)***	**1.00000 (<.0001)***	**0.82808 (0.0016)****	0.45774 0.1569	1.00000	**0.69007 (0.0188)****	**0.82808 (0.0016)****	-0.27771 0.4083
Connection	**0.69007 (0.0188)****	**0.69007 (0.0188)****	**0.83333 (0.0014)****	0.29481 0.3788	**0.69007 (0.0188)****	1.00000	0.46667 0.1479	0.00000 1.0000
Pressure	0.44854 0.1664	**0.82808 (0.0016)****	**0.63333 (0.0364)****	0.55277 0.0778	**0.82808 (0.0016)****	0.46667 0.1479	1.00000	-0.26830 0.4250
Price	-0.27771 0.4083	-0.27771 0.4083	0.00000 1.0000	0.00000 1.0000	-0.27771 0.4083	0.00000 1.0000	-0.26830 0.4250	1.00000

***** Significant at 1%   ****** Significant at 5%

Appendix B5.2 (a): Correlation of Water Service with Age (20 to 30 years old)

Pearson Correlation Coefficients, n = 151
Prob > |r| under H0: Rho=0

	Leakage	Burst Pipes	Reservoir	Water Quality	Disruption	Connection	Pressure	Price
Leakage	1.00000	**0.76596 (<.0001)***	**0.64711 (<.0001)***	**0.45836 (<.0001)***	**0.41032 (<.0001)***	**0.46081 (<.0001)***	**0.41518 (<.0001)***	**0.19749 (0.0151)****
Burst Pipes	**0.76596 (<.0001)***	1.00000	**0.63670 (<.0001)***	**0.48938 (<.0001)***	**0.45445 (<.0001)***	**0.49821 (<.0001)***	**0.43576 (<.0001)***	**0.18281 (0.0247)****
Reservoir	**0.64711 (<.0001)***	**0.63670 (<.0001)***	1.00000	**0.44650 (<.0001)***	**0.49572 (<.0001)***	**0.49360 (<.0001)***	**0.52324 (<.0001)***	**0.24131 (0.0028)****
Water Quality	**0.45836 (<.0001)***	**0.48938 (<.0001)***	**0.44650 (<.0001)***	1.00000	**0.40706 (<.0001)***	**0.39688 (<.0001)***	**0.31602 (<.0001)***	0.11756 0.1506
Disruption	**0.41032 (<.0001)***	**0.45445 (<.0001)***	**0.49572 (<.0001)***	**0.40706 (<.0001)***	1.00000	**0.70443 (<.0001)***	**0.42760 (<.0001)***	**0.22607 (0.0053)***
Connection	**0.46081 (<.0001)***	**0.49821 (<.0001)***	**0.49360 (<.0001)***	**0.39688 (<.0001)***	**0.70443 (<.0001)***	1.00000	**0.41006 (<.0001)***	**0.23196 (0.0042)****
Pressure	**0.41518 (<.0001)***	**0.43576 (<.0001)***	**0.52324 (<.0001)***	**0.31602 (<.0001)***	**0.42760 (<.0001)***	**0.41006 (<.0001)***	1.00000	**0.26773 (0.0009)***
Price	**0.19749 (0.0151)****	**0.18281 (0.0247)****	**0.24131 (0.0028)****	0.11756 0.1506	**0.22607 (0.0053)***	**0.23196 (0.0042)****	**0.26773 (0.0009)***	1.00000

***** Significant at 1% ****** Significant at 5%

Appendix B5.2 (b): Correlation of Water Service with Age (31 to 40 years old)

Pearson Correlation Coefficients, n = 75
Prob > |r| under H0: Rho=0

	Leakage	Burst Pipes	Reservoir	Water Quality	Disruption	Connection	Pressure	Price
Leakage	1.00000	**0.69006 (<.0001)***	**0.46643 (<.0001)***	**0.38658 (0.0006)***	**0.75604 (<.0001)***	**0.69917 (<.0001)***	0.10002 0.3932	-0.00060 0.9959
Burst Pipes	**0.69006 (<.0001)***	1.00000	**0.64226 (<.0001)***	**0.43753 (<.0001)***	**0.67514 (<.0001)***	**0.60437 (<.0001)***	0.08356 0.4760	-0.09305 0.4272
Reservoir	**0.46643 (<.0001)***	**0.64226 (<.0001)***	1.00000	**0.24459 (0.0344)****	**0.47243 (<.0001)***	**0.38798 (0.0006)***	0.07753 0.5085	0.08670 0.4595
Water Quality	**0.38658 (0.0006)***	**0.43753 (<.0001)***	**0.24459 (0.0344)****	1.00000	**0.47431 (<.0001)***	**0.49176 (<.0001)***	0.14504 0.2144	-0.06833 0.5603
Disruption	**0.75604 (<.0001)***	**0.67514 (<.0001)***	**0.47243 (<.0001)***	**0.47431 (<.0001)***	1.00000	**0.79192 (<.0001)***	0.19912 0.0868	-0.00345 0.9766
Connection	**0.69917 (<.0001)***	**0.60437 (<.0001)***	**0.38798 (0.0006)***	**0.49176 (<.0001)***	**0.79192 (<.0001)***	1.00000	**0.23861 (0.0392)****	-0.01103 0.9252
Pressure	0.10002 0.3932	0.08356 0.4760	0.07753 0.5085	0.14504 0.2144	0.19912 0.0868	**0.23861 (0.0392)****	1.00000	0.14495 0.2147
Price	-0.00060 0.9959	-0.09305 0.4272	0.08670 0.4595	-0.06833 0.5603	-0.00345 0.9766	-0.01103 0.9252	0.14495 0.2147	1.00000

***** Significant at 1%   ****** Significant at 5%

Appendix B5.2 (c): Correlation of Water Service with Age (41 to 50 years old)

Pearson Correlation Coefficients, n = 83
Prob > |r| under H0: Rho=0

	Leakage	Burst Pipes	Reservoir	Water Quality	Disruption	Connection	Pressure	Price
Leakage	1.00000	**0.86836 (<.0001)***	**0.61427 (<.0001)***	**0.58756 (<.0001)***	**0.75545 (<.0001)***	**0.66327 (<.0001)***	**0.72848 (<.0001)***	0.11279 0.3100
Burst Pipes	**0.86836 (<.0001)***	1.00000	**0.74399 (<.0001)***	**0.62899 (<.0001)***	**0.88313 (<.0001)***	**0.80767 (<.0001)***	**0.82825 (<.0001)***	0.13935 0.2090
Reservoir	**0.61427 (<.0001)***	**0.74399 (<.0001)***	1.00000	**0.37280 (0.0005)***	**0.73552 (<.0001)***	**0.60753 (<.0001)***	**0.62798 (<.0001)***	0.18165 0.1003
Water Quality	**0.58756 (<.0001)***	**0.62899 (<.0001)***	**0.37280 (0.0005)***	1.00000	**0.47841 (<.0001)***	**0.44505 (<.0001)***	**0.60683 (<.0001)***	-0.02211 0.8427
Disruption	**0.75545 (<.0001)***	**0.88313 (<.0001)***	**0.73552 (<.0001)***	**0.47841 (<.0001)***	1.00000	**0.72944 (<.0001)***	**0.73192 (<.0001)***	0.19682 0.0745
Connection	**0.66327 (<.0001)***	**0.80767 (<.0001)***	**0.60753 (<.0001)***	**0.44505 (<.0001)***	**0.72944 (<.0001)***	1.00000	**0.84604 (<.0001)***	0.24196 **(0.0275)****
Pressure	**0.72848 (<.0001)***	**0.82825 (<.0001)***	**0.62798 (<.0001)***	**0.60683 (<.0001)***	**0.73192 (<.0001)***	**0.84604 (<.0001)***	1.00000	0.15112 0.1727
Price	0.11279 0.3100	0.13935 0.2090	0.18165 0.1003	-0.02211 0.8427	0.19682 0.0745	**0.24196 (0.0275)****	0.15112 0.1727	1.00000

***** Significant at 1%   ** Significant at 5%

Appendix B5.2 (d): Correlation of Water Service with Age (More than 51 years old)

Pearson Correlation Coefficients, n = 83
Prob > |r| under H0: Rho=0

	Leakage	Burst Pipes	Reservoir	Water Quality	Disruption	Connection	Pressure	Price
Leakage	1.00000	**0.76403 (<.0001)***	**0.66947 (<.0001)***	**0.50024 (<.0001)***	**0.63281 (<.0001)***	**0.71383 (<.0001)***	**0.52633 (<.0001)***	0.10510 0.3443
Burst Pipes	**0.76403 (<.0001)***	1.00000	**0.57597 (<.0001)***	**0.57564 (<.0001)***	**0.61082 (<.0001)***	**0.67126 (<.0001)***	**0.51477 (<.0001)***	0.16325 0.1403
Reservoir	**0.66947 (<.0001)***	**0.57597 (<.0001)***	1.00000	**0.48585 (<.0001)***	**0.51519 (<.0001)***	**0.67482 (<.0001)***	**0.41413 (<.0001)***	0.09483 0.3938
Water Quality	**0.50024 (<.0001)***	**0.57564 (<.0001)***	**0.48585 (<.0001)***	1.00000	**0.53619 (<.0001)***	**0.56380 (<.0001)***	**0.50527 (<.0001)***	0.10873 0.3279
Disruption	**0.63281 (<.0001)***	**0.61082 (<.0001)***	**0.51519 (<.0001)***	**0.53619 (<.0001)***	1.00000	**0.75004 (<.0001)***	**0.58182 (<.0001)***	**0.22882 (0.0375)****
Connection	**0.71383 (<.0001)***	**0.67126 (<.0001)***	**0.67482 (<.0001)***	**0.56380 (<.0001)***	**0.75004 (<.0001)***	1.00000	**0.63652 (<.0001)***	0.18302 0.0977
Pressure	**0.52633 (<.0001)***	**0.51477 (<.0001)***	**0.41413 (<.0001)***	**0.50527 (<.0001)***	**0.58182 (<.0001)***	**0.63652 (<.0001)***	1.00000	**0.34337 (0.0015)****
Price	0.10510 0.3443	0.16325 0.1403	0.09483 0.3938	0.10873 0.3279	**0.22882 (0.0375)****	0.18302 0.0977	**0.34337 (0.0015)****	1.00000

***** Significant at 1%   ****** Significant at 5%

Appendix B5.3 (a): Correlation of Water Service with Child (2 children or fewer)

Pearson Correlation Coefficients, n = 214
Prob > |r| under H0: Rho=0

	Leakage	Burst Pipes	Reservoir	Water Quality	Disruption	Connection	Pressure	Price
Leakage	1.00000	**0.83441 (<.0001)***	**0.66232 (<.0001)***	**0.50420 (<.0001)***	**0.52150 (<.0001)***	**0.53549 (<.0001)***	**0.40482 (<.0001)***	**0.19271 (0.0047)***
Burst Pipes	**0.83441 (<.0001)***	1.00000	**0.65794 (<.0001)***	**0.50165 (<.0001)***	**0.55970 (<.0001)***	**0.56454 (<.0001)***	**0.40841 (<.0001)***	**0.19513 (0.0042)****
Reservoir	**0.66232 (<.0001)***	**0.65794 (<.0001)***	1.00000	**0.42983 (<.0001)***	**0.50863 (<.0001)***	**0.47822 (<.0001)***	**0.41502 (<.0001)***	**0.22525 (0.0009)***
Water Quality	**0.50420 (<.0001)***	**0.50165 (<.0001)***	**0.42983 (<.0001)***	1.00000	**0.45022 (<.0001)***	**0.43591 (<.0001)***	**0.35879 (<.0001)***	0.09407 0.1703
Disruption	**0.52150 (<.0001)***	**0.55970 (<.0001)***	**0.50863 (<.0001)***	**0.45022 (<.0001)***	1.00000	**0.67770 (<.0001)***	**0.44208 (<.0001)***	**0.21174 (0.0018)****
Connection	**0.53549 (<.0001)***	**0.56454 (<.0001)***	**0.47822 (<.0001)***	**0.43591 (<.0001)***	**0.67770 (<.0001)***	1.00000	**0.42702 (<.0001)***	**0.21900 (0.0013)****
Pressure	**0.40482 (<.0001)***	**0.40841 (<.0001)***	**0.41502 (<.0001)***	**0.35879 (<.0001)***	**0.44208 (<.0001)***	**0.42702 (<.0001)***	1.00000	**0.25168 (0.0002)***
Price	**0.19271 (0.0047)****	**0.19513 (0.0042)****	**0.22525 (0.0009)***	0.09407 0.1703	**0.21174 (0.0018)****	**0.21900 (0.0013)****	**0.25168 (0.0002)***	1.00000

***** Significant at 1% ****** Significant at 5%

Appendix B5.3 (b): Correlation of Water Service and Child (3 to 5 children)

Pearson Correlation Coefficients, n = 122 Prob > |r| under H0: Rho=0								
	Leakage	**Burst Pipes**	**Reservoir**	**Water Quality**	**Disruption**	**Connection**	**Pressure**	**Price**
Leakage	1.00000	**0.72406 (<.0001)***	**0.59450 (<.0001)***	**0.41968 (<.0001)***	**0.70706 (<.0001)***	**0.67692 (<.0001)***	**0.45356 (<.0001)***	0.09721 0.2868
Burst Pipes	**0.72406 (<.0001)***	1.00000	**0.71769 (<.0001)***	**0.59856 (<.0001)***	**0.72636 (<.0001)***	**0.64893 (<.0001)***	**0.49695 (<.0001)***	0.03543 0.6984
Reservoir	**0.59450 (<.0001)***	**0.71769 (<.0001)***	1.00000	**0.44848 (<.0001)***	**0.62411 (<.0001)***	**0.68375 (<.0001)***	**0.50673 (<.0001)***	0.13036 0.1524
Water Quality	**0.41968 (<.0001)***	**0.59856 (<.0001)***	**0.44848 (<.0001)***	1.00000	**0.55303 (<.0001)***	**0.49002 (<.0001)***	**0.42779 (<.0001)***	0.04843 0.5963
Disruption	**0.70706 (<.0001)***	**0.72636 (<.0001)***	**0.62411 (<.0001)***	**0.55303 (<.0001)***	1.00000	**0.86051 (<.0001)***	**0.56398 (<.0001)***	**0.21556 (0.0171)****
Connection	**0.67692 (<.0001)***	**0.64893 (<.0001)***	**0.68375 (<.0001)***	**0.49002 (<.0001)***	**0.86051 (<.0001)***	1.00000	**0.60511 (<.0001)***	**0.23947 (0.0079)****
Pressure	**0.45356 (<.0001)***	**0.49695 (<.0001)***	**0.50673 (<.0001)***	**0.42779 (<.0001)***	**0.56398 (<.0001)***	**0.60511 (<.0001)***	1.00000	**0.21333 (0.0183)****
Price	0.09721 0.2868	0.03543 0.6984	0.13036 0.1524	0.04843 0.5963	**0.21556 (0.0171)****	**0.23947 (0.0079)****	**0.21333 (0.0183)****	1.00000

***** Significant at 1% ****** Significant at 5%

Appendix B5.3 (c): Correlation of Water Service with Child (6 to 8 children)

Pearson Correlation Coefficients, n = 41 Prob > |r| under H0: Rho=0								
	Leakage	**Burst Pipes**	**Reservoir**	**Water Quality**	**Disruption**	**Connection**	**Pressure**	**Price**
Leakage	1.00000	**0.63741 (<.0001)***	**0.54328 (0.0002)***	**0.53023 (0.0004)***	**0.62357 (<.0001)***	**0.66531 (<.0001)***	0.27346 0.0836	-0.13497 0.4002
Burst Pipes	**0.63741 (<.0001)***	1.00000	**0.59537 (<.0001)***	0.42010 0.0062	**0.59923 (<.0001)***	**0.82080 (<.0001)***	**0.36719 (0.0182)****	0.02941 0.8552
Reservoir	**0.54328 (0.0002)***	**0.59537 (<.0001)***	1.00000	0.20884 0.1901	**0.71802 (<.0001)***	**0.54328 (0.0002)***	0.19074 0.2322	0.11707 0.4660
Water Quality	**0.53023 (0.0004)***	**0.42010 (0.0062)****	0.20884 0.1901	1.00000	0.19888 0.2126	**0.45679 (0.0027)****	0.21761 0.1717	-0.04919 0.7601
Disruption	**0.62357 (<.0001)***	**0.59923 (<.0001)***	**0.71802 (<.0001)***	0.19888 0.2126	1.00000	**0.70035 (<.0001)***	0.22058 0.1658	0.02752 0.8644
Connection	**0.66531 (<.0001)***	**0.82080 (<.0001)***	**0.54328 (0.0002)***	**0.45679 (0.0027)****	**0.70035 (<.0001)***	1.00000	**0.39666 (0.0102)****	-0.13497 0.4002
Pressure	0.27346 0.0836	**0.36719 (0.0182)****	0.19074 0.2322	0.21761 0.1717	0.22058 0.1658	**0.39666 (0.0102)****	1.00000	0.20338 0.2022
Price	-0.13497 0.4002	0.02941 0.8552	0.11707 0.4660	-0.04919 0.7601	0.02752 0.8644	-0.13497 0.4002	0.20338 0.2022	1.00000

***** Significant at 1% ****** Significant at 5%

Appendix B5.3 (d): Correlation of Water Service with Child (More than 9 children)

Pearson Correlation Coefficients, n = 11 Prob > |r| under H0: Rho=0								
	Leakage	**Burst Pipes**	**Reservoir**	**Water Quality**	**Disruption**	**Connection**	**Pressure**	**Price**
Leakage	1.00000	**0.67082 (0.0239)****	0.08333 0.8075	0.51640 0.1039	**1.00000 (<.0001)***	**0.81009 (0.0025)****	**0.81009 (0.0025)****	-0.01513 0.9648
Burst Pipes	**0.67082 (0.0239)****	1.00000	0.05590 0.8703	0.34641 0.2967	**0.67082 (0.0239)****	**0.82808 (0.0016)****	**0.82808 (0.0016)****	0.17593 0.6048
Reservoir	0.08333 0.8075	0.05590 0.8703	1.00000	0.16137 0.6355	0.08333 0.8075	0.17359 0.6097	0.17359 0.6097	0.06809 0.8423
Water Quality	0.51640 0.1039	0.34641 0.2967	0.16137 0.6355	1.00000	0.51640 0.1039	0.41833 0.2004	0.41833 0.2004	0.16408 0.6297
Disruption	**1.00000 (<.0001)***	**0.67082 (0.0239)****	0.08333 0.8075	0.51640 0.1039	1.00000	**0.81009 (0.0025)****	**0.81009 (0.0025)****	-0.01513 0.9648
Connection	**0.81009 (0.0025)****	**0.82808 (0.0016)****	0.17359 0.6097	0.41833 0.2004	**0.81009 (0.0025)****	1.00000	**1.00000 (<.0001)***	0.08405 0.8059
Pressure	**0.81009 (0.0025)****	**0.82808 (0.0016)****	0.17359 0.6097	0.41833 0.2004	**0.81009 (0.0025)****	**1.00000 (<.0001)***	1.00000	0.08405 0.8059
Price	-0.01513 0.9648	0.17593 0.6048	0.06809 0.8423	0.16408 0.6297	-0.01513 0.9648	0.08405 0.8059	0.08405 0.8059	1.00000

***** Significant at 1% ****** Significant at 5%

Appendix B5.4 (a): Correlation of Water Service with Person (2 persons or fewer)

Pearson Correlation Coefficients, n = 67
Prob > |r| under H0: Rho=0

	Leakage	Burst Pipes	Reservoir	Water Quality	Disruption	Connection	Pressure	Price
Leakage	1.00000	0.72934 (<.0001)*	0.49913 (<.0001)*	0.23570 0.0548	0.52848 (<.0001)*	0.51485 (<.0001)*	0.64668 (<.0001)*	0.32415 (0.0075)**
Burst pipe	0.72934 (<.0001)*	1.00000	0.66863 (<.0001)*	0.30680 (0.0116)**	0.56815 (<.0001)*	0.58776 (<.0001)*	0.65843 (<.0001)*	0.31407 (0.0096)**
Reservoir	0.49913 (<.0001)*	0.66863 (<.0001)*	1.00000	0.30439 (0.0123)**	0.59305 (<.0001)*	0.63767 (<.0001)*	0.58872 (<.0001)*	0.18778 0.1281
Water Quality	0.23570 0.0548	0.30680 (0.0116)**	0.30439 (0.0123)**	1.00000	0.47380 (<.0001)*	0.44389 (<.0004)*	0.42191 (<.0004)*	0.11225 0.3658
Disruption	0.52848 (<.0001)*	0.56815 (<.0001)*	0.59305 (<.0001)*	0.47380 (<.0001)*	1.00000	0.86782 (<.0001)*	0.75737 (<.0001)*	0.15878 0.1994
Connection	0.51485 (<.0001)*	0.58776 (<.0001)*	0.63767 (<.0001)*	0.44389 (<.0002)*	0.86782 (<.0001)*	1.00000	0.77791 (<.0001)*	0.27982 (0.0218)**
Pressure	0.64668 (<.0001)*	0.65843 (<.0001)*	0.58872 (<.0001)*	0.42191 (<.0004)*	0.75737 (<.0001)*	0.77791 (<.0001)*	1.00000	0.26124 (0.0327)**
Price	0.32415 (0.0075)**	0.31407 (0.0096)**	0.18778 0.1281	0.11225 0.3658	0.15878 0.1994	0.27982 (0.0218)**	0.26124 (0.0327)**	1.00000

* Significant at 1%   ** Significant at 5%

Appendix B5.4 (b): Correlation of Water Service with Person (3 to 5 persons)

Pearson Correlation Coefficients, n = 180
Prob > |r| under H0: Rho=0

	Leakage	Burst Pipes	Reservoir	Water Quality	Disruption	Connection	Pressure	Price
Leakage	1.00000	**0.83813 (<.0001)***	**0.64195 (<.0001)***	**0.59369 (<.0001)***	**0.63931 (<.0001)***	**0.63919 (<.0001)***	**0.31978 (<.0001)***	0.06148 0.4123
Burst Pipes	**0.83813 (<.0001)***	1.00000	**0.70804 (<.0001)***	**0.63028 (<.0001)***	**0.61299 (<.0001)***	**0.60312 (<.0001)***	**0.32192 (<.0001)***	0.08945 0.2324
Reservoir	**0.64195 (<.0001)***	**0.70804 (<.0001)***	1.00000	**0.51584 (<.0001)***	**0.57062 (<.0001)***	**0.50468 (<.0001)***	**0.30940 (<.0001)***	**0.17906 (0.0162)****
Water Quality	**0.59369 (<.0001)***	**0.63028 (<.0001)***	**0.51584 (<.0001)***	1.00000	**0.55296 (<.0001)***	**0.56287 (<.0001)***	**0.40028 (<.0001)***	0.12107 0.1055
Disruption	**0.63931 (<.0001)***	**0.61299 (<.0001)***	**0.57062 (<.0001)***	**0.55296 (<.0001)***	1.00000	**0.72143 (<.0001)***	**0.35678 (<.0001)***	**0.20079 (0.0069)****
Connection	**0.63919 (<.0001)***	**0.60312 (<.0001)***	**0.50468 (<.0001)***	**0.56287 (<.0001)***	**0.72143 (<.0001)***	1.00000	**0.31390 (<.0001)***	**0.20399 (0.0060)****
Pressure	**0.31978 (<.0001)***	**0.32192 (<.0001)***	**0.30940 (<.0001)***	**0.40028 (<.0001)***	**0.35678 (<.0001)***	**0.31390 (<.0001)***	1.00000	**0.23909 (0.0012)****
Price	0.06148 0.4123	0.08945 0.2324	0.17906 0.0162	0.12107 0.1055	**0.20079 (0.0069)****	**0.20399 (0.0060)****	**0.23909 (0.0012)****	1.00000

***** Significant at 1% ****** Significant at 5%

Appendix B5.4 (c): Correlation of Water Service with Person (6 to 8 persons)

Pearson Correlation Coefficients, n= 113 Prob > |r| under H0: Rho=0								
	Leakage	**Burst pipe**	**Reservoir**	**Water Quality**	**Disruption**	**Connection**	**Pressure**	**Price**
Leakage	1.00000	**0.67518 (<.0001)***	**0.63238 (<.0001)***	**0.41651 (<.0001)***	**0.51647 (<.0001)***	**0.52060 (<.0001)***	**0.46900 (<.0001)***	0.11153 0.2395
Burst Pipes	**0.67518 (<.0001)***	1.00000	**0.52298 (<.0001)***	**0.52727 (<.0001)***	**0.54435 (<.0001)***	**0.58855 (<.0001)***	**0.53773 (<.0001)***	0.03565 0.7077
Reservoir	**0.63238 (<.0001)***	**0.52298 (<.0001)***	1.00000	**0.32428 (0.0005)***	**0.43546 (<.0001)***	**0.57707 (<.0001)***	**0.56233 (<.0001)***	0.10314 0.2770
Water Quality	**0.41651 (<.0001)***	**0.52727 (<.0001)***	**0.32428 (0.0005)***	1.00000	**0.33284 (0.0003)***	**0.28107 (0.0026)****	**0.29718 (0.0014)****	-0.04438 0.6407
Disruption	**0.51647 (<.0001)***	**0.54435 (<.0001)***	**0.43546 (<.0001)***	**0.33284 (0.0003)****	1.00000	**0.63684 (<.0001)***	**0.48525 (<.0001)***	0.10222 0.2813
Connection	**0.52060 (<.0001)***	**0.58855 (<.0001)***	**0.57707 (<.0001)***	**0.28107 (0.0026)****	**0.63684 (<.0001)***	1.00000	**0.67401 (<.0001)***	0.11075 0.2429
Pressure	**0.46900 (<.0001)***	**0.53773 (<.0001)***	**0.56233 (<.0001)***	**0.29718 (0.0014)****	**0.48525 (<.0001)***	**0.67401 (<.0001)***	1.00000	0.14201 0.1335
Price	0.11153 0.2395	0.03565 0.7077	0.10314 0.2770	-0.04438 0.6407	0.10222 0.2813	0.11075 0.2429	0.14201 0.1335	1.00000

***** Significant at 1% ****** Significant at 5%

Appendix B5.4 (d): Correlation of Water Service with Person (More than 9 persons)

Pearson Correlation Coefficients, n = 31 Prob > |r| under H0: Rho=0								
	Leakage	**Burst Pipes**	**Reservoir**	**Water Quality**	**Disruption**	**Connection**	**Pressure**	**Price**
Leakage	1.00000	**0.77212 (<.0001)***	**0.55870 (0.0011)****	**0.65440 (<.0001)***	**0.61813 (0.0002)***	**0.65934 (<.0001)***	**0.51145 (0.0033)****	0.09545 0.6095
Burst Pipes	**0.77212 (<.0001)***	1.00000	**0.70709 (<.0001)***	**0.56894 (0.0008)***	**0.81736 (<.0001)***	**0.77212 (<.0001)***	**0.52189 (0.0026)****	0.18305 0.3243
Reservoir	**0.55870 (0.0011)****	**0.70709 (<.0001)***	1.00000	**0.42203 (0.0180)****	**0.64406 (<.0001)***	**0.43843 (0.0136)****	0.28473 0.1205	0.27130 0.1399
Water Quality	**0.65440 (<.0001)***	**0.56894 (0.0008)***	**0.42203 (0.0180)****	1.00000	**0.51823 (0.0028)****	0.53714 0.0018	**0.47629 (0.0068)****	0.07819 0.6759
Disruption	**0.61813 (0.0002)***	**0.81736 (<.0001)***	**0.64406 (<.0001)***	**0.51823 (0.0028)****	1.00000	**0.87363 (<.0001)***	**0.47537 (0.0069)****	0.24164 0.1903
Connection	**0.65934 (<.0001)***	**0.77212 (<.0001)***	**0.43843 (0.0136)****	**0.53714 (0.0018)****	**0.87363 (<.0001)***	1.00000	**0.57724 (0.0007)****	0.05799 0.7566
Pressure	**0.51145 (0.0033)****	**0.52189 (0.0026)***	0.28473 0.1205	**0.47629 (0.0068)****	**0.47537 (0.0069)****	**0.57724 (0.0007)***	1.00000	0.27066 0.1408
Price	0.09545 0.6095	0.18305 0.3243	0.27130 0.1399	0.07819 0.6759	0.24164 0.1903	0.05799 0.7566	0.27066 0.1408	1.00000

***** Significant at 1% ****** Significant at 5%

Appendix B5.5 (a): Correlation of Water Service with Terraced House

Spearman Correlation Coefficients, n = 145
Prob > |r| under H0: Rho=0

	Leakage	Burst Pipes	Reservoir	Water Quality	Disruption	Connection	Pressure	Price
Leakage	1.00000	**0.76442 (<.0001)***	**0.63318 (<.0001)***	**0.34930 (<.0001)***	**0.56358 (<.0001)***	**0.55657 (<.0001)***	**0.46733 (<.0001)***	-0.05118 0.5410
Burst Pipes	**0.76442 (<.0001)***	1.00000	**0.66973 (<.0001)***	**0.33780 (<.0001)***	**0.54189 (<.0001)***	**0.57735 (<.0001)***	**0.46127 (<.0001)***	0.00162 0.9846
Reservoir	**0.63318 (<.0001)***	**0.66973 (<.0001)***	1.00000	**0.47836 (<.0001)***	**0.56527 (<.0001)***	**0.71662 (<.0001)***	**0.49851 (<.0001)***	0.05977 0.4752
Water Quality	**0.34930 (<.0001)***	**0.33780 (<.0001)***	**0.47836 (<.0001)***	1.00000	**0.44885 (<.0001)***	**0.36023 (<.0001)***	**0.39308 (<.0001)***	-0.00239 0.9772
Disruption	**0.56358 (<.0001)***	**0.54189 (<.0001)***	**0.56527 (<.0001)***	**0.44885 (<.0001)***	1.00000	**0.69267 (<.0001)***	**0.61204 (<.0001)***	0.01867 0.8236
Connection	**0.55657 (<.0001)***	**0.57735 (<.0001)***	**0.71662 (<.0001)***	**0.36023 (<.0001)***	**0.69267 (<.0001)***	1.00000	**0.63411 (<.0001)***	0.10441 0.2114
Pressure	**0.46733 (<.0001)***	**0.46127 (<.0001)***	**0.49851 (<.0001)***	**0.39308 (<.0001)***	**0.61204 (<.0001)***	**0.63411 (<.0001)***	1.00000	0.16574 0.0463
Price	-0.05118 0.5410	0.00162 0.9846	0.05977 0.4752	-0.00239 0.9772	0.01867 0.8236	0.10441 0.2114	0.16574 0.0463	1.00000

***** Significant at 1%   ****** Significant at 5%

Appendix B5.5 (b): Correlation of Water Service with Two-Storey House

Spearman Correlation Coefficients, n = 107 Prob > |r| under H0: Rho=0								
	Leakage	**Burst Pipes**	**Reservoir**	**Water Quality**	**Disruption**	**Connection**	**Pressure**	**Price**
Leakage	1.00000	**0.81806 (<.0001)***	**0.76263 (<.0001)***	**0.43319 (<.0001)***	**0.76956 (<.0001)***	**0.74427 (<.0001)***	**0.46403 (<.0001)***	0.09408 0.3351
Burst Pipes	**0.81806 (<.0001)***	1.00000	**0.78486 (<.0001)***	**0.43326 (<.0001)***	**0.74868 (<.0001)***	**0.75578 (<.0001)***	**0.46930 (<.0001)***	0.06356 0.5155
Reservoir	**0.76263 (<.0001)***	**0.78486 (<.0001)***	1.00000	**0.41793 (<.0001)***	**0.67234 (<.0001)***	**0.70918 (<.0001)***	**0.53871 (<.0001)***	0.10460 0.2836
Water Quality	**0.43319 (<.0001)***	**0.43326 (<.0001)***	**0.41793 (<.0001)***	1.00000	**0.41350 (<.0001)***	**0.45202 (<.0001)***	**0.30405 (0.0015)****	0.05935 0.5437
Disruption	**0.76956 (<.0001)***	**0.74868 (<.0001)***	**0.67234 (<.0001)***	**0.41350 (<.0001)***	1.00000	**0.83762 (<.0001)***	**0.48702 (<.0001)***	0.10943 0.2619
Connection	**0.74427 (<.0001)***	**0.75578 (<.0001)***	**0.70918 (<.0001)***	**0.45202 (<.0001)***	**0.83762 (<.0001)***	1.00000	**0.51597 (<.0001)***	0.11116 0.2543
Pressure	**0.46403 (<.0001)***	**0.46930 (<.0001)***	**0.53871 (<.0001)***	**0.30405 (0.0015)****	**0.48702 (<.0001)***	**0.51597 (<.0001)***	1.00000	0.17764 0.0672
Price	0.09408 0.3351	0.06356 0.5155	0.10460 0.2836	0.05935 0.5437	0.10943 0.2619	0.11116 0.2543	0.17764 0.0672	1.00000

***** Significant at 1% ****** Significant at 5%

Appendix B5.5 (c): Correlation of Water Service with Semi-Detached House

Spearman Correlation Coefficients, n = 29 Prob > |r| under H0: Rho=0								
	Leakage	**Burst Pipes**	**Reservoir**	**Water Quality**	**Disruption**	**Connection**	**Pressure**	**Price**
Leakage	1.00000	**0.86349 (<.0001)***	**0.84440 (<.0001)***	0.17441 0.3655	**0.46013 (0.0120)****	**0.52360 (0.0036)****	**0.41261 (0.0261)****	0.36713 0.0501
Burst Pipes	**0.86349 (<.0001)***	1.00000	**0.84922 (<.0001)***	0.23000 0.2300	**0.60591 (0.0005)***	**0.66312 (<.0001)***	0.42263 0.0224	0.25511 0.1817
Reservoir	**0.84440 (<.0001)***	**0.84922 (<.0001)***	1.00000	0.16066 0.4051	**0.61127 (0.0004)***	**0.66743 (<.0001)***	**0.44908 (0.0145)****	0.32447 0.0859
Water Quality	0.17441 0.3655	0.23000 0.2300	0.16066 0.4051	1.00000	**0.44958 (0.0144)****	**0.47043 (0.0100)****	**0.41418 (0.0255)****	-0.16764 0.3847
Disruption	**0.46013 (0.0120)****	**0.60591 (0.0005)***	**0.61127 (0.0004)***	**0.44958 (0.0144)****	1.00000	**0.93828 (<.0001)***	**0.68088 (<.0001)***	0.20505 0.2860
Connection	**0.52360 (0.0036)****	**0.66312 (<.0001)***	**0.66743 (<.0001)***	**0.47043 (0.0100)****	**0.93828 (<.0001)***	1.00000	**0.62111 (0.0003)***	0.24158 0.2068
Pressure	**0.41261 (0.0261)****	**0.42263 (0.0224)****	**0.44908 (0.0145)****	0.41418 0.0255	**0.68088 (<.0001)***	**0.62111 (0.0003)***	1.00000	0.14511 0.4526
Price	0.36713 0.0501	0.25511 0.1817	0.32447 0.0859	-0.16764 0.3847	0.20505 0.2860	0.24158 0.2068	0.14511 0.4526	1.00000

***** Significant at 1% ****** Significant at 5%

Appendix B5.5 (d): Correlation of Water Service with Bungalow

Spearman Correlation Coefficients, n = 31 Prob > |r| under H0: Rho=0								
	Leakage	**Burst Pipes**	**Reservoir**	**Water Quality**	**Disruption**	**Connection**	**Pressure**	**Price**
Leakage	1.00000	**0.68216 (<.0001)***	**0.46433 (0.0085)****	**0.61437 (0.0002)***	**0.37064 (0.0401)****	**0.46768 (0.0080)****	**0.64386 (<.0001)***	-0.11056 0.5538
Burst Pipes	**0.68216 (<.0001)***	1.00000	**0.52744 (0.0023)****	**0.61583 (0.0002)***	**0.42885 (0.0161)****	**0.43762 (0.0138)****	**0.62118 (0.0002)***	-0.10670 0.5678
Reservoir	**0.46433 (0.0085)****	**0.52744 (0.0023)****	1.00000	0.24593 0.1823	**0.44547 (0.0120)****	0.25210 0.1713	0.25518 0.1659	0.10945 0.5578
Water Quality	**0.61437 (0.0002)***	**0.61583 (0.0002)***	0.24593 0.1823	1.00000	0.33809 0.0628	**0.49628 (0.0045)****	**0.58644 (0.0005)***	-0.26073 0.1566
Disruption	**0.37064 (0.0401)****	**0.42885 (0.0161)****	**0.44547 (0.0120)****	0.33809 0.0628	1.00000	**0.47207 (0.0073)****	**0.44183 (0.0128)****	0.13449 0.4707
Connection	**0.46768 (0.0080)****	**0.43762 (0.0138)****	0.25210 0.1713	**0.49628 (0.0045)****	**0.47207 (0.0073)****	1.00000	**0.76844 (<.0001)***	0.20949 0.2580
Pressure	**0.64386 (<.0001)***	**0.62118 (0.0002)***	0.25518 0.1659	**0.58644 (0.0005)***	**0.44183 (0.0128)****	**0.76844 (<.0001)***	1.00000	0.14302 0.4428
Price	-0.11056 0.5538	-0.10670 0.5678	0.10945 0.5578	-0.26073 0.1566	0.13449 0.4707	0.20949 0.2580	0.14302 0.4428	1.00000

***** Significant at 1% ****** Significant at 5%

Appendix B5.5 (e): Correlation of Water Service with Others

Spearman Correlation Coefficients, n = 80 **Prob > |r| under H0: Rho=0**								
	Leakage	**Burst Pipes**	**Reservoir**	**Water Quality**	**Disruption**	**Connection**	**Pressure**	**Price**
Leakage	1.00000	**0.90354** **(<.0001)***	**0.76752** **(<.0001)***	**0.48175** **(<.0001)***	**0.65006** **(<.0001)***	**0.60479** **(<.0001)***	**0.55989** **(<.0001)***	0.19398 0.0847
Burst Pipes	**0.90354** **(<.0001)***	1.00000	**0.76752** **(<.0001)***	**0.42595** **(<.0001)***	**0.69653** **(<.0001)***	**0.58197** **(<.0001)***	**0.62876** **(<.0001)***	0.19398 0.0847
Reservoir	**0.76752** **(<.0001)***	**0.76752** **(<.0001)***	1.00000	**0.45957** **(<.0001)***	**0.78988** **(<.0001)***	**0.54239** **(<.0001)***	**0.68137** **(<.0001)***	0.20839 0.0636
Water Quality	**0.48175** **(<.0001)***	**0.42595** **(<.0001)***	**0.45957** **(<.0001)***	1.00000	**0.43499** **(<.0001)***	**0.39322** **(0.0003)***	**0.39635** **(0.0003)***	0.13394 0.2362
Disruption	**0.65006** **(<.0001)***	**0.69653** **(<.0001)***	**0.78988** **(<.0001)***	**0.43499** **(<.0001)***	1.00000	**0.67322** **(<.0001)***	**0.63762** **(<.0001)***	**0.22451** **(0.0453)****
Connection	**0.60479** **(<.0001)***	**0.58197** **(<.0001)***	**0.54239** **(<.0001)***	**0.39322** **(0.0003)***	**0.67322** **(<.0001)***	1.00000	**0.71449** **(<.0001)***	0.20711 0.0653
Pressure	**0.55989** **(<.0001)***	**0.62876** **(<.0001)***	**0.68137** **(<.0001)***	**0.39635** **(0.0003)***	**0.63762** **(<.0001)***	**0.71449** **(<.0001)***	1.00000	0.20438 0.0690
Price	0.19398 0.0847	0.19398 0.0847	0.20839 0.0636	0.13394 0.2362	0.22451 0.0453	0.20711 0.0653	0.20438 0.0690	1.00000

***** Significant at 1% ****** Significant at 5%

Appendix B6

Appendix B6.1 (a): Correlation of Strategies with Malay

Spearman Correlation Coefficients, n = 329 Prob > |r| under H0: Rho=0				
	Integrated	**Training**	**Funding**	**Education**
Integrated	1.00000	**0.67452 (<.0001)***	**0.69341 (<.0001)***	**0.67434 (<.0001)***
Training	**0.67452 (<.0001)***	1.00000	**0.68304 (<.0001)***	**0.67448 (<.0001)***
Funding	**0.69341 (<.0001)***	**0.68304 (<.0001)***	1.00000	**0.72553 (<.0001)***
Education	**0.67434 (<.0001)***	**0.67448 (<.0001)***	**0.72553 (<.0001)***	1.00000

***** Significant at 1%

Appendix B6.1 (b): Correlation of Strategies with Chinese

Spearman Correlation Coefficients, n = 48 Prob > |r| under H0: Rho=0				
	Integrated	**Training**	**Funding**	**Education**
Integrated	1.00000	**0.91858 (<.0001)***	**0.96386 (<.0001)***	**0.92938 (<.0001)***
Training	**0.91858 (<.0001)***	1.00000	**0.88155 (<.0001)***	**0.87619 (<.0001)***
Funding	**0.96386 (<.0001)***	**0.88155 (<.0001)***	1.00000	**0.89032 (<.0001)***
Education	**0.92938 (<.0001)***	**0.87619 (<.0001)***	**0.89032 (<.0001)***	1.00000

***** Significant at 1%

Appendix B6.1 (c): Correlation of Strategies with Indian

Spearman Correlation Coefficients, n = 11 Prob > |r| under H0: Rho=0				
	Integrated	**Training**	**Funding**	**Education**
Integrated	1.00000	**1.0000 (<.0001)***	**1.0000 (<.0001)***	**0.81009 (<.0025)***
Training	**1.00000 (<.0001)***	1.00000	**1.0000 (<.0001)***	**0.81009 (<.0025)***
Funding	**1.00000 (<.0001)***	**1.0000 (<.0001)***	1.00000	**0.81009 (<.0025)***
Education	**0.81009 (<.0025)***	**0.81009 (<.0025)***	**0.81009 (<.0025)***	1.00000

***** Significant at 1%

Appendix B6.1 (d): Correlation of Strategies with Others

Spearman Correlation Coefficients, n = 4 Prob > |r| under H0: Rho=0				
	Integrated	**Training**	**Funding**	**Education**
Integrated	1.00000	0.81650 0.1835	0.81650 0.1835	0.81650 0.1835
Training	0.81650 0.1835	1.00000	0.33333 0.6667	**1.00000 <.0001***
Funding	0.81650 0.1835	0.33333 0.6667	1.00000	0.33333 0.6667
Education	0.81650 0.1835	**1.00000 <.0001***	0.33333 0.6667	1.00000

***** Significant at 1%

Appendix B6.2 (a): Correlation of Strategies with Age (20 to 30 years)

Pearson Correlation Coefficients, n = 151 Prob > |r| under H0: Rho=0				
	Integrated	**Training**	**Funding**	**Education**
Integrated	1.00000	**0.55110 (<.0001)***	**0.58783 (<.0001)***	**0.58291 (<.0001)***
Training	**0.55110 (<.0001)***	1.00000	**0.67146 (<.0001)***	**0.57964 (<.0001)***
Funding	**0.58783 (<.0001)***	**0.67146 (<.0001)***	1.00000	**0.62048 (<.0001)***
Education	**0.58291 (<.0001)***	**0.57964 (<.0001)***	**0.62048 (<.0001)***	1.00000

***** Significant at 1%

Appendix B6.2 (b): Correlation of Strategies with Age (31 to 40 years)

Pearson Correlation Coefficients, n = 75 Prob > |r| under H0: Rho=0				
	Integrated	**Training**	**Funding**	**Education**
Integrated	1.00000	**0.73780 (<.0001)***	**0.72457 (<.0001)***	**0.69389 (<.0001)***
Training	**0.73780 (<.0001)***	1.00000	**0.65416 (<.0001)***	**0.75025 (<.0001)***
Funding	**0.72457 (<.0001)***	**0.65416 (<.0001)***	1.00000	**0.74000 (<.0001)***
Education	**0.69389 (<.0001)***	**0.75025 (<.0001)***	**0.74000 (<.0001)***	1.00000

***** Significant at 1%

Appendix B6.2 (c): Correlation of Strategies with Age (41 to 50 years)

Pearson Correlation Coefficients, n = 83 Prob > |r| under H0: Rho=0				
	Integrated	**Training**	**Funding**	**Education**
Integrated	1.00000	**0.76521 (<.0001)***	**0.76740 (<.0001)***	**0.84217 (<.0001)***
Training	**0.76521 (<.0001)***	1.00000	**0.71091 (<.0001)***	**0.68957 (<.0001)***
Funding	**0.76740 (<.0001)***	**0.71091 (<.0001)***	1.00000	**0.80950 (<.0001)***
Education	**0.84217 (<.0001)***	**0.68957 (<.0001)***	**0.80950 (<.0001)***	1.00000

***** Significant at 1%

Appendix B6.2 (d): Correlation of Strategies with Age (More than 51 years)

Pearson Correlation Coefficients, n = 83 Prob > |r| under H0: Rho=0				
	Integrated	**Training**	**Funding**	**Education**
Integrated	1.00000	**0.76310 (<.0001)***	**0.65987 (<.0001)***	**0.69594 (<.0001)***
Training	**0.76310 (<.0001)***	1.00000	**0.67939 (<.0001)***	**0.69233 (<.0001)***
Funding	**0.65987 (<.0001)***	**0.67939 (<.0001)***	1.00000	**0.78153 (<.0001)***
Education	**0.69594 (<.0001)***	**0.69233 (<.0001)***	**0.78153 (<.0001)***	1.00000

***** Significant at 1%

Appendix B6.3 (a): Correlation of Strategies with Child (2 children or fever)

Pearson Correlation Coefficients, n = 214 Prob > |r| under H0: Rho=0				
	Integrated	**Training**	**Funding**	**Education**
Integrated	1.00000	**0.65941 (<.0001)***	**0.69745 (<.0001)***	**0.65710 (<.0001)***
Training	**0.65941 (<.0001)***	1.00000	**0.65865 (<.0001)***	**0.58526 (<.0001)***
Funding	**0.69745 (<.0001)***	**0.65865 (<.0001)***	1.00000	**0.67979 (<.0001)***
Education	**0.65710 (<.0001)***	**0.58526 (<.0001)***	**0.67979 (<.0001)***	1.00000

*Significant at 1%

Appendix B6.3 (b): Correlation of Strategies with Child (3 to 5 children)

Pearson Correlation Coefficients, n = 122 Prob > |r| under H0: Rho=0				
	Integrated	**Training**	**Funding**	**Education**
Integrated	1.00000	**0.71365 (<.0001)***	**0.60980 (<.0001)***	**0.66850 (<.0001)***
Training	**0.71365 (<.0001)***	1.00000	**0.68668 (<.0001)***	**0.78526 (<.0001)***
Funding	**0.60980 (<.0001)***	**0.68668 (<.0001)***	1.00000	**0.78631 (<.0001)***
Education	**0.66850 (<.0001)***	**0.78526 (<.0001)***	**0.78631 (<.0001)***	1.00000

*Significant at 1%

Appendix B6.3 (c): Correlation of Strategies with Child (6 to 8 children)

Pearson Correlation Coefficients, n = 41 Prob > |r| under H0: Rho=0				
	Integrated	**Training**	**Funding**	**Education**
Integrated	1.00000	**0.50278 (<.0001)***	**0.54215 (<.0001)***	**0.81732 (<.0001)***
Training	**0.50278 (<.0001)***	1.00000	**0.80429 (<.0001)***	**0.66746 (<.0001)***
Funding	**0.54215 (<.0001)***	**0.80429 (<.0001)***	1.00000	**0.73580 (<.0001)***
Education	**0.81732 (<.0001)***	**0.66746 (<.0001)***	**0.73580 (<.0001)***	1.00000

*Significant at 1%

Appendix B6.3 (d): Correlation of Strategies with Child (More than 9 children)

Pearson Correlation Coefficients, n = 11 Prob > |r| under H0: Rho=0				
	Integrated	**Training**	**Funding**	**Education**
Integrated	1.00000	**0.82808 (0.0016)***	**0.91147 (<.0001)***	**0.91147 (<.0001)***
Training	**0.82808 (0.0016)***	1.00000	**0.81242 (0.0024)***	**0.81242 (0.0024)***
Funding	**0.91147 (<.0001)***	**0.81242 (0.0024)***	1.00000	**1.00000 (<.0001)***
Education	**0.91147 (<.0001)***	**0.81242 (0.0024)***	**1.00000 (<.0001)***	1.00000

*Significant at 1%

Appendix B6.4 (a): Correlation of Strategies with Person (2 persons or fewer)

Pearson Correlation Coefficients, n = 67 Prob > |r| under H0: Rho=0				
	Integrated	**Training**	**Funding**	**Education**
Integrated	1.00000	**0.85472 (<.0001)***	**0.72188 (<.0001)***	**0.81279 (<.0001)***
Training	**0.85472 (<.0001)***	1.00000	**0.70973 (<.0001)***	**0.70728 (<.0001)***
Funding	**0.72188 (<.0001)***	**0.70973 (<.0001)***	1.00000	**0.59612 (<.0001)***
Education	**0.81279 (<.0001)***	**0.70728 (<.0001)***	**0.59612 (<.0001)***	1.00000

*Significant at 1%

Appendix B6.4 (b): Correlation of Strategies with Person (3 to 5 persons)

Pearson Correlation Coefficients, n = 180 Prob > |r| under H0: Rho=0				
	Integrated	**Training**	**Funding**	**Education**
Integrated	1.00000	**0.66286 (<.0001)***	**0.62117 (<.0001)***	**0.58406 (<.0001)***
Training	**0.66286 (<.0001)***	1.00000	**0.64426 (<.0001)***	**0.68726 (<.0001)***
Funding	**0.62117 (<.0001)***	**0.64426 (<.0001)***	1.00000	**0.73587 (<.0001)***
Education	**0.58406 (<.0001)***	**0.68726 (<.0001)***	**0.73587 (<.0001)***	1.00000

*Significant at 1%

Appendix B6.4 (c): Correlation of Strategies with Person (6 to 8 persons)

Pearson Correlation Coefficients, n = 113 Prob > |r| under H0: Rho=0				
	Integrated	**Training**	**Funding**	**Education**
Integrated	1.00000	**0.59922 (<.0001)***	**0.77497 (<.0001)***	**0.77063 (<.0001)***
Training	**0.59922 (<.0001)***	1.00000	**0.71639 (<.0001)***	**0.56130 (<.0001)***
Funding	**0.77497 (<.0001)***	**0.71639 (<.0001)***	1.00000	**0.78907 (<.0001)***
Education	**0.77063 (<.0001)***	**0.56130 (<.0001)***	**0.78907 (<.0001)***	1.00000

*Significant at 1%

Appendix B6.4 (d): Correlation of Strategies with Person (More than 9 persons)

Pearson Correlation Coefficients, n = 31 Prob > |r| under H0: Rho=0				
	Integrated	**Training**	**Funding**	**Education**
Integrated	1.00000	**0.55574 (0.0012)***	**0.37516 0.0376**	**0.61608 (0.0002)***
Training	**0.55574 (0.0012)***	1.00000	**0.68596 (<.0001)***	**0.66672 (<.0001)***
Funding	**0.37516 0.0376**	**0.68596 (<.0001)***	1.00000	**0.61693 (<.0002)***
Education	**0.61608 (0.0002)***	**0.66672 (<.0001)***	**0.61693 (0.0002)***	1.00000

*Significant at 1%

Appendix B6.5 (a): Correlation of Strategies with Terraced House

Spearman Correlation Coefficients, n = 145 Prob > |r| under H0: Rho=0				
	Integrated	**Training**	**Funding**	**Education**
Integrated	1.00000	**0.74363 (<.0001)***	**0.78529 (<.0001)***	**0.71280 (<.0001)***
Training	**0.74363 (<.0001)***	1.00000	**0.59737 (<.0001)***	**0.68253 (<.0001)***
Funding	**0.78529 (<.0001)***	**0.59737 (<.0001)***	1.00000	**0.71352 (<.0001)***
Education	**0.71280 (<.0001)***	**0.68253 (<.0001)***	**0.71352 (<.0001)***	1.00000

*Significant at 1%

Appendix B6.5 (b): Correlation of Strategies with Two-Storey House

Spearman Correlation Coefficients, n = 107 Prob > |r| under H0: Rho=0				
	Integrated	**Training**	**Funding**	**Education**
Integrated	1.00000	**0.70209 (<.0001)***	**0.72513 (<.0001)***	**0.72611 (<.0001)***
Training	**0.70209 (<.0001)***	1.00000	**0.76332 (<.0001)***	**0.79542 (<.0001)***
Funding	**0.72513 (<.0001)***	**0.76332 (<.0001)***	1.00000	**0.77097 (<.0001)***
Education	**0.72611 (<.0001)***	**0.79542 (<.0001)***	**0.77097 (<.0001)***	1.00000

*Significant at 1%

Appendix B6.5 (c): Correlation of Strategies with Semi-Detached House

Spearman Correlation Coefficients, n = 29 Prob > |r| under H0: Rho=0				
	Integrated	**Training**	**Funding**	**Education**
Integrated	1.00000	**0.61488 (0.0004)***	**0.73193 (<.0001)***	**0.58082 (0.0010)***
Training	**0.61488 (0.0004)***	1.00000	**0.70563 (<.0001)***	**0.55381 (0.0018)***
Funding	**0.73193 (<.0001)***	**0.70563 (<.0001)***	1.00000	**0.78195 (<.0001)***
Education	**0.58082 (0.0010)***	**0.55381 (0.0018)***	**0.77097 (<.0001)***	1.00000

*Significant at 1%

Appendix B6.5 (d): Correlation of Strategies with Bungalow

Spearman Correlation Coefficients, n = 31 Prob > |r| under H0: Rho=0				
	Integrated	**Training**	**Funding**	**Education**
Integrated	1.00000	**0.66982 (<.0001)***	**0.54163 (0.0017)***	**0.58020 (0.0006)***
Training	**0.66982 (<.0001)***	1.00000	**0.80144 (<.0001)***	**0.70901 (<.0001)***
Funding	**0.54163 (0.0017)***	**0.80144 (<.0001)***	1.00000	**0.69465 (<.0001)***
Education	**0.58020 (0.0006)***	**0.70901 (<.0001)***	**0.69465 (<.0001)***	1.00000

*Significant at 1%

Appendix B6.5 (e): Correlation of Strategies with Others

Spearman Correlation Coefficients, n = 80 **Prob > |r| under H0: Rho=0**				
	Integrated	**Training**	**Funding**	**Education**
Integrated	1.00000	**0.72894** **(<.0001)***	**0.73928** **(<.0001)***	**0.77077** **(<.0001)***
Training	**0.72894** **(<.0001)***	1.00000	**0.77436** **(<.0001)***	**0.66293** **(<.0001)***
Funding	**0.73928** **(<.0001)***	**0.77436** **(<.0001)***	1.00000	**0.75006** **(<.0001)***
Education	**0.77077** **(<.0001)***	**0.66293** **(<.0001)***	**0.75006** **(<.0001)***	1.00000

*Significant at 1%