A COMPARATIVE STUDY IN RESIDENTIAL WATER USE MODELLING (THE STUDY CASE : INDONESIA)

by

Panani Kesai

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A COMPARATIVE STUDY IN RESIDENTIAL WATER USE MODELLING

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PANANI KESAI

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ABSTRACT

This thesis deals with an investigation of factors affecting residential water consumption in Indonesia. Data used were household level data of 990 residential water customers in 8 urban centres of various sizes in the island of Java in Indonesia. Since there is a wide range of customer differences, a multistage sampling technique was used to obtain the data.

The analysis of variance showed that the current prediction model used in Indonesia can be improved. It was found that different housing types had significantly different per capita consumption. On the other hand, for a given housing type the size of the urban centre did not show a relationship with the consumption. The study also demonstrates that the electrical bill, the yard area, and the availability of flushing toilet, washing machine, and car, are positively related to a higher per capita consumption in the better housing types.

The proposed model explains the often observed deviations from anticipated demand. It could improve demand forecasting per housing type or per urban centre. A customer classification based on housing type will be able to serve as a basis for better pricing policy and for economic studies of pricing and demand.

ACKNOWLEDGEMENT

I would like to gratefully acknowledge the Canadian International Development Agency (CIDA) and the Government of Indonesia for sponsoring this study. I would also like to express my appreciation to Prof. C. Booy and Dr. A.B. Sparling for their guidance and advice during the preparation of this document and during the academic years. The appreciation is extended to Prof. Dr. M.G. Britton for his review of this document and the constructive comments.

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Chapter 1

INTRODUCTION

1.1. General

In recent decades the urban public water supply on the island of Java in Indonesia has deteriorated for three reasons. The rapid urban growth has outstripped the growth of the piped water system; reductions in the government budget have slowed down the expansion of the required public works and the water resources have been increasingly subject to pollution. Water conservation policies are therefore being considered.

One of the problems with developing such policies is that the method currently used in Indonesia for estimating water demand is not reliable. It uses only the size of the urban population as a single parameter. Since a good water demand model is essential for the planning of a water conservation policy this study aimed at developing such a model.

The first objective of the study was to determine what factors affect residential water use. This has been the subject of many earlier studies but these were performed for other countries. The conditions in Indonesia are different in many respects. Also, the independent variables that were used in the models resulting from these studies are not always available in Indonesia.

The second objective was to determine whether a new demand model using the data that can be made available in Indonesia would be a significant improvement over current methods.

The third objective was to investigate whether the new model could serve as a basis for a better pricing policy and for an economic study of supply and demand in the public water sector.

A data collection program was undertaken and it forms the basis for this work.

1.2. Design of the new model

Many demand models have been developed and are described in the literature. Most of these, however, are for developed countries. In Indonesia the urban setting is quite different and data about the demographic variables used in the published models are often not available. For example, in most countries a water demand study commonly contrasts residential water use for different conditions such as summer and winter, humid and arid areas, urban and rural areas, flat rate and metered areas, and multi- and single-dwelling units. The area in

Indonesia under the present study do not have such contrast. However, the fact that Indonesia has predominantly single-dwelling family units does not imply homogeneous water customer groups as indicated by Weber (1993). The size and quality of the single-dwelling units vary widely among income groups. This may cause differences in actual water demand. While in many cases appraised property value is used as an indicator of water consumption, (Howe and Linaweaver, 1967), such records of property value are not available in Indonesia. Using income data obtained from surveys is questionable since the testimony of respondents was commonly found to be unreliable in surveys.

The present consumption model used in Indonesia is a single-variable model with as independent variable the population of the urban centre. It is difficult to rely on any demand projection and any pricing policies based on this model. The lack of classification in the model has also caused a difficulty in measuring price elasticity.

It was considered that the housing type could possibly serve as the primary variable in the estimation of the water demand. It is relatively easy to determine in existing developments. In new developments government policy prescribes a fixed ratio for the housing types that are being planned. It would therefore also serve as a good indicator of water demand for new developments.

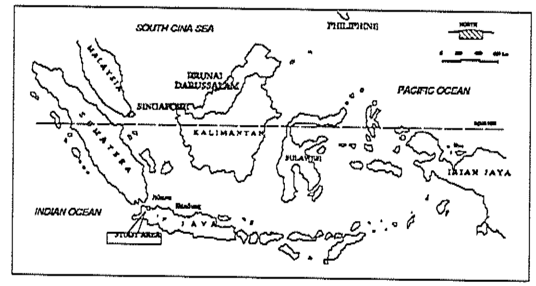
The housing type can be expected to be highly correlated with other variables that determine the water demand of the household and that are more difficult, or not possible to measure. It was considered that the house type could serve as a proxy variable for such other variables as yard area, water consuming appliances, car ownership, and electricity consumption.

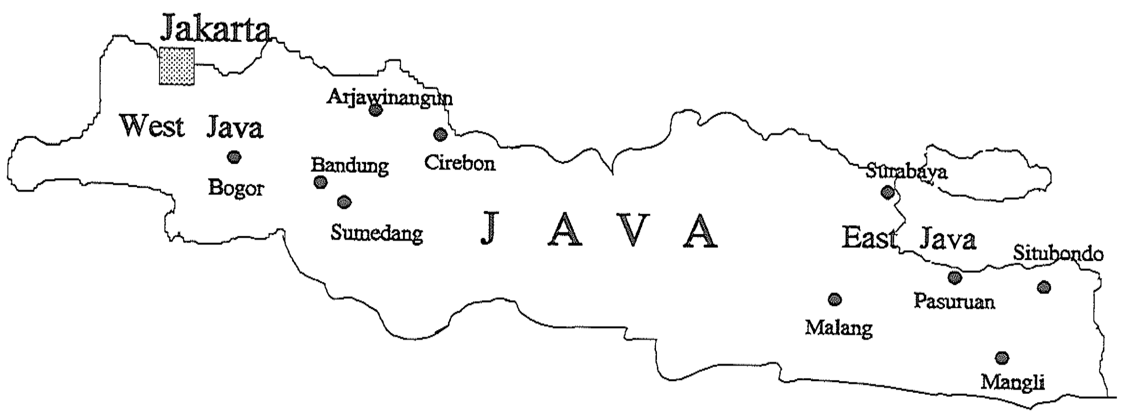
Since the mixture of housing types varies with the size of the urban centre it was decided to investigate water consumption patterns for small, medium and large towns. As the climate gets distinctly dryer in the more easterly parts of the island of Java it was decided to select five urban centres of different size in the province of West Java and five similar ones in the province of East Java (see **Figure 1.1**).

Using six different housing types, a stratified sampling strategy could be formulated on the basis of housing, urban setting and geographic location.

A number of potentially useful additional explanatory variables, about which data can be obtained in Indonesia, were identified, such as household size, electricity consumption, yard area, car ownership, and water using appliances. Stratifying the data to be collected on the basis of all these variables would require an excessive amount of data. It was decided, therefore, to collect these supplementary data in addition to the data on principal variables and to use them as

Figure 1.1 : The study areas





further information for the purpose on improving the model if possible.

1.3. Data Collection

Data were collected through a household survey in the period from May to July 1993. Only households with metered piped-water connections were designated as the unit for analysis. For each housing type 30 households were selected for interviews. The questions were about the household backgrounds, the household size, the electric bill, the yard area, the availability of flushing toilet and washing machine, the number of cars owned, and whether the households are using an additional source of water. Finally, the water consumption data were obtained from the billing records. These data covered a one year period from June 1992 to May 1993.

1.4. Analysis

This study involved qualitative and quantitative data, so an analysis of variance method and a regression model analysis were used. The analysis of variance was used for a two-factor analysis problem, the housing type and the urban setting. With a Tukey's contrast method, the significant effects of the housing type and the urban setting on water use could be analyzed. The regression model analysis and descriptive statistics were used to explained the effects of additional explanatory variables on the variation of per capita consumptions for different housing types.

Chapter 2

BACKGROUND

2.1. Urban population growth

Indonesia, like other South East Asia nations, has experienced unprecedented rapid urbanization during the past decades. Between 1980 and 1990 the annual urban growth rate averaged 5.4%. This brought the urban population from 32.8 million to 55.5 million which represents an increase from 22% to 31% of the total population. This rapid urbanization puts a major strain on the Governments to provide sufficient basic public services. An adequate water supply is one of them. The percentage of population served by public water supply advanced little between 1980 and 1990 because population growth outpaced the piped water system growth (The World Bank, 1993). This creates serious problems. On the one hand, human development is very much dependent on an adequate water supply. On other hand, meeting this requirement would place a heavy strain on the available drink water resources. A water conservation policy must therefore be part of the expansion program.

2.2. Current service

2.2.1. Coverage

To meet at least partially the demand imposed by the urban population increase, the Government has set a target for water supply development in the fourth five year plan, Repelita IV, (1984-1989) in Indonesia. The target was to provide piped water supplies to 75% of the urban population. At the same time, the pressure on the demand would be decreased by accepting a lower per capita allowance.

In that period, there has been significant progress in expanding the water supply. For example, the number of households served increased from 1.6 million to 3.7 million in that time. Nevertheless, the percentage of population served advanced little in this decade because population growth outpaced the piped water system growth. A World Bank Report (1993) indicated that in 1989, only 15% of households in 14 major cities in Indonesia were connected to piped water. Thus, the servicing of residential areas fell far short of the target mentioned earlier. For the fifth five year plan, Repelita V (1989-1994) the Government of Indonesia therefore adopted a more realistic target. It aims at provide clean water to 80% of the urban population. Forty seven percent of the urban population will be served by piped water supplies and 33% by non-piped water supplies (public tap and water terminal).

2.2.2. Per capita consumption

The failure to achieve the earlier target set by the Government was caused by a number of factors. Some of these are unaccounted-for water, an insufficient development budget, and institutional weaknesses. An important factor, however, is the water allowance policy for piped water supplies. This factor did not receive sufficient attention in policy making. Present water supply development programmes are based on relatively low demand estimates. These are as shown in **Table 2.1**, and are likely to be inadequate. Studies have found that the actual per capita piped water consumption is much higher than the current allowance and demand setting.

Table 2.1 : Urban residential water demand used by the Central Government of Indonesia

Year	1994	1995	1996	1997	1998	1999	2000
Average (L/c/d)	59	64	69	77	84	92	101

Source : MPW, 1993

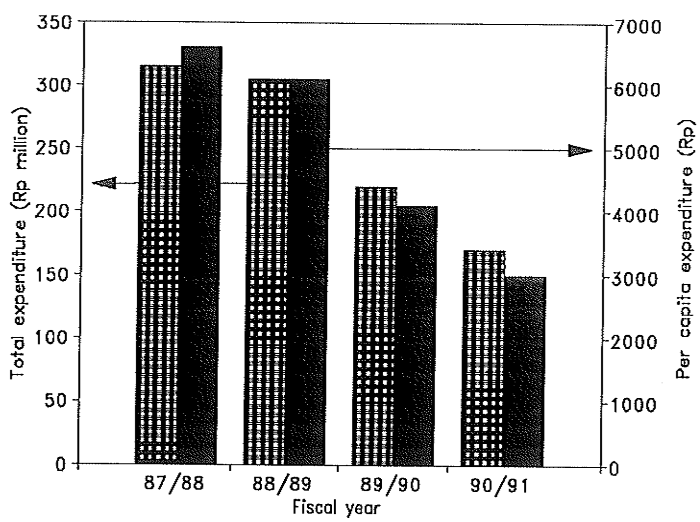
In Repelita IV and Repelita V (1984-1994), the problem of level of service has been approached from a "basic need" allowance that varies by size of urban centres (see **Table 2.2**). In order to address the "basic need" level, the Central Government only funds 60 L/c/d while the local authorities are

Table 2.2 : Per capita water allowance in Repelita IV and V (1984-1994)

Urban size (population in thousand)	Urban centre category	Per capita allowance (Repelita V) (L/c/d)	Per capita allowance (Repelita IV) (L/c/d)
> 1,000	Metropolitan	190	210
500 - 1,000	Large city	170	170
100 - 500	Medium town	150	150
20 - 100	Small town	130	90
5 - 20	Sub-district town	100	60

Source : MPW and PT Indah Karya (1988)

Figure 2.1 : Urban water supply expenditure trends in recent years in Indonesia (the Central Government expenditure)



Source : The World Bank report, 1993

responsible for the remaining amount of a new water system project. Unfortunately, after several Repelitas, increasing water supply provisions still depends very much on the Central

Government while its spending budget for water supply development has been decreasing (see **Figure 2.1**). Moreover, the "basic need" approach is usually not suitable since most current water supply projects are extension projects of the capacity and distribution network, for which a demand pattern has already been established.

2.2.3. Previous studies

The current water demand model was developed by the Ministry of Public Works (MPW) and PT Indah Karya in 1988. The model is a single-variable model with the population of urban centres as the independent variable and water allowance per capita per day as the dependent variable as shown in **Equation 2.1**.

$$y = 3 + 25\,x \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad \textbf{(Equation 2.1)}$$

where :

y = water consumption (L/c/d)

x = log of population of urban centres

for populations over 1000

The data used were collected from household surveys of dwellings connected with piped water supplies in 34 urban centres in Indonesia. The water consumption data were obtained from billing records and the estimated amount by the respondents; then the two kind of data were cross-checked.

The model suggests that allowances of water consumption per capita per day should be related to the population of urban centres (see **Table 2.2**). According to the study, the earlier Repelita IV's demand setting was too low for the smaller urban centres but too high for the larger urban centres.

The study ignored the possibility that different patterns of water use among customers might exist. Although most water customers are in single-dwelling units, it does not imply a homogeneous water customer sector as indicated by Weber (1993). The single-dwelling family unit varies widely among income groups. This affects the levels of water consumption (Howe and Linaweaver, 1967). Furthermore, the study itself may lead to substantially over- or under-estimation of demands because no consideration was given to other important factors such as economic level of the household, price, and water using appliances (Howe and Linaweaver, 1967). Since there were wide ranges between the lower boundary and the higher boundary among water customers in urban centres, the models did violated the statistical assumption of homogeneity (Weber, 1993). Weber also stated that a water consumption model with population as a single-variable can ensure a good forecast only among homogeneous customers. Therefore, the conclusion drawn by the current model might be confounded by other factors, related to the economic circumstances of the customers. The model itself can not be used as a basis for any further economic and demand management studies.

In the same year of 1988, MPW and Bandung Institute of Technology (ITB) studied residential water consumption in eight variously sized towns and found that piped water consumption in seven of the eight town was over 130 litres per capita per day for permanent housing. The study classified customers into three categories based on their housing quality : permanent, semi permanent, and temporary. These are Indonesian designations of the type of building material used in the house. It was a good start since it used a proxy parameter for relative affluence. As economic conditions improved, however, most housing in the urban areas are now included in the permanent category. Semi permanent housing on islands other than Java is influenced much more by traditional values than by economic factors. Thus, these categories were less useful from a view point of water demand planning.

2.2.4. Current Survey of Demand

Currently, Indonesian engineers and planners base water demand for new or extended water supply systems on household surveys, called "real demand surveys". These surveys are used to investigate potential customer demand. The demand is estimated on the basis the number of potential customers and the water demand criteria for their urban centre categories. These surveys do not recognize different classifications of customers, even though attempts are made to assess the household incomes, no attention is paid to existing consumption rates for different categories of customers. It therefore happened that projects began operation, for which the new customers were mostly wealthy. This then led to a shortage in the water supply resulting in a decrease in distribution pressure. It was evident that this was caused by the new customers using more water than predicted. In addition, while the pricing policy recognized different classifications as mentioned below, the uncertainty in water demand caused a distortion in the effect of the pricing policy.

2.2.5 Water pricing

Water enterprises in Indonesia divide customer groups into classifications for the purpose of pricing only. The costumers are divided into sectors of users such as residential, commercial, industrial, and social institution. Each sector is classified into sub sectors. For example, residential customers are typically divided into three classes, Class X, Class Y, and Class Z. Class X is for dwelling only, Class Y is for dwellings used commercially, and Class Z is for high class housing. Since the highest number of customers as well as the greatest users are residential customers and most residential customers are included in Class X, the intended cross-subsidizing of one class from other classes could not be achieved.

To encourage conservation, the water enterprises in most urban centres charge customers with incremental block pricing. The idea of classifications and incremental block pricing was initiated for a cross subsidizing approach from the more wealthy customers to the less wealthy even though household rates are normally set below cost (0.8 A "average price" factor). However, households with piped water connections benefit from this subsidy policy, while very low income families rely on standpipes or vendors who charge them more than the tariffs charged for house connections (World Bank Report, 1993). In addition to this, the report suggests that a review of the tariff structure is urgently needed. In the opinion of the writer a review of the customer classification system, from the point of view of demand is also needed. The households that use water to irrigate their lawns and gardens violate the basic needs approach which is a reason for cross-subsidizing. Therefore, those who benefit from the subsidizing policy may be separated from the household families that do not have lawns and gardens. They are usually low income families and stay in low cost housing.

Chapter 3

LITERATURE REVIEW

Variables used to forecast water demand are uncertain; however, the better the understanding of the relationship of urban growth to increased water demand, the less the uncertainty. Researchers in the North America have studied the significance of several factors affecting municipal water use. The following factors affect municipal water use : climate, size of the community, density of development, economics, dependability and quantity of the supply, water conservation, and the extent of metered services (Metcalf and Eddy, 1991). Various water demand models have been proposed by researchers for different purposes. Most studies were about the price elasticities of water.

3.1. Factor affecting water use

3.1.1. Climate

3.1.1.1. Temperature and precipitation

Most researchers agree that climatic effects such as temperature and precipitation can significantly impact water use, and it can be stated that water consumption is certainly related to weather variables (Weber, 1993). When it is hot and dry, there is an increase in water use, particularly for outdoor use. The lower the average summer rainfall or the higher the average summer temperature, the greater the water demand. Therefore, temperature and precipitation have to be considered where water demand models cover large regions with different climatic conditions.

It has been found that there are significant differences in demand and response to price change, between arid and humid regions (Howe and Linaweaver, 1967). It was also found that the response to prices varied between sprinkling uses (in summer) and inside uses (in winter). Rainfall tends to be a highly significant factor in the demand in flat rate areas, but not in metered areas (Kitchen, 1975).

Kitchen (1975) obtained a different result in an area where the greater the average summer rainfall, corresponded with a consumption per dwelling unit. His study covered 57 urban centres with populations over 10,000 in Canada. He explained this by saying that where there was low average rainfall, the cities, would impose warnings and controls with regard to the consequences of the excessive use of water, particularly for sprinkling. In other words, consumers are responsive to water conservation efforts during peak periods.

3.1.1.2. Evapotranspiration

Despite the fact that most studies utilize temperature and precipitation to account for the seasonal variation in water use, it was confirmed that models using evapotranspiration minus precipitation were better than models using temperature and rainfall (Morgan and Smolen, 1976). The elasticity measures using the former models yield higher price and income elasticities than the latter models. Nevertheless, it is more convenient to utilize easily observed meteorological variables (temperature and precipitation) to estimate sprinkling demands rather than a more difficult calculation which may be more exact (Kitchen, 1975; Morgan and Smollen, 1976).

3.1.2. Demographic

3.1.2.1. Population

The importance of population factors in forecasting water demand has been considered since the early 1990s. The population of urban centres influences per capita water consumption. The larger communities have higher demands for piped water. Along with the average per capita water use, the peak rate of use is also affected by the population (Metcalf and Eddy, 1991). A single-variable model of water demand utilizing population as the independent variable is often used; however, care must be taken because such a single-variable model will ensure quite a good forecast only in communities made up primarily of single-family dwellings or other homogeneous costumer sectors (Weber, 1993).

3.1.2.2. Customer classification

Data of water consumption should be based on the homogeneity of the consumption pattern by customer group and area. If there is a difference in consumption patterns in area within the total service area, there will be a need to collect consumption data separately by customer group or area (Weber, 1993).

When customer classification is needed to analyze demand patterns, water demand models might utilize the existing or projected land use for residential, commercial, industrial, and public land within the ultimate boundaries of the water utility. Those categories might be segmented so that residential land use is divided into two or more density classifications if different pattern of consumption exist (Weber, 1993). For example, density classification might have categories like single-family housing, condominiums, and apartments. In condominiums and apartments outdoor water use is generally much less than in single-family homes because of reduced needs for landscape watering (Metcalf and Eddy, 1991).

However, not all communities have such classifications. For small communities or communities in developing countries including Indonesia, most residential land use is predominated by single-family housing, so planners utilized population density per square unit as the basis for density classification or no classification at all.

3.1.2.3. Household

Although a certain minimum of water is required for basic needs, the residential customer also uses water for such non-essential purposes as sprinkling lawns, washing automobiles, and supplying water-using appliances. These non-essential uses are responsive to pricing policy.

If there is a variation in the number of persons per dwelling unit, one would expect an increase in domestic consumption per dwelling unit (Howe, 1967; Grima, 1973). On the other hand, per capita consumption would decrease since the amount of outdoor water use does not depend on household size.

The number of persons per dwelling unit was found to be the only important factor that significantly affected the domestic water demand in the metered areas with septic tanks (Howe and Linaweaver, 1967). Therefore, a direct relationship between this variable and the quantity of water demanded per dwelling unit or per capita may be established.

3.1.3. Economic factors

Several studies suggest that water use is influenced by economic circumstances. Price and its structure, and economic capabilities of customers are indicated as factors that affect water consumption.

3.1.3.1. Water-pricing

Studies have shown that pricing policy affects water demand. However, the price effect will be significant only if the price reflects the actual cost of providing the water (Howe and Linaweaver, 1967; Bonem, 1968). Economically, it may be stated that the effects of a price change on the water demand by customers contains two components : an income effect and a substitution effect. If the total expenditure for water is small compared to other expenditures, the effect can be expected to be negligible. Under those conditions the water demand can not be related to relative affluence and must be gauged by other factors such as availability of water consuming appliances and outside watering (Howe and Linaweaver, 1967).

Water agencies can charge their customers with unmetered service or metered service. A system with unmetered service charges customers a flat rate. On the other hand, in metered service the charge vary with the water quantity used. Furthermore, there are various water-pricing policies in the metered service : a declining block rate, a constant rate, a seasonal rate, and an incremental block pricing. However, the price is usually not an isolated factor that affects water use. Other factors include customer behaviour and system of service.

It was found that price was more influential on sprinkling uses than on inside uses (Howe and Linaweaver, 1967; Morgan, 1974). In addition, price elasticities are higher for industry than for household (Turnovsky, 1976). Furthermore, a flat and a metered rate structure resulted in different effects on residential water uses where there was a decrease in water demands after meter installations (Hanke, 1970). It was felt that in metered centres, the greater the percentage of apartment dwelling units or flats that were rented, the greater would be the demand for water. Essentially this should occur because individual tenants of an apartment are seldom metered (although the building is metered). Consequently, the price per unit of water consumed is treated as a fixed price, i.e., not dependent on the quantity consumed. As a result, they tend to be less conscious of the quantity of water consumed and therefore may use more per dwelling unit. When there is an increase in water demand, the incremental block pricing policy offers conservation and distribution advantages (Gysi and Loucks, 1971). However, doubt arose when no statistical differences in demand related to rate structure were found (Steven et al, 1992).

3.1.3.2. Economic level of household

Water demand is related to economic level of the water customers through the use of water-consuming appliances, baths, etc (Howe and Linaweaver, 1967; Kitchen, 1975). In addition, water-consuming appliances, baths, and gross lot area can affect outdoor use and can be used as indication of the economic level of the households. In case such information is not available, household income or property value could have a significant positive relationship to residential water demand. The property value was found as an important factor in modelling the sprinkling water demand along with the price factor in metered area, but the only factor in the flat rate area. Therefore, different classes of users implied by their property values may consistently place differing actual demands on the system. However, it was also found that income tends to be statistically insignificant in explaining the variation in demand for water in both the flat-rate and the metered study in the North America (Kitchen, 1975).

3.1.4. Water consuming appliances

As is indicated, household appliances or activities are significant explanatory variables in determining household water use. A washing machine and dishwasher increased daily per capita water consumption, and they also increase household energy consumption (Clouser and Miller, 1979). In addition, a conservation program utilizing efficient plumbing fixtures reduces water use. It was predicted that by having uniform water efficiency standards for plumbing fixtures (toilets, urinals, showerhead, and faucets), there would be a decrease in the average use of household water (Vickers, 1993).

3.2. Methods used

Most water demand forecasts use regression analysis that typically explains 85 to 95 percent of variation in monthly water demand (Weber, 1993). Regression models include single-variable models and multiple-regression models. Single-variable models frequently regress water consumption based on population, household, or employment. Although this method is much simpler for communities that do not have adequate data, the assumption of homogeneous customers must not be violated.

Multiple-regression models include a combination of several independent variables such as population, number of households, household income, lot sizes, land-use densities, seasonal patterns of use, employment, and various weather variables (Weber, 1993). In measuring the effects of dichotomy conditions, dummy variables can be used. Multiple-regression models are referred to as econometric models when the primary variables are things like household income and water price. Broader econometric models are seldom used because of a lack of data.

Other methods that may be used are time series and cross-sectional models. In time series analysis, consumption is evaluated over time. Meanwhile, cross-sectional analysis might evaluate, for a point in time, the effect on consumption of household income, home value, family size, lot size and marginal prices in several areas of an agency's total service area.

3.3. Suggestions from previous studies

Kitchen (1975) stated that what is now needed is a model based upon household level data, like, detailed information on the actual consumption per household broken down into seasonal demands, demands at particular times of the day, number of taps, bathroom facilities, household size, assessed property value, lot area, etc. Steven et al (1992) suggested that more analysis with different data sets, particularly with household level data and data for the commercial and industrial sectors, seem warranted.

3.4. Possible alternative variables

Type of housing and neighbourhood might be used as indication of income and property value for basis of customers classification. Sociologists often interpret social class on the basis of the physical conditions that surround the household, such as well-zoned residential neighbourhoods, slums or squatter settlement. In Indonesia there are no slums or squatter settlement as such. A distinct housing class is formed by the 'kampung' which is not organized settlement.

Those who live in well-zoned residential neighbourhoods have a higher standard of living than those who live in the 'kampung' housing. Furthermore, it may be assumed that the people in kampungs use water more for indoor use rather than for outdoor use such as sprinkling, and car washing. They do not use expensive water using appliances such as washing machines and flushing toilets.

Chapter 4

RESEARCH METHODOLOGY

4.1. General

Data were collected in the period from May to July 1993. The data were obtained through a household survey in eight differently sized urban centres in the provinces of West Java and East Java in Indonesia. A stratified random sampling method was used to obtain monthly household water consumption data of 990 households. The data covered a one-year period from June 1992 to May 1993.

The objective of the sampling was to obtain information on the effect of a number of variables on the monthly water consumption. The primary variables upon which the stratification was based are : location (in East or West Java), size of the town and housing type. In each of the locations five towns were identified. It was subsequently realized that the cities with a population over 1 million would be sufficiently different to warrant a separate study. For this reason both Bandung and Surabaya were dropped from the list, leaving 8 different urban centres in the study. Six different housing types were identified in the core of the town and in the suburbs. For each type of house 30 households were selected for interviews.

Table 4.1 : The composition of the sample groups

Urban centres	Population in 1990	Housing types					
		Core area			Suburban area		
		A	B	C	D	E	F
Mangli (EJ1)	5,000	x			x		
Situbondo (EJ2)	90,000	x	x		x	x	
Pasuruan (EJ3)	125,000	x	x		x	x	
Malang (EJ4)	660,000	x	x	x	x	x	x
Arjawin. (WJ1)	9,000	x			x		
Sumedang (WJ2)	89,000	x	x		x		
Cirebon (WJ3)	272,000	x	x	x	x	x	x
Bogor (WJ4)	600,000	x	x	x	x	x	x

Source : Survey result (1993)

Legend : the 'x' mark indicates that the housing type presents in that particular urban centres

Table 4.1 shows the composition of the sample groups. Since not all towns had a sufficient number of all housing types the total number of interviews came to 990. Only households with metered piped-water connections were designated as the unit for analysis. Households consuming water only from other sources such as wells, rivers or springs were not included.

The data obtained were used in an analysis of variance. Together with the water consumption data, additional information was collected, such as the household size, the household electric bill, the yard area, the use of flushing toilet and washing machine, the car ownership, and other additional water sources in order to be able to examine whether this could lead to the inclusion of additional explanatory variables in the model. A regression analysis was used for this purpose.

4.2. Data collection

4.2.1. Urban setting selection

The selection of the urban centres proceeded as follows. All urban centres in East Java and West Java were grouped into five categories, and then from each group one urban centre was randomly selected. The five urban centres in the province of West Java were Arjawinangun (WJ1), Sumedang (WJ2), Cirebon (WJ3), Bogor (WJ4), and Bandung (WJ5). In the province of East Java, they were Mangli (EJ1), Situbondo (EJ2), Pasuruan (EJ3), Malang(EJ4), and Surabaya (EJ5). As is explained before the both Bandung and Surabaya were dropped from the list, leave 8 different urban centres in the study.

4.2.2. Housing type selection

In the selected urban centres, the water customers were identified and grouped based on their housing types. Two areas had to be distinguished : the inner areas within the centre and in mass development housing in the suburban areas. In the inner areas, the housing types were stratified into three classes : lower (Type A), middle (Type B), and higher (Type C) classes. Type A was defined for dwellings in the settlement areas where there was no direct access road and only a footpath available to it or where the lot area was typically less than 100 square meters per house. Type B was used for a neighbourhood with access roads of under 3.5 meters width or well-zoned housing with lot areas from 100 to 200 square meters per house. Type C was used for luxury housing, typically with wider access roads or lot areas more than 200 square meters per house. Identifying the type, the housing quality and the site-plan was given greater weight than the actual lot areas. This was done in small urban centres where poor houses could have large lot areas. Type A (the lower class) in all categories of urban centres typically had no direct access road.

Within mass development housing (suburban) areas, water customers were also stratified into three classes : low cost housing (Type D), middle cost housing (Type E), and luxury housing (Type F). Type D housing was defined as housing with typical lot area less than 100 square meters and developed with government subsidies. Type E housing was housing with a typical lot area of between 100 and 200 square meters. Type F housing typically had more than 200 square meters of lot area and a luxury appearance.

The second stage was to randomly select an urban and a suburban areas for each housing type in the selected urban centres. In the small urban centres, the housing neighbourhood tends to be more homogeneous within inner and suburb (mass housing) areas (see Table 4.1). Table 4.1 displays a matrix of the sample populations between urban setting (row) and housing type (column). It is evident that the larger urban centres have a larger number of housing types.

4.2.3. Respondent selection

The sampling was accomplished by randomly choosing several dwellings with piped water connections in individual selected types while skipping the boarding dwellings such as one would find near universities or schools. The respondents were the tenants that were able to answer the questions. The sampling and survey were conducted by the author himself to maintain consistency. Some researchers question this 'self-survey' method because it may lead to a change in collection strategy based on information collected during the survey. It should be noted therefore that the author did not make any changes during the survey.

4.3. Sample sizing

Size of the sample for this study was designed by using procedures and specifications in Table A.10 of Neter, et al, (1991). These procedures and specifications are applicable when all factor levels have equal sample sizes. The equal sample design reflects the equality of importance among the factor levels, maximizes the precision of various comparison, and is robust for certain departures from some assumptions are required by the ANOVA model analysis.

The present study estimated that the largest difference in per capita consumption among different housing types, Δ, was 200 L/c/d and the standard deviation, σ, was 100 L/c/d. Therefore, the sample size obtained by using these estimate was 18 samples for each of the factor levels. Then it was chosen a 30 samples for each factor level.

4.4. Questionnaire

A long list of questions was printed on the forms used for the door-to-door survey (see **Table A.1 in Appendix A**); not all were used in the present study. The information not used was useful as background information. An example is the education and occupation of the householder.

First, respondents were asked about the utility registration number. This number was necessary in searching monthly water use and water bill data available in the water utilities offices. The monthly water consumption rate considered in this study were for a full year period from June 1992 to May 1993. The other questions include household size, source type (any other sources besides piped water source), monthly electrical bill, yard area, water pressure, and ownerships of car, washing machine, flushing toilet.

Additional sources of water may affect water consumption and information on this was collected. Customers with access to good quality and shallow groundwater may be considered to be in lesser need of piped supply than those who do not have this access. Therefore, a distinction was made between those who used piped supplies as their only water source and those who used an additional source. The monthly electricity bill was considerably related to the economic capabilities of the respondent. The water distribution pressure was considered an important factor in water consumption since it affects rates of flow. The pressure in the area under investigation was measured by using a manometer.

The question on the type of plumbing fixtures related to the use of pouring or flushing toilet types. This distinction is important since flushing toilets consume more water than pouring toilets. The respondents also were asked whether they use washing machines. The yard area were obtained because it affects sprinkling and watering use. The last question of the questionnaire was about the number of cars owned. Most cars are washed at home rather than in a public car wash. The data collected are presented in **Table A.2 in Appendix A**. This table only displays the related variable entries used in the study.

4.5. Analysis

The present study used both regression models and analysis of variance methods. A regression model describes the statistical relationship between a dependent variable and one or more independent variables. Both the independent and dependent variables are quantitative. In the analysis of variance, the independent variables may be quantitative or qualitative. Even when the independent variables are quantitative, there is no need to assume the nature of relationship between the independent and the dependent variables like in regression models (Neter, et al, 1991).

4.5.1. Analysis of variance

To determine the relationship between the water consumption and the housing type and the urban setting, as listed in Table 4.1, an analysis of variance was used. The main independent variables in the analysis of variance were the qualitative factors of urban setting and housing type. Factor levels of the urban settings ranged from EJ1 to EJ4 and from WJ1 to WJ4. Factor classifications of housing types were Types A, B, C, D, E, and F. Together they are presented in Table 4.1. The analysis of variance model chosen was the fixed factor model. This means that the results are all fixed categories. For any size of urban centre, the water consumption must be estimated by comparison with the standard centres listed in **Table 2.2**.

The analysis of variance was used to obtain the estimated water consumption for household for each of the housing types and each urban centre. An addition the analysis was used to determine whether there were any significant differences in water consumption between the housing types and urban centres. It was assumed that the models are linear without interaction among the factors. The validity of this assumption was subsequently verified. Two additional factors had to be considered in the analysis of variance model. The first is the household size and the second the availability of additional source. These were considered to have significant effects on the water consumption. This made the model a three-factor model which increased precision of analysis.

4.5.2. Regression analysis

Regression analysis was subsequently used to relate the explanatory variables mentioned above to the water consumption within the cells formed by the matrix of Table 4.1. The additional household data include the electrical bill, the yard area, ownership of car, flushing toilet, and washing machine. These are highly correlated with the housing types. For this reason, separate regression models were developed for each of the different housing types. A common test then was performed to determine whether the data could be pooled into a general regression model.

Chapter 5

RESULTS AND DISCUSSIONS

5.1. General

An analysis of the data showed that sample distributions of water consumption were positively (right) skewed distributions. Since the ANOVA method assumes normally distributed samples, a logarithmic transformation was made. ANOVA also requires equality of variance among factor levels. This was also shown to be the case, so the ANOVA procedure could proceed.

The analysis demonstrated that there is a strong positive relationship between housing type and water consumption level. The better housing type had a higher water consumption. No significant difference in water use levels were found between the urban and the suburban areas for equal housing type. A regression analysis and a tabulate procedure demonstrated the significance of other factors for explaining the residual variance of the water consumption for each of the housing types. These are the electrical bill, the yard area, the availability of a flushing toilet and a washing machine, and the number of cars owned.

For a given housing type, the effect of the size of the urban centres on the water consumption level was not significant. The larger urban centres have higher average water consumptions because they have a higher percentage of the better housing types.

One may expect, therefore, that a model based on housing type will perform better than the model that is currently in use, which is based on population and size of urban centre.

5.2. Examination of the data sets

The response variable obtained in the survey was residential water consumption per household per month, expressed as cubic meters per month. It will be referred to as household consumptions. These figures were obtained from billing records. For the purpose of the analysis, the water consumption per capita per day in litre per capita per day, was obtained by dividing the monthly household consumption by the household size and the number of days in a month. It is referred to as per capita consumption.

5.2.1. Sample distribution

Histograms of the data show that the sample distributions of per capita consumption were mostly positively (right) skewed distributions. **Figures 5.1.(a) and 5.1.(b)** show typical examples of the per capita consumption for a given urban setting, namely EJ4 (Malang) and for a given housing type, namely D.

Figure 5.1 : Histogram plots of distribution of per capita water consumptions in EJ4 (Malang) and Type D

(a) **EJ4** (Malang) (b) **Type D**

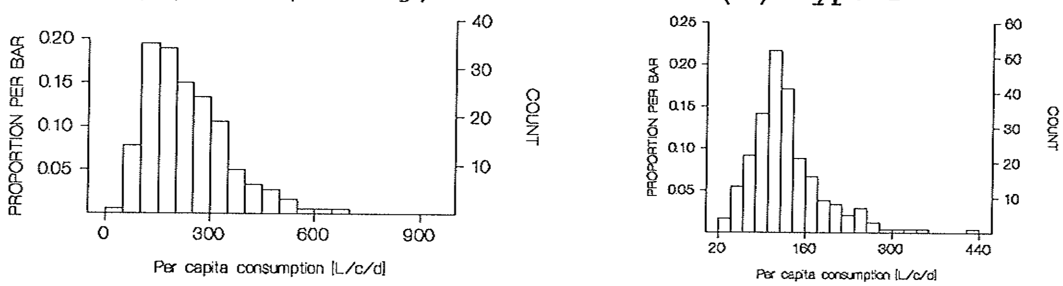
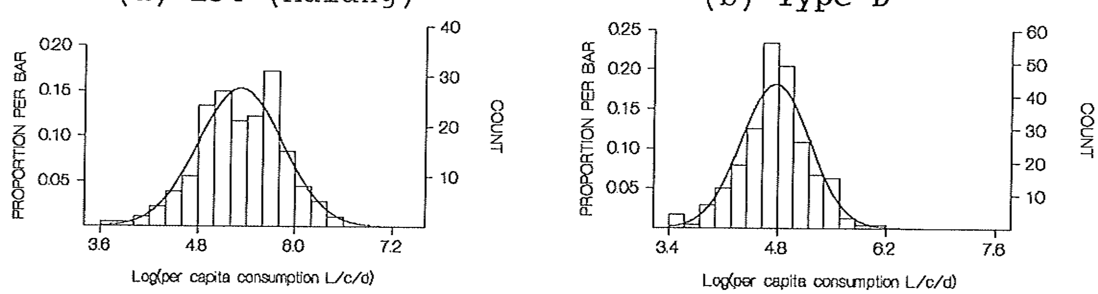


Figure 5.2 : Histogram plots of distribution of **log** per capita water consumptions in EJ4 (Malang) and Type D

(a) **EJ4** (Malang) (b) **Type D**



As was mentioned before, the skewed distributions of the response variable were transformed by taking the logarithm of the data in order to obtaining an approximately normal distribution (Moore and McCabe, 1993). Examples are shown in **Figures 5.2.(a) and 5.2.(b)**.

5.2.2. Equality of Variance

Besides the normality of the sample distribution, the ANOVA method requires an equal variance among population groups. Several formal tests such as the Bartlett Test and the Hartley Test are available for checking on the equality of the variance (Neter et al, 1991). The present study utilized the approach recommended by Moore and McCabe (1993), which is much simpler and still adequate. The test requires that the ratio of the largest to the smallest sample standard deviation is less than 2. If this condition is met then the ANOVA method can be used with the assumption of equal variance.

Table 5.1 shows the standard deviations of each housing type within each town. The column of Ratio H is the largest ratio among the housing types for a given urban setting, and the row of Ratio T was the largest ratio among the urban setting for a given housing type. The table shows that most figures in the Ratio H column and the Ratio T row were less than 2. There was an exception in the Ratio T row for Type B

Table 5.1 : Equality of standard deviation among categories of town and types of housing

Town	A	B	C	D	E	F	Ratio H
			Type of housing				
EJ1	0.439			0.423			1.039
EJ2	0.412	0.410		0.482	0.451		1.176
EJ3	0.542	0.420		0.490	0.485		1.291
EJ4	0.424	0.455	0.477	0.438	0.530	0.318	1.666
WJ1	0.513			0.300			1.716
WJ2	0.572	0.657		0.389			1.688
WJ3	0.475	0.326	0.393	0.426	0.447	0.376	1.456
WJ4	0.449	0.338	0.317	0.484	0.505	0.344	1.594
Ratio T	1.154	2.014	1.504	1.641	1.186	1.180	

Source : Calculation (1994)

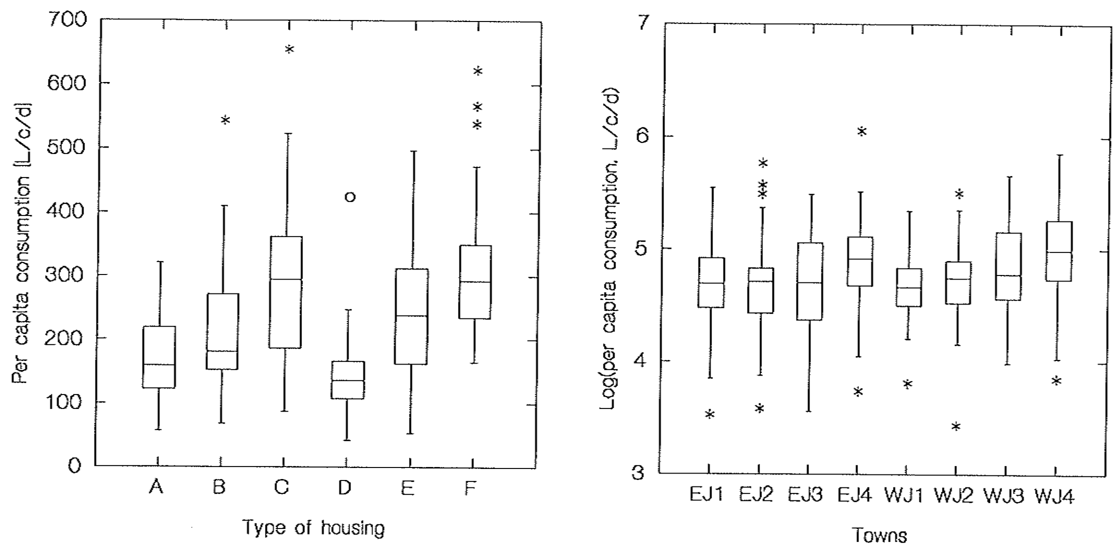
where the ratio was a slightly higher than 2 (2.0141). This single deviation was considered to be insignificant.

5.2.3. Strength of the relationship

Side-by-side box-plots of the distributions of per capita consumption showed a positive relationship between housing type and consumption level. For example, **Figures 5.3.(a) and 5.3.(b)** show box plots of water consumption distributions for a given urban setting EJ4 (Malang), and for a given housing type D. Figure 5.3.(a) indicates that medians of the consumption levels increase with the better type of housing. On the other hand, Figure 5.3.(b) indicates no significant relationship between the size of urban centre and the level of

Figure 5.3 : Box-plots of log per capita consumptions for EJ4 (Malang) and Type D

(a) **EJ4** (Malang) (b) **Type D**



water consumption. The small increase that is evident is probably related to the fact that what is classified as type D is not the same for the larger and the smaller urban centres.

The box plots suggest that the urban and suburban categories could be pooled, so that A would be combined with D, B would be combined with E, and C would be combined with F. This suggestion was checked by means of a t-test. **Table 5.2** list the t values and the corresponding probabilities based on the null hypothesis that there is no difference between the urban and the suburban settings. The table shows that the null hypothesis must be rejected for three of 15 cases. A more accurate analysis was performed later in connection with ANOVA to check this finding.

Table 5.2 : T-test and P-value for contrast of the means of per capita consumption per category of town between type A and D, B and E, and C and F

TOWN	t value A=D	t value B=E	t value C=F	P value A=D	P value B=E	P value C=F
EJ1	0.547			0.588		
EJ2	1.060	0.146		0.298	0.885	
EJ3	-1.276			0.212		
EJ4	3.786	1.666	-1.6607	0.001	0.107	0.108
WJ1	-3.775			0.001		
WJ2	-0.338			0.738		
WJ3	-3.775	-3.775	-0.391	0.071	0.000	0.698
WJ4	0.953	0.324	2.046	0.349	0.748	0.050

Source : Calculation (1994)

5.3. Analysis of Variance

5.3.1 General

Originally, the present study was set up as a nested two-factor analysis. One factor is housing type and the other urban setting. The treatments of the former factor are housing type A, B, and C in the core area, and housing type D, E, and F in the suburban areas. The analysis of this factor relates to the question whether per capita consumption levels for different housing types are significantly different.

For the factor of the urban setting, the treatments are village, small town, medium town, and large city in the provinces of East Java and West Java. The investigation for this factor is whether for a given housing type the per capita consumption for different size of urban centres is different. It was also investigated whether the consumption levels in the provinces of East Java and West Java are significantly different.

This nested two-factor analysis was not possible because in a nested design all factor levels should be available. When the survey was made it was clear that housing type C and F were present only in the larger centres to a significant degree. Therefore, it was decided to investigate the effect of the housing type and the urban setting separately.

It was also considered that the per capita consumption is dependent on the number of persons in the household and on the availability of an additional source of water. This led to the development of two three-factor models. The first uses as factors of housing types, household size, and source type. The second uses as factors of urban setting, household size, and source type.

The first model is used for a given urban setting, the second for a given housing type. These two models were used to determine whether there is a significant difference between factor levels or whether these could be combined. After combination of the different factor levels the second model was then used for the estimation. This is further illustrated in **Section 5.8**, Possible application.

5.3.2. Three factor analysis

Since definite urban settings and the housing types were chosen, the present study used what is called a fixed effect ANOVA model as the basis for analysis. In addition, the linear model was based on the assumption that no interaction exist among the factors. This assumption was confirmed by a comparative procedure of a statistical software package. It was found that interaction among factors was not statistically significant. An example is shown in **Table B.1 in Appendix B**.

The model for a given urban setting is

$$\mathbf{WC}_{ijk} = \mathbf{C} + \mathbf{HT}_i + \mathbf{HS}_j + \mathbf{ST}_k + \mathbf{e}_{ijk} \quad ......(5.1)$$

and for a given housing type is

$$\mathbf{WC}_{ijk} = \mathbf{C} + \mathbf{US}_i + \mathbf{HS}_j + \mathbf{ST}_k + \mathbf{e}_{ijk} \quad ......(5.2)$$

where :

$\mathbf{WC}_{ijk}$ is logarithm of water consumption (per capita)

$\mathbf{C}$ is a constant

$\mathbf{HT}_i$ is the housing type

$\mathbf{US}_i$ is the urban setting

$\mathbf{HS}_j$ is the household size

$\mathbf{ST}_k$ is source type (additional source : Yes or No)

$\mathbf{e}_{ijk}$ is error variance, independent $N(0, \sigma^2)$

random variables $i = 1, ..., r; \; j = 1, ..., n_i;$

$k = 1, ..., m_j$

5.3.2.1. Effect of housing type

Table 5.3 is a summary of the output of the analysis of variance for each given urban setting. F values and P values in the table indicate that there is a significant difference in the per capita consumption level among the different housing types. This does not tell us specifically which per

Table 5.3 : A summary of the ANOVA Tables for each given urban setting

Town category	d.f. (a,b)	Per capita R2	Per capita F-stat.	Per capita P-value	Household R2	Household F-stat.	Household P-value
EJ1	1,51	0.319	0.022	0.883	0.447	0.022	0.883
EJ2	3,107	0.375	6.551	0.000	0.367	6.551	0.000
EJ3	3,108	0.393	10.826	0.000	0.378	10.826	0.000
EJ4	5,161	0.475	17.138	0.000	0.621	17.138	0.000
WJ1	1,51	0.333	0.065	0.800	0.311	0.065	0.800
WJ2	2,73	0.470	6.599	0.002	0.478	10.758	0.000
WJ3	5,164	0.638	38.786	0.000	0.753	38.786	0.000
WJ4	5,163	0.477	14.205	0.000	0.476	14.205	0.000

Source : Calculation (1994)

capita consumptions differ. The specific differences among the housing types were demonstrated by a Tukey's contrast analysis. **Table 5.4** shows an example, in which differences among the mean responses of the different housing types in EJ4 are presented by a matrix of Tukey's pairwise comparison probabilities. The other results are listed in **Table B.2 in Appendix B**. Table 5.4 shows that there were significant

Table 5.4 : A matrix of Tukey's pairwise comparison probabilities for EJ4 (Malang)

Using least squares means.
Post Hoc Test of 'per capita consumption'
Using model MSE of 0.159092 with 161 d.f.

Housing type	A	B	C	D	E	F
A	1.000					
B	0.014	1.000				
C	0.000	0.097	1.000			
D	0.341	0.000	0.000	1.000		
E	0.094	0.987	0.020	0.000	1.000	
F	0.000	0.306	0.996	0.000	0.052	1.000

Source : Calculation (1994)

differences between per capita consumption of housing types A and B, and types D and E. These differences were significant at the 0.05 level. The matrix also shows that the urban and the suburban settings make no difference. The per capita consumptions for types A and D, types B and E, and types C and F were not significantly different the same at the 0.05 level.

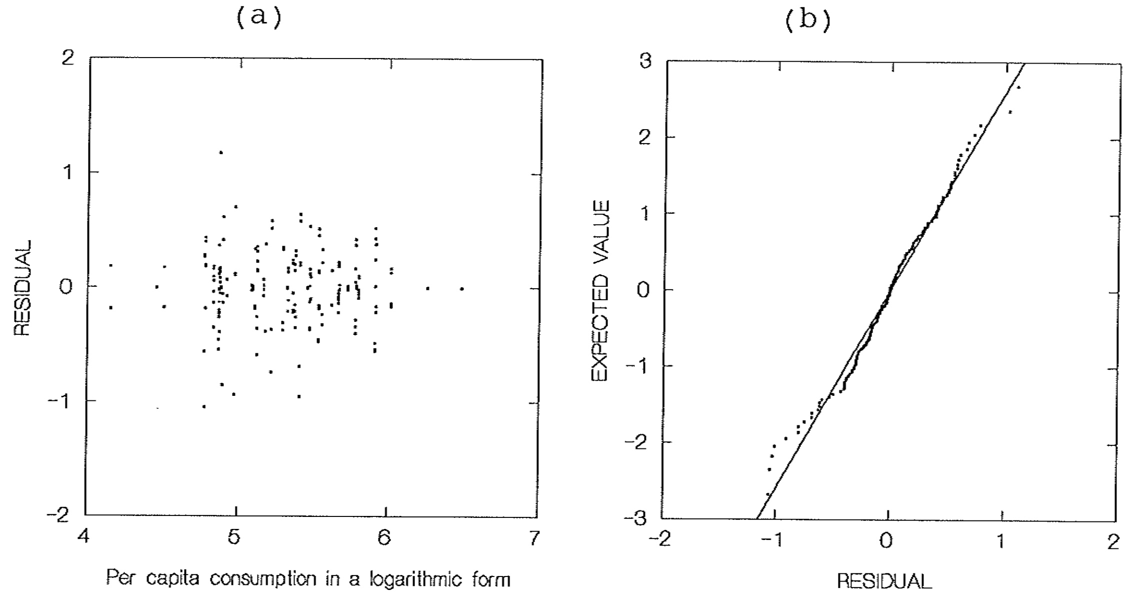
This table contradicts a previous conclusion in Table 5.2 which shows that per capita consumptions of types A and D are not equal for the urban setting EJ4. The reason for this is that the test based on the three-factor model compares households of different types were compared with the same household sizes and additional source of water. This was not done in the former test.

The difference between types B and C, and types E and F were significant at the 0.10 level. The present study emphasizes the difference between types A and B, and types D and E which include the largest portion of residential water customers. **Table B.2**. supports the conclusion of the three-factor analysis except for the urban setting WJ4.

For the urban setting WJ4, there was no significant different between per capita consumption for type A and for type B, and for type D and for type E. This may probably be explained by analyzing the effect of water distribution pressure on water consumption in that particular area, which is a hilly topographically. Housing types A and D are located in the lower area. This lower area is in a zone with higher water distribution pressure. The higher area, where the housing types B and E occur is in a lower pressure zone. Even though people store water for bathing in open storage tanks, a plentiful supply of water in the higher pressure zone will encourage customer more water use.

A residual analysis of the model revealed that no unusual patterns exist in plots of residuals versus the expected value. For example, **Figures 5.4.(a)** shows the residual plots of per capita consumption and household consumption for urban setting EJ4, so it was reasonable to conclude that error terms are homogeneous. The normality plots of the residuals suggested that the error terms were normally distributed as assumed. For example, the residual plots for EJ4 are presented

Figure 5.4 : Residual plots of per capita consumption for EJ4 (Malang)
(a) residuals v. expected value; and
(b) normal probability plots of residuals



in **Figure 5.4.(b)**. There were some departures from the straight lines; however, they were in extreme places which is acceptable (Montgomery, 1991). The result leads to the conclusion that the logarithm transformations of the independent variable, from Y to Y′ = log(Y), have provided an adequate linear model.

5.3.2.2. Analysis of effect of urban centre size

Figure 5.5 is a box plot of the per capita consumption of different urban centres for a given housing types A. The

Figure 5.5 : Box plot of log of the per capita consumption for a given housing type A

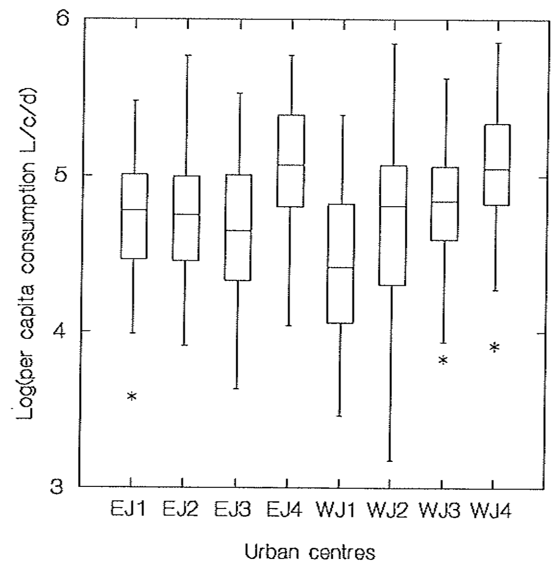


figure suggests that the per capita consumptions for a given Types A were not equal for the different urban centres, so were for a given housing type D in Figure 5.3.(b). These plots may lead one to conclude that a larger population is associated with more water consumption. This conclusion would be supported by F values and P values in **Table 5.5**.

However, a contrast analysis demonstrated that a such conclusion may not be drawn. For example, for a given housing type A, there was no significant difference in per capita consumption among different size of urban centres in the province of East Java, but in West Java, there was a significant difference only between the largest urban centre and the remaining ones (see **Table 5.6**). Contrast analysis for

Table 5.5 : A summary of the ANOVA Tables for the given housing types

Housing types	d.f. (a,b)	Per capita R2	F-stat.	P-value	Household R2	F-stat.	P-value
A	7,218	0.424	4.994	0.000	0.460	4.994	0.000
B	5,164	0.346	7.219	0.000	0.437	7.219	0.000
C	2,76	0.644	0.287	0.751	0.806	0.287	0.751
D	7,223	0.333	5.110	0.000	0.431	5.110	0.000
E	4,138	0.470	6.416	0.000	0.305	6.416	0.000
F	2,78	0.494	1.064	0.350	0.771	1.064	0.350

Source : Calculation (1994)

Table 5.6 : A matrixes of Tukey's pairwise comparison probabilities for housing type A

Using least squares means.
Post Hoc Test of 'per capita consumption'
Using model MSE of 0.167117 with 218 d.f.

Towns	EJ1	EJ2	EJ3	EJ4	WJ1	WJ2	WJ3	WJ4
EJ1	1.000							
EJ2	0.997	1.000						
EJ3	0.970	1.000	1.000					
EJ4	0.816	0.378	0.168	1.000				
WJ1	0.125	0.503	0.769	0.001	1.000			
WJ2	0.998	1.000	1.000	0.341	0.563	1.000		
WJ3	1.000	1.000	0.996	0.692	0.337	1.000	1.000	
WJ4	0.186	0.035	0.005	0.951	0.000	0.021	0.095	1.000

Source : Calculation (1994)

other housing types (B, D, and E) also demonstrated that a significant difference could be found only between the largest urban centres in both provinces and the remaining urban centres. For given housing types C and F, the per capita consumptions were not different (see **Table B.3 in Appendix B**). In short, differences in per capita consumption among different urban sizes can be found only between the large cities and the lower sizes. Therefore, one should not conclude in general that for a given housing type there is a relationship between the size of the urban centre and the level of per capita consumption. However, the consumption for housing types A,B, D and E are not the same for the large cities and the smaller urban centres. The conclusion is that, while there is a difference in per capita consumption between the larger cities and the smaller urban centres, one can not assume a numerical relationship between urban size and the per capita consumption. As in the previous model, the error terms were reasonably homogeneous. Normal probability plots of the error terms suggested that the assumption of normally distributed deviations appears to be reasonable.

5.4. Regression Model

The study attempted to explain the variation of per capita consumption among different housing type from additional explanatory variables such as household economic level and the use of water for non-essential purposes. An indicator of the household economic level is the electrical bill. The level of water use for non-essential purposes is indicated by the yard area, the availability of a flushing toilet and a washing machine, and the number of cars owned. In addition, there are two the additional factors considered in the ANOVA model; they are the household size and the availability of an additional source of water. The effect of all those factors mentioned on the per capita consumption was examined by using a multiple regression analysis.

Table 5.7 shows the coefficients resulting from this analysis. Each line refers to a cell in the ANOVA. The coefficients shown were significant at the 0.05 level. It appears that the different factors are significant for different housing types.

It can be seen that the electrical bill positively affects the per capita consumption for 18 out of 33 cells. Although the effect was evident in a fewer number of cells, the yard area, the availability of a flushing toilet, a washing machine, and the number of cars owned, increased the per capita consumption as expected.

Table 5.7 also shows that factors of the household size and the additional water sources had negative effects on the per capita consumptions. The household size was effective in 25 of 33 cells, while the additional source of water showed an effect in only 4 cells.

There are a large number of regression models (33 cells) in Table 5.7 which makes general conclusion about the

Table 5.7 : Regression functions for every individual cell

Urban setting	Coefficient							
	CONSTANT	Hhold size	Yard area	Elect. bill	Car	Toilet type	Washing machine	R2
	Housing type A							
EJ1	122.0							0.000
EJ2	153.6	-12.1		0.005				0.367
EJ3	234.1	-19.7						0.282
EJ4	178.2					source : -90.5		0.138
WJ1	147.9	-10.2	0.37					0.254
WJ2	136.9	-9.0	0.50	0.004				0.648
WJ3	66.0	14.4	0.87	-0.006		source : -124.2		0.410
WJ4	306.7	-20.6		0.030				0.364
	Housing type B							
EJ2	114.3			0.002	44.3			0.138
EJ3	111.1			0.003	102.7			0.318
EJ4	217.8	-17.7			59.2	53.5	90.6	0.663
WJ2	272.0	-23.6		0.003			193.3	0.512
						source : -42.7		
WJ3	453.7	-46.9		0.002				0.484
WJ4	259.6	-12.0	0.20					0.132
	Housing type C							
EJ4	199.0					113.3		0.357
WJ3	-127.9		0.27			409.3		0.658
WJ4	503.0	-64.8				143.0		0.630
	Housing type D							
EJ1	184.9	-13.7						0.308
EJ2		-5.6		0.033				0.968
EJ3	184.0	-36.2		0.005				0.681
EJ4	103.5		4.94					0.361
WJ1	150.1	-9.2						0.151
WJ2	122.8	-8.4		0.004				0.164
WJ3	178.7	-18.1		0.008				0.215
WJ4	267.0	-39.3		0.010				0.455
	Housing type E							
EJ2	298.6	-55.1		0.006	110.5			0.591
EJ3	332.7	-49.5				source : -49.5		0.411
EJ4	125.4	-31.7	1.87	0.003				0.667
WJ3	405.6	-77.3			185.7			0.647
WJ4			3.33	0.007	99.1			0.924
	Housing type F							
EJ4	281.3	-11.3			43.1		192.4	0.698
WJ3	257.0	-42.0	2.78	0.002			85.8	0.919
WJ4	202.1	-42.4		0.005	198.4			0.616

Source : Calculation (1994)

significance of the coefficients very uncertain. A general linear test would be required to determine which regression functions could be combined. It was decided that a more extensive data base would be required to construct reliable models that incorporate these additional variables.

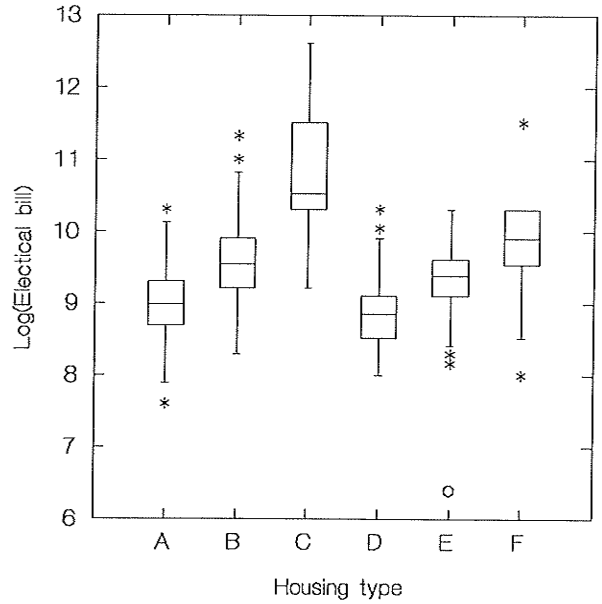
5.5. Presentation of factor effects

An examination of the factor effects may be able to explain why the better housing types have higher levels of water consumption. The variation of the electrical bill is shown by a box-plot in **Figure 5.6**. Variation of other factors are described by means of tables.

5.5.1. The electrical bill

Figure 5.6 is a box-plot of electrical bills per housing types for the entire sample. The figure shows a strong positive relationship between level of electrical bill and housing type. This relationship was conformed by a Tukey's contrast analysis that shows the significant differences in the electrical bill among different housing types at the 0.05 level (see **Table B.4 in Appendix B**).

Figure 5.6 : A Box-plot of **electrical bill** per housing type (for the entire sample)



5.5.2. The water using appliances

Further explanations of the variation in water consumption are shown in the tables below (Table 5.8 and Table 5.9). The ownership of water consuming appliances is related to household incomes (Howe and Linaweaver, 1967). In Indonesia, the appliances were mostly owned in housing types C and F as shown in tables below. These tables show the availability of water using appliances for different housing type. Almost no resident Types A and D used such appliances.

For example, the better housing type had a larger percentage of customers using the flushing toilets in spite of pouring toilets (1% in Type A to 91% in Type C, and 3% in Type D to 97% in Type F) (see **Table 5.8**). A flushing toilet consumes more water (20 litres) than pouring toilet (2 litres) per flushing (Kalbermatten et al, 1987). This is supported by a positive coefficient for the flushing toilet in the regression model in Table 5.7.

Table 5.8 : Percents of type of **toilet** (columns) by housing type (rows)

Type of toilet	Type of housing							
	A	B	C	D	E	F	Total	N
Flushing	1	13	37	1	3	18	8	81
Pouring	99	67	9	97	81	3	73	723
Both	0	21	54	2	16	79	19	186
TOTAL	100	100	100	100	100	100	100	
N	240	180	90	240	150	90		990

Source : Calculation (1994)

The presence of a washing machine increased by housing type (from 0% in type A to 34% in type C, and from 3% in type D to 42% in type F) (see **Table 5.9**). Clouser and Miller (1979) estimate that a washing machine increased per capita per day water consumption range from 15 to 80 litres This is supported by the positive coefficient of washing machine variable in Table 5.7.

Table 5.9 : Percent of using **washing machine** (columns) by housing type (rows)

Using washing machine	Type of housing A	B	C	D	E	F	Total	N
No	0	15	34	3	9	42	12	118
Yes	100	85	66	97	91	58	88	872
TOTAL	100	100	100	100	100	100	100	
N	240	180	90	240	150	90		990

Source : Calculation (1994)

5.5.3. Car ownership

Cars could be owned in all housing types; however, the number of cars owned increased related to an increase in the housings types. Only 6% and 9% of the customers in Types A and D owned a car while 71% and 86% owned one or more in Types C and F (see **Table 5.10**).

Table 5.10 : Percents of **car** (columns) by housing type (rows)

Number of cars	Type of housing A	B	C	D	E	F	Total	N
None	94	58	29	91	67	14	69	687
1	5	36	32	8	32	70	24	233
=> 2	1	7	39	2	1	16	7	70
TOTAL	100	100	100	100	100	100	100	
N	240	180	90	240	150	90		990

Source : Calculation (1994)

From the regression analysis and the tables above one may draw the conclusion that the better housing type have more factors affecting an increase in per capita consumption. The literature uses income and property value as proxy variables for water-using appliances. The figure given above lead one to conclude that the housing type can equally well serve as a proxy variable. In short, housing type could be used as explanatory variable of water demand models. It also may be used for classification of residential water customers in the urban centres under study.

5.6. Household size

It was observed that within a housing type the overall mean of per capita consumptions may be considered to be identical to the mean of per capita consumption for a 6-person household. Therefore, an assumption of 6 person household size can be used for water demand estimation in the future. It may be noted that currently a household is assumed to consist of 7 persons.

5.7. The effect of climate

West Java and East Java were originally considered to have possibly different consumption patterns because of different climatic conditions. While there was no evidence that the temperature of both regions is different as shown by F-statistic and P-values in **Table 5.11**, the average rainfall and humidity in East Java and West Java are significantly different at the 0.05 level. However, while highly significant, the differences were not considered to be extreme.

Usually, the climatic effect on water consumption is considered only where there is an extreme difference in climatic condition such as between summer and winter, hot and cold, or humid and arid areas.

Table 5.11 : A summary of the ANOVA Table of comparison between rainfall, temperature, and humidity in West Java and East Java

Factors	Mean	d.f.	R2	F-stat.	P-value
Rainfall	233; 190	(1,505)	0.674	40.2521	0.0000
Temperature	26; 26	(1,120)	0.096	2.5110	0.1157
Humidity	81; 79	(1,120)	0.436	7.8621	0.0059

Source : Calculation (1994)

It was therefore concluded that contrasting water use pattern in West Java and East Java was not necessary. The climatic effect on water consumption should be investigated on a seasonal basis. This may confirm whether there is significant change in water use pattern in each housing type when the season changes. Moreover, the effect of sprinkling may be separated from indoor use. This will requires a multi-year record study, which should be undertaken in the future.

5.8. Possible application

5.8.1. Demand estimation

5.8.1.1. By housing type

After finding of equality of the per capita consumption between the urban and the suburban areas for an equal housing type, and between the province of East Java and West Java for an equal urban centre, the sample population could be pooled to some degree. Thus, the number of housing types could be reduced from 6 to 3 and from 8 to 4 for the number of urban settings. With an assumption of 6 person household size, the ANOVA coefficient could be developed to be a table of water demand estimates as presented in **Table 5.12**. Since an additional source of water has significant effect on per capita consumption, the table distinguishes between areas have additional source of water and those do not.

By using this table, a water demand level for a certain housing type in a certain urban setting can be estimated. For example, a demand estimate for a housing type D with no good groundwater available for a medium size town is 99 L/c/d or

Table 5.12 : Water demand estimates for certain urban setting, certain housing type (the unit is in L/c/d)

Urban category	No additional source Housing type A,D	B,E	C,F	With additional source Housing type A,D	B,E	C,F
Village	94			77		
Small town	95	153		78	131	
Medium town	99	178	320	82	153	254
Large city	128	214	323	106	183	256

Source : Calculation (1994)

say 100 L/c/d. For values in between the discrete factor levels, a weighted calculation can be done.

5.8.1.2. Basic consumption requirement

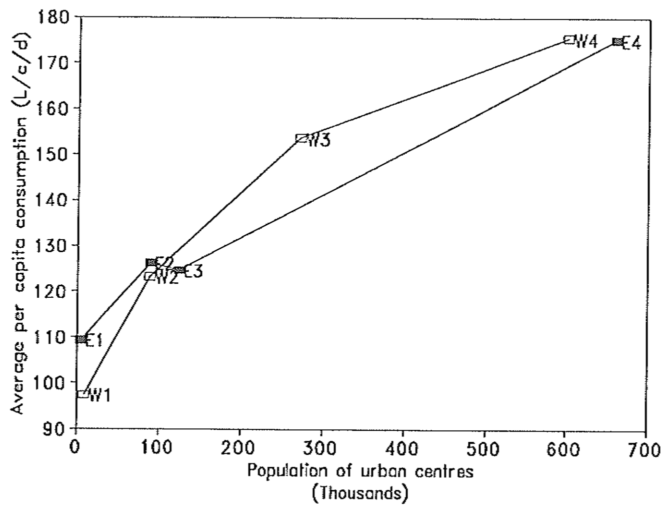
The Central Government grant for basic water supply provision is based on a level of 60 L/c/d as a "basic need" of water supply provision for the lower income group. This "basic need" standard is lower than the per capita consumption for the housing types A and D (see table 5.12). Since housing types A and D mostly did not have car, flushing toilet, washing machine available, and yard area, their per capita consumption could be considered as indication of an actual level of 'basic consumption requirement'. The correction of this basic consumption requirement will prevent unrealistic targets and short falls in the water demand provision for the lower income group.

5.8.1.3. The size of urban centre

Despite finding of no direct relationship between the urban setting and per capita consumption for a given housing type, the size of urban centre has an effect on the average per capita consumption. This is the result of a higher percentage of better housing types in the larger towns. For example, by using Hasfarm Dian ratio (1988) the composition of customers in Types A, B, C, D, E, and F might be represented in the ratio, 6 : 3 : 1 : 6 : 3 : 1, respectively. Then, the weighted average per capita consumptions per urban setting were plotted to the size of urban centres as shown in **Figure 5.7**. This figure suggests a positive correlation between the average per capita consumption and the size of urban centre. The figure also shows that the relationship between average per capita consumption and urban population was not linear. This figure provides a better plot than the model which currently is being used. In certain circumstances, however, one can not directly assume that a small urban centre has a lower average of water consumption. This was because some small urban centres have a large percentage of the better housing type, particularly those close to large cities or tourist resorts.

Figure 5.7 can be used for a projection of residential water demand in those regions. It shows plots of the size of urban centres and the average per capita consumptions. With

Figure 5.7 : Relationship between urban population and average per capita water consumptions



such plot, an average water demand for a certain urban size can be estimated. One could increase the number of urban centres in the plot with less field survey. In practice, larger housing block is used as unit of analysis rather than the household. The per capita consumption is total consumption in the block divided by multiplication of the number of the household connections and 6 persons and the number of days in a month. In obtaining the average demand, a weighted calculation can be done.

5.8.2. Customer classifications

The findings of this study can be used to improve the classifications of residential water customers currently used. The classifications should be related to a water tariff structuring. To prevent financially-capable customers from benefitting from the subsidized 0.8 'A' tariff, major customers of Class X may be sub-divided into two major classes. The low income groups identified as housing types A and D in the present study become Class X1, and the middle income groups identified as housing types B and E become Class X2. The water price should be different between Class X1 and Class X2. Class X2 should not benefit from the subsidized price. Therefore, it is expected that these sub-divisions can improve water price structuring along with improvement of the utility financially and or discourage customers from using water for substitutional purposes. Moreover, in this way a fair water demand projection can be obtained. New customers may be classified by housing type despite of unreliable income data. In an existing area, new customers can be easily identified. For new housing, a composition of the housing types can be obtained from the housing developers. This classification may prevent under- or over-estimate of water requirement and price setting bias.

5.8.3. Future studies

The housing types can be used as a factor in a water demand model wherever it is difficult to obtain assessed property value and household income data. However, this type of classifications require extensive field surveys, particularly when a study covers a large number of urban centres. Population density may then be a preferred alternative. Planners usually favour it. However, a field survey is still required to identify the actual land use to prevent vacant areas from being included in the calculation. A further study is required to determine whether population density and housing types are significantly interchangeable.

Population density is used in the literature as one of water demand variables (Kitchen, 1975; Stevens et al, 1992; Weber, 1993). On average, a population density indicates urban and rural areas, since the larger urban population will have a higher population density. If a higher density is caused by multi-dwelling units such as apartment and block, a higher level of water consumption will be expected. However, the current study of the effect of the housing types, a higher population density (Types A and D) is associated with less water use than the lower density (Types B, C, E, and F). Therefore, in Indonesia a population density variable should be used with care. For a regional study involving many urban areas, the use of a total urban population variable will be simpler than using the population density.

5.8.4. Economic study of supply and demand

A good pricing policy requires a study of price elasticity. The price elasticity study should investigate whether there is a significant difference in price response for different housing types. Literature divides water customers by the value of residential property when a study on a long run effects of water pricing policies is carried out (Howe and Linaweaver, 1967; Gysi and Loucks, 1971). This price elasticity study will provide further data in this area, so a capacity expansion model can be developed. This model may indicate what percentage of the population may be served from a redistribution of the existing capacity after a pricing increase or for how long a new capacity expansion can be delayed.

Chapter 6

CONCLUSIONS AND RECOMMENDATIONS

6.1. Conclusions

The present study used household level data from a household survey in eight different urban centres in the provinces of East Java and West Java in Indonesia. Although the urban centres were predominated by single-dwelling units, the ANOVA method found that different neighbourhood housing types showed significant differences in the per capita consumption. The better housing types have higher levels of the per capita consumption. Moreover, the regression model analysis and a descriptive statistical analysis demonstrated the effects of several additional explanatory variables on per capita consumption for different housing types. There were fewer factors influencing the water use in the lower income groups than in the higher income groups. In addition, the effect of the size of urban centres reflects the larger percentage of better housing which results in a greater than average per capita consumption for the larger urban centres.

The present study leads to the conclusion that the housing type can be used as a classifying factor of residential water customers. The classification explained the effects of housing type, urban population, household size, and other additional factors, so that a better model could be obtained. The model can result a better demand forecasting in the regions. Meanwhile, for demand management purposes, the findings may be the basis for a further economic study to obtain a better understanding in pricing effect on water use pattern. The better classification may also prevent distortions caused by of pricing policy, so water demand management may be improved. An optimization of services can be achieved through a financial improvement and or redistribution of water use reduction.

6.2. Recommendations

Although the present study has led to a better model, it is only a first step to improve the current water demand management in Indonesia. The ANOVA method found the effect of housing type and urban setting, but the regression models obtained require more data before they can be used. To achieve that goal, the following recommendations are made.

1. A more adequate sample size is required to build a robust model that include the variations of urban sizes. The

present sample size was designed to place more emphasis on the ANOVA method than on regression analysis. Therefore, a larger sample size will improve the model.

2. A further analysis of seasonal effect on water use within different housing types is required. This can show whether indoor use and outdoor (sprinkling) use can be separated. Indoor use can be obtained from water use in rainy season, and the outdoor use is obtained from total consumption in dry season subtracted by water use for indoor use in rainy season.
3. A better pricing policy requires a study on price elasticity. The price elasticity study can investigate whether there is a significant difference in response by different housing types to a price increase. The housing classification may conclude which customer groups are more likely elastic to a price increase.

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Appendix A

Table A.1 : Household questionnaire form

1. Questionnaire # :

2. Date of interview :

3. a. Address :
   b. Household connection # :

4. Housing types :
   a. Low income (Type A) b. Middle income (Type B)
   c. High income (Type C) d. Low cost housing (Type D)
   e. Medium cost housing (Type E) f. High cost housing (Type F)

5. House construction :
   a. Permanent b. Semi-permanent c. Temporarily

6. Household activities :
   a. Dwelling only b. Commercial c. Rented d. Others

7. Householder education :
   a. Elementary b. Junior HS c. Senior High d. University

8. Householder Occupation :
   a. Civil servant b. Pension c. Private

9. Household size :
   a. Adult : persons
   b. Child (under 10 years) : persons

10. a. Monthly income : Rp.
    b. Monthly expenditure : Rp.

11. Availability of additional water sources :
    a. No b. Yes

12. a. Monthly water bill : Rp.
    b. Monthly electricity bill : Rp.

13. Average monthly water consumption * : [M3]

14. Plumbing fixtures :
    a. Flushing toilet b. Pouring toilet

15. Washing machine :
    a. Available b. Not

Table A.1 : Household questionnaire form (Continued)

16. Area
    a. Lot area : m2
    b. Yard area : m2

17. Car ownership : cars

18. Water distribution pressure : [M]

19. Remark :

* filled at the offices.

Table A.2 : Collected household data per individual cell (the housing type A in the urban setting EJ1)

Household size (person) (1)	Addit. sources (2)	Electrical bill (Rp) (3)	Flushing toilet (4)	Washing machine (5)	Yard area (m2) (6)	Number of cars (unit) (7)	Household consumption (m3/month) (8)
2	1	10,000	0	0	0	0	2
4	1	15,000	0	0	0	1	6
4	0	14,000	0	0	10	0	11
4	0	12,000	0	0	15	0	12
7	1	7,000	0	0	10	0	12
4	0	N.A.	0	0	0	0	12
4	0	N.A.	0	0	0	0	12
7	1	6,000	0	0	20	0	13
4	1	9,000	0	0	10	0	13
2	1	N.A.	0	0	0	0	14
6	1	13,000	0	0	5	0	15
3	1	5,000	0	0	5	0	15
4	1	10,000	0	0	5	0	15
6	1	10,000	0	0	10	0	16
8	0	13,000	0	0	0	0	16
3	1	4,800	0	0	10	0	16
8	0	12,000	0	0	0	0	18
4	1	7,000	0	0	0	0	18
4	1	8,000	0	0	0	0	19
6	0	7,000	0	0	20	0	19
5	1	N.A.	0	0	0	0	19
6	0	6,000	0	0	50	0	20
5	1	N.A.	0	0	0	0	20
5	1	9,000	0	0	0	0	21
5	1	8,000	0	0	0	0	21
6	1	11,000	0	0	0	0	24
6	1	12,000	0	0	0	0	25
5	1	18,000	0	0	5	0	32
7	0	9,000	1	0	20	0	39
7	0	8,000	1	0	15	0	40

Remarks : Column (3) : N.A. = not available
Column (2) : 0 = no additional source, 1 = with additional source
Column (4)&(5) : 0 = not available; 1 = available

Table A.2 : Collected household data per individual cell (the housing type D in the urban setting EJ1) (Continued)

Household size (person) (1)	Addit. sources (2)	Electrical bill (Rp) (3)	Flushing toilet (4)	Washing machine (5)	Yard area (m2) (6)	Number of cars (unit) (7)	Household consumption (m3/month) (8)
6	1	5,500	0	0	20	0	6
2	1	7,000	0	0	30	0	8
2	1	8,000	0	0	20	0	8
2	1	6,000	0	0	15	0	8
2	1	7,000	0	0	50	0	8
6	1	5,500	0	0	40	0	8
6	1	6,000	0	0	10	0	10
6	1	7,000	0	0	20	0	12
6	1	6,000	0	0	5	0	13
6	1	5,000	0	0	15	0	14
6	1	8,000	0	0	10	0	15
5	1	15,000	0	0	40	0	15
3	1	4,000	0	0	10	0	16
6	1	10,000	0	0	10	0	16
5	1	15,000	0	0	20	0	16
5	1	10,000	0	0	20	0	16
5	1	12,000	0	0	30	0	16
6	1	7,000	0	0	10	0	17
6	1	10,000	0	0	10	0	17
4	1	9,000	0	0	5	0	18
3	1	5,000	0	0	20	0	18
6	1	6,000	0	0	30	0	18
4	1	7,000	0	0	10	0	18
4	1	6,000	0	0	20	0	19
4	1	9,000	0	0	10	0	20
3	1	4,000	0	0	20	0	23
8	1	15,000	0	0	20	0	26
8	1	12,000	0	0	20	0	27
8	1	10,000	0	0	20	0	28
8	1	8,000	0	0	20	0	29

Remarks : Column (3) : N.A. = not available
Column (2) : 0 = no additional source, 1 = with additional source
Column (4)&(5) : 0 = not available; 1 = available

Table A.2 : Collected household data per individual cell (the housing type A in the urban setting EJ2) (Continued)

Household size (person) (1)	Addit. sources (2)	Electrical bill (Rp) (3)	Flushing toilet (4)	Washing machine (5)	Yard area (m2) (6)	Number of cars (unit) (7)	Household consumption (m3/month) (8)
4	1	7,000	0	0	0	0	6
3	1	2,000	0	0	30	0	8
2	0	3,000	0	0	0	0	8
2	0	4,000	0	0	10	0	8
3	1	5,000	0	0	30	0	9
4	1	8,000	0	0	30	0	9
4	1	6,000	0	0	20	0	10
6	1	6,000	0	0	100	0	11
2	1	5,000	0	0	40	0	12
3	0	7,000	0	0	0	0	13
3	0	6,000	0	0	0	0	13
4	1	9,000	0	0	10	0	13
4	1	8,000	0	0	5	0	14
8	1	3,500	0	0	0	0	14
4	0	N.A.	0	0	0	0	15
4	0	6,000	0	0	0	0	15
5	1	7,000	0	0	2	0	16
3	0	9,000	0	0	0	0	16
5	1	6,000	0	0	5	0	16
3	0	10,000	0	0	0	0	16
7	1	6,000	0	0	0	0	20
7	1	5,000	0	0	0	0	21
6	0	6,000	0	0	0	0	21
6	0	7,000	0	0	0	0	21
5	0	6,000	0	0	10	0	23
12	1	11,000	0	0	50	0	24
5	0	5,000	0	0	0	0	25
4	1	N.A.	0	0	0	0	25
12	1	12,000	0	0	20	0	27
3	1	15,000	0	0	30	0	29

Remarks : Column (3 : N.A. = not available
Column (2) : 0 = no additional source, 1 = with additional source
Column (4)&(5) : 0 = not available; 1 = available

Table A.2 : Collected household data per individual cell (the housing type B in the urban setting EJ2) (Continued)

Household size (person) (1)	Addit. sources (2)	Electrical bill (Rp) (3)	Flushing toilet (4)	Washing machine (5)	Yard area (m2) (6)	Number of cars (unit) (7)	Household consumption (m3/month) (8)
3	0	5,000	0	0	150	0	6
3	0	7,000	0	0	50	0	10
4	0	12,000	0	0	10	0	14
7	0	7,000	0	0	0	0	14
4	0	11,000	0	0	0	0	14
9	0	15,000	0	0	50	0	15
3	0	6,000	0	0	30	0	16
3	0	4,000	0	0	20	0	16
4	0	9,000	0	0	20	0	18
4	0	8,000	0	0	0	0	18
5	0	15,000	0	0	50	1	19
5	0	17,000	0	0	30	1	19
5	1	28,000	0	0	40	0	20
5	1	20,000	0	0	30	0	20
6	0	16,000	1	1	50	1	25
5	0	12,000	1	1	10	1	26
5	0	14,000	1	1	20	1	26
6	0	13,000	1	1	25	1	26
6	1	N.A.	0	0	20	0	26
6	1	N.A.	0	0	50	0	26
6	0	9,000	0	0	0	1	28
6	0	N.A.	0	0	0	1	28
6	0	15,000	1	0	20	1	30
6	0	17,000	1	0	100	1	30
7	0	10,000	1	0	20	0	33
7	0	12,000	1	0	10	0	33
5	0	10,000	0	0	0	0	35
5	0	9,000	0	0	20	0	37
4	0	N.A.	1	0	100	1	39
6	0	45,000	0	1	150	1	81

Remarks : Column (3) : N.A. = not available
Column (2) : 0 = no additional source, 1 = with additional source
Column (4)&(5) : 0 = not available; 1 = available

Table A.2 : Collected household data per individual cell (the housing type D in the urban setting EJ2) (Continued)

Household size (person) (1)	Addit. sources (2)	Electrical bill (Rp) (3)	Flushing toilet (4)	Washing machine (5)	Yard area (m2) (6)	Number of cars (unit) (7)	Household consumption (m3/month) (8)
4	0	6,000	0	0	0	0	10
5	0	15,000	0	0	20	0	11
4	0	8,000	0	0	0	0	11
3	0	6,500	0	0	10	0	11
3	0	8,000	0	0	10	0	11
3	0	7,000	0	0	15	0	12
5	0	13,000	0	0	30	0	12
4	0	8,000	0	0	25	0	13
4	0	14,000	0	0	20	0	13
4	0	12,000	0	0	30	0	14
4	0	12,000	0	0	15	0	16
6	0	9,000	0	0	20	0	17
4	0	10,000	0	0	20	0	17
4	0	10,000	0	0	20	0	17
5	0	14,000	0	0	0	0	17
2	0	8,000	0	0	0	0	18
5	0	9,000	0	0	0	0	18
6	0	7,000	0	0	10	0	19
2	0	10,000	0	0	20	0	19
5	0	12,000	0	0	15	0	19
2	0	13,000	0	0	15	0	20
5	0	N.A.	0	0	0	1	23
5	0	12,000	0	0	30	1	24
5	0	20,000	0	0	50	0	26
5	0	N.A.	0	0	10	1	26
5	0	14,000	0	0	50	0	27
4	0	13,000	0	0	20	1	27
2	0	18,000	0	0	10	0	28
5	0	16,000	0	0	20	0	29
4	0	15,000	0	0	0	1	30

Remarks : Column (3) : N.A. = not available
Column (2) : 0 = no additional source, 1 = with additional source
Column (4)&(5) : 0 = not available; 1 = available

Table A.2 : Collected household data per individual cell (the housing type E in the urban setting EJ2) (Continued)

Household size (person) (1)	Addit. sources (2)	Electrical bill (Rp) (3)	Flushing toilet (4)	Washing machine (5)	Yard area (m2) (6)	Number of cars (unit) (7)	Household consumption (m3/month) (8)
4	0	6,000	0	0	0	0	10
5	0	15,000	0	0	20	0	11
4	0	8,000	0	0	0	0	11
3	0	6,500	0	0	10	0	11
3	0	8,000	0	0	10	0	11
3	0	7,000	0	0	15	0	12
5	0	13,000	0	0	30	0	12
4	0	8,000	0	0	25	0	13
4	0	14,000	0	0	20	0	13
4	0	12,000	0	0	30	0	14
4	0	12,000	0	0	15	0	16
6	0	9,000	0	0	20	0	17
4	0	10,000	0	0	20	0	17
4	0	10,000	0	0	20	0	17
5	0	14,000	0	0	0	0	17
2	0	8,000	0	0	0	0	18
5	0	9,000	0	0	0	0	18
6	0	7,000	0	0	10	0	19
2	0	10,000	0	0	20	0	19
5	0	12,000	0	0	15	0	19
2	0	13,000	0	0	15	0	20
5	0	N.A.	0	0	0	1	23
5	0	12,000	0	0	30	1	24
5	0	20,000	0	0	50	0	26
5	0	N.A.	0	0	10	1	26
5	0	14,000	0	0	50	0	27
4	0	13,000	0	0	20	1	27
2	0	18,000	0	0	10	0	28
5	0	16,000	0	0	20	0	29
4	0	15,000	0	0	0	1	30

Remarks : Column (3) : N.A. = not available
Column (2) : 0 = no additional source, 1 = with additional source
Column (4)&(5) : 0 = not available; 1 = available

Table A.2 : Collected household data per individual cell (the housing type A in the urban setting EJ3) (Continued)

Household size (person) (1)	Addit. sources (2)	Electrical bill (Rp) (3)	Flushing toilet (4)	Washing machine (5)	Yard area (m2) (6)	Number of cars (unit) (7)	Household consumption (m3/month) (8)
8	0	10,000	0	0	0	0	6
8	0	7,000	0	0	0	0	9
7	1	4,500	0	0	0	0	9
7	1	3,500	0	0	0	0	11
3	0	N.A.	0	0	10	0	11
7	1	6,000	0	0	0	0	12
3	0	N.A.	0	0	0	0	12
5	0	5,000	0	0	0	0	13
7	1	6,500	0	0	0	0	13
5	0	7,500	0	0	0	0	13
7	1	5,000	0	0	0	0	16
5	0	3,000	0	0	0	0	16
8	0	14,000	0	0	0	0	16
5	0	N.A.	0	0	0	0	16
7	1	7,000	0	0	0	0	17
8	0	8,000	0	0	0	0	17
7	0	10,000	0	0	0	0	17
7	0	7,000	0	0	0	0	18
7	1	8,000	0	0	0	0	21
7	1	9,000	0	0	0	0	21
3	0	4,000	0	0	3	0	22
5	0	N.A.	0	0	0	0	22
5	0	N.A.	0	0	0	0	23
3	0	6,000	0	0	5	0	23
6	0	4,500	0	0	0	0	25
6	0	N.A.	0	0	0	0	26
6	1	10,000	0	0	0	0	30
6	1	8,000	0	0	0	0	32
8	0	5,000	0	0	0	0	44
8	0	N.A.	0	0	0	0	47

Remarks : Column (3) : N.A. = not available
Column (2) : 0 = no additional source, 1 = with additional source
Column (4)&(5) : 0 = not available; 1 = available

Table A.2 : Collected household data per individual cell (the housing type B in the urban setting EJ3) (Continued)

Household size (person) (1)	Addit. sources (2)	Electrical bill (Rp) (3)	Flushing toilet (4)	Washing machine (5)	Yard area (m2) (6)	Number of cars (unit) (7)	Household consumption (m3/month) (8)
6	1	9,000	0	0	0	0	10
5	1	4,000	0	0	0	0	12
4	1	N.A.	0	0	50	0	12
6	1	12,000	0	0	0	0	12
4	1	8,000	0	0	40	0	12
4	1	6,000	0	0	20	0	12
5	1	8,000	0	0	10	0	13
4	1	9,000	0	0	30	0	14
5	1	11,000	0	0	30	0	22
5	1	8,500	0	0	100	0	22
4	0	13,000	0	0	25	0	24
5	1	12,000	1	0	40	0	25
4	0	15,000	0	0	30	0	25
5	1	7,000	1	0	50	0	26
5	1	11,000	0	0	0	0	27
5	1	N.A.	0	0	0	0	27
7	1	11,000	0	0	20	0	28
7	1	9,000	0	0	10	0	29
5	1	13,000	1	0	10	0	33
5	1	30,000	1	0	5	0	34
8	0	8,000	1	0	50	1	35
5	1	14,000	0	0	10	0	36
5	1	12,000	0	0	20	0	36
5	0	16,000	0	0	20	1	38
8	0	N.A.	1	0	50	1	38
10	1	10,000	0	0	10	0	38
10	1	N.A.	0	0	0	0	40
7	1	8,000	1	1	30	1	40
7	1	N.A.	1	1	50	1	41
5	0	N.A.	0	0	100	1	51

Remarks : Column (3) : N.A. = not available
Column (2) : 0 = no additional source, 1 = with additional source
Column (4)&(5) : 0 = not available; 1 = available

Table A.2 : Collected household data per individual cell (the housing type D in the urban setting EJ3) (Continued)

Household size (person) (1)	Addit. sources (2)	Electrical bill (Rp) (3)	Flushing toilet (4)	Washing machine (5)	Yard area (m2) (6)	Number of cars (unit) (7)	Household consumption (m3/month) (8)
3	0	3,000	1	0	10	0	6
6	1	8,000	0	0	10	0	6
3	0	6,000	1	0	10	0	6
3	0	3,000	1	0	10	0	7
3	0	4,500	1	0	10	0	7
6	1	5,000	0	0	10	0	8
2	0	7,000	0	0	10	0	9
2	0	6,000	0	0	10	0	9
2	0	4,000	0	0	10	0	10
6	1	4,000	0	0	10	0	10
2	0	7,000	0	0	10	0	10
4	1	11,000	0	0	0	0	10
6	1	7,500	0	0	10	0	11
2	0	5,000	0	0	10	0	11
4	1	7,000	0	0	0	0	11
6	1	7,500	0	0	10	0	11
4	1	5,000	0	0	0	0	11
4	1	5,000	0	0	0	0	12
2	0	4,500	0	0	10	0	12
4	0	6,000	0	0	10	0	12
4	0	8,000	0	0	10	0	13
2	0	5,000	0	0	10	0	13
2	0	3,000	0	0	10	0	14
4	0	8,000	0	0	10	0	14
4	0	8,000	0	0	10	0	14
2	0	6,000	0	0	10	0	15
5	1	6,000	0	0	20	0	19
5	1	7,000	0	0	20	0	20
5	1	15,000	0	0	20	0	20
5	1	4,500	0	0	20	0	21

Remarks : Column (3) : N.A. = not available
Column (2) : 0 = no additional source, 1 = with additional source
Column (4)&(5) : 0 = not available; 1 = available

Table A.2 : Collected household data per individual cell (the housing type E in the urban setting EJ3) (Continued)

Household size (person) (1)	Addit. sources (2)	Electrical bill (Rp) (3)	Flushing toilet (4)	Washing machine (5)	Yard area (m2) (6)	Number of cars (unit) (7)	Household consumption (m3/month) (8)
5	1	15,000	0	0	60	0	6
7	1	10,000	0	0	10	0	7
5	1	6,000	0	0	10	0	9
5	1	7,000	0	0	50	0	10
5	1	20,000	0	0	20	0	10
5	1	11,000	0	0	10	0	11
4	1	9,000	0	0	10	0	14
4	1	7,000	0	0	10	0	14
3	1	15,000	0	0	5	0	14
5	1	12,000	0	0	50	0	14
4	1	7,000	0	0	10	0	15
5	1	30,000	0	0	15	0	15
4	1	14,000	0	0	10	0	15
5	1	11,000	0	0	10	0	15
5	1	9,000	0	0	20	0	16
5	1	6,000	0	0	10	0	17
4	1	12,000	0	0	10	2	17
2	1	9,000	0	0	0	0	17
5	1	7,000	0	0	10	0	17
4	1	20,000	0	0	10	2	17
8	0	9,000	0	0	0	0	20
4	0	12,000	0	0	20	0	21
4	1	14,000	0	0	30	0	22
3	1	8,000	0	0	20	0	22
5	1	N.A.	0	0	20	1	22
6	1	9,000	0	0	20	1	23
6	1	11,000	0	0	20	1	24
5	1	14,000	0	0	10	0	24
4	1	10,000	0	0	10	0	24
6	1	15,000	0	0	50	0	32

Remarks : Column (3) : N.A. = not available
Column (2) : 0 = no additional source, 1 = with additional source
Column (4)&(5) : 0 = not available; 1 = available

Table A.2 : Collected household data per individual cell (the housing type A in the urban setting EJ4) (Continued)

Household size (person) (1)	Addit. sources (2)	Electrical bill (Rp) (3)	Flushing toilet (4)	Washing machine (5)	Yard area (m2) (6)	Number of cars (unit) (7)	Household consumption (m3/month) (8)
2	1	9,000	0	0	0	0	3
2	0	6,000	0	0	50	0	10
2	0	5,000	0	0	20	0	10
5	0	5,000	0	0	0	0	14
4	0	7,000	0	0	0	0	15
6	0	N.A.	0	0	0	0	16
2	0	10,000	0	0	0	0	18
5	0	6,000	0	0	30	0	18
8	1	6,000	0	0	0	0	18
5	0	7,000	0	0	0	0	20
3	0	N.A.	0	0	0	0	20
6	0	2,700	0	0	0	0	23
6	1	N.A.	0	0	0	0	23
3	0	7,000	0	0	0	0	24
6	0	9,000	0	0	0	0	25
6	0	4,000	0	0	0	0	26
10	0	7,500	0	0	0	0	26
8	0	20,000	0	0	0	0	26
6	0	11,000	0	0	0	0	27
6	0	10,000	0	0	0	0	28
5	0	6,000	0	0	0	0	29
5	0	5,500	0	0	0	0	30
4	0	6,500	0	0	0	0	31
5	0	6,000	0	0	0	0	32
5	0	10,000	0	0	0	0	35
5	0	15,000	0	0	0	0	36
7	0	10,000	0	0	0	0	50
12	0	N.A.	0	0	0	0	62
12	0	N.A.	0	0	0	0	65
7	0	15,000	0	0	0	1	67

Remarks : Column (3) : N.A. = not available
Column (2) : 0 = no additional source, 1 = with additional source
Column (4)&(5) : 0 = not available; 1 = available

Table A.2 : Collected household data per individual cell (the housing type B in the urban setting EJ4) (Continued)

Household size (person) (1)	Addit. sources (2)	Electrical bill (Rp) (3)	Flushing toilet (4)	Washing machine (5)	Yard area (m2) (6)	Number of cars (unit) (7)	Household consumption (m3/month) (8)
3	0	30,000	1	0	50	1	17
3	0	17,000	1	0	40	1	19
7	0	14,000	0	0	15	0	19
10	0	15,000	1	0	0	0	20
7	0	14,000	0	0	15	0	23
5	1	13,000	0	0	2	1	25
5	1	10,000	0	0	2	1	25
7	0	N.A.	0	0	15	1	26
7	1	23,000	1	0	10	0	28
3	0	50,000	1	1	30	1	29
7	1	19,000	1	0	30	0	29
7	1	15,000	0	0	20	1	31
6	1	16,000	1	1	10	0	32
5	1	N.A.	0	0	50	1	32
7	1	10,000	0	0	5	1	32
3	0	20,000	1	1	20	1	33
6	1	N.A.	1	1	10	0	34
4	0	N.A.	1	0	50	0	36
5	1	16,000	0	0	20	1	36
4	0	18,000	1	0	20	0	38
8	0	30,000	1	0	15	1	38
8	0	18,000	1	0	20	1	40
5	0	N.A.	0	1	0	1	41
5	0	21,000	0	1	0	1	42
6	0	50,000	1	0	20	2	45
10	0	N.A.	1	0	20	0	47
10	0	14,000	1	0	30	0	47
6	0	20,000	1	0	15	2	48
5	0	23,000	1	1	50	1	62
4	0	40,000	1	1	15	2	65

Remarks : Column (3) : N.A. = not available
Column (2) : 0 = no additional source, 1 = with additional source
Column (4)&(5) : 0 = not available; 1 = available

Table A.2 : Collected household data per individual cell (the housing type C in the urban setting EJ4) (Continued)

Household size (person) (1)	Addit. sources (2)	Electrical bill (Rp) (3)	Flushing toilet (4)	Washing machine (5)	Yard area (m2) (6)	Number of cars (unit) (7)	Household consumption (m3/month) (8)
6	1	30,000	1	0	50	1	16
4	0	25,000	1	0	120	0	20
6	1	N.A.	1	1	200	2	20
4	0	10,000	1	0	50	0	22
4	1	35,000	1	0	130	0	29
4	1	60,000	1	0	100	0	30
3	0	15,000	1	0	100	0	31
3	0	20,000	1	0	80	0	32
3	1	40,000	1	0	100	0	42
3	1	35,000	1	0	150	0	44
5	0	50,000	1	0	400	2	46
10	1	75,000	0	0	50	0	46
5	0	60,000	1	0	100	2	47
5	0	70,000	1	0	300	0	48
5	0	40,000	1	0	200	0	49
6	0	N.A.	1	0	1000	2	49
6	0	80,000	1	0	200	2	50
10	1	30,000	0	0	100	0	51
14	1	40,000	1	1	50	1	54
5	1	42,000	1	0	100	0	54
5	1	20,000	1	0	50	0	55
8	0	N.A.	0	0	50	1	56
8	0	60,000	0	0	100	1	57
14	1	100,000	1	1	100	1	62
6	1	50,000	1	1	100	2	72
6	1	35,000	1	1	150	2	77
10	1	150,000	1	0	500	2	86
10	1	60,000	1	0	150	2	91
9	0	N.A.	1	1	200	2	141
18	1	N.A.	1	0	250	2	354

Remarks : Column (3) : N.A. = not available
Column (2) : 0 = no additional source, 1 = with additional source
Column (4)&(5) : 0 = not available; 1 = available

Table A.2 : Collected household data per individual cell (the housing type D in the urban setting EJ4) (Continued)

Household size (person) (1)	Addit. sources (2)	Electrical bill (Rp) (3)	Flushing toilet (4)	Washing machine (5)	Yard area (m2) (6)	Number of cars (unit) (7)	Household consumption (m3/month) (8)
6	0	17,000	0	0	10	1	8
2	0	6,000	0	0	0	0	8
2	0	5,000	0	0	0	0	8
5	0	8,000	0	0	10	1	9
4	0	5,000	0	0	0	0	9
4	0	6,000	0	0	10	0	10
4	0	4,500	0	0	10	0	12
4	0	7,000	0	0	10	0	12
3	0	4,000	0	0	10	0	13
3	0	6,000	0	0	10	0	13
4	0	4,000	0	0	0	0	13
4	0	7,000	0	0	0	0	14
4	0	6,000	0	0	10	0	15
4	0	7,000	0	0	10	0	15
5	0	5,000	0	0	10	1	18
4	0	3,000	0	0	10	0	18
6	0	5,000	0	0	10	0	18
4	0	4,500	0	0	10	0	18
5	0	7,500	0	0	10	1	19
3	0	3,500	0	0	0	1	21
4	0	8,000	0	0	5	0	23
6	0	6,000	0	0	10	0	26
6	0	8,000	0	0	10	0	26
5	0	7,000	0	0	10	1	30
6	0	14,000	0	0	0	0	32
6	0	9,000	0	0	0	0	33
7	0	7,500	0	0	10	0	34
7	0	9,000	0	0	10	0	35
5	0	N.A.	0	0	10	1	37
4	0	5,000	0	0	20	0	51

Remarks : Column (3) : N.A. = not available
Column (2) : 0 = no additional source, 1 = with additional source
Column (4)&(5) : 0 = not available; 1 = available

Table A.2 : Collected household data per individual cell (the housing type E in the urban setting EJ4) (Continued)

Household size (person) (1)	Addit. sources (2)	Electrical bill (Rp) (3)	Flushing toilet (4)	Washing machine (5)	Yard area (m2) (6)	Number of cars (unit) (7)	Household consumption (m3/month) (8)
7	0	9,000	0	0	40	0	11
2	0	15,000	1	0	50	0	13
5	1	20,000	0	0	70	1	13
2	0	N.A.	1	0	40	0	14
3	1	18,000	1	0	50	1	14
3	1	14,000	1	0	50	1	15
2	0	N.A.	1	0	30	0	15
7	0	24,000	0	0	50	0	16
3	0	N.A.	1	0	100	1	19
5	1	12,000	0	0	50	1	19
3	0	N.A.	1	0	40	1	20
2	0	9,000	0	0	100	1	21
4	0	13,000	1	0	50	0	21
4	0	17,000	1	0	100	0	21
2	0	13,000	0	0	50	1	23
4	0	13,000	1	0	60	0	25
6	0	21,000	1	0	100	0	25
3	0	12,000	1	1	150	1	26
6	0	15,000	1	0	70	0	26
3	0	10,000	1	1	40	1	27
2	0	30,000	1	1	80	1	28
2	0	19,000	1	1	40	1	30
4	1	13,000	1	0	50	0	32
4	1	20,000	1	0	100	0	33
3	0	7,000	1	0	40	0	36
3	0	6,000	1	0	130	0	38
5	1	15,000	1	0	130	1	47
5	1	11,000	1	0	90	1	50
6	0	17,000	1	1	100	1	50
6	0	20,000	1	1	60	1	51

Remarks : Column (3) : N.A. = not available
Column (2) : 0 = no additional source, 1 = with additional source
Column (4)&(5) : 0 = not available; 1 = available

Table A.2 : Collected household data per individual cell (the housing type F in the urban setting EJ4) (Continued)

Household size (person) (1)	Addit. sources (2)	Electrical bill (Rp) (3)	Flushing toilet (4)	Washing machine (5)	Yard area (m2) (6)	Number of cars (unit) (7)	Household consumption (m3/month) (8)
1	0	10,000	1	0	150	0	6
1	0	5,000	1	0	200	0	6
2	0	20,000	1	0	200	1	18
2	0	15,000	1	0	150	1	19
2	0	19,000	1	0	150	1	19
3	0	23,000	1	0	100	0	21
3	0	18,000	1	0	100	0	23
3	0	13,000	1	0	300	0	24
3	0	10,000	1	0	150	0	24
3	0	21,000	1	0	100	0	25
3	0	15,000	1	0	100	0	25
4	0	40,000	1	0	250	1	26
4	0	35,000	1	0	100	1	26
4	0	20,000	1	0	50	1	27
3	0	N.A.	1	0	200	1	32
3	0	N.A.	1	0	100	1	32
3	0	20,000	1	0	100	1	33
8	0	35,000	1	0	200	1	39
5	1	N.A.	0	0	100	2	43
5	0	23,000	0	0	100	2	43
5	1	N.A.	0	0	200	2	45
4	0	25,000	1	1	150	2	45
8	0	N.A.	1	0	150	1	45
4	0	N.A.	1	1	150	2	57
6	0	17,000	1	0	150	1	58
6	0	45,000	1	0	100	1	58
6	0	N.A.	1	0	200	1	60
4	0	N.A.	1	1	150	2	65
4	0	19,000	1	1	300	2	68
4	0	N.A.	1	1	150	2	75

Remarks : Column (3) : N.A. = not available
Column (2) : 0 = no additional source, 1 = with additional source
Column (4)&(5) : 0 = not available; 1 = available

Table A.2 : Collected household data per individual cell (the housing type A in the urban setting WJ1) (Continued)

Household size (person) (1)	Addit. sources (2)	Electrical bill (Rp) (3)	Flushing toilet (4)	Washing machine (5)	Yard area (m2) (6)	Number of cars (unit) (7)	Household consumption (m3/month) (8)
3	1	7,000	0	0	0	0	5
6	1	N.A.	0	0	0	0	6
5	1	6,000	0	0	0	0	7
4	0	5,000	0	0	0	0	8
4	0	N.A.	0	0	0	0	9
5	1	8,000	0	0	0	0	9
5	0	7,000	0	0	0	0	10
8	1	4,000	0	0	0	0	10
6	1	4,000	0	0	0	0	10
3	0	N.A.	0	0	0	0	11
5	0	N.A.	0	0	0	0	11
10	1	6,500	0	0	15	0	11
5	0	N.A.	0	0	0	0	13
5	0	14,000	0	0	0	0	14
10	1	N.A.	0	0	0	0	14
7	1	N.A.	0	0	0	0	15
6	1	8,000	0	0	100	0	15
4	1	3,500	0	0	0	1	17
6	0	5,000	0	0	20	0	17
9	1	N.A.	0	0	0	0	17
3	0	4,000	0	0	0	0	18
4	0	5,000	0	0	10	0	18
6	1	10,000	0	0	0	0	20
6	1	7,000	0	0	10	0	22
4	0	13,000	0	0	30	2	23
7	0	5,000	0	0	0	0	23
6	0	11,000	0	0	0	0	23
10	1	5,000	0	0	10	0	24
5	1	3,500	0	0	0	0	25
6	1	7,000	0	0	150	0	39

Remarks : Column (3) : N.A. = not available
Column (2) : 0 = no additional source, 1 = with additional source
Column (4)&(5) : 0 = not available; 1 = available

Table A.2 : Collected household data per individual cell (the housing type D in the urban setting WJ1) (Continued)

Household size (person) (1)	Addit. sources (2)	Electrical bill (Rp) (3)	Flushing toilet (4)	Washing machine (5)	Yard area (m2) (6)	Number of cars (unit) (7)	Household consumption (m3/month) (8)
4	0	6,000	0	0	10	1	5
2	0	6,500	0	0	10	0	7
2	0	5,000	0	0	10	0	7
3	0	5,000	0	0	10	0	8
4	0	8,000	0	0	10	1	8
3	0	6,000	0	0	10	0	9
3	0	N.A.	0	0	10	0	11
3	0	N.A.	0	0	10	0	11
3	0	7,000	0	0	10	0	11
3	0	6,000	0	0	10	0	11
4	0	5,000	0	0	10	0	12
4	0	3,000	0	0	10	0	12
5	0	6,000	0	0	10	0	12
5	0	7,000	0	0	10	0	12
3	0	6,000	0	0	10	0	13
5	0	6,000	0	0	10	0	14
3	0	7,000	0	0	10	0	14
5	0	5,000	0	0	10	0	14
3	0	5,000	0	0	10	0	15
4	0	7,000	0	0	10	0	15
4	0	9,000	0	0	10	0	16
7	0	6,000	0	0	10	0	16
7	0	8,000	0	0	10	0	17
4	0	6,000	0	0	10	0	17
4	0	5,000	0	0	10	0	17
3	0	4,500	0	0	10	0	19
6	0	5,000	0	0	10	0	19
6	0	5,000	0	0	10	0	19
7	0	7,000	0	0	10	0	22
7	0	7,000	0	0	10	0	22

Remarks : Column (3) : N.A. = not available
Column (2) : 0 = no additional source, 1 = with additional source
Column (4)&(5) : 0 = not available; 1 = available

Table A.2 : Collected household data per individual cell (the housing type A in the urban setting WJ2) (Continued)

Household size (person) (1)	Addit. sources (2)	Electrical bill (Rp) (3)	Flushing toilet (4)	Washing machine (5)	Yard area (m2) (6)	Number of cars (unit) (7)	Household consumption (m3/month) (8)
6	1	7,000	0	0	50	0	4
2	1	4,000	0	0	10	0	8
7	0	10,000	0	0	0	0	10
7	0	8,000	0	0	0	0	11
4	0	4,000	0	0	0	0	12
3	0	11,000	0	0	5	0	13
4	0	6,000	0	0	0	1	13
6	1	N.A.	0	0	0	0	14
4	0	5,000	0	0	0	0	15
3	0	6,000	0	0	10	0	16
6	1	N.A.	0	0	0	0	17
4	0	12,000	0	0	0	0	19
6	1	6,000	0	0	10	0	21
5	0	10,000	0	0	0	0	22
3	0	6,500	0	0	20	0	22
5	0	7,000	0	0	0	0	23
4	0	9,000	0	0	2	1	23
20	1	6,000	0	0	0	0	23
5	0	9,000	0	0	0	1	24
11	1	9,000	0	0	0	0	24
5	0	9,000	0	0	0	2	24
11	1	15,000	0	0	0	0	24
5	0	15,000	0	0	0	2	25
7	0	5,000	0	0	0	0	26
7	0	11,000	0	0	0	0	26
14	1	10,000	0	0	10	0	27
14	0	8,000	0	0	100	0	27
3	0	5,000	0	0	150	0	31
6	0	20,000	0	0	0	0	33
12	0	20,000	0	0	10	0	41

Remarks : Column (3) : N.A. = not available
Column (2) : 0 = no additional source, 1 = with additional source
Column (4)&(5) : 0 = not available; 1 = available

Table A.2 : Collected household data per individual cell (the housing type B in the urban setting WJ2) (Continued)

Household size (person) (1)	Addit. sources (2)	Electrical bill (Rp) (3)	Flushing toilet (4)	Washing machine (5)	Yard area (m2) (6)	Number of cars (unit) (7)	Household consumption (m3/month) (8)
1	1	N.A.	0	0	450	0	5
1	1	8,000	0	0	50	0	5
6	1	N.A.	0	0	0	1	6
10	1	30,000	0	0	0	1	8
8	1	N.A.	1	0	200	2	12
8	1	15,000	0	0	30	0	12
4	0	17,000	0	0	50	0	15
8	1	10,000	0	0	10	0	15
4	0	N.A.	0	0	50	0	15
5	0	6,000	0	0	10	1	16
5	1	15,000	0	0	300	0	17
5	1	16,000	0	0	20	1	17
5	1	10,000	0	0	30	1	18
7	0	16,000	1	0	20	1	18
5	1	12,000	0	0	50	1	19
7	0	20,000	1	0	40	1	20
4	1	11,000	0	0	30	0	21
6	1	18,000	0	0	10	1	24
3	1	10,000	0	0	20	0	25
4	1	26,000	0	0	20	2	25
3	0	15,000	0	0	50	0	26
4	1	10,000	0	0	20	2	27
3	0	10,000	0	0	50	0	27
4	1	13,000	0	0	50	0	28
5	1	18,000	0	0	15	0	36
10	0	18,000	1	0	50	0	38
9	0	15,000	0	0	40	0	50
9	0	19,000	0	0	20	0	51
6	0	20,000	1	1	30	1	56
6	0	17,000	1	1	50	1	61

Remarks : Column (3) : N.A. = not available
Column (2) : 0 = no additional source, 1 = with additional source
Column (4)&(5) : 0 = not available; 1 = available

Table A.2 : Collected household data per individual cell (the housing type D in the urban setting WJ2) (Continued)

Household size (person) (1)	Addit. sources (2)	Electrical bill (Rp) (3)	Flushing toilet (4)	Washing machine (5)	Yard area (m2) (6)	Number of cars (unit) (7)	Household consumption (m3/month) (8)
5	0	6,000	0	0	10	0	5
2	0	5,000	0	0	10	0	6
2	0	4,000	0	0	10	0	7
3	0	5,000	0	0	0	0	10
3	0	6,000	0	0	0	0	10
3	0	6,500	0	0	0	0	11
5	1	7,000	0	0	10	0	11
6	0	N.A.	0	0	10	0	12
5	0	10,000	0	0	10	0	12
5	0	6,000	0	0	10	1	12
3	0	7,000	0	0	10	0	12
5	0	8,000	0	0	10	1	12
4	1	8,000	0	0	10	1	15
6	0	8,000	0	0	10	0	16
4	0	6,500	0	0	20	0	18
4	0	7,000	0	0	20	0	18
6	0	10,000	0	0	10	0	19
6	0	7,000	0	0	10	0	19
5	0	5,000	0	0	10	0	20
5	0	4,000	0	0	10	0	20
6	0	13,000	0	0	10	0	22
6	0	7,000	0	0	10	0	23
4	0	23,000	0	0	200	0	23
9	0	7,000	0	0	10	0	25
7	0	12,000	0	0	10	0	25
7	0	6,000	0	0	10	0	25
9	0	15,000	0	0	10	0	26
5	0	9,000	0	0	10	1	27
5	0	14,000	0	0	10	2	32
6	0	11,000	0	0	10	0	44

Remarks : Column (3) : N.A. = not available
Column (2) : 0 = no additional source, 1 = with additional source
Column (4)&(5) : 0 = not available; 1 = available

Table A.2 : Collected household data per individual cell (the housing type A in the urban setting WJ3) (Continued)

Household size (person) (1)	Addit. sources (2)	Electrical bill (Rp) (3)	Flushing toilet (4)	Washing machine (5)	Yard area (m2) (6)	Number of cars (unit) (7)	Household consumption (m3/month) (8)
7	1	N.A.	0	0	10	0	7
7	1	6,500	0	0	10	0	10
7	1	7,500	0	0	5	0	12
4	0	6,000	0	0	0	0	12
4	0	N.A.	0	0	0	0	12
4	0	4,000	0	0	0	0	13
7	1	N.A.	0	0	0	0	13
4	0	4,500	0	0	0	0	14
6	0	14,500	0	0	10	0	21
6	0	14,500	0	0	75	0	21
6	0	6,000	0	0	15	0	23
6	0	6,500	0	0	0	0	23
6	0	N.A.	0	0	0	0	24
6	0	N.A.	0	0	0	0	25
6	0	5,500	0	0	0	0	26
6	0	7,000	0	0	0	0	26
6	0	6,500	0	0	10	0	27
6	0	5,000	0	0	10	0	28
13	1	13,000	0	0	0	0	28
6	0	5,000	0	0	10	0	28
6	0	8,000	0	0	10	0	30
6	0	5,000	0	0	10	0	31
6	0	7,000	0	0	20	0	32
6	0	9,000	0	0	15	0	33
13	1	6,000	0	0	15	0	34
6	0	4,500	0	0	0	0	35
13	1	11,000	0	0	30	0	36
13	1	9,000	0	0	20	0	39
6	0	5,000	0	0	0	0	44
6	0	5,000	0	0	10	0	50

Remarks : Column (3) : N.A. = not available
Column (2) : 0 = no additional source, 1 = with additional source
Column (4)&(5) : 0 = not available; 1 = available

Table A.2 : Collected household data per individual cell (the housing type B in the urban setting WJ3) (Continued)

Household size (person) (1)	Addit. sources (2)	Electri-cal bill (Rp) (3)	Flushing toilet (4)	Washing machine (5)	Yard area (m2) (6)	Number of cars (unit) (7)	Household consumption (m3/month) (8)
7	1	14,000	0	0	30	0	20
5	0	12,000	0	0	10	0	22
7	1	6,000	0	0	20	0	22
5	0	5,000	0	0	0	0	23
5	0	15,000	0	0	30	0	25
7	1	14,000	0	0	30	0	28
6	0	23,000	0	0	50	1	30
4	0	12,000	0	0	20	1	32
6	0	19,000	0	0	20	1	32
4	0	13,000	0	0	15	1	32
6	0	14,000	0	0	30	1	33
6	1	11,000	0	0	30	0	34
6	1	11,000	0	0	450	0	35
4	0	10,000	0	0	10	1	35
6	1	15,000	0	0	50	0	35
6	0	10,000	0	0	0	0	36
5	1	9,000	0	0	10	0	36
5	1	16,000	0	0	20	0	37
6	0	14,000	0	0	0	0	37
6	0	13,000	0	0	0	0	37
4	1	11,000	0	0	40	0	38
5	1	13,000	0	0	20	0	39
4	1	17,000	0	0	100	0	43
7	0	15,000	0	0	20	0	47
7	0	7,500	0	0	20	0	48
7	0	7,500	0	0	20	0	49
7	1	9,000	0	0	20	0	54
9	1	18,000	1	1	50	2	57
9	1	83,000	1	1	150	2	58
9	1	23,000	1	1	25	2	59

Remarks : Column (3) : N.A. = not available
Column (2) : 0 = no additional source, 1 = with additional source
Column (4)&(5) : 0 = not available; 1 = available

Table A.2 : Collected household data per individual cell (the housing type C in the urban setting WJ3) (Continued)

Household size (person) (1)	Addit. sources (2)	Electrical bill (Rp) (3)	Flushing toilet (4)	Washing machine (5)	Yard area (m2) (6)	Number of cars (unit) (7)	Household consumption (m3/month) (8)
8	1	30,000	0	0	150	1	29
8	1	60,000	0	0	200	1	33
4	1	N.A.	1	0	200	1	37
8	1	30,000	0	0	1000	1	38
4	1	25,000	1	0	150	1	39
4	1	30,000	1	0	100	1	40
8	1	25,000	0	0	300	1	43
6	0	N.A.	1	1	100	1	44
6	0	23,000	1	1	250	1	46
6	0	50,000	1	1	100	1	48
6	0	N.A.	1	1	100	1	50
5	1	35,000	1	0	300	0	50
6	0	40,000	1	0	100	1	51
5	1	40,000	1	0	100	0	53
6	0	35,000	1	0	200	1	53
6	0	N.A.	1	0	100	1	53
9	1	40,000	1	0	100	2	53
5	1	25,000	1	0	100	0	54
6	0	N.A.	1	0	100	1	55
5	1	30,000	1	0	150	0	55
9	1	65,000	1	0	100	2	56
9	1	50,000	1	0	150	2	58
9	1	200,000	1	0	100	2	59
11	1	45,000	1	0	100	2	131
10	1	40,000	1	0	200	2	133
11	1	100,000	1	0	200	2	139
11	1	50,000	1	0	300	2	148
13	0	300,000	1	1	500	2	183
12	0	50,000	1	1	300	2	203
14	0	70,000	1	1	1000	2	266

Remarks : Column (3) : N.A. = not available
Column (2) : 0 = no additional source, 1 = with additional source
Column (4)&(5) : 0 = not available; 1 = available

Table A.2 : Collected household data per individual cell (the housing type D in the urban setting WJ3) (Continued)

Household size (person) (1)	Addit. sources (2)	Electrical bill (Rp) (3)	Flushing toilet (4)	Washing machine (5)	Yard area (m2) (6)	Number of cars (unit) (7)	Household consumption (m3/month) (8)
3	0	7,000	0	0	10	0	7
3	0	7,000	0	0	10	0	8
5	0	5,000	0	0	10	0	8
4	0	4,000	0	0	10	0	9
4	0	6,000	0	0	10	0	9
5	0	7,000	0	0	10	0	10
5	0	8,000	0	0	10	0	15
5	0	6,000	0	0	10	0	15
2	0	3,000	0	0	10	0	16
4	0	7,000	0	0	10	0	16
5	0	4,000	0	0	10	0	16
4	0	6,000	0	0	10	0	17
2	0	4,500	0	0	10	0	17
5	0	4,500	0	0	10	0	17
4	0	6,000	0	0	10	0	19
4	0	7,000	0	0	10	0	20
3	0	8,500	0	0	10	0	21
6	0	4,500	0	0	10	0	21
6	0	6,000	0	0	10	0	21
7	0	7,000	0	0	10	0	22
8	0	6,000	0	0	10	0	22
7	0	4,500	0	0	10	0	22
8	0	6,500	0	0	10	0	23
3	0	5,000	0	0	10	0	23
4	0	6,000	0	0	10	0	24
4	0	5,000	0	0	10	0	24
8	0	7,000	0	0	10	1	30
8	0	9,000	0	0	10	1	31
7	0	13,000	0	0	10	0	37
7	0	9,000	0	0	10	0	38

Remarks : Column (3) : N.A. = not available
Column (2) : 0 = no additional source, 1 = with additional source
Column (4)&(5) : 0 = not available; 1 = available

Table A.2 : Collected household data per individual cell (the housing type E in the urban setting WJ3) (Continued)

Household size (person) (1)	Addit. sources (2)	Electrical bill (Rp) (3)	Flushing toilet (4)	Washing machine (5)	Yard area (m2) (6)	Number of cars (unit) (7)	Household consumption (m3/month) (8)
4	0	14,500	0	0	50	0	8
4	0	8,500	0	0	50	0	9
4	0	25,000	0	0	50	0	10
4	0	5,000	0	0	50	0	12
3	0	15,000	0	0	30	0	12
4	0	15,000	0	0	50	0	13
3	0	14,000	0	0	30	0	13
4	0	13,000	0	0	50	0	13
3	0	17,000	0	0	30	0	14
2	0	12,000	0	0	20	0	14
2	0	11,000	0	0	10	0	14
2	0	9,000	0	0	5	0	15
3	0	17,000	0	0	10	0	15
3	0	12,000	0	0	10	0	15
4	0	9,000	0	0	50	0	15
4	0	14,000	0	0	50	0	16
3	0	15,000	0	0	10	0	16
3	0	14,000	0	0	30	0	16
3	0	4,000	0	0	30	0	17
3	0	8,000	0	0	30	0	17
3	0	11,000	0	0	30	0	23
3	0	18,000	0	0	5	0	24
3	0	21,000	0	0	30	0	25
3	0	16,000	0	0	30	0	27
3	0	6,000	0	0	30	0	27
3	0	19,000	0	0	50	1	30
5	0	11,000	0	0	50	1	31
5	0	16,000	0	0	50	1	32
5	0	21,000	0	0	50	1	32
3	0	25,000	0	0	50	1	33

Remarks : Column (3) : N.A. = not available
Column (2) : 0 = no additional source, 1 = with additional source
Column (4)&(5) : 0 = not available; 1 = available

Table A.2 : Collected household data per individual cell (the housing type F in the urban setting WJ3) (Continued)

Household size (person) (1)	Addit. sources (2)	Electrical bill (Rp) (3)	Flushing toilet (4)	Washing machine (5)	Yard area (m2) (6)	Number of cars (unit) (7)	Household consumption (m3/month) (8)
2	0	23,000	1	0	100	0	19
2	0	17,000	1	0	100	0	19
2	0	13,000	1	0	100	0	20
2	0	14,000	1	0	100	0	21
2	0	19,000	1	0	100	0	21
7	0	40,000	1	0	100	1	28
7	0	100,000	1	0	100	1	31
3	0	30,000	1	0	100	1	33
7	0	80,000	1	0	100	1	33
3	0	40,000	1	0	100	1	34
3	0	35,000	1	0	100	1	34
3	0	24,000	1	0	100	1	37
3	0	25,000	1	0	100	1	38
7	0	N.A.	1	0	100	1	39
7	0	50,000	1	0	100	1	41
7	0	40,000	1	1	100	1	43
7	0	50,000	1	1	100	1	46
7	0	25,000	1	1	100	1	48
7	0	30,000	1	1	100	1	52
7	0	30,000	1	1	100	1	54
5	0	23,000	1	1	100	1	65
5	0	N.A.	1	1	100	1	69
9	0	60,000	1	1	100	1	69
5	0	40,000	1	1	100	1	73
9	0	N.A.	1	1	100	1	75
9	0	35,000	1	1	100	1	77
5	0	N.A.	1	1	100	1	78
9	0	40,000	1	1	100	1	78
9	0	N.A.	1	1	100	1	81
5	0	31,000	1	1	100	1	84

Remarks : Column (3) : N.A. = not available
Column (2) : 0 = no additional source, 1 = with additional source
Column (4)&(5) : 0 = not available; 1 = available

Table A.2 : Collected household data per individual cell (the housing type A in the urban setting WJ4) (Continued)

Household size (person) (1)	Addit. sources (2)	Electrical bill (Rp) (3)	Flushing toilet (4)	Washing machine (5)	Yard area (m2) (6)	Number of cars (unit) (7)	Household consumption (m3/month) (8)
8	0	10,000	0	0	5	0	12
7	0	7,000	0	0	0	0	15
4	0	8,000	0	0	0	0	17
6	0	N.A.	0	0	0	0	17
3	0	7,000	0	0	0	0	19
2	0	4,000	0	0	0	0	19
6	0	6,000	0	0	10	0	22
3	0	5,000	0	0	0	0	24
4	0	4,000	0	0	0	0	25
7	0	8,000	0	0	0	0	27
6	0	13,000	0	0	0	1	27
6	0	18,000	0	0	0	1	27
9	1	13,000	0	0	0	0	27
6	0	7,500	0	0	0	0	27
6	0	7,500	0	0	0	0	28
5	0	7,000	0	0	0	0	29
12	1	12,000	0	0	0	0	31
6	0	7,000	0	0	0	0	33
6	0	9,000	0	0	0	0	33
10	0	9,000	0	0	275	0	33
7	0	13,000	0	0	10	1	33
7	0	15,000	0	0	5	1	34
8	0	7,000	0	0	0	0	35
8	0	9,000	0	0	0	0	39
11	0	N.A.	0	0	0	0	40
4	0	30,000	1	0	5	0	41
8	0	5,000	0	0	0	0	41
4	0	N.A.	0	0	0	0	42
7	0	20,000	0	0	0	1	59
8	1	11,000	0	0	2	0	59

Remarks : Column (3) : N.A. = not available
Column (2) : 0 = no additional source, 1 = with additional source
Column (4)&(5) : 0 = not available; 1 = available

Table A.2 : Collected household data per individual cell (the housing type B in the urban setting WJ4) (Continued)

Household size (person) (1)	Addit. sources (2)	Electrical bill (Rp) (3)	Flushing toilet (4)	Washing machine (5)	Yard area (m2) (6)	Number of cars (unit) (7)	Household consumption (m3/month) (8)
6	1	9,000	1	1	15	1	16
2	0	20,000	1	0	50	0	16
4	0	15,000	0	0	5	0	19
6	0	11,000	0	0	20	0	20
4	0	20,000	1	0	10	0	20
5	0	15,000	1	0	10	0	21
7	0	15,000	0	0	40	1	22
5	0	60,000	1	1	20	1	27
8	0	10,000	0	0	10	0	27
7	0	25,000	0	0	50	1	29
6	0	N.A.	1	1	25	2	30
5	0	15,000	1	0	20	0	31
5	0	15,000	1	0	20	0	31
7	1	20,000	1	1	10	0	31
7	0	8,000	0	0	0	0	33
5	0	10,000	0	0	20	0	33
10	0	N.A.	0	0	0	2	39
6	0	N.A.	0	0	400	1	39
7	0	35,000	0	0	50	1	44
8	0	15,000	1	0	10	1	46
7	0	25,000	0	0	30	1	46
5	0	50,000	0	0	15	1	47
8	1	40,000	1	0	30	1	47
8	1	23,000	1	0	30	1	47
8	0	17,000	1	1	70	1	47
8	0	N.A.	1	1	70	1	47
5	0	20,000	0	0	0	0	49
5	0	9,000	0	0	10	0	52
8	0	20,000	1	1	70	0	54
12	1	30,000	0	0	800	2	107

Remarks : Column (3) : N.A. = not available
Column (2) : 0 = no additional source, 1 = with additional source
Column (4)&(5) : 0 = not available; 1 = available

Table A.2 : Collected household data per individual cell (the housing type C in the urban setting WJ4) (Continued)

Household size (person) (1)	Addit. sources (2)	Electrical bill (Rp) (3)	Flushing toilet (4)	Washing machine (5)	Yard area (m2) (6)	Number of cars (unit) (7)	Household consumption (m3/month) (8)
3	1	15,000	1	0	200	0	24
3	1	25,000	1	0	150	0	25
2	1	20,000	1	0	300	0	26
3	1	30,000	1	0	150	0	27
3	1	25,000	1	0	200	0	28
5	1	45,000	1	0	50	0	28
6	1	30,000	1	0	150	0	29
3	1	25,000	1	0	100	0	29
8	0	40,000	1	1	100	2	35
4	0	40,000	1	1	150	1	40
8	0	N.A.	1	1	200	2	42
5	0	50,000	1	1	50	1	42
4	0	40,000	1	1	100	1	44
6	0	30,000	1	1	200	1	44
7	0	N.A.	1	1	150	2	47
9	1	N.A.	1	1	100	2	54
5	0	N.A.	1	1	100	1	56
9	1	40,000	1	1	100	2	58
8	0	50,000	1	1	100	2	59
5	0	N.A.	1	1	100	1	62
5	0	30,000	1	1	250	1	63
5	0	25,000	1	1	300	1	63
5	0	45,000	1	1	300	1	63
9	1	30,000	1	1	500	2	64
5	0	30,000	1	0	100	2	65
9	1	60,000	1	1	150	2	65
5	0	50,000	1	0	250	2	69
9	1	30,000	1	1	250	2	72
5	0	60,000	1	0	150	2	74
5	0	60,000	1	0	150	2	79

Remarks : Column (3) : N.A. = not available
Column (2) : 0 = no additional source, 1 = with additional source
Column (4)&(5) : 0 = not available; 1 = available

Table A.2 : Collected household data per individual cell
(the housing type D in the urban setting WJ4)
(Continued)

Household size (person) (1)	Addit. sources (2)	Electrical bill (Rp) (3)	Flushing toilet (4)	Washing machine (5)	Yard area (m2) (6)	Number of cars (unit) (7)	Household consumption (m3/month) (8)
5	0	8,000	0	1	5	0	10
5	0	5,000	0	1	20	0	11
3	0	6,000	0	0	0	0	12
5	0	7,000	0	0	5	0	17
12	0	30,000	0	0	0	0	17
5	0	16,000	0	0	10	0	18
4	0	5,000	1	0	0	0	19
5	0	7,000	0	0	10	0	19
7	0	6,000	0	0	5	0	19
2	0	4,000	0	0	10	0	20
7	0	9,000	0	0	10	0	20
5	0	9,000	0	1	20	1	20
12	0	13,000	0	0	10	0	20
2	0	5,000	0	0	30	0	21
4	0	11,400	1	0	0	0	21
4	0	7,000	1	0	0	0	22
5	0	7,000	0	1	15	1	22
5	0	9,000	0	1	5	1	22
3	0	4,500	0	0	0	0	24
8	0	15,000	0	0	10	0	27
8	0	12,000	0	0	5	0	28
8	0	15,000	0	0	10	0	30
6	0	12,000	0	1	15	0	30
6	0	12,000	0	1	10	0	31
6	0	8,000	0	1	5	0	32
5	0	11,000	0	0	5	0	35
5	0	17,000	0	0	5	0	36
9	0	20,000	0	0	5	2	52
9	0	7,000	0	0	0	2	57
9	0	20,000	0	0	10	2	60

Remarks : Column (3) : N.A. = not available
Column (2) : 0 = no additional source, 1 = with additional source
Column (4)&(5) : 0 = not available; 1 = available

Table A.2 : Collected household data per individual cell (the housing type E in the urban setting WJ4) (Continued)

Household size (person) (1)	Addit. sources (2)	Electrical bill (Rp) (3)	Flushing toilet (4)	Washing machine (5)	Yard area (m2) (6)	Number of cars (unit) (7)	Household consumption (m3/month) (8)
4	0	9,000	0	0	15	0	7
4	0	13,000	0	1	20	1	10
4	0	6,000	0	0	15	0	11
4	0	16,000	0	0	20	0	12
5	0	9,000	0	0	10	0	16
4	0	10,000	0	1	40	1	16
4	0	12,000	0	1	30	1	18
4	0	11,000	0	1	20	1	18
5	0	21,000	0	0	20	1	22
6	0	22,000	0	0	25	0	23
5	0	N.A.	0	0	20	1	23
6	0	9,000	0	0	15	0	23
6	0	17,000	0	0	15	0	23
6	0	15,000	0	0	30	0	24
5	0	10,000	1	1	15	1	25
5	0	11,000	1	1	20	1	26
5	0	16,000	1	1	30	1	27
5	0	15,000	1	1	15	1	28
4	0	15,000	0	0	30	1	28
4	0	9,000	0	0	10	1	31
5	0	15,000	0	0	20	1	32
4	0	12,000	0	0	10	1	33
5	0	13,000	0	0	30	1	33
4	0	16,000	0	0	20	1	33
5	0	14,000	0	0	20	0	34
5	0	20,000	0	0	20	0	35
5	0	20,000	0	0	10	0	51
5	0	16,000	0	0	40	1	66
5	0	12,000	0	0	20	1	69
5	0	27,000	0	0	50	1	77

Remarks : Column (3) : N.A. = not available
Column (2) : 0 = no additional source, 1 = with additional source
Column (4)&(5) : 0 = not available; 1 = available

Table A.2 : Collected household data per individual cell (the housing type F in the urban setting WJ4) (Continued)

Household size (person) (1)	Addit. sources (2)	Electrical bill (Rp) (3)	Flushing toilet (4)	Washing machine (5)	Yard area (m2) (6)	Number of cars (unit) (7)	Household consumption (m3/month) (8)
5	1	N.A.	1	0	100	1	16
2	0	25,000	1	1	40	1	22
3	0	N.A.	1	1	40	1	22
4	0	15,000	1	1	40	1	23
3	0	N.A.	1	1	80	1	23
5	0	20,000	1	1	100	1	23
3	0	30,000	1	1	50	1	25
5	1	N.A.	1	0	100	1	29
3	0	30,000	1	1	200	1	29
6	0	17,000	1	1	150	1	29
3	0	35,000	1	1	70	1	30
6	0	25,000	1	1	70	1	32
3	0	25,000	1	1	70	1	32
5	1	55,000	1	0	200	1	33
5	1	35,000	1	0	250	1	34
5	1	N.A.	1	0	100	1	35
7	0	45,000	1	0	60	1	35
5	1	40,000	1	0	150	1	36
8	0	30,000	1	0	250	1	38
3	0	20,000	1	1	200	1	38
7	0	50,000	1	0	300	1	39
8	0	25,000	1	0	150	1	41
6	0	60,000	1	0	150	1	44
8	0	25,000	1	0	200	1	46
7	0	50,000	1	1	150	2	55
9	0	20,000	1	1	40	2	58
7	0	40,000	1	1	100	2	62
10	0	30,000	1	1	150	2	96
7	0	45,000	1	1	80	2	110
6	0	25,000	1	1	100	2	116

Remarks : Column (3) : N.A. = not available
Column (2) : 0 = no additional source, 1 = with additional source
Column (4)&(5) : 0 = not available; 1 = available

Appendix B

Table B.1 : Test of fit model without interaction among factors of CLASS, PERSON, AND SOURCE for Malang's samples.

DEGREES OF FREEDOM = 137
PEARSON CHI-SQUARE = 311.22 PROBABILITY = .000
LIKELIHOOD RATIO CHI-SQUARE = 218.43 PROBABILITY = .000
RAFTERY BIC = -493.00
INDEX OF DISSIMILARITY = 39.99

Table B.2 : Matrixes of Tukey's pairwise comparison probabilities per individual towns

(a) **WJ1** (Arjawinangun)

USING LEAST SQUARES MEANS.
POST HOC TEST OF 'per capita consumption'
USING MODEL MSE OF .150485 WITH 49. DF.

	A	D
A	1.000	
D	0.800	1.000

(b) **WJ2** (Sumedang)

USING MODEL MSE OF .196774 WITH 73. DF.

	A	B	D
A	1.000		
B	0.036	1.000	
D	0.429	0.002	1.000

(c) **WJ3** (Cirebon)

USING MODEL MSE OF .116470 WITH 164. DF.

	A	B	C	D	E	F
A	1.000					
B	0.000	1.000				
C	0.000	0.055	1.000			
D	1.000	0.000	0.000	1.000		
E	0.036	0.250	0.000	0.056	1.000	
F	0.000	0.014	0.961	0.000	0.000	1.000

(d) **WJ4** (Bogor)

USING MODEL MSE OF .139761 WITH 163. DF.

	A	B	C	D	E	F
A	1.000					
B	0.788	1.000				
C	0.000	0.000	1.000			
D	0.124	0.002	0.000	1.000		
E	0.995	0.501	0.000	0.373	1.000	
F	0.009	0.221	0.301	0.000	0.003	1.000

Table B.2 : Matrixes of Tukey's pairwise comparison probabilities per individual towns (continued..)

(e) **EJ1** (Mangli)

USING MODEL MSE OF .144444 WITH 51. DF.

	A	D
A	1.000	
D	0.883	1.000

(f) **EJ2** (Sitobondo)

USING MODEL MSE OF .145199 WITH 107. DF.

	A	B	D	E
A	1.000			
B	0.063	1.000		
D	0.552	0.001	1.000	
E	0.059	0.468	0.023	1.000

(g) **EJ3** (Pasuruan)

USING MODEL MSE OF .170041 WITH 108. DF.

	A	B	D	E
A	1.000			
B	0.041	1.000		
D	0.344	0.000	1.000	
E	0.052	0.214	0.018	1.000

Table B.3 : Matrixes of Tukey's pairwise comparison probabilities per individual housing types

(a) Type **B**

USING LEAST SQUARES MEANS.
POST HOC TEST OF 'per capita consumption'
USING MODEL MSE OF .160059 WITH 164. DF.

Town	EJ2	EJ3	EJ4	WJ2	WJ3	WJ4
EJ2	1.000					
EJ3	0.601	1.000				
EJ4	0.001	0.244	1.000			
WJ2	1.000	0.677	0.003	1.000		
WJ3	0.000	0.118	0.999	0.001	1.000	
WJ4	0.021	0.743	0.977	0.057	0.908	1.000

(c) Type **C**

USING MODEL MSE OF .066942 WITH 76. DF.

Town	EJ4	WJ3	WJ4
EJ4	1.000		
WJ3	0.789	1.000	
WJ4	0.814	0.997	1.000

(d) Type **D**

USING MODEL MSE OF .138696 WITH 223. DF.

Town	EJ1	EJ2	EJ3	EJ4	WJ1	WJ2	WJ3	WJ4
EJ1	1.000							
EJ2	0.973	1.000						
EJ3	0.773	1.000	1.000					
EJ4	0.998	0.122	0.190	1.000				
WJ1	0.929	1.000	1.000	0.040	1.000			
WJ2	1.000	0.837	0.831	0.897	0.638	1.000		
WJ3	1.000	0.407	0.494	0.999	0.200	0.997	1.000	
WJ4	0.666	0.000	0.002	0.629	0.000	0.037	0.233	1.000

Table B.3 : Matrixes of Tukey's pairwise comparison probabilities per individual housing types (continued)

(e) Type **E**

USING MODEL MSE OF .158834 WITH 138. DF.

Town	EJ2	EJ3	EJ4	WJ3	WJ4
EJ2	1.000				
EJ3	1.000	1.000			
EJ4	0.007	0.067	1.000		
WJ3	0.997	1.000	0.019	1.000	
WJ4	0.020	0.472	0.967	0.128	1.000

(f) Type **F**

USING MODEL MSE OF .075225 WITH 78. DF.

Town	EJ4	WJ3	WJ4
EJ4	1.000		
WJ3	0.603	1.000	
WJ4	0.905	0.318	1.000

Table B.4.a : ANOVA Table of log(electrical bill) by housing type, and

DEP VAR : LEBILL N : 808
MULTIPLE R : 0.678 SQUARED MULTIPLE R : 0.460

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
CLASS$	234.7409	5	46.9482	136.7180	0.0000
ERROR	275.4022	802	0.3434		

Table B.4.b : Tukey's matrix of pairwise comparison probabilities

POST HOC TEST OF 'electrical bill'
USING MODEL MSE OF .343394 WITH 802. DF.

Housing type	A	B	C	D	E	F
A	1.0000					
B	0.0000	1.0000				
C	0.0000	0.0000	1.0000			
D	0.0966	0.0000	0.0000	1.0000		
E	0.0000	0.0081	0.0000	0.0000	1.0000	
F	0.0000	0.0123	0.0000	0.0000	0.0000	1.0000