Pakistan Journal of Social Sciences 10 (1): 17-21, 2013
ISSN: 1683-8831
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# Impacts of Small Water Projects Towards Poverty Alleviation in Mvomero District, Morogoro, Tanzania

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**Abstract:** This study was done to examine the contribution of small water projects in the households towards poverty alleviation. The study used a cross-sectional design and survey method to collect the data. Multistage sampling was used to obtain the sample in which four wards were purposively selected. In each ward one village was randomly selected in which 20 respondents were interviewed from each village. Data analysis was done by using Statistical Package for Social Science (SPSS) in which descriptive statistics along with Principle Component Analysis (PCA) were used. The study identified irrigation, livestock, aquaculture, food canteens, selling of water, ice-creams and juice, bricks making and local brew production as the main households' water projects. The role of these projects included creation of employments in which the majority of employees were women. The small projects generated households' income in which over 60% of the participants in the water projects had an income above poverty threshold.

**Key words:** Livestock, food canteens, juice, employments, participants

## INTRODUCTION

Poverty is a phenomenon in which a person or community is deprived of and or lacks the essentials for a minimum standard of well-being and life (Silver, 1994). Poverty alleviation is one of the major issues of concern in developing countries as reflected in the Tanzania's national strategy for growth and poverty reduction (URT, 2005). Poverty alleviation is the first goal in the United Nations Millennium Development Goals (UN Millennium Project, 2005). Numerous factors are known to contribute to poverty in the developing countries, the major one being water shortage (African Development Fund, 2006). Water problems are considered to affect half of the humanity (Silver, 1994). For instance, almost two in three people who lack access to clean water survive on less than US$2 a day with one in three living in less than US$1 a day. Sub-Sahara Africa loses about 5% of GDP or some US$28.4 billion annually due to water and sanitation deficits (UNDP, 2006). In 2003, this loss exceeded the total aids flows and debt relief to the region (Ibid.). Water has both direct and indirect impacts towards poverty alleviation and the increase of household income of the poor (Soussan, 2002). Tanzania's Poverty Reduction Strategy Paper (PRSP) recognized that eliminating poverty will not be done without providing every person with access to safe drinking water.

Economically, water can be used in various activities such as agricultural irrigation, manufacturing of goods and processing of various raw materials and food products (Abayawardena and Hussain, 2002). For instance, it is estimated that agricultural sector consumes an average of 70% of total of freshwater used in Southern Africa region. In Tanzania, >40% of its population still lacks access to clean and safe water. Water supply coverage is estimated at 50% for rural and 70% for urban areas. About 30-40% of rural water supply schemes are not functioning properly. Therefore, the incidence of water-borne diseases is widespread in areas where water is scarce and sources are of doubtful quality. Water is an essential ingredient to economic growth and poverty alleviation and a basic need to human life. Investment in water projects can contribute a lot to the economic growth of countries with poor economies through agricultural irrigation and other income generating activities (Hussain and Hanjra, 2004).

Though the roles of water are impressive, it is important to know the net benefits from water resources and the group of people in the society that benefit from these earnings and whether such economic earnings have anything to do with poverty alleviation. Also as water is rapidly becoming a scarce resource in the world, Tanzania has to get ready from various challenges and limitations arising from the exploitation of water resources,

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worthwhile to examine its effects to the economy in general and the poor in particular. The main objective of this study was to examine the contribution of household's water projects towards poverty alleviation in the study area. It sought to identify and suggest ways in which water can be used to contribute towards households' poverty alleviation in Tanzanian through water based projects.

## MATERIALS AND METHODS

**Research design:** A cross-sectional study design was used. This design allows data to be collected at a single point in time. The design can also be used in descriptive study and determination of relationships between variables (Varkevisser *et al*., 2003).

**Sampling procedure:** The methodology adopted for the study was a multistage sampling. Simple random sampling was used to select four villages and 80 respondents. In each village, 20 respondents were interviewed. The participants as well as the nature and type of involvement were examined.

**Data types and sources:** Both secondary and primary data were collected. This secondary information was supplemented with primary data which was obtained through questionnaire-based interviews. During the survey, participants in water projects were interviewed about use of water, occupation, water costs and benefits including income, employment, expenditure and household welfare.

**Data collection instruments:** Various instruments were used for data collection including documentation of information and data from existing reports and documents on water issues and poverty. Structured questionnaires were used to generate quantitative data. Key informants were also used to collect qualitative data that captured specific changes and information.

**Data processing and analysis:** The Statistical Package for Social Science (SPSS) Software was used for data analysis in this study. In the analysis, descriptive statistics was used to include frequency and $\chi^2$-test as to summarize the data and compare statistical difference of proportions for different variables. Also, Asset Index was used along with Principal Component Analysis (PCA) were used in the analysis as to indicate the quintiles on the poverty status of the households. Then, the comparison was made between household income, expenditure and the asset index to classify household socio-economic positions.

Other variables were also compared to determine the socio-economic position of households in the study area. The asset index was expressed as:

$$A_i = \frac{f_i \times (a\,j_i - a_i)}{s_i} + \ldots + \frac{f_n \times (aj_n - a_n)}{s_n}$$

Where:

$A_i$ = An asset index for each household (j = 1, …, n)
$f_i$ = The scoring factor for each durable asset of household (i = 1, …, n)
$aj_i$ = The ith asset of jth household (i, j = 1, …, n)
$a_i$ = The mean of ith asset of household (i = 1, …, n)
$s_i$ = The standard deviation of ith asset of household (i = 1, …, n)

The computation for this formula was done automatically using SPSS. In the study area participation in water projects was examined in relationship to the household's poverty status. The poverty status of the households were analyzed in relationship to income, employment from water projects, asset index and welfare quintiles. As it was noted that monitory metric to poverty has a lot of weaknesses. Thus, the comparison between these variables including income and the household welfare quintiles was of a key importance in order to indicate poverty status of households in the study area. The households asset index was calculated by using the formula given above in which 17 variables were used. The summary of scoring factors, mean and standard deviation is shown in Table 1. This statistical summary was used to compute the Asset index (Ai) of each household to determine the quintiles. The values were computed in the equation as:

$$A_i = \frac{f_i \times (a\,j_i - a_i)}{s_i} + \ldots + \frac{f_n \times (aj_n - a_n)}{s_n}$$

Table 1: A summary of scoring factors, mean and standard deviation

| Variables | Scoring factor (f) | Variance (%) | Mean (a) | SD (s) |
|---|---|---|---|---|
| 1 = Own a bicycle | 0.324 | 24.386 | 2.06 | 1.095 |
| 2 = Own a motorcycle | -0.056 | 15.112 | 1.09 | 0.284 |
| 3 = Own a car | -0.095 | 10.966 | 1.02 | 0.157 |
| 4 = Own a farm/land | -0.093 | 7.850 | 3.35 | 2.171 |
| 5 = Own livestock | -0.116 | 6.408 | 3.81 | 2.882 |
| 6 = Own a hand hoe | 0.252 | 6.016 | 3.28 | 1.387 |
| 7 = Own a TV-set | -0.100 | 4.853 | 1.09 | 0.326 |
| 8 = Own a refrigerator | -0.052 | 4.365 | 1.10 | 0.409 |
| 9 = Own a radio | 0.372 | 3.794 | 1.98 | 0.779 |
| 10 = Own a torch | 0.278 | 3.723 | 1.83 | 0.883 |
| 11 = Own a bush knife | 0.033 | 3.309 | 2.39 | 0.864 |
| 12 = Own an axe | -0.094 | 2.845 | 1.81 | 0.618 |
| 13 = Own a bed and mattress | -0.015 | 1.992 | 2.90 | 1.239 |
| 14 = Own a sofa set | -0.009 | 1.464 | 1.45 | 0.571 |
| 15 = Own a sewing machine | 0.111 | 1.404 | 1.10 | 0.686 |
| 16 = Own a cupboard | 0.259 | 0.884 | 1.08 | 0.265 |
| 17 = Own a table | 0.028 | 0.630 | 1.13 | 0.460 |

For instance, the first household had the following characteristics (assets) 2 bicycles, 0 motorcycle, 0 car, 2 farm/land, 0 livestock, 3 hand hoes, 0 television-set, 0 refrigerator, 1 radio, 1 torch, 3 bush-knives, 1 axe, 2 beds and mattress, 0 sofa set, 0 sewing machine, 0 cup-board and 0 table. Using the scoring factor in Table 1 (Ai) the first PCA was obtained as:

$$\frac{0.324\times(2-2.06)}{1.095}+\frac{-0.056\times(0-1.09)}{0.284}+\frac{-0.095\times(0-1.02)}{0.157}+$$
$$\frac{-0.093\times(2-3.35)}{2.171}+\frac{-0.116\times(0-3.81)}{2.882}+\frac{0.252\times(3-3.28)}{1.387}+$$
$$\frac{-0.100\times(0-1.09)}{0.326}+\frac{-0.052\times(0-1.10)}{0.409}+\frac{0.372\times(1-01.98)}{0.779}+$$
$$\frac{0.278\times(1-1.83)}{0.883}+\frac{0.033\times(3-2.39)}{0.864}+\frac{0.094\times(1-1.81)}{0.618}+$$
$$\frac{-0.015\times(2-2.90)}{1.239}+\frac{-0.009\times(0-1.45)}{0.571}+\frac{0.111\times(0-1.10)}{0.686}+$$
$$\frac{0.259\times(0-1.08)}{0.265}+\frac{0.028\times(0-1.13)}{0.460}=-0.65$$

The scoring factor can either be positive or negative. The negative values indicate the characteristics of the household with low quintile/socio-economic status while the positive values indicate the characteristics of the household with high quintiles. When values are entered into computation the negative values decrease the index while the positives increase it.

## RESULTS AND DISCUSSION

In the study area, the households owning bicycle, motorcycle, car and farm/land had a high index while owning a table and sewing machine, cupboard and sofa set had a low index as indicated in Table 1. After obtaining Ai values for each household, the quintiles were used to categorize the household into five quintiles in order to determine the position of the household. The welfare quintiles are indicated in Table 2. In the welfare quintiles, the first quintile presents the poorest while the fifth presents the wealthiest. The positions were increasing from poorest to the better off as indicated in Table 2. The numbers of households and their percentiles in the categories were also given in order to show the poverty status in the study area.

**The contribution of households' water projects in poverty alleviation:** The contribution of households' water projects in Mvomero district was examined through the linkage between water and economic activities that are critical to poverty alleviation. A number of variables were examined including the identification of main water projects in the households, number of employees and the households' income from water projects.

Table 2: The welfare quintiles

| Quintiles | Lowest limit | Upper limit | Number of households | Households (%) |
|---|---|---|---|---|
| First | Minimum | -2.0784 | 18 | 22.5 |
| Second | -2.0783 | -1.8077 | 15 | 18.8 |
| Third | -1.8076 | -1.2698 | 17 | 21.3 |
| Fourth | -1.2697 | -0.6963 | 15 | 18.8 |
| Fifth | -0.6962 | Maximum | 15 | 18.8 |

Table 3: Employment from water projects and welfare quintiles

| | Welfare quintiles (%) | | | | | |
|---|---|---|---|---|---|---|
| Variable (N = 80) | Poorest | 2nd | 3rd | 4th | Wealthiest | p-value |
| **Number of employees in water projects (distribution)** | | | | | | |
| 1-5 | 94.4 | 93.3 | 82.4 | 93.3 | 60.0 | - |
| 6-10 | 0.0 | 6.7 | 5.9 | 6.7 | 33.3 | - |
| >10 | 5.6 | 0.0 | 11.8 | 0.0 | 6.7 | 0.054 |

The study identified projects such as irrigation farming, livestock, aquaculture, food canteens, selling of water, ice-creams and juice, bricks making and local brew production as the main water projects in Mvomero district. Among the projects, irrigation farming constituted the highest proportion of the wealthiest in the study area. World Bank (2003) analysis showed that agriculture continues to be a dependable pro-poor sector in developing countries. The current study showed that participants in irrigation farming consisted of >66% of the wealthiest in the population while participants in local brews production and ice-cream making each of them consisted about 13.3% of the wealthiest. However, the association between water projects and the welfare quintiles was not statistically significant ($p<0.142$).

**Employment and the household welfare quintiles:** Employment is considered to be crucial in poverty alleviation. In connection to water projects, the aggregates on the number of employees were also analyzed. The contribution of employments in households welfare were indicated by the number of employees participated in the single activity (enterprise). The results for water projects on employments are indicated in Table 3. Various water projects employed from 1-5 persons. Over 90% of the poorest in the population was formed by the activities that employed between 1 and 5 persons. This group was followed by the activities that employed between 6 and 10 persons and >10 persons was the least proportion of the poorest in the sample population. Also, among the wealthiest, about 60% was formed by the activities that employed between 1 and 5 persons. The less the number of the people the project employed the higher became the percentile of wealthiest

status in the population. The relationship between the numbers of employees and welfare quintiles was found to be statistically significant ($p<0.054$).

**Income and welfare quintiles:** In the study area, annual income was divided into three main categories namely, household annual earnings from water projects, annual income from non-water projects and overall annual income from both water and non water projects. Participation in water related projects revealed various levels of incomes, among which the lowest received the annual income below US$300 per year and the highest received the more than US$750 per year. The lowest income from water projects consisted only 33.3% among the poorest and >33% of the wealthiest in the population. The highest income from these activities consisted of >16% of the poorest and about 6.7% of the wealthiest in the population.

The analysis of annual income in relationship to welfare quintiles showed that relative poverty measures assisted to determine the economic positions of households in the study area. For instance, the proportion of those who received below US$300 as the lowest income (living below poverty threshold), their proportion was 32.5% when income alone was analyzed. This category was changed in which among them formed about 33.3% of the poorest and >33% of the wealthiest in the sample population when quintiles were included in the analysis. This showed that assets index contributed to show a situation of poverty in the households. Some of the households which had the lowest income were ranked as wealthiest because they had higher quintiles. Likewise, when income alone was analyzed in the proportion of those who had annual income of more thanUS$750 from water projects was 16.3%. But when the welfare quintiles were included, the same proportion of this category was changed in which among them only 6.7% were found to be wealthiest and >16.7% were found to be the poorest in the sample population. However, the results indicated that the difference between respondents' income from water related economic activities and welfare quintile was not statistically significant ($p<0.439$).

**Annual income from non-water projects and the household welfare quintiles:** In the current study some of the water projects showed that their annual income was very low. Therefore, it was important during the study to know about their income from other sources which were not related to water projects (Table 4). According to respondents, incomes from other sources were used as substitutes to the main households' incomes which relied on water. The results indicated that income from other activities varied in which the lowest income from non-water projects was belowUS$300 per year and the highest income was more thanUS$750 per year. Those who received below US$300 formed >83% of the poorest and about 40% of the wealthiest in the sample population. Those who received US$750 formed >11% of the poorest and about 33.3% of the wealthiest in the sample population. In general, the proportion of wealthiest among those that received income of more than US$300 was higher than those below US$450 in the study area. The results showed that the difference between households' income and welfare quintiles was statistically significant ($p<0.030$).

Table 4: Annual income from non water projects and welfare quintiles

| | Welfare quintiles (%) | | | | | |
|---|---|---|---|---|---|---|
| Variable (N = 80) | Poorest | 2nd | 3rd | 4th | Wealthiest | p-value |
| **Annual income from non water projects (Distribution)** | | | | | | |
| Below US$300 | 83.3 | 73.3 | 70.6 | 80.0 | 40.0 | - |
| US$301-450 | 5.6 | 0.0 | 23.5 | 13.3 | 6.7 | - |
| US$451-550 | 0.0 | 13.3 | 5.9 | 0.0 | 0.0 | - |
| US$551-650 | 0.0 | 6.7 | 0.0 | 6.7 | 13.3 | - |
| US$651-750 | 0.0 | 0.0 | 0.0 | 0.0 | 6.7 | - |
| Above US$750 | 11.1 | 6.7 | 0.0 | 0.0 | 33.3 | 0.030 |

**Overall total annual income and the household welfare quintiles:** As it was noted, several households that relied on water projects had their substitute of income from other sources that were not related to water projects. In this study, the incomes from both activities water projects and others were combined in order to determine their contribution in the household poverty status. This was done by analyzing the overall total annual income of the households. The overall total annual income was divided into categories that included below US$300 per year as the minimum earning and more than US$750 per year as the maximum earning. When these incomes were analyzed into welfare quintiles the composition of the minimum earning was about 33.3% of the poorest and the maximum earners formed >38% of the poorest in the population. None of household received an income between below US$301 and 450 and between US$550 and 650 was found among the poorest in the population.

Moreover, >53% of the wealthiest was formed by those who received the overall annual income of more than US$750 in the sample population. Among the wealthiest, this group was followed by those that received income below US$300 and between US$450 and 550. Though the overall annual income included the aggregates of income from both water and non water projects sources, the association between household incomes and welfare quintiles was not statistically significant ($p<0.426$).

## CONCLUSION

The contribution of water projects in Mvomero district in poverty alleviation included the creation of employments in which the majority of employees were women. They also generated households' income in which >60% of the participants in the water projects had an income above poverty threshold. However, these small projects faced the problems such as weather and climate change, lack of fuel wood for bricks production, shortage of arable land, lack of pesticides and fertilizers and poor irrigation infrastructure. It was also noted that the relationship between income from water projects and welfare quintile was not significant. Due to these findings, this study recommended that stakeholders in water projects should diversify their economic activities; find alternative sources of fuel; practice a forestation and irrigation farmers should form groups to manage their own irrigation schemes.

## ACKNOWLEDGEMENTS

Researchers owe much thank to Dr. Daniel Perkaske, SDS of Salvatorian US Province with his Special projects fund that provided the financial support for this study. Researchers are also acknowledging the support and guidance of Prof. M.M.A. Mtambo and Dr. R. Mdegela from Sokoine University of Agriculture.

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