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7.0 EXTENT OF ADOPTION OF SELECTED INNOVATIONS AMONG SMALLHOLDER PADDY FARMERS IN MVOMERO DISTRICT, TANZANIA

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Abstract

Presently, different stakeholders play a key role in paddy production by introducing innovations to paddy farmers in Tanzania. However, the farmers tend to adopt innovations at different rates, which call for an establishment of the extent of the adoption of introduced innovations. This study was conducted in Mvomero District, Morogoro, Tanzania to determine the extent of adoption of innovations in paddy production. A cross-sectional research design was adopted and 299 respondents were sampled using simple random technique. Data were collected using questionnaire and in-depth interviews. Three Focus Group Discussions (FGDs) with 6 to 12 participants and Key Informant Interviews were conducted. Qualitative data were analysed using content analysis. The extent of adoption of innovations was analysed with fundamental statistics values, namely, frequencies and percentage. Study findings revealed that the adoption of systems of rice intensification (SRI) is concentrated into 3 to 7 practices and few respondents adopted 1 to 2 and 8 to 11 SRI practices. The adoption of Power Tillers (PTs), Wooden Threshers (WTs) and Combine Rice Mills (CRMs) were difficult accounted for 47, 5 and 18percent of all the respondents, respectively. It is complex for a smallholder paddy farmer to adopt full a package of an innovation in which its composition has several production principles. Extension Officers are advised to design context-specific extension programmes for easy adoption of paddy innovations to rural farmers.

Key words: SRI, adoption, innovation, paddy, smallholder farmer

1.0 Introduction

The adoption of paddy innovations is important to rural farmers. It is the decision of farmers to accept and make use of paddy innovation, which is perceived beneficial in achieving a sustainable increase in farm productivity leading to improved well-being of the respective farmers (Rogers, 2003). Adoption, in this case, occurs when there is a continued use of paddy innovations by farmers. Scholars define innovation as an idea, farming practice, and or a system that is perceived as new by individuals (Rogers, 1995; Leeuwis, 2004). In this paper, innovations refer to new paddy production practices, production tools, and threshing, and processing tools. The paddy innovations in this paper are System of Rice Intensification (SRI), Power Tillers (PTs), Wooden Thresher (WTs) and Combine Rice Mills (CRMs). These tools are considered innovations because they are new in paddy production and processing in the study area. Thus, this paper refers to adoption of SRI, PTs, WTs and CRMs in paddy production as the application of SRI techniques, the use of PTs in land preparation, threshing paddy using WTs and processing paddy using CRMs, respectively.

In this paper, SRI is defined as a set of paddy production practices which involve twelve practices namely; the selection of seeds using floating-sink method, raising of seedlings in nursery, transplanting seedlings of 8-15 days old, uprooting and transplanting within 15-30 minutes, keeping uprooted seedlings in moist conditions, and single transplanting. Other practices include transplanting at shallow depth, spacing at 25cm x 25cm, early and regular weeding, water control by alternate flooding and wetting, application of compost manure, and disuse of herbicides. PT, WT, and CRM are the single entity tools by themselves, which are used for land preparation, threshing, and processing of paddy respectively.

The application of innovations in paddy production and processing has many advantages to rural farmers. For example, several scholarly works indicate that the adoption of SRI by paddy growers increases yields per hectare usually by 50 to 200 percent or more; reduces water requirements by 25 to 50 percent, and reduces the cost of production by 8 to 20 percent (Islam *et al.,* 2014; Katambara *et al.,* 2013). Other benefits include minimal capital costs, which make SRI methods more accessible to poor farmers who do not need to borrow money; the rice plants under SRI have been noted to be more robust against extreme weather events, pests, and diseases due to plant vigour and strength (Gujja and Thiyagarajan, 2010; Dobermann, 2004). Also, the adoption of PT and WT is anticipated to save time, increase yields, profits, incomes and employment, expand the area under cultivation, and reduce workload and labour required in paddy production and threshing (Sims and Kienzle, 2016; Miah and Haque, 2015; Quayum and Ali, 2012). The Combine Rice Mills (CRMs) are the processing machines, which perform many operations that produce higher quality and yields of white rice from paddy (Nambi *et al.,* 2017). In other words, CRMs add value to the processed rice, which leads to fetching lucrative market and earning higher income among the respective farmers.

The government of Tanzania (GOT) has made efforts to introduce and promote paddy innovations among rural farmers including those in Mvomero District with the aim of improving production, productivity and farmers' wellbeing. Since 2005, the GOT introduced paddy innovations to farmers including rice varieties such as SARO 5 (TXD 306), IR05N 221 (named Komboka, be liberated) and IR03A 262 (named *Tai,* eagle), and good agronomic practices such as SRI, water-saving irrigation technologies. Others are rice planting techniques, integrated pest

management (IPM), tools and implements-reapers, PTs, threshers, combine harvesters, and processing machines (URT, 2009; URT, 2013). The SRI, PTs, WTs, and CRM innovations have been in use in the study area since 1999 (Katambara *et al.*, 2013). However, the practice shows that paddy farmers do not readily accept innovations immediately due to lack of awareness. Up to 2015, the Government of Tanzania (GOT), through Agricultural Sector Development Strategy (ASDP) Phases One and Two has been promoting better access and use of agricultural knowledge, technologies, and infrastructure to paddy farmers in 20 irrigation schemes including Mkindo and Dakawa. Similarly, extension agents have been advocating these innovations to ensure that smallholder paddy farmers take adoption in full. Despite the efforts made by the government and extension agents and the benefits of the adoption of paddy innovations, the level of adoption of paddy innovations introduced in Mvomero District is not yet established. Therefore, this study assessed the adoption of four selected paddy innovations among farmers. Specifically, it determined the extent of adoption of the selected innovations. The study findings will contribute to the body of knowledge on the extent of adoption of SRI, PTs, WTs, and CRMs in the study area. In addition, the findings of this study will inform policy makers and paddy production stakeholders on the readiness of farmers to adopt paddy innovations.

This study adopts a sociological model of adoption of innovation. The model considers adoption as a learning process and that every person goes through mental steps during that learning process about innovation (Semgalawe *et al.*, 1998; Rogers and Shoemaker, 1971). The process involves four stages, awareness, evaluation, trial, and adoption. In awareness stage, a farmer learns about the new idea, evaluation stage involves comparison of the expected benefits of the innovation with his/her conventional ones, while in the trial stage a farmer decides to try an innovation in a small plot/quantity of paddy and then use it on a larger plot/ quantity of paddy. The adoption stage involves complete application (confirmation) or otherwise discards the innovation. In this study, adoption implies a process in which a farmer continues using an innovation. One of the limitations of this theory is that, it does not take into account an individual's resources or social support to adopt a new behaviour (or innovation). This study addresses this limitation by establishing the extent of adoption of SRI, PTs, WT, and CRMs thereby calling for the intervention from different paddy production stakeholders to support farmers to adopt such innovations through various initiatives such as training and other relevant interventions.

2.0 Methodology

Research Design

Cross-sectional research design was adopted whereby data were collected once in time at the study area. Data collection exercise was conducted in June 2016 during when most of the farmers were transplanting seedlings.

Study Area

The study was conducted in Mvomero District in Morogoro Region and two paddy irrigation schemes namely Mkindo and Dakawa were selected (figure 1). These schemes are the only smallholder irrigation schemes where the selected innovations were introduced. The district was chosen because this is where the two irrigation schemes are located.

Sample and Sampling Design

This study involved paddy farmers from two schemes who were selected using simple random technique in different points and corners of the schemes. A sample size of 299 paddy farmers was estimated by Yamane's formula (Yamane, 1973). Proportionate sampling technique was used to obtain 96 and 203 respondents from Mkindo and Dakawa respectively.

Data Collection Methods

The study involved a mixed-methods approach, which facilitated the deployment of both qualitative and quantitative methods in data collection. Primary data were gathered using a questionnaire and in-depth key informants' interviews (KIIs). Three Focus Group Discussions (FGDs) with 6 to 12 participants were conducted using FGD guide; and three KIIs were conducted using a checklist. Key informants (KIs) were obtained using heterogeneous purposive sampling since KI one was the Principal of Mkindo Farmers Training Centre while KI two was a Combine Rice Mill operator and KI three was a researcher in Cholima research station.

Data Analysis

Qualitative data were analyzed through content analysis, whereby pieces of information from the KIIs were condensed, coded, and organized into different themes and compared based on the study objectives. The extent of the adoption of innovations was analyzed with fundamental statistics values, mainly, frequencies, and the percentages for adopters and non-adopters. This approach was also used by other scholars such as Oman *et al*. (2010), Mackrell *et al*. (2009), Miller *et al*. (2008). In this study, the extent of adoption of PTs, WTs, and CRMs was presented in frequencies and percentages of farmers who adopted, while for SRI the extent of adoption depicted the number of practices applied by farmers whereby there were non-adopters who did not adopt any practice to full adopters who applied all 12 SRI practices.

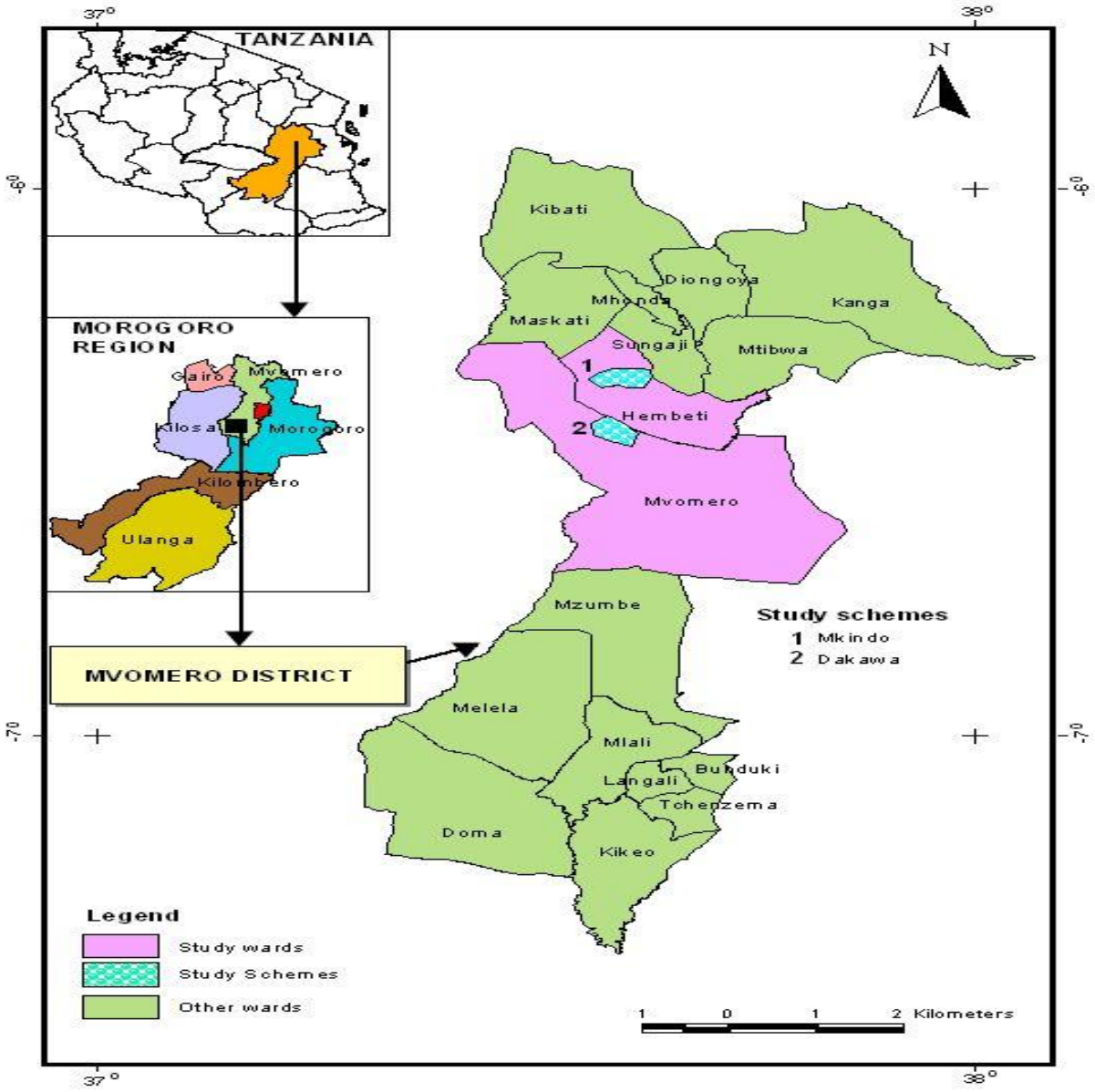

Fig. 1: Map showing the study area

3.0 Results and Discussion

3.1 Extent of Adoption of SRI

Taking into account that System of Rice Intensification (SRI) is composed of twelve practices, this study presents and discusses the extent of adoption in terms of the number of practices adopted by farmers. The findings on the extent of adoption of SRI indicated that 10 percent of famers did not adopt any practice, 4percent adopted one practice e 6percent adopted two practices 15.4percent, adopted three practices 15.1percent, four practices 13.1 percent, five practices and 11percent six practices. other results indicate that 10.4 percent adopted seven practices, 3.7 percent eight practices 2 percent nine practices; 3.7 percent ten practices, 1.3percent eleven and the respondents who adopted twelve practices (full adoption) were 3.7% (Table 1).

Table 1: Extent of adoption of SRI

Adoption status of SRI (practices)	Frequency	%
00 practice (Non-adoption of SRI)	30	10.0
1 practice	12	4.0
2 Practices	18	6.0
3 Practices	46	15.4
4 Practices	45	15.1
5 Practices	41	13.7
6 Practices	33	11.0
7 Practices	31	10.4
8 Practices	11	3.7
9 Practices	6	2.0
10 Practices	11	3.7
11 Practices	4	1.3
12 Practices (full adoption of SRI)	11	3.7
Total	299	100.0

The findings show that 10 percent of all the respondents did not adopt any of 12 SRI practices (Table 1). This means that 90percent of all the respondents adopted SRI practices ranging from one practice to a varying combination of two to twelve SRI practices. However, the results indicate that the distribution of the adoption of SRI is concentrated around 3 to 7 practices, with a limited percentage of respondents adopting 1 to 2 and 8 to 12 SRI practices. This implies that when a package of paddy innovation is blended with several practices, there is a possibility that some practices are more complex to understand than others thereby making them difficult for farmers to follow all of them at once. This eventually slows the rate of adoption.

3.2 Extent of Adoption of PT, WT and CRM

The extent of adoption of the three innovations differs from one another based on the percentage of farmers who adopted each innovation.

3.2.1 Extent of Adoption of Power Tillers (PTs)

The finding demonstrates that PTs were the frequently adopted innovation compared to WTs and CRMs accounting for 47percent of the farmers (Table 2). It is clear from the findings that more than half of all the respondents did not adopt this innovations. This implies that the PTs were difficult to be adopted in the study area. A similar observation is reported by Ngegba (2016) in rice farming community from six different villages of Northern Sierra Leone. The study found that less than 15percent of the farmers had adopted power tillers because of difficulties in operating the said innovation.

Table 2: Extent of adoption of Power tillers, Wooden threshers and Combine Rice Mills (n=299)

Innovation	Adopters		Non-adopters	
	Frequency	%	Frequency	%
Power tillers	140	46.8	159	53.2
Wooden threshers	16	5.4	283	94.6
Combine Rice Mills	53	17.7	246	82.3

In addition, information from Focus Group Discussions (FGDs) and Key Informant Interviews (KIIs) supports the conclusion that low rate adoption of PTs was its difficultness to operate by farmers. For instance, a KI from Chollima Agro-Scientific research centre argues that:

> *"...power tillers are environmental-specific innovations whose operations are difficult in Dakawa Irrigation Scheme because of heavy soil whose texture is clay in nature. Furthermore, majority of farmers possess large plots" (KII three, 24th May 2016).*

This quotation suggests that power tillers work best on sandy soil and work efficiently in small farms compared to large farms. Heavy soil retards PT's speed and the PTs work longer than expected on large farms, thus, influence farmers' decision on adoption.

3.2.2 Extent of Adoption of Woden Threshers (WTs)

According to the findings, only 5.4 percent of all the respondents adopted WTs (Table 2). The findings show that more than half of all the respondents did not adopt WTs. This implies that WTs are difficult to adopt in the study area. Similarly, a study conducted in Northern Sierra Leone by Ngegba (2016) found that less than 15percent of the farmers adopted paddy threshers and the majority did not adopt due to complications in operating them.

In addition, operation costs is another aspect that militates against the adoption of WTs. The results obtained from KIIs indicate that it was difficult to adopt WTs in the study area due to high costs involved, as key informant says,

> *"...it is costly to operate WT in the field because it requires purchasing big canvas and timbers plus transporting these to and from the field during threshing period" (KII one, 19th March 2016).*

This result implies that high costs attached to the adoption of innovation can act as a constraint against farmers' application of such an innovation, since adds to the costs of operation and the reduction of profit to be realized.

3.2.3 Extent of Adoption of CRMs

The findings indicate that 17.7percent of all the respondents adopted CRMs (Table 2). In other words, the majority of paddy farmers did not adopt CRMs. This implies that majority of farmers do not process their paddy using CRMs. The processing of paddy using this innovation requires paddy to be dried well enough to reduce breakage of milled kernels; in contrast, majority of rural farmers dry their paddy locally. Therefore, the local paddy drying system sustains high breakage during milling thereby producing little whole white rice kernels.

In addition, qualitative information shows that the processing of paddy using CRMs requires a large quantity of paddy at one time. One Key informant (KI), this to say about the adoption of CRM:

> *"...small-holder paddy farmers prefer convention mills than CRM because processing paddy with CRM requires large quantity in order to operate the machine" (KII two, 22nd March, 2016).*

The costs involved in the adoption of an innovation, which in turn add to operation costs, minimise profit a farmer anticipates to realize from paddy production.

4.0 Conclusions and Recommendations

4.1 Conclusions

The combination of many practices for System of Rice Intensification (SRI), made it difficult for rural farmers to apply all practices concurrently. This is why the adoption pattern was concentrated into 3 to 7 SRI practices with limited adoption in a combination of 8 to 11 SRI practices. The adoption of PT, WT, and CRM was difficult in the study area because the innovations were inappropriate to farmers' situation.

Recommendations

- It is advised that Extension Officers have to educate and train farmers to understand clearly and eventually practice the innovations whenever introduced in a rural setting.
- Active participation of paddy farmers in agricultural empowerment interventions is needed because their willingness is important in the adoption of innovations.
- Extension Officers and agricultural interventionists should design farm-level innovations that reflect the paddy production and processing attributes of the potential recipients in the rural farmers' communities.

Area for Further Research

This study found that each innovation had different extent of adoption. Therefore, it is suggested that further research should be conducted to assess the level of awareness of the farmers on each innovation. This is because ignorance on the innovations by paddy farmers may worsen the collection of quality information.

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