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LOCAL WATER USERS' VOICES ON PERCEPTIONS OF EXOGENOUS FACTORS DRIVING WATER INSTITUTIONAL CHANGES IN IRINGA AND KILOMBERO DISTRICTS, TANZANIA

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ABSTRACT

Although there is substantial institutional changes in the water sector, insights into how exogenous factors influence these changes at local levels to remain insufficiently established, especially in developing countries like Tanzania. This study tries to fill this gap by examining local water users' voices on perceptions of exogenous factors that influence water institutional change. To this end, farmer-managed irrigation schemes from Iringa and Kilombero districts in Tanzania were involved as study cases. A household survey using a structured questionnaire was a major tool for data collection. An in-depth interview with key informants and document analysis carried out to supplement information from the household survey. The results indicate that three-quarter of respondents are aware of changes in water management institutions that occur over time, and only 25% are not aware. Thus, even though local water users have reported being aware of institutional changes in water sector context, it looks as those use water is eye lens blinded with news legal institutions, as they seem to turn away from water regulations and water fees. Some important exogenous factors including drought, human population pressure, irrigation infrastructure development and price changes of irrigated crops seem to influence the availability of water by reducing their amount and hence put additional pressures on rules in-use, which is a basis for institutional changes. This has important implications for institutional and structural transformation narratives. Suggesting that policy and decision makers should take into consideration the implication of exogenous factors on water governance narrates.

KEYWORDS: *Exogenous Factors, Institutional Change, Water Sector, Tanzania*

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INTRODUCTION

Experience with the last 50 years of water governance has shown that improvement of infrastructure alone is not sufficient to ensure optimal management gains, let alone economic and sustainability. Appropriate institutions are desirable to accompany technology for equity, economic efficiency, and sustainability of water management. One of the most commonly known definitions of institutions is the rules of the game (North, 1990). Many scholars refer to this definition by stating that institutions are laws, regulations, policies, property rights and define ownership, disposition and use rights to the natural resource as well as policies for protection and exploitation of a resource (Cleaver 2012; Ostrom, 2014; Cleaver

and De Koning, 2015). Institutions can, therefore, be rules, or sets of rules (i.e. arrangements), that structure social interaction by shaping or constraining actor behavior. Institutions influence people's behavior and that provide a degree of stability and predictability in social relations (Hall and Taylor, 1996; Cleaver, 2012). Scholars who subscribe to this definition of institutions appreciate that rules often relate to formalized, written-down regulations (North, 1990; Ostrom, 1990), informal norms and beliefs relate to social relations, culture, normative conventions, and cognitive beliefs (Scott 2001). Both formal and informal institutions play an important role in water resources management in their potential to set rules and demarcate responsibilities between actors; co-ordinate mechanisms to minimize jurisdictional overlaps or deficiencies; bridge the gap between political and natural boundaries; match responsibilities, and serve as authorities and facilitators of action (Cleaver, 2012).In this perspective, these insights have substantiated in management of common pool resources such as water, forest fish and grazing land. In these resources, institutions are crucial in addressing challenges related to fairness in access, allocation and distribution of resources to evade overexploitation and depletion (Haller, 2007; Cleaver, 2012).

As Giddens (1984, p. 42) states, "Institutions by definition are the more enduring features of social life." However, this does not imply that institutions never change. Institutions are not static; they go with the flow as they gradually respond to the external environment and internal pressures (Shepsle and Bonchek 1997). Scientifically, there is a lack of understanding of the effects of exogenous factors of policy reforms at the local level (Andersson 2003). Although ample research has been taken on institutions and natural resource management as well as institutional changes, the exact effect of institutional change on water resource management at the local society remains to a certain extent unpredictable (Ostrom 1990; North, 1990; Vatn, 2005; Hall, 2010). Generally, there is little understanding of the external factors driving institutional change in the water sector, especially in developing countries. It widely increasingly urged that irrespective of the importance of water, efforts to establish legitimate stable water management institutions have often failed because institutional promoters have not recognized the difficulties involved in institutional change and linkage between institutional evolution and exogenous factors (Hall, 2010).

Institutions evolve through continuous interactions and practices normally in response to prevailing situations (Haller, 2010). These prevailing situations are factors associated with institutional change and stability. Available literature leads to an argument that these changes describe a complex process in which the newly designed institutions are partly conflicting with existing socially embedded institutions (e.g. Cleaver, 2012; Cleaver and De Koning 2015). Political consideration has been one of the important factors to determine water institutional reforms in the past (Hall, 2010). However, determinants of water institutional change may vary over time due to the prevailing situation. Evidence suggested that change of governing institutions and structures depends on many factors including human behavior or characteristics, economic and political aspects (Saleth and Dinar, 2004; Sehring, 2009). For examplestudies by Saleth and Dinar (2004; 2005) and Zhang et al. (2014) revealed institutional change is not only influenced by endogenous factors, which are internal to the water sector but also through the influence of exogenous factors that are outside of the water sector.

Endogenous factors may typically include water users' characteristics (e.g. age, sex, education, and power relations); conflicts over water between individual and communities; operational inefficiency of institutions and social linkages. Exogenous factors including among others economic development, demographic growth, technological changes, political and policy reforms, international commitments and natural calamities including droughts and floods (Saleth and

Dinar, 2005; Haller, 2010; Zhang *et al.*, 2014).In this sequence, induced institutional innovations demand and supply changes theoretical perspective, suggest that water rules including tradable water user rights and non-market institutions, may evolve when resources become scarcer (Haller, 2010).

While there is a number of disputes in recognizing the impacts of exogenous factors such as drought, temperature, and population on water access and availability (Paavola, 2008; IPCC, 2013), there are inadequate empirical evidence over how these factors typically influence institutional changes in the water sector. Deficiency of this kind of information is a constraining factor for the development of long enduring institutions. Saleth and Dinar (2004), Haller (2010) and Zhang et al. (2014) underscore the need to understand and consider the influence of various factors on institutional change. Understanding the influence of exogenous factors is important for any development actor seeking to introduce "best-practice" institutions and hence improve water management outcomes (Haller, 2010). As noted by Saleth and Dinar (2005), an appropriate choice of case studies may provide deeper insights into the role of changing external factors in stimulating institutional evolution.

According to Van den Ban and Hawkins (2000), a perception has been defined as the process by which information or stimuli is received from our environment and transformed into psychological awareness. The understanding of people perception about water resource management is very important because it has an influence on the adaptation process. This paper examines the perception of local water users on the exogenous features to explain how they have influenced or are likely to influence institutional change and reformation, and implications of this on the water sector in Tanzania. Such explanations also investigate the design of policies and rules that can ensure good governance of water resources. The paper has organized into five major sections. Section one provides an introduction, research gaps, and objective of the paper. Section two and three describe the theoretical and conceptual framework guided the study and methodology respectively. The paper presents and discusses the results in section four, and finally, the paper provides conclusions and recommendations in section five.

Conceptual and Theoretical Framework

The conceptual framework illustrated in Fig. 1 assumes that drivers of change from outside the water sector have significant impacts on triggering institutional changes and trajectories of water sector development as well as practical water management. The study is based on the concepts of induced institutional innovation and demand and supply theories. According to proponents of these theories, an underlying factor driving the demand for institutional change is the desire to capture benefits made possible through technological development, changes in relative product and factor prices and the size of the market (Feeny, 1988; North, 1990; Wegerich, 2001). The relative advantage of technological development can influence both the demand for and the supply of water. As water, users and managers are aware of the advantages of improved irrigation infrastructure they will likely engage in irrigated agriculture, which then will demand more water putting pressure on existing rules, and this will in many cases likely drive institutional change.

North (1990), using a demand management approach to institutional change, argues that the most single important source of institutional changes is changes in relative prices. Increased demand for irrigated crops raise market prices and could "automatically" influence institutional change as production possibility sets changes, relative profitability changes and the optimal resource allocation changes as well. Mbeyale (2009)studying shifts from common property regimes to private property regimes argues that changes in technology and demand can make the resource more valuable- more rival- and with larger potential to profitably exclude others from accessing the same resource. Hence, changes (increases) in

output prices (crops) for the outcomes of the resource use (water) may then lead to interacting actors changing rules and regulations for managing the water resources. Feeny (1988) follows this up arguing that the basic driver of the demand for changes in institutional arrangements is the recognition that existing arrangements leave potential gains un-captured (institutional failure).

The induced institutional innovation model also takes account other factors such as population increase, increasing drought occurrence, floods and interactions of an increasing number of ethnic groups with different social institutions within a resource regime. Zhang *et al. (*2014) argued that as population increases, more formal common property regimes become more relevant. Changes of tenure and more irrigation land and water use emerges as people's demand for food increases in the area. This would also feed back into various aspects of institutional changes. In general, these factors have accentuated the dwindling water availability in most of the water river basins in Tanzania, including the Rufiji Water River Basin. Binswanger (1978) further argues that institutional change may also occur because of advances in the supply of knowledge about social and economic behavior, organization and change. In the case of water policy and laws, either shifts in knowledge or the social sciences and their related professions could induce changes. Moreover, external knowledge does not necessarily change the entire rules in-use but primarily those that are directly influenced by new knowledge.

In the analytical framework (Figure 1), the agency and actors (elites) as well as processes and practices are important for local environmental actions and encourage changes in institutions. Furthermore, also because of contingent events or influences, issues can become more relevant to actors which might trigger their willingness to support and to further enable changes (Wegerich, 2001). Actors and agency, in turn, form new institutions or establish manifestations of old formal and informal institutions. According to the theoretical framework, it is possible to overcome the problem of free riding through revisions and the formation of new efficient institutions. Furthermore, changes in governance rules and structures are paramount to buffer the effects of exogenous forces on people's access to water for livelihood activities (Walsh, 2012). The implication of institutional change and re-formation is manifested in the processes of managing water to enhance efficient use of the resource.

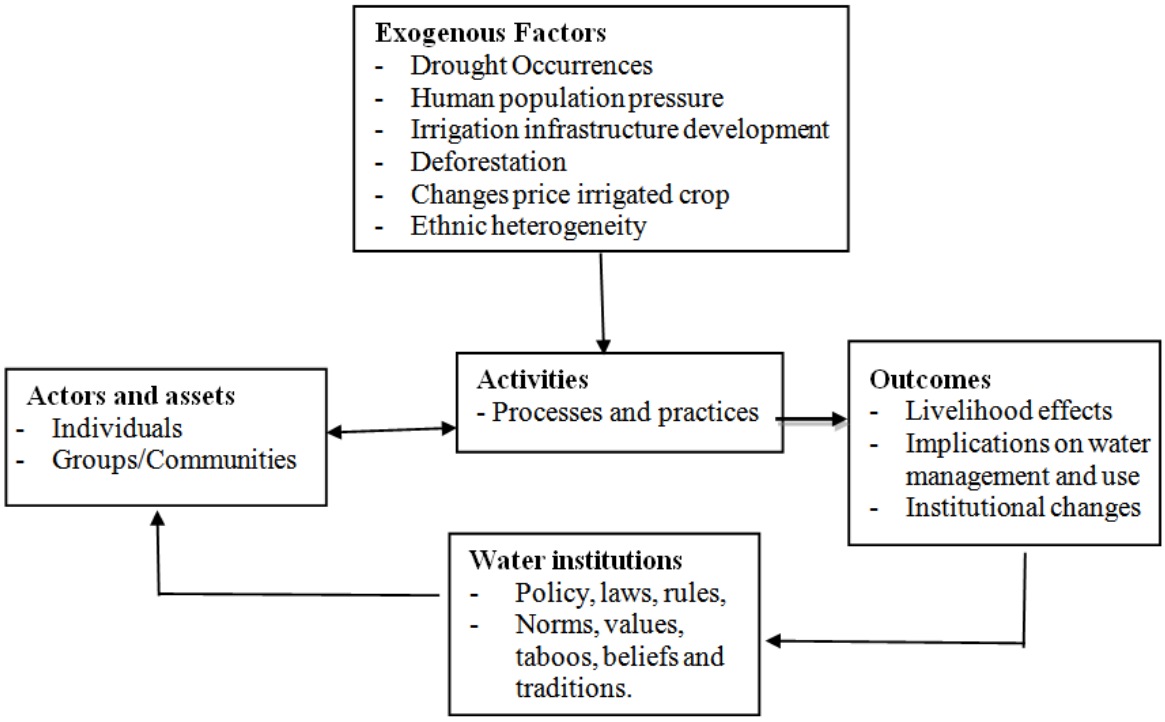

Figure 1: A Framework for Local Institutional Changes in the Water Sector (Source: Authors Constructed 2016)

Like in other African countries, water governance in Tanzania is a mix of formal and informal institutions. These institutions have undergone chance since immemorial. The changes demonstrate a shift from informal (norms, values, and traditions) governance behavior towards more formal governance. Institutions evolve through continuous interactions and practices normally in response to prevailing situations. Available literature leads to an argument that these changes describe a complex process in which the newly designed institutions are partly conflicting with existing socially embedded institutions.

Despite the considerable study of the meanings, roles of institutions, and internal factors causing institutional evolution (e.g. Ostrom 1990; North, 1990; Vatn, 2005) understanding exogenous factors driving institutional remains a challenge (Hall 2010). In other words, the evolution of institutional structures is dependent on human behavior and environmental factors.

Methodology

Study Areas

The study was conducted in Iringa(Iringa Region) and Kilombero District (Morogoro Region), Tanzania. The districts lie within a high potential agricultural area with substantial water catchments in the Rufiji River Water Basin (RRWB). There are several reasons for our selection. First, both districts are among districts that contribute significantly to the national food security through paddy production. Secondly, the two districts face severe environmental challenges related to substantial water and land use changes, policy landscape for Tanzania and climate change.

Lastly, we did consider that the water management institutions in the districts would be in transition processes towards a new institutional landscape. These contexts thus allow us to describe and analyze factors likely to induce and form institutional changes in the water sector. It should be possible to generalize findings, at least to some degree. The

study employed a mixed methods design that entails collecting, analyzing, and mixing qualitative and quantitative data in the same study (Creswell, 2014). A multistage sampling technique was employed in drawing the study sample. Firstly, two divisions, Mkula (Kilombero District) and Pawaga (Iringa District) were purposely selected based on the availability of Farmers Managed Irrigation Schemes (FMIS). Secondly, one ward from each division was selected based on the same criteria used for selecting divisions. Thirdly, two villages in each ward were purposively selected based on being located in the same agro-climatic ecological zone, one having a traditional and the other one having a semi-improved FMIS and that there was a common core irrigated crop. Paddy was a key crop grown in all irrigation schemes.

The schemes and villages (in brackets) selected were Mlenge (Itunundu), Mkombozi (Mboliboli) in Iringa District; Mkula (Mkula) and Magombera-Kibyoko (MAKI) (Magombera) in Kilombero District. Mlenge and Mkula irrigation schemes are semi-improved while the other two are traditional schemes. The study has drawn randomly 172 farm household heads from sampling frames (Table 1).The decision on the sample size (n) was based on Boyd *et al.* (1981) that at least 5% of the total population in each zone is a minimum size to ensure meaningful statistical inference. A structured questionnaire was administered to seek more detailed information on external factors likely to trigger institutional change. The questionnaire was administered by face-to-face interviews. This method is suitable for reaching most rural populations (Laws *et al.*, 2005). In addition, 40 key informants were interviewed to capture community views with respect to the past and present situation related to institutional changes.

Table 1: Household Numbers and Sampling Intensity in Study Areas, Iringa and Kilombero Districts, (2013)

District	Village	Households in the Village	Scheme Name	Households in the FMIS	Sample Size	Sampling Intensity (%)
Iringa Rural	Mboliboli	1 300	Mkombozi	930	60	7
	Itunundu	1 610	Mlenge	854	50	6
Kilombero	Mkula	322	Mkula	322	32	10
	Magombera	294	MAKI	294	30	10
Total		**3 526**		**2 400**	**172**	**7**

Data Analysis

Qualitative data were subjected to content analysis, which reduced and clustered recorded information into smaller, meaningful units based on themes, trends frequently cited and strongly held opinions. Interpretations were made by researchers and subsequently used in the discussions. Statistical data analyses were done using the Statistical Product and Service Solutions (SPSS). Descriptive statistical analysis was computed to determine frequency and percentages. Inferential analysis was done to test the likelihood that the exogenous factors to drive institutional changes.

Farmers' perceptions of institutional changes were measured by using Likert scales. The scale has been found to be an effective technique for the measurement of social attributes such as attitudes and values, awareness, perceptions and norms and knowledge(Likert, 1932). The study used a five-points. Likert scale (5 = strongly agree, 4 = agree, 3 = undecided, 2 = disagree and 1 = strongly disagree). Responses from all statements were also combined to create a measurement of institutional change indicators. The interrelated statements were considered for a period of 40 years. These were as follows:

- Socially embedded institutions have evolved and changed;
- Formal rules including water rights to access irrigation water have changed;

- Cost recovery regulations and involvement of local water users in decision making bodies through representation have changed;
- Conflict resolution mechanisms and the working of sanctions to non-compliants have changed over time and space;
- Forms of social networks such as clan-based groups have changed; and
- Formal water administration organizations have changed.

These basic six statements delineate the main areas of which institutional changes are likely to be prominent during the transition period. This is not to say that there may not be other dimensions of such changes, but we developed these to provide a focus for the empirical analysis. Before further analysis, the responses were subjected to the reliability of a scale to determine whether an instrument can be interpreted consistently across different situations (De Vaus, 2002). The most common measure of scale reliability is Cronbach's alpha, where the value ranges from 0 to 1.0. Cronbach's Alphas that are less than 0.7 are generally considered poor while those between 0.7 and 1.0 are an acceptable value. In our case, the Cronbach's Alpha was 0.762 reflecting that the data were internally fairly stable and consistent. The score from each statement was summed up to get the overall scores per respondent. The most favorable response would have a score of 5 x 6= 30; the neutral opinion towards institutional changes would have a score of 3 x 6 = 18; and the most unfavorable attitude would have a score of 1 x 6 = 6. The unfavorable response was represented by 6 to 17 while favorable opinion was represented by 19 to 30. A score of 18 meant a neutral (indifferent) opinion (Kothari, 2004). On this basis, unfavorable responses below 18 imply institutions did not change (0), while favorable responses above 18 indicate institutions changed (1).

A Binary Logistic Regression Model (Logit Model) was used to determine the influence of the exogenous factors driving water institutional changes. The logit model was selected because the dependent variable which is the decision by the local water users on whether institutions have changed or not was categorized into a 'yes' or 'no' answer. The following equation was adopted:

$$\text{Log}\,(P_i/1\text{-}P_i) = \beta_0 + \beta_1 \chi_i = + \beta_2 \chi_2 = \ldots\ldots\ldots\ldots + \beta_6 \chi_6 = + e \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

The independent variables;

χ_i =Drought occurrences (estimated as the number of months a farmer experienced with drought) χ_2 = Deforestation in the catchment areas (dummy, 1 = yes occurred, 0 = If not)

. χ_3 = Human population pressures (dummy, 1 = increased, 0 = not increased)

. χ_4 = Ethnic heterogeneity (estimated as the number of ethnic groups in the community)

. χ_5 = Changes in market demand for paddy as a core irrigated crop

. χ_6 = Construction or improvement of irrigation infrastructures (dummy, 1 = improved, 0 = if not).

RESULTS AND DISCUSSIONS

Basic Characteristics of Water Users in the Irrigation Schemes

Out of the 172 respondents, 85% were males and 15% females. The mean age of the household heads was 42 years, with a minimum and maximum of 20 and 89years respectively. Eighty percent of the respondents were married, 13% were widowed, and 7% were single (unmarried and divorced). With regard to education, 82% of the respondents had primary education, 7% had secondary education and 11% had no formal education.

Local Water Users' Voices on Perceptions of Water Institutional Changes

Table 2 summarize local water users' perceptions of changes of water institutions for the past 40+ years. The statistics show that 74.5% of the water users had the opinion that institutional changes and reforms evolved over time. These results compare well with the key informants' opinions, which indicated that both formal and informal rules have evolved over time. They acknowledged that changes in several issues including the introduction of new regulations on using water (altered water rights), new arrangements on the ownership of irrigation schemes and the transfer of water management responsibilities from central government to the basin and village levels. Water User Associations (WUAs) bypassed and weakened traditional networks. The traditional networks had their particular norms, beliefs, taboos, and conventions that were strong in keeping the traditional characteristics of collective actions as well as when putting under pressure for changes.

Table 2: Farmers' Perception of water Institutional Changes in Iringa and Kilombero Districts, (2013) (n=172)

Score	Frequency	%
6	9	5.2
12	30	17.4
18	19	11.0
24	53	30.8
30	61	35.5
Total	172	100.0
Categories of Institutional Changes		
Did not change	39	25.5
Changed	114	74.5
	153	100.0

Key informants including both users and managers of water resources perceived that the needs for institutional reforms are strongly linked with four key issues: first, population increase with respect to both natural growth and in-migration. Second, conflicts among water users, which necessitated the need to come up with legitimate institutions.Thirdly, water shortage caused by climate change impacts and lastly international and national political influences. These findings portray popular views in Sub-Saharan Africa that relative changes in natural resources institutional set-up are the result of human population movement, changes in demand and supply of resources and peaceful interactions between various ethnic groups (Boesen*et al.*, 1999; Lein, 2004; Madulu, 2005).

Exogenous Factors Driving Water Institutional Changes

The previous section indicated that a substantial proportion of water users in FMISs in Iringa and Kilombero Districts agreed to the fact that institutional changes and reforms are taking place over time and in space. Statistical analysis carried out through a binary regression model exposed variables that are likely to play significant effects on altering water institutions(Table 3). The overall model indicates a statistically significant chi-square statistic ($p<0.000$).

This indicates that the model gave better predictions of the outcome categories. A Goodness of Fit test showed (p>0.05) which indicates data and the model predictions were similar, implying a significant model.

The Pseudo R-Square was 0.34 Cox and Snell 0.611 and Nagelkerke R^2 of 0.764, implying that independent variables entered in the model explained 61% and 76% of the variance on water institutional change. The empirical findings of the binary regression model indicate that four out of six factors (drought occurrence, population growth, irrigation technological development, and increase demand of paddy crop have a significant influence on perceived institutional changes. The rest of the variables were not significant. Overall, the model significantly predicted 76% for institutional changes is in response to the four aforementioned factors.

Table 3: Exogenous Determinants of Institutional Changes in Water Sector, in Iringa and Kilombero Districts, (2013) (n=172)

Variables Entered in the Model	ß	S.E	Wald	p-value	Exp (B)/Odds Ratio
Drought	4.725	1.118	17.875	0.000	0.069
Deforestation	0.091	0.085	1.169	0.280	1.096
Human population pressure	0.458	0.259	11.234	0.002	1.580
Ethnic heterogeneity	1.365	1.176	1.349	0.245	3.918
Irrigation technology development	0.345	0.085	18.356	0.000	1.412
Market demand of paddy	0.211	0.002	6.582	0.012	1.235
Constant	66.151	14.252	21.543	0.000	3143+28
Omnibus Tests of Model Coefficients (Chisquare= 126.633; Sig.=.000); Log likelihood = 55.502a; Cox & Snell R Square =.611; Nagelkerke R Square =.764 Hosmer and Lemeshow test (Chisquare = 5.402; Sig.=.714)					

The findings show that irrigation technology development was statistically significant at $p < 0.01$, and had a stronger Wald criterion of 18.356 and ß = 0.345 (Table 3). The findings reveal that as the development of the irrigation infrastructure increases, the probability of perceived institutional change and reforms in FMISs increase. This specific finding match with the real-life experiences in the irrigation schemes, where increasing pressures for institutional change are being exerted by water and environmental stakeholders to make agriculture comply more directly with environmental conditions.

This finding further implies that the development of irrigation technologies such as the construction of headwork structures (with control gates) in the irrigation schemes has the ability to initiate institutional changes. The Government construction of headwork structures (with control gates) and the main canals in some of the village irrigation schemes have continued over the years with the ultimate goal of transforming irrigated agriculture from subsistence to more commercially oriented farming. A vivid example is seen in Mlenge semi-improved FMIS, where since 1992, when the Government of Tanzania invested in the construction of irrigation infrastructures, the number of beneficiaries increased tremendously. Because of these constructions, a need for new institutional arrangements and rules to reconcile with the pressure on water resources was strongly felt and changes carried out. This finding corroborates with the qualitative information reported that the increasing number of water users and uses create challenges for existing rules-in-use and the response in most cases is to institutionalize new rules to ensure a more sustainable collective sharing of water. Along the same line of thinking, Cleaver and De Koning (2015) also argue that new technologies such as headwork structures with control gates have the ability to initiate institutional changes.

The technical control gates imposed in irrigation systems may itself serve the purpose of a new working rule and make other rules rather redundant (Cleaver and De Koning, 2015). This finding corroborates well with induced innovation dictating that new information or knowledge and technology on the farming system may trigger practices or technical changes. These, in turn, could lead to either the development of new institutions or manifestations of the old formal and informal institutions (Feeny, 1988; Wegerich, 2001).

Drought as a factor for water shortage was found to be statistically significant at $p < 0.05$; Wald = 17.875 and ß = 4.725. The positive coefficient on ß implies that perceived drought occurrence makes institutional change more probable. The irrigators´ perceptions on environmental forces expressed in terms of droughts, floods, or human-induced climate change may be strong shock factors leading to institutional change in the water sector. These forces may both initiate and or accelerate institutional changes at both local and national levels. For example, Kashagili*et al. (*2009) noted that climate change and variability brought variations in precipitation in the Rufiji River Basin Catchment and acted as a basis for water scarcity and conflicts over water. According to Paavola (2008), a string of severe drought in Tanzania occurred in 1971, 1975-1976, 1983, 1987; 1992, 1996-1997 and 1999-2001. Extreme events due to successive droughts affect livelihoods and cost lives, and eventually demand alteration in policy, laws and organizational structures.

Lein and Tagseth (2009) argue that in order to ensure wiser water use and secure more water for the downstream hydropower plants, the Government of Tanzania embarked upon an Integrated Water Resource Management system in 1992, as a means of bringing in various stakeholders including private capital and international expertise to upgrade the mechanisms of good water governance. North (1990) and Lein (2004) argue that shocks associated with high social costs can stimulate those affected to lobby policymakers for water reforms. A crisis can also reduce the opposition of those interest groups that oppose changes; making them accepts that a more flexible system of allocation is necessary. Other shocks, such as floods, can provide the impetus for reform (Haller, 2010). In Tanzania, floods that occurred in Kilosa District in 2010 and some parts of Dar es Salaam between 2012 and 2015 was a major factor accelerating the process of shifting inhabitants from valley bottoms to other areas. Likewise, floods attributed to the need to build the capacity of risks recovering committees. The floods also accentuated the need for water policy reforms in Tanzania.

The findings imply that different environmental factors may encourage various courses of action by different stakeholders. In particular, the water sector may moderate water management regulations and requirements for additional water and environmental regulatory activities. Conversely, the water sector may also encourage a stronger policy reaction to meet both government and environmental stakeholders' objectives. The main message here is that particularly in the water sector – proper protection and management of water resource needs a strong instructional set-up to counteract the effects of declining water availability due to prolonged droughts and progressively increased demands attributed by population growth. Facing divergent attitudes towards sustainable water management for the future, the issue of institutional change and re-formation appears as strategic important for the water sector to shift from a largely subsidized, production-oriented agriculture, towards a more environmentally and cost-responsible sector through the application of water rights or permit regulations.

Another strong predictor of institutional change was human population pressure. A logistic regression model produced a statistical significant impact at $p < 0.052$, Wald = 11.234 and ß = 0.456. The findings reveal that as the human population increases, the probability of institutional change and re-formation increases in the water sector. The qualitative data further supported this finding, which indicated that institutional changes and formations are associated with variation

in water demand and supply attributed by the decline in water flows due to prolonged droughts and increases in human population who depend on irrigated agriculture. Simultaneous population increase in the study areas was associated with migration. For example in Iringa District, it was reported that a number of in-migrants came from Dodoma, Mbeya, Njombe and Morogoro regions searching for potential land for irrigation. Likewise, the Wamaasai and Wasukuma from Northern and North Western regions of Tanzania came to the study villages searching for greener pastures and with time, they have settled as agro-pastoralists (Moshaet *al.*, 2016). Their settlement places huge pressure on irrigated land and water resource, attributed by increased demands for food, thereby raising water competition and enhancing future land and water conflicts.

The increase in population created a water shortage scenario where demand exceeds supply; consequently calling for new institutions. The public policy formulations in Tanzania have responded to such a crisis by introducing institutional reforms in the water sector. Changes typically consisted of marginal adjustments to the existing water policy, law, rules, and enforcement that constitute the institutional framework. The main reason for the change is the reduction of transaction costs and increased resource use efficiency (North, 1990). These findings corroborate with Saleth and Dinar (2004) findings that population pressure and water scarcity are factors of institutional change and reformation. They stress the relational character of institutions and actors and of the relationships between population growth and water scarcity.

It was also important to look into how paddy market demand or changes in the price of paddy predict an institutional change in the water sector. The change in paddy price shows a statistically significant $p < 0.02$ result with the Wald criterion of 6.582 and ß = 0.211 (Table 3). These findings suggest that as the demand for paddy increases in the study area, more farmers were engaged in irrigated paddy production hence putting additional pressure on water withdrawal. This forms a basis for review and re-design of existing and the evolution of new institutions.

Market pressures have a substantial influence on institutional arrangements and changes in irrigation schemes. In Tanzania, market forces in terms of availability of market and attractive prices of maize and paddy had positive influences on production levels (URT, 2008). Good market conditions motivate farmers to produce more and sell the surplus for cash incomes. These results confirm the tenets of North (1990) supply and demand theory argued that the most important source of institutional change is the change of relative prices of a commodity.

Concerning deforestation and ethnicity, the study found no statistically significant causal relations between the perceptions of institutional changes and conditions relating to deforestation processes, and ethnic composition changes. However, a positive relationship has been observed, which agrees with findings from direct observations that there has been deforestation taking place in the study areas. Problems resulting from deforestation such as increased flooding or less sustainable water supply, and reduced water quality may stimulate reforms at the water basin level, but was not at present recognized by the local stakeholders.

CONCLUSION AND RECOMMENDATIONS

The study set out to use local water user perceptions to appraise whether water management institutions have changed over time or not. It also set out to use binary regression model outputs to evaluate various exogenous factors and their potential to influence water institutional change. The descriptive statistical output showed that water institutions have evolved substantially over the previous four decades, and it is likely that they will continue to evolve in the future because of the prevailing environmental conditions and increased human population. The study revealed that exogenous factors,

including irrigation technology development, increase human population pressure and prolonged drought generated a negative impact on water flows. When water demands progressively trespasses supply, it opened up a political space for institutional reforms.

Changes in the social, economic and environmental conditions have led to a prevailing situation of formal and informal rules to run in parallel or as Cleaver (2012)argues, as an institutional bricolage, where we observe a multilayer landscape of institutions, often resulting in conflicting ideas and policies, which form persistent reasons for sub-optimal performance in managing water resources. An appropriate congruence and allowing for trade-offs between formal and informal institutions should be the basis for any water institutional reform.

There are also some broader implications of the study's outcomes. Any form of institutional change requires positive support from local water users, water managers, and policymakers. Such attempts can be fruitful when they are strongly based on local initiatives and on a full understanding of prevailing internal and external constraints, and when they are correctly placed in the socio-economic context. The involvement of communities, particular those at the grassroots who utilize the water resources is a critical strategy for developing long enduring rules and robust institutions.

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