*Journal of Global Environment Engineering*, Vol. 12, pp.33-49, 2007

# A CASE STUDY ON THE BENIFIT TO THE RELATIVELY POOR AT ODA WATER SUPPLY PROJECTS IN KENYA

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## Abstract

Even though water is a basic human need, the poor cannot access the basic water requirement for various reasons. This study therefore investigated the benefit of Official Development Assistance (ODA) funded water supply projects to society with a view to clarifying differences in water usage characteristics between the poor and not poor in both rural and urban areas. The poor were defined by the concept of relative poverty as those with income less than 50 % of the median for the entire population. It became clear that there are differences between the poor and not poor in terms of water use characteristics.

KEYWORDS: *relative poverty, poverty rate, water consumption, ODA, water supply project.*

## 1. Introduction

Official Development Assistance (ODA) plays an important role in providing access to safe water in developing countries. Despite the efforts to provide safe water, statistics show that in 2002 more than 1.1 billion people in the world did not have access to improved drinking water sources defined as house connection, public standpipe, borehole, protected dug well, protected spring, and rainwater (WHO and UNICEF, 2004). In the Millennium Development Goals (MDGs), the international community has set to halve the number of the poor and those without access to safe water by 2015 as the first and eighth targets, respectively. There is no doubt that achievement of the MDGs is closely

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related to ensuring access to safe water for all, especially the poor who tend to be disadvantaged in society.

It is for this reason that water supply is one of the top priorities in ODA. Many ODA funded water supply projects are being implemented in developing countries and studies focusing on evaluating the impact of these projects have been undertaken (Yamada *et. al.*, 1999, 2000, 2001, 2003a,b, 2004; Saheki *et. al.*, 2005).

However, none of these studies have focused on understanding the benefit of the projects to the poor in society. As an indication of our progress towards achieving the MDG targets, it is important to focus also on the benefit to the poor in society, since achieving the targets will greatly depend on how far this disadvantaged group benefits from development interventions. For this reason this study focused on clarifying differences in water use characteristics between the poor and not poor among beneficiaries of ODA funded water supply projects.

Absolute poverty rate is commonly used for estimating poverty in developing countries. United Nations defines poverty and extreme poverty lines as US$2/capita/day and US$1/capita/day, respectively. The number of people living on less than US$1 a day was 1.14 billion in 2005 (United Nations, 2005). However, these poverty lines are defined differently by different researchers and organizations. For example, Mizoguchi and Matsuzono (1997) defined US$370/capita/day as poverty and US$275/capita/year as extreme poverty based on equivalent purchasing power. If absolute poverty is used as a standard, the poor are more in rural areas where the mean income is low than in urban areas where the mean income is high. The concept of absolute poverty is used to grasp poverty internationally and globally. For analysis in this paper, the concept of absolute poverty is not used. Instead, the authors use relative poverty as discussed below.

Organization of Economic Cooperation and Development (OECD) adopts relative poverty rate to compare the poor with the not poor. Relative poverty rate is defined as the share of individuals with equivalized disposable income less than 50 % of the median for the entire population (OECD, 2005). This poverty rate is based on relative poverty concept at regions, nations, districts, and towns. According to the concept, even in rich countries where absolute poverty does not exist, there are necessarily the relatively poor. This study adopted the concept of relative poverty to analyze differences in water usage characteristics between the poor and the not poor at ODA water supply projects. Indicators incorporating relative poverty were developed and significant differences were found between the poor and not poor. ODA must meet the needs of the poor. The study demonstrates the need to consider indicators of the relative poverty. Generally, at ODA funded projects, outcomes have been evaluated at average levels for all beneficiaries. By using relative poverty as a standard, it is possible to undertake more detailed analysis of the beneficiaries.

## 2. Methodology

### 2.1 Field Survey

Field surveys were undertaken at five water supply projects in the Republic of Kenya in August and October 2005. The five projects were funded by ODA and other International Non Profit Organizations. Three of the project areas are rural, and two are urban. The project areas are located in Eastern and Central Provinces in Kenya (Figure 1). Generally, Kenya is a dry country with annual

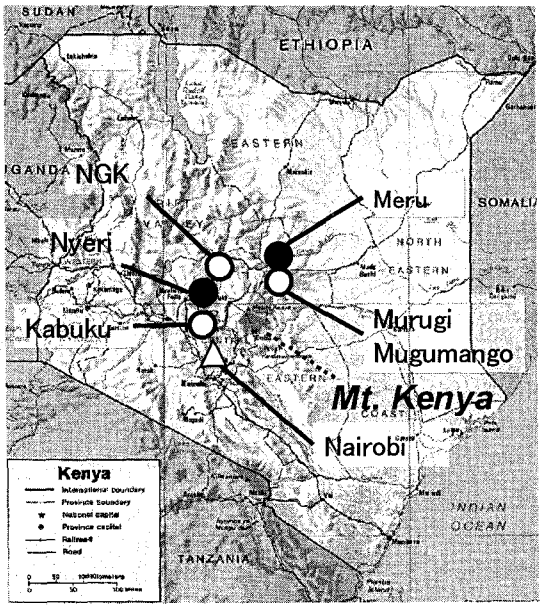



Figure 1. Five targeted areas around Mt. Kenya in the Republic of Kenya

Table 1. Water supply projects surveyed in Kenya

| Projects [1] | Kabuku | MM | NGK | Meru | Nyeri Area1 | Nyeri Area 2 |
|---|---|---|---|---|---|---|
| Collected questionnaire | 106 | 87 | 140 | 70 | 38 | 72 |
| Province | Central | Eastern | Central | Eastern | Central | |
| District | Kiambu | Meru South | Nyeri | Meru Central | Nyeri | |
| Charactoristic of area | Rural | Rural | Rural | Urban | Urban | |
| Water Source | Protected Spring | River | River | River | River | |
| Water Transport System | Pumping | Gravity | Gravity | Pumping | Pumping | |
| Water Intake capacity ($m^3$/d) | 125 | 3,100 | 1,903 | 4,000 | 9,000 | |
| WTP [2] capacity ($m^3$/d) | N/A | N/A | N/A | 4364 | 8071 | |
| No. of connections | 4,000 | 2,882 | 700 | 320 | 9,109 | |
| Served population | 6,000 | 40,000 | 5,000 | 31,000 | 63,500 | |
| Coverage (%) | 35.6 | 80 | 85 | 62.3 | 50 | |
| Revenue (million Ksh) [3] | 2.67 | 0.25 | na | 59.7 | 7.99 | |
| Initial costs (million Ksh) [3] | 4.1 | 3.4 | 4 | 890 | na | |
| Main donors [4] | SIDA | CHF | ADF | MOFA | KfW | |
| Operation body [5] | Community | Community | Community | MEWASS | NYEWASCO | |

[1] MM: Murugi Mugumango Water Society, NGK: Njogu-Ini Gitero Kabati Water Project (No water meters)

[2] WTP: Water Treatment Plant. N/A: Not Aplicable

[3] Ksh: Kenya Shilling, (US$1 was equivalent to Ksh 73 in August 2005)

[4] SIDA: Swedish International Development Agency, CHF: Canada Hunger Foundation, ADF: African Develc ment Foundation, MOFA: Ministry of Foreign Affairs( Japan), KfW: Kreditanstalt fur Wiederaufbau (German

[5] MEWASS: Meru Water and Sewrage Service. NYEWASCO: Nyeri Water Supply and Sewarage Company.

precipitation of 762mm (Jomo Kenyatta International Airport Meteorology Station, 1969-1980) in Nairobi. Details of the projects surveyed are shown in Figure 1 and Table 1. The targeted areas were 5 towns around Mt. Kenya. Meru South and Meru Central districts are benefited with rainfall of mean 1259mm (Meru Meteorology Station, 1975-1980).

The study methods included: 1) Interview with people and organizations concerned with the projects including government and non governmental organizations, and officers in charge of water supply systems, 2) Water supply facility inspection, 3) Water quality analysis from the water sources to the taps for biological, physical and chemical quality, and 4) Questionnaire survey to project beneficiaries. Collected questionnaire numbers are shown in Table 1. Nyeri was divided into two areas, namely Area 1 which is the new town and was connected to the water supply in the last 2-5 years and Area 2 which is the old town and was connected to the water supply more than 10 years ago.

### 2.2 Poverty rate

As mentioned above, the OECD concept of relative poverty (OECD, 2005) was adopted in this study to determine the poverty line. The poverty line was defined as 50 % of the median income of the surveyed sample, with the poverty rate corresponding to share of individuals with income below this line. The samples were divided into the poor (those with income below the poverty line) and the not poor (those with income above the poverty line). Income was analyzed in terms of individual income and income divided by square root of the number of family members as suggested by OECD. Analysis of variance (ANOVA) was used to check statistically the differences in water use characteristics between the poor and the rest (not poor). From here, "the poor" and " the rest" are pair words. The concept of relative poverty assumes normal distribution which is adapted to the natural world and the OECD uses it to make comparisons among developed countries. However, income distribution is not necessarily normal even in developed country. Within these limitations, the concept was applied to developing countries in this study.

## 3. Results

### 3.1 Poverty rate

#### (1) Household income

Income distribution at the surveyed project sites was obtained from questionnaire survey data. Figure 2 shows the distribution of the household (HH) income (Currency exchange rate as of August 2005 was US$ 1 = Ksh 73). Figure 2 shows the mean incomes which are the means of the income brackets used in the questionnaire survey.

According to the household income distribution, the survey areas can be divided into three categories socio-economically, namely typical rural type at Murugi Mugumango (MM) and Njogu-Ini Gitero and Kabati (NGK), typical urban type at Meru and Nyeri Area 2, and intermediate type between rural and urban at Kabuku and Nyeri Area1. The former town is located close to Nairobi (around 20 km away), and the latter town is newly served with house connection next to old town. The income distribution shows that in rural areas, not only the average income is lower than in urban areas, but also the distribution is less normal and concentrated in the lower income bracket. Urban

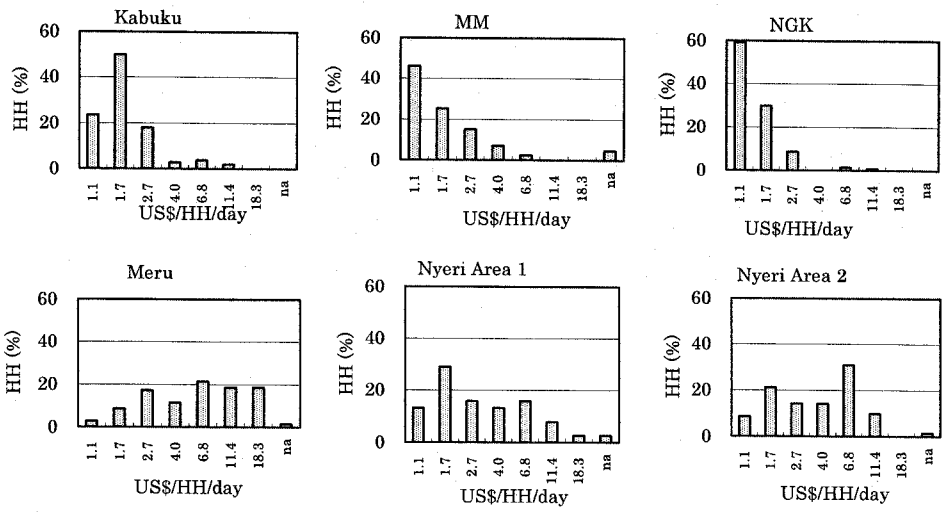



Figure 2. Daily household income distribution (US$/HH/day)

income has symmetrical distribution with two peaks.

As shown in Figure 2, the same 7 income brackets were used at all areas in the questionnaire survey irrespective of whether they were rural or urban. We had expected that the seven income brackets were suitable for all the survey areas but the results showed that incomes at rural areas were lower than our anticipation. The poor people concentrated at the lowest income bracket in the rural areas, so it was difficult to draw sufficient data below the relative poverty line of 50% of the median of household income. Therefore household income data was not used for comparison between the poor and the rest.

(2) Income divided by square root of number of family members

As was mentioned above, OECD suggests the use of income divided by the square root of number of family members for comparison purposes. However, as for the case of household income, it was difficult to draw sufficient data below the relative poverty line of 50% of the median of household income divided by the square root of number of family members. Therefore this approach was not used in this study.

(3) Individual income

Because of the difficulty with drawing sufficient data as described above, an attempt was made to use individual income (household income per capita) for analysis. In order to look at the poor in detail, the brackets for individual income were increased from the 7 used in the questionnaire survey for household income to 14.

Using this approach, it was possible to obtain data below 50 % of the median for all the areas except MM. Use of 60 % median as the poverty line has been researched by other authors (OECD, 2005, Yoshioka, 1997). When this was applied to MM data, it was possible to obtain sufficient data below the poverty line for MM. No significant differences were observed between the 50 % median and 60 % median for the other 4 projects. Therefore, based on the OECD method, this study adopted 50 % median for the 4 projects and 60 % median for MM.

Individual income distributions are shown at Figure 3. The data were divided into two categories of the poor and not poor according to the poverty line defined above.

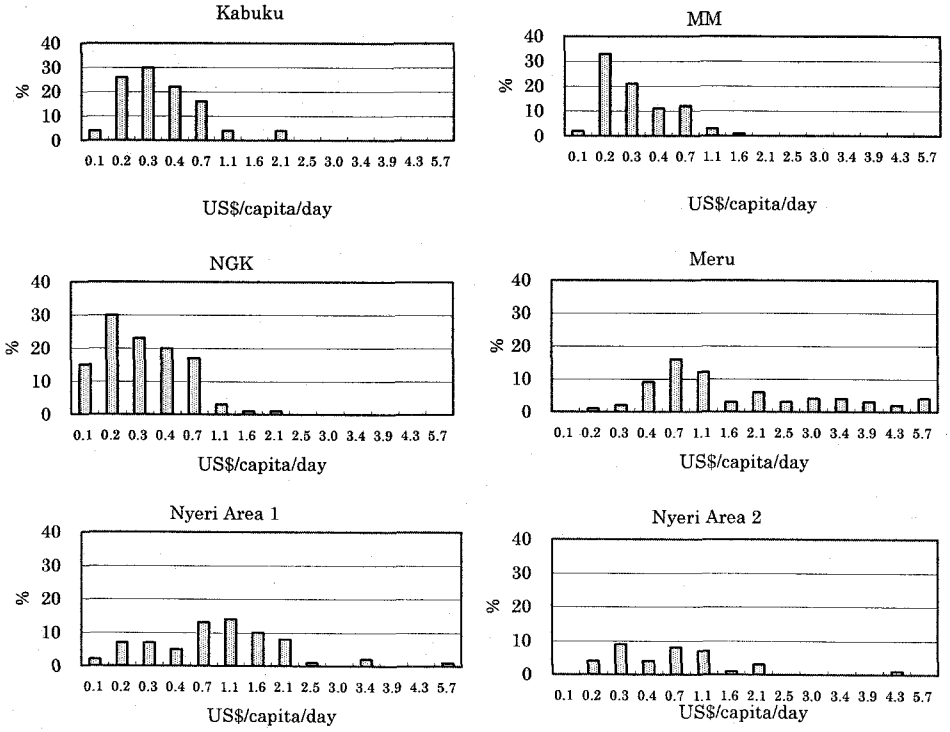



Figure 3. Daily individual income distribution (US$/capita/day)

### 3.2 Factors affecting water consumption

ANOVA was applied to the data to analyze the differences between the two categories. Table 2 shows the household income and the results of ANOVA that are discussed below.

Income/capita, farmland size/capita, and weighted livestock/capita are supposed to be factors that affect water consumption (L/c/d) in developing countries. The differences in farmland size per capita and weighted livestock per capita between the poor and the rest were investigated using ANOVA. Weighted livestock per capita was determined from unit watering volume, which was set as 30 L/cow/day (International Welfare Agency, 1999). The results of ANOVA are shown in Table 2. There was significant difference in weighted livestock between the poor and the rest at Kabuku and NGK. At NGK, farmland size was significantly different between the poor and the rest.

Table 2. ANOVA test results of the difference between the poor and the rest

| Parameters | | Kabuku | | MM | | NGK | | Meru | | Nyeri Area1 | | Nyeri Area2 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Monthly HH income | US$/HH/d | 2.2 | | 1.9 | | 1.6 | | 8.2 | | 4.2 | | 4.7 | |
| Monthly individual income | US$/c/d | 0.46 | | 0.35 | | 0.32 | | 2.04 | | 0.85 | | 1.16 | |
| Coefficient of variation [1] | | 39 | | 63 | | 75 | | 71 | | 90 | | 66 | |
| Water consumption (L/c/d) | P value [2] | 0.054 | * | 0.089 | * | - | | 0.125 | | 0.172 | | 0.215 | |
| | The poor | 26.1 | | 138 | | 78.9 | | 35.8 | | 35.8 | | 79.3 | |
| | The rest | 64.7 | | 257 | | 114 | | 89.2 | | 89.2 | | 116 | |
| Family size (member) | P value | 0.000 | *** | 0.000 | *** | 0.000 | *** | 0.005 | *** | 0.009 | *** | 0.000 | *** |
| | The poor | 12.3 | | 9.1 | | 9.2 | | 6.8 | | 6.8 | | 8.3 | |
| | The rest | 5.3 | | 5.5 | | 4.6 | | 4.9 | | 4.9 | | 4.1 | |
| Members/water taps [3] | P value | 0.000 | *** | 0.000 | *** | 0.000 | *** | *0.003* | *** | *0.501* | | 0.000 | *** |
| | The poor | 12.3 | | 8.5 | | 5.7 | | *3.7* | | *3.7* | | 5.6 | |
| | The rest | 5.1 | | 5.1 | | 2.6 | | *4.2* | | *4.2* | | 2.4 | |
| Room (numbers/c) | P value | 0.003 | *** | 0.170 | | 0.000 | *** | 0.011 | ** | 0.600 | | 0.006 | *** |
| | The poor | 0.26 | | 0.48 | | 0.70 | | 0.93 | | 0.93 | | 0.59 | |
| | The rest | 0.76 | | 0.69 | | 1.42 | | 1.02 | | 1.02 | | 1.10 | |
| Farmland size (ha/c) | P value | 0.796 | | 0.152 | | 0.035 | ** | 0.868 | | 0.455 | | 0.539 | |
| | The poor | 0.13 | | 0.22 | | 0.09 | | 0.17 | | 0.17 | | 0.06 | |
| | The rest | 0.16 | | 0.39 | | 0.08 | | 0.30 | | 0.30 | | 0.08 | |
| Weighted livestock (numbers/c) | P value | 0.052 | * | 0.238 | | 0.042 | ** | 0.641 | | 0.149 | | 0.979 | |
| | The poor | 0.21 | | 0.35 | | 0.27 | | 0.33 | | 0.33 | | 0.21 | |
| | The rest | 0.49 | | 0.93 | | 0.34 | | 0.87 | | 0.87 | | 0.21 | |

[1] Coefficient of variation: standard deviation/average.on household monthly income

[2] P values and symbols: Probability value P<0.1*, P<0.05**, P<0.01*** are 90%, 95%, and 99% confident level statistically. 0.6*median is used only at MM, because data are too few below the 0.5*median

[3] *Italic numbers* are reverse trends.

Multiple Regression Analysis (MRA) was used to analyze water consumption, income, farmland size and weighted number of livestock. Relatively higher correlation was obtained in urban areas with Nyeri Area 1 having the highest coefficient of determination of 0.81. It should be noted that except for NGK all water consumption data used were metered data. At NGK, as there are no meters, the water consumption data used were estimated from questionnaire data of use frequency. With this consumption, the three factors showed relatively high coefficient of determination of 0.28. At Kabuku, MM and Nyeri Area 2, the three factors had relatively lower coefficient of determination of less than 0.10. So in these areas, there may be more factors affecting water consumption.

In rural areas, the results show that water consumption (L/c/d) does not mainly depend on the size of farmland. They did not irrigate all farmlands. It may depend on other factors such intensive usage of land. In all the rural projects surveyed, only small-scale irrigation (garden irrigation) is allowed. At NGK, "drip" irrigation consisting of a rubber hose with small holes is used mainly. This saves water more than sprinkler. The use of water for irrigation was rationed. Other than NGK, farmers use sprinkler irrigation. Additions to water supply, farmers make use of rainwater for irrigation.

Table 3. MRA [1] coefficient of 3 factors on water consumption (L/c/d)

| | | Kabuku | MM [2] | NGK [3] | Meru | Nyeri Area 1 | Nyeri Area 2 |
|---|---|---|---|---|---|---|---|
| Income US$/c | The poor | -0.048 | - | 0.076 | 0.004 | -0.069 | 0.007 |
| | The rest | 0.003 | 0.021 | -0.011 | 0.005 | 0.047 | -0.006 |
| Farmland size ha/c | The poor | 12.1 | - | 60.0 | -178.2 | 5.1 | 84.0 |
| | The rest | -21.8 | -5.9 | 146.1 | -202.4 | 67.7 | 13.3 |
| Weighted livestock/c | The poor | -11.6 | - | 27.6 | 86.8 | 26.8 | 8.5 |
| | The rest | 28.8 | 9.7 | -2.4 | 114.2 | -14.6 | 26.3 |
| Interceptor | The poor | 39.8 | - | 10.5 | 74.6 | 62.8 | 72.7 |
| | The rest | 49.1 | 213.2 | 41.7 | 62.2 | -17.7 | 131.0 |
| R2 Coefficient of determination | The poor | 0.024 | - | 0.526 | 0.318 | 0.466 | 0.038 |
| | The rest | 0.058 | 0.018 | 0.282 | 0.387 | 0.807 | 0.031 |

[1] MRA:Multiple Regression Analysis

[2] MM did not have sufficient data for calculation.

[3] Even though NGK has no meters, an atempt was made to calculate the water consumption before the project.

### 3.3 Situation before project implementation in rural area

#### (1) Water sources

Figure 4 shows the mainly used sources of water (main source) and other sources (sub source) in the surveyed areas before the water supply projects.

As can be seen in the figure, many households depended on more than one source. There are no so significant differences between the poor and the rest. At Kabuku and MM projects, main sources were spring and river and the sub resource was rainwater. At NGK project, the main source was the river and there was no sub source. This is because NGK is located in a very dry area with river water as the only available water source.

#### (2) Labor for drawing water

The distance walked and time spent to draw water are shown in Table 4. Average total time (hr/HH/d), total distance (km/HH/d), and volume (L/HH/d) were 3.6 hours, 13 km, and 150 L (150 kg) for the poor, respectively. These amounts were 1.1 – 1.3 times higher than the corresponding amounts for the rest.

#### (3) Water consumption

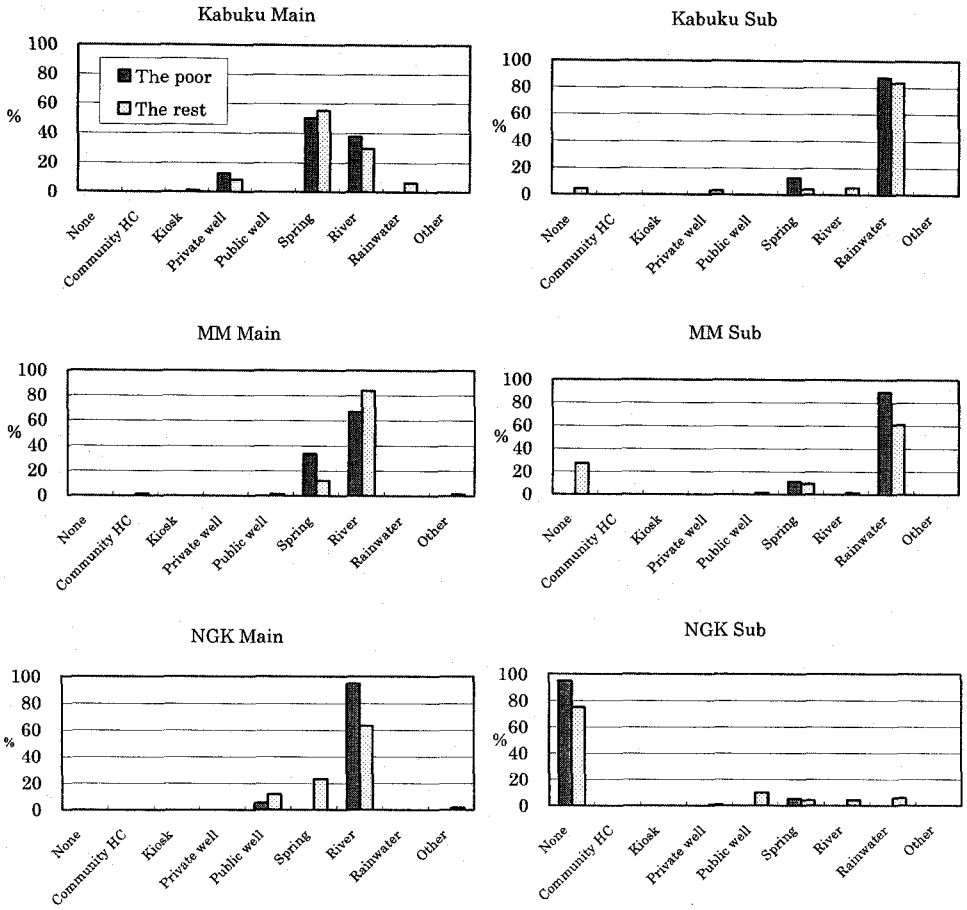
In rural areas, before the present water supply projects, people had depended on water sources such as rivers, springs and public wells. Unit water consumptions before the projects are shown in Table 4 and Figure 5.

Table 4. Labor for water (L/HH) and consumption (L/c/d) before the projects

| | | Total daily time spent (hr/HH/d) [1] | Round trip distance (km/HH/d) [2] | Volume of water drawn (L/HH/d) | Water consumption (L/c/d) |
|---|---|---|---|---|---|
| Kabuku (rural) | The poor | 2.8 | 8.6 | 291.3 | 22.3 |
| | The rest | 3.5 | 11.6 | 148.5 | 30.0 |
| MM (rural) | The poor | 3.5 | 12.1 | 122.2 | 14.4 |
| | The rest | 3.0 | 10.2 | 115.7 | 23.6 |
| NGK (rural) | The poor | 4.6 | 18.3 | 35.6 | 2.9 |
| | The rest | 3.3 | 11.9 | 91.5 | 20.7 |
| Average (rural) | The poor | 3.6 | 13.0 | 149.7 | 13.2 |
| | The rest | 3.2 | 11.2 | 118.6 | 24.8 |

[1] Time includes waiting time for turn.

[2] Round trip distance is calculated with speed of 4km/hr.




Kiosk is a water selling point with meter managed by person for the poor who do not have house connection. Kiosk water is more expensive than house connection at unit volume. Community HC is by community projects.

Figure 4. Main water sources (left) and sub sources (right) before the projects

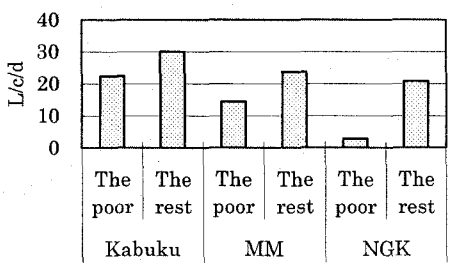



Figure 5. Water consumption (L/c/d) in rural area before the projects

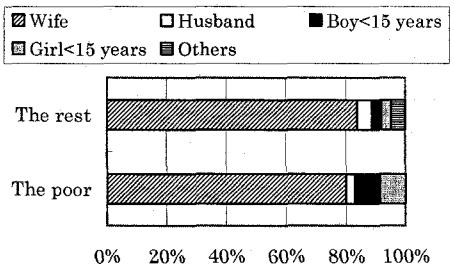



Figure 6. Main water transporters in rural area before the projects

At the three projects in rural areas, the consumption for the poor was 3 - 22 L/c/d. On average, the water consumption of the not poor people was 1.9 times higher than that of the poor. Water consumption at NGK was the lowest. Even the rest (not poor) could use only 20 L/c/d on average before the project.

(4) Transporters of water

Main transporters of water are shown at Figure 6. Housewives occupied at 80 % approximately. In rural area, the transporters other than housewife were mainly occupied by children less than 15 years. In the rest, less than 15 year children's share was less than that of the poor. The projects liberated housewives and children from drawing water generally.

3.4 Situation after project implementation

(1) All seasons

The metered water consumption from project source (house connection) is shown in Table 5 (data for NGK were not available).

Table 5. Monthly average metered water consumption (L/c/d) with house connection

| Year month | | 2004.9 | 10 | 11 | 12 | 2005.1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Kabuku | The poor | 33 | 35 | 11 | 35 | 37 | 33 | 26 | 27 | 19 | 17 | 22 | 20 | 25 |
| | The rest | 89 | 79 | 20 | 71 | 82 | 80 | 73 | 75 | 50 | 51 | 54 | 53 | 71 |
| MM | The poor | 200 | 129 | 60 | 74 | 225 | 174 | 98 | 137 | 67 | 113 | 90 | 138 | 291 |
| | The rest | 362 | 280 | 91 | 93 | 390 | 272 | 260 | 240 | 142 | 283 | 223 | 343 | 434 |
| Meru | The poor | 33 | 49 | 51 | 93 | 56 | 63 | 81 | 74 | 69 | 72 | 114 | 106 | 105 |
| | The rest | 108 | 102 | 114 | 133 | 108 | 94 | 129 | 107 | 107 | 109 | 147 | 118 | 118 |
| Nyeri | The poor | 47 | 35 | 26 | 40 | 39 | 63 | 26 | 35 | 39 | 30 | 27 | 29 | 38 |
| Area 1 | The rest | 71 | 77 | 55 | 85 | 71 | 113 | 71 | 83 | 78 | 60 | 68 | 68 | 82 |
| Nyeri | The poor | 82 | 74 | 55 | 84 | 84 | 115 | 79 | 66 | 84 | 76 | 53 | 57 | 76 |
| Area 2 | The rest | 139 | 141 | 94 | 123 | 123 | 136 | 122 | 107 | 136 | 110 | 91 | 111 | 120 |

At Kabuku project, the poor could not get from the project more 20 L/c/d of water (the basic water requirement) for three months. Generally, all projects can supply water throughout the year in spite of dry seasons. Using yearly average data (Table 2), there were no significant differences between water consumption for the poor and the rest.

Table 6 shows the results of ANOVA based on monthly water consumption data. The differences in monthly water consumption between the poor and the rest are significant (P value < 0.01) in all projects. In all areas, individual consumptions for the poor are less than 40 – 65 % of those for the rest. The difference is larger in urban areas than in rural areas.

The number of water taps per household member is an important indicator of convenience. These data are shown in Table 2. The poor have fewer water taps per capita than the rest, indicating that the poor are more inconvenienced than the rest.

Table 6. The results of ANOVA for monthly average water consumption (L/c/d)

| Project | P value | | Average consumption (L/c/d) | | |
|---|---|---|---|---|---|
| | | | The poor (a) | The rest (b) | a/b |
| Kabuku | 0.001 | *** | 26 | 65 | 0.40 |
| MM | 0.009 | *** | 138 | 262 | 0.53 |
| Meru | 0.002 | *** | 74 | 115 | 0.65 |
| Nyeri Area 1 | 0.000 | *** | 36 | 75 | 0.48 |
| Nyeri Area 2 | 0.001 | *** | 76 | 120 | 0.63 |

Poverty line is set at 0.5*median of individual income except for MM where 0.6*median is used.

(2) Dry seasons

In Kenya, there are two dry seasons from June to October and from January to February. Rainfall is especially low between July and August. Project water supply decreases in the dry season and therefore people have to depend on alternative sources (sub sources) such as rivers, springs, wells or other community water supply projects. The ratio of users of sub sources and consumption (L/c/d) from sub sources are shown in Table 7 and Figure 7.

Table 7. Labor for drawing water (L/HH/d, hr/HH/d) and consumption (L/c/d) from sub sources in dry season after the projects

| | | Sources at rivers, springs, and wells (Natural sources) [1] | | | | | Community water | |
|---|---|---|---|---|---|---|---|---|
| | | No. of users (%) | Volume of water drawn (L/HH/d) | Water consumption (L/c/d) | Total time spent (hr/HH/d) | Total distance (km/HH/d) | No. of users (%) | Volume (L/HH/d) |
| Kabuku | The poor | 75 | 188 | 14.6 | 3.0 | 9.6 | - | - |
| | The rest | 40 | 169 | 30.9 | 2.4 | 7.2 | - | - |
| MM | The poor | 56 | 88 | 9.3 | 3.7 | 12.8 | - | - |
| | The rest | 58 | 107 | 20.9 | 3.1 | 10.4 | - | - |
| Meru [2] | The poor | 22 | 140 | 12.2 | 1.7 | 5.2 | 22 | na |
| | The rest | 9 | 85 | 53.8 | 3.4 | 5.6 | 13 | 890 |
| Average | The poor | 51 | 145 | 12.3 | 3.1 | 10.1 | - | - |
| | The rest | 36 | 65 | 27.3 | 2.9 | 8.8 | - | - |

[1] NGK people depend on the project water only. No data in Nyeri.

[2] In Meru community water average was 890 L/HH/month (26.7m3/month) at the rest (not poor) in Meru.(n=3)

The poor at Kabuku and MM use sub sources at the ratio of 75 % and 56 % respectively. On the other hand, the rest of the people use sub source at the ratio of 40 % and 58 %, respectively. The poor use 14.6 L/c/d and the rest use 9.3 L/c/d at Kabuku and MM respectively. Fifty one percent of households on average depend on sub sources after the projects. (Table 7 and Figure 7).

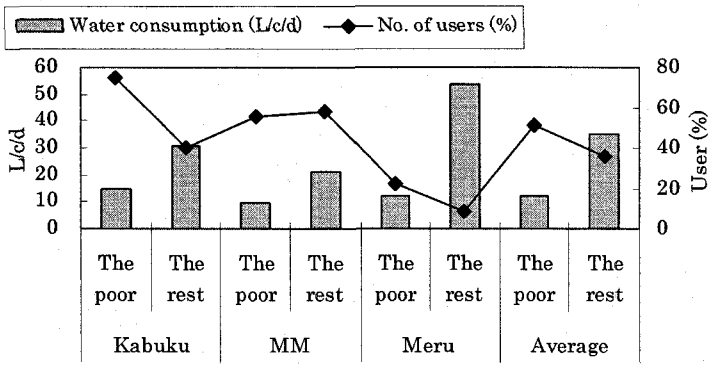



Figure 7. Consumption on sub water source in dry season after the projects

At NGK project, beneficiaries do not depend on sub sources of water because they have not suitable sub sources.

As for labor, total distance walked per day is about 10.1 km for the poor and 8.8 km for the rest (Table 9). Volume of water drawn were 145 L/HH/d at the poor and 65 L/HH/d at the rest. So even the projects, the poor have to work for water in dry season.

3.5 Water tariff and cost

(1) Water consumption and cost

The variation in monthly water consumption is shown in Figure 8.

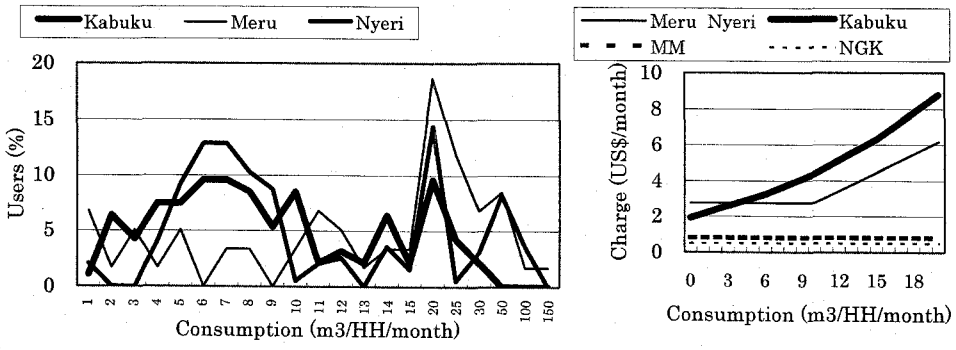



Figure 8. Water consumption distribution and water charge in 3 areas

There are 2 peaks at 6-7 $m^3$ and 20 $m^3$ in Kabuku and Nyeri. Two thirds of consumers at Kabuku and Nyeri concentrated under the 10 $m^3$/month block. Kabuku has a small peak at 2-3 $m^3$. Consumers under 10 $m^3$ consumption may be showing the willingness to save water. But at Meru, fewer than 10 $m^3$ consumers are less than one third. These trends may be attributed to differences in income and the water tariff structure. Kabuku Water Society provides complete proportional tariff that has blocks at

0-6 $m^3$, 7-10 $m^3$, and 11-15 $m^3$ and 15-20 $m^3$. Kabuku has proportional and relatively expensive tariffs (Figure 8 (right)). Even if the tariff is high, consumers can save water and expense (cost) by their will under this tariff construction. Meru and Nyeri projects have almost similar tariffs that are set by the government with a flat rate under 10 $m^3$. There is no incentive for consumers to save water under the tariff structure. As in Kabuku there is no flat charge block, residents can save the water under 10 $m^3$. Kabuku water tariff structure matches the real situation between water demands and payable ability. The tariff considers the poor. NGK and MM has unique tariffs, whose unit water charges are relatively cheap for farmers with small-scale irrigation. Two projects provide water by gravity flow without treatment.

(2) Water cost/income

Relationships between monthly water cost and income are shown at Figure 9 (left). Kabuku is exceptional, because although income is low, charge/income is highest. Generally water cost is proportional to income except for Kabaku. The ratio of the water charge and income ranged from 1 % to 6 %. Six percent charge is expensive for poor farmers. In Kabuku, water is provided by pumping and gravity flow without treatment.

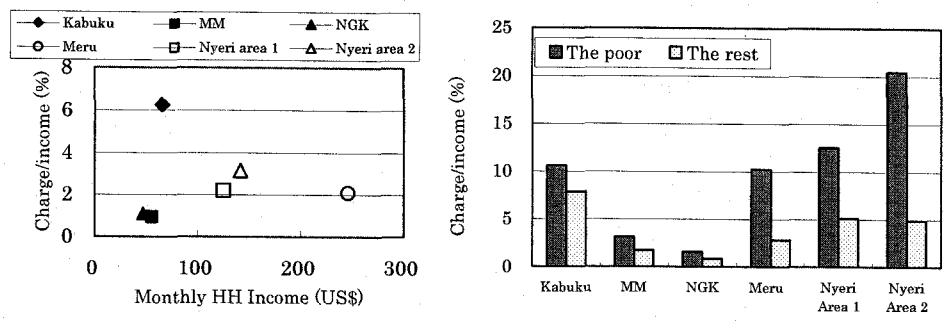



Figure 9. Water charge/income distribution (left) and water charge/income at the poor and the rest (right)

Kabuku has very critical operating condition because it has to meet the cost of electricity for pumping water. In addition, the total number of connections at 320 is too small for economies of scale. The poor have to pay 10 % of income for water at Kabuku, Meru and Nyeri Area1, and 20 % at Nyeri Area 2 (Figure 9 (right)).

Table 8 shows the results of ANOVA test for water charge/income between the poor and the rest. Both are significantly different. As NGK area was the poorest, 59.3 % residents concentrated at the lowest bracket (1.1 US$/HH/d). The median is also 1.1.

Table 8. Water charge/income (%) for the poor and the rest before the projects

| | After projects | | | | | | Before |
|---|---|---|---|---|---|---|---|
| | Kabuku [1] | MM [1] | NGK [2] | Meru [3] | Nyeri Area 1 [3,5] | Nyeri Area 2 [3,5] | Meru [3,4] |
| Poverty line US$/HH | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| P value | 0.007 | 0.000 | 0.000 | 0.000 | 0.005 | 0.002 | 0.000 |
| | *** | *** | *** | *** | *** | *** | *** |
| Water Charge /HH's Income (%) for the poor | 10.6 | 3.1 | 1.6 | 10.3 | 12.5 | 20.4 | 5.6 |
| Water Charge /HH's Income (%) for the rest | 7.9 | 1.7 | 0.9 | 2.8 | 5.1 | 4.9 | 1.2 |

[1] Poverty line is set at the 0.6*median of household income in MM and Kabuku.

[2] Poverty line is set at the median of household income in NGK, which is the lowest bracket US$32.1/month .

[3] Poverty line is set at the 0.5*median of household income in Meru and Nyeri.

[4] At income at "before" data, present income was used.

[5] Nyeri Area 1 had not sufficient data (8) and Nyeri Area 2 had no data because it was not house connection.

### 3.6 Water related equipment coverage

Table 9 shows the coverage of water related equipment. In urban areas, shower and lever flush toilet dissemination were 66 % for the rest and 35 % (about 2 times lower) for the poor. In rural areas the dissemination was lower at 12 % at Kabuku and 11 % at MM. Shower and improved sanitation are necessary in all areas. However, the data show inequity in dissemination between urban and rural areas. Although washing machines were surveyed, the dissemination was 0.0 % in both urban and rural areas.

Table 9. Water related equipments coverage (%) after the projects

| | | Kabuku | MM | NGK | Meru | Nyeri Area 1 | Nyeri Area 2 |
|---|---|---|---|---|---|---|---|
| Shower | The poor | 12.5 | 11.1 | 0.0 | 52.2 | 9.1 | 33.3 |
| | The rest | 2.0 | 6.4 | 3.3 | 76.6 | 22.2 | 66.7 |
| Lever flush toilet | The poor | *12.5* | *11.1* | 0.0 | 47.8 | 0.0 | 38.1 |
| | The rest | *2.0* | *6.4* | 2.2 | 78.7 | 14.8 | 64.6 |

### 3.7 Evaluation of projects by beneficiaries

Changes from before to after beneficiaries in a 5 level questionnaire survey calculated the projects. The levels are given points such as, "improved; +2", "slightly improved; +1", "not changed; 0", "slightly worsened; -1" and "worsened; -2". This evaluation is for the impact of projects. The results are shown at Figure10. At MM, there are significant differences between the poor and the rest. The poor highly evaluate water related disease reduction, education opportunity increase, and time spending with family increase. But in other projects, the evaluations by the 2 groups are not so different. NGK beneficiaries evaluate the projects highly at all items. But in MM and Meru, evaluation points are

relatively low. In MM and Meru, the poor do not evaluate water volume highly. Water quality is highly evaluated at Kabuku, Meru, and Nyeri Area1. Because Kabuku's water source is protected spring, Meru and Nyeri water are treated. Overally, urban people do not evaluate income increase as much as rural people. At rural areas, water has relation with economic activities that contribute to poverty reduction.

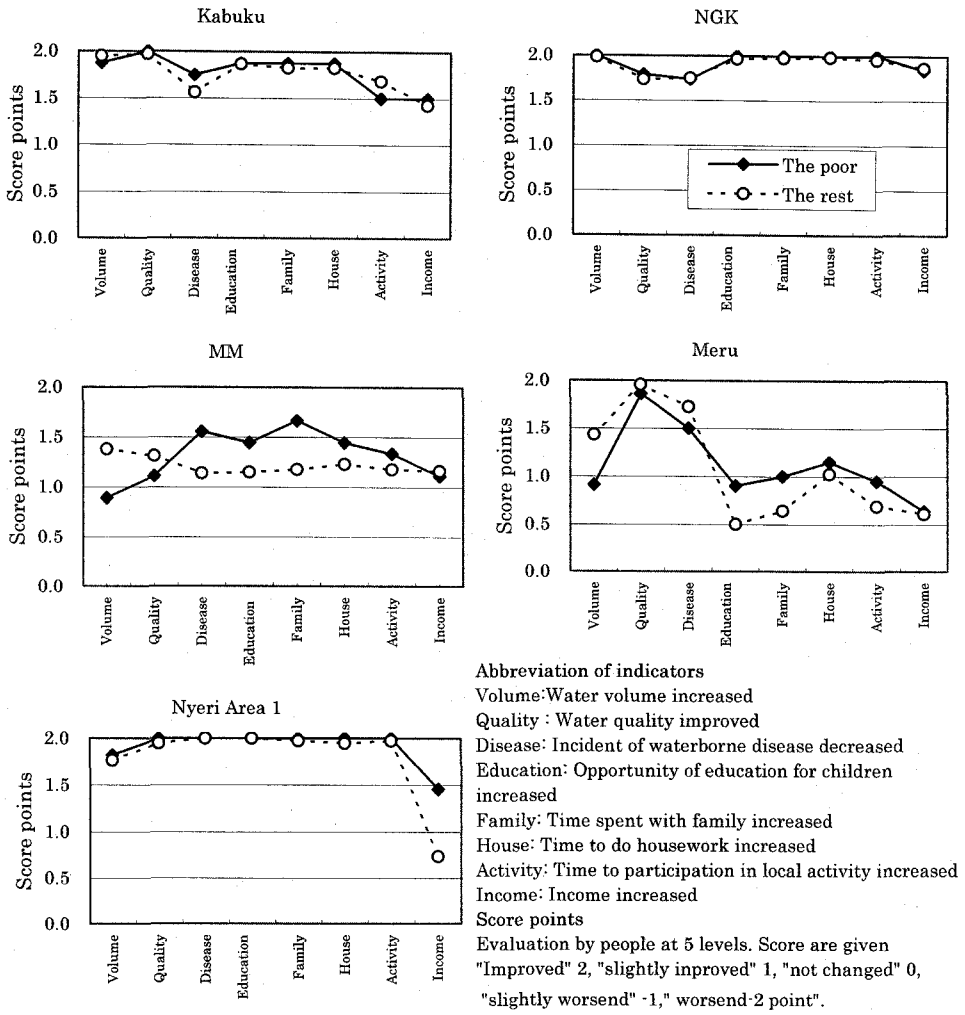



Figure 10. Evaluation projects by beneficiaries

## 4. Conclusion

(1) Absolute and relative poverty in water supply have been studied. Both types of poverty have to be considered at water supply ODA funded in developing countries. There are significant differences between the poor and the rest in many indicators.

(2) Generally the poor used less water than the rest before and after the projects. In urban areas,

water cost/income is 2-3 % with water treatment. In rural areas, water cost/income is 1-2 % without water treatment and with gravity flow. But in Kabuku where water is pumped, water cost/income is 6 %. The poor pay 10-20 % of income for water cost in urban areas.

(3) The study shows that it is important to ensure that benefits of ODA funded projects reach all beneficiaries. Even if water supply projects are successful at average, the poor get less benefit than the rest. ODA donors and recipient governments have to consider the poor during planning and designing of the projects. Equity of benefits is important in basic human needs projects. If equity is difficult to achieve, some form of subsidy in water tariff structure is necessary.

## Acknowledgement

We thank National and local offices of the Ministry of Water and Irrigation of the Republic of Kenya, projects leaders and staffs, and all people in Kenya who supported this study. Financial support from Kurita Water and Environment Foundation is acknowledged.

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