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Social capital and diffusion of water system innovations in the Makanya watershed, Tanzania

S.D. Tumbo[a], K.D. Mutabazi[a], K.F.G. Masuki[b,*], F.B. Rwehumbiza[a], H.F. Mahoo[a], S.J. Nindi[c], J.G. Mowo[b]

[a] Soil-Water Management Research Group, Sokoine University of Agriculture, P.O. Box 3003, Morogoro, Tanzania
[b] World Agroforestry Centre, African Highland Initiative, Box 26416 Kampala, Uganda
[c] Tanzania Wildlife Research Institute, Box 661, Arusha, Tanzania

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ABSTRACT

Social capital is one of the major drivers in the diffusion process of water system innovations within agrarian communities in a watershed. However, there is limited information on the nature and extent of social capital, and how it influences the diffusion of water system innovations at community level. This paper explores the role of social capital on the uptake of water system innovations in the Makanya watershed. Information on role of social capital in the diffusion of water systems innovations was analysed using data collected through key informants interviews, focus group discussions and structured questionnaire. Qualitative and quantitative methods were used to analyse the data and the results were summarized in tables and figures. Results show that the social capital elements, which are key to adoption of WSIs are group belonging and information pathways. Group belonging was significant in the diffusion of terraces at $P < 0.001$ in the upland and $P < 0.1$ at watershed level. Information and communication pathways were not significant in the diffusion of terraces but were significant ($P < 0.01$) in the diffusion of *ndivas* and diversion canals. This paper recommends the inclusion of these parameters in the design of uptake and up-scaling strategy for WSIs especially in the study area.

1. Introduction

The world aggregate demand for the import of cereals has increased from 80 million metric tonnes in 1961 to 278 metric tonnes by 2001, with Africa accounting for the fastest growth in food import for 18% of the world import compared to just 8% fifteen years ago (Chopra, 2004). This means it is necessary to double or even triple world food production over the next generation (Kruger, 1995). One way of meeting the future food demand is through increased water productivity in both irrigated as well as in rainfed agriculture. This will require innovations in rainfed agriculture that address poverty alleviation and food security (Narayan, 1997). Peasants, who comprise of over three fourths of the world population, are producing 1–2 t/ha of cereal while commercial farmers produce 8–10 t/ha (Kruger, 1995). The comparison of the two, peasant farmers in Africa and commercial farmers shows that the peasants are in the best position to double or triple production but only if basic limiting factors can be overcame. The two main limiting factors to increase crop yield for peasant farmers are the low use of fertilizer and water.

Generally, the higher yields observed in commercial farming are mainly to the use of inorganic fertilizers and irrigation. For example, the world average maize yield by 2005 was 4.63 t/ha while in Africa was 1.72 t/ha (Rakotoarisoa et al., 2011). The corresponding world fertilizer use was 124 kg/ha in 2005, while for Eastern Africa with exception of Mauritius the use was about 13.5 kg/ha. Similarly, the share of irrigated crop land compared to the total agricultural land by 2003 was 18% and 2.2% in the world and Eastern Africa, respectively. The study by the University of Essex found that one mechanism that led to increased production was better use of the natural capitals such as land and water (Pretty, 2001). When water is better harvested and utilized it directly improves productivity. In rainfed environments, better water harvesting and utilization improves productivity of the current land and by enabling new lands to be brought under farming. Innovations that improve water productivity while conserving the soil are here referred to as water system innovations (WSIs).

The WSIs are innovations such as water harvesting technologies, drip irrigation, terraces, deep tillage, sub-soiling and cover crops. The study by Nyangena (2004) on the adoption of soil and water conservation (SWC) techniques found that the techniques are many, varied and their productivity effects occur over time and depend on plot specific factors including topography, soils and climate. Sub-soiling in Babati, Tanzania increased maize yield from 0.75–1 t/ha to 4 t/ha (Mariki, 2003). Gross margins per hectare of

* Corresponding author.
E-mail addresses: kennymasuki@gmail.com, kenneth.masuki@yahoo.co.uk (K.F.G. Masuki).

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beans were higher for ripper users compared to conventional tillage (use of hand hoe) (Bishop-Sambrook et al., 2004). Even though most of the WSIs have demonstrated benefits in terms of increased yield and/or income but their diffusion has relatively remained low and disappointing. Place et al. (2002) anticipated more studies in agriculture in Africa will focus on technology development and adoption/diffusion mainly in rainfed agriculture because scarcity of water limits irrigation practices.

This study investigates the role of social capital on the technology diffusion to the Makanya watershed in the Northern Tanzania. Social capital is harder to measure compared to other economic capitals and variables, and recognition by economists of this concept is fairly recent (Goodwin, 2003; Ostrom, 2001). Literature started to appear in early 1990 and reaching a couple of hundreds in early 2000 (Ostrom and Ahn, 2010). Its importance has been strengthened by the observation that variations in social capital across communities and societies can help to explain some of the differences in their economic development (Goodwin, 2003).

The Makanya watershed is unique as is characterized by differences between the upland, midslope and lowland in terms of biophysical characteristics, weather, farming system, ethnic composition and access to market. The adoption of water system innovation in the watershed shows higher adoption of terraces in the upland compared to the midslope and lowland, higher adoption of diversion canals in the lowland compared to midslope and upland (Byakugila et al., 2008; Tumbo et al., 2011). There is very low adoption of other WSIs such as deep tillage, borders and ridges. Given the well-established fact on the positive influence of social capital on technology diffusion, this paper investigates important social capital elements that can be used in the scaling-up strategies to accelerate diffusion of WSIs.

Diffusion is defined as the process by which an innovation or new knowledge is communicated through certain channels over time among the members of a social system (Rogers, 2003) and adoption is defined as a decision to apply an innovation and continue to use it (Van de Ban and Hawkins, 1996). Therefore, an innovation could be adopted/fully used by few members of the community but not diffused, because very few members of the community are using it. Generally, innovation is considered to be a key component of economic evolution, and development (Dougherty, 1996). The innovation people create and technologies people use play a fundamental role in shaping the efficiency, equity, and environmental sustainability of natural resource management (McCulloch et al., 1998). This has been the reason for substantial investments in research to improve diffusion of agricultural technologies from new crop varieties to natural resource management practices. Over the decades, technology diffusion of innovations in agriculture has always been a problem with no leap forward solution in sight (Palis et al., 2002). For example, Nyangena (2004) observed that adoption of soil and water conservation techniques in Kenya to be very low. Reasons for the low adoption are not yet fully understood. Most studies on adoption and diffusion have not focussed beyond the individual, i.e. at the interaction of individual with another individual (Palis et al., 2002). Consequently, community wide factors of technology uptake are not clearly known.

The introduction of social interactions in the technology diffusion process is important in information sharing and technological complementarities. The density of social networks, the strength of the connections between nodes, and the type of behaviour associated with the connections will influence the diffusion of innovations (Robalino, 2000). Social networks are subset of a social capital, which also include associated norms that have an effect on the technology uptake decisions. Social capital is “features of social organization, such as networks, norms and social trust that facilitate coordination and cooperation for mutual benefit” (Putnam, 1995).

Studies relating technology diffusion to social capital are not new (Isham, 2000; Robalino, 2000; Palis et al., 2002; Nyangena, 2004). Most of these studies have shown that social capital promotes the adoption of socially efficient technologies (Robalino, 2000). Isham (2000) investigated how the characteristics of social structure affected information sharing and the diffusion of innovation among households in rural Tanzania.

Among other objectives, the study tested the hypotheses that farmers in villages with higher level of social capital will have higher level of cumulative information to adopt more rapidly and found that ethnic capital in terms of tribally-based social affiliations to have strong influence on adoption. Robalino (2000) studying social capital, technology diffusion and sustainable growth in the developing world found that subsidies or incentive are necessary in accelerating technology diffusion. However, the effectiveness of incentives depends largely on the level of social capital. Palis et al. (2002) investigated the out-scaling of integrated pest management (IPM) technology in the Philippines and the findings showed that a trained farmer is more likely to share IPM technology with a relative than a non-relative. Furthermore, IPM sharing with both kin and non-kin will more likely to occur in the farm than in house neighbourhood. Nyangena (2004) investigated the adoption of soil and water conservation technology in rural Kenya. The investigation found that the probability of adoption of technology was increasing with social capital especially with adoption of bunds and *fanya-juu* terraces.

This study adapted a framework for social capital measurement known as Integrated Questionnaire for the Measurement of Social Capital (SC-IQ) proposed by Grootaert et al. (2004). This framework is comprehensive compared to other methods. Measures of social capital should be as comprehensive as possible covering networks, values and norms dimensions and should balance between the attitudinal and the behavioural aspects (Cote and Healy, 2001). For example, Halpern (1999) who suggested the use of social trust to measure social capital, even though is very important but is just one of the dimensions of social capital.

The questions from SC-IQ were used to design the household questionnaire and the checklists for key informants and focus group discussions. The questions were crafted to address six specific hypotheses constructed to unveil the role of social capital elements in WSIs diffusion. These elements include group and networks, trust and solidarity, collective action and cooperation, information and communication, social cohesion and inclusion, and political participation and empowerment. In pursuit of the stated hypotheses, descriptive analyses were used. Probit models were estimated to identify important predictor variables including social capital elements and respondent characteristics.

2. Conceptual framework

The social capital conceptual framework being used in this study is based on Grootaert et al. (2004) referred to as the Integrated Questionnaire for the Measurement of Social Capital (SC-IQ). The framework consists of six dimensions which are explained as follows:

2.1. Groups and networks

This dimension is referred to as the “structural” dimension of social capital (Harpham et al., 2002). Groups with linkages often have better access to resources, especially outside the community, such as from government or NGOs. Networks assist members in a community to obtain assistance in case of need and therefore are useful in the management of risk.