THE ROLE OF COMMUNITIES OF PRACTICE ON ADOPTION OF AGRICULTURAL INNOVATIONS AND TECHNOLOGIES: CASE OF THE SYSTEM OF RICE INTENSIFICATION APPROACH IN MWEA IRRIGATION SCHEME

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DECLARATION

This thesis is my original work and has not been presented for the award of degree in any other university or institution or for any other purpose.

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This work is dedicated to my adorable husband Armstrong and my angels Salma Neema and Taji Amani.

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LIST OF ACRONYMS AND ABBREVIATIONS

ASDS-	Agricultural Sector Development Strategy
CIFAD-	Cornell International Institute for Food Agriculture and Development
CoPS-	Communities of Practice
DIT-	Diffusion of Innovation Theory
GDP-	Gross Domestic Product
GoK-	Government of Kenya
JKUAT-	Jomo Kenyatta University of Agriculture and Technology
LDCs-	Least Developed Countries
MIAD-	Mwea Irrigation and Agricultural Development Center
MIS-	Mwea Irrigation Scheme
MTP-	Medium Term Plan
NIA-	National Irrigation Authority
NRDS-	National Rice Development Strategy
SRI-	System of Rice Intensification
TPB-	Theory of Planned Behavior
USAID-	United States Agency for International Development
WARDA-	West Africa Rice Development Association

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ABSTRACT

Over the years, the introduction and reception of agricultural innovations and technologies have faced partial success as measured by observed rates of adoption. Utilization of Communities of Practice (CoPs) as communication pathways is one of the ways by which innovators can enhance the rates of innovation adoption. CoPs are a circle of persons with the same interest, problems, or preoccupation about a subject and widen their understanding and mastery in such areas by indulging in an ongoing basis.

Primarily, they are known for knowledge management; however, there is minimal empirical evidence in literature on the role they play in engaging, adopting, and retention of agricultural innovation and technologies. This study, therefore, sorts to document the role of CoPs in advancing the adoption of agricultural innovations and technologies. It employed a case study to investigate the System of Rice Intensification (SRI) approach at the Mwea Irrigation Scheme. It is guided by three specific objectives: (i) to investigate the level of awareness and existence of CoPs among the promoters of SRI; (ii) to assess the influence of farmers' knowledge, engagement, and learning ability on the adoption and retention of SRI technology and; (iii) to assess the usefulness of CoPs in influencing adoption and retention of SRI technology in Mwea Irrigation Scheme. The study purposefully targeted 347 farmers and 10 SRI promoters and three managers of the technology who were subjected to a series of interviews and focus group discussions. The study established that the majority of the farmers were aware of the existence of CoPs. It also ascertained the usefulness of CoPs in the dissemination of information and the adoption and retention of SRI technology. It is also found that the engagement of CoPs influences the adoption and retention of SRI technology at the Mwea Irrigation Scheme followed by knowledge of the use of CoPs and finally learning about the use of CoPs.

CHAPTER ONE:

1.1 Background Information

Agriculture is the cornerstone of Kenyan development and the key to creating equitable and sustainable growth for its people (Kibere *et al.,* 2014). This has further been emphasized in the Kenyan Vision 2030, the Medium Term Plan (MTP) III, the Kenyan President's Big Four priority agenda for 2017- 2022, and the Agricultural Sector Growth and Transformation Strategy (ASTGS).In the MTP III, the agriculture and livestock sector accounts for the largest share, 27 percent, of GDP contributing. Further, it provides critical supportive linkages to other sectors contributing approximately 75 percent of industrial raw materials, 65 percent of export earnings, and 60 percent of the total employment.

In MTP II, the sector recorded an average growth rate of 4.2 percent. However, annual growth rates varied primarily due to variable weather. Growth in agriculture Gross Value Added improved from 5.4 percent in 2013 to 5.5 percent in 2015 before declining to 4.0 percent in 2016, and a further 1.6 percent Government of in 2017 due to insufficient rains (World Bank, 2017). One of the strategies the Kenyan Government is employing to salvage this sector is an investment in irrigated agriculture (Njenga *et al.,* 2011). More is however needed to sustain livelihoods and assure national food security. There is also a need to encourage farmers to have the ability to generate and/or adopt new agricultural innovations (Ochienno, 2014).

Interest in integrating agricultural technology across most developing nations started as early as the 1980s. During this time, development economists among other researchers argued that increased agricultural production due to technological innovation uptake would concurrently offer opportunities for income diversification among adopters (Barnes, 2018). This also concurs with

Umar et al. (2009) argument that the adoption of more advanced innovative technologies will result in lower agricultural input prices, greater economic efficiency, and increased overall macro-economic growth. As divulged by Hailemariam *et al.,* (2013), the adoption and diffusion of sustainable agricultural practices have become an important issue in tackling low agricultural productivity and poverty.

Agricultural production has experienced a change in terms of how farmland activities are undertaken and this has influenced the labor associated with agricultural farming and the performance of agriculture, globally. Dissemination of new farming techniques including new irrigation methods, new methods of crop farming, and adapted cropping patterns would be the appropriate derivatives of the paradigm shift required in the agriculture sector of the arid region (Robert *et al.,* 2014). The extent of adoption of these agricultural practices is influenced by among others social capital and networks. This implies that policy makers should seek to strengthen social protection schemes to improve their adoption, (Hailemariam *et al.,* 2013).

The adoption and diffusion of these agricultural innovations have often been determined by communication on the transfers of technologies (Ochienno, 2014). Over the years, agricultural innovation owners (multinational companies and promoting agencies) have tried to educate and sensitize the public/target audience about new technologies but not much progress has been made (Ochienno, 2014). In most cases, these innovators have employed change-agent-centered processes that are characterized by a system where innovators come up with an innovation which is then promoted by change agents to farmers who either adopt or reject it (Seline *et al.,* 2014). The trend is shifting from this to farmer-led extension, in which farmers are the principal agents of change in their community and help disseminate the new technology to other farmers (Meijer *et al.,* 2015). However, the extent to which farmers themselves are involved in the development and experimentation of innovations has been neglected in the adoption process (Seline *et al.*, 2014).

Organizations and/or individuals can either enhance or stimulate the adoption of innovations through diverse tools including a community of practice (CoPs). CoPs are a group of individuals who interact regularly sharing a problem or a zeal for something they do and come together to learn how to do it better. Within these groups, opinion leaders, change agents and the most successful adopters of specific innovations are identified and empowered to positively influence non-adopters among their groupings to embrace new technologies. Once influenced, group members gain innovative knowledge and spread it encouraging others to adopt it (Wenger *et al.*, 2015). The concept of CoPs can be good participatory assistance or a farmer/farm-centered approach. According to Hailemariam *et al.,* (2013) they have the potential to improve socioeconomic factors which in turn can control the conduct of researchers, change agents, and farmers in gaining innovation insights. By monitoring such participatory processes, innovation promoters can get timelier feedback concerning particular innovations' adoption and use (Esther, 2018).

In the adoption process, the first group to use innovation is termed as innovators, followed by early adopters, then the early majority, the late majority, and lastly the laggards. CoPs are tipped to be very essential in bridging the gap between the adopters and laggards. Persons with enough knowledge of innovation, who understand the technological wants of a group of people, are needed in the adoption process to steward the group through the technology adoption process (Wenger *et al.*, 2010). Using CoPs to promote the adoption and diffusion of different rice cropping innovations can be a very good investment by the Kenyan government. Rice is one of the priority crops and can be used to accelerate Kenya's agricultural transformation towards a commercial and modern sector.

Rice irrigation schemes in Kenya are managed by the National Irrigation Authority (Irrigation Act, 2019). There are seven public schemes including Mwea, Hola, Bura, West Kano, Bunyala, Ahero, and Perkerra. The Authority is mandated to technically and administratively manage aspects of sustainable and integrated irrigation and drainage services in the schemes; the resettlement and compensation of farmers. It is also mandated with the development and management (operations and maintenance) of irrigation infrastructure, production of crops in the schemes, post-harvest handling, marketing, and control of land use and management (Irrigation Act, 2019). In 2009, to improve rice production, Systems of Rice Intensification (SRI) was introduced in the Mwea irrigation scheme. This technology employs a sustainable use of water and land for high yields (Francis *et al*., 2020). SRI is an agro-ecological methodology that increases the productivity of irrigated rice by changing the management of plants, soil, water, and nutrients. The central principles of SRI are based on a criterion where rice field soils are kept moist rather than continuously saturated to minimize anaerobic conditions and improve root growth besides supporting the growth and diversity of aerobic soil organisms (Uphoff, 2006). The rice plants should be planted singly and spaced optimally wide to permit more growth of roots and canopy and keep all leaves photosynthetically active. The rice seedlings should also be transplanted when young, less than 15 days old with just two leaves, quickly, shallow, and carefully, to avoid trauma to roots and to minimize transplant shock. According to Rani *et al*., (2021), SRI creates a triple-win situation for agriculture, climate security, and food security because; it sustainably increases rice production and farmer incomes (greater crop productivity); strengthens crops' resilience to climate change and variability (facilitates adaptation); reduces rice production's contribution to climate change (helps promote mitigation)

1.2 Statement of the research problem

CoPs are groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly. As opined by Etienne and Beverly (2015), they are everywhere. They are a familiar experience; so familiar perhaps that it often escapes our attention. Yet when they are given names and brought into focus, they can become a perspective that can help us understand our world better. In particular, they can allow us to see past more obvious formal structures such as organizations, classrooms, or nations, and perceive the structures defined by engagement in practice and the informal learning that comes with it (Tsing, 2013). Despite being a better platform that researchers can use to advance agricultural innovations, little has been done to exploit it. They have been few documented scholarly pieces on their use in the diffusion of innovations. As such, there is flimsy knowledge about their existence and influence in the adoption of agricultural innovation amongst the farmers.

In Kenya, approximately 95 percent of rice production is put under irrigation with the remaining 5 percent being rain-fed (National Rice Development Strategy, 2019). In order to improve rice production through the sustainable use of both water and land, Systems of Rice Intensification (SRI) offers the best chances as observed in other rice-producing nations (Francis *et al.*, 2020). SRI improves food security through increased rice production, water conservation, smallholder farmers' income, and reduced national rice import bill (Ndirangu, 2015).

Since its introduction in Mwea in 2009, the rate of SRI adoption has been low among rice farming households (Ndirangu, 2015). According to Ochienno, (2014), the number of farmers that have adopted SRI is not proportionate to the rice-farmer population in the Mwea Irrigation Scheme where the SRI project has been pioneered. From the 1980s when SRI was developed in Madagascar (Jules *et al.*, 2018) to the first trial in China, the results from the trials encouraged farmers to seek more information from farmers who had successfully practiced SRI (Thiyagarajan, 2002). Despite the existence of CoPs among the farmers within the schemes, their impact on dissemination, adoption, and retention of SRI technology hasn't been felt much.

1.3 General objective

The general objective of the study was to document the role that Communities of Practice (CoPs) have in the adoption of agricultural innovations and technologies in Kenya making a case on SRI at the Mwea Irrigation Scheme.

1.4 Specific objectives

The study was guided by the following specific objectives:

i. To investigate the level of awareness and existence of CoPs among the implementers of SRI in the Mwea Irrigation Scheme,
ii. To assess the influence of farmers' knowledge, engagement and learning ability on the adoption, and retention of SRI technology,
iii. To assess the usefulness of CoPs in influencing the adoption and retention of SRI technology.

1.5 Research questions

This study sort to answer the following research questions;

i. What is the level of awareness of promoters of SRI in the Mwea Irrigation Scheme on CoPs?

ii. How do farmers' knowledge, engagement, and learning ability influence the adoption and retention of SRI technology?

iii. How useful are CoPs in influencing the adoption and retention of SRI technology?

1.6 Justification of study

SRI technology was the introduction in Mwea in 2009. Since its inception, the rate of adoption has been low among rice farming households (Ndirangu, 2015). According to Ochienno, (2014), the number of farmers that have adopted SRI is not proportionate to the rice-farmer population in the Mwea Irrigation Scheme where the SRI project had been pioneered. Provisionally, a paltry 30 % of the 2606 farmers residing and farming in the scheme have adopted the technology (NIA, 2019). From the 1980s when SRI was developed in Madagascar (Jules *et al.,* 2018) to the first trial in China, the results from the trials have encouraged the technology promoters to encourage farmers to seek more information from farmers who had successfully practiced it (Thiyagarajan, 2002). However, there has been a glaring deficit in information about the technology amongst the farmers in the Kenyan pioneering technology area, Mwea (Ole-Ronkei, 1995). CoPs have been hinted at to be a good platform that can advance the information rollout of the innovation. However, there has been minimal attention directed to their role in most technological adoption (Manning, 2008), including SRI. In previous research on agricultural technological adoption, the focus has been more on the role of economic variables (principally, prices) in the diffusion of new technologies (Ochienno, 2014), and least on communicating the innovations to the farmers. This study sort to fill this gap in the literature by outlining the classical requisite to pay importance to the use of CoPs as appropriate communication channels in communicating agricultural innovations. To the study, the identification of these CoPs by SRI promoters and their maximum utilization can earn them tremendous adoption rates. The researcher's investigation of CoPs patterns hopes to unearth the methods of communication that are more likely to influence the adoption of modern technologies.

1.7 Significance of the study

This study is of significance to different multi-level stakeholders. Its findings will offer valuable insights concerning key factors influencing the adoption of SRI agricultural innovations. Such will guide future related adaptive responses. The study findings will also be valuable to the Government (particular county governments and the central Government), NIA, and the respective farmers as they will ignite debates and useful discussions on the benefits and constraints underpinning SRI technological adoption and implementation. Further, it's significant in the realization of the Big 4 Agenda especially the Food and Nutrition Security. Lastly, this study is important to researchers and academicians, especially in teasing out several determinants of (as well as further study gaps in) agricultural innovations' adoption in today's agricultural technological advancement.

1.8 Scope of the study

This study was limited to the analysis of the role CoPs play in advancing the adoption of the System of Rice Intensification (SRI) approach. It focused on the promoters of the technology and the farmers who were involved in the implementation of the technology. The study focused on the farmers who have been part of this program since its inception in 2009 to the time the study was being undertaken. The farmers in focus were those in Mwea Irrigation Scheme exposed to this technology. The study also delved into the evaluation of SRI's acceptance trends concerning the effective use of CoPs.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter covers the theoretical review that guides the study. A conceptual framework that shows the relationships of the variables is also outlined. Empirical studies that explore related literature by scholars are examined whose critique establishes the gaps that this study seeks to fill. The chapter ends with a summary.

2.2 Theoretical framework

The study adopted the Social Learning Theory as developed by Albert Bandura (1963) and the Diffusion of Innovation Theory (DIT) as developed by Rogers (1995) to explain that CoPs work in social settings and that technological adoption happens variedly across societies and individuals. Social learning theory argues that learning occurs in social contexts. Both theories are appropriate for the study as they portray learning and adoption of innovations as social activities which are part of our human nature.

2.2.1 Social learning theory as premise to explain CoPs

Social theory of learning looks at our interaction with the world around us. As established by Gunawardena (1995), learning takes place in a social context, and it occurs by observing a behavior and by observing the consequences of the behavior (see figure 2). It involves observation, extraction of information from those observations, and making decisions about the performance of the behavior (Bandura, 1971). Social learning theory is relevant to our daily actions, our policies, and the technical, organizational, and educational systems we design (Wenger, 2010). Communities of Practice are types of social learning platforms that are best accomplished through collaborative learning (Cassidy, 2011). As established by Wenger (2010), CoPs include the idea that "learning is as much a part of our human nature as eating or sleeping". Wenger (1998) highlights four basic premises in which CoPs operate; Human beings are social creatures and social learning strategies should be utilized when teaching; Knowledge is demonstrated through competence; Learning is a matter of participating and active engagement with the world and; Learning produces meaning and makes engagement with the world meaningful.

CoPs are social interaction platforms that call for participation that is, being active in the practices of social communities and constructing identities (Wenger, 1998). CoPs involve a common interest among group members to learn new concepts or accomplish particular tasks. To such attainment, the members teach each other regularly throughout the period that the particular group meets (Wenger, 1998). Social events influence new behavior and learners' reaction to them (Bandura, 1986).

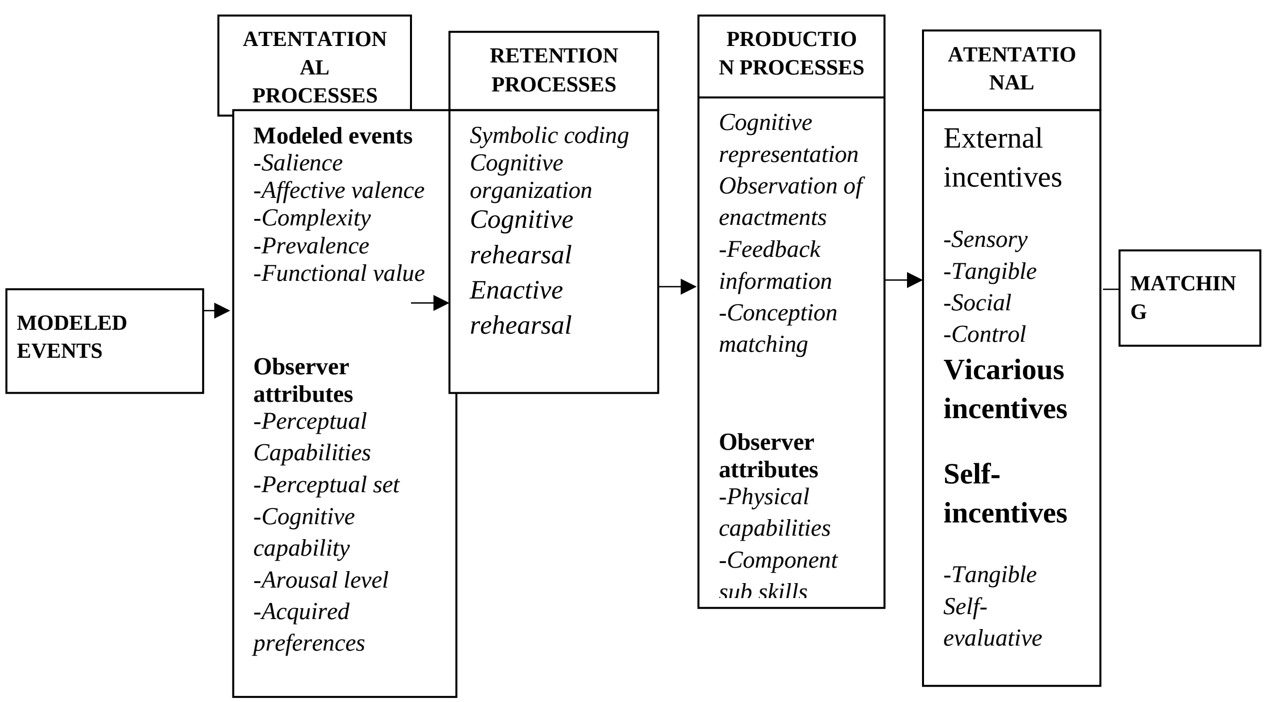

Figure 1| social learning theories (Source- Bandura, 1986).

2.2.2 Diffusion of innovation theory

Diffusion of innovation theory seeks to explain how, why, and at what rate new ideas and technologies spread (Rogers, 1995). According to Rogers, diffusion is a process by which an innovation is communicated over time among the participants in a social system. The innovation, its related communication channels, time, and embedded social systems are four factors that influence the speed of adopting new ideas. The diffusion process heavily relies on human capital. Innovativeness is an expression of how early an individual or other unit of adoption is adopting a new idea compared to other members of the social system. Innovation adopters are divided into five categories (Rogers, 1995): innovators, early adopters, early majority, late majority, and laggards in that order as shown in figure 2 below:

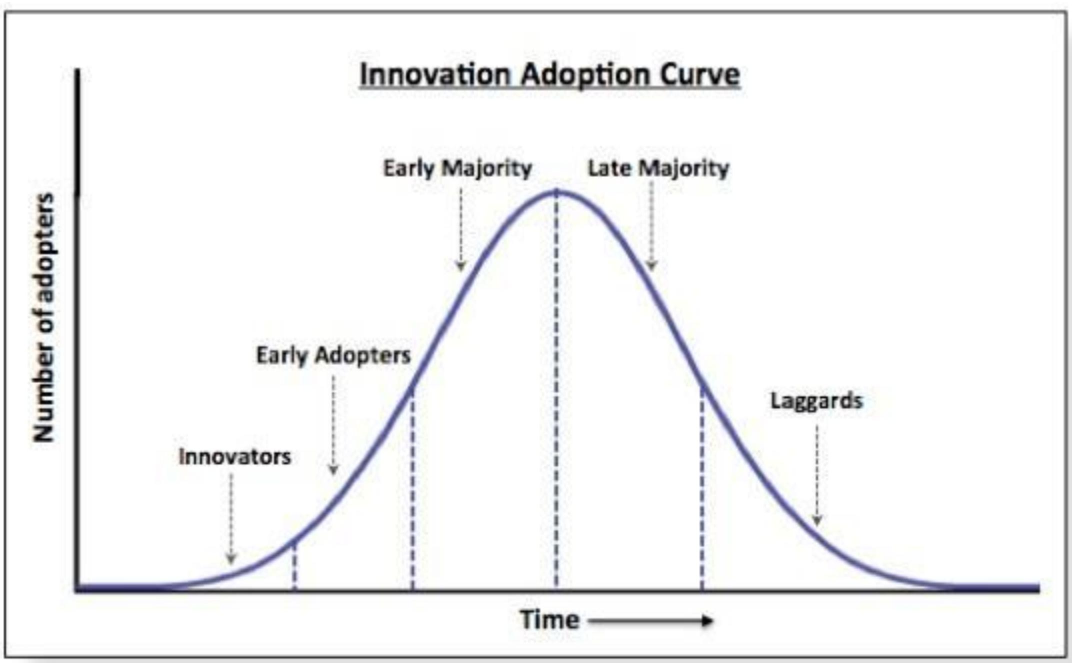

Figure 2| Innovation adoption curve (Source-Rogers, 1995)

Technologists believe that advantageous innovations will sell themselves – that the obvious benefits of a new idea will be widely realized by potential adopters, and that the innovation will therefore diffuse rapidly (Rogers, 1995). This is seldom the case thus the need to utilize CoPs as a promising tool in selling these technologies to targeted audiences.

Mass media is often more effective in creating awareness of innovation, whereas personal contacts (CoPs) are more effective in forming an opinion about a new idea (Ochienno, 2014). Ochienno further states that such interpersonal communication is facilitated if conveyors of information are optimally similar to the receivers in certain attributes and CoPs lie in this circle. More education and participation in a farmer association can both improve one's access to information on a new technique and help a farmer deal with changes required by new technologies (Feder *et al.*, 1985; Rogers, 1995). So information seems to be a factor in System of Rice Intensification adoption, as it is in most adoption studies, and so is the utilization of existing CoPs.

The rate of adoption is the relative speed with which an innovation is adopted by members of a social system. The social system; CoPs, with its interrelated units shares an interest in finding solutions to a common goal such as improving common agricultural systems for enhanced livelihoods. CoPs have a system that has a social and communication structure that facilitates or impedes the diffusion of innovations in the system. Norms, being part of the social system, are the established behavior patterns for system members. Often, opinion leaders play a crucial role in influencing system members. Change agents have the explicit role of influencing members in a certain direction. Both opinion leaders and change agents are central actors in the diffusion of innovations (Torbon, 2011). Thus, CoPs could be the catalyst long-awaited to fasten the adoption rate of innovations.

2.3 Conceptual framework

CoPs have the potential to play a vital role in advancing the adoption rates of agricultural technological innovations because they bring together groups of people (innovators, adopters) with mutually shared interests and different levels of knowledge and experience to develop and adopt particular innovations. If the innovators/promoters of these innovations effectively engage identified members in these CoPs (who act as opinion leaders, farmer agents) who in turn influence their respective group members, the diffusion/adoption rates plausibly increase. Figure 3 describes how CoPs influence the adoption of agricultural technology innovations; which is the sole focus of the study.

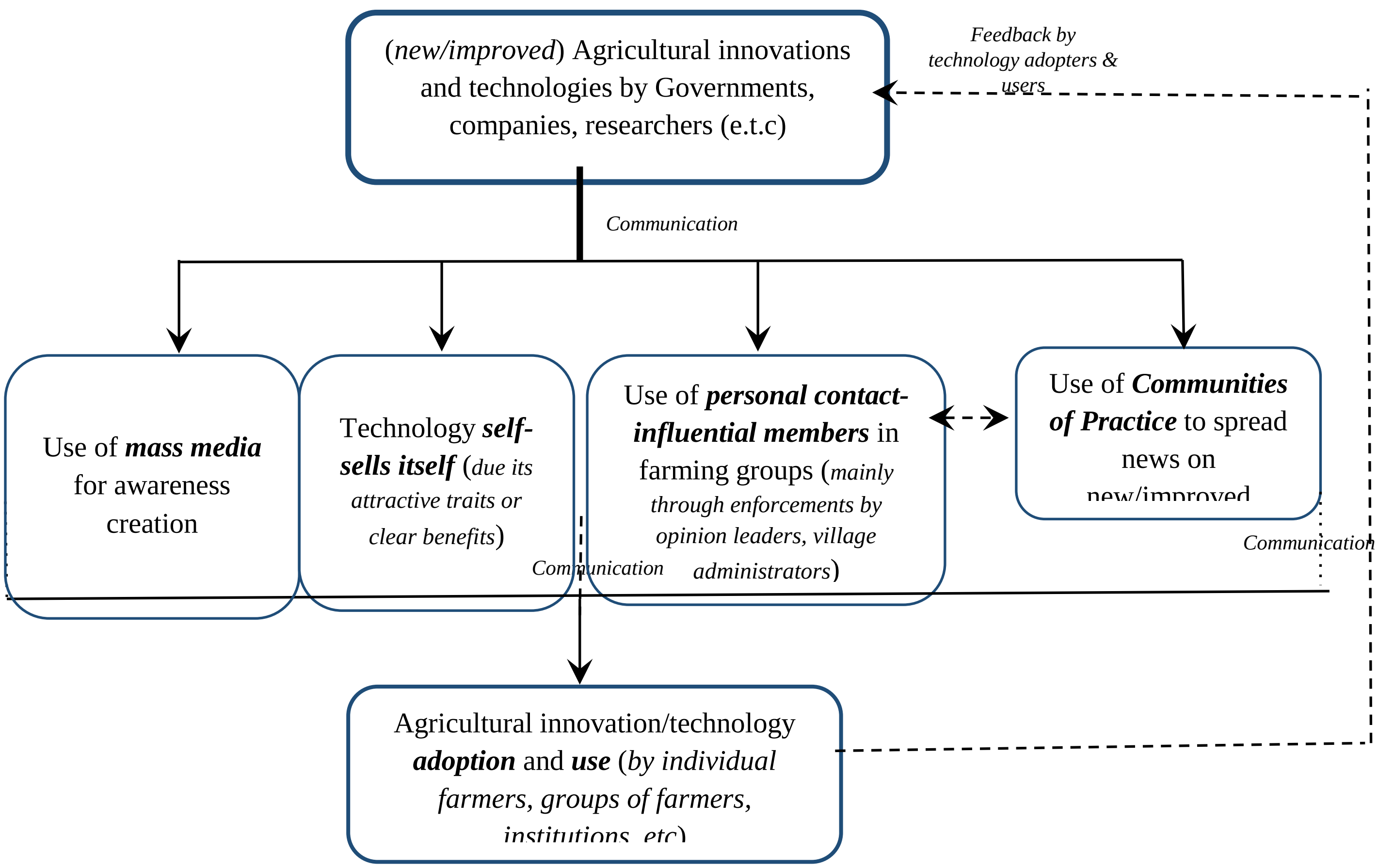

Figure 3| Conceptual framework for utilizing communities of practice in advancing the adoption of agricultural innovations and technologies (source-Author, 2019)

2.3.1 Communities of practice (CoPs)

The model of CoPs came from knowledge management literature (Cummings et al., 2005) and entails a group of individuals who interact regularly sharing a problem or a zeal for something they do, and, come together to learn how to do it better (Wenger, 1997).

As established by Wenger (1997), CoPs are distinct in three main aspects: their domain, community, and practice. This is because, they have common areas of interest within which members participate in common issues, and dialogues and share information with each other. Subsequently, participants acquire knowledge from each other. With time, members develop and practice a range of shared problems, methods, and modes of solving the problems thus a common practice. As such, CoPs consist of groups of people who deepen their knowledge and know-how in an issue by interacting continuously (Wenger *et al*, 2015).

2.3.2 Formation of Communities of Practice

A community of practice's life cycle can be explained in three (3) stages that comprise five (5) phases (potential, coalesce, mature, sustain transform) (Wenger *et al.*, 2002) - see also figure 1).

Formation (potential and coalescing): at this stage, the primary interactions emerge, a mutual ground is molded and there is the formation of relationships that are informal and centered on the generation of value. For instance, in relation to adopting agricultural innovations/technologies, this is the stage where the innovations are introduced, and you find the farmers forming groups to discuss or to understand its details better.

Integration includes the maturing and stewardship stage: here, the focus is on particular topics or topics. New members are recruited and unique communication or operation methods are formulated as interactions progress, members are invited to give ideas. The community is continuously growing at this stage. For example, in the case of the farmers at this stage they discuss how beneficial is or how it will affect their farming practices; in the process of determining if to adopt or not.

Transformation: here community development gets to a point where a common solution has been identified for the common interest topic or issue and at this stage; the group may come to closure or engage in a different issue. It is also possible at this phase that; a new community is formed or the current community could be combined with others to come up with a formal unit. For example, in the case of the farmers, this is the stage where they have collectively weighed all the benefits/effects and settled on either adopting the innovation/technology or not adopting it.

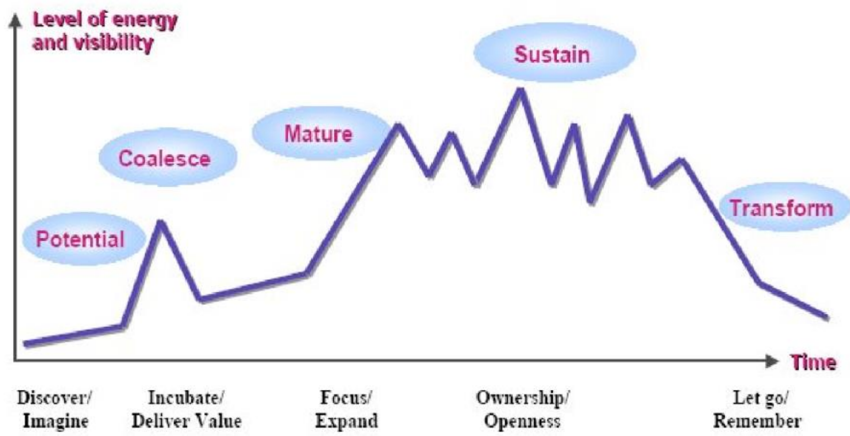

Figure 4|Community life cycles related to time and level of energy and visibility (source; Wenger et al., 2002)

2.3.3 Communities of Practice in communicating and influencing agricultural innovations' uptake

Cummings et al. (2005), opined that effective use of CoPs brings about enhanced reach to information, and contributes to the acquisition of knowledge thus increasing individual satisfaction and one's sense of belonging hence the adoption of the introduced innovation and, commitment/engagement to it. As established by Klerkx and Proctor (2013), farmers in a CoP are more empowered to innovate than farmers seeking expert support at an individual level because they gain in a more participatory system in various linkages.

Lack of interaction between farmers and other actors hinders innovation adoption because they are separated from the innovators (Hall and Clark, 2009) or detached from linkages to inventions and resources (Spielman *et al.*, 2009). In other cases, individual farmers do not have enough power to initiate the necessary influential modifications that are needed for invention diffusion (Hounkonou *et al.*, 2012). Since the 1980s, farmers' ability to generate knowledge individually (Chambers *et al.*, 1989) and to invent (Richards, 1985) has been recognized, and is largely exhibited that this is knowledge in its own right, separate from that of agronomists and extension workers (Goulet, 2013). There is however not much research done in relation to the utilization of peers, which can be translated to the utilization of CoPs, in advancing the adoption of agricultural innovations.

2.3.4 Communities of Practice in Development

The argument that members in CoPs have a mutual understanding, and a similar way of saying things to one another in a useful way brings out CoPs as a tool to exchange and interpret information. CoPs have the capacity to maintain this understanding in a more "active" way – a case that is not informed by manuals or database knowledge (Wenger *et al.*, 2002). Saunders (2000) argues that it is possible to conceptualize development-related evaluation as a series of 'knowledge-based practices'. CoPs are very relevant to development because development is a series of knowledge-based practices.

CoPs speed up the application of innovative ideas for decision-making, learning, and partnering (USAID, 2004). They facilitate improved access to development and operational knowledge; improved mentoring; improved knowledge sharing; more rapid problem resolution; better introduction of new employees; broadening of personal networks to Agency-wide communities; improved employee morale and retention; and enhanced social capital (USAID, 2004).

2.3.5 Adoption and Retention of a technology

As opined by Rogers (1962), adoption means that a person does something different than what they had previously with the key to adoption being that the person must perceive the idea, behavior, or product as new or innovative.

Adoption of innovation does not happen simultaneously in a social system; rather it is a process whereby some people are more apt to adopt the innovation than others. Stages, by which a person adopts an innovation, and whereby diffusion is accomplished, include awareness of the need for innovation, decision to adopt (or reject) the innovation, initial use of the innovation to test it, and continued use of the innovation. This, as established by Rogers is influenced by; Relative Advantage – The degree to which an innovation is seen as better than the idea, program, or product it replaces; Compatibility – How consistent the innovation is with the values, experiences, and needs of the potential adopters; Complexity – How difficult the innovation is to understand and/or use.; Triability – The extent to which the innovation can be tested or experimented with before a commitment to adopt is made; Observability – The extent to which the innovation provides tangible results.

Rogers further outlines that, a failed diffusion does not mean non-adoption of technology rather; it refers to diffusion that does not reach or approach 100-percentage adoption due to its own weaknesses, competition from other innovations, or simply a lack of awareness. From a social network perspective, a failed diffusion might be widely adopted within certain clusters but fail to make an impact on more distantly related people. Networks that are over-connected might suffer from a rigidity that prevents the changes an innovation might bring, while some innovations also fail because of a lack of local involvement and community participation.

2.4 System of Rice Intensification

SRI concept was established back in the 1980s in Madagascar (Stoop *et al.,* 2002). Its initial trial was done and the results from the trial encouraged farmers to seek more information from farmers who had successfully practiced it (Thiyagarajan, 2002). SRI was introduced in Pakistan's Sheikhupura district by the LokSanjh Foundation (Uphoff et al. 2002). Eighty percent of SRI methods had many benefits including the use of less water and stronger roots which prevent lodging, crop loss, and seasonal fungal and pest attacks (Uphoff et al. 2008). Cultivation of SRI crops produced around five to ten pounds more than traditional rice crops per yield as a result of lower grain loss due to heavy winds (Mati, 2011).

In Kenya, SRI was formally launched on August 18, 2009, at Mwea Irrigation Agricultural Development Centre (MIAD) with its trials showing that the system gave more yields with high water savings (Mati, 2011). In summary, SRI practices (i) produce better grains with a stronger aroma that improves their market demand, (ii) use fewer seeds reducing production costs, (iii) save 30 percent water, and (iv) are practicable with all rice varieties (National Irrigation Authority, 2013).

Under conventional methods, transplantation of seedlings is done at a rate of two (2) seedlings per hole with twenty (20) by twenty (20) centimeters. Water levels are raised to an average of five (5) centimeters after transplantation and after ten (10) days a farmer is needed to do gapping to replace dry and weak seedlings. On the other hand, under SRI, 8 – 15 days, old seedlings with 3 leaves are grown in a raised nursery bed. Single seedlings are planted with a minimum time interval between the time they are taken out from the nursery and planted carefully at a shallow depth (1-2 cm). Planting at grids of either 20 x 20 cm or 25 x 25 cm (or 30 x 30 cm or even wider if the soil is very fertile) using a rope or roller marker to achieve precise inter-plant distances to facilitate inter-cultivation, (Gujja *et al*, 2013). Transplanting single young seedlings has the following benefits (Sharif, 2009); no transplanting shock if transplanting is done carefully; no competition for nutrients, water, and space within a hill; wider spacing enables all leaves to be photosynthetically active unlike with crowding where lower leaves do not get enough exposure to sunlight for photosynthesis; earlier arrival within a better growing environment in the main field extends the time for filleting; Seed requirements are reduced and; Much greater potential for tilling and root growth.

Since 2009, the adoption level of SRI has been low in Mwea, creating the need to invest more in system awareness. The promoters of the system need to improve the information sharing modes for an enhanced expert-informed farmers' implementation (Joel, 2011). For instance, most farmers face the challenge of obtaining new technology inventions' know-how on farming through mass media since most of them are based in rural areas (Ndirangu, 2015).

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter discusses the study area, research design target population, sampling design and sample procedure, sample size, data collection methods, data analysis and presentation.

3.2 Area of study

The research focused on the Mwea Irrigation Scheme which was started way back in 1966 (Thairu, 2010). It is one of the seven public schemes managed by the National Irrigation Authority situated in Kirinyaga County. It is the pioneer and the project implementation scheme of SRI technology. The Scheme is about 100 Km North-East of Nairobi. Temperatures range from a minimum of 12°C to a maximum of 26°C with an average of 20°C (Ochienno, 2014). Rainfall ranges between 1,100 mm and 1,250 mm per annum with the predominant crop grown to be rice with a gazetted area of 30,350 acres (Thairu, 2010). The scheme is divided into five sections all having a total of sixty-seven units. Each unit has approximately one-hundred farmers. The scheme has four rivers traversing it, Tana, Thiba, Nyamidi, and Ripingaz as shown in figure 5 below:

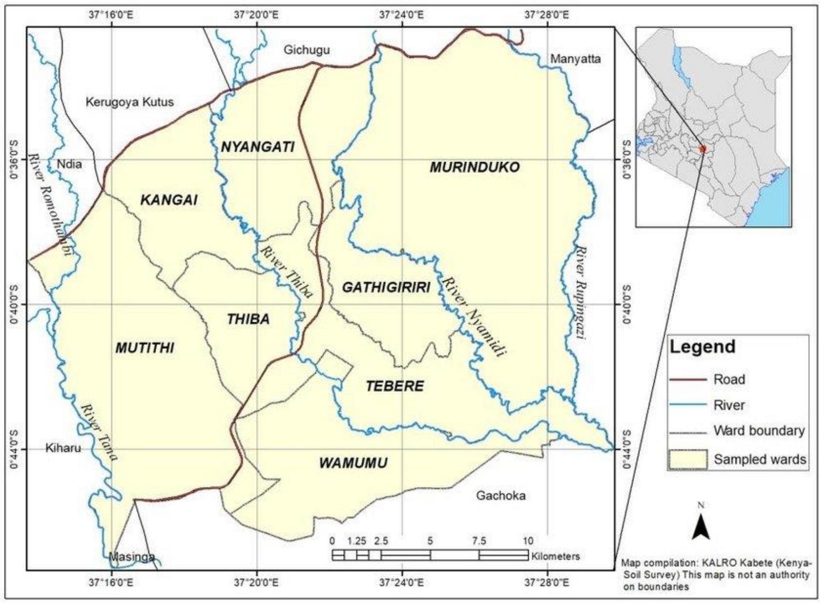

Figure 5|Mwea Irrigation Scheme map (Mutero et al, 2000)

3.3 Research Design

The researcher adopted a descriptive research design. The goal was to describe a phenomenon and its characteristics concerned with what or why something happened (Hussein, 2015). Descriptions are the starting point for identifying variables and building research questions that can be tested using other methods. This approach is sometimes the only way to study behavior or situation because it is either physically or ethically impossible to produce it in an experiment.

3.3.1 Determination of sample size and data collection.

Probability proportional to size sampling method developed by Yates and Grundy (1953) was used to calculate the sample population as there was a finite population of farmers to sample from; 2606 farmers who had been exposed to the technology. This was formulated as follows:

$$n = \frac{Z^2 \ (1-p)p}{e^2}$$

Equation 1| Formulae to work out the sample size for the households to be interviewed.

Where; n = sample size; Z = desired Z-value yielding the desired degree of confidence=1.96 (two-tailed), p = estimated population proportion (0.5), e = absolute size of the error in estimating p that the study was willing to permit=0.0529. Out of this, 347 farmers were sampled for the study. The sampling frame of 2606 was guided by a list of farmers residing within the scheme and growing rice as the main crop since the introduction of SRI in 2009. The selection of farmers for the interview was random but confined to the 5 sections and 67 units within the scheme. In each scheme unit, at least 5 farmers were randomly selected for the study with a minimum of 70 farmers per scheme section. Structured questionnaires were administered to these selected farmers.

Other target populations comprised of SRI stakeholders including SRI promoters. The promoters of SRI in this context are employees of the National Irrigation Authority attached to promote SRI within the Scheme. Due to their few numbers, total sampling was applied to select all the ten. Together with sixty-seven farmers identified by the promoters to be having relevant knowledge about SRI, one from each scheme unit, was clustered for discussions (FGDs). Each group discussion comprised 13 individuals as recommended by Caplan (1990). Five FGD were conducted, one in each scheme unit area. The remaining interviewees, including the Scheme Manager, SRI project manager, and the lead researcher were guided through key informant interviews (KIIs). Three were conducted.

3.3.2 Pilot Testing

Cooper and Schindler (2006) define a pilot test as a stage where research instruments (questionnaires) are administered to a number of individuals in the target population who are not included in the sample size so as to test the reliability and validity of the instruments. A pilot test was carried out on 19 farmers selected randomly from the scheme. The results obtained were analyzed with the internal consistencies measured by the use of *Cronbach's* Alpha. The Alpha values ranged between 0 and 1. The Co-efficient values from the analysis ranged between 0.6-0.7 which is an acceptable indicator of reliability (Robinson, 2009).

In order to provide proxy data for the selection of a non-probability sample, the questions were revised. The questionnaires were then designed to reflect the feedback obtained from the pilot test and respondents gave their views personally.

3.3.3 Actual data collection: Procedures/letter of consent

Prior to the field surveys, a letter of authorization from the University of Nairobi was processed. This assisted in the data collection process as it guaranteed the respondents that the study was purely for academic purposes. The researcher also drafted a letter of introduction to the respondents elaborating on the purpose of the study and guaranteeing anonymity and confidentiality of the information provided (appendix 1). The document was also used to seek participants' consent before each interview. The data collection process was conducted at the Mwea Irrigation Scheme. Questionnaire administration was done by convening a group of 20 farmers in each session of questionnaire administration. It also involved explaining the purpose of the study and a training session on filling out the questionnaire. Questionnaire administration took two weeks. Thereafter, the five focus group discussions and key informant interviews were done. Four enumerators were recruited and trained to assist in the data collection.

3.4 Empirical data analysis

3.4.1 Analysis of the level of awareness and existence of CoPs among the adopters of SRI

A set of binary questions (Yes or No) were formulated to answer these objectives. The data obtained was mainly quantitative. To ensure effective analysis, the filled questionnaires were objectively coded to eliminate any margin of error and ensure maximum accuracy. The quantitative analysis relied on descriptive statistics and; the use of tables and charts displaying frequency distributions and percentages. Analysis and presentation were done by the use of the Statistical Package for Social Sciences (SPSS) program version 22. Analysis from such descriptive displays was augmented with information from the focus group discussions and key informant interviews to give them more meaning, and as such, answer to the study objectives.

3.4.2 Assessment of the usefulness of CoPs in influencing adoption and retention of SRI technology

This was mainly answered descriptively from the responses of the promoters and farmers. As in the first specific objective, quantitative data aimed at addressing this objective was coherently analyzed with the qualitative ones from the FDGs and KIIs.

3.4.3 Assessment of the influence of CoP's on farmers' knowledge, engagement and learning ability on adoption and retention of SRI,

The study adopted a linear regression model as specified below:

$$Y = b_o + b_i X_i + e \quad \text{.................... Equation 1}$$

Equation defined;

$$Y = \beta 0 + \beta 1K1 + \beta 2E2 + \beta 3L3 + \mathcal{E} \quad \text{.................... Equation 2}$$

Where Y= adoption and retention of SRI technology

K1=Knowledge

E2=Engagement

L3=Learning

Independent Variables	Description	Expected influence
K1	Knowledge	+
E2	Engagement	+
L3	Learning	+

That is:

$$AR\text{-}SRI\ (Y) = \beta0 + \beta1K1 + \beta2E2 + \beta3L3 + \beta4U4 + \beta5R5 + \varepsilon \quad \ldots\ldots\ldots\ldots\ldots \text{Equation 2}$$

Where: (a) e is the error term

Y= adoption and retention of SRI technology

The study used STATA version 14 to analyze the data aimed at addressing this objective. The degrees of correlation (r) between continuous variables were measured using Karl Pearson's coefficient while Spearman correlation was used between discrete independent and dependent variables. Chi-square tests were also applied to analyze the interactivity between the study variables

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

The survey examined the role of Communities of Practice (CoPs) in the adoption of agricultural innovations and technologies in Kenya (case of SRI at Mwea Irrigation Scheme). This chapter contains the findings of the study and discussions on the findings, which answer research questions. Data collected were reports produced in form of tables and charts.

4.2 Response Rate

The research targeted 347 respondents who were supplied with questionnaires. All the questionnaires administered were filled and returned giving a 100% response rate. The researcher was able to conduct detailed key informant interviews and focus group discussions as outlined in the study methodology. All the studies were polished and prepared for analysis.

4.3 Pilot Study Results

A pilot study was undertaken to pre-test data collection instruments for validity and reliability. The researcher randomly selected 19 farmers for the pilot. The reliability of the questionnaire was measured statistically and internal consistency techniques were applied using *Cronbach's* Alpha. The alpha values range between 0 and 1 with reliability increasing with the increase in value. The reliability of the scale for the constructs describing the variables of the study was found to be sufficient because all the items and composite reliability coefficients were above 0.6 sets as the acceptable minimum (Numally, 1978). Table1 illustrates the results of the reliability analysis.

The study showed that the alpha coefficient for the three items was above 0.739 suggesting that the items had relatively high internal consistency. Level of awareness had a coefficient of 0.79, firm knowledge had a coefficient of 0.80, and usefulness had a coefficient of 0.82. It was also noted that a reliability coefficient of 0.70 or higher is considered acceptable in most social research situations. According to Mugenda & Mugenda, (2003) coefficient of 0.6-0.7 is a commonly accepted rule of thumb that indicates acceptable reliability. The findings show that there is a moderate correlation among the items. These findings clearly show that the research instrument used in the study was reliable.

Table 1: Reliability Coefficients

Scale	Cronbach's Alpha	No. of Items	Comments
Knowledge	0.79	7	Accepted
Engagement	0.80	7	Accepted
Learning	0.82	8	Accepted

4.4 Social-economic characteristics

4.4.1 Level of Education

A majority (40%) of the respondents had secondary education, 23% had primary education, and 26 % had a college education. About 5.5% had a university education and only 5% of the respondents had no formal education similar results were highlighted by Patel *et al.*, (2020, April) when they were seeking to redress the Technology professionals' perspectives on challenges and why most software are not accessible within the tropic. With the majority having secondary education, deductions could be that they responded effectively to the survey questions and offered more accurate information on the area of interest. They could interpret and answer questions in the questionnaire without guidance and influence from external sources. The very high education level is auspicious as the choice to adopt agricultural innovations is expressively influenced by farmers' education (P. Koncy and R. Tsafack, 2016).

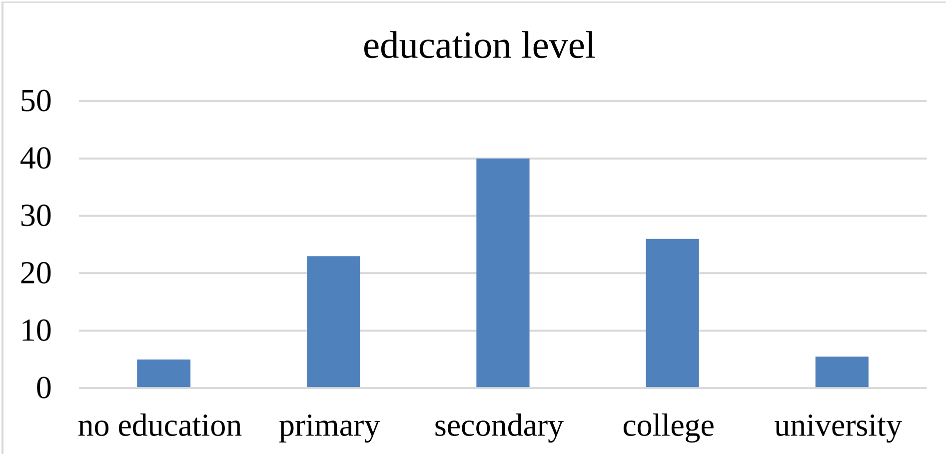

Figure 6|Level of Education

4.4.2 Years as rice farmer

The majority (67.64%) of the respondents had experience in rice farming for a period of 6-10 years. About 25% had more than 11 years of experience in rice farming while 7.36% had less than 5 years of rice farming. This information was important because it was assumed that more experienced respondents had both past and present knowledge of the adoption of agricultural innovations and technologies experiences and therefore offer credible information for the study. This is illustrated in figure 7. The research established that most of the workers had worked for a considerable period of time and hence the information they gave was credible and reliable for they know the organization quite well. Therefore the respondents have adequate working experience with the National Irrigation Authority and therefore possess the necessary knowledge and information which was considered useful for this study.

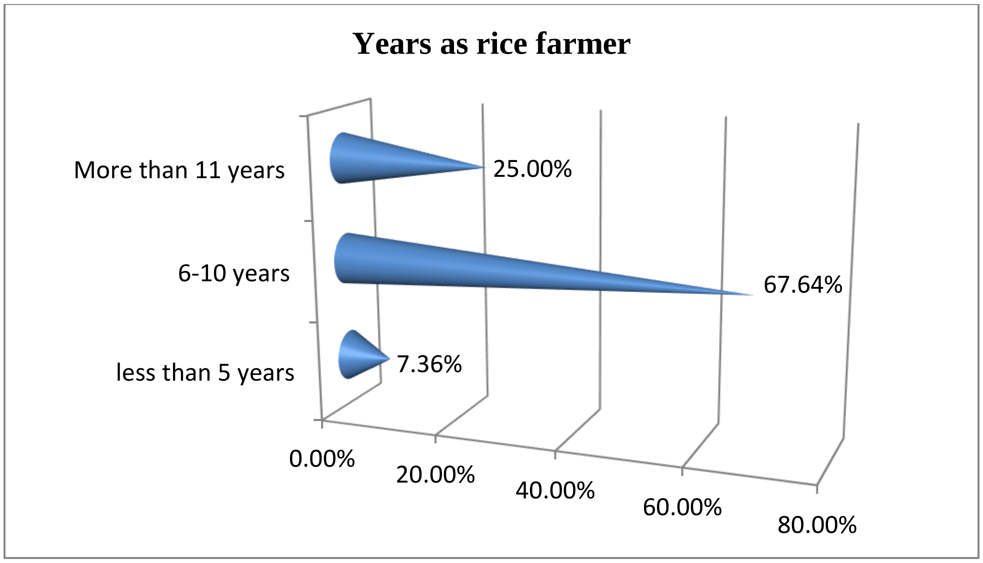

Figure 7|Years as rice farmer

4.4.3 Age

The researcher sort to know the respondents' age bracket; the majority (25.27%) indicated that they were in the age brackets of 36-45, 23.00% indicated that they were between 26-35 years old, 20.1% were between 45-55 years old, 18 % were 18-25 years old while 13.63% were above 56 years old. It was established that there were older farmers than youthful farmers. A study by Wabwoba and Wakhungu (2013) in Kirinyaga County reported similar results and concluded that the low involvement of the youth in farming in the county was a worrying trend that could affect its goal of achieving economic growth through agricultural investments. This is considering the negativity associated with old age. Older farmers are tenacious and would rather stick to the traditional way of doing things than change to 'unknown ventures' (Lloyd, 2016).

The modal age group was 36-45 years. This was, however, auspicious as this category of farmers is energetic, enthusiastic, and less risk-averse. They can invest in and easily adopt innovations as long as they are packaged and appropriately communicated. Correspondingly, Blau (2017) explained that most of them are technologically oriented and exposed to various sources of information. Hence it is more likely for the latter to get introduced and adopt SRI. However, Conroy (2005) delineated that frequent contact with nature and command of age on farmers' contribution to new technology is indecisive. This conclusion contradicted the norm that younger farmers are more likely to absorb an initiative (Nsabimana & Masabo, 2005). The results are illustrated in figure 8.

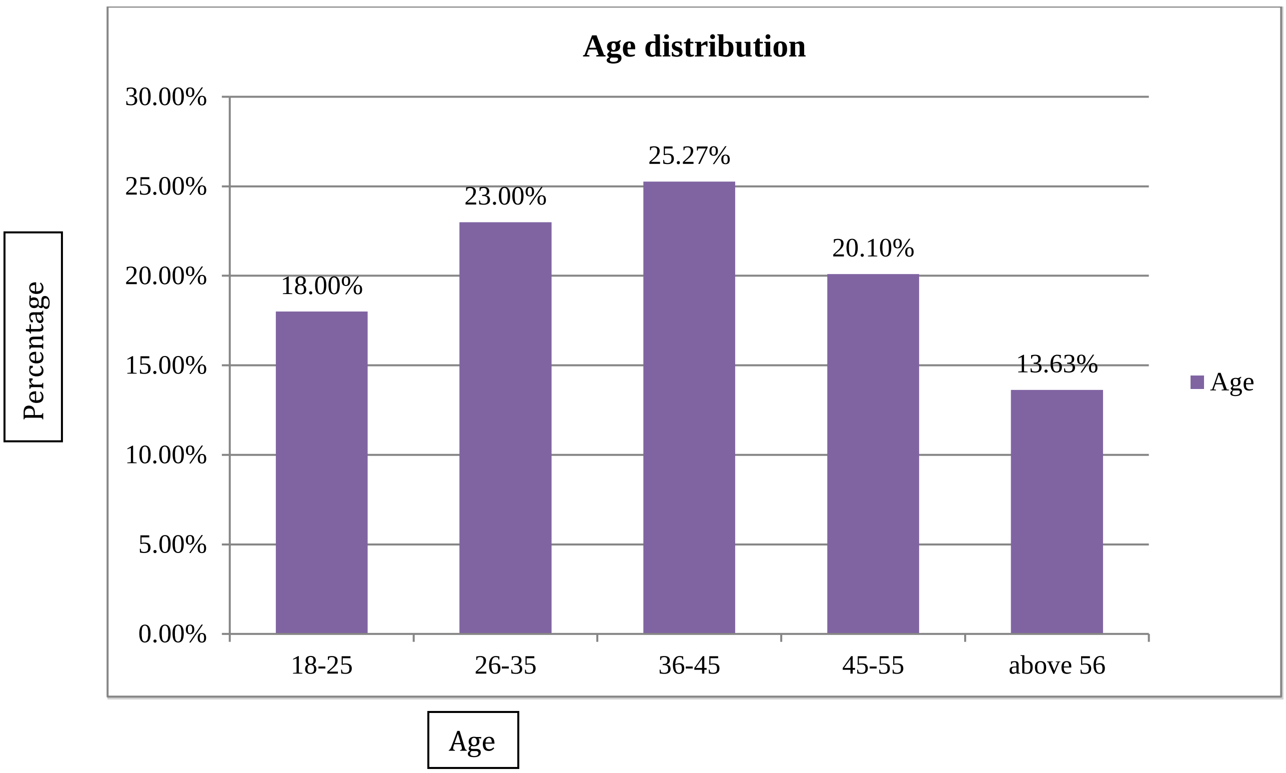

Figure 8|Age distribution

4.4.4 Gender

The respondents were also requested to indicate their gender. About 55.88 %, the majority of the respondents were males while 44.12% were female. This tally's well with the expectations of the "Role of men in the society as the sole providers of a family in the African setting". The results are illustrated in figure 9.

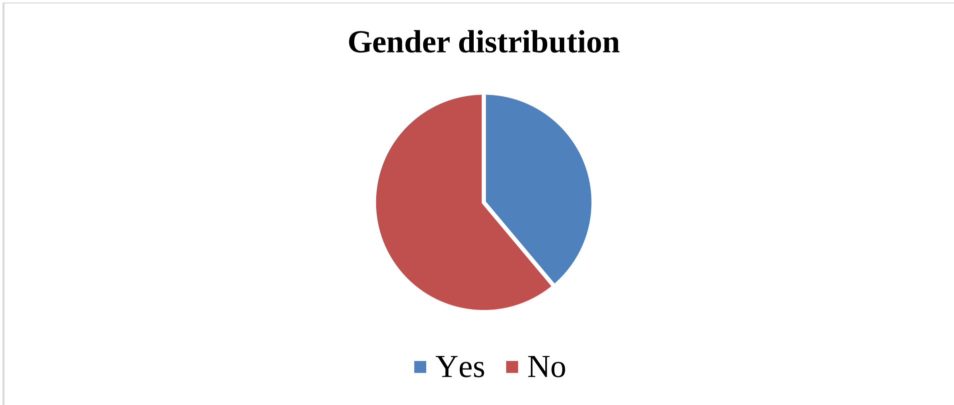

Figure 9|Gender distribution

4.4.5 Farm size

The respondents were requested to indicate their farm size. The majority, 45%, had 4-5 acres, 34% had 2-3 acres, 12% had less than 1 acre and 9% had more than 5 acres. The results are illustrated in figure 10.

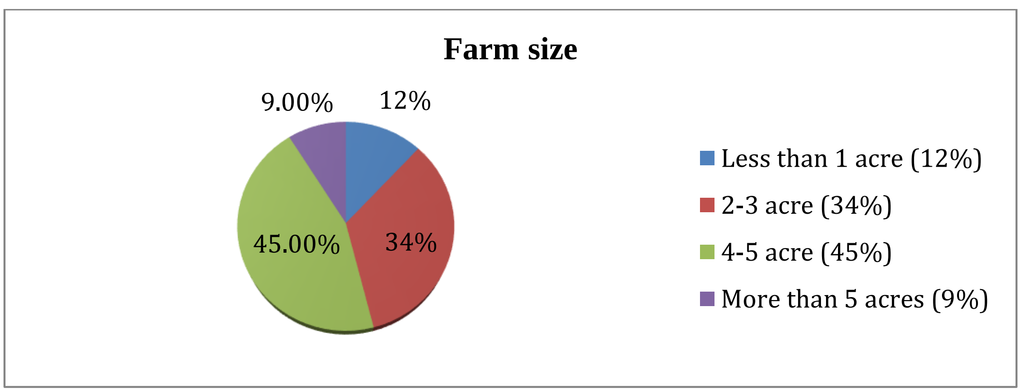

Figure 10|Farm size

4.4.6 Adoption of System of Rice Intensification

The respondents were requested to indicate if they had adopted SRI. About 38.9% of the farmers indicated that they had adopted the technology while 61.1% had not adopted as shown in figure 11. This result corresponded with NIA's findings that below-average farmers had adopted SRI.

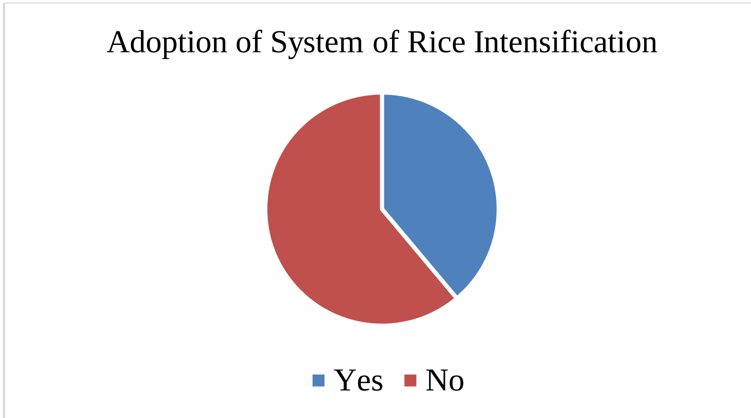

Figure 11|Adoption of System of Rice Intensification

4.5 Descriptive Analysis

4.5.1 How rice intensification system was learned

The farmers were asked to indicate if they had heard about SRI. It was interesting that all of them were aware of the technology. This was because of the close-knit and proximity within which they operate in the scheme with fellow farmers. Getting information about the technology becomes easy. They were also asked to highlight their sources of information about SRI; 84 farmers indicated that they got the information from their farmers' group leaders, 81 got the information informally through their farmers' group therein referred to as CoPs, 62 from extension officers while 65 of the farmers received the information from the MIAD officers (the promoters). The group leaders and the CoPs proved to be very useful avenues through which most of the farmers received information about SRI. The informal nature of these channels could have played both to the advantage and disadvantage to the information flow about this technology. These farmer group leaders have long been known to be effective in persuasion to adopt innovations due to their ability to facially express themselves, use body language, apply vocal tonality and give real-time feedback about innovation. Besides, they have the likelihood to score highly on the familiarity index with the farmers; they interact on almost a daily basis.

This explanation would also suffice for the informal farmers' group (CoPs).

Table 2: How you learned about SRI

How you learned about SRI	No.s
Extension Officer(s)	62
MIAD officers	65
Farmer group leaders	84
Other informal farmer groups (Cops)	81

4.5.2 Discussion of SRI with other farmers

The researcher sought to know if the respondents engaged in farming discussions or any other discussions in their respective groups. The majority of the respondents (65.88%) agreed (yes) while (34.12%) disagreed (no). Apart from farming, the respondents indicated that they also discussed matters to do with family, politics, business, and value addition. It was observed from the responses that engagements in different communities shaped the thinking of the members hence determining their adoption or non-adoption of any introduced new innovations or technologies. The study agrees with the study by Spielman *et al.*, (2009) which states that a lack of interaction between farmers and other actors hinders innovation adoption because they are separated from the innovators or detached from linkages to inventions and resources.

The results are illustrated by figure 12.

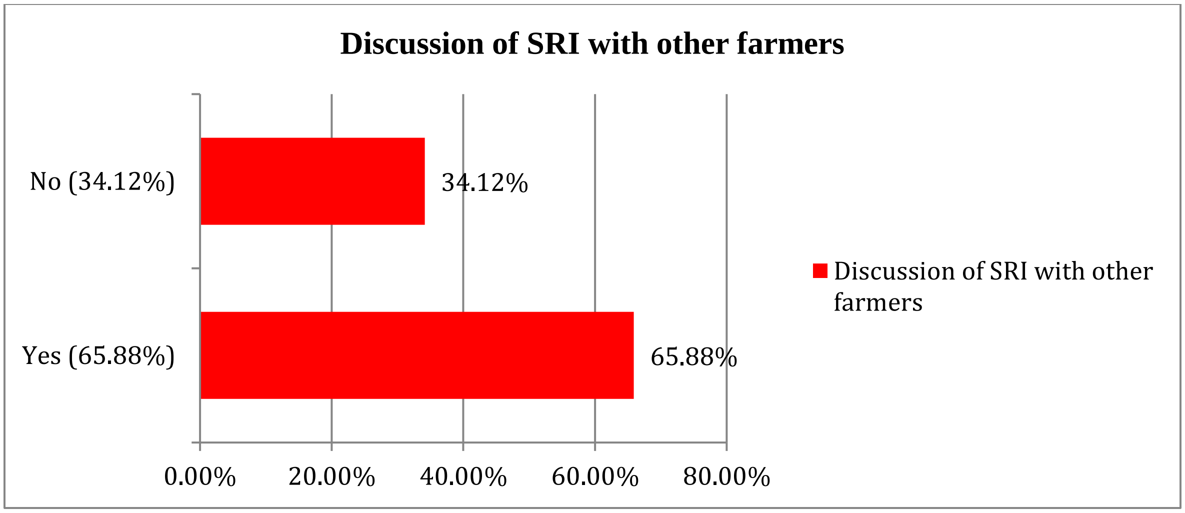

Figure 12|Discussion of SRI with other farmers

4.5.3 Where does SRI discussion happen?

This study was interested in determining how SRI discussions happen in the Scheme. To answer this, the respondents were asked to indicate where they most probably discussed information about SRI. Table 3 shows the distribution of their responses. According to the findings, the respondents indicated to a large extent that 49.6% of their discussion on SRI happened in farmers` day meetings, 29.7% in merry-go-round meetings and 20.7% of the SRI discussion happens in churches. Church meetings, merry-go-rounds, and farmer's day meetings are good examples of CoP platforms.

Table 3: Where does SRI discussion happen?

Where does SRI discussion happen?		
	No.	**(%)**
In church	72	20.7
In merry go round meeting	103	29.7
In farmers` day meeting	172	49.6

Asked whom they discussed the technology with within the scheme, 67.9 % stated that they discussed it with fellow farmers who had adopted SRI, 24.6% discussed it with farmers' group leaders while 7.5% stated that they don't discuss the technology with anyone. What this meant is that most discussions about SRI took place in social groupings. In a study by Garner (2017), it was revealed that in social groups there are greater chances that they include varied members of an agricultural society. Among them are the extension agents, lead farmers, and peer farmers. In describing the characteristics of members of the groups, Garner outlined that extension agents and lead farmers were indeed always willing to share information with others. They are early adopters of technologies, good communicators with facilitation skills, and literate and gender-sensitive. They are therefore highly placed on the group's social ladder. Being in groups with individuals of such personalities exposes a farmer to various spheres of life. They become more capable to adopt innovations that aim to improve their agricultural activities.

Table 4: Who do you discuss with on the issue of SRI?

Who do you discuss with on the issue of SRI		
	No.	**(%)**
Fellow farmers who have adopted SRI	235	67.8
Farmer groups leaders	85	24.5
No one	27	7.7

4.5.5 CoPs Awareness, membership and Influence

The majority of the respondents, 72.4%, indicated that they were aware and were members of CoPs while (27.5%) were not. Of the 72.4%, about 92% were adopters of SRI while only 23% of the non-adopters of SRI were aware and had memberships of CoPs. About 75.4 % of the respondents also agreed that CoPs were available amongst them, while 24.6% disagreed. The majority of the respondents, 63.7%, acknowledged that CoPs were meeting their expectations while 36.3% had contrary opinions. About 65.20% agreed that they can recommend the utilization of CoPs in the dissemination of information about innovation while (34.8%) disagreed. Lastly, 71% of the respondents agreed that CoPs influence SRI adoption while 29% disagreed with the statement. The researcher also sought to know how the respondents could rate the usefulness of CoPs in disseminating agricultural information. About 84.1% stated that CoPs were useful. This was in agreement with the study by Cummings *et al.,* (2005) who stated that the model of CoPs came from knowledge management literature and entails a group of individuals who interact regularly sharing a problem or a zeal for something they do and, come together to learn how to do it better.

The study also agrees with Wenger (1997), that CoPs have common areas of interest within which members participate in common issues, dialogues and share information with each other and that they consist of groups of people who deepen their knowledge and know-how in an issue by interacting continuously and emerge naturally. As shown in table 5.

Table 5: Statements on CoPs

Statements on CoPs				
	Yes (F)	**(%)**	**No (F)**	**(%)**
Are you aware of CoPs (informal group within farmer groups)	250	72.0	97	28.0
Are these Cops available amongst yourselves	260	74.9	87	25.1

Do you belong to a CoP?	200	57.6	147	43.4
Has the group met your expectations	220	63.4	127	36.7
Can you recommend utilization of CoPs in disseminating agricultural innovations	225	64.8	122	36.2
Does CoP influence your SRI adoption (yes) or non-adoption (No)	247	71.1	100	28.9
How can you rate the usefulness of Cops in disseminating agricultural information Useful (yes) Not useful (No)	290	83.6	57	16.4

4.5.7 Influence level on the given communication channels in disseminating agricultural innovation

The study sought to compare the influence level of different communication channels (mass media, extension officers, Government agencies, farmer groups, and CoPs) in disseminating agricultural innovations and technologies. To answer this, the respondents were asked to rate the channels based on their influence in the dissemination of agricultural innovations. Table 6 shows the distribution of their responses.

Table 6: Communication channels in disseminating agricultural innovation

Communication Channels	**Very influential**		**Moderate**		**Least influential**	
	F	(%)	F	%	F	(%)
Mass Media	189	55	120	34.7	38	10.3

Extension Officers	125	36.2	169	48.9	53	14.9
Government agencies	140	40.5	150	43.4	57	16.1
Farmer group	152	43.4	135	39.1	60	17.5
Communities of Practice	282	81.1	35	10.1	30	8.8

F represents the frequency of the medium usage by the farmers

From the results, CoPs were the most influential channels of communicating information about innovations, followed by mass media channels. It was also incidental that the majority of the respondents with secondary education rated the mass media channels as very influential in disseminating information about agriculture. A bivariate correlation analysis revealed a negative relationship (df =60, correlation coefficient=0.364, p = -0.004) between the respondents' level of education and the rating of a communication channel. Based on the information richness theory, a communication channel is considered very influential depending on its ability to communicate in varied means. Education is believed to enhance farmers' ability to access, process, and analyze information disseminated through various means (Schmidt and Pearson, 2016). The extension agents have long been influential in persuasion to adopt innovations due to their ability to facially express themselves, use body language, apply vocal tonality and give real-time feedback (Grünig and Kühn, 2017). It would be graceless to contend that farmers with no or low education were not able to interpret these stated cues. However, education gave the farmers an edge to comprehend and internalize any slight message sent by the extension agents to affirm influence to disseminate information. As such, in reference to the 'seeing is believing' rationale, a respondent without education discoursed that after learning how effectively a fellow farmer had planted and was ripping big as a result of the technology, she got curious to also adopt it. The farmer felt she had benefited more because she not only got to know about the technology, she also experienced its benefits, attributing it to her high rating for its influence to disseminate information about the innovation. In this regard, the personal contacts among the farmers in the social groups (CoPs) yielded fruits as they were able to share their experiences and get feedback. To apply this, the promoters of SRI and relevant stakeholders should strive to add value to the already established farmer-to-farmer dissemination approach by training farmers perceived to lead by example often called model, master, or lead farmers on better ways to create awareness.

4.6 Inferential Test

4.6.1 Model Summary

The coefficient of determination explains the extent to which changes in the dependent variable can be explained by the change in the independent variables or the percentage of variation in the dependent variable. The four independent variables studied explain 90.9% of the adoption and retention of SRI technology in the Mwea irrigation scheme as represented by adjusted R square. This, therefore, means that other variables not studied in this research contribute 9.1 % of the adoption and retention of SRI technology in the Mwea irrigation scheme. Therefore, further research should be conducted to investigate the other variables and factors (9.1%) that influence the adoption and retention of SRI technology in the Mwea Irrigation Scheme. As illustrated in table 7.

Table 7:Model Summary

Model	R	R Square	Adjusted R Square	Std Error of the Estimate
1	.967a	.915	.909	.5699

a. Predictors: (constant), Knowledge, Engagement and Learning of innovation adoption

4.6.2 ANOVA

Table 8, shows the regression and residual (Error) Sum of squares. The variance of the residuals (or errors) is the value of the mean square which is 1008.96. As can be observed in table 8, the predictors X1-X4 represent the independent variables, which are the role of Communities of Practice (CoPs) in the adoption of agricultural innovations and technologies in Kenya (case of SRI at Mwea Irrigation Scheme). It also provides the data to compute R2 which is the sum of squares-regression divided by the sum of squares total R squared. SS-regression/SS-total 4035.871 /4= 1008.96. It also reports that the summary of ANOVA and F- a statistic that reveals the value of F (1.305) is significant at a 0.05 confidence level. The value of F is large enough to conclude that the set of independent variables X1-X4 is the role of Communities of Practice (CoPs) in the adoption of agricultural innovations and technologies in Kenya.

Table 8: ANOVA

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	4035.871	4	1008.96	1.305	0.05
Residual	414.535	110	2.229		
Total	4450.406	113			

4.6.3 Regression coefficient

The possible value of Y when all independent variables are equal to zero is 6.072. The data findings analyzed also showed that taking all other independent variables at zero, a unit increase in Knowledge of CoPs will lead to a 0.362 increase in adoption and retention of SRI technology; this means that there is a significant relationship between knowledge of CoPs and adoption and retention of SRI technology. The P-value was 0.03 and thus the relationship was significant.

A unit increase in engagement in CoPs will lead to a 0.423 increase in adoption and retention of SRI technology; this means there is a significant relationship between engagement of CoPs and adoption and retention of SRI technology at the Mwea Irrigation Scheme. The P-value was 0.05 and thus the relationship was significant.

A unit increase in learning on the use of CoPs will lead to a 0.271 increase in adoption and retention of SRI technology at the Mwea Irrigation Scheme; this means that there is a significant relationship between learning on the use of CoPs and adoption and retention of SRI technology at Mwea Irrigation Scheme. The P-value was 0.01 and thus the relationship was significant.

This infers the engagement of CoPs influences the adoption and retention of SRI technology at the Mwea Irrigation Scheme followed by knowledge on the use of CoPs and finally learning on the use of CoPs.

The researcher conducted a multiple linear regression analysis to determine the relationship between the adoption and retention of SRI technology at the Mwea Irrigation Scheme and the three independent variables. The regression model was; $Y = \beta0 + \beta1K1 + \beta2E2 + \beta3L3 + \mathcal{E}$

Whereby: $\beta0$ is the regression intercept; $\beta1$-$\beta3$ is the regression coefficients; Y is the dependent variable (adoption and retention of SRI technology at Mwea Irrigation Scheme); K1 is the Knowledge; E2 is Engagement; L3 is Learning. As per the SPSS generated coefficient, the equation ($Y = Y = \beta0 + \beta1K1 + \beta2E2 + \beta3L3 + \mathcal{E}$) becomes: $Y= 0.423K1+ 0.362E2+ 0.271L3 +6.072$. As illustrated in table 9:

Table 9: Regression Coefficient

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
(Constant)	6.072	3.061	1.652		.106
Knowledge	0.362	0.073	0.204	2.221	0.03
Engagement	0.423	0.079	0.623	5.344	0.04
Learning	0.271	0.058	0.375	3.063	0.01

Dependent Variable: Adoption and retention of SRI technologies at Mwea irrigation Scheme

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary

The general objective of the study was to analyze the role of Communities of Practice (CoPs) in the adoption of agricultural innovations and technologies in Kenya (case of SRI at Mwea Irrigation Scheme). The study was guided by the following specific objectives: To investigate the level of awareness and existence of CoPs among the promoters of SRI in the Mwea Irrigation Scheme, To assess the influence of farmers' knowledge, engagement, and learning ability on adoption and retention of SRI technology and To assess the usefulness of CoPs in influencing adoption and retention of SRI technology.

5.2 Conclusion

The study concludes that some of the socio-economic factors influencing the adoption of agricultural innovations and technologies include age, education, rice farming experience, and farm size. The younger and well-educated the farmer, the more likely they are to adopt and retain a new initiative or technology in rice farming. The study also concluded that the most experienced farmers in rice farming are more likely to try new ways of farming, unlike inexperienced farmers.

The study also concluded that farmers in Mwea are aware of the availability of communities of practice existing amongst them and belonged to one although they did not particularly identify or categorize them as such. More so, farmers who had actively participated in Communities of Practice had been influenced to adopt and stick to SRI, and others had learned and adopted SRI by following discussions done in their respective Communities of Practice. Communities of Practice were found very useful in disseminating agricultural information by themselves. Amongst other communication channels like mass media, extension officers, Government agencies, and farmer groups, Communities of Practice are the most influential informational channels.

Another conclusion from the study is that the promoters/innovators of these technologies need to do more in providing all relevant information concerning their ideas to farmers. Since extension officers as per the study seem not to be the best channel for communicating information to farmers in Mwea, relevant stakeholders should explore, pilot, and use other information-dissemination channels including social network platforms (e.g. mobile phone messaging, use of WhatsApp, Facebook and Twitter).

5.3 Recommendations

The study recommends innovators or promoters of agricultural innovations and technologies maximize existing Communities of Practice (CoPs) to influence their farming practices. They should actively note and utilize many informal groups among the farmers to communicate ideas, research findings, and any other farming practices.

This study also recommends the promoters of SRI should value CoPs; which mostly are viewed as informal groups and find ways of documenting many ideas, which are initiated in them as they try to find solutions to their farming problems. They should also pay attention to the grievances from the farmers that result in the groupings, to inform their innovations or even their knowledge management.

5.4 Recommendations for further research

From the study and the related conclusions, the researcher recommends further research in the area of production and agribusiness using other variables and also incorporating in the study the other industries. This study was limited to the role CoPs play in advancing the adoption of SRI. It focused on promoters of the system as well as the farmers implementing it. Further studies need to be done to find ways of documenting many ideas and solutions, which are initiated and found in these groups. In addition, future studies need to be done to see how innovators can gain access to these groups in an informal way without nullifying them as CoPs.

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APPENDICES

APPENDIX I

Letter of introduction

Rhoda Mbuvi

University of Nairobi

Date: 9th January 2017

Dear (Respondent), I am a student at University of Nairobi and currently undertaking a Research Project titled "Assessing the role of Communities of Practice in Agricultural Technological Innovation Adoption: The System of Rice Intensification approach in Mwea Irrigation Scheme". As one of the selected respondents in this study, kindly respond to the questions attached to the letter of introduction. The information provided is for academic purposes and will therefore be held in confidence and in complete anonymity. Your participation in the study is also voluntary.

Thank you.

Rhoda Mbuvi

Signature: _______________ Date: _______________ Mobile No:_______________

APPENDIX II

Questionnaire for farmers

Section 1: Socio-Economic Information (Tick at the appropriate box)

Gender

Male	( )
Female	( )

Age

18 – 25	( )
26 – 35	( )
36 – 45	( )
45 – 55	( )
Above 56	( )

Education

None	( )
Primary	( )
Secondary	( )
Polytechnic	( )
College	( )
University	( )

Years as a rice farmer

Less than 5 years ( )

6 – 10 years ( )

More than 11 years ( )

Farm size

Less than an acre ( )

2-3 acres ( )

4-5 acres ( )

More than 5 acres ( )

Have you adopted the System of Rice intensification?

Yes ( )

No ( )

Section 2: Awareness and Utilization of Communities of Practice (Tick at the appropriate box)

How did you learn about SRI?

Extension officer(s) ( )

MIAD officers ( )

Farmer groups leaders ( )

Other informal groups within the farmer groups (CoPs) ( )

Others (specify): ______________________________________

Do you discuss about SRI with other farmers?

Yes ( )

No ( )

If yes,

Where do you do the discussions?

In church ( )

In merry go round meetings ( )

In farmers' day meetings ( )

Any other place(kindly indicate), ____
____
____

Who do you discuss issues relating to SRI with?

Fellow farmers who have adopted SRI ( )

Farmer groups leaders ( )

No one ( )

Any other place(kindly indicate), ____
____
____

Are you aware of CoPs (informal groups within farmer groups)?

Yes ( )

No ( )

Are these CoPs available amongst yourselves?

Yes ( )

No ( )

Do you belong to any of the CoPs

Yes ( )

No ( )

What do talk about in this group?

Politics ( )

Family ( )

Farming ( )

Any other place(kindly indicate), ____

How frequently do you meet?

Daily ( )

Weekly ( )

Monthly ( )

Others (specify) ________________________________

Where do you meet? __________________________________

Has the group meet your expectation?

Yes ( )

No ( )

How can you rate the usefulness of CoPs in disseminating agricultural information?

Very useful ( ), Useful ( ), Not useful ( )

Has being in a CoP influenced your SRI adoption or your lack of adoption?(tick appropriately)

Adoption ( )

Non-adoption ( )

To what extend can you rate No.19 above?

Very much ( ), Much ( ), little ( ), None ( )

Can you recommend utilization of CoPs in disseminating agricultural innovations?

Yes ( )

No ( )

22. How can you rate the influence level following communication channels in disseminating agricultural innovations like SRI? (1= Least influential, 2=moderate, 3=very influential)

Mass Media (radio, television, website etc) ( )

Extension Officers ( )

Government agencies ( )

Farmer groups ( )

CoPs (Groups within farmer groups) ( )

Thank you for your participation

APPENDIX III:

Key informant interview guide

Do you have any knowledge on CoPs?

Are you aware of existing CoPs amongst the farmers adopting SRI?

Have you identified and utilized informal groups amongst the adopters of SRI to promote the adoption of SRI project?

How many farmers have adopted SRI?

Have you utilized the farmers who have adopted SRI to reach non-adopters?

How have socio-economic factors amongst the farmers affected the SRI adoption rate?

How effective are informal groups amongst the farmers in influencing adoption level?

What are the observed impacts of farmers who have adopted the system of rice intensification technology?

APPENDIX IV

Focus group guide

Do farmers have enough information on SRI?

Have the promoters of SRI communicated effectively on SRI matters?

Do you have any knowledge on CoPs?

Are there CoPs among the farmers in Mwea?

Are they more formed along farmer blocks or socio-economic factor basis?

What is discussed in these groups?

How useful are CoPs?

How effective are informal groups amongst the farmers in influencing adoption level?