Influence of Exogenous Variables on Interaction of Small Scale Farmers with other Actors in Agricultural Projects: a Case of RIPAT-SUA Project in Morogoro Region, Tanzania

***Ringo, G.P.[1] and Malisa, E.T.[2]**

[1]Department of Policy, Planning and Management, Sokoine University of Agriculture, P.O. Box 3035, Morogoro, Tanzania
[2]Department of Development and Strategic Studies, Sokoine University of Agriculture, P.O. Box 3024, Morogoro, Tanzania

*Corresponding author e-mail: *gringogasper2013@gmail.com*

Abstract

Exogenous variables have the potential to influence interactions but have received little attention in the literature. Guided by Ostrom's Institutional Analysis and Development (IAD) framework and social exchange theory (SET), the study described the patterns of farmers-other actors' interactions, and determined exogenous factors influencing interactions using RIPAT-SUA project as a case study. Quantitative and qualitative data were collected through questionnaire survey and Focus Group Discussion (FGD)/key informant interview respectively. Multiple regression and content analysis were used to analyse quantitative and qualitative data respectively. Farmers-other actors' interactions in agricultural projects increase with a decrease in distance from the market. Diversity of crops/livestock produced and the number of resources shared by actors had statistically significant influence on interactions. The RIPAT approach plays a crucial role in shaping the interactions; it influences the type of actors the farmers interact with and the pattern of interactions. The findings support the IAD and the SET, which, respectively, postulate that biophysical conditions (in this case proximity to market), and cost and rewards (in this case resources shared) are driving forces for farmers' interactions. Rather than referring to it just as cost and rewards as the SET does, it should be explicit that both material and social benefits are important in shaping interactions. The study recommends ensuring that agricultural interventions are rewarding to farmers. Designing and implementation of agricultural projects ought to employ the RIPAT approach to spur fruitful interactions.

Keywords: Interactions, small-scale farmers, actors, RIPAT, projects

Introduction

In Sub-Saharan Africa (SSA), small-scale farming is a key component for food security, economic development and sustainable livelihood. Among other things, agriculture has a great importance in the production of foods and income generation in SSA. Small scale farming is estimated to represent 80% of all smallholder farmers in SSA and serves as economic stability for small scale farmers' in the area (Freeman and Qin, 2020; Aref, 2011). Despite the importance of agriculture in a developing country, access to agricultural information, agricultural inputs/ resources and markets is limited in the rural areas where most of the agricultural activities are done (Abdul-rahaman and Abdulai, 2018; Mojo *et al.,* 2017). These challenges stimulated governments, development agencies and agro-inputs firms to form farmer groups to smoothen the flow of information, knowledge sharing, resources flow, and market information flow from one farmer to another.

Farmers involved in agricultural activities have different knowledge, production experience and agricultural information. Under this condition, farmers' interact to learn from one another. Interaction of farmers involves the exchange of resources and information, which probably influence farmers' decision to participate in agricultural projects or group

activities (Duinen *et al.,* 2012). Famers rely on interaction with various actors (fellow farmers, buyers, agro-inputs firms, NGOs, agricultural professionals/researchers) for information pick up, resources sharing, and knowledge sharing (Warnet, 2015; Duinen *et al.,* 2012). This makes different projects implementing organizations like Research, Community, and Organizational Development Associates (RECODA) and Sokoine University of Agriculture (SUA), together implementing RIPAT-SUA project, to collaborate with local government authorities, different stakeholders and farmer groups which in turn increases interactions.

Rural Initiatives for Participatory Agricultural Transformation (RIPAT) approach uses farmer groups for training, transferring information, resources, and sharing market information (Vesterager *et al.,* 2013). Projects guided by the RIPAT approach collaborate with extension officers, local government authorities, farmers, buyers and village leaders, and this, in turn, increases the interaction among farmers and other actors. Therefore, the study considers interaction as one of the appropriate ways for farmers to access/share ideas, knowledge, resources and information from different actors.

Farmers' decisions, whether to participate in project activities or not, and actions, are motivated by their interactions with other actors[1], among others. Studies done in the farmer groups field indicate that farmers' social interaction had a positive effect on farmers' adoption of new technology and increase in farm productivity (Freeman and Qin 2020; Mojo *et al.,* 2017; Ayalew *et al.,* 2016; Warnet, 2015; Muanga and Schwarze, 2014; Mashavave *et al.,* 2013; Duinen *et al.,* 2012). Since interaction is important for participation in agricultural projects, and subsequently, the adoption of new technologies, a thorough exploration of farmers' interactions with other actors is imperative.

In Morogoro Municipal Council and Mvomero Districts, where the study was conducted, farmers interact with different actors and this differs by the specific location of the farmer. In this area, RIPAT-SUA project, which served as a case in this study, was being implemented. The RIPAT-SUA project was designed to cover villages located along the land catena of the Uluguru Mountains, including the lowland, midland and highland areas. Relevant questions here are, firstly, whether there is any difference in interaction across the slope and, secondly, what are the factors influencing farmers' interactions. Therefore, the paper attempted to: (i) examine the association between interactions and the farmer's location (ii) describe the patterns of interactions between farmers and other actors (iii) determine the influence of various factors, including types of information shared, resources shared, diversity of income-generating activities, diversity of crop/livestock produced, and distance to the market, on farmers' interactions. These factors have the potential to influence farmers' interactions but have received little attention in the farmer groups' literature.

Identification of the variables to be studied was guided by the Ostrom's Institutional Analysis and Development (IAD) framework and the theory of social exchange According to the IAD, action situation (space where individuals, groups, NGOs and institutions interact) influences farmer's decision to participate in groups / agricultural projects. The action situation[2], on the other hand, is influenced by external forces such as biophysical conditions (climatic condition, the status of road infrastructure, soil property, and slope) surrounding the actors (individuals or groups), characteristics of the community, interaction with actors from outside the community and institutions (including religious and educational institutions, policies, norms, and beliefs) (Ostrom, 2011). The social exchange theory proposes that actors possess different levels of information, power and motivation that influence their decision making and interaction (Thomas and Thigpen, 1993). The theory views human interaction and exchange a kind of result-driven social behaviour related to cost and rewards (SWDG, 2019). An individual farmer will make a decision based on a certain benefit found in agricultural project through interaction with different social actors (institution, researchers,

[1] *Actors refer to individuals, groups, NGOs or other organizations/ institutions. In this study an actor shares information and/ or resources with farmers.*

[2] *Action situation refers to social space where individual interact, exchange goods/services, and solve problems.*

buyers and agro-company) which offer different benefits (training, access to credit, market and agricultural inputs) to the farmers.

Methodology

The study was conducted in Morogoro Municipal Council and Mvomero Districts, which were purposively selected because RIPAT-SUA project was being implemented in the area (Fig. 1). The project covers 7 villages (Mnyanza, Tangeni, Mlali, Kipera, Kinyenze, Pekomisegese, and Changarawe) from Mvomero District and 9 streets (Ruvuma, Kauzeni, Magadu, Konga, Mzinga, Mfine, Towero, Mundu and Kivaza) from Morogoro Municipal Council which together form a total of 22 farmer groups, each with 25-30 members (RIPAT-SUA Project, 2021). The community in the selected study area depends mainly on agriculture as a source of their income and means of livelihood (Malisa *et al.,* 2017).

RIPAT-SUA project is a SUA-RECODA[3] collaborative project, implemented in the lowland, midland and highland areas of the Uluguru Mountains within Morogoro Municipal Council and Mvomero Districts following the RIPAT approach. The project started in February, 2018 with eight farmer groups. RIPAT approach is a participatory extension approach that aims to close the agricultural technology gap (Vesterager *et al.,* 2013). According to Larsen and Lilleør (2016), the stated overall development goal of RIPAT is to reduce poverty and improve food security among smallholder farmers by facilitating high and sustainable levels of adoption of improved agricultural and livestock technologies disseminated through local farmer groups. Founded in

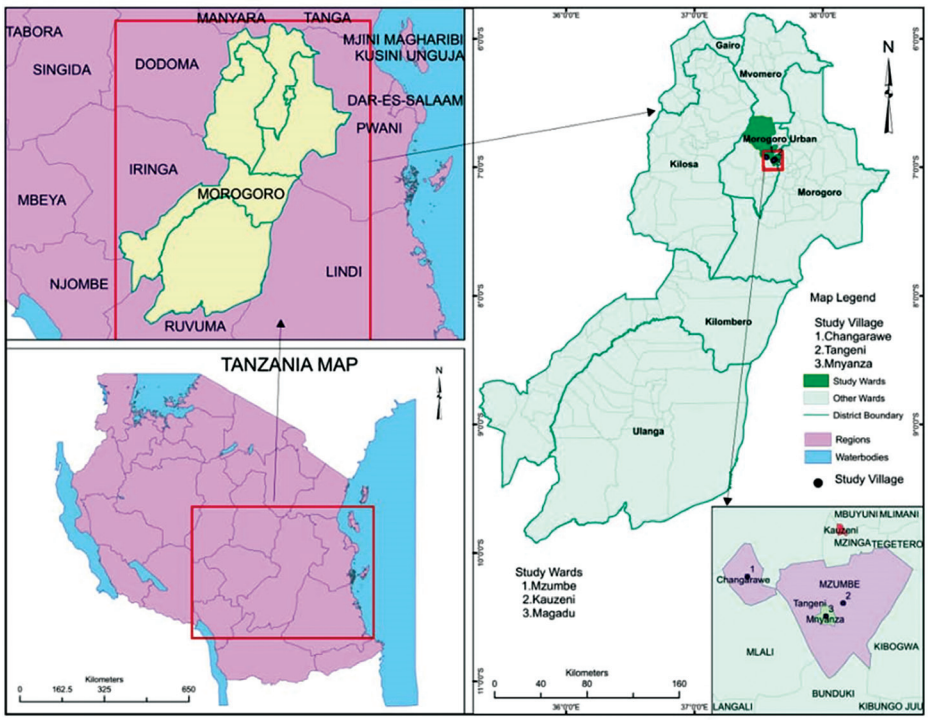

Figure 1: Map of Morogoro Municipal Council and Mvomero Districts showing the study area

[3] *SUA-Sokoine University of Agriculture-is a Tanzanian public University whose mission is to promote development in agriculture, natural resources and allied sectors through training, research and delivery of services. RECODA-Research, Community and Organizational Development Associates-is a Tanzanian NGO established in 2000 with the aim of bridging the technology gap in development through research, consultancy, capacity-building, and facilitation of community-based projects.*

2006 in a partnership between the Rockwool Foundation and RECODA, RIPAT approach is founded on three cornerstones, which are creation of a vision of better future through sensitization of communities to the potential for change and the mobilization of farmers to take charge of their own development; establishment of farmer/producer groups with good leadership to enable the transfer of appropriate agricultural technologies through participatory demonstration learning technique, and ultimately the establishment of producer association to leverage marketing skills and opportunities; and close collaboration with local government authorities, village leaders and government agricultural extension officers to ensure the project sustainability and further spreading to the wider community (Vesterager *et al.,* 2013). Farmer groups and associations, and collaborations that are part and parcel of the RIPAT approach, necessitate interaction of farmers with other actors. The study intended to explore the patterns and determinants of such interactions.

The study adopted both qualitative and quantitative approach for data collection. The study population consisted of all group members of the RIPAT "start" groups under the RIPAT-SUA project. The study focused on the RIPAT "start"[4] groups because farmers in the groups had already spent more than one year of membership in the group and had interacted with different actors within and outside their groups. Out of 22 farmer groups under the project, eight (8) groups were purposively selected based on their being the RIPAT-SUA "start" groups. The rest of the groups were formed during the RIPAT "spreading" phase and were less than one year old during the time of data collection for this study.

A list of farmer group members from the project's RIPAT "start" groups was obtained from the group leaders. Respondents were randomly selected from the list using "=Rand ()" command in Microsoft Excel to generate a random number from each group. In each group, the random numbers generated were arranged from the smallest to the largest number whereby the first 15 members (at least 50%) were selected making 120 respondents and questionnaire was administered to them. Focus Group Discussions

Table 1: Description of the predictor variables

Variables	Measurement
Age of the farmer	Number of years since born
Sex of the farmer	1= Male, 0= Female
Accessibility of the farmers' location (road condition)	1 = road passable throughout the year and 0 = road not passable throughout the year
Institutions/organizations available	Number of the institutions available in the farmers' location measured as a continuous scale
Distance from the market	Time farmers used to walk from home to the nearest market measured at the scale level
Diversity of income-generating activities	Number of income-generating activities done by farmers measured at scale level
Diversity of crops/ livestock produced	Number of livestock species/crops varieties produced by farmers measured at the scale level
Number of resources shared by the actors	Number of resources supplied to the farmers measured at the scale level
Diversity of information access	Number of information sources farmers have access to, measured at the scale level

[4]*RIPAT "start" phase involves formation of groups to participate in the RIPAT project from the start while RIPAT "spreading" involves expansion of the project area through formation of new farmer groups in villages adjacent to the RIPAT "start" groups' villages. RIPAT "spreading" is implemented one to two years after project start (Vesterager et al., 2013)*

(FGDs) were conducted using three groups from the RIPAT "start" phase making a total of 24 participants. Each of the FGDs comprised 8 participants with slightly more females than males. One group was selected from each of the three distinct altitudes of the land catena of the Uluguru Mountains where the project was being implemented.

Data were collected through questionnaire survey, FGD and Key Informant Interview (KII) in which project manager, project facilitator from RECODA and a lead farmer were interviewed. Using questionnaires, quantitative data were obtained from group members, while qualitative data were gathered through FGD and KII with the aid of FGD guide and checklist of questions respectively.

Data collected using questionnaire were coded and entered in IBM SPSS (version 20). To ensure the quality of data, data cleaning was done. Frequencies, percentages and mean were used to describe the patterns of interactions. Cross-tabulation was used to establish the association of the interaction and farmer's geographical location. A multiple regression model was used to estimate factors influencing interaction in agricultural projects. Before analysis, predictor variables were checked for multicollinearity and variables with less than 0.1 tolerance value and VIF of more than 10 were not included in the regression model (Daoud, 2017). The dependent variable, interaction of farmers with other actors, was captured as a continuous variable using a composite index whereby the number of information type shared, frequency of information flow and number of actors present in the farmers' location were combined. The equation is presented hereunder based on Healey (2013) and Field (2009) who asserted that multiple regression model with more than one predictor variables can be written as:

$$Y=\beta_0+\beta_1X_1+\beta_2X_2+\beta_3X_3+\beta_4X_4+\beta_5X_5+\beta_nX_n+\epsilon \quad (1)$$

Whereby Y=farmer's extent of interaction, captured as continuous variable, and X_1, X_2, X_3, X_4, X_5,...X_n are predictor variables used in the model, whose description is indicated in Table 1.

Results and Discussion

Association between interaction and farmers' location

The RIPAT-SUA project was being implemented in the lowland, midland and highland areas which differ by institutions available, community attributes, biophysical conditions, and information flow. These variables were hypothesized to potentially influence farmers' interactions. Interaction of farmers in the agricultural project was measured by combining the number of actors, the number of information type shared and frequency of information flow to the farmers. Levels of interaction among the respondents were categorized into "low" (those scoring 13-27) and "high" (those scoring 28-44) using the mean score (Table 2).

The results show that there is a significant association between interaction and location of the group members at 10% significance level. The results show that majority (66.7%) of farmers located in the highland area, that is, Mnyanza village and Mgambazi Street had lower interaction level as compared to other villages (Tangeni and Changarawe villages). The main reason for the low interaction could

Table 2: Farmers' interactions by location

Location of the farmer	Village/Ward	Sample size	Level of interaction		χ^2	Sig
			Low (13-27)	High (28-44)		
Highland	Mnyanza village & Mgambazi street	45	30(66.7%)	15(33.3%)	5.253	0.072
Midland	Tangeni village	30	12(40.0%)	18(60.0%)		
Lowland	Changarawe village & Kauzeni street	45	24(53.3%)	21(46.7%)		
Total		**120**	**66(55.0%)**	**54(45.0%)**		

Source: Field data (2019)

be the relatively low number of actors found in the area and poor road infrastructure restricting the movements of different actors to the area. The highest interaction (60%) was observed in the midland area while in the lowland area, the proportion of farmers belonging to high levels of interaction was 46.7%, which is a medium position when compared with the rest of the areas (Table 2).

A possible explanation for the highest interaction among farmers located at the midland (Tangeni village) is that the village possesses a market where farmers, especially those from Tangeni and Mnyanza villages, meet with buyers from Morogoro town and other areas at least twice a week to sell their crops and buy some items. At Tangeni market different actors, including farmers, buyers, input suppliers, domestic item dealers, transporters and tax collectors, meet and share miscellaneous information, including agriculture-related ones. The findings agree with those reported by Mutenje *et al.* (2016) which showed that market area is a centre for sharing information with different actors (inputs supplier, buyers, and other farmers). Besides, Tangeni village has a Roman Catholic Church which serves people not only from the village but also from the neighbouring villages. People meet at the church at least every Sunday.

In the lowland area, there was high number of institutions/organizations, including a University, schools, churches, and NGOs, but lower levels of interaction compared to the midland area, though relatively higher than that of the upland area. This is probably to do with the nature of the institutions present. It was observed that institutions which were more pronounced when it comes to causing interactions include the local markets and the Roman Catholic (RC) Church. In the study area, the RC Church and local market which bring together relatively more people are located at Tangeni village, which is in the midland area. In addition to providing an avenue for farmers to meet with diverse types of actors, the two institutions appear to be instrumental in facilitating the flow of diverse information types. Not only that but also people from the lowland area have been going to the crop market at Tangeni village to buy goods in bulk for retailing in the lowland area which in turn, increases the rate of information sharing in the midland area compared to the lowland area. A key informant from Tangeni village reported that: *"Tangeni market brings together people from all villages in Mzumbe ward, and some other wards and villages in Morogoro Municipal Council and Mvomero District respectively. In addition, some people come from as far as Dar es Salaam to sell or advertise their products at the market"* (27/2/2020, Tangeni village).

Patterns of farmers-other actors' interactions

Farmers' interactions are mainly about communication for information and resource sharing among farmers and between farmers and other actors in the action situation. Interaction patterns have been conceived of, and therefore, discussed in terms of: the actors involved, information/resources shared among actors, frequency of information/resources flow, the direction of information/resources flow, means of information/resources sharing and perceived strength of interactions as detailed below.

Type and frequency of information/resources flow, and actors involved

Farmers-other actors' interactions in the study area involved several actors. Actors with interest in agriculture, and relevant for the study's action situation, were identified by the FGD participants. They include Sustainable Agricultural Tanzania (SAT)-an NGO involved in promoting agro-ecological farming; *Mtandao wa Vikundi vya Wakulima Tanzania* (MVIWATA) meaning Network of Farmers' Groups in Tanzania, which is involved in facilitating farmers' networking; Institute for Fish Pen Production Kingolwira (IFPPK)-involved in promotion of fish farming; AKM Glitters-a company involved in chick supply; NMBU/SUA[5] a SUA and NMBU (Norwegian University of Life Sciences) collaborative

[5] *NMBU/SUA collaborative programme had phased out during the study period; however, the actor was still in the minds of the FGD participants especially because the demonstration plots supported by the actor were still around and SUA was still present though under different arrangement.*

Table 3: Patterns of interaction: across actors' comparison

Interaction patterns		Actors								
		RECODA/SUA	Extension oficers	Buyers	NMBU/SUA	SAT	MVIWATA	UNITA	IFPPK	AKM Glitters
Direction of information/ resources flow	From actors to the farmer	101(78.3)	14(10.8)	2(1.6)	4(3.1)	8(6.2)	0(0)	0(0)	0(0)	0(0)
	From farmers to the actors	0(0)	2(40)	1(20)	1(20)	1(20)	0(0)	0(0)	0(0)	0(0)
	Both ways	19(29.7)	21(32.8)	16(25)	1(1.6)	3(4.7)	1(1.6)	1(1.6)	1(1.6)	1(1.6)
Frequency of information/ resources flow per year		47 (36.1)	13(10)	18(13.8)	6(4.6)	31(23.8)	6(4.1)	6(4.6)	2(1.5)	1(0.8)
Means of information sharing	Informal meetings	29(70.7)	7(17)	3(7.3)	0(0)	1(2.4)	0(0)	0(0)	0(0)	1(2.4)
	Formal meetings	44(75.9)	10(17.2)	0(0)	0(0)	4(6.9)	0(0)	0(0)	0(0)	0(0)
	Trainings	47(87)	1(1.9)	0(0)	0(0)	6(11.1)	0(0)	0(0)	0(0)	0(0)
	Farmer to famer extension	0(0)	19(82.6)	0(0)	3((13)	0(0)	0(0)	1(4.3)	0(0)	0(0)
	Farmers' study tour	0(0)	2(33.3)	0(0)	1(16.7)	1(16.7)	1(16.7)	0(0)	1(16.7)	0(0)
	Exchange at the market	0(0)	0(0)	10(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Strength of interaction	Strong	83(79.8)	12(11.1)	2(1.9)	1(1.0)	4(3.8)	1(1.0)	1(1.0)	0(0)	0(0)
	Moderate	33(51.6)	12(18.8)	8(12.5)	5(7.8)	5(7.8)	0(0)	0(0)	1(1.6)	0(0)
	Weak	4(14.8)	15(55.6)	4(14.8)	0(0)	3(11.1)	0(0)	0(0)	0(0)	1(3.7)

NB: *In brackets are percentages*
Source: Field data (2019)

project known as Enhancing Pro-poor Innovation in Natural resources and Agricultural Value Chains (EPINAV) involved in natural resources management; UNITA-a Roman Catholic sister organization; and Research Community and Organizational Development Associates (RECODA) and Sokoine University of Agriculture (SUA), which are involved in research, consultancy and outreach activities (Table 3). SUA and RECODA have been treated as one actor because they were implementing a joint project namely RIPAT-SUA project in the study area.

All these actors have been sharing a diversity of agriculture-related information and/or resources with farmers. FGD findings showed that most of the information and resources were coming from RECODA/ SUA and were meant to facilitate farmers' engagement in agricultural activities. Supply of resources is usually accompanied by information on how to use them, which in turn increases the rate of information flow to the farmers. Resources shared, which include seeds, chicks, dairy goats, piglets, and farm equipment like *chaka* (Zambian) hoes, are necessary for farmers' participation in agriculture. Supply of the resources involved linking farmers with service providers or RECODA/SUA acquiring such resources and supplying them to farmers (RIPAT-SUA project, 2019).

As for the frequency of information sharing, the highest frequency of information/ resource flow (36.1%) was depicted by RECODA/SUA followed by SAT (23.8%) while the least was AKM Glitters (0.8) (Table 3). There were fewer cases of information sharing by extension officers (10%) when compared with RECODA/ SUA and SAT. This could be due to limited number of extension officers which makes it difficult to reach many farmers. Likewise, FGD findings revealed that most of the farmers located in the midland and highland areas have limited access to extension services, which in turn decreases the rate of information flow from either side.

Higher frequency of information sharing by RECODA/SUA can be explained by the adoption of the RIPAT approach in project implementation. The RIPAT approach uses lead farmers (LFs) in bridging agricultural technology gaps to small-scale farmers (Vesterager *et al.,* 2013). Lead farmers are individuals who, during the project implementation period, are identified as people who have developed social entrepreneurship as agents for change and are among the successful farmers from within the group (Vesterager *et al.,* 2013). The major role of the LFs is to facilitate adoption and diffusion of project interventions (Ringo *et al.,* 2020). According to RIPAT-SUA Project (2021), there are 31 LFs in the project area. Explaining his role as a LF, a key informant said: *"I train farmers; I facilitate formation of groups and conduct field follow ups. In my group, I advise on compliance with our principle that each group member has to train at least three non-group members and supply them with planting materials"* (28/2/2020, A LF from Tangeni village). From the quote, it is clear that the RIPAT approach leverages the flow of information and resources.

Direction of information/resources flow

Information and/or resources flowed mainly from other actors to the farmers (65.2%), followed by information flowing both ways (32.3%) and lastly information flow from farmers to other actors (2.5%). This trend implies that the existing farmers-other actors' interaction is characterised by farmers acting largely as information/resources recipients. Other actors-farmers information flow was most evident for RECODA/SUA-farmers interaction (84.2%) followed by SAT and NMBU/SUA, both of which scored 66.7% (Table 4). This is logical because the three actors have been involved in training farmers as well as in provision of resources which are necessary for the adoption of the newly introduced production technologies. Therefore, they acted as the source of information/resources for farmers. Farmers-other actors' information/resource flow pattern was non-existent for the actors, like AKM Glitters, IFPPK and UNITA, whose relationship with farmers involved farmers acting as buyers of the resources. For these actors, both ways information/resource flow pattern was the exclusive pattern.

Both ways information/resource flow pattern was most evident with extension officers

Table 4: Patterns of interaction - individual actors' comparison

Interaction patterns		Actors									
		RECODA/SUA	Extension oficers	Buyers	NMBU/SUA	SAT	MVIWATA	UNITA	IFPPK	AKM Glitters	Total
Direction of information/ resources flow	From actors to the farmer	101(84.2)	14(37.8)	2(10.5)	4(66.7)	8(66.7)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	129(65.2)
	From farmers to the actors	0(0.0)	2(5.4)	1(5.3)	1(16.7)	1(8.3)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	5(2.5)
	Both ways	19(15.8)	21(56.8)	16(84.2)	1(16.7)	3(25)	1(100)	1(100)	1(100)	1(100)	64(32.3)
Means of information sharing	Informal meetings	29(24.2)	7(17.9)	3(23.1	0(0.0)	1(8.3)	0(0.0)	0(0.0)	0(0.0)	1(100)	41(20.7)
	Formal meetings	44(36.7)	10(25.6)	0(0.0)	0(0.0)	4(33.3)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	58(29.3)
	Trainings	47(39.2)	1(2.6)	0(0.0)	0(0.0)	6(50)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	54(27.3)
	Farmer to famer extension	0(0.0)	19(48.7)	0(0.0)	3(75)	0(0.0)	0(0.0)	1(100)	0(0.0)	0(0.0)	23(11.6)
	Farmers' study tour	0(0.0)	2(5.1)	0(0.0)	1(25)	1(8.3)	1(100)	0(0.0)	1(100)	0(0.0)	6(3.03)
	Exchange at the market	0(0.0)	0(0.0)	10(76.9)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	10(5.05)
Strength of interaction	Strong	83(69.2)	12(30.8)	2(14.3)	1(16.7)	4(33.3)	1(100)	1(100)	0(0.0)	0(0.0)	104(52.5)
	Moderate	33(27.5)	12(30.8)	8(57.1)	5(83.3	5(41.7)	0(0.0)	0(0.0)	1(100)	0(0.0)	64(32.3)
	Weak	4(3.3)	15(38.5)	4(28.6)	0(0.0)	3(25)	0(0.0)	0(0.0)	0(0.0)	1(100)	27(13)

NB: In brackets are percentages
Source: Field data (2019)

(56.8%) followed by SAT (25%), NMBU/SUA (16.7%) and RECODA/SUA (15.8%) in case of extension service and agricultural training-related actors (Table 4). Results show that information flow from farmers to extension officers took place mainly through farmer-to-farmer extension (48.7%), which involves extension officer visiting a farmer on-farm for advice. With this channel, the farmer explains to the extension officer his/her agricultural problems based on which the extension officer advises. The arrangement necessarily calls for an exchange and hence both ways pattern of interaction. Similar findings were observed by Development for International Department (2003), which reported prevalence of two way communication between farmers and researchers, extension staff, veterinary staff and local administrators. Both ways information flow pattern was also highly evident for buyers (84.2%) (Table 4) and this can be explained by farmers-buyers relationship involving the farmer giving commodities to the farmer and the buyer giving money to the farmer in return.

Means of information flow and strength of farmers-other actors' interactions

Information flow channels, which existed in the study area, include formal meetings (29.3%), training (27.3%), informal meetings (20.7%), farmer-to-farmer extension (11.6%), exchange at the market (5%) and farmers' study tours (3%) (Table 4). Formal meetings were most applicable to RECODA/SUA (36.7%) followed by SAT (33.3%) (Table 4). The RIPAT approach, which RECODA/SUA embraces, requires that project implementing organization (RECODA/SUA) meets with farmers at least once every week during the first year of the project (Vesterager *et al.,* 2013). This forms the possible explanation for higher scores on formal meetings by RECODA/SUA. Another clue to the findings is implied in the following quote by RIPAT-SUA project facilitator: *"We share information through quarterly meetings with farmers, but also individual farmers are supposed to fill quality control forms which help us to understand progress and challenges which farmers are facing"* (11/03/2020, Changarawe village).

For training, SAT scored the highest (50%) followed by RECODA/SUA (39.2%). SAT has been visiting the area for specific training and therefore, when the actor is in the study area, often times the purpose is to conduct training. On the other hand, based on KII with RIPAT-SUA Project Manager, RECODA/SUA field officers are always (at least four days a week) in the area, not necessarily for training, but for follow-ups (farmer-to-farmer extension) or meetings. The exchange at the market was only applicable for the buyers (76.9%), this been their most important avenue for exchange; market place brings farmers and buyers together. The other channels used for farmers-buyers interaction pattern was informal meetings (23.1%) (Table 4). In practice, farmers and buyers conduct their exchanges through haphazard meetings; they meet at the market without prior agreement.

As for the strength of interactions, the respondents scored their interaction with most of the actors as strong (52.5%) followed by moderately strong (32.3%) and lastly, weak interaction (13.6%) (Table 4). Majority of the respondents (79.8%) indicated that there is a strong interaction with RECODA/SUA. This was followed by 11.1% who assigned their interaction with extension officers as strong, with SAT holding the third position (3.8) (Table 4). This implies that, RECODA/SUA was closer to the farmers in terms of conducting trainings, sharing information, and providing resources that are required for farmers' engagement in agricultural activities. From the following information from Changarawe village FGD participants, the findings are vindicated: RIPAT-SUA project facilitators make a follow-up on everything they teach us and provide necessary information on different crops and livestock we produce. Not only that, but also they come to visit us in case of any emergence on crops and livestock provided through solidarity chain arrangement. Lower scores for the strength of farmers-extension officers' interaction, when compared with RECODA/SUA could be due to few numbers of extension officers in the study area which makes it difficult for them to reach every farmer.

From the discussion above, it is clear that RECODA/SUA has scored the highest in terms

Table 4: Patterns of interaction - individual actors' comparison

Interaction patterns		Actors									
		RECODA/SUA	Extension oficers	Buyers	NMBU/SUA	SAT	MVIWATA	UNITA	IFPPK	AKM Glitters	Total
Direction of information/ resources flow	From actors to the farmer	101(84.2)	14(37.8)	2(10.5)	4(66.7)	8(66.7)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	129(65.2)
	From farmers to the actors	0(0.0)	2(5.4)	1(5.3)	1(16.7)	1(8.3)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	5(2.5)
	Both ways	19(15.8)	21(56.8)	16(84.2)	1(16.7)	3(25)	1(100)	1(100)	1(100)	1(100)	64(32.3)
Means of information sharing	Informal meetings	29(24.2)	7(17.9)	3(23.1	0(0.0)	1(8.3)	0(0.0)	0(0.0)	0(0.0)	1(100)	41(20.7)
	Formal meetings	44(36.7)	10(25.6)	0(0.0)	0(0.0)	4(33.3)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	58(29.3)
	Trainings	47(39.2)	1(2.6)	0(0.0)	0(0.0)	6(50)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	54(27.3)
	Farmer to famer extension	0(0.0)	19(48.7)	0(0.0)	3(75)	0(0.0)	0(0.0)	1(100)	0(0.0)	0(0.0)	23(11.6)
	Farmers' study tour	0(0.0)	2(5.1)	0(0.0)	1(25)	1(8.3)	1(100)	0(0.0)	1(100)	0(0.0)	6(3.03)
	Exchange at the market	0(0.0)	0(0.0)	10(76.9)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	10(5.05)
Strength of interaction	Strong	83(69.2)	12(30.8)	2(14.3)	1(16.7)	4(33.3)	1(100)	1(100)	0(0.0)	0(0.0)	104(52.5)
	Moderate	33(27.5)	12(30.8)	8(57.1)	5(83.3	5(41.7)	0(0.0)	0(0.0)	1(100)	0(0.0)	64(32.3)
	Weak	4(3.3)	15(38.5)	4(28.6)	0(0.0)	3(25)	0(0.0)	0(0.0)	0(0.0)	1(100)	27(13)

NB: In brackets are percentages
Source: Field data (2019)

Table 5: Factors influencing farmers' interaction

Independent variables	Unstandardized coefficients	Standardized coefficients		t	Sig.	Collinearity statistics	
	B	Std. error	Beta			Tolerance	VIF
Institution/organizations available	0.069	0.135	0.076	0.511	0.611	0.273	3.665
Diversity of income generation activities	0.151	0.774	0.017	0.195	0.846	0.793	1.261
Distance to the market	-0.018	0.008	-0.187	-2.222	0.028**	0.843	1.187
Diversity of crops/livestock produced	0.620	0.264	0.227	2.347	0.021**	0.638	1.566
Road condition	1.920	1.772	0.153	1.084	0.281	0.299	3.350
Age of the farmer	-0.024	0.043	-0.046	-0.554	0.581	0.876	1.141
Sex of the farmer	-0.449	1.096	-0.035	-0.410	0.683	0.797	1.255
Number of resources shared by the actors	1.796	0.284	0.525	6.319	0.000***	0.865	1.156
Diversity of information access	-0.104	0.496	-0.021	-0.209	0.835	0.570	1.755
(Constant)	13.164	3.953		3.330	0.001***		

Dependent variable: Interaction (Unstandardized R=+0.586, R2=0.343, Adjusted R2=+0.289)
*N.B. ***, ** are levels of significance at 1%, 5% respectively*
Source: Field data (2019)

of frequency of information and resources flow, other actors-farmers resource flow pattern, and perceived strength of farmers-other actor interaction. The respondents saw RECODA/ SUA as the most instrumental actor in the provision of resources and information necessary for their engagement in agricultural activities. The findings corroborate the IAD's postulation that actors interact in light of the incentives they face to generate outcomes directly in the world (Ostrom, 2011).

Factors influencing farmers' interaction

Predictor variables included in the regression model were having R of 0.343 and adjusted R of 0.289 which means that predictor variables were able to explain the dependent variable in the model by 34.3% and the explanatory power was 28.9% for individual predictors included in the model respectively (Table 5). Multiple regression results (Table 5) show that the following variables have a statistically significant influence on farmers' interactions: distance to the market (p=0.028), diversity of crops/livestock produced (p=0.021), and the number of resources shared by the actors (p=0.000). Against expectations, institutions did not have statistically significant influence on farmers' interactions. This is probably due to the fact that, institutions which act also as organizations, such as the village government, the market, and religious and educational institutions, were considered as actors and therefore formed one of the three variables which were combined to generate interaction variable (dependent variable). The study villages are barely distinct in terms of policies, rules, norms and beliefs.

Distance to the market was negatively affecting farmers' interaction with fellow farmers and other actors at 5% significant level. This means that the interaction of farmers decreases with increase in distance from the market. The result implies that as the distance from farmer's home to the market increases, the chances that a farmer will attend to the market frequently decreases and therefore the likelihood of a decrease in information flow from different actors at the market. As indicated in Table 2, farmers located in the highland area had lower interaction levels than farmers located in the midland area, which is closer to Tangeni market. The findings are similar to the observations by Ayalew *et al.* (2016) and Mutenje *et al.* (2016) that farmers located away from social services (market and other institutions like finance institutions) are less likely to get information of new crops or agricultural inputs slowing their rate of adoption of agriculture technology. The market being closer is a location advantage for the farmers to interact and share information concerning crop price, required crops/crop products and the best season to produce a certain type of crops.

Distance from the market may also imply likelihood with which agricultural activities can be rewarding because it has to do with transport cost and overall post-harvest handling cost. The proximity of market infrastructures to the farmers' location can also be looked at from the biophysical conditions' perspective, which Ostrom (2011) identifies as an important factor influencing interactions. Thus, in line with the IAD and the social exchange theory, biophysical conditions, and cost and rewards are important driving forces for farmers' interactions.

Results show further that the diversity of crops/livestock produced; in this case, farmers involved in diversifying crops/livestock were significantly affecting farmers' interaction in agricultural projects. This implies that, a farmer producing a diversity of crops/livestock will also receive and/ or share diverse information according to the crops/livestock he/she produces and hence the likelihood of higher levels of interaction than those involved in single crops/ livestock. Therefore, farmers with different types of crops/livestock meet with different actors (buyers, farmers, extension officers and NGOs) for different crops/livestock leading to more information sharing compared to a farmer with fewer types of crops/livestock.

As for resources shared, the findings show that the number of resources shared by the actors to the farmers was positively affecting farmers' interaction. Often, the supply of resources to farmers is accompanied with information such as why are the resources supplied, how to use them, and what are the expected results. Thus, it is logical to contend that the more the number of

resources shared the more the likelihood of high interaction levels. Also, resource supply, from the point of view of agricultural projects, could involve the supply of agricultural inputs and/ or equipment to farmers. In this case, the more the number of resources supplied by agricultural projects the more likely it is that farmers will interact more with resource suppliers and with fellow farmers. For example, through the RIPAT-SUA project, farmer groups' members have accessed several resources, including day-old chicks from AKM Glitters Company, banana suckers from biotechnology laboratory in Arusha, iron bean seeds from Tanzania Agricultural Research Institute (TARI) Selian, orange-fleshed sweet potato (OFSP) vines from SUGECO[6] and cassava stem cuttings from TARI Kibaha (RIPAT-SUA project, 2019).

Acquisition of these resources involved the interaction of the farmers with at least six service providers. The FGD findings revealed that there was a surge of farmers' inclination to the production of OFSP, thanks to the availability of the crop's market at SUGECO. This sellers-buyer relationship, between farmers and SUGECO, was driven by the existing transactions between the two actors. Elaborating their motivation for participating in agricultural projects, the FGD participants from Mnyanza village reported that some of the famers participate in groups to work together in agricultural activities, not only that we interact with different stakeholders who supply to us resources necessary for agriculture production.

From the FGD findings, it is implied in the first case (farmers-SUGEGO interaction) that the driving force for the interaction was the anticipated material benefits. In the second case, however, participation is driven by expected social gains. Thus, the findings corroborate the social exchange theory which, according to SWDG (2019), views human interaction and exchange a kind of result-driven social behaviour related to cost and rewards. However, rather than just referring to it as cost and rewards, it should be explicit in the social exchange theory that both material and social benefits are important when it comes to motivating factors for actors' interactions.

[6] *SUGECO stands for Sokoine University Graduate Entrepreneurs Cooperative*

Conclusions

Actors with the highest scores in terms of frequency of information and resources flow scored the highest in terms of other actors-farmers' resource flow pattern; they also scored the highest in terms of perceived strength of farmers-other actors' interaction. Thus, consistent with the IAD's postulation, actors interact in light of the incentives they face to generate outcomes directly in the world. The study concludes also that exogenous factors, including biophysical conditions such as proximity to the crop market infrastructures, cost and rewards such as resources brought by actors to the action situation, and diversity of resources sought based on diversity of crops or livestock produced, influence farmer's interaction. The RIPAT approach plays a crucial role in shaping farmers-other actors' interactions; it influences the type of actors the farmers interact with and the pattern of interactions. It is through interaction with various actors and biophysical conditions at farmer's disposal that a farmer accesses information and resources necessary for their production activities. Cost and rewards offer deterrents and incentives necessary for the farmers' interactions. The findings agree with the IAD and the social exchange theory, which, respectively, postulate that biophysical conditions, and cost and rewards are important driving forces for farmers' interactions. The findings suggest that, rather than referring to it just as cost and rewards as it is in the social exchange theory, it should be explicit that both material and social benefits are important when it comes to motivating factors for actors' interactions.

The study recommends that individuals, government and non-governmental organizations involved in the promotion of agriculture ensure that the interventions promoted are rewarding to the farmer, both in the short and long-term while considering exogenous factors for farmers' participation in agricultural projects. As exemplified by the RIPAT-SUA project, interactions that are rewarding are likely to result in participation of farmers in agricultural projects. This could be through ensuring the right information and resources are shared appropriately and

at the right time, and that there are avenues for information sharing. Recommended avenues include village/ward level agricultural stakeholders' meetings, which could be conducted quarterly. These meetings bring together farmers, extension officers, NGOs, and technical and political leaders. Establishment of market infrastructures in strategic locations, where farmers could reach with their products and meet with buyers, is also recommended. Since the RIPAT approach plays a crucial role in shaping farmers-other actors' interactions in a way that ensures a win-win situation among the actors, employing the approach in designing and implementation of agricultural projects would very likely spur fruitful farmers-other actors' interactions. Lastly, it is recommended that further studies be conducted to establish empirically the effect of interactions on farmer's participation in agricultural projects.

Acknowledgements

Authors are grateful to RIPAT-SUA Project Management and the local government authorities for Morogoro Municipal Council and Mvomero Districts for availing relevant literature and for administrative support. Sokoine University of Agriculture is thanked for granting researchers' clearance whereas study participants are acknowledged for their unconditional participation in the study. Thanks are also due to anonymous reviewers of this paper.

References

Abdul-rahaman, A. and Abdulai, A. (2018). Do farmer groups impact on farm yield and efficiency of smallholder farmers? Evidence from rice farmers in Northern Ghana. Food Policy: 1–11.

Aref, F. (2011). Farmers' participation in agricultural development: The case of Fars province, Iran. *Indian Journal of Science and Technology* 4(2): 155–158.

Ayalew, M.D., Nicolas, G. and Matz, J.A. (2016). Social networks, agricultural innovations, and farm productivity in Ethiopia. In: Proceding of STAARS conference in Addis Ababa, 4-5 December, 2015; Nordic Conference in Development Economics, 15-16, June 2015, Copenhagen, and the 13th International Conference on the Ethiopian Economy, 23-25, July 2015, Addis Ababa. 1-44pp.

Bryman, A. (2008). Social Research Methods. OXFORD, New York. 809pp.

Daoud, J.I. (2017). Multicollinearity and regression analysis. *Journal of Physics: Conference Series* :1-7.

Development for Interaction Department (2003). Impact Assessment and Long term Sustainability of the FARM-Africa's Farmer-to-Farmer Extension Mode. Livestock Production Programme, Kenya. 68pp.

Duinen, R., Van, Filatova, T., Veen, A. and Van Der. (2012). The role of social interaction in farmers' climate adaptation choice Uninversity of Twente 2012. In: Proceeding of International Congress on Environmental Modelling and Software Managing Resources of a Limited Planet, Sixth Biennial Meeting. (Edited by Seppelt, R *et al.*), 2012, Leipzig, Germany, 2012. 1–12pp.

Field, A. (2009). Discovering statistics Using SPSS (3rded.). SAGE, Los Angeles, London. 857pp.

Freeman, K. and Qin, H. (2020). The role of information and interaction processes in the adoption of agriculture inputs in Uganda. Agronomy 10(202): 1–16.

Frost, J. (2020). Multicollinearity in regression analysis: Problems, detection, and solutions. [https://statisticsbyjim.com/regression/multicollinearity-in-regression-analysis/] site visited on 4/5/2020.

Healey, J.F. and Mitchell, L.S.E. (Eds.) (2013). The Essentials Of Statistics: A Tool for Social Research. WADSWORTH, Australia. 483pp

Kiser, L.L. and Ostrom, E. (1982). The Three Worlds of action: A metatheoretical synthesis of institutional approaches. In: Strategies of Political Inquiry, ed. Elinor Ostrom. Beverly Hills, CA: SAGE. 179–222pp.

Larsen, A.F. and Lilleør H.B. (2014). Beyond the field : The impact of farmer field schools

on food security and poverty alleviation. World Development 64: 843–859.

Lavrakas, P.J. (2008). Encyclopedia of Survey Research Methods. [book/about/Enclopedia_of_Survey_Research_Methods.html?id=Lp_v&SrFL_sC&source=kp_book_description&redir_esc=y] site visited on 31/4/2020.

Levin, K.A. (2014). Study design III : cross-sectional studies. Evidence-Based Dentistry 1-3.

Malisa, E.T., Ringo, E.D. and Mahonge, C.P. (2017). Situation analysis for the establishment of project applying RIPAT Approach adjacent to SUA. 11pp.

Mashavave, T., Mapfumo, P., Mtambanengwe, F., Gwandu, T. and Siziba, S. (2013). Interaction patterns determining improved information and knowledge sharing among smallholder farmers. *African Journal of Agricultural and Resource Economics* 8(1): 1–12.

Mchomvu, Z.F. (2015). The Role of Farmer Field Schools in Dissemination of Technologies to Paddy Farmers in Mvomero. Dissertation for Award of Msc Degree at Sokoine University of Agriculture, Morogoro, Tanzania, 86pp.

Mojo, D., Fischer, C. and Degefa, T. (2017). The determinants and economic impacts of membership in coffee farmer cooperatives : recent evidence from rural Ethiopia. *Journal of Rural Studies* 50: 84–94.

Muanga, E.N., Schwarze, S. and Qaim, M. (2014). Social networks and farmer exposure to improved crop varieties in Tanzania. Department of Agricultural Economics and Rural Developmen, Georg-August-University of Goettingent, Germany. 32pp

Mutenje, M., Kankwamba, H., Mangisonib, J. and Kassie, M. (2016). Technological forecasting & social change agricultural innovations and food security in Malawi: Gender dynamics, institutions and market implications. Technological Forecasting & Social Change 103: 240–248.

Ostrom, E. (2011). Background on the Institutional Analysis and Devolopment Framework. *Policy Studies Journal* 39(1): 7–27.

Ringo, D.E. (2020). Personality traits of high-performing lead farmers in farmer-to-farmer extension: A case of the Rural Initiatives for Participatory Agricultural Transformation Approach, Tanzania. Thesis for Award of PhD Degree at Sokoine University of Agriculture, Morogoro, Tanzania, 203pp.

RIPAT-SUA Project (2019). Quarter three (July-September 2019) progress report for RIPAT-SUA Project. 31pp.

RIPAT-SUA Project (2021). Quarter one (January-March 2021) progress report for RIPAT-SUA Project. 32pp.

Setia, M.S. (2016). Methodology series module 3 : Cross-sectional studies. *Indian Journal of Dermatology* 61(3): 261–264.

SWDG (Social Work Degree Guide) (2019). Social Work Degree Guide. [www.socialworkdegreeguide.com/faq/what-is-social-exchange-theory/] site visited on 11/6/ 2019.

Thomas, B.J.K., and Thigpen, J. (1993). A social exchange explanation of participation in the U.S . farm. Southern Rural Sociology 12(1): 1–23.

Warnet, J.E. (2015). Social networks are important source of agriculture knowledge. [https://ucanr.edu/blogs/blogcore/postdetail.cfm?postnum=18380] site visited on 17/4/2020.

WS (Weather Spark) (2020). Average Weather in Morogoro Tanzania. [https://weatherspark.com/y/100113/Average-Weather-in-Morogoro-Tanzania-Year-Round] site visited on 31/3/2020

Vesterager, J.M., Ringo, D.E., Maguzu, C.W., and Ng'ang'a, J.N. (2013). The RIPAT Manual-Rural Initiatives for Participatory Agricultural Transformation. RECODA, Arusha. 161pp.