Implications of Self-selection Effects and Transaction Costs on Implementation of Collective Action Management for the Common: Evidence from Smallholder Irrigated Rice Farms in the Lake Victoria Basin, Tanzania

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Abstract

This paper explores how farmers self-select into irrigation farming ecosystem, and describe their characteristics and effects on Collective Actions (CA) management in irrigation systems. The study sampled seven irrigation schemes; both traditional improved and modern ones located in the Lake Victoria basin, namely Mahiga irrigation scheme (Ngudu), Igongwa (Misungwi), Nyida (Shinyanga rural), Maliwanda and Nyatwali (Bunda), Cheleche and Irienyi (Rorya). Cross sectional research design is employed to collect data from a total of 184 randomly sampled farm households involved in rice irrigation farming. Collected data are analyzed using Heckman two step procedures to identify self-selection factors. The inverse mills ratio result from the Heckman model is positive and significant at less than 5 % level, confirming the evidence for the presence of self-selection for the sampled farmers. Factors like large number of household labour force; non tangible benefits like reciprocated information sharing and use of CA association as a bridge to access support; good working rules in the group; net area sown; trust in group members and leaders; irrigation position; respect of public services provision /contributions**;** dodging contributions**;** violation of rules are important determinants of self-selection, each with specific implication that impact positively or negatively on CA survival. The study concludes that irrigation farming ecosystem choice is a non-random choice, and hence selection of members for organized CA establishment should base on factors described above, which significantly impacted positively self-selection into treatment (irrigation ecosystem type).

Key words: Collective action; smallholder farmers' irrigation systems; transaction costs; Self-selection; Heckman two step procedures; Tanzania

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1.0 Introduction

Governments in developing countries worldwide have transferred in a varying degree the rights and management responsibilities for natural resources such as forestry, rangelands, protected areas, water sheds and, irrigation systems to the communities (Meinzen-Dick, 2004; Araral, 2008). This policy shift is a response towards among other factors, greater awareness of the governments in regard to incentive problems happened amongst these resources management. In Tanzania, the irrigation sub-sector governance and management policy requires users of water to organize themselves in a collective action mode so that they can access water through a common water-rights permit (NIPO, 2010). The common water rights permit is an institution with clearly defined property rights and legal aspects considered to allow contracts to be enforced for water resource utilization based on collective management of the group (water users).

In Tanzania, the irrigation systems are either traditional improved or modern schemes which, are all managed by the community organized themselves into groups of irrigators or water users' association (WUA) in accordance with the rights and eligibility of member participation in the irrigation farming as defined by their institution (collective action management formed) and government common resources management guidelines. It was expected that organized water user groups in a CA is a strategy that translates into efficient performance of irrigation systems in Tanzania (NIPO, 2009; NAPO, 2013). However, the envisaged expectation of water users organized group as a strategy to enhance efficient performance has not been the case because most irrigation systems perform poorly, as a result low level of irrigation farming practice is evident (You *et al.* 2011). A number of factors have been argued to contribute to the problem in irrigation schemes, like poor operation and maintenance of infrastructure, poor water management and control, inefficient extension services (NIPO, 2009), and farmers' disregard of by-laws (Rajabu and Mahoo, 2008), which altogether are embodied in a collective action management and member commitment behavior. Understanding better the working of CA is important to make irrigation systems and policy in Tanzania more effective. Little or none is debated in the literature on the actual working of CA and its mechanism of organizational efficiency in irrigation systems.

A good number of literature e.g. Meinze-Dick, (2000), and Ostrom, (2002,2010), have identified factors such as group size, physical characteristics of the common resource, and characteristics of resource users influence collective action successfulness in the commons. At the same time, Komakech *et al.* (2012) studied how local institutions (laws, norms) emerge to facilitate CA in a small water catchment area in Tanzania; they argued that a combination of inequalities and interdependence of resource users explain sustained CA. Generally, these studies provided insights on factors which facilitate CA management, but they did not explicitly tell the extent of their effects. For example, how member farmers self-select into groups or farming types, and how related transaction costs (management) influence choices and acceptability of CA- which is the subject of this study. Self-selection is the tendency of people to make choice based on their abilities, needs and preferences –or simply based on their attitudes. At the same time transaction costs are the costs of contact or search, cost of contract or negotiating terms, and control or cost of monitoring and enforcement of agreements arising as a consequence of uncertainty (incomplete contract, information asymmetry, and asset specificity investment to the transaction) (Williamson, 2005; Groenewegen *et al*, 2010). In irrigation systems, transaction costs could be defined as the costs arising from acquiring and handling the information about the mobilization of voluntary cooperation on irrigation infrastructure operation and maintenance (O&M), water allocation and distribution, water management and control, contributions of relevant fees and contracts compliances, as well as social contract/ resource users' reputation (respect of laws and regulations) on interactions, and so on. Farmers can self-select their farming ecosystem types also based on unobserved behavior (heterogeneity) to cope with their preferences and needs. In this regards manifestation of CA member commitment can be understood better using self-selection analysis technique.

Most of the previous work studying CA have assumed zero transaction costs and exogenous variables, which is not the case, and they have ignored some relevant non tangible values like social networks and helpfulness, and unobserved differences (heterogeneity) resulting from preferences among households such as livelihood strategies/adjustments like choice of farming ecosystem type, accessible local economic opportunities, abilities and attitudes, inputs used, and engagement in off farm (or entrepreneurship) activities, which can condition farmers' decisions to foster or deter CA successfulness (Dercon *et al.* 2012).

This very study therefore, explored in details the interdependence of group characteristics and the farming ecosystem type and choice surrounding farm households in the context of self-selection amongst irrigation famers with the view to understanding their effects on CA management successfulness. In particular, evaluated the attitude among farmers and the nature of CA survival: establishment method and commitments there in, transaction costs and socio-economic factors for successfulness. Criteria generated from member farmer's decisions on CA participation and commitments in the irrigation scheme are important indicators (factors) for CA establishment and performance evaluations of irrigation systems software.

The remainder of this study is organized as follows. Section 2 presents conceptual and theoretical framework. Section 3 describe the methodology and types of data used. Section 4 presents and discusses the estimated results. Section 5 provides conclusion with recommendations.

2.0 Conceptual and theoretical framework

The policy for irrigation schemes operations and management provides power to the irrigators organizations (water users' association groups). At the same time, to be an irrigator one must be an irrigator member, and that should own land in the irrigation scheme (NIPO, 2010). Apparently, this restricted participation in the irrigation scheme raises sample selection problem due to nonrandom assignment into treatment. This action situation renders participants self-select into treatment presumed on the basis of economic arguments outcome in mind and unobserved characteristics. Self-selection could produce endogeneity, which manifests into discrete constructs with 'endogeneous' in nature such that have outcome implications; that is a cause and effect (Heckman, 1979; Clougherty et al, 2016). In fact, self-selection endogenety based represent omitted variable bias (Clougherty et al, 2016).

Theoretically, omitted variable occurs when regressor X which is correlated with both dependent variable and one or more regressors is left out of the model, and so the variance explained by omitted variable Z falls on the error tem (Stone and Rose, 2011). It is in this essence that with the restricted participation policy in irrigation scheme, it points that participation choice data are missing - caused by another omitted variable, Z, - which drives farm household decisions through evaluative criteria and unobserved (heterogeinety) characteristics, that is whether or not irrigation resource (participation) is valued. So whether or not we observe irrigation farming ecosystem choice as an outcome of policy action (treatment) depends on individual farmer decisions, whether they value the irrigation resource for their livelihood or not.

Consistently, we conceptualize the variables relationships based on utility function, and presume that farmers are rational individuals who have full knowledge and information on the following aspects: the importance of the irrigation resource for their livelihood, all strategies available in a particular situation including associated outcomes, understand the behavior of others in the irrigation scheme and working of the rules, and finally implicitly rank in orders such outcomes in terms of individual preferences, measured by utility (Ostrom, 2010).

The decision whether a farmer chooses to be a member of irrigation water users' association group (farming type 1) in a given irrigation scheme is likely influenced by governance characteristics and transaction costs among other local economic endowment, like land ownership –whether hired or owned, including the position of the field plots (head ender, middle or tail ender) and likely proportion of land area sown over cultivated within the irrigation command area. Governance characteristics can be order (e.g. cohesion or conflicts) and arrangements such as coordination, e.g. communication and monitoring strategies, which make use of formal or informal rules in the transaction relations (Williamson, 2005; Deneke *et al*. 2011).

3.0 Methodology

The study area

The study was conducted in the Lake Victoria water basin (LVB) covering seven irrigation schemes both improved traditional and modern ones hosted in each of the five districts named in brackets: Mahiga irrigation scheme (Ngudu), Igongwa (Misungwi), Nyida (Shinyanga rural), Maliwanda and Nyatwali (Bunda), and Cheleche and Irienyi (Rorya). These districts have different agro ecological system defined by different farming system zonation (FSZ) that is characterised by soil types and input-output market conditions as important factors to distinguish the zonation.

Rice farming is the major crop cultivated in all of these irrigation schemes. These irrigation schemes also differ in terms of infrastructure status and sources of water. For example, Mahiga, Igongwa and Nyida irrigation schemes are traditional improved irrigation schemes, which depend on temporary rivers for their water source, while Maliwanda, Cheleche, and Irienyi are also traditional improved scheme, which have reservoir/ dams to collect rain water during the season. These schemes are active during the rainy seasons. On the other hand, Nyatwali irrigation scheme in Bunda district is the only modern scheme which was constructed based on engineering requirement and more than half of the canals are cemented. It uses electrical pump for water abstractions with the main sources of water being Lake Victoria, hence the scheme operates all year round.

Altogether, the management is guided by the National Irrigation Policy (NIPO, 2010). The management involves various stakeholders at various levels, ranging from National, Local Government Authority, Irrigators Organizations (Water Users Associations/groups), and irrigation farmers who are the direct beneficiaries of the resource use and implementers of the farming activities within the scheme. The latter two are the focus of this paper.

Research design
The study relied on primary data involving cross sectional design, which drawn individual farmers participating in irrigation farming. The collected data comprised of farm households and groups' aspects/characteristics, which covered mainly the governance, transaction costs, technology characteristics, and the social capital variables in the form of their various proxies. Farm household was used as a unit of observation for the analysis. To identify the causal effect relations, the design compared farmers participating in the irrigation farming by creating clusters during analysis: those engaged in irrigation farming perse*;* and those engaged in both irrigation and rain fed ecosystem farming in each of the scheme surveyed to identify the factors which reflect manifestation of whether CA is valued.

Sampling procedure and sample size
The survey employed a multi stage sampling procedure based on two stages approach. First, purposive sampling was used to obtain a total of 7 irrigations schemes-both traditional and modern which are distributed along water basin of Lake Victoria in the five districts described above. The selection criteria for the irrigation schemes were based on the potential functional (operational) of the irrigation facilities, and age of the scheme (that is, has been working/operational for the past 5-10 years or so) in order to capture the dynamic conditions. The second stage involved survey respondent selection, where from each scheme, 30 farm households- participants in the irrigation farming, in addition to off farm activities engagement were randomly sampled. In total 7 irrigation schemes, and initially 210 households were thought, however, 184 households (about 87.6% response rate) was reached after data cleaning and management.

Data types
Dependent variables: The study objective was to explore the determinants of how farmers self-select into farming types (irrigation and otherwise/rain fed) ecosystems, and describe their characteristics and effects/impact on CA management. Based on the theoretical foundation of self-selection method as described by Heckman, (1979), the dependent variable data type was constructed to suit two step procedures. In the first step, the dependent variable was constructed based on the choices made in accordance with farming types ecosystems. These data were measured as dummy variables; either the farmer chooses the farming type1 or not (coded as 1= irrigation and 0= otherwise). The second step dependent variable was assigned a dummy variable to ascertain the decisions for those farmers chose farming type 1, if they value the choice made or not as measured on their responses on irrigation dependency (reliance), coded as 1= depend/value irrigation farming for their livelihood, 0= otherwise).

Independent variables: The independent variables were constructed from data set/information gathered that were classified into three groups (i) Biophysical and irrigation characteristics, which comprised of irrigation type /infrastructures status, soil fertility status, and water source (ii) Attributes of irrigators organizations (Water users' association), which included group regulations/ management in relation to TCs (contact, contract, and control), governance (leadership style and managerial discretion) like number of meetings convened, and contract compliance rates, which were captured in their various proxies. Attitudinal behavioral data such as respect of public service provision (contributions), dodging contributions, and violation of rules were capture in a likert scale technique during the survey and analysed using factor reduction technique, where proposed factors were reduced into Factor1, Factor2 and Factor3 respectively, and retained for final regression analysis (iii) household characteristics, these included respondents age, education, sex, household labour force eligible for farming, total household annual income, farm financial support, improved seed input use, recognition of local economy in the surrounding area, and measurements of the appreciation of non-tangible benefits like information sharing (frequency), and farmer to farmer helpfulness. Detailed measurement of data for all variables used in the regression analysis is presented in Table 1.

Method

The analysis involved estimation of probit Heckman selection model, which controls for self-selection to identify factors that explain the choices made by farmers. To estimate the effect of farming type choice on CA management, data gathered allow two step procedures: that the farming type 1 ecosystem choice is observed for those farmers who chose to participate in irrigation farming, only if they value participation the most. In this case, the dummy variable that measures whether or not they value (rely up on) participation is modelled directly as dependent variable in a simultaneous equation in the two steps for sample selection model as proposed by Heckman (1979).

The modeling proceeds in a sequential process as follow: first, estimation of regression equation considering the mechanism determining the outcome variable of interest, and second, the selection equation considering part of the sample whose outcome is observed and the mechanism for the selection process.

Mathematically the two equations for the individual i on the sample of Nobservations are formalized as;

$$Y_{1i} = X_{1i}\beta_1 + U_{1i} \tag{1}$$

$$Y_{2i} = X_{2i}\beta_2 + U_{2i} \qquad i = 1, \ldots, I \tag{2}$$

Where,

Y_{1i} is the dependent variable observed for a sub sample only if a binary variable $Y_{2i} \geq 0$

X_{ji} is a $1\ x\ k_j$ vectors of exogenous variables

β_j is a $k_j x\ 1$ vectors of parameters to be estimated

$$E\left(U_{ji}\right) = 0\,, \quad E\left(U_{ji}U_{j'i''}\right) = \sigma^{jj^i} \quad , \qquad i = i''$$
$$= 0, \qquad i \neq i''$$

If σ is non zero, correlation between the two error terms exist and sample selection model can be consistently estimated.

As given above, the sample selection rule provides that the availability of data on Y_{1i} is observed only if $Y_{2i} \geq 0$, it follows that,

$$E(U_{1i}|X_{1i}, \qquad Y_{2i} \geq 0)$$

$$E(U_{1i}|X_{1i}, \qquad U_{2i} \geq -X_{2i}\beta_2)$$

The conditional expectation for the subsample observation of Y_{1i}, has the regression function given in equation (3) as,

$$E(Y_{1i}\ |X_{1i}\ , Y_{2i}\ \geq 0) = X_{1i}\ \beta_1 + E(\ U_{1i}|U_{2i} \geq -\ X_{2i}\ \beta_2) \qquad (3)$$

If $E(U_{1i}\ |\ U_{2i}\ \ \geq\ -X_{2i}\ \beta_2) = \frac{\sigma_{12}}{\sqrt{\sigma_{22}}}\ \lambda_i$ and,

$$E\ (U_{2i}|U_{2i}\ \geq -X_{2i}\beta_2\ ) = \frac{\sigma_{22}}{\sqrt{\sigma_{22}}}\ \lambda_i$$

Then, the inverse Mills ratio, $\lambda = \frac{\theta(Z_i)}{1-\emptyset(Z_i)} = \frac{\theta(Z_i)}{\phi(-Z_i)}$ (4)

Where, θ and ϕ are the standardized normal density and distribution functions respectively. The inverse Mills ratio is the monotone of the decreasing function of the probability that an observation is selected into the sample. The regression function depends on X_{1i} and X_{2i}.

4.0 Results and Discussion

4.1 Descriptive Statistics

Table 1 summarizes variables names, their definitions, unit measures, mean values and standard deviation. Self-selection in this context refers to the tendency of farmers engaged in irrigation farming to make choices that are relevant to their preferences, ability and needs in respect to the farming system types (irrigation and rain fed). The choice is usually influenced by economic opportunities surrounding them based on observed and un observed (heterogeneity) characteristics. Thus, specific identification of self-selection factors is crucial in understanding irrigation farmers' behavior and developing recruitment and retention strategies for irrigators CA members committed to work with greater impact in the irrigation systems. A number of explanatory variables in an exclusion restriction (to avoid collinearity problem) were included in the regression model with sample selection to determine farmers' behavior, examine the effects/impact of self-selection on the choice of farming type and implicitly reflecting CA commitment. The null hypothesis that the decision for farmers to self-select into farming type does not base on TCs (contact, contract & control), economic opportunities in the area and perceptions of non-tangible benefits like socio network such as reciprocated information sharing was also tested. The summary descriptive statistics and definition of variables used in the Heckman selection model two step regressions are presented in Table 1.

Table1: Descriptive statistics and definition of variables used in Heckman two step regressions

Variable	Definition	Unit measure	Mean	Std
type1irrg	irrigation farming ecosystem choice: 1= irrigation farming, 0= otherwise	dummy	0.917	0.28
totfarmland	Total farmland size owned (acres)	acres	2.53	2.46
Age	Respondent's number of years old	years	44.09	12.00
sex	1=male, 0= female	dummy	0.803	0.39
hhlabor	Number of members eligible for farming at household	number	3.93	2.23
educ	Respondent's education level 1= standard7, 2= secondary, 3= tertiary	Categorical	2.95	1.01
trust	Trust in group members regarding irrigation resources utilization: 1= yes, 0= no	dummy	0.95	0.19
irigntyp	Irrigation type depended 1= modern, 0= traditional improved	dummy	0.16	0.37
farmsacspt	Farmers financial support from saccos 1=yes, 0=no	dummy	0.25	0.43
imprvseed	Use of improved seed1= yes, o=no	dummy	0.73	0.44
soilirrgat	Soil fertility status in irrigation farm land: 1= fertile soils, 0= otherwise	dummy	0.37	0.48
totincome	Total household income (Tanzania shilling)	TSh (currency)	1 804 523	1651419
econoprtnity	Recognize economic opportunities availability 1=yes, 0 otherwise	dummy	0.64	0.48
irrgreliab	Irrigation farming reliability: 1= depend on, 0= no	dummy	0.73	0.45
irgnetareason	Irrigation net area sown: acres	acres	2.13	2.15
Nontangible	Non tangible benefits: technology information sharing, 2=farmer to farmer helpfulness,3= producer marketing power, 4= use of CA as bridge for external support	categorical	0.8	0.40
Irrgdist	Distance of irrigation scheme from the homestead: km	km	2.11	3.43
Irrgtrain	Irrigation technologies training acquisition: 1= yes, 0= no	dummy	0.75	0.43
Irigposition	Position/location of farmer plot in the irrigation scheme: 1=head, 2=middle, 3=tail	categorical	2.12	0.66
Factor1	Respect of public services provision /contributions: likert scale	Likert scale	6.12	1
Factor2	dodging contributions: likert scale	Likert scale	-2.43	1
Factor3	Violation of rule: likert scale	Likert scale	3.95	1
Contrnmcst	Contract agreement compliance measured in non-monetary cost contribution payment after harvest: bag of rice	Number of rice bags	3.97	5.46
Gpleader	Group leadership: 1= good/satisfactory,0= no/bad	dummy	0.65	0.47
ruleworkdumy	Working of rules and enforcement in a CA: 1= good, 0 = bad	dummy	0.64	0.48

4.2 Self-selection and transaction costs on implementation of collective action management

Results of the Heckman two step sample selection regressions are presented in Table 2. The data set contains missing values therefore, observations with missing data were removed, and hence, only a sample of 67 observations remained for the econometric estimation. The Wald chi square test for the model fit indicates significant differently from zero at less than 1% level (Chi-square probability = 0.000). Furthermore, the correlation factor (inverse mills ratio) result for the model is positive and significant at less than 5 % level (p=0.028) providing evidence for the presence of sample selection, hence suggesting that the irrigation farming ecosystem choice (*type 1 farmer*) is a nonrandom choice. The positive numerical value for the inverse mills ratio suggest that there is positive selection effects in these data and those who select into the irrigation farming rely most on the ecosystem than a random drawing from the population with comparable characteristics. Therefore, the unobserved factors that make choice more likely tend to be associated with higher level of irrigation farming participation choice dependence status-implicitly a manifestation of valuing and respect of law for CA. On the basis of these results the null hypothesis was rejected in favour of the alternative, and concludes that farmers self-select into farming ecosystem types (*type 1 farmer*) on the ground of TCs (contact, contract & control), economic opportunities in the area and perceptions of non-tangible benefits like socio network such as information sharing, besides unobserved characteristics not directly measured.

Specifically, the first stage (outcome) regression results are informative in understanding the characteristics of individual farmers engaged in the irrigation farming (*type1 farmer*). Five factors (variables) were significant in explaining irrigation farming ecosystem type1 choice. The variable **Age** coefficient is negative and significant at 10% level suggesting that younger farmers are more likely to choose for irrigation farming ecosystem type1 than would old farmers do, probably because younger farmers are energetic with less household responsibilities and also commercial oriented, so could afford complying with the collective action (CA) social contract arrangements without dodging, since they value the resource for their livelihood development and sustenance. The variable **sex** is positive and significant at less than 1% level suggesting higher probability of men than women to participate in irrigation farming. A possible reasoning is probably due to the traditional and customary patterns in the African setting in general, and Tanzanian in particular - that men have higher influence on the access and control of resources and the responsibility to ensure household security. Men can also endure- in case of havoc arising for the irrigation facilities use amongst water users association (WUA) members, besides having opportunities to attend various trainings than women would do. The variable education level (**educ)** categorized into: primary level; secondary level; and tertiary (college and University) levels were all positive and significant at less than 1%; 5% and 10% respectively.

Table 2: Heckman two step selection model regression results

Variable	Coefficient	SE	Z value
type1irrg			
Totfarmland	-0.0069	0.0159	-0.43
Age	-0.0049	0.0029	-1.68***
Sex	0.2223	0.0766	2.90*
Hhlabor	0.0082	0.0131	0.63
Educ: primary	0.2254	0.0815	2,76*
Secondary	0.3945	0.1822	2.17**
College	0.2459	0.1313	1.87***
Trust	1.2542	0.2154	5.82*
Irigntyp	-0.1711	0.1607	-1.06
Farmsacspt	0.0955	0.9525	1.00
Imprvseed	-0.1277	0.1368	-0.93
Soilirrgat	0.1103	0.0550	2.00**
Totincome	2.93	2.65	1.10
Econoprtnity	-0.0487	0.0884	-0.55
Const	-0.4365	0.2358	-1.85***
Irrgreliab			
Irgnetareason	-0.5426	0.2449	-2.21**
Nontangble: information sharing	-1.2407	6.5486	-0.19
:use of CA as bridge	2.7261	1.1415	2.39*
Hhlabor	0.3463	0.2087	1.66***
Trust	3.1257	1.687	1.85***
Irrgdist	0.0173	0.2105	0.08
Irrgtrain	1.0182	0.9972	1.02
Irigposition: headender	-	-	-
:middle	0.0527	0.8032	0.07
:tailender	-2.3710	1.0495	-2.26**
Factor1	1.4812	0.6924	2.14**
Factor2	0.8233	0.4260	1.93***
Factor3	-2.9112	0.9641	-3.02*
Contrnmcst	0.0226	0.0506	0.45
Gpleader	-0.0131	0.0094	-1.4
Ruleworkdumy	1.7707	0.8322	2.13**
Totincome	-2.56	3.71	-0.69
Lamda	0.1613	0.7361	2.19**
Constant	-3.1527	2.2699	-1.39
Wald Chi^2: 84.87			
Prob> Chi^2: 0.0000			
N: 67			

Notes: Significance levels: * = p<1%, ** = p<5%, and ***= p<10%

These results suggest that education is an important determinant of farming ecosystem choice, with primary level individuals having higher likelihood of choosing and relying on type1 farming ecosystem, followed by secondary level and lastly those with tertiary education level. The higher probability of choosing type 1(irrigation farming ecosystem) for individuals with primary level of education is perhaps the fact that farming is their main occupation as opposed to the more educated individuals (with secondary and tertiary levels) who are more likely to seek and easily secure other formal employment /jobs elsewhere. The variable trust of individuals in irrigation group and leadership (**trust**) was positive and significant at less than 1% level, suggesting that increase in trustworthy is likely to increase choice and reliance of type 1 farming ecosystem. The reasoning is straight forward that farmers require exclusive rights and benefits realization on the use of resource without reasonable doubt arising from group or resource management.

The variable soil fertility status in the irrigation command area (**soilirrgat**) - a dummy variable defined as 1= fertile soils, 0= otherwise, was positive and significant at less than 5% level. Not surprising, having fertile soils in the irrigation land increases the probability of farmers' participation because they are sure of realizing higher yields, hence this calls for irrigation land improvement. The economic opportunities variable (**econoprtnity)** paints an interesting picture in the farming ecosystem choice (irrigation participation and reliance). The coefficient is negative and not significant. Though it is not significant, results suggest that increasing availability of economic opportunities in the area reduces the likelihood of farmers to participate in the irrigation farming, perhaps because they can be engaged /earn their livelihood from other available wider economy stream sources. This has an implication on the importance of irrigation resource to the users. These results conform to the findings by Ostrom, (2010) that if the resource is not important to the users then the likelihood of managing it efficiently might be doomed. The variable related to SACCOS/financial support for farmers (**farmsacsupt**) is positive and not significant. Though the coefficient is not significant the positive sign suggests that the irrigation farming ecosystem choice is likely influenced by existence of SACCOS/ financial support rendered to farmers to enhance capital investment. This is particularly important because irrigation farming requires capital investment to meet operations and maintenance aspects and other own production and marketing costs obligations. These results therefore point to the need of a clearly well managed finance-irrigation schemes linkage model to support farmers fully participation in the irrigation farming ecosystem.

The variable irrigation type (**irigtnype)** (defined as 1= modern and 0= tradition) was negative and not significant. Despite the fact that irrigation type variable did not matter in influencing choice, the results suggest that farmers in tradition irrigation systems were less likely to choose and rely on irrigation farming ecosystem-implicitly were not likely to value the irrigation system, and consequently the CA, perhaps because of un reliability of the physical availability of water resources for most of irrigation schemes which depend most on rainfall that is erratic-the situation, which pre dispose farmers at production risks. These results point to the need of improving irrigation schemes hardware to enhance efficient and physical resource use reliability. The variable improved seed use (**imprvseed)** is negative and not significant suggesting an opposing influence in the choice of irrigation ecosystem. The possible explanations can be probably because improved seeds are not readily available in the formal seed system marketing, hence making it difficult and skeptical to rely on improved seed. Other explanation can be because improved seeds require intensive inputs use for an ideal management, yet inputs are expensive that farmers cannot afford to comply with in a recommended package and hence resulting into low returns compared with irrigation investment made, or it can be that improved seeds have no preferred traits for production, marketing and consumption. The variable total household income (**totincome)** is positive and not significant. Although not significant, the sign for the coefficient suggests that individual farmers with high total income were likely to choose for irrigation farming ecosystem. These results are not surprising because irrigation farming requires capital investment both cash and non-cash. The variable coefficient for total household farmland (**totfarmland)** is negative and not significant. The negative sign results suggest that households with less total farmland were less likely to choose irrigation farming ecosystem perhaps because a smaller land ownership payoff does not motivate engagement in irrigation farming when compared to the investment costs required in a CA setting for irrigation farming.

The selection regression results indicated that several factors are important determinants of farmers' self-selection into types. The model fit and correlation factors results as described above have confirmed the presence of sample selection. The variable household labour (**hhlabor**) coefficient was positive and significant, suggesting that households with greater number of members eligible and engaged in farming self-select into the irrigation farming type, perhaps because they can have a freedom of labour division ''without compromising'' to meet household's tasks and compliance with CA social contractual arrangement as per irrigation group organization and institutions (laws, norms) requirement. Farmers can also self select with respect to non-tangible benefits, the variable that had options, which included: farmer to farmer helpfulness (reciprocity information/material sharing), and use of CA as a bridge to acquire external services support like research, extension advisory services, and business development. The variable non-tangible benefits (**non-tangible**) particularly, the option for use of CA organization as a link/bridge for external support is positive and significant suggesting the likelihood of farmers to self select into irrigation ecosystem type. This can be important for those farmers committed and strategically wishing to receive external support services to boost their efforts for livelihood improvement. These findings point to the need of strengthening public policy support services particularly, those related to irrigation technologies as well as business development and chain wide collaboration.

The working of rules variable in the irrigation group (**ruleworkdumy**) is positive and significant; suggesting that farmers evaluate the implementation and enforcement of rules in relation to their benefits would be realized in the irrigation systems. In this respect, farmers self select on the basis of '' perceived'' good functioning of the rule, and hence irrigation ecosystem choice is, as a result observed. Therefore, the impact of this self section might be compliance of irrigation contract arrangement because they respect the authority as a result of good rules and enforcement, hence abide by irrigation CA institutions (activities participation and contributions). Rules enforcement varies between groups and leadership styles across the irrigation schemes, and hence important aspects in explaining non-random choice depending on individual farmer's preference and attitude. These results point to the need of carefully screening/choice of group members and leaders those would implement and enforce the rules to the expectation of perceived good rule in the irrigation systems. The good rules and enforcement as perceived by farmers are characterized by fair consideration of resources distribution and accountability of coffers to the benefit of all members. The variable irrigation net area sown variable (**irignetarea**) is an important determinant for self selection. The coefficient is negative and significant at less than 5% level, showing that farmers self select based on the net irrigation area sown such that farmers with less net area sown do not value participation on irrigation farming, which explicitly indicates less commitment and value of CA social contract agreements, as a result irrigation farming ecosystem (type 1) is observed for those not choosing for irrigation farming type1. This is not queer because farmers are rational, and thus evaluate implicitly the cost-benefits of CA participation in irrigation schemes and what would be realized when compared with such a smaller area sown. In other words, the impact for this self selection might be associated with low morale/motivation to choose for the type1 farming ecosystem in that regard. These findings therefore call for equitable distributions and allocation of land and tasks requiring CA in the irrigation schemes depending on individual farmer's area sown.

Trust variable (**trust**) in group members and leaders was positive and significant determinant of farmers self-selection into types of farming ecosystems for those farmers with access to irrigation facilities. Results indicated that irrigation farming ecosystem choice was observed on the ground of trust. Trust plays an important role in social interactions, particularly in enhancing the provision of public good services. These findings are similar to other studies like Kreps, (1990), and Sene, (2012), which also indicated that trust reduces TCs, and predict/ encourage participation in local public goods production. The impact of this self selection might be encouragement of individual farmer who chooses irrigation ecosystem type 1 to cooperate in a voluntary way for the activities in the public goods provision such as in irrigation schemes, reduce free riding, and hence respect of the law in the CA. However, because trust manifestation for an individual is not easy to predict /show, this points to the need of devising fair mechanisms for resources distribution and accountability, which might be used as proxy indicator for trust. Furthermore, farmers self select into types on the ground of irrigation positions/ location of plot(s) in the irrigation schemes. The variable for the irrigation position/location was based on options of: head ender, middle and tail ender. The variable irrigation position (**irigposition)** tail ender option is negative and significant at less than 5% level suggesting less likelihood of choosing for irrigation farming ecosystem. This is perhaps because of the fact that being at the end part from water source pre-dispose one at lower chance of having sufficient water required for the crops- moreover, poor water management and control, hence irrigation farming choice is not observed for the tail enders.

The impact for this might be free riding, dodging contributions and violation of rules set forth. This calls for fair resource distribution amongst WUA members. Other options (head ender and middle) were positive and insignificant. The variables related to attitudinal behavioral factors (in a factor reduction analysis approach) with options which included: respect of public services provision /frequency contributions (**Factor1**); dodging contributions (**Factor2);** and violation of rules (**Factor 3)** were important determinants for farmer self selection into types. The variable related to respect of public services provision /contributions (**Factor1)** was positive and significant at less than 5% level. Attitude related to frequent contributions and respect of public service provision is relevant for commitment in the irrigation farming ecosystem under CA. The impact of this self selection is relevant for retaining CA members committed to participate in the irrigation farming ecosystem (type1). The variable with respect to dodging contributions **(Factor2)** was positive and significant at less than 10% significant level. Self selection with respect to factor2 is equivalent to free riding and opportunistic behavior. Free riding is maximization of own welfare without compensation of others' efforts such as dodging contributions to the irrigation CA efforts, where as opportunistic behavior occurs when actors deliberately take advantage of the situation in pursuit of self interest at the expense of others, which can be cheating or hide of relevant information. Farmers with non-commitment behaviour or those worry contributions because of mismanagement albeit relying on irrigation farming ecosystem might also self select into type.

These results also conform to Komakech *et al*, (2012), that interdependence of group members sustain CA. Therefore, the dodging behavior might be due to the fact that dodgers expect others to contribute for them because those who comply have the ability, or that those who dodge have no ability to contribute despite reliance of the resource use for their livelihood sustenance. The impact of this self selection is important for understanding CA members' incomes ability and recruitment strategy for public services provision. It is also important to understanding the level/amount affordable to be contributed by all members to enhance compliance rate. The variable violation of rules (**Factor 3)** is negative and significant at less than 5% level, implying that farmers with attitude towards violation of rules such as diversion of irrigation water and other disobedience of laws/bylaws are likely not to be in the irrigation farming ecosystem type1 sample, particularly in the LVB because they are the ones violating the contract agreement in a CA, and perhaps a sufficient percentage of individuals subscribe to the institutions (formal and informal rules) due to bad repercussion experienced . Other variables were not significant and hence did not matter in influencing farmers to self select into treatment (type 1 farming ecosystem).

5.0 Conclusions and Recommendations

The study concludes that irrigation farming ecosystem choice (*type 1 farmer*) is a nonrandom choice, and hence selection of members for organized CA establishment with greater impact on irrigation systems performance should base on factors such as families with greater number of members eligible and engaged in farming at household- much as labor market is imperfect, and mechanization is rudimental; non tangible benefits, particularly using organized CA as a bridge to help farmers get support from various service providers in implementing sustainable farming practices and take part in post- harvest agribusiness activities downstream in a value chain management perspectives; good working of rules in the irrigation group is important to encourage and build up attitude related to frequent contributions and respect of law on public service provision because were found to be positive and significantly influencing self-selection into treatment (irrigation farming ecosystem).

On the other hand, factors which impose negative effects/challenges that discourage farmers from fully exerting commitment effort contributions in the irrigation farming ecosystem were: dodging contributions (factor2), and violation of rules/ bylaws (Factor3), which were also relevant for farmers' self-selection. These factors should be accounted for because their impacts are important for understanding CA members' incomes ability and motivation, and recruitment strategy for public services provision. They are also important in understanding setting up contribution level/amount affordable by all members to enhance compliance rate. Overall, the study recommends improvement of mechanization to overcome the high number of household members required to work in irrigation farming. Further, carefully selection of CA members and establishment of sustainable linkages with external service providers will enhance CA survival.

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