Rural Initiatives for Participatory Agricultural Transformation (RIPAT) and Rural Development

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CHAPTER 6

The Contribution of the RIPAT Approach in the Adoption of Agricultural Technologies in the Uluguru Mountains

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Abstract

Extension services play pivotal roles in linking farmers to knowledge, information and technologies that are central to attaining agricultural productivity. The limited number of extension agents coupled with the use of inappropriate approaches in the delivery of extension services has been regarded as one of the causes of low adoption of agricultural technologies. To overcome this, innovative and cost-effective agricultural extension approaches have been developed and promoted. One of such approaches is the Rural Initiatives for Participatory Agricultural Transformation (RIPAT) which forms the focus of this chapter. Specifically, the chapter presents: (i) the role of the RIPAT approach in the adoption of agricultural technologies, (ii) technologies promoted by the RIPAT-SUA project and their adoption by farmers, and (iii) factors affecting the adoption of the promoted technologies. The findings presented are drawn from an exploratory cross-sectional research done in six randomly selected villages surrounding the Uluguru Mountains where the RIPAT-SUA project has been implemented. A total of 238 households (120 RIPAT participating farmers and 118 non-group farmers) were randomly selected from the project villages for the farmers' survey. Additionally, a total of 15 key informants were involved in in-depth interviews. Desk review of project documents was also conducted. Descriptive statistics and content analyses were used for the quantitative and qualitative data analysis respectively. The study found that a basket of options that gave farmers the opportunity to choose the technologies they can implement was the key to adoption of technologies. In this respect, 92.5% of the group members adopted more than two technologies whereas 69% of non-group members adopted at least two technologies from the basket of options. The RIPAT approach has great potential to reach many farmers through its scaling-up tactic involving the RIPAT start and RIPAT spreading groups using lead farmers. This approach can facilitate the dissemination of new agricultural technologies in situations with limited professional extension workers. The study therefore recommends that the Ministry of Agriculture should integrate the RIPAT approach in the public agricultural extension framework.

Keywords: Extension approaches, Farmer groups, Basket of options, RECODA

Introduction

Extension services play a pivotal role in linking farmers to knowledge, information and technologies that are central to agricultural productivity (Soire *et al.*, 2016). In Tanzania, as in many other developing countries, the current structure of extension services is heavily reliant on the public sector (Mdemu *et al.*, 2017; Mmbando & Baiyegunhi, 2016; Siyao, 2012; Rutatora & Mattee, 2001). According to Agricultural Sector Development Programme Phase II (ASDP II) (URT, 2016) there is a gap of 6,244 and 10,000 extension workers for crop and livestock, respectively. Limited number of government extension workers is among the factors contributing to the limited uptake of new technologies by farmers hence poor agricultural productivity in Tanzania (Mdemu *et al.*, 2017; Mmbando & Baiyegunhi, 2016; Siyao, 2012). Thus, there is a need to increase the number of extension workers to fill the gap and/ or use innovative approaches for the delivery of extension and training services to ensure increased agricultural productivity through timely dissemination of agricultural technologies.

Participation of the private sector in the delivery of extension services to complement the government efforts has been reported in Tanzania (Rutatora & Mattee, 2001). Recent efforts to introduce Public Private Partnership (PPP), Farmer Field School (FFSs) and Ward Resource Centres (WRCs) have the potential of enhancing effective farmer support services. According to ASDP-1, the FFS approach has been recognised as being efficient by extension service providers including Research, Community and Organisational Development Associates (RECODA), an NGO based in Tanzania. It provides agricultural extension services to small-scale farmers through an approach known as Rural Initiatives for Participatory Agricultural Transformation (RIPAT). RIPAT was launched in Tanzania in 2013, and in 2014 it was implemented in several villages in northern Tanzania on a trial basis. The RIPAT-SUA project, which applied the RIPAT approach, was implemented in the selected communities surrounding the Uluguru Mountains from 2018 to June 2021.

Literature indicates that the dissemination of agricultural technologies in many developing countries including Tanzania has, over the years, been implemented using two dominant approaches which are Training and Visit (T&V) and Farmer Field School (FFS) (Simpson & Owens, 2002; Lilleør & Lund, 2013; Waddington *et al.*, 2014). The main difference between the two is that the former is a 'top-down' approach whereas the latter is a 'bottom-up' one. On the one hand, T & V approach denotes the transfer of technical information done by specialists and field staff through contact farmers in villages who are, in turn, responsible for diffusing knowledge to other members in the local community. On the other hand, FFS is a participatory, experiential, and reflective learning approach to improving the problem-solving capacity of farmers through highly trained facilitators working with farmer groups. According to Mvena *et al.* (2013), the dominant T&V and FSS approaches have been criticised for, among others, being limited to demonstration of technologies, limited use of farmer's knowledge and the use of already packaged information. Furthermore, it has been argued that various innovations which are proposed by researchers do not help farmers because the role of farmers' knowledge is overlooked (Leeuwis & Ban, 2004). Thus, the FFS approach targets capacity building of farmers through experiential learning using farmer research and experimental plots (Nederlof and Odonkor, 2006). According to Davis and Mekonnen (2012), any classic FFS is not designed to develop new technology; it rather provides strong elements of adaptive research.

Despite this, the role of research institutions in the development of new agricultural technologies is still a key to agricultural development. Thus, Wambura *et al.* (2015) assert that there is a need for effective transmission of research findings to farmers if research efforts are to contribute to agricultural progress.

Effective dissemination of research findings requires an effective agricultural extension system working in tandem with the research system and very closely with farmers. Lukuyu *et al.* (2012) point out the need to develop low-cost sustainable approaches for service provision that goes beyond extending messages to playing a key role in promoting farmers as the principal agents of change in their communities. Such approaches need to enhance farmers' learning and innovation and improve their capacities to organise themselves for more efficient production and marketing. Even though FFS was designed to serve this purpose, it is still constrained with low coverage. Again, T&V is equally limited as it does not consider the role of farmers' knowledge and their context. As a matter of fact, group approaches to provision of extension services have been widely promoted since many people are reached at once. A good example is RECODA which came up with an innovative RPAT approach that links researchers, extension workers and farmers as well as facilitates scaling out to wider areas using lead farmers. However, the RIPAT approach is still new in Tanzania, and little is known about how it enhances the adoption of agricultural technologies. This chapter therefore presents (i) the role of RIPAT in the adoption of agricultural technologies (ii) the technologies promoted by RIPAT-SUA project and their adoption by farmers and (iii) the factors influencing the adoption of the promoted technologies.

RIPAT approach

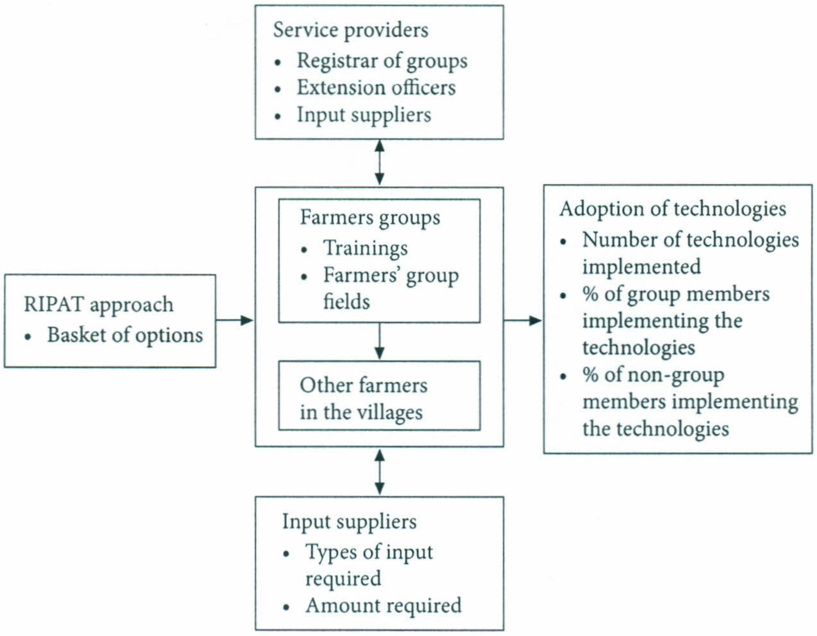
RIPAT, as an approach, is designed as a modified FFS taking it as its starting point for farmer groups and experiential learning. The RIPAT groups comprise 25-30 members. The use of farmer groups has largely been driven by a pragmatic approach to achieve the objective of 'closing the technology gap' rather than by an adherence to existing participatory extension approaches such as the FFS methodology. Unlike the traditional FFS, the RIPAT approach provides for experiential learning with farmers through the agricultural technologies in a basket of options, which is promoted based on the farming system and agro-ecological environment of the target area. A situation analysis is done prior to the dissemination of agricultural technologies to be included in the basket of options. The RIPAT approach largely *combines* top-down and bottom-up approaches through the teaching of new research based knowledge (top-down) and simultaneous facilitation of practical, hands-on experiential learning and discussion or reflection that helps in adapting the new technology to local conditions (bottom-up). All RIPAT group members (farmers) are exposed to a set of technology options through group fields. The aim is to equip farmers with knowledge and skills for each technology to enable them to adopt it in their household farms based on the available resources and/or preferences. Each group is supported in the establishment of the group field in terms of seeds and initial flock. Other costs are covered by farmers to create a sense of ownership. Additionally, farmers are linked to the suppliers of agricultural inputs for implementing the technologies. Besides, a RIPAT approach involves formalised collaboration with local government authorities, village leaders, and agricultural extension and livestock officers. This is to ensure support for and local ownership of the development intervention, and to promote implementation of the technologies and further spread to the wider community.

Conceptual framework

The study used an inductive approach in assessing the contribution of RIPAT approach in the adoption of agricultural technologies. According to Rogers (2003), the adoption decision process involves an information-seeking and information-processing activity in which a person is inspired to minimise uncertainty about the advantages and disadvantages of an innovation. Therefore, extension approaches used for disseminating agricultural technologies play a great role in the adoption of technologies. Each extension approach has its key elements that catalyse the adoption process. Thus, the key elements of the RIPAT approach are the basket of options, organising farmers into groups, capacitating them, linking them with input suppliers, and establishing formal collaboration with local government authorities (Figure 6.1).

The study assumed that the basket of options comprised of improved technologies of crop and livestock production that were promoted to farmers for adoption. However, farmers needed information on how to implement the technologies and demonstration served as a good method for disseminating information to the farmers. Learning about the technologies was facilitated through organising farmers into groups coupled with the establishment of farmers' group fields. The farmers' group fields acted as demonstration plots for farmers to learn and practise the same in their own fields as well as disseminate the technologies to other non-group members. Farmers' group fields motivated non-group members to implement the agricultural technologies promoted through the approach by observing the group fields' performance. The study further assumed that the link between farmers and input suppliers and local government authorities aimed to enhance the uptake of technologies in a more sustainable manner. This is because they (farmers) would be able to contact both input suppliers and government officials for help when embarking on agricultural production activities.

Figure 6. 1: *Conceptual framework*



Methodology

Description of the study area

The study was conducted in Mvomero and Morogoro Municipal Council where the RIPAT-SUA project was implemented. The two districts are located in the Eastern zone of Tanzania. Morogoro Municipality is in North-East of Morogoro Region between 6°00' and 8°00' Latitudes South of Equator, also between Longitudes 36°00' and 38°00' East of Greenwich. Mvomero District is located at Latitude 06°26' South and

Longitude 37°32' East. According to Tanzania's 2012 Population and Housing Census, Morogoro Municipality had 56,723 households and Mvomero district had 58,314 households with a total population of 286,248 and 312,109, respectively (URT, 2013). The study on which this chapter is based was exploratory and covered six (6) purposively selected villages in the Uluguru Mountains in which the RIPAT-SUA project was implemented. Of the six villages, three villages were from the highlands and the other three villages were from the lowlands. Besides, out of the six selected villages, two were with the RIPAT start while four were part of RIPAT spreading groups.

Data collection

Data collection was conducted through a desk review of RIPAT-SUA project documents such as the quarterly reports and the RIPAT manual. Documentary review was helpful in understanding the design of the RIPAT. Also, quarterly reports provided information on how the project that used RIPAT approach (RIPAT-SUA project) was implemented and monitored. The study also involved in-depth interviews with a total of 15 key informants comprising agricultural extension officers at district level (2), ward level (2), village level (9), and RIPAT-SUA project staff (2). The interviews were done to explore the key informants' experiences regarding the use of the approach on issues like applicability of the agricultural technologies, affordability of inputs, and the role of trained facilitators. Additionally, a household survey was conducted using an interview schedule with both open and close-ended questions. The unit of analysis for the survey was the household because each RIPAT group member represented a household. Selection of the households was done using the stratified sampling technique. The households in the selected villages were grouped into RIPAT group members and non-group members. A random sampling method was then used to select 15 households from each RIPAT group. Additionally, 30 and 15 non-group member households were randomly selected from the RIPAT start and RIPAT spreading villages, respectively. This was done to enable proportionate sampling because each village with RIPAT start had two groups while only one group was formed in the RIPAT spreading villages. Therefore, the study involved a total of 238 households (Table 6.1). A non-response of 3% was experienced during data collection since the expected sample size was 240 respondents.

Table 6. 2: *Number of households selected for study by group and location*

Village/Street	Location	Group	Group's status	Number of respondents	Number of non-farmers
Changarawe	Low land	Nuru	RIPAT Start	15	30
		Amani	RIPAT Start	15	
Mnyanza	Upland	Chikena	RIPAT Start	15	27
		Twikinde	RIPAT Start	15	
Pekomisegese	Upland	Tukalehamwe	RIPAT Spreading	15	15
Konga A	Low land	Chapakazi	RIPAT Spreading	15	15
Mfine	Upland	Nyota	RIPAT Spreading	15	15
Kipera	Low land	Mashujaa	RIPAT Spreading	15	16
Total				120	118

Findings

Role of RIPAT in facilitating the adoption of the technologies

Community sensitisation and group mobilization

The study indicated that the approach used in sensitising the RIPAT-SUA project facilitated the adoption of technologies promoted by the project. Project sensitisation from the regional level down to the community level created awareness of the technologies at various levels including several villages and/or streets in the selected wards. It involved giving detailed explanations on the project activities and the obligations of the project. Community members were enabled in informed decision making through enhanced commitment to the project activities. Among the key obligations by community members were readiness to form groups as well as provision of land for the establishment of farmers' group fields. These two aspects enhanced a sense of ownership of the project from initiation stage. Drawing from the study, it is evident that the RIPAT approach facilitated the adoption of agricultural technologies through community members' awareness creation which helped to decide on whether to accept or reject the project interventions. Literature has indicated the importance of farmers' participation in adoption of agricultural technologies (Ainembabazi & Mugisha, 2014; Anandajayasekeram & Workneh, 2007; Asiabaka, 2002). The adoption of the newly introduced technologies depends on the level of community members' participation. When farmers participate fully in the process, they become more empowered and can learn from each other.

Furthermore, the study shows that the RIPAT– SUA project had two steps 'the RIPAT start' and the 'RIPAT spreading' groups (as per RIPAT approach). The RIPAT start involved selection of groups which started implementing the RIPAT-SUA project activities. These groups acted as a platform for building community-based experts, creating desire, awareness, and source of planting materials for the entire community (beyond the RIPAT group members). Deliberate efforts of training farmers who could train others under the training of trainers (ToT) approach were done to ensure local based experts (lead farmers) were available within the community. The best lead farmers from RIPAT start were paired with the government agricultural extension officers and trained on how to start new groups in the neighbouring communities. In the second year, RIPAT Start was followed up by a 1-year RIPAT Spreading group. Trained facilitators from the RIPAT-SUA project mentored, supervised, and supported the work of lead farmers and government agricultural extension officers.

Generally, the work in RIPAT spreading is not done by the expensive NGO staff but by the much cheaper lead farmers residing in the community. This is in practice, a farmer-to-farmer extension. The approach further applied a sister group concept in the agro-inputs sharing or supply. Sister groups are formed later within or outside the village and are supplied with inputs from groups graduated from phase 1 (RIPAT 'Start'). The RIPAT Start groups were paired with new groups established in RIPAT Spreading and supplied inputs for the technologies identified from the basket of options. Findings from the farmers survey indicated no statistically significant association (Chi-Square score of 3.049) of the group formation (RIPAT Start and RIPAT Spreading) and the adoption of agricultural technologies among group members. This implies agricultural dissemination done by lead farmers in RIPAT spreading groups had a similar effect to that provided by RIPAT-SUA project facilitators in the RIPAT Start groups. Thus, well trained lead farmers can play a potential role in disseminating agricultural technologies in situations where public extension workers are limited.

The group approach was among the factors that facilitated the adoption of technologies. The key informants reported the difference between the RIPAT approach and other agricultural extension approaches such as the traditional FSS and T&V in that the farmers were left to decide to join the groups voluntarily without being forced by the project and/or the government. As a result, group members were committed to undertake the activities that were introduced during the sensitisation meetings. The study shows that most of the framers (87%) joined the RIPAT because they wanted to learn about livestock keeping and crop farming (Table 6.2). Indeed, given that the RIPAT approach requires learning by doing, farmers were required to attend the meetings regularly for effective learning. Further investigations on the level of attendance indicated that 74.2% of the group members interviewed attended all the meetings. This level of attendance was considerably high indicating that farmers had the opportunity to regularly learn about the technologies' implementation step by step. It was during these meetings that farmers were taught how to undertake technologies disseminated by the RIPAT-SUA project. Therefore, it could be asserted that continued learning through group meetings enhances adoption of the promoted technologies.

Table 6. 3: *Motivation for farmers to join RIPAT groups*

Reasons for joining groups	Responses	Percent of cases
Banana Farming	29	24.2
Livestock and Farming education	104	86.7
Best seeds	11	9.2
Working together	8	6.7
Observed performance during field trip	5	4.2
****Total**	**157**	**130.8**
Meeting attendance		
Attend some meetings	31	25.8
Attend all meetings	89	74.2
Total	**120**	**100.0**
Level of the last harvest		
Increased	107	89.2
Remained the same	13	10.8
Total	**120**	**100.0**

Reasons for joining groups	Responses	Percent of cases
Reasons for the level of last harvest		
Use of manure	65	55.1
Use of proper spacing	96	81.4
Use of improved seed	12	10.2
Not yet harvested	9	7.6
Drought	1	0.8
****Total**	**183**	**155.1**

** The totals are based on multiple responses

Learning about improved farming practices involving the use of improved seed varieties and other improved agronomic practices such as proper spacing and manure application done in the group fields resulted in an increased level of yield. The study shows that non-group members indicated that the adoption of agricultural technologies disseminated through the RIPAT-SUA project was due to the good harvests seen in the farmer groups' fields. On the other hand, the findings from the group-members survey presented in Table 6.2 show that 89.2% of the respondents reported an increase in the level of harvest during the previous season due to the use of proper spacing (81.4%) and manure applications (55.1%). Improved level of production is among the factors motivating farmers to implement the new technologies introduced to them.

Enabling availability of extension services

The findings from key informant interviews indicated that the RIPAT approach facilitated adoption of agricultural technologies by providing regular extensions services to farmers. Regular meetings between farmers and project facilitators and/or extension workers provided a platform for farmers to report problems faced while using agricultural technologies. Thus, both farmers and extension workers made use of group meetings as an opportunity to get information on the needs, hence enhancing the performance of production activities. Again, problems were immediately tackled through the meetings as they emerged and before they negatively impacted on the crops and animals. Additionally, arrangements for individual farmers' visits to solve specific challenges were done in collaboration with the government agricultural extension officers. The study revealed that farmers adopted agricultural technologies as they were assured of extension services in case of any problems faced in the production process.

On the one hand, the RIPAT approach offers opportunities to the farmers in the group to provide extension services among themselves and to non-group farmers. Farmers reported to have been providing advice to fellow farmers on issues related to field layout, preparation of holes, spacing, manuring, planting and general crop management. Special training to lead farmers equipped them with the knowledge and skills to undertake the mentioned activities. The lead farmers were also regarded as 'extension officers' in the RIPAT spreading groups since the groups had less contact with RIPAT-SUA project staff. This shows covertly that, the RIPAT approach enhances farmer-to-farmer extension as it was affirmed by one of the government extension officers who remarked: *'Farmers have trust amongst themselves when there is an introduction of new technology'* (Mkuyuni Village Agricultural Extension Officer, December 2020) implying that there is a crucial role played by lead farmers in teaching other farmers on the basket of options.

On the other hand, government extension officers were available to support farmers to tackle the challenges faced. Most farmers (68.6%) reported that the visits by government extension officers increased due to RIPAT-SUA project activities. This was further revealed by one of the lead farmers who observed that *'...agricultural extension officers are busy with us due to RIPAT-SUA project activities'* (Lead farmer, Changarawe Village, December 2020). However, unlike the traditional crop varieties and animal breeds, improved varieties are prone to pests and diseases; hence they require proper management and close monitoring. Thus, the increase in visits by government extension officers provided services that were required by farmers in managing their production activities especially for livestock, with a particular focus on vaccination and treatment of animals.

Facilitating linkage between researchers and input suppliers

The promoted technologies are associated with the use of improved varieties that are not readily available in the project areas. The key informant interviews with the RIPAT-SUA project officials revealed that the project supported farmers with initial capital in terms of seeds, chicks, dairy goats, and pigs with the agreement to raise their capital for them to purchase the same in future. Through the RIPAT approach farmers were linked with research institutions where most of the planting materials/seeds were solicited. Research institutions had the opportunity to get feedback from farmers on the problems experienced during the use of improved varieties in the real field situation contributing to an enhanced research, extension, and farmer linkage. Literature (Wambura *et al.*, 2015; Duveskog, 2011; Leeuwis & Ban, 2004) has indicated the importance of this linkage in contributing to sustainable agricultural development. The study shows that the RIPAT approach facilitated the linkage of three actors through extension officers who solicited improved varieties for crops and livestock from research institutions or authorised input dealers. Extension workers ensured that farmers were implementing the technologies as per the recommendations through learning by doing in groups and individual fields and gave feedback to researchers. This linkage helped in solving the challenges encountered during research in the utilisation of technologies in real field environment with ultimate contribution to sustainable agricultural development in the changing contexts.

Further investigation on research-extension-farmer linkage indicated that one of the high iron rich bean varieties (JESCA) used by the RIPAT-SUA project was approved whereas the other two varieties (Selian 14 and Selian 15) were still under trials. This provides a good example on the linkage of research, extension, and farmers. Through a well-established contact between the RIPAT-SUA project and Tanzania Agricultural Research Institute, Selian, the latter utilised the research-farmer opportunity provided through the RIPAT approach by undertaking the trials for the two high iron rich beans varieties. This was possible as the RIPAT approach provided space for farmers to learn by doing in farmer group fields under close supervision by trained staff before the technologies were implemented in the individual fields. The RIPAT approach to extension services enhances the linkage among researchers, extension workers and farmers through the implementation of technologies in a proper way. The appropriate technologies are confirmed through testing in the actual field environment whereas proper implementation of technologies is achieved through the presence of technical staff who can help farmers implement the technologies following the recommended agronomic practices. The RIPAT approach use of improved varieties from research institutions and/or authorised dealers provided farmers with an opportunity to provide information on how the technologies fit to their field environment.

Linkage with the government officials

The study investigations on the involvement of government officials in the implementation of the RIPAT-SUA project indicated that the project was sensitised from the regional down to the community level. In-depth interviews with government officials at the district level showed that the project was introduced to various government departments such the District Agricultural, Irrigation and Cooperative Officers (DAICOs) where the District Projects Coordinators (DPCs) were appointed to connect the project to the agricultural department. It was further found that these officials accompanied the RIPAT-SUA project staff in the sensitisation meetings at ward and village/street levels. At the ward and village or street levels, several government officials were involved including ward and village executive officers, agriculture and livestock extension officers and community development officers. All these staff made important contributions to the implementation of RIPAT-SUA project activities. This, in turn, contributed to the adoption of agricultural technologies by farmers.

Additionally, the study indicated that government extension officers' involvement in the project enabled them to fulfil their obligations. It was easy for them to disseminate agricultural information using the farmers groups that they helped to establish through the RIPAT-SUA project as is evident in the following remarks by an agricultural extension officer:

> *agricultural information dissemination was done through village assemblies which are not conducted regularly .... we are using RIPAT groups for timely dissemination of agricultural information to farmers* (Magadu Ward Agricultural Extension Officer, December 2020).

Furthermore, the project quarterly reports indicated the involvement of government officials from the district to village levels in the quarterly coordination meetings. During quarterly coordination meetings, which also brought together all extension staff, reports were presented on progress by the farmers' groups on implementation of project activities. These meetings helped the government officials to be aware of the challenges that needed their attention. More specifically, the meeting of farmers and agricultural extensions officers enabled experience sharing in solving problems experienced by farmers in the adoption of the promoted agricultural technologies. In sum, because of being brought on board from the beginning of the RIPAT –SUA project, some extension staff had a positive opinion about the project as revealed in the following remarks:

> *RIPAT-SUA project has established a foundation to us; I will continue to assist the groups so that they continue implementing the activities* (Magadu Ward Agricultural Extension Officer, December 2020).

Technologies promoted by RIPAT-SUA project

Types of promoted technologies

This study found that the SUA-RIPAT project promoted a total of 10 interventions, which were grouped into four categories; namely, crop production, animal husbandry, conservation agriculture, and Village Savings and Loans Association (VSLA) as indicated in Table 6.4. Farmers were supposed to choose technologies that suited their context in terms of resource endowment and interest.

Table 6. 4: *Types of technologies promoted in the basket of options*

Category of options	Types of technologies promoted
Crop production	1. Improved banana production technologies
	2. Orange Fleshed Sweet Potatoes (OFSP)
	3. Cassava.
	4. High iron beans
	5. Home vegetable gardening
Animal husbandry	1. Dairy goats
	2. Pigs
	3. Improved local chicken rearing
Conservation agriculture	1. Terracing
	2. Nine seeded holes
	3. Zambian hoe
	4. Rainwater harvesting
Village Savings and Loans Association	

The study indicated that the interventions in the basket of options complemented each other. Given the nature of the project area, conservation agriculture was important to reduce soil erosion through the use of terraces as well as use of crop production technologies such as the Zambian hoe and nine seeded holes for maize production. These technologies help in preventing soil erosion, conserving water, and increasing agricultural production. Farming practices that permit keeping of moisture in the soils and/or decreased water runoff in the uplands are very important. Also, animal husbandry is complementary to crop production. For example improved banana production requires the use of manure. Given the topography of the study area, it was difficult for the farmers in the upland to get farmyard manure. Manure application is particularly important when it comes to increased crop productivity to meet the market demand and in making crop production more profitable. This demonstrates crop-livestock integration leading to nutrient recycling whereby crop production uses manure and livestock use crop by-products.

The findings from the RIPAT manual (Vesterager *et al.*, 2017) further showed that the farmer groups had a VSLA component in their daily activities. The component is very important in bringing farmers together. For example, one of the district officials contended that, '*VSLAs are the cornerstones; they will make farmers remain connected since there are so many opportunities to be used by other projects since many projects implement their activities through groups*' (Morogoro Municipal Council DPC, December 2020). VSLAs were not a standalone option; rather they were done together with crop and animal husbandry. The key informant interviews with RIPAT-SUA project staff on the integration of VSLAs with other farmers' group field activities indicated that VSLA activities were undertaken after farmers' field operations. Besides, study revealed that farmers, who were interested in VSLAs, automatically adopted the technologies promoted to qualify for VSLA membership. In the low-income communities, VSLA is an alternative source of cash for the group and individual group members (Mwangi & Kariuki, 2015). When the farmers needed cash to support their agricultural activities, such as purchase of seeds and pesticides, VSLAs were an immediate source of small loans. This is in line with the study by Mwangi and Kariuki (2015) that indicated the role of credit in stimulating technology adoption. With credit, farmers are able to finance the improved technologies, hence high adoption rate. Additionally, findings from the key informants indicated that VSLAs brought cohesion among group members. Since the VSLA activities were done concurrently with group field activities, solidarity was attained through VSLAs to enhance participation of group members in field activities. Similar findings were reported by Musinguzi (2016).

Adoption of promoted agricultural technologies by farmers

The findings of the study in Table 6.5 show that 92.5% of the group members adopted more than two technologies. On the other hand, only 36.4% of the non-group farmers adopted the disseminated technologies out of which 69.6% of farmers adopted at least two technologies. This implies that group members adopted technologies more than non-group members. Additionally, the findings indicate that adoption of technologies is not limited to group members as non-group members are also adopting them. This suggests that the RIPAT approach facilitates the spread of technologies in a community.

Table 6. 5: *Status of technologies adoption by farmers*

Adopted the technologies	Adoption by farmers			
	Group members		Non-group farmers	
	Frequency	Percent	Frequency	Percent
Yes	120	100.0	43	36.4
No	0	0.0	75	63.6
Total	**120**	**100.0**	**118**	**100.0**
Level of technologies adoption				
More than two technologies	111	92.5	13	30.2
Two technologies	6	5.0	15	34.8
One technology	3	2.5	15	34.8
Total	**120**	**100.0**	**43**	**100.0**

Furthermore, the findings in Table 6.6 show that improved banana and local chicken were adopted by most of group members (97.5% and 55.4% respectively) and non-group farmers (81.4% and 39.5% respectively). However, orange fleshed sweet potato was also adopted by group members (59.5%) and non-group members (25.6%). The reasons explaining adoption of the promoted technologies include availability of markets, high yield, and food security. Banana and chicken were traditionally practised by farmers using local varieties. However, the RIPAT-SUA project introduced improved varieties for banana and local chicken as well as the use of good agronomic practices and animal husbandry, respectively. Based on farmers' experience with traditional production, the decision to adopt improved varieties and good agronomic or animal husbandry practices followed a predictable pattern known to the farmer. Therefore, farmers expected improvements in terms of production in relation to the investment made during the production process. Mwangi and Kariuki (2015) point out that, farmers who perceive the technology as being consistent with their needs and compatible to their environment are likely to adopt since they find it as a positive investment.

On the other hand, the technologies that were least adopted by farmers were pigs followed by iron rich beans and vegetables gardening. The low-level adoption of pig husbandry may be because most of the dwellers in the study area are Muslims as such pig rearing was contrary to their religious beliefs. Also, low adoption of home vegetables gardening and iron rich beans was because they were not common crops in the study areas. They were therefore regarded as new technologies to farmers, and as such their uptake was slower. Nevertheless, orange-fleshed sweet potato (OFSP) was a new technology in the study area but its uptake was relatively high compared to other new technologies due to the availability of market (see also Zhang *et al.*, 2019 on the importance of market in technology adoption) following its nutritive values, widely promoted through literature (Mwanga & Ssemakula, 2011; Anderson *et al.*, 2007; Attaluri & Ilangantileke, 2007; Hagenimana & Low, 2000).

Table 6. 6: *Technologies promoted and their levels of adoption by farmers*

Technologies promoted	Adoption by farmers			
	Group members		Non-group farmers	
	Responses	Percent of cases	Responses	Percent of cases
Improved banana	118	97.5	35	81.4
Orange-fleshed sweet potatoes	72	59.5	11	25.6
Cassava	44	36.4	5	11.6
Conservation Agriculture	37	30.6	8	18.6
Pigs	28	23.1	5	11.6
Dairy goat	29	24.0	2	4.7
Improved local chicken	67	55.4	17	39.5
Village saving and loans association	38	31.4		
High iron beans	24	19.8	8	18.6
Home vegetable gardening	29	24.0	4	9.3
Total	**486**	**401.7**	**95**	**220.9**
Reasons for adopting the technologies				
High yield	109	94.0	31	81.6
Easy management in the farm	43	37.1	10	26.3

Technologies promoted	Adoption by farmers			
	Group members		Non-group farmers	
	Responses	Percent of cases	Responses	Percent of cases
Stable to weather changes	37	31.9	2	5.3
Marketability	176	151.7	29	76.4
Food	59	50.9	2	5.3
Get loan easily	144	124.1		
Total	**568**	**489.7**	**74**	**194.7**

Findings are based on multiple responses

Dissemination of the agricultural technologies to non-group farmers

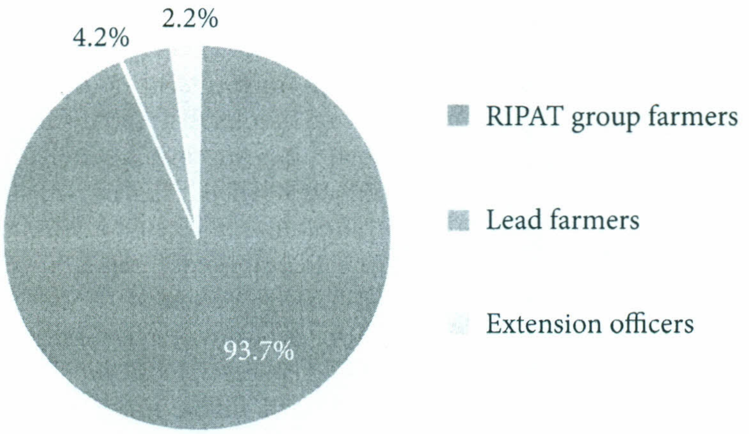
Figure 6.1 shows that non-group farmers received information on the technologies promoted by RIPAT-SUA project from farmers (93.7%) and lead farmers (2.2%). This shows that fellow farmers provided the main sources of information on agricultural technologies. It can be argued that, the group members including lead farmers did not keep the information to themselves contrary to the findings by Siddiqui *et al.* (2012) and Mvena *et al.* (2013) which were based on experiences from the traditional FFS. The group members and lead farmers disseminated the agricultural technologies to non-group farmers through provision of planting materials as well as demonstration on how to implement the technologies. The findings from the farmers survey with non-group members indicated no statistically significant difference (Chi-Square score of 0.611) in the adoption of technologies by non-group members in the RIPAT's start and RIPAT spreading villages. RIPAT spreading groups had similar effect as with RIPAT start on influencing the adoption of technologies among non-group members. This implies that the RIPAT approach has the potential of scaling up with more or less the same effect on the adoption of agricultural technologies among non-group farmers.

Moreover, reaching more farmers through RIPAT spreading groups using lead farmers was perceived by RECODA to be a low-cost extension method. Indeed, the important role played by lead farmers in extension was highlighted by a village official in an in-depth interview.

> *...during village meetings, community members are encouraged to seek information from lead farmers on the implementation of improved agricultural technologies promoted by RIPAT-SUA project* (Mkuyuni Village chairperson, November 2020).

The official's remarks imply that, lead farmers were key in enhancing the adoption of agricultural technologies. It was further found that lead farmers provided a good link between farmers and government extension officers since the lead farmers were in regular contact with the farmers; hence easy understanding of the problems faced by farmers and communicating with government extension officers for immediate solutions. However, this should be complemented with other strategies to facilitate the work by lead farmers. In-depth interviews with lead farmers indicated limited transportation facilitation and lack of protective gears like coats and gumboots. Nevertheless, it is still advantageous to use them because they have strong social and cultural ties as a result of having their residence in the communities they serve.

Figure 6.1: *Source of information on technologies by non-group farmers*



Group fields established through the RIPAT approach were important sources of planting materials for both group and non-group farmers. The RIPAT-SUA project provided the groups with planting materials for establishment of group fields. Thereafter, group members accessed planting materials from the group fields. Once the group members planted the crops in their own farms, it became a good additional source of planting materials within the village. Non-group members indicated that they obtained banana, OFSP and cassava planting material from either group fields and/or individual farmers' fields. Availability of inputs such as seed has been pointed out as an important factor in promoting the adoption of technologies and their ultimate contribution to increased agricultural production (Mdemu *et al.*, 2017; Osei *et al.*, 2017; Waddington *et al.*, 2014; Lille & Lunds, 2013). The findings from this study imply that, the adoption of banana, OFSP and cassava technologies was partly because of the availability of the planting materials to non-group members.

Challenges faced in the adoption of promoted agricultural technologies by farmers

The study found various reasons for non-adoption of the technologies which included limited land, lack of seed and difficulties to implement (Table 6.7). Additionally, the key informant interviews revealed that the implementation of banana farming was hindered by availability of land. Moreover, the household survey findings indicated an average farm size to be 3.6 acres among the farmers involved in the study. This is relatively small land holding when compared to the national average of 5.8 acres. According to Derksen-Schrock *et al.* (2011), most farms in Tanzania vary from less than one to three hectares, with an average farm size of 2.4 hectares (5.8 acres). However, the study found that renting was one of the means used to access land for crop production. This could be one of the reasons which made it difficult for some of the farmers to plant perennial crops like banana. Banana production is termed as a scale-dependent crop such that land size is a necessary condition for adoption by farmers (Mwangi & Kariuki, 2015). Even though findings indicated improved bananas were to be adopted by both group and non-group farmers, the rate could have been much higher if land shortage had not been a challenge. Similarly, Davis and Mekonnen (2012), Mwangi and Kariuki (2015) and Butt *et. al.* (2015) report on the limited impact of FFS on farmers with small land size because farmers may not have had enough land to try a new technology.

Furthermore, some technologies would generally seem hard to implement as testified by a key informant:

> *...the process of making holes as per required spacing is tiresome as such some group members left the group at the beginning and they requested to join back after seeing the performance of the group field* (Key informant, Mkuyuni Village, November 2020)

Table 6. 7: *Reasons for limited adoption of technologies*

Reasons for not adopting the technologies	Adoption by farmers			
	Group members		Non-group farmers	
	Responses	Percent of cases	Responses	Percent of cases
Limited land	90	90.9	28	84.8
Hard to implement	34	34.3	10	30.3
Lack of seeds	111	112.1	43	81.8
Religion	15	15.2	–	–
Waiting for solidarity chain	69	69.7	–	–
Drought	10	9.1	–	–
Lack of education	–	–	18	54.5
Health problems	–	–	7	18.2
Not motivated	–	–	10	30.3
Attending other issues	–	–	6	15.2
Total	**329**	**332.3**	**122**	**369.7**

Findings are based on multiple responses

Lack of seeds was another challenge mentioned by respondents. Improved seeds were not readily available in the project area. Interviews with the RIPAT-SUA project facilitators indicated that improved seeds were obtained from authorised input dealers for easy follow-ups in case of any challenge. For example, banana and cassava planting materials were obtained from Arusha and Kibaha, respectively. Also, high iron beans and OFSP cuttings were solicited from Tanzania Agricultural Research Institute (TARI), Selian in Arusha, and the Sokoine University Graduate Entrepreneurs Cooperative (SUGECO) in Morogoro, respectively. Additionally, during the study period, it was reported that the availability of banana suckers and cassava cuttings from the RIPAT start groups was not enough to meet the demand of planting materials for individual group members and the rest of the community members. Linking farmers to the sources of seeds for cassava, OFSP, banana and beans had an important contribution to the adoption of agricultural technologies. However, agricultural production with improved varieties needs reliable sources of inputs required in the production process. Through the RIPAT approach, arrangements for the availability of inputs were using sister groups model whereby the RIPAT start groups were partnered with the RIPAT spreading groups to supply them with planting materials. This was particularly important for the crops that used suckers (banana) and cuttings (cassava and OFSP).

Conclusions and recommendations

Approaches for the dissemination of improved agricultural technologies have an important role to play in the improvement of agricultural productivity. This study investigated the contribution of the RIPAT approach in the adoption of improved agricultural technologies. The study addressed three aspects; namely, (i) the role of RIPAT approach in the adoption of agricultural technologies (ii) the technologies promoted by RIPAT-SUA project and their adoption by farmers, and (iii) the challenges faced in the adoption of the promoted technologies. This has highlighted the pillars of RIPAT approach for enhanced adoption of technologies for individual farmers within the group and beyond the group members. These pillars are farmer groups' mobilization, basket of options, linkage to researchers, input suppliers and local government authorities. As a result of the adoption of the RIPAT approach many farmers have been reached through its scaling up approach called RIPAT start and RIPAT spreading groups. The approach has great potential to upscale through the establishment of several phases of the spreading groups with the former phase of the spreading group playing the role of the sister groups. Group mobilization coupled with farmers' group fields is crucial in reaching many farmers at once and enhancing learning by doing the factors that facilitate adoption of technologies. Learning by doing enable farmers to better understand the qualities of the technologies for making informed decisions. On the other hand, the basket of options facilitated adoption by providing farmers with a wide range of technologies to choose. The RIPAT-SUA project, a project implemented using RIPAT approach, promoted a total of 10 interventions. From these 10 interventions, most of the group and non-group members adopted banana, improved local chicken and OFSP more than other agricultural technologies. Farmers adopted the technologies due to availability of markets, high yields, and food security. However, the reasons for non-adoption were limited land, lack of seeds and hardship in implementing the technologies.

The study concludes that the RIPAT approach has the potential in reaching wider communities through the dissemination of agricultural technologies. The use of farmer groups and lead farmers well equipped with hands-on skills from extension officers can provide potential solutions to the challenge of limited extension officers that has contributed to poor extension services over decades. Thus, available public agricultural extension officers can have greater impact by working with groups of farmers and lead farmers in disseminating potential agricultural technologies for improvement of agricultural production. The study therefore recommends the following:

- The Ministry of Agriculture should integrate the RIPAT approach in the public agricultural extension framework, and
- The President's Office–Regional Administration and Local Governments Authorities should recognise the role played by lead farmers.

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