Farmers' Participation in Irrigated Farming in Chamwino District in Dodoma Region Central Tanzania

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ABSTRACT

Irrigated farming has been practiced for a long time in many parts of the world including Tanzania aiming at increasing food production. A rural community is important food production sector that produces and nourishes rural as well as urban people with quality food. The aim of this study was to assess factors affecting rural communities to engage in irrigation farming in Buigiri ward located in Chamwino district, central Tanzania. Data were collected by interviewing farmers using questionnaires as a main tool, which comprised of closed and open ended questions. Descriptive statistics and regression analyses were done by using Statistical Package for Social Sciences (SPSS). Findings showed that 99% of farmers have acquired knowledge on good practices on irrigation agriculture. However, only 65% of farmers are practicing irrigated agriculture while 35% are not practicing. Results further indicated that 54% of farmers attended meetings which were geared towards highlighting farmers about irrigated farming. About 31% of farmers learned through farm field schools, and 14% of farmers received irrigation knowledge through seminars and workshops. Findings show 87.7% of farmers are using surface irrigation method, 9.2% of farmers use drip irrigation and only 3.1% of farmers are using sprinkler irrigation method. It was revealed that capital ($P<0.001$), availability of water sources ($P<0.001$), land ($P<0.001$), proper knowledge on irrigation methods ($P<0.001$) and respondent's education level significantly ($P < 0.05$) influenced the community engagement in irrigation agriculture. However, the remaining factors which included sex of respondent, respondent's age (years), respondent's marital status and irrigation methods used did not significantly ($P > 0.05$) influence the community engagement in irrigation agriculture. It was concluded

that majority of farmers had received training in irrigation agriculture, however due to various factors, some of them do not engage with irrigation agriculture. Irrigation methods used was dominated by surface irrigation. Available canals are not well managed as a result water leakage exist which led to substantial loss of water before reaching farming plots.

Keywords: Irrigation, smallholder farmers, determinants

1.0 INTRODUCTION

Irrigation means the application of a specific amount of water at a particular location in order to meet the requirements of a crop growing at that location in amounts that are appropriate to the stages of crop growth. It can also mean the application of water in amounts necessary to bring soil to the desired moisture level prior to crop planting (URT, 2010).

The Tanzanian economy still depends on agriculture as its mainstay. ESRF (2000) reported that during the period between 1995 and 2000, the contribution of agriculture to the total GDP has been around 50 per cent. The ratio of non-monetary agriculture has been relatively high (44% on average), underscoring the importance of production for own consumption. This non-monetary contribution is large because most farmers operate small-scale farms that contribute 70-80 per cent to total employment and 55% of the country's foreign exchange in 1998 (ESRF, 2000). Currently, the Agriculture sector contributes 27.7% of Tanzania's GDP and about 30% of its export earnings, while employing over 80% of the nation's work-force, accordingly the sector continues to drive growth in the country (CIA, 2015). Despite of its importance, agriculture was very much affected by inadequacy, seasonality and unreliability of rainfall and periodic droughts (URT, 2010).

Irrigation practice is one of the effective means in increasing and stabilizing food and cash crop production and productivity for curbing food shortages and increasing export of cash crop and its products. In this regard, a concise plan and implementation for the development of irrigation infrastructure is pertinent. Water is a central and basic natural resource, which sustains life and provides for various social and economic needs including irrigated agriculture. It is considered as a key factor in the socio-economic development and the fight against poverty. The social and economic circumstances prevailing today have increased the competition in water demands by all users and thus creating a threat in its sustainability. It therefore entails integrated planning, development and management in support of food security and poverty reduction, as well as environmental safeguards amongst others (URT, 2010).

According to IPTRID (1999), irrigated agriculture provides 40% of world food production on only 17% of total cultivated land. The World Food Summit in 1996

estimated that 60% of the extra food required to sustain the world in the future must come from irrigated agriculture (FAO, 1996). Much of this increase must come from improvements in existing schemes, as new sites for development are scarce (IPTRID, 1999). It is estimated that, three-quarters of the total irrigated area of 260 million hectares is in developing countries where smallholder agriculture still predominates (FAO, (1999). The bulk of improvements in food supply from irrigation are expected to come from changes in a sector still dominated by small producers. The rural poor are not simply people deserving help and justice: small-scale irrigators are, and will continue to be, a vital part of future world food security (IPTRID, 1999).

The use of irrigation in Tanzania goes back to the Iron Age and traditional irrigation system has long been of considerable importance in various part of the country. Though, one of the main constraints to growth in agriculture is the continued dependence by small-scale farmers on hand-hoe cultivation in rain-fed agricultural systems. Irrigated agriculture, therefore, is important for improvement in farm incomes for the majority of the rural population in Tanzania.

Due to the investments made through various projects and programs by the International Development Association (IDA), Agriculture Sector Development Program (ASDP), the Participatory Agricultural Development and Empowerment Project (PADEP), the River Basin Management and Smallholder Improvement Project (RBM SSIP); and the Tanzania Social Action Fund (TASAF), the total area of land under improved irrigation infrastructure has increased by 51%, from 264,388 ha in 2006 to 399,775 ha in 2012 – and the number of people using irrigation increased from 33,000 in 2005 to 1 million in 2012 (Wold Bank, 2013). Paddy is commonly grown on these schemes and yields can be as much as four times those of rain-fed areas, although the various types of irrigation schemes and management systems result in a range of 1-6 tons/ha. Traditional irrigation schemes are initiated and operated by farmers and include schemes based on traditional furrows in the highland areas and simple water diversion schemes on the lowlands. They tend to have poor infrastructure, poor water management, low yields, and salinity and water logging problems.

Irrigation was one among key factors that contribute to food security, poverty alleviation and economic growth. The Government in the year 2002 prepared the National Irrigation Master Plan, which strongly emphasized the need of having

the Irrigation Policy and a Legal and Regulatory Framework to oversee sustainable irrigation development.

In Tanzania most of the irrigated areas were under surface irrigation, mainly used by smallholders. Water distribution was usually by lined and unlined canals, and furrows and basins were widely used. Sprinkler irrigation was used by few large-scale commercial farmers which was not common amongst smallholders and drip irrigation was rarely used (FAO, 2005). Therefore this study was aimed to assess factors affecting rural communities in engaging with irrigation farming.

2.0 METHODOLOGY

2.1 The study area

The study was conducted at Buigiri ward in Chamwino district. Buigiri is located at Latitude -6 08' 00" and Longitude 36 02' 00". The choice of the study area is due to the fact that irrigation farming is being practiced by several farmers; hence it was practically suitable for the study topic.

2.2 Research design and Sampling

Non-experimental research design was used in the study. The study specifically used cross-sectional design. The design was used because it enabled collection of data at a single point at a time and determines relationship between variables.

In this study, structured interview, self-administered interview, focus group discussions and observation were used to get primary data while documentary review was used to collect secondary data. For structured interview questionnaire was a tool for data collection while in focus group discussion and documentary review checklists were used.

The study involved a sample of 100 households from the area. The sample size was obtained according to Yamane (1967) as $n = N/ (1+N (e)^2)$.

Where, n = Sample size, N = Total number of households in the area, e = is the level of precision, which was 10% for this study. Moreover, 5 key informants (district officials and ward leaders) were also involved in the study.

Both probability and non-probability sampling procedures were used. Simple random sampling was used in selecting households while purposive sampling was used for selection of key informants and villages to be involved in the current study.

2.3 Data Analysis

Statistical Package for Social Science (SPSS) Version 20 was used in analyzing data. Descriptive statistics analysis was used to get frequencies and percentages while logit regression was used to analyse factors affecting community engagement in irrigated farming.

2.4 Model specification

$$\text{Ln}\left(\frac{p\,(Y=1)}{1-p\,(Y=1)}\right) = a + \beta_1X_1 + \beta_2X_2 + \beta_3X3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7 + \ldots \beta_nX_n + \varepsilon$$

P(Y=1) = Probability that a farmer engage in irrigated farming;

X_1= Age of respondent; X_2= Respondent's sex; X_3= Respondent's education level; X_4= Respondent's marital status; X_5= Land ownership; X_6= Capital for irrigation practices; X_7= Community knowledge on irrigation; X_8= Irrigation methods; X_9= Source of water.

a= Intercept (constant).

β_1 to β_n= Regression coefficients for independent variables.

ε= Random error term

3.0 RESULTS AND DISCUSSION

3.1 Respondent Characteristics

Table 1 present respondents' age, sex, education level, marital status and occupation. Results show that out of 100 respondents, 26% were aged below 30 years, 55% aged between 31 and 50 years, and only 19% was aged above 50 years. This observation indicates that most of heads of households are in the

productive age, hence if they have enough capital and knowledge to invest in irrigated agriculture they can increase their per capital income as well as food security in the study area as well as in the country.

Findings showed that 59% of respondents were males and the remaining (41%) were females (Table 1). These results implies that males dominated irrigated farming in the ward. These findings comply with that of Stephens (1992) who argued that though most technologies are considered gender neutral, they are often gender biased during their introduction and use by societies. Also Oladele (2011) noted that it was a wide belief that males are dominating agricultural sector as compared to female.

Furthermore, results in Table 1 present education level of respondents whereby 55% of farmers had primary education, 25% had never attended school, 17% had secondary education, and 3% had at least college education. These results indicate that majority (75%) of the farmers engaging in irrigated agriculture had formal education. Oni *et al*. (2005) reported that literate farmers are likely to accept new innovation than illiterate farmers thereby enhancing their productivity and greater farms' returns.

Findings also showed that 55% of farmers were married, 32% were single, 10% were widowed, and 3% were divorced (Table 1). Since marriage tends to makes people settle in a single place for a long period of time especially for those who depend entirely on farming as their occupation, hence it is assumed that this group will boost irrigation sector more than any other groups.

The results in Table 1 revealed that 64% of them were practicing farming as their only occupation, 17% were civil servants who also engage in farming, 16% were businessmen who also practicing crop farming and 3% were doing carpentry activities as well as farming.

These observations indicate that the majority of respondents in the study area were practicing farming only as their occupation and main source of income and food for their families. It implies that, agriculture so far remain as the main source of income for most of Tanzania rural people, this is due to the fact that areas for cultivation can be accessed while business opportunities are very limited. These findings also comply with that of CIA (2015) which states that agriculture provides employment opportunities to about 80% of Tanzanians.

Table 1: Characteristics of respondents (n=100)

Category		Number	Percentage
Age			
	Below 30 years	26	26.0
	31-50 years	55	55.0
	Above 50 years	19	19.0
Sex			
	Male	59	59.0
	Female	41	41.0
Education level			
	Never attended school	25	25.0
	Primary school	55	55.0
	Secondary school	17	17.0
	College/ University	3	3.0
Marital status			
	Married	55	55.0
	Single	32	32.0
	Divorced	3	3.0
	Widowed	10	10.0
Occupation			
	Farming only	64	64.0
	Civil servants and farming	17	17.0
	Business and farming	16	16.0
	Carpentry and farming	3	3.0

3.2 Sources of knowledge on irrigated farming

Results revealed that 99% of respondents had attended training in relation to irrigation farming and only 1% did not attend any training (Table 2). This implies that most of the population in the study area are aware of irrigation. Through focus group discussion, farmers mentioned that agricultural extension staffs were the main source of knowledge on modern irrigation agriculture techniques. This is contrary to the findings of Stevens and Ntal (2011) who reported that only 2% of farmers gain knowledge on irrigation agriculture in Lesotho. However, in current study only 65% of respondents reported to practice irrigation farming despite of gaining knowledge through attending various trainings as indicated in Table 2. This implies that some farmers despite being able to attend the training on irrigation farming but they still rely on rain-fed agriculture.

Results in Table 2 indicated that 54% of farmers attended meetings which were geared towards highlighting farmers about good practice on irrigated farming. About 31% of farmers learned through farm field schools, and 14% of farmers received irrigation knowledge through seminars and workshops. This observation implies that majority of farmers have acquired knowledge on irrigation through meeting. However, as it was revealed by district and ward officials that meetings are mostly being used for awareness creation and sensitization hence, there is a need of using meetings to address the importance of embracing irrigated agriculture to this group of farmers who had already received knowledge on irrigation farming but still depend on rain fed agriculture. The implication of few farmers getting knowledge through seminars makes irrigation in the ward to be practiced locally by many farmers because seminars are not done frequently, this in turn leads to low crops yields.

Table 2: Attendance and Sources of Training on Good Practices on Irrigation Agriculture

	Frequency	**Percentage**
Attendance (n = 100)		
Yes	99	99
No	1	1
Source of training (n =99)		
Farm field schools	31	31.4
Meetings	54	54.5
Seminar and workshops	14	14.1
If practise irrigated farming (n= 100)		
Yes	65	65
No	35	35

3.3 Irrigation Methods Used

Findings revealed that 57 (87.7%) farmers are using surface irrigation method, 6 (9.2%) farmers use drip irrigation and only 2 (3.1%) farmers are using sprinkler irrigation method. This observation implies that, majority of farmers who practices irrigation farming use surface irrigation which consumes more water compared to drip system which is water serving system since water is the scarce

resource. The findings further observed that the available canals are not well managed by farmers and other stakeholders as a result water leakage exist which led to substantial loss of water before reaching farming plots. This is a serious problem, since through focus group discussion, farmers' urges that irrigation farming contributes substantial portion of food which is either used directly by households or sold to earn cash for households' welfare.

According to Brouwer *et al*. (1988), surface irrigation can be used for all types of crops. Sprinkler and drip irrigation, because of their high capital investment per hectare, are mostly used for high value cash crops, such as vegetables and fruit trees. They are seldom used for the lower value staple crops. These findings are in agreement with what has been found by this study. Furthermore, the choice of irrigation methods depends on availability of water resources, climate and soil conditions, the topography, water quality and economic aspects (Brouwer *et al*,. 1988).

Table 3: Irrigation methods used (n=65)

Methods used	Number	Percentage
Surface irrigation	57	87.7
Drip irrigation	6	9.2
Sprinkler irrigation	2	3.1

3.4 Sources of water for irrigation its reliability and adequacy

The results in Table 4 revealed that 75.4% of farmers in the ward use runoff catchment reservoir which collects rain water from stream for irrigation activities, 16.9% used wells which were dug locally at their farms and 7.7% used bore hole. There was only one bore hole shared by farmers in the ward with reliable water. Furthermore, findings indicated that 76.9% of farmers had sources of water are reliable and can sustain a substantial period of farming season while 23.1% of farmers said that sources of water are not reliable and water is inadequate support the whole cropping season. It can be observed that majority of farmers are using water from runoff catchment dam which depends on rain to feed it. However, shortage of rainfall in some years is the big obstacle to farmers because the dam gets dried before the next rain season.

Table 4: Sources of water, reliability and adequacy (n=65)

Variable	Frequency	Percentage
Source of water		
Well	11	16.9
Borehole	5	7.7
Runoff catchment dam /reservoir	49	75.4
Reliability and adequacy		
Yes	50	76.9
No	15	23.1

3.5 Factors affecting farmers' engagement in irrigated agriculture

In examining factors affecting community engagement in irrigation farming, a multiple logit regression model was used where the predictor variables were age of respondent, respondent's sex, respondent's education level, respondent's marital status, land ownership, capital for irrigation practices, irrigation methods, community knowledge on irrigation and sources of water.

Results in Table 5 present factors affecting community engagement in irrigation farming whereby regression analysis results shows that five of the nine independent variables included in the analysis significantly ($P < 0.001$, $P < 0.05$) influenced farmers' decision to engage in irrigated agriculture. Capital was among the factors significantly influenced farmers' decision to engage in irrigation. The positive regression coefficient implies that capital positively affecting community engagement in irrigation farming. Availability of capital will probably lead community to engage more in irrigation farming probably by adopting sprinkler and drip irrigation methods which are more costly than surface irrigation method. These findings is in agreement with that of Bandeth (2010) who revealed that farmers with better economic status are more inclined to participate in irrigated agriculture.

Availability of water also positively influenced farmers engagement in irrigated farming ($P < 0.001$). This finding concurs with that of Chandran and Chackacherry (2004).

The coefficient for farm size was negative and significant (P < 0.001). Botlhoko and Oladele (2013) and Azizi and Zamani (2008) reported dissimilar observation in their study conducted in South Africa and Iran, respectively. The negative regression coefficient observed in this study implies that land ownership and community engagement in irrigated agriculture are negatively related. This is probably due to the fact that not all land is being used by the community in irrigation farming because of either lack of capital, inadequate irrigation infrastructures and reliability of sources of water.

Proper knowledge on irrigation methods had a positive coefficient (0.157) and the coefficient was significant (P < 0.001). However, in contrast, Chandran and Chackacherry (2004) reported that Knowledge on scientific agricultural management did not significantly influenced farmers to participate in irrigation management.

Finding from this study also revealed increased education level increased chances of a farmers to engage in irrigated farming (P <0.05). This finding is contrary to what was reported by Botlhoko and Oladele (2013) that level of education does not have significant effect for farmers to participate in agricultural projects.

However, sex, age and marital status of respondent and irrigation methods used in farming did not significantly (P > 0.05) influence the community engagement in irrigation farming (Table 5). The non significance effect of age was also reported by Alam *et al*. (2012) in Pakistan. Also Chandran and Chackacherry (2004) reported similar observation for the effects of age and sex in India.

Table 5: Logit regression analysis for factors affecting community engagement in irrigation agriculture

Independent variable (X)	Beta (β)	Std. Error (s.e)	Sig
(Constant)		.055	.000
Age	-.065	.001	.286
Respondent sex	-.065	.015	.209
Education level	.125	.012	.038*
Marital status	-.059	.012	.279
Size of land owned	-.209	.004	.001**
Capital	.447	.006	.001**
Knowledge on irrigation methods	.157	.029	.001**
Irrigation methods	.084	.013	.084
Source of water	.357	.008	.001**

*=Significant at <P 0.05 and **= Significant at <0.001

4.0 CONCLUSION AND RECOMMENDATIONS

Majority of the community had knowledge on irrigation farming and most of them attended trainings on irrigation. On irrigation methods used were dominated by surface irrigation and few farmers are practicing drip irrigation and using sprinkler. However, available canals are not well managed as a result water leakage exist which led to substantial loss of water before reaching farming plots.

Major source of water for irrigation was from runoff catchment reservoir which collects rain water from stream. Few farmers also depend on water wells which are dug locally at their farms, as well as bore holes. Factors that positively influenced farmers' engagement in irrigated farming included access to capital, availability of water, having knowledge on irrigated farming, and increased education level. However, increased farm size was negatively associated with adoption of irrigated farming.

It is evidenced that irrigation farming contributes to socio-economy of farmers in rural communities like Buigiri ward is important in contributing substantial portion of food which is either used directly by the rural communities or sold to earn cash for households' welfare. It is therefore a potential industry that needs a boost by improving irrigation agricultural technologies and support from favorable socio-economic policy, as well as efficient institutional support services because there is need to accelerate technology uptake to address declining farm productivity being experienced by rural communities. Public and private institutions should help the community in the study area to solve problem of leakages in the canals and increase number of bore holes so as to increase reliability of water.

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