ROLE OF FARM ATTACHMENT PROGRAMME ON TECHNOLOGY ADOPTION AMONG SMALL HOLDER FARMERS IN BARINGO AND NAKURU COUNTIES, KENYA

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A Thesis submitted to graduate school in partial fulfilment for the requirement of the award of Master of Science Degree in Agricultural Economics of Egerton University

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DECLARATION AND RECOMMENDATION

Declaration

This Thesis is my original work and to the best of my knowledge, has not, wholly or in part, been submitted for an award of any certificate in any other institution.

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Recommendation

This Thesis was developed with our guidance and approval as University supervisors.

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DEDICATION

I dedicate this work to my Mother Janex Kisiangani who has always invested her time and resources to facilitate my education.

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ABSTRACT

Despite the pertinence of Agriculture to the economy, its potential has not been realized. To address this shortfall, research and training institutions have designed and generated knowledge and technologies. However, the innovations generated have hardly reached the end users. In response, Egerton University established Farm Attachment Programme (FAP) to innovatively engage small-scale farmers in 2014. Despite FAP being in operation since 2014, little is known about its effectiveness and how the main stakeholders perceived it. This study sought to determine its Strengths, Weaknesses, Opportunities and Threats (SWOTs) to evaluate the factors influencing perceptions towards FAP, and determine its effectiveness on technology adoption among small-scale farmers. A survey of 100 farmers was conducted in two counties using interview schedules and a proportional sampling technique to randomly select and interview a sample of 154 students using pre-tested questionnaires. A Confirmatory Factor Analysis(CFA) model was used to determine the SWOT of FAP. To determine the perception of farmers and students, a perception index was created using a CFA then an ordered logit regression employed. From the SWOT analysis, higher factor loadings of 0.763 on Factor 2 indicated that increased technology awareness and access among farmers was the main strength of FAP while 0.686 on Factor 1 indicated that increase in farmer linkage was the main opportunity. On the other hand, loadings of 0.830 and 0.760 on factor 3 and 4 indicated that short attachment duration and high costs of student accommodation were the main weakness and threat of FAP respectively. The ordered logit results showed that farmer's perception was positively influenced by security of tenure, slope and students' knowledge. The number of contact with extension agents had a positive effect on students' perception. On technology adoption, majority of farmers, 64% were introduced to tillage management, followed by 63% to relay cropping. Crop rotation was the most adopted practice, by 92.7% of the farmers, followed by green manure at 91.7%. The Tobit results revealed that the intensity of adoption was positively influenced by security of tenure and number of cohorts a farmer had hosted student (s). The overall adoption rate was 43.21% It was found that the programme was effective in enhancing the hands-on experience and agricultural productivity of students and farmers respectively. In addition, the programme was more effective in enhancing the rate of technology adoption than the conventional extension programme. Therefore, the study recommends a policy for strengthening the acquisition of title deeds to motivate farmers to undertake long-term investments of the interventions introduced. Based on the intensity of adoption, the study further recommends that the programme should be expanded to other counties in the country.

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ABBREVIATIONS AND ACRONYMS

AGEC/AGBM	Agricultural Economics and Agribusiness Management
AGED	Agricultural Education and Extension
ANSC	Animal Science
CFA	Confirmatory Factor Analysis
CHS	Crops, Horticulture and Soils
ESL	Early School Leavers
FAP	Farm Attachment Programme
FFS	Farmer Field School
GoK	Government of Kenya
KNBS	Kenya National Bureau of Statistics
MoA	Ministry of Agriculture
NAADS	National Agricultural Advisory Services
NAE	National Agricultural Extension
NAEP	National Agricultural Extension Policy
NALEP	National Agricultural and Livestock Extension Programme
NSDGs	New Sustainable Development Goals
SIPs	Sustainable Intensification Practices
SWOT	Strengths, Weaknesses, Opportunities and Threats
T and V	Training and Visit
TVET	Technical Vocational Educational Training
UTAUT	Unified Theory of Acceptance and Use of Technology
VET	Vocational Education and Training
VIF	Variance Inflation Factor
SARDEP	Semi-arid Rural Development Programme

CHAPTER ONE
INTRODUCTION

1.1 Background information

Agriculture is the mainstay of the Kenyan economy directly contributing 25.9% of the GDP and about 65% of the export earnings (KNBS, 2016). It is objectively a vital tool for employment creation and poverty reduction accounting for 18% and 60% of the formal and total employment respectively (KNBS, 2016). Therefore, it is critical to the country's economic development and poverty alleviation. The performance of the Kenyan economy is largely attributed to the performance of agriculture. To this end, the agricultural sector, with an emphasis on its contribution to rural development, is a major driver among other sectors for delivering an economic growth rate of 10% as envisaged in Vision 2030 policy framework (GoK, 2016). Despite its contributions to the economy, the sector has not realised its full potential. This is attributable to limited scope for expanding into new lands, low awareness and utilisation of agricultural technologies and lack of multi-sectoral approach to rural development. As a result, different interventions targeting small-scale farmers' agricultural productivity have been emphasized (Stewart *et al*., 2014). Agricultural extension is one of the major programmes that have been initiated to increase farmer knowledge and information.

Agricultural extension is the application of research information and knowledge to agricultural practice through farmer education. Agriculture productivity greatly depends on the provision of quality extension services (Feder *et al*., 2010). In an effort to increase agricultural productivity, the government established the National Agricultural Extension (NAE) to increase small-scale farmers' utilisation of improved agricultural technology. However, the system was under criticism for delivering top-down and supply-driven agricultural advisory services incapable of reaching small-scale farmers and responding to their demands and technological challenges (Ragasa *et al*., 2016). Thus, for agriculture to improve, farmers should adopt modern farming techniques in place of traditional practices (Uddin *et al*., 2016).

Low agricultural productivity among small-scale farmers can be attributed to their inability to respond positively to new ideas. Therefore, farmers should be educated on how best to apply new ideas and innovations to their farming activities due to the technicality and complexity of innovations (Ali and Bahadur, 2016). Hence, for the country to achieve increased agricultural

productivity, farmers need basic agricultural education to help them move from traditional to progressive farming. Agricultural advisory service encompasses many aspects of agriculture including, provision of timely information to farmers, linking them to sources of inputs and credit facilities and provision of education services to farmers (Gido *et al*., 2014).

Since independence, extension systems have focused on strategies reflecting agricultural and rural development goals (Davis, 2008). A well-designed and implemented extension plan can tremendously increase agricultural productivity (Swanson and Rajalahti, 2010). This is the backdrop of considering the future direction of extension in Kenya. Initially, extension services were supply driven and solely provided through the Ministry of Agriculture (MoA) in a top-down approach limiting farmers' participation (Gido *et al*., 2014). The introduction of Training and Visit (T and V) Extension model was a vital milestone in the history of extension services in Kenya. The premise of T and V was that there was enough technology awaiting diffusion and adoption by farmers (Anderson and Feder, 2005). It was first introduced in Kenya on a pilot basis in 1982 and was useful in the adoption of hybrid seeds and fertilizer especially in the high-potential areas but had little effect on productivity and incomes among farmers in rain-fed areas.

In the mid-1990s, the GoK and World Bank started exploring new approaches to an extension system that would address these constraints (MoALF, 2015). In 2001, the MoA formulated National Agricultural Extension Policy (NAEP) to link research and extension activities, decentralize decision making and integrate public and private service providers to resolve issues facing farmers. To operationalize NAEP, MoA prepared National Agricultural and Livestock Extension Programme (NALEP) to enhance the contribution of agriculture to the country's economic growth (Ngigi *et al*., 2011). Furthermore, it was endeavoured to make extension demand driven and increase its efficiency in the country. Despite these efforts, there have been mixed results regarding the effectiveness of agricultural extension systems.

Institutions of higher learning have been earmarked as important conduits for designing and generating knowledge, information, and technologies. However, the knowledge and technologies generated are not directly disseminated to the end users to facilitate rural development (Mungai *et al*., 2016). In response, Egerton University in collaboration with other stakeholders piloted the Farm Attachment Programme (FAP) in Baringo and Nakuru counties to engage students to specific farms for at least eight weeks in cohorts. Direct attachment of students to farms facilitate the transfer of innovations and technologies that can

improve farm performance and agricultural productivity resulting in socio-economic progress (Kalule *et al*., 2014).

The Farm attachment programme (FAP) involves the selection of small-scale progressive farmers in Baringo and Nakuru Counties with the recommendation of the MoA. Students from five agricultural related departments from Egerton University are attached to such farms (Mungai *et al*., 2016). The departments include Agricultural Economics and Agribusiness Management, Crops, Horticulture and Soils, Animal Science, Agricultural Extension and Education and Applied Community Development Studies. Before attaching students, the programme through the department of field attachment advertises the positions for student internships on farms in the two counties after which students from the named departments apply. Qualified students based on merit and departmental representation are then shortlisted for an interview. An interview is then conducted for selection of the best-suited students for the programme (Mungai *et al*., 2016).

The Programme then organizes two induction workshops; one for farmers and the second one for both the farmers and students. Farmer induction workshop is meant to clearly inform the programme on the challenges that farmers are facing on their farms. The programme also informs the farmers about the responsibilities of the students while on the farm and how the farmer should assist the students to gain practical experience. The second induction workshop is then organized to familiarise the students with farmers they will be attached to and inform students on what they are expected to do and the situation of the farms.

Selected farmers receive students in cohorts to build and follow-up on recommendations of the previous group of fellow students underpinned by the University. Students focus on making general appraisal of the farm and together with the farmer suggests interventions. The second and subsequent cohorts are sent to the same farm(s) in the subsequent years to oversee implementation of the agreed interventions. Student placement ensures close interaction between farmers and interns giving them an opportunity to apply theoretical knowledge gained in their curriculum to real-life situations and learn practical skills relevant to their academic specialization. This study considered a number of farm solutions proposed to farmers in terms of technologies by students during their attachment, where a farmer may have adopted all, a given number or failed to adopt any of the proposed solutions (technologies).

1.2 Statement of the problem

Egerton University piloted the Farm Attachment Programmeme in Baringo and Nakuru counties in 2014. The programme started with 26 farmers and 28 students, and by March 2017, 359 students and 198 farmers had participated in the programme. Small-scale farmers often face the problem of insufficient and sporadic contact with extension agents making it hard to access important knowledge and skills towards the use of advanced agricultural technologies. This programmeme established a platform to engage student in cohorts to specific farms where they focussed on making general appraisal of the farm and together with the farmer propose interventions. Since inception of the programmeme, farmers' and students' perception towards the programmeme have not been assessed comprehensively. Moreover, the strengths, weaknesses, opportunities and threats of the programmeme have also not been evaluated. Furthermore, the effectiveness of FAP in terms of technology adoption among the participating farmers in Baringo and Nakuru counties has not been documented. Therefore, this study sought to examine how the programme had benefited the farmers in the two Counties and establish how the major stakeholders (Farmers and students) perceived it.

1.3 Objectives

1.3.1 General objective

To contribute towards improved farm productivity among small-scale farmers in Baringo and Nakuru Counties, Kenya through assessment of the student advisory services in FAP.

1.3.2 Specific objectives

i. To determine the Strengths, Weaknesses, Opportunities and Threats (SWOT) of the farm attachment programmeme.
ii. To determine the factors influencing farmers' perceptions towards FAP.
iii. To determine the factors influencing students' perceptions towards FAP.
iv. To determine the effect of FAP on the intensity of technology adoption among small-scale farmers.

1.4 Research questions

i. What are the strengths, weaknesses, opportunities and threats associated with FAP?
ii. What influenced the perception of the farmers towards the farm attachment programmeme?

iii. What influenced the perception of the students towards the farm attachment programmeme?
iv. How effective is the farm attachment programmeme in enhancing technology adoption among small-scale farmers?

1.5 Justification of the study

University-community partnerships promoting rural development has grown in popularity worldwide (Francis *et al*.,2016). Universities in the contemporary society are recognized as engines of economic development as they have emerged as birthplaces of innovations and new technologies. With two to four million Kenyans relying on food aid, the country is committed to its overarching call of achieving middle-income status through the two main pillars of economic development of Vision 2030 and the NSDGs of ending poverty in all its forms and achieving food security. To realise this, the nation is committed to rural development that can best be realised through increased agricultural productivitySmall-scale farmers must be sensitized to adopt new ideas and innovations in their farming activities. With the complexity of innovations and new ideas, farmers need to be supported through transformative farmer educational programmemes.

To this end, there was need to provide a robust and effective demand-driven agricultural advisory service to small-scale farmers to enhance their adoption of agricultural technologies that will, in turn, increase agricultural productivity. The FAP is primarily involved in rural development through the provision of agricultural advisory services critical in enhancing farm performance and solving major farm problems. Attaching students directly to farmers enhances the proactive engagement of small-scale farmers in proposing the needed farm interventions. Furthermore, it enhances technology adoption but also accords learners an opportunity to acquire and apply knowledge, technical skills and gain hands-on experience in an immediate and relevant setting. Therefore, there was need to determine the strengths, weaknesses, opportunities and threats for the programmeme to understand its relative effectiveness to small-scale farmers in terms of technology adoption and associated immediate outcomes. It was also vital to assess its benefits to students in terms of equipping them with appropriate technical advisory skills

1.6 Scope and limitation of the study

This study was conducted in Nakuru and Baringo counties and involved farmers and students as sampling units. It was limited to the assessment of selected farming communities in

Baringo and Nakuru counties. The study was also limited to students that were previously attached to the farm attachment programmeme from Agricultural Economics and Agribusiness Management, Crops, Horticulture and Soils, Animal Science and Agricultural Extension and Education Departments.

1.7 Operational definition of terms

Farm Attachment Programmeme: A programmeme established by Egerton University in collaboration with other stakeholders to innovatively engage small-scale farmers by attaching students from agricultural related disciplines to them.

Agricultural extension: is the application of scientific research information, input and knowledge to agricultural practices through farmer education.

Small-scale farmer: Farmers practicing agriculture on less than 10 acres of land and predominantly depend on family labour.

Extension: The interaction and responsiveness of the University and other stakeholders to the demands of the society, agricultural sector in particular.

Demand-driven extension: A situation where the farmer expresses the desire and need for agricultural training and advisory services.

Supply-driven extension: Where the government through the ministry of agriculture designs agricultural training without incorporating farmers in the design.

Experiential learning: Education that integrates theory and practice by combining academic enquiry with actual experience.

Effectiveness: The capability of students to influence farmers to adopt agricultural technologies.

Intensity of adoption: Level of technology use by the farmers in the programmeme.

Technology: Agricultural interventions and solutions proposed by the students on attachment.

New Animatics: Improved livestock actiities

CHAPTER TWO
LITERATURE REVIEW

2.1 State of agriculture in Kenya

About 20% of land in Kenya is arable, yet maximum yield has not been reached leaving considerable potential for increase in productivity (GoK, 2015). This has made agriculture policy to revolve around the primary goals of increasing productivity, especially for small-scale farmers. However, most farmers in Kenya farm without basic agricultural inputs and updated technologies with inadequate extension services (Kibett, 2011). Kenyan agriculture is mainly rain-fed and more than 80% of the country is arid and semi-arid with an average annual rainfall of 400mm. Droughts are frequent and crops have been noted to fail in one out of every three seasons (GoK, 2016). Although Kenya has a well-established agricultural research system, use of modern technology in production is limited. Most farmers also lack information on the right types of inputs to use and the appropriate time of application. Hence, there is a need to establish a robust and efficient extension system.

2.2 Extension models and evolution

A number of agricultural extension models have been utilized in developing countries with the aim of achieving rural development. In Kenya, a number of approaches have been tried but have recorded mixed levels success. This has led to the restructuring of the extension system by incorporating elements of the past approaches that were successful and suggested development theories (Davis and Place, 2003). With agricultural development being the desired product, first models of extension in Kenya were run via the MoA by extension agents. Research and extension mainly focused on large and small-scale farmers in medium and high-potential areas with demonstrations and trials mostly on research stations. Except for hybrid maize, these models failed to successfully transfer agricultural technologies to farmers. This led to the establishment of farming systems approach that focussed on low-resource small-scale farmers in the 1980s through farmer input and on-farm trials.

In 1982, the World Bank financed Training and Visit (T and V) extension system in Kenya after T and V proving a great success in Turkey and India (Evenson, 1997). This system endeavoured to professionalize the extension system and reach out to more small-scale farmers by using contact farmers to multiply its effects. However, the system was highly structured making it more top-down and with high expenses and rigidity. With the economic hard times of 1980s to many developing countries, severe drought coupled with high oil

prices led to huge foreign debts (GoK, 2016). Kenya botched to recuperate from budget deficits leading to the decline of government budgets making it hard for the country to further fund T and V (Davis and Place, 2003).

The inability of the extension services spearheaded by the government and inadequate funds to sufficiently meet farmers' demands aggravated the search of other potential actors. As a result, the private sector which was profit oriented emerged. Despite of the efficiency of the private sector, the arrangement overlooked the arid and semi-arid areas where there was little chance to profit. With the determination of donors to only consider the best extension service providers, Non-governmental organizations (NGOs) emerged as key actors with comparative advantage over traditional service providers due to a surge in grass root contacts, sustainable programmemes that encompassed participatory approaches (Kavoi *et al*., 2014).

Seeing the effects, donors gave NGOs more attention because they shifted the rural development thinking to decentralization and privatization. With the number of actors increasing since the early days, finding the best extension model in light of Kenya's current economy has remained a puzzle. With stakeholders making calls of putting the small-scale farmer first, there is demand for a multi-provider extension model (Pluralistic), a model where the state takes the role of a facilitator. Facilitation, partnerships and sustainability concepts and theories behind extension have developed into more recognizable and prescribed approaches which according to Taye (2013) included farmer field schools, demand driven extension and Farmer-to Farmer extension frameworks.

Farmer Field School (FFS) was first applied in Indonesia in 1989 to reduce reliance on pesticides among rice farmers by enhancing their crop ecology (Mancini *et al*., 2006). FFSs are participatory, experiential and empowering in nature drawing on the priorities and challenges identified by farmers rather than those determined by outsiders (Stewart *et al*., 2014). It provides farmer-centred learning experiences that promote farmer empowerment through education. It engages a group of 25-30 farmers per training session. In this approach, farmers are expected to increase their knowledge and master vital management skills premised on informed understanding of what is happening in their own farms and develop independence from the recommendations provided by the extension service (Kavoi *et al*., 2014).

Initially, extension services spearheaded by the MoA were supply-driven, dawdling and costly (Semi-Arid Rural Development Programmeme (SARDEP), 2002). This led to the

development of demand-driven approach by the SARDEP, a bilateral organization financed by the Dutch government focussing on community development in Kenya. The approach was structured to be flexible, apt and responsive to farmers' needs. Furthermore, the programmeme concentrated on building group capacity and providing participatory assistance to farmers on issues pertaining land use planning. The service was developed in consultation with local development agencies and other stakeholders in the area then promoted through radio, fliers and the SAEDEP magazine locally renown as Kabotindet (MoAL, 2015). This made farmers to approach the district extension office requesting for training. However, sustainability of the programmeme became a problem especially after the Dutch government withdrew funding since the programmeme focused on small-scale farmers with limited resources.

2.3 Experiential learning

Traditionally, learning in a university setting according to Jackel (2011), involves taking courses that major on theoretical frameworks and scientific methodologies depending on the major signed up for by a student. However, the primary concern has remained to be the type of skills that students take with them after graduation, whether they pursued their higher learning for sole purposes of academic credit, for civic engagement, or for career development. As an effect, there have been calls for a system of learning that would enhance learner's connection between "real world" applications and academic content, thereby bridging the gap between the classroom and "real world" situations and demonstrating the need for knowledge application.

Experiential learning is a form of education for students in institutions of higher learning engaging them in solving problems by proactively applying knowledge beyond the class premised on real-life contexts and challenges (Knobloch, 2003). The system encompasses an array of potential experiences, including academic service-learning, service learning attachment prohrams, cooperative education arrangements, and community service-learning. According to Edziwa *et al*. (2012), it is a process of knowledge creation through experience where students have a chance to acquire and apply knowledge and technical skills in an immediate and relevant setting. The process accords learners an environment to build skills and knowledge from direct experience. Edziwa *et al*. (2012) asserts that experiential learning takes place through four tenets: Learning through real-life contexts, learning by doing, learning through projects and learning through solving problems. Furthermore, Juliet Miller in the study on Experiential education in 1982, says that experiential education is designed to

broaden the scope of learning experiences beyond the conventional classroom environment to community and occupational settings. Miller further argued that the programmemes engineering these collaborations uses the planned experiences to bolster cooperation between convetional institutions of learning and the outside world includingindustry, government, labor and community groups to backstop learning.

2.4 Sociological component of experiential learning

The existing body of literature jointly indicates that cooperative education curriculum as similarly observed by Jackel (2011), promotes the students' ability to achieve the beneficial goals of sociological curriculum by practically applying their knowledge to sociological perspectives thus shaping their comprehension of their lives through practical "sociological imagination." As argued by Miller (1990), this form of imagination allows a learner to execute their ideological mindset through the integration of classroom learning and the pragmatic sociological issues and career clarifications. In addition, internships sheds light on the diverse and complex challenges encountered in the real world situations that could not be directly addressed by the curriculums that students are exposed to (Kolb, 2014).

Farm attachment is a work related form of learning that includes a period of learning in a farm setting (Edziwa *et al*., 2012). Students agriculture related disciplines are attached directly to farms to gain hands-on experience. Attachment in Egerton University for practical exposure takes 8-10 weeks scheduled for third year Bachelor's degree students and second year diploma students. The primary role of farm attachment is to provide exposure to the real world of work (Mungai *et al*., 2016). During this programmeme, students put into practice the technical skills and theory learned in their curricula.

Educators and policy makers have called for models of learning and teaching that would change the role of instructors from knowledge deliverers to facilitators of proactive student learning. Agricultural discipline should therefore, reflect on foundational principles of learning by analyzing emerging issues rather than concentrating on foundational principles of the discipline. Masimira (2012) argues that experiential learning has a connection to real life issues faced by students outside the classroom both present and in the future. Experiential learning promotes students' problem-solving abilities, critical thinking, synthesizing academic knowledge and applying technical skills in real life situations.

2.5 Future prospects of extension provision in Kenya

Premised on the current status of extension in Kenya and Sub-Saharan Africa, there has been profound motivation to experiment wide-ranging alternative methods with greater emphasis on pluralistic farmer-led extension services (Lyne *et al*., 2017). Due to the diversity of approaches mirroring the heterogeneity of rural areas, extension agents will need special skills that go beyond the basic technical skills. Based on the current status of extension in Kenya, there is a dearth literature on the capacity and performance of extension system. This type of information is needed to assess the SWOT of extension to buttress efforts of reducing rural poverty through the improvement of small-scale farmers' welfare (Sæther, 2010).

2.6 The Egerton University farm attachment programmeme

Egerton University being a premier institution in agriculture in East and central Africa, the institution is committed to improving the relevance of agricultural science training and outreach to farm needs (Mungai *et al*., 2016). Following a needs assessment, universities in collaboration with other stakeholders are conducting a joint review of the curricula to strengthen competencies of students in technical advisory services. Efforts are in place to nurture students in the participating disciplines to be analytical observers and be part of the solution of providing coordinated knowledge. The project has created mechanisms to address farmers' challenges through targeted trainings, generation of relevant agricultural information and an innovative farm attachment programmeme in which students and farmers closely interact with the backstopping of university staff to consistently address specific issues (Mungai *et al*., 2016). At the end of each attachment cycle, a platform involving farmers, lecturers and other stakeholders is organized to discuss attachment experiences and lessons at each stage to address critical and emerging farm issues. New challenges and innovations brought forth in the discussions are then incorporated in research to assist in the dissemination of useful agricultural messages.

2.7 Methodologies in strengths, weaknesses, opportunities and threats (SWOT) analysis

2.7.1 Qualitative multiple-case study

Tukundane *et al*. (2015) conducted a SWOT analysis in Mbarara district in Uganda to gain insights into the Vocational Education Training (VET) skills programmeme for marginalized youths and how they are prepared for livelihood opportunities. The analysis was based on perceptions and experiences of key stakeholders in the programmeme. They used a qualitative multiple-case study approach that allowed exploration of particular issues within

each specific VET setting and across programmemes. This method leads to a greater insight into the study phenomenon compared to single-case studies hence, better for analytic generalisation and theorising (Cheng, 2010). It also produces exemplary research knowledge giving a qualitative standpoint assisting in the comprehension of training skills within various settings (Thomas, 2010a; Thomas, 2010b).

2.7.2 Maximum variation method

A study on skills development on Early School Leavers (ESL) was conducted in Uganda in four phases in 2015. In the first phase, programmemes training ESL were explored through desk research, visiting education departments and training centres, and finally interacting with local people knowledgeable about the programmemes. Cases for study were then selected on the criteria of maximum variation. The second phase involved interviewing students and instructors in the selected VET institutions then a follow-up study on some graduates of the programmemes and interaction with their employers. In the last phase, a workshop was organized and those who had participated were invited to present their preliminary findings and conclusions for feedback to ascertain whether their findings represented participants' actual views. Data was collected using individually focused interviews, observation and documentary analysis. Despite the results only covering four cases, they provided exemplary information capable of making analytical theorising and generalisation of the programmeme's skill development throughout the whole nation. The exemplary knowledge, according to Clausen (2012) could be used to improve existing programmemes and aid in the design and implementation of similar programmemes in the future.

2.8 Factors determining technology adoption

Many areas of the globe where agriculture transformation has been documented, agricultural productivity growth have been driven by improved farm technologies (Uaiene *et al*., 2009). Technology is the knowledge that enables some tasks to be accomplished more easily improving the farming situation by changing the farmers' status quo to a more desirable level (Mwangi and Kariuki, 2015). A country's ability to fully utilise its agricultural potential depends on the innovativeness of the actors in the agricultural sector. The capacity of farmers and other actors to innovate in their production activities is contingent on the availability of technology (Lavison, 2013). The Asian green revolution as demonstrated by Minten and

Barret (2008) is a clear indication of how improved technology adoption is critical to the modern day agricultural transformation.

Therefore, availability of modern agricultural technologies to farmers and their ability to adopt and utilise them is equally critical. Unravelling the reasons for low technology adoption among farmers requires the specific factors influencing their decisions to adopt be identified. According to Ali and Behera (2016), technology makes farming easier than it could have been in its absence. Farmers' decisions on how and whether to adopt technology are conditioned by the dynamic interaction between features of the technology itself and the array of circumstances surrounding them. According to Mwangi and Kariuki (2015), it is essential for the designers and disseminators of technologies to understand the factors influencing these decisions. Mignouna *et al*. (2011) in their study on the determinants of adoption of maize resistant variety found that farmers are likely to adopt technologies they perceive as compatible with their environment and consistent with their needs. It is also noted that farmers' perception of the characteristic of a technology positively influences their adoption decision (Akinbode and Bamire, 2015).

Many studies Lavison (2013); Akinbode and Bamire (2015); Mwangi and Kariuki (2015), have been conducted on technology adoption. However, there is scanty literature on the specific factors determining technology adoption. If the problem of low agricultural productivity in Baringo and Nakuru County is to be addressed, then the gap of low technology adoption must be bridged. From the foregoing, this study will examine the specific factors that influence adoption of agricultural technologies among small-scale farmers in Baringo and Nakuru County in Kenya.

2.9 Theoretical and conceptual framework

2.9.1 Theoretical framework

This study will use Unified Theory of Acceptance and Use of Technology (UTAUT). This theory has commonly been employed in many studies investigating hindrances to the acceptance and usage of technologies (Kripanont, 2007; Dulle and Minishi-Majanja, 2011; Zhou *et al*., 2011). The theory was proposed by Venkatesh *et al*. (2003) during their examination of factors influencing the intention of utilization and usage of information technology among 150 small manufacturing operators. Technology acceptance is about how people accept and adopt some technology to use (Alwahaishi and Snasel, 2013). It is hence

vital to predict and explain an individual's behaviour towards acceptance and usage of technology.

Various studies acknowledge that the UTAUT contributes to a better comprehension of the drivers of acceptance and use of new technologies than other similar theories (Al-Qeisi, 2010; Dulle and Minishi-Majanja, 2011; Venkatesh *et al*., 2012). Previous studies (Kripanont, 2007; Venkatesh *et al*., 2012; Alwahaishi and Snasel, 2013) conducted using UTAUT have demonstrated that perceived ease of use and usefulness are central determinants of technology adoption, as long as they do not cause a significant increase in the production cost. For an innovation to be accepted, it has to be diffused well among the targeted end-users (Rogers, 2003). In this study, students on attachment focus on the general farm appraisal and together with the farmer come up with interventions and technologies to address farm challenges. Students' effectiveness was then determined by how farmers accepted and adopted solutions and interventions in form of technologies proposed to them. Therefore, the theory is cardinal to the study as it helps in explaining the behaviour exhibited by farmers towards acceptance and usage of the interventions introduced to them by the students and hence, the intensity of technology adoption.

2.9.2 Conceptual framework

The rate of adoption of a given technology greatly depends on the attributes of that particular technology (Rogers, 2003). From figure 1, farmers' ability to adopt given technology(ies) depends on their perception which is a function of their perception towards a given technology, socio-economic, institutional and farm characteristics. These factors influence the type of technology that a farmer adopts. In the presence of an effective advisory service, in this case from student attachees, farmers' perception influences the perception on relevance of the information given, the technical advisory ability of the student, the responsiveness of the student farm challenges as they arose, and the knowledge of the student on agricultural aspects. A combination of the student' characteristics influences the perception that a given farmer has towards the programmeme. In return, the perception developed by the farmer influenced the willingness of a given farmer to adopt the technologies proposed by the student. Albeit the willingness, farmer's adoption behaviour was to a larger extent dependent on the socio-economic factors, farm characteristics and institutional factors. The adopted technologies as asserted by majority of farmers improved

farm efficiency and food security through reduction of losses and engaging in the production of several types crop and livestock enterprises.

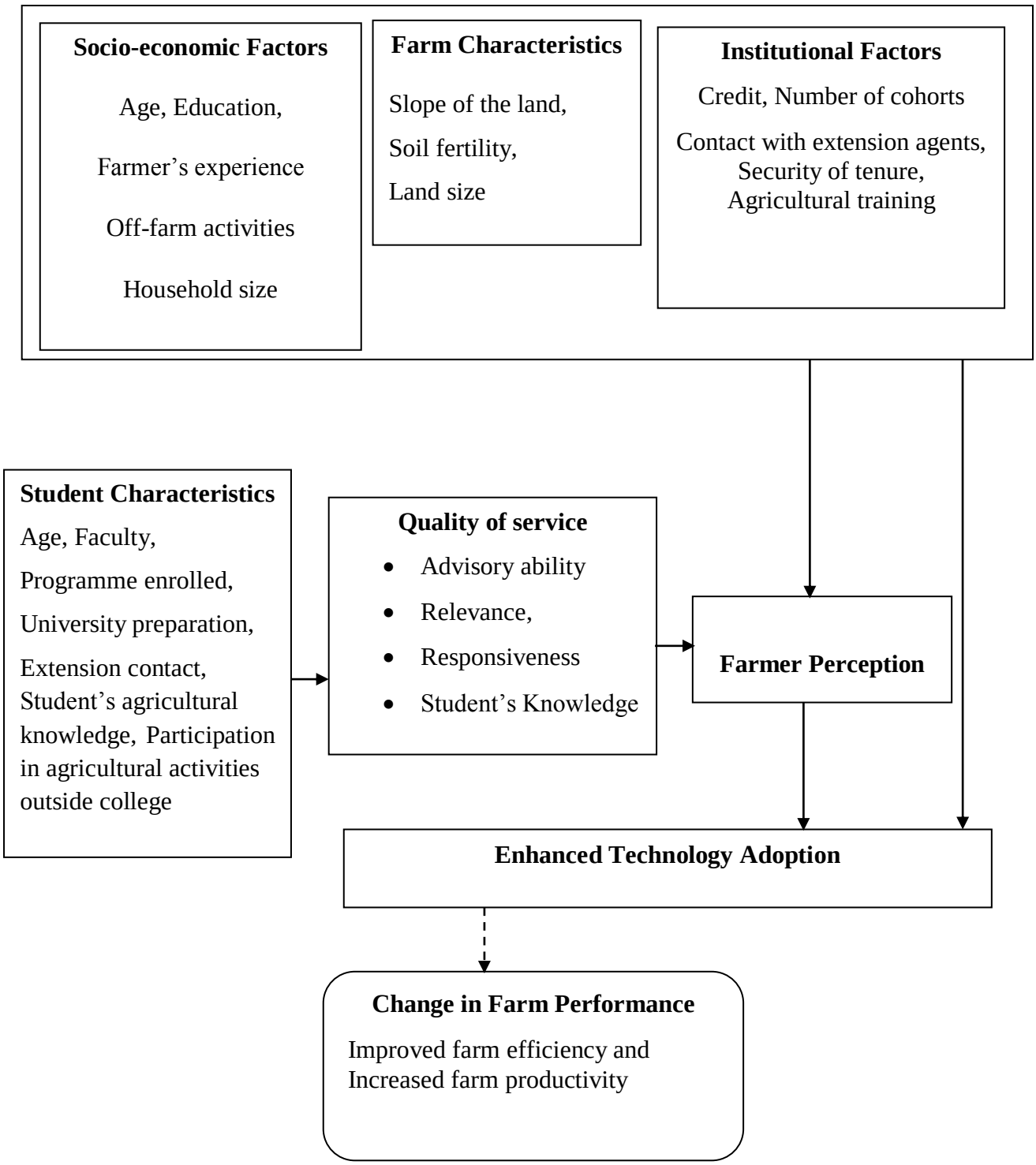

Figure 1: Conceptual framework on the effectiveness of FAP on technology adoption

CHAPTER THREE
METHODOLGY

3.1 Study area

The study was conducted in Baringo and Nakuru counties in the rift valley region of Kenya. Nakuru County constitutes eleven sub-counties. The county covers an area of 7495.1 km^2. It lies between Longitude 36° 00'0.00" E and latitude 0° 29'59.99" N. It's the fourth largest county in Kenya in terms of population with a population of 1,603,325 from the 2009 census survey (Nakuru County Integrated Development Plan, 2013). Main crops grown and marketed include coffee, maize, wheat, barley, and beans. Major industries in the County are flour milling and grain ginneries with crops from the county providing the primary source of raw materials.

Nakuru County experiences a bimodal rainfall pattern with highs of 1800mm and lows of 500mm (Nakuru County Integrated Development Plan, 2013). There are about 400,000 households, 25% of which are female-headed. Rich volcanic soils, energetic labour force, reliable rainfall in most parts of the County and availability of ready market have contributed to an increase in cultivated land. Approximately, 72.5% of lands in the county have title deeds with less than 20% of the households considered landless. Land under food crops in the county is 243,711.06 hectares while 71,416.35 hectares is under cash crops (Nakuru County Integrated Development Plan, 2013). The average farm size for both food and cash crops per household is 0.77 hectares. Dairy farming under zero grazing system is on the rise as a vital economic activity due to the favourable weather environment, diminishing land size and ready market for milk. In this county, the study was carried out in Njoro, Rongai, Bahati, Molo and Gilgil sub-counties.

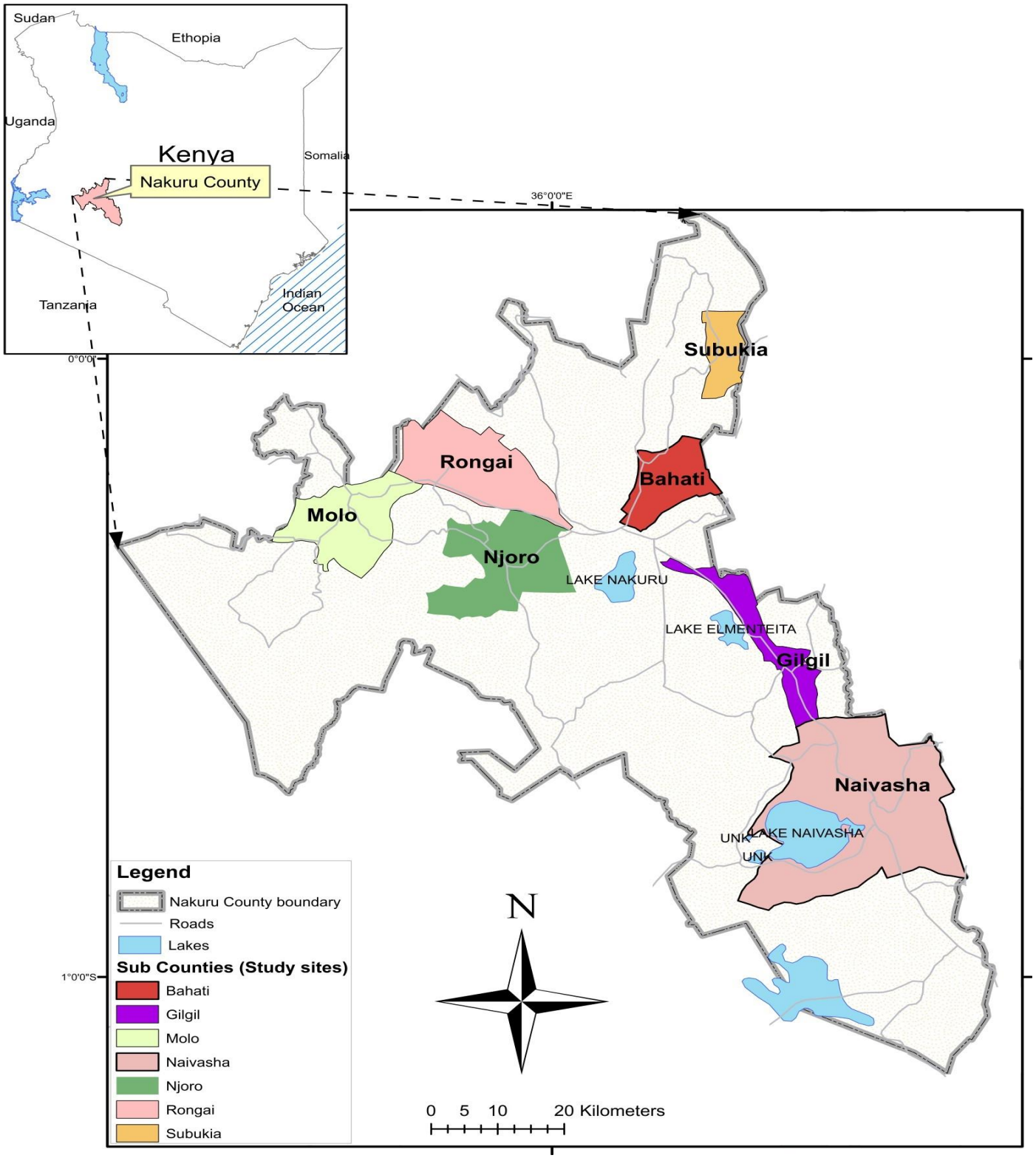

Figure 2: Map of Nakuru County

Source: World Resource Centre (2014)

This study also covered Baringo County, which is administratively and politically divided into six sub-counties. The county recorded a population of 555,561 (279,081 males and 276,480 females) in the 2009 Kenyan census. The county lies between Longitude 36° 00'0.00" E and Latitude 0° 39'59.99" N (Baringo County Integrated Development Plan, 2013). The county's inter-censual growth rate is at 3.3 % per annum, which is above the national average of 3%. Baringo County is in the Great Rift Valley region of Kenya and covers an area of 11,015.3 km^2.

Baringo County varies in altitude with the highest points being 3000m above the mean sea level and low points being nearly 700m above the mean sea level. Baringo is classified as an ASAL. Most parts of East Pokot, Mogotio, Baringo Central, Baringo South and Baringo North sub-counties are arid and semi-arid except Koibatek sub-county which is in a highland zone. Rainfall varies between 1000mm and 1500mm in the highlands to 600mm per annum in the lowlands (Baringo County Integrated Development Plan, 2013). Koibatek Sub-County receives the highest rainfall amount while the lowland sub-counties of Mogotio, Baringo North, and East Pokot receive relatively low amounts.

Temperature ranges from 10ºC to 35ºC with an average wind speed of 2m/s with the climate varying from humid highlands to arid lowlands. The major crops grown in the area include Maize, sorghum, finger millet, beans, cowpeas, garden peas, green grams, sweet potatoes and Irish potatoes. Beans and maize cover the largest acreage while garden peas cover the lowest acreage (Baringo County Integrated Development Plan, 2013). Maize is the leading cash and food crop in the county although its production has been low due to poor crop husbandry and poor rainfall distribution. Land holding within the sub-county varies from one-sub-county to another with an average farm size of 2.5 hectares. The Southern part of the county, Koibatek sub-county has an average landholding of 2.5 hectares demarcated with title deeds while in the Northern part, East Pokot Sub-County land is still communal managed by the community. This study will focus in Ravine, Torongo, Emining, Mochongoi and Mogotio sub-counties.

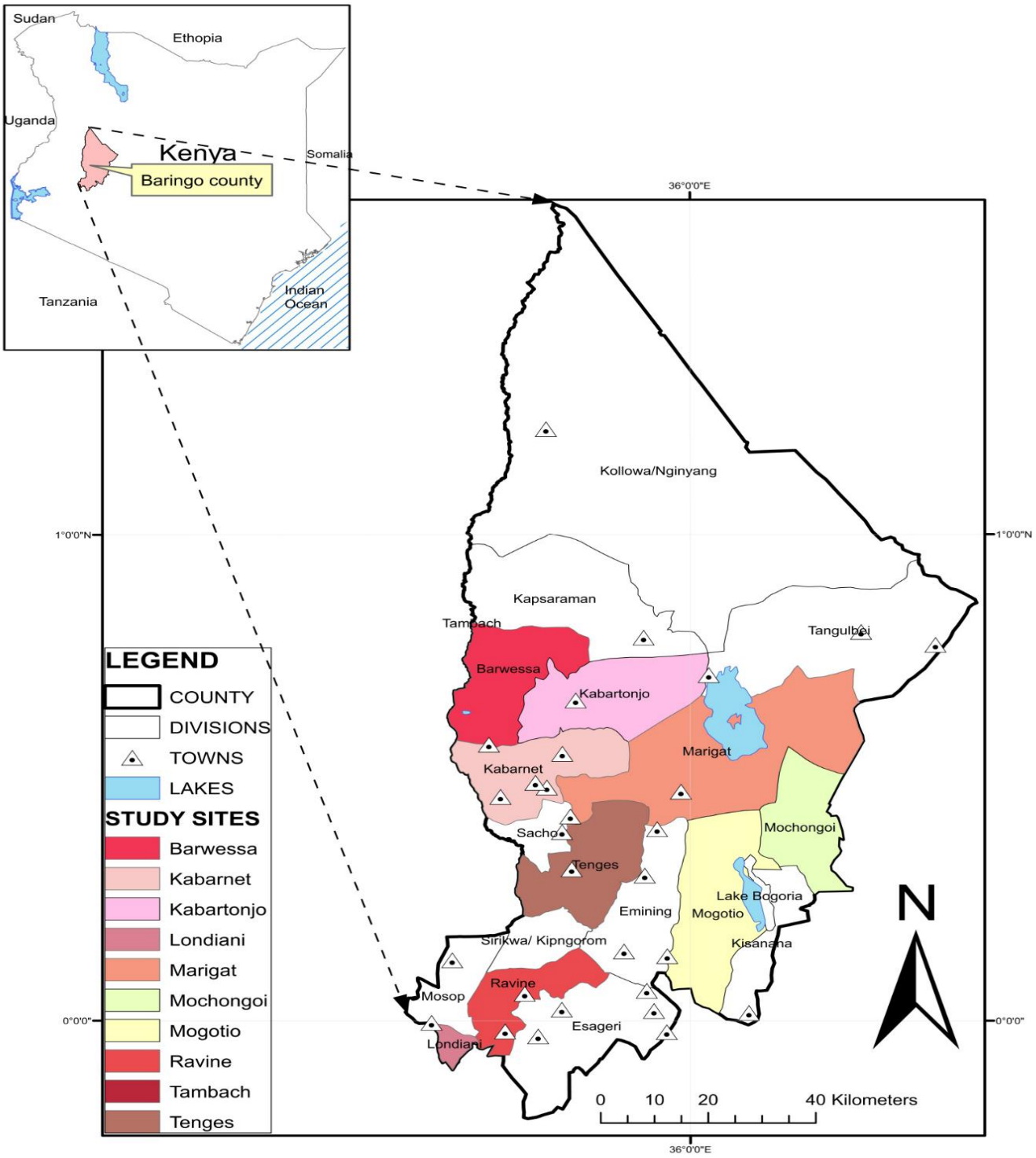

Figure 3: Map of Baringo County

Source: World Resource Centre (2014)

3.2 Sampling technique

The study used multistage sampling technique. The first stage involved the purposive selection of the two counties and sub-counties in which the programmeme has engaged farmers. The second stage then involved a survey of 100 farmers from the counties as shown

in Table 1. Third stage involved the stratification of the students into their respective departments after which they were randomly sampled to the proportionate sample of 154 students. The study had an allowance of 10 students to cater for low response rate not clear. The students were sampled from the population of students attached to farms since the programmeme inception in 2014.

Table 1: Proportionate composition of farmers in Baringo and Nakuru counties.

Nakuru County	**Number of farmers**	**Baringo County**	**Number of farmers**
Njoro	33	Ravine	11
Rongai	12	Torongo	07
Bahati	05	Emining	03
Molo	10	Mochongoi	05
Gilgil	08	Mogotio	06
TOTAL	**68**	**TOTAL**	**32**

Table 2: Proportionate composition of students per department

Department	AGEC/AGBM	CHS	ANSC	AGED	ACDS	TOTAL
Students	9	47	31	48	17	152

Note: AGEC/AGMB = agricultural Economics and Agribusiness management, CHS = Crops, Horticulture and Soils, ANSC = Animal Science, AGED = Agricultural Education and Extension, and ACDS = Community Development Studies

3.3 Sample size determination

The selected students attached to the farms formed the sampling units. Since the population of students engaged in the FAP was finite, the formula by Yamane (1967) was applied and a total of 254 respondents were interviewed.

The formula is presented as follows;

$$n = \frac{N}{1 + N(e)^2} \tag{2}$$

$$n_s = \frac{250}{1 + 250(0.05)^2} = 153.85 \approx 154 ,$$

$n = (n_s + \mathrm{N_f}) = 154 + 100 = 254$

where; n = Sample size, N =Population size, e = acceptable sampling error, $\mathrm{N_f}$ =Sample size for farmers, n_s =Sample size for students and p= 0.05 are assumed.

3.3.1 Questionnaire return rate

The study constituted of two main units, farmers and students. A survey through interview schedules was conducted on the farmers engaged in the programmeme by trained enumerators. On the other hand, a proportionate sample of 154 students was randomly selected and interviewed from different departments within the agriculture discipline. The study, therefore, distributed 164 questionnaires as claimed by Asch et al. (1997), to cater for low return rates. Out of this, a total of 152 questionnaires were sent back. This represented a 92.68% return rate, which is deemed sufficient according to Kothari and Warner (2007), who pointed out that 90% return rate is the accepted threshhold. However, the completion rate of the survey was 98.70% since the study proposed a sample of 154 students yet 152 returned their questionnaires.

3.4 Data and data collection

Primary data was collected from all the farmers engaged in the programmeme using pretested semi-structured questionnaires by trained enumerators through interview schedules, observation, and records analysis. Students were interviewed through interview schedules and google forms and follow-up through phone calls. Data from students who were still on campus were collected through face to face interviews while those who had already completed their degree and diploma programmemes were sent questionnaires through google forms then clarifications were sought through phone calls.

3.5 Analytical framework

Objective one: To determine the strengths, weaknesses, opportunities and threats (SWOT) of the FAP.

To achieve this objective, the farmers' perception towards the programmeme were condensed into four composite clusters. To determine the SWOT analysis of the programmeme, 27 variables were subjected to factor analysis through principal component factoring. The constructs were then rotated using an Oblique rotation technique due to suspected inter-correlations between the constructs as represented in equation 3. Reliability and internal consistency tests were then conducted to ensure that the model was suitable for the data. Afterwards, the observed and the latent variables were combined to come up with clusters that were renamed as strengths, weaknesses, opportunities and threats based on factor loadings (Olivier *et al*., 2018).

$$Y_1 = q_{11}x_{12} + q_{12}x_2 + \ldots\ldots\ldots + q_{1n}xn \quad (3)$$

$$Y_j = q_{j1}x_{j1} + q_{j2}x_2 + ...+ q_{jn}x_n$$

Where Y_1,…… Y_j = Correlated factor constructs

$q_1 - q_n$ =Correlation coefficients

$x_1 - x_j =$ Farmer perceptions towards the programmeme.

Objective two and three

Since the student and farmer perception was grouped in to four Likert items on a linear continuum of four ordered dependent categories: '1=Very ineffective', '2= ineffective', '3 Effective', and '5= Very effective', a binary choice model could not be used. This meant that the two objectives could only be analysed by models that allowed for more than two dependent variables (Ezebilo *et al*., 2013). Therefore, the possible models to be used were multinomial and ordered models. Similarly, multinomial model was not suitable for this study since it's often applied to modelling of unordered dependent variables (Sun *et al*., 2017). The study, therefore, employed an Ordered Logit Regression model for objective two and three. However, for objective three, the analysis was conducted in two phases, the first stage involved the profiling of the farmer perception index through a confirmatory factor analysis model. The index was generated with the principal component factoring technique. The factor loadings were then weighted and the index generated included in the ordered logit model as a dependent variable.

The κ, βs and m-1 were the parameters that needed to be estimated. Predicted probabilities taken by y were then computed by solving these equations.

$$pr(y_i > j) = \frac{\exp(x_i\beta - \kappa_J)}{1 + \left[\exp(x_i\beta - \kappa_j)\right]}, j = 1,2,....,m-1, \text{ Which implied}$$

$$pr(y_i = m) = \frac{\exp(x_i\beta - \kappa_{m-1})}{1 + \left[\exp(x_i\beta - \kappa_{m-1})\right]} \quad (4)$$

In the case of m=3, and m-n the above equations simplified to;

$$pr(y = m) = 1 - \frac{1}{1 + \exp(x_{i-1}\beta - \kappa_{m-1})} \quad (5)$$

$$pr(y = j / x) = 1 - \frac{\exp(x_{i-1}\beta - \kappa_3)}{1 + \exp(x_{i-1}\beta - \kappa_3)} \quad (6)$$

To ensure that $pr(y = j / x)$ is between 0 and 1, $x_i\beta - \kappa_J \geq x_{i-1}\beta - \kappa_{j-1}$. Failure to impose this constraint during estimation, the predicted probabilities can be greater than 1 or negative (Melissa and Bryman, 2009). The empirical model was then estimated as follows;

$$y_f = \beta_o + \beta_1 Age + \beta_2 Gend + \beta_3 Educ + \beta_4 Fm\exp + \beta_5 Hsize + \beta_6 OffmI + \beta_7 Tenure + \beta_8 Soilfert + \beta_9 Slope + \beta_{10} Lsize + \beta_{11} nExten + \beta_{12} nTrain + \beta_{13} Creditacce ss + \beta_{14} Grpmemb + \beta_{15} nHost + \beta_{16} s\,\mathrm{Re}\, sponsivene ss + \beta_{17} sKnowledge + \beta_{18} sAdability + irelevance + \varepsilon_i \quad (7)$$

y_f =Farmers' perception towards the Farm Attachment Programmeme

Table 3*:* Ordered Logit model variables for farmers' perceptions

Variable	Description	Measurement	Hypothesized sign
Dependent variable			
sResponsiveness	*Student's Responsiveness to farm challenges*	*Likert scale*	
sKnowldge	Students knowledge on agric.	Likert scale	
sAdabilty	*Student's Advisory ability*	*Likert scale*	
Relevance	Relevance of the information given by students	Likert scale	
Explanatory Variables			
Age	Age of the household head	Years	±
Gend	*Gender of the household head*	*Dummy*	±
Educ	Number of schooling years completed by the household head	Number	±
FmExp	*Period the farmer has been involved in agricultural activities*	*Years*	+
Hsize	The number of household members actively involved in agricultural activities	Number	+
OffmI	*Income generated from other activities other than farming*	*KES*	±
Tenure	Security of tenure	Dummy (with or w/o deed)	+
Soilfert	*Fertility status of the main agricultural plot*	*Likert scale (Low as reference)*	+
Slope	Slope of the main agricultural plot	Likert scale (Low as reference)	+
LSize	*Size of the land owned*	*Acreage*	±
nExten	No of contacts with other extension service providers	Number	+
nTrain	*No. of agric. Trainings attended*	*Number*	+
Credit	Access to finance and product market	Dummy (Yes/No)	+
Grpmemb	*Farmers involvement in agricultural group activities*	*Likert scale*	+
nHosts	Number of times a farmer has hosted students	Likert scale	+

$$y_s = \beta_o + \beta_1 age + \beta_2 gend + \beta_3 program + \beta_4 Faculty + \beta_5 Time\_attach + \beta_6 Horigin + \beta_7 \Pr ogSprt + \beta_8 PartAgricAct + \beta_9 Uni \Pr ep + \beta_{10} nExten + \beta_{11} fKnowledge + \beta_{12} \Pr ogeffect + \beta_{13} CareerExpc t + \varepsilon_i \quad (8)$$

y_s =Students' perception towards the farm attachment programme.

β = is the standardized regression coefficient

The model variables, description and their hypothesized relationships are shown in the Table 3;

Table 4: Ordered Logit model variables for students' perceptions

Variable	Description	Measurement	Hypothesized Sign
Dependent Variable			
Student perception	Importance of the programme to the student	Likert scale	
Explanatory Variable			
Age	Age of the student	Years	±
Gend	Gender of the student	Dummy	±
Programme	Entry level of the student	Dummy(Degree or Diploma)	±
Faculty	The discipline undertaken	Dummy (Agriculture or Others (AGED, ACDS)	+
Time_Attach	Time since attachment	Months	±
HOrigin	Residential home of the student	Dummy(Rural or Urban)	±
Progsprt	Support given to the student during attachment	KES	+
PartAgricAct	Participation in agricultural activities outside college	Dummy (Yes or No)	+
Uni_Prep	University preparation	Likert scale	+
Nexten	No. of contacts with extension	Number	+
Fknowledge	Farmer knowledge on agriculture	Likert scale	+
ProgEffect	Effect of the programme on career	Likert scale	±
CareerExpect	Student's career expectation	Scale of 100	±

Objective four: To determine the effectiveness of the farm attachment programme in enhancing technology adoption among small-scale farmers.

In the programme, students proposed a number of solutions in form of technologies to farmers in the two counties. Farmers adopted a given number of technologies out of the total that were proposed by students depending on their perception, socio-economic, institutional and technical aspects. The intensity of technology adoption by an individual farmer was measured by the number of technologies adopted divided by the number of technologies proposed.

To determine the effectiveness of student attachees in enhancing technology adoption among small-scale farmers in the two counties, a Tobit model was employed. In cases where the dependent variable is categorical, taking values of 0 and 1, probit or logit models are used (Park, 2015). When adoption is continuous, a censored regression model is appropriate as it can differentiate between limits (zero or censored) and non-limits (continuous or uncensored) observations unlike Probit and logit models.

The proportion of adoption in ratio form was treated as the dependent variable while socio-economic, plot characteristics, institutional factors and farmer perception as predictor variables. Tobit model was used to examine the factors determining the probability of adoption and the extent of technology usage by estimating all the technologies simultaneously at a point in time. The ratio of technologies that a farmer had adopted out of the total proposed by the student were then computed as follows;

TA_{ij} = Period in years that farmer *i* had used a given proportion of technologies j as the dependent variable in the Tobit model with an observed value of the latent variable TA^*_{ij}.

$$TA^*_{ij} = \beta_o + x_i\beta + \varepsilon_i \quad (9)$$

Where, i= is the number of technologies

β_{jk} = parameters to be estimated using maximum likelihood.

TA_{ij} is specified as a function of farmers' socio-economic status and institutional and technical aspects of agricultural production. TA_{ij} = time (in months) farmer *i* started using a given technology (*i*=1, 2, 3……n), proportion of technology adoption j (j=number of technologies divided by the total number of technologies proposed).

$$TA_{ij} = TA^{*}_{ij} if TA_{ij} > 0,\ TA_{ij} = TA^{*}_{ij} if TA^{*}_{IJ} \leq 0 \quad (10)$$

If TA_{ij} >0 (uncensored observation), farmer i had adopted technology j in period m but if TA_{ij} = 0 (censored observation), the farmer had not adopted any technology. According to Greene. (2012), the expected value of the observed TA_{ij} was computed as follows;

$$E(TA_{ij} / x_{ijm}) = \left[x'_{ijm}\ \beta_j \varphi \frac{(x_{ijm}\beta_j)}{\sigma_j} \right] + \sigma_j \phi \frac{(x_{ijm}\beta_j)}{\sigma_j} \quad (11)$$

Where; φ and ϕ represents the distribution and normal density functions respectively. The proportion adopted according to Söderbom (2009) was shown as;

$$\partial E(TA_{ij} / x_{ijm}) \Big/ (\partial x_{ijmk}) = \beta_{jk} \varphi \frac{(x_{ijm}\beta_j)}{\sigma_j} \quad (12)$$

$$E\left[TA^{*}_{ij} / TA_{ij} > 0, x_{ijm}, x_{ijmk} = AdoptedRatio\right] - E\left[TA^{*}_{ij} / TA_{ij} > 0, x_{ijm,} x_{ijmk} = 0\right] \quad (13)$$

The empirical model was estimated as follows;

$$TA_{ij} = \beta_0 + \beta_1 Age + \beta_2 \text{Gend} + \beta_3 \text{Educ} + \beta_4 \text{Fmexp} + \beta_5 \text{Hsize} + \beta_6 \text{Slope} + \beta_7 \text{Soilfert} + \beta_8 Tenure + \beta_9 Lsize + \beta_{10} Creditaccess + \beta_{11} \text{Grpmemb} + \beta_{12} \text{sKnowledge} + \beta_{13} \text{Responsiveness} + \beta_{14} Contentrelv + \beta_{15} Ad\_ability + \beta_{16} nHost + \varepsilon_i \quad (14)$$

The model variables, explanations and hypothesized relationships are shown in Table 4;

Table 5: Tobit model variables on factors determining technology adoption

Variable	Description	Measurement	Hypothesized sign
Dependent variable			
Proportion of adoption	The intensity of technology adoption	Ratio of adoption	
Explanatory variables			
Age	Age of the Household	Years	±
Gend	*Gender of the household head*	*Dummy*	±
Educ	Number of schooling years completed by the household head	Number	+
Famerexp	*Period in years the farmer has been involved in agricultural activities*	*Farming years*	+
Hsize	The number of household members actively involved in agricultural activities	Number	+
Slope	*Slope of the main agricultural plot*	*Likert scale*	±
Soilfert	Perception on fertility status of the main agricultural plot	Likert scale	±
Tenure	*Security of tenure*	*Dummy*	+
Lsize	Size of the land owned	Acreage	+
Credit	*Access to finance and product market*	*KES or in Kind*	+
Grpmemb	Farmers involvement in agricultural group activities	Dummy (Yes/No)	+
sKnowledge	*Knowledge of the student on agricultural issues*	*Likert scale*	+
Responsiveness	Students responsiveness to farm challenges	Likert scale	+
ContentRelv.	*Appropriateness of the student advisory services*	*Likert scale*	+
Adability	Student's technical advisory ability	Likert scale	+
Nhost	*Number of times a farmer has hosted students*	*Number*	+

Note: Ratio of adoption = Technology(ies) adopted divided by technologies proposed

CHAPTER FOUR
RESULTS AND DISCUSSION

This chapter presents the analysis of results and discussion in five major sections premised on the study objectives. This includes the SWOT analysis of the FAP, factors influencing farmers' perceptions towards the Farm Attachment Programme (FAP), factors determining students' perceptions towards the FAP and finally the effect of FAP on the intensity of technology adoption among small and medium scale farmers in Nakuru and Baringo counties. A factor analysis model was used to decompose the farmers' perception towards the programme into the strengths, weaknesses, opportunities and threats (SWOT) of the programme. An ordered logit regression was employed to determine the specific factors influencing farmers' and students' perceptions towards the programme. To determine the effect of the FAP on the intensity of technology adoption among farmers in the programme, a left censored Tobit model was used.

4.1 Strengths, weaknesses, opportunities and threats (SWOT) of FAP

To determine the strengths, weaknesses, opportunities and threats of the FAP, Confirmatory Factor Analysis (CFA) model was used. Students from different departments in agriculture and education discipline were attached to farmers with different resources, education level, farming experience and social capital among other factors as advisory agents. With the farmers' identification of the programmes' SWOTs being subjective, errors were likely to occur during categorization. Therefore, to avoid misspecification errors, the study employed a CFA model to ensure correct categorization of the individual factors into strengths, weaknesses, opportunities and threats as experienced by farmers in the FAP (Glen, 2017).

A CFA model was employed on standardized variables to condense the number of interrelated variables into few factors that were grouped into strengths, weaknesses, opportunities and threats (Teryima, 2016). Since the variables under analysis were conceived multidimensional, various dimensions were non-orthogonal resulting into relatively high correlations. Therefore, to fully capture the diversity in the human behaviour by condensing these variables into fewer components for easier rotation, a Promax rotation was employed (Brown, 2009). This rotation created factor loadings ranging from 0.30 to 0.830, clustering the items into four extracted factors.

Prior to the extraction of factors, several pre-estimation tests were conducted to assess the suitability of the data and adequacy of the sample size for factor analysis. The data was

screened for out-of-range values and univariate outliers by observing the factor loadings on each of the factors that were analyzed for the model. As a result, variables that had factor loadings of less than 0.30 were according to Olivier *et al.* (2018) identified and dropped, a test that strengthened the Cronbach's alpha. Excluding the loadings that were less than 0.30 yielded a sixteen-factor solution from 27 factors. Premised on literature contention regarding the appropriate or minimum sample size for factor analysis to be effective, the data was satisfactory for factor analysis as a sample size of at least 100 has been suggested sufficient (Thompson, 2004; Brown, 2009; Teryima, 2016; Olivier *et al*., 2018). Furthermore, the data was sufficient for the execution of a CFA model as it provided a ratio of over 6 cases per variable with a sampling ratio of 6.25 (Glen, 2017). To enhance the model further, missing data was subjected to listwise deletion.

Regarding the number of component extraction, the model has for quite some time been acutely criticized for subjectivity (Thompson, 2004; Tsai and Liou, 2017). To overcome the criticisms, the latent variables were subjected to a series of systematic and sequential pre-estimation tests prior to factor construction and reduction to establish a clear decision pathway regarding the strengths, weaknesses and opportunities extraction. A series of decisions were therefore, made before coming to a four-item factor structure. This was after reviewing the Eigen values, factor loadings, scree plot, and reliability and validity statistics (Thompson, 2004; Brown, 2009; Glen, 2017; Hauben *et al*., 2017; Teryima *et al*., 2016).

Cronbach's alpha for reliability, Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of Sphericity were conducted prior to the factor analysis to determine if factor analysis was a suitable model for this data. The pre-estimation tests proofed that factor analysis was a suitable model, yielding a Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy of 0.619 with an associated p value of < 0.001. This indicated that the sampling was adequate for factor analysis as a KMO of 0.6 has been suggested to be suitable, thereby indicating that partial correlation was minimal (Glen, 2017; Olivier *et al*., 2018). Furthermore, a Cronbach's alpha of 0.705 was obtained. According to Teryima *et al*. (2016), the Cronbach alpha should at least be 0.7. A Cronbach's alpha of 0.705, indicated that 70.5% of the of the 27 variables that were used in determining the SWOT of the programme were consistent. According to Olivier *et al*. (2018); Tsai and Liou (2017), this indicated a good internal consistency and reliability, further indicating that factor analysis was a suitable model for this data.

Despite the fact that majority of the communalities obtained were higher than 0.6, only one variable had a communality value above 0.8. This indicated a weak association between the variables used in the model (Hauben *et al.*, 2017). The analysis yielded a KMO and Bartlett's test of Sphericity value of 0.619 with an associated p-value of 0.000 indicating that the set of variables derived were adequately related, therefore, validating the use of factor analysis model and Promax rotation (Brown, 2009; Glen, 2017; Olivier *et al.*, 2018). The confirmatory factor analysis model results are presented in Table 6.

Table 6: Confirmatory factor analysis model results

Constructs		Factor1	Factor2	Factor3	Factor4	Communalities
Timely Feedback by the students		**0.632**	-0.199	0.008	-0.294	0.580
Increase in farm yields		**0.635**	0.151	-0.010	0.232	0.665
Increase in food security		**0.686**	0.100	-0.020	0.001	0.673
Higher responsiveness by students to farm challenges		**0.679**	-0.083	0.136	-0.051	0.682
Increased technology awareness		-0.126	**0.645**	0.150	0.071	0.765
Increased technology access		0.035	**0.763**	-0.056	-0.031	0.645
Increase in farm efficiency		0.419	**0.447**	-0.009	-0.100	0.557
Increased farmer Linkage		0.317	**0.326**	0.013	-0.024	0.716
Enterprise incompatibility		0.346	**0.441**	-0.116	0.150	0.644
Mismatch of student skills		0.154	-0.092	**0.312**	-0.036	0.803
Drastic climate variability and drought		0.037	-0.036	**0.830**	0.044	0.711
Limited resources by farmers to implement the interventions		0.053	0.111	**0.828**	-0.089	0.729
Interpersonal relationship challenges		0.022	0.207	**0.336**	-0.276	0.688
The attachment duration was short		-0.190	0.187	-0.205	**0.760**	0.734
High costs of student accommodation		0.009	0.024	-0.472	**-0.671**	0.753
Culture differences		0.224	-0.508	-0.144	**0.530**	0.772
Eigen values		2.958	2.08	1.648	1.448	
Cumulative percentage		15.567	35.192	49.616	61.72	
Kaiser-Meyer-Olkin Measure of Sampling Adequacy			0.619			
Bartlett's Test of Sphericity	Approximate Chi-Square		265.504			
	Degrees of freedom		136			
	Significance		0.0000			
Reliability Statistics, Cronbach's alpha			0.705			

Extraction Method: Principal Axis Analysis.

Rotation Method: Promax with Kaiser Normalization.

In total, 27 variables relating to SWOTs of the FAP were included in the factor analysis with Promax (Oblimin) rotation. The analysis yielded four factors explaining 61.72% of the variance of the entire set of variables. Factor 1 was labelled Strength (S), due to higher loadings by the following items; timely feedback by students, increase in farm yields, increase in food security and higher responsiveness by students. This factor explained 15.56% of the variance. The second factor derived was labelled Opportunity (O). This was due to the correlation of the following variables; increased technology awareness, increased technology access, increase in farm efficiency and increased farmer linkages. This factor explained 19.63% of the variance.

The third factor was labelled Weaknesses (W) after the following variables loaded robustly; interpersonal challenges, Mismatch of student skills to the farmers' needs and expectations, and at times timing of the farm attachment could be unfavourable (drastic climate variability and drought). Weaknesses explained 14.42% of the variance. Lastly, the fourth factor was labelled as Threats (T) as the highest loadings included: short attachment duration, high costs of student accommodation, and cultural differences. The variance explained by this factor was 12.10%.

Table 7: The SWOT Matrix of the programme

Strengths	**Weaknesses**
• Timely feedback by students to farmers • Increased farmer linkages • Food security (diversification of food crop production) • Higher responsiveness by students	• Interpersonal challenges • Mismatch of student skills • Short attachment duration
Opportunities	**Threats**
• Increased technology awareness • Increased technology access • Farm efficiency • Increase in farm yields	• Unfavourable timing of the farm attachment (Drastic climate variability and drought) • High costs of student accommodation • Cultural differences

4.1.1 Strengths

4.1.1.1 Timely Feedback by students

Nearly half, 48% of the farmers in the programme felt that the students gave prompt response and solutions regarding the challenges that arose. The traditional top-down extension services as asserted by Nambiro *et al*. (2006), extension agents would assess farmers' situations in time but take relatively longer before responding back to the farmers. On the other hand, students worked hand in hand with farmers to give them real-time solutions and suggestions for implementations. This arrangement, therefore, makes it easier to monitor the proposed recommendations after which if not effective, the necessary adjustments are effected before farmers committing substantial resources.

4.1.1.2 Increase in farm yields

Notably, majority of the farming households in Sub-Saharan Africa are smallholder, profoundly affected by climatic and non-climatic shocks, traditional farming techniques, and policy inconsistencies (Muyanga and Jayne, 2006). As a consequence, farmers in the region have been trapped under low agricultural productivity circle. the programme was designed to address the challenge of low productivity through the introduction of appropriate technological solutions.

Approximately 60% of the farmers in the programme perceived that they had largely benefitted from the direct interaction with students in terms of farm output relative to the previous years. They said that this arrangement gave them an opportunity to experience both the practical and theoretical knowledge gained by students in their curriculum. Through this interaction, farmers were introduced to science and technology such as soil testing, improved seed variety, improved breeds and improved agricultural techniques.

Consequently, students from the institution are technically equipped and imparted with these techniques and information, thereby transferring the same to the farmers. Farmers attributed the significant increase in their farm yields to the new techniques and practices introduced by the students. In a similar arrangement undertaken by extension agents, Uaine *et al*. (2009) echoes similar sentiments that extension agents transfer the knowledge and techniques gained through specialized agricultural related training, conferences and seminars attended. Similarly, Lyne *et al.* (2017); Hamilton and Hudson (2017) found that agricultural extension and advisory services have positive impacts on farm output and earnings.

Increase in farm yields could allude that new technologies ensures that farmers utilize their resources efficiently optimizing their yields. Furthermore, farmers predicted that their output will remain high as the students engaged them in all the phases of the technical implementation. According to Lavison (2013), when farmers articulately understand the specific operations to undertake to curb production inefficiencies in their farm, they become more innovative in curbing occasional farm challenges.

4.1.1.3 Food security

Approximately 27.7% of the Kenyan population according to FAO *et al*. (2015) is worryingly undernourished. After explaining to the farmers what food security entails (state of having reliable access to a sufficient quantity of nutritious food), 21% of the farmers indicated that the programme had significantly made them food secure. The farmers attributed this status to the new agricultural technologies and practices like diversification of agricultural enterprises introduced by students on attachment. This ensured that farmers had a variety of agricultural products, which were not only economically beneficial but also met their dietary needs and food preferences. More than half of the farmers, 54% confirmed that in as much as they produced to maximize output and therefore profit, they diversified the farm production capacities to meet their dietary needs.

4.1.1.4 Higher responsiveness by students

About 57% of the farmers in the programme observed that students responded promptly to the challenges that arose on the farm by giving real-time solutions. The timely reaction saved them from incurring heavy losses and expenses as problems on the farm were dealt with in their earlier stages. This was possible since the students were available on the farm throughout the entire attachment period. An aspect that made the farmers rank this arrangement higher than the extension services provided by the ministry of agriculture (Terblanché, 2008). This could be attributed to the fact that the students worked hand-in-hand with farmers ensuring that the farmers understood when and how they should react to farm issues. Furthermore, the farmers also reaffirmed that the programme availed unprecedented opportunities in form of technological solutions to overcome the time-to-time challenges experienced on their farms (Ragasa, 2014).

4.1.2 Weaknesses

4.1.2.1 Mismatch of students' skills to farmers' expectations and needs

Farmers had high expectations from the programme, and therefore, the students. This did not dawn well on a section of farmers as 13% were dissatisfied with the technical skills and advisory capabilities of students. This could be attributed to the enterprise specificity among some of the farmers in the programme.

Majority of the farmers who were dissatisfied with the students' abilities, 77.54% undertook only one agricultural enterprise, either livestock farming or horticulture. For instance, if a student from the department of crops, horticulture and soils is taken to a farmer specializing only in livestock activities, there is a higher likelihood of such a student struggling to meet the expectations of such a farmer. A similar scenario is possible when a student from the department of animal science and veterinary science is attached to a farmer who has specialized in crops. However, this challenge can easily be addressed by succinctly reviewing the enterprises undertaken by different farmers before attaching students. Additionally, the curriculum can be reviewed to entail practical learning to fully equip students with technical farm knowledge.

4.1.2.2 Interpersonal challenges

In terms of interpersonal relationship with the students, 16% of the farmers indicated that they experienced interpersonal challenges with students. This ranged from communication challenges, staple food, tradition, beliefs and gender. This could be explained by the conventional admission of students from different parts of the country with different ethnical backgrounds diverse cultural and traditional beliefs by the University. As a result, differences in the local languages between the farmers and students could result though not to a large extent, to communication barrier.

Diverse cultures and traditions could mean that the types of cuisines in the places of attachment could not be what the students are used to, making it hard for them to adjust. This made a number of farmers to propose that students brought for attachment should look for places of residence during the attachment periods and only avail during the day for farm work responsibilities. Furthermore, some farmers indicated that there were abrasions between the students and the workers on the farm with some workers feeling that they were more conversant with farm challenges and therefore, operations as compared to the students. Hence, making it hard to implement some of the interventions brought by the students.

A number of farmers especially those in cooperatives and SACCOs claimed that there were instances of abrasions between employees and the students. They attributed the abrasions to the potential threat that students posed to their position due to inferior qualifications relative to the students. As a result, there were instances of reluctance among the full-time employees in disclosing pertinent information to the students. A similar experience was reported in a study conducted on Distance Learning (ODL) in Zimbabwe by Bukaliya (2012), where abrasions between fulltime employees and interns militated the effectiveness of the internship programme besides employers treating interns as sources of cheap labour and temporary solutions for shortfalls in the industrial labourers.

4.1.2.3 Unfavourable timing (Attachment during off-season)

A section of the farmers (15%), observed that the periods during which they received students, the weather was unfavourable making it hard to undertake most of the interventions proposed by students, particularly agronomic practices, as they were weather-dependent. Most of the farm activities or enterprises undertaken by farmers in Nakuru and Baringo counties are weather depended. The primal activities undertaken by the farming households in the programme are agronomy and dairy farming. Majority of these farmers indicated that they received students mostly in September and January when the climate was not favourable, particularly for farmers who were not practising irrigation to benefit from the technological solutions and interventions introduced by students. Consequently, this minimized the overall benefits that farmers could have instead accrued from the interaction making the FAP not as effective as it could have otherwise been. This conformed to the assertions by Kibett (2011), who reported that agricultural activities in Sub-Saharan Africa are undermined by adverse climatic and weather shocks.

4.1.3 Opportunities

4.1.3.1 Increased technology awareness and access

Since students had been exposed to new and improved production techniques through their class and practical sessions at the university, 67% of the farmers in the programme indicated that students had introduced them to new agricultural technologies and practices. Farmers expressed their satisfaction with the programme's commitment to the free flow of agricultural information, training and retraining programmes through students on attachment. Majority of the farmers in the programme agreed that students' interventions and solutions enhanced their innovative capacity regarding their production activities. This conformed to the assertions of

Uaiene *et al*. (2009); Lavison (2013); Mwangi and Kariuki (2015) who claimed that technology enables farmers to transform their routine traditional practices through enhanced innovative capacity.

Majority of the farmers, 70% claimed to have been introduced to; new animatics, new agronomic practices, crop rotation, intercropping, relay cropping, tillage management, chemical innovations, strip growing, improved seeds, soil and water conservation, artificial insemination, silage management, new pests and disease control, new crop varieties and livestock breeds, green house farming and value addition. Majority of these farmers felt that the programme had presented them with the opportunity to access technologies that they had not been initially exposed to or used but failed due to inadequate knowledge and technological know-how of efficiently articulating them.

4.1.3.2 Increase in farm efficiency

Majority of farmers in the programme indicated that their mentality towards farming had been changed after their interaction with students. Approximately 51% of the farmers felt that students had compelled them to treat their farms as systems that needed to be evaluated regularly and upgraded in terms of new agricultural practices, including recording keeping. They pointed out that they had been introduced to new practices that not only minimized agricultural costs of production but also increased output and revenue per unit of inputs invested. This made them perceive farming as a self-sustaining and profitable enterprise.

Moreover, the farmers indicated that the programme was effective in assisting them to reduce the cost of labour incurred in the day-to-day farm operations. The students assisted in farm evaluation and planning, making majority of farmers in the programme to realize that cutting on the number of workers on the farm and contracting them on a daily basis was more economical and effective, saving them significant amounts of money that they channelled in other activities on the farm. Farmers attributed the efficiency on their farms to their mutual participation in the programme as they were able to learn and be incorporated in every stage of intervention at the farm level. As a result, farmers learned more from the students. This could translate into a more sustainable and long-lasting changes both at the farm level and in the overall behaviour of the farmers (Wandji *et al*., 2012).

4.1.3.3 Increased farmer linkage

Not all farmers from the two counties received students. Therefore, they shared the students particularly those in groups and in co-operative societies with students moving from the host

farmers to other farmers to also assist them. Majority of the farmers attested that initially, they could hardly access their neighbours' farms and exchange ideas on agricultural matters as many feared for duplication of their farming strategies and ideas. However, with the dawn of the programme, students were could reach out to a number of farmers in the same vicinity. As a result, farmers started interacting and visiting each other's farms to see what the students had done, particularly those that were not in the programme.

As a result, a number of farmers started sharing ideas and experiences, a move they indicated had jointly improved their farming practices. Furthermore, this interaction according to farmers increased their urge to link up with other agricultural stakeholders particularly credit providers, input providers, the ministry of agriculture, extension agents, agricultural co-operatives and other marketing agencies. This outcome as asserted by farmers enhanced their agricultural production throughout the chain as it fostered linkages between farmers and other pertinent agricultural stakeholders.

4.1.4 Threats

4.1.4.1 Insufficient attachment duration

Approximately 66% of the farmers in the programme reported that the period allocated for attachment (8 weeks) was too short citing that it elapsed before majority of the specific projects that had been initiated by students came to completion. As a consequence, farmers were at risk incurring losses especially if left without guidance for the remaining phases of the projects introduced. This compelled a number of farmers not commit their resources with fears of failure due to the project initiators and implementers leaving early. Besides, farmers indicated that trainings introduced by the students were very beneficial although, short-lived. This was a problem particularly to the farmers who were members of co-operative societies and groups as they reported to have shared a student(s) therefore, increasing the demand for the programme in the two counties. Bukaliya (2012) emphasized that the duration that has been allocated for attachment in different disciplines is insufficient both for the students and their potential employers.

4.1.4.2 High costs of student accommodation

About 46% of the farmers felt that hosting a student(s) was expensive. Since majority of the farmers resided far from the university, they had to host them on their farms. The farmers posited that since these students were instrumental in technological interventions and solutions on their farms, they were independently and personally obliged to support them

during their stay on the farms. The support according to the farmers and students was in terms of food, shelter, fare, stipend and at times talk time among other necessities. Some farmers pointed out that they had to give the students special treatment to maintain a healthy and positive relationship with the university in addition to the great assistance these students were offering on their farms. As an effect, some farmers suggested that the University should provide accommodation and financial assistance to the students to relieve them off some burden during the attachment period.

4.1.4.3 Cultural differences

With the University admitting students from all walks of life, 30% of the farmers found cultural diversity a challenge since farmers do not have the sole option of choosing the student(s) to be attached to them based on religion, gender and place of origin among other factors. Cultural diversity according to farmers was both a positive and negative challenge or experience. On one side, it provided the opportunity to learn and appreciate other peoples' culture and tradition (way of doing things and beliefs) particularly those that seemed friendly and appealing. Diametrically, some of the farmers indicated that other cultures put on show by some students were unappealing, making it hard to accommodate such students.

4.2 Determinants farmer perception towards farm attachment programme

4.2.1 Confirmatory factor analysis and perception parameters

Before the profiling of the ordered logit model, a farmer perception index was generated using a Confirmatory Factor Analysis (CFA) model from four latent parameters that included; the relevance of the information by the students, their responsiveness to farm challenges, their knowledge on agricultural issues, and their technical advisory ability. The parameters were measured using a Likert scale each consisting of four Likert items. To get the combined effect of the four parameters, the generated factor loadings were weighted by principal component factoring (PCF) to test for internal consistency and validity (Olsen *et al.*, 2017).

Upon PCF on the four parameters, an inter-parameter covariance of 0.1591 and a scale reliability coefficient of 0.6221 was obtained, indicating that there was no overlap in variance, thereby warranting orthogonal varimax rotation (Brown, 2009; Olivier *et al*., 2018). A mean of 3.068 with a standard deviation of 0.522 was obtained as presented in Table 8. To determine the fitness of the CFA, and the adequacy of the sample, Bartlett's Sphericity and Kaiser-Meyer-Oklin (KMO) tests were conducted and a chi-square of 73.231 with a

corresponding p-value of 0.000 and a KMO of 0.657 obtained, thereby rejecting the null hypothesis that the parameters were inter-correlated (Brown, 2009).

Table 8: Factor Analysis for the farmer' perception index

Constructs	Items	Factor loadings	CR	AVE
Relevance	Rating of the information delivered	0.37		
Responsiveness	Rating of the students responsiveness	0.71	0.62	0.49
Knowledge	Rating of the students' knowledge	0.82		
Advisory ability	Rating of the students technical advisory ability	0.85		

Note: CR; Composite reliability, while AVE is the Average variance extracted

Furthermore, the validity and reliability test as asserted by Hauben *et al.* (2017); Olsen *et al*. (2017), indicated that CFA was suitable for further analysis. The factor loadings were then weighted to calculate the perception index by summing the factor loading of each parameter by the total number of responses for each category. The generated index was then classified and scaled as; "Less effective" for a mean range of 1 - 1.60, "Neutral" for 1.61 - 2.40, "Effective" for 2.41 – 3.20, and finally 3.21 – 4.00 for "Very effective". An ordered logit model was then performed to determine the factors influencing the farmers' perception.

Table 9: Farmers' perception towards FAP (N = 100)

Perception	Proportion	Mean Weight	Std. Dev.
1 = Very ineffective	15	1.300	0.548
2 = Ineffective	22	2.005	0.492
3 = Effective	27	2.805	0.480
4 = Very effective	36	3.605	0.439

Note: Perception statement was rated on Likert based scale of 4: *1 = Very ineffective, 4 = Very effective*.

Of the farmers in the programme, 36% (n = 36) declared that the programme was very effective in enhancing their agricultural production through improved agricultural technologies. Twenty-seven percent perceived it effective the rest felt it was ineffective. Majority of the farmers, 63% (n = 63) said that the recommendations given by the students were in line with their expectations and were efficient in addressing the challenges they faced in the past. Farmers also indicated that the students' responsiveness to farm challenges was timely and successful in combating challenges that occurred in the course of their interaction. This, enabled farmers to highlight the areas where they were going wrong. Majority of them

indicated before interacting with the students, they could wait for a problem to persist before they could seek for appropriate measures and strategies.

4.2.2 Factors influencing farmer perception towards FAP (Ordinal Logistic estimates)

With farmer perceptions ordered sequentially, an ordered logistic model was used to show the effects of a set of independent variables on the perception that farmers had towards FAP.

4.2.2.1 Statistical tests and specification diagnostics for Ordered Logit regression model

With cross-sectional data majorly associated with problems of multi-collinearity and heteroscedasticity, preliminary tests and diagnostics, including the Variance Inflation Factor (VIF) and pair-wise correlation (pwcorr) were performed to ensure data compliance and consistency. Multi-collinearity according to Faggion *et al*. (2014), is a state of moderate or high inter-associations among the predictor variables resulting into poor reliability of the statistical inferences made about a given dataset. VIF and pair-wise correlations were performed to test for the presence of higher interdependencies and associations among the continuous and categorical predictor variables respectively. VIF is used to determine the precision of estimation in a regression model by expressing the extent to which the interdependence among the explanatory variables degrades the precision of the model estimate (Kavzoglu *et al*., 2014).

By the rule of thumb, VIF values above 5 in a model indicates the presence of high interdependence among the predictor variables of a regression model (Faggion *et al*., 2014; Kavzoglu *et al*., 2014; Akinwande *et al*., 2015). VIF values above 10 indicate poorly estimated regression coefficients. The VIF results for ordinal logistic regression model used to determine the factors influencing farmers' perception towards the FAP are presented as shown in Table 10.

Table 10: VIF test for continuous predictors in the Ordinal Logistic Regression Model

Variable	VIF	1/VIF
Age Sq.	4.92	0.203167
Age	4.83	0.207076
Number of Agric. Training	2.99	0.334177
Number of Extension contacts	2.64	0.379454
Asset Value	1.71	0.583469
Land size	1.50	0.667749
Household size	1.29	0.774681
Years of schooling of the H/H	1.26	0.793943
Number of attachment cohorts	1.20	0.834539
Mean VIF	2.48	

The mean VIF as presented in Table 10 was 2.48, indicating that there was no strong association among all the continuous predictor variables in the ordered logit model premised on the rule of thumb as all the VIF values were less than 5 (Mutale *et al*., 2017).

Diametrically, a pair-wise correlation was conducted for the categorical variables to test for multi-collinearity and the results as presented in Table 11 indicated that the categorical variables were also not highly interdepended. By the rule of thumb, values above 0.7 in a pair-wise correlation indicate higher levels of correlation among the categorical variables used in predicting a regression (Vu *et al*., 2015; Heit *et al*.,2017). Premised on the results presented in Table 11, the proposed explanatory variables exhibited values lower than the threshold 0.7, indicating absence of any problem involving two or more covariates used in the model. Therefore, all the potential predictor variables were retained for the execution of an ordered logit regression model to determine the specific factors that influenced farmers' perception towards the programme.

Table 11: Pair-Wise coefficients for categorical variables in the Ordinal Logistic Model

	Sten	Sfert	Slope	Gender	Poccup	Offmact	Nhost	Exten	Atrain	Creditacc	Grpmemb
Sten	1.0000										
Sfert	-0.0173	1.0000									
Slope	-0.1187	-0.5742	1.0000								
Gender	0.0738	-0.0188	0.0476	1.0000							
Poccup	-0.0949	0.0196	-0.1105	0.0094	1.0000						
Offmact	-0.0701	-0.1974	0.1255	0.1287	-0.3249	1.0000					
Nhost	-0.1134	-0.0543	-0.0096	0.0178	-0.1040	0.0370	1.0000				
Exten	-0.1803	0.0082	-0.0289	-0.0375	-0.1416	0.1874	0.1377	1.0000			
Atrain	-0.0103	0.1369	-0.0870	-0.0327	-0.1369	-0.0569	-0.0572	0.1543	1.0000		
Creditacc	-0.2019	0.0074	-0.1045	-0.0321	-0.0825	0.0197	-0.2238	0.1622	0.1734	1.0000	
Grpmemb	0.1349	0.0427	-0.0167	-0.0793	-0.2012	0.0936	-0.1457	-0.0385	0.1633	0.1070	1.0000

Note: Sten=security of tenure, Sfert=soil fertility, Poccup=primary occupation, Offmact=off-farm activities, nhost=Number of times a farmer has hosted student(s), Exten=access to extension services, Atrain=access to agricultural training, Creditacc=Access to credit, Grpmemb= Group membership

Maximum likelihood method was used to estimate the ordered logistic model. From the test results presented in Table 12, the model coefficients (cut1, cut2, cut3, and cut4) were -3.5120, -1.9997, 0.3439, and 2.6373. The log likelihood of the fitted model was -96.9251 implying that the model converged and predictors used in the regression were significantly different from zero. The number of observations as indicated by the ordinal logistic regression results were 100 indicating that all the respondents gave their perception of the programme. Furthermore, the log likelihood Chi-square (LR $Chi^2(21)$) was 94.14 indicating that all the parameters were jointly significant at 1% therefore, the model had a good fit. The McFadden's Pseudo R-squared (Pseudo R^2) was 0.3269 indicating that the explanatory power of the model was stronger as it was above the statistical threshold value of 20% as asserted by Henser *et al*. (2005); Srisopaporn *et al*. (2015) further confirming that the perceptions of the farmers towards the programme were ascribed to the covariates considered in the model.

The results indicate that among the 17 hypothesized predictor variables used in the model, nine were found to significantly influence farmers' perception towards the programme. These included age squared, off-farm income, household size, security of tenure, soil fertility, the slope of the land, number of agricultural training attended in a year, credit access, and Student's knowledge on agricultural issues. Among these nine variables age squared, household size, security of tenure, soil fertility, the slope of the land and students' knowledge on agricultural issues were positively associated with farmers' perception towards the programme while the remaining three variables had a negative association as shown in Table 12.

Table 12: Factors influencing farmer perception towards FAP (Ordinal Logistic estimates)

Variable	Coefficient	Std. Error	p>|z|
Household characteristics			
Gender	0.0994	0.4949	0.841
Age	-0.0121	0.0436	0.780
Age Sq.	0.1439***	0.0517	0.005
Years of Schooling	-0.0169	0.0791	0.831
Off-farm income	-0.4771**	0.2372	0.044
Household size	0.1167*	0.0657	0.076
Plot Characteristics			
Security of tenure	1.7631***	0.6321	0.005
Soil fertility			
Medium	-1.3940***	0.5360	0.009
High	-2.5583***	0.7102	0.000
Slope			
Medium	1.2026*	0.6740	0.074
Steep	1.9644**	0.9241	0.034
Land size	0.0309	0.0337	0.358
Institutional characteristics			
Extension contacts	0.0267	0.0203	0.184
Number of Agric. Training	-0.1358**	0.0672	0.043
Credit access	-0.9029*	0.5293	0.088
Group membership	-0.4979	0.9022	0.581
Student characteristics			
Number of hosts	-0.1082	0.1720	0.529
Student responsiveness	-0.7474	0.5364	0.164
Student's knowledge	0.5928*	0.3362	0.078
Student advisory ability	-0.4593	0.3837	0.231

Ordered logistic regression	Number of obs	=	100
	LR $Chi^2(21)$	=	94.14
	Prob > Chi^2	=	0.000
Log likelihood = -96.9251	Pseudo R^2	=	0.3269

Note: ***, **, *, = significance at 1%, 5% and 10% respectively

Age squared had a positive and significant effect on farmers' perception towards the programme at 1% level of significance. However, the result is interpreted with caution since the coefficient is polynomial with an inverse U – shape. The coefficient of age was negative while that of age squared was positive. This implied that as age of the farmers in the programme increased, their corresponding perception to incorporate and invest in the technological solutions proposed by the students also increased. This could imply that young farmers are constrained by resources and therefore, less likely to implement the recommendations introduced. On the other hand, the perception of older farmers could be

associated with their experience in farming hence, capable of evaluating the usefulness and benefits associated with the programme premised on their past experiences, thereby guiding their perceptions. Likewise, since older farmers are unbridled by resources as asserted by Baloch and Thapa (2016), they are more likely to incorporate the interventions introduced, therefore, experiencing the envisioned benefits and changes by FAP. This finding was contrary to expectations as either side of the farmers in the programme was expected to perceive the programme more effective. This is because younger farmers have a tendency of being less risk-averse, more innovative, and flexible compared to the older farmers (Etwire *et al*., 2014). Furthermore, younger farmers are expected to demand the programme more in order to compensate for their shortfalls in farming experience and knowledge.

Regarding participation in off-farm activities, there was a negative and significant relationship between off-farm income and perception at 5% level of significance. It could be that farmers participating in off-farm activities have limited time for agricultural activities and possibly farming is a secondary economic activity to them. As a result, there is no motivation to seek and adhere to the interventions of the programme. Furthermore, there is a higher likelihood that the time frame during which students assess the farm and come up with suitable interventions and solutions coincides with the off-farm activities rendering the household heads incapable of meeting the students regularly. For this reason, these farmers end up benefiting partially or not at all hence, the negative perception. Gido *et al*. (2014), notes that income creates competition for time allocated to agricultural activities, thereby reducing family labour and time of farmers interacting with extension agents. However, Asante *et al*. (2011); Etwire *et al*. (2014) found a positive relationship between farmer perception and agricultural programmes which they attributed to the inputs and new farming techniques that farmers were introduced to.

There was a positive and significant influence of household size on perception towards FAP at 10% level of significance. This implies that farmers are more likely to perceive the programme more effective with an increase in the household size. Households with larger sizes are more likely to have sufficient labour to undertake the interventions proposed due to the labour-intensive nature of the practices introduced. There is no unanimity among researchers on the role played by household size in influencing the farmers' perception towards agricultural programmes. For instance, Etwire *et al*. (2014), found that households with more human capital are more likely to adopt new labour-intensive technologies, hence increase in their perception as opposed to households with less. However, Muhammad *et al*.

(2015) found a negative relationship and argued that increase in family size increases the household budget allocation on essential goods like clothing and food reducing the amount of money available for investing in technological solutions.

Security of land tenure, this is the legal regime through which farmers own land with the certainty of inducing long-term investments on the farm. The results indicate that security of tenure had a positive and significant relationship with farmer perception towards the programme at 1% level of significance. This implies that owning land title is likely to increase the perception that farmers have towards the programme. Farmers with title deeds tend to seek and incorporate more technical advisory services from the programme than their counterparts. This could be ascribed to the fact that security of tenure augments farmers' desire to invest in long-term projects. As a result, these farmers are more interested in the solutions provided by the programme, therefore, perceiving it more effective as compared to their counterparts. Diametrically, lacking access to the security of land is more likely to reduce the interest of farmers in investing in long-term innovative technologies introduced by the students, therefore, farmers with no full access and authority to land utilization will not be in a position to incorporate long-term technological intervention, thus benefiting less as compared to their counterparts.

Regarding the fertility status of the soil, the farmers' perception towards the fertility status of their soil was ranked into low, medium and high. The low fertility status was treated as a reference category in the ordered logit model. The results indicate that soil fertility had a negative and significant effect on the farmers' perception towards the programme at 1%. Premised on the results, farmers with less fertile plots were more likely to perceive the programme as effective compared to their counterparts. This could imply that farmers whose plots were less fertile were introduced to technologies and interventions that aimed at replenishing or improving the fertility status of their plots as compared the farmers whose plots were fertile.

Regarding the slope of the main agricultural plot, slope was ranked into gentle, medium and steep gradients. Gentle slope was then treated as a reference category. The results indicate that slope of the main plot significantly influenced the perception of the farmers towards the programme positively. A medium slope positively influenced the perception of the farmers towards the programme at 10% while a steep plot at 5%. This implied that farmers' perception increased with the gradient of the slope of their main agricultural plot. The

implication of this could be that students introduced soil and water conservation practices to farmers whose plots were steeper to counter the effects of soil erosion as compared to those who were located on gentler slopes. To this effect, farmers whose main plots were located on steeper gradients as argued by Moges and Taye (2017) would acquire more interventions related to soil and water conservation practices, techniques of implementation, and maintenance in comparison to their counterparts.

A negative and significant relationship at 5% was found between the number of agricultural related training and the perception held by farmers towards the programme. The negative relationship implies that as farmers' exposure to training increases, their knowledge and awareness on appropriate interventions to be undertaken on the farm increases. As a result, farmers are likely to be equally knowledgeable and therefore, likely to be aware of the interventions that students introduce to them, thereby not meeting their level of expectations. Furthermore, most agricultural trainings are likely to have similar components as those of the farm attachment programme, therefore, introducing the farmers to little or no new technologies at all. In addition, according to Tafese (2016), this could be attributed to the quality, type and timing of the training farmers had been exposed to. This result contradicts that of Moges and Taye (2017), who established a positive and very significant ($p<0.01$) relationship between farmers' motivation to invest in soil and water conservation measures introduced and their participation in agricultural training.

With regard to credit access, there was a negative and significant effect between credit access and farmer perception towards the programme at 10%. This means that farmers access to credit is likely to affect the perception they have towards the programme negatively. This could be ascribed to the negative effect associated with the risk averse behaviour of farmers in the programme. Risk evasiveness is likely to arise due to the high cost of accessing credit from financial institutions imposed especially on smaller loans to cater for adverse selection associated with small-scale farmers. As a result, farmers may become reluctant to risk their collateral to risky innovations by allocating debt capital advanced to them in form of loans. This reduces their purchasing and investment power, since technological solutions are capital intensive in nature, farmers are likely to invest less or not at all, making them to have minimal benefits from the programme, hence reduced perception. Therefore, if the social costs associated with credit are low, farmers are likely to seek for credit to undertake the interventions of the programme and as a result, they are likely to benefit more. This means that the debt servicing requirements of the credit advanced to the farmers is a motivating

factor for farmers to seek knowledge and enhanced technologies from the technically equipped students to increase their productivity. These results tally with those of Diiro and Sam (2015), who found a negative relationship between receipt of credit and adoption of improved seeds which they attributed to the risk evasiveness nature of farmers and high cost of servicing debt capital. However, the results are inconsistent with the findings of Gido *et al*. (2014) who argued that credit access enhances the farmers' purchasing power and ability to meet the transactions costs involved in agricultural production.

In line with expectations, farmers' perception of the programme was positively influenced by the students' knowledge on agricultural issues at 10% level of significance. The implication of this is that farmers are only motivated to incorporate the interventions proposed by the students they thought were knowledgeable on agricultural issues. Knowledgeable students are likely to more technically equipped and conversant with agricultural aspects on the farm, therefore, are more likely to make meaningful interventions on the farm. As a result, they are more likely to convince the farmers to invest in a number of practices compared to those who seem less knowledgeable, hence farmers are more likely to have a positive attitude.

4.3 Determinants of student perception towards FAP

Students' perceptions were determined based on a number of parameters. This included; Time since attachment, discipline of study, the programme enrolled, student's involvement in agricultural activities outside college, university preparation, support during attachment, number of contacts with extension agents during attachment, farmers' knowledge on agricultural issues, and career expectation. The results as presented in Table 13 indicates that majority of the students attached in the programme, 40.79% perceived the programme as effective while 36.84% felt the programme was very effective. Only 22.38% of the students felt the programme was ineffective.

Table 73: Students perception towards FAP (N = 152)

Perception	Frequency	Proportion
1 = Very ineffective	6	3.95
2 = Ineffective	28	18.43
3 = Effective	62	40.79
4 = Very effective	56	36.84

4.3.1 Statistical tests and specification diagnostics for Ordinal Logistic regression model

To ensure compliance and consistency of the data, pre-estimation tests and diagnostics including the VIF, pair-wise correlation (pwcorr), and white test were conducted to test for multi-collinearity and heteroscedasticity respectively. The VIF and pairwise results are presented in Table 14 and 15. Accordingly, the results indicated an overall VIF of 1.14. Two variables, students' place of resident categorized into a dummy of either rural and urban was correlated with the main occupation undertaken by the students' parents with a coefficient value of 0.79 which is above the accepted threshold of 0.7 (Vu *et al*., 2015; Heit *et al*., 2017). As a result, these two variables were dropped from the ordered logit model. On the other hand, all the VIF values were less than 5 which premised on the rule of thumb as argued by Mutale *et al*. (2017), indicated that there was no strong association among the continuous predictor variables used in the ordered logit model. Consequently, all the potential predictor variables were retained in the of ordinal logistic regression to determine the specific factors that influenced students' perception towards the programme.

Table 14: VIF test for continuous predictors in the Ordinal Logistic Regression Model

Variable	**VIF**	**1/VIF**
Number of years since attachment	1.19	0.8390
Age of the student	1.17	0.8540
Number of contact with extension agents	1.05	0.9552
Mean VIF	1.14	

Table 15: Pair-Wise coefficients for categorical variables in the Ordinal Logistic Model

Variable	Programme	Faculty	Gend	AgricPart	Uni_Prep	Support	Fknowldge	Career Expect	Extension
Programme	1.0000								
Faculty	-0.0980	1.0000							
Gender	-0.0737	0.1657	1.0000						
Agric_Part	0.0834	-0.0386	-0.0523	1.0000					
Uni_Prep	-0.0131	0.1291	0.0681	0.0129	1.0000				
Support	-0.0045	0.0854	-0.0244	-0.0058	-0.0336	1.0000			
Fknowldge	0.1819	0.0590	-0.0525	-0.1286	-0.0530	-0.0473	1.0000		
Career Expectetion	0.1061	0.0377	0.0444	-0.1061	-0.0109	0.2656	-0.0030	1.0000	
Extension	-0.0350	0.1174	0.0201	0.0087	-0.0084	0.0920	0.0582	0.1743	1.0000

The ordered logit results are presented in Table 17. The model coefficients included four values (cut1, cut2, cut3, and cut4), 1.6287, 2.8448, 4.9387 and 8.1786 respectively. The log likelihood of the fitted ordered logit model was -133.4122 indicating that the model converged with the predictors used in the model significantly different from zero. The number of observations as shown in the ordered logistic regression results were 151 indicating that only one respondent failed to give his or her perception of the FAP.

The likelihood ratio (LR $Chi^2(21)$) was 119.41 with a corresponding p-value of 0.000 indicating that all the parameters were jointly significant at 1% further confirming that the model had a good fit. The statistical significance of the likelihood ratio corroborated that ordered logit model was suitable for the data and therefore, according to Zulfiqar and Thapa (2018) the null hypothesis was rejected implying that the significant variables sufficiently accounted for the perceptions held by students towards the programme. The McFadden's Pseudo R-squared (Pseudo R^2) was 0.3092 indicating a strong explanatory power of the model as it was above the statistical threshold value of 20% as posited by Henser *et al.* (2005); Srisopaporn *et al.* (2015). As a result, the perceptions of the students towards the programme were ascribed to the covariates used in the model. To determine the effects of unequal error variance in the data, a Cameron and Trivedi's white test was performed. This test was preferred as it incorporates both magnitude and direction of change for non-linear forms of unequal variances therefore, overcoming the weaknesses of Breusch-Pagan test that only detects linear forms of heteroscedasticity (Williams, 2015). This test is a special case of the Breusch-Pagan test that aims at relaxing the assumption of normally distributed errors. The results as presented in Table 16 indicated insignificant levels of unequal variance as a Chi^2 of 16.95 was insignificant.

Table 16: Whit-test for Heteroscedasticity

Source	**Chi^2**	**df**	**P**
Heteroscedasticity	16.95	9	0.0495
Skewness	4.95	3	0.1756
Kurtosis	14.47	1	0.0001
Total	36.37	13	0.0005

As presented in Table 17, the results indicate that among the 15 hypothesized explanatory variables used in the model, eight were found to significantly influence the perception that

students had towards the farm attachment programme. Of the variables significantly influencing students' perception towards FAP was influenced by students' involvement in agricultural activities outside college, time since a student was attached to the programme in years, faculty enrolled, the number of times a student had contact with extension agents, the knowledge of the farmer a student was attached to on agricultural issues and career expectations of a

Table 87: Factors influencing students' perception towards FAP (Ordered Logit estimates)

Variable	Coefficient	Std. Error	p>|z|
Age	-0.1852	0.0998	0.150
Student's gender	0.2203	0.3795	0.562
Faculty	0.6359*	0.3694	0.085
Programme enrolled	1.3042**	0.5876	0.026
Time since Attachment in years	0.4267***	0.1185	0.000
Residential place	0.6507	0.4994	0.193
Part. in Agric. Activities outside college	-1.9738*	1.0530	0.061
University preparation	0.4856**	0.1922	0.012
Support during attachment	-0.3955	0.4646	0.395
No. of extension contacts	0.2498***	0.0680	0.000
Farmer knowledge on agriculture	0.3936***	0.1517	0.009
Programme effect	0.3054	0.2028	0.132
Career expectation	1.4043***	0.2535	0.000
Ordered Logistic regression		No. of obs =	151
		LR Chi^2 (21) =	119.410
		Prob > Chi^2 =	0.000
Log likelihood = -133.4122		Pseudo R^2 =	0.3092

Note: ***, **, * significant at 1%, 5% and 10% probability respectively

Regarding the programme, the student had enrolled to (either degree or diploma), a positive and significant relationship was established with students' perception of the programme at 5% level of significance, implying that degree students were more likely to perceive the programme as more effective compared to their counterparts. Regarding the technical and practical aspects, degree students are more likely to be have gained hands-on experience that they initially did not have. Diploma students are mostly considered to have more hands-on experience due to their exposure to more farm practicals. As a result, degree students were more likely to be exposed to new farm experience that their counterparts could have already been exposed to, hence benefiting more from the programme.

The effect of time since attachment was found to be positive and significant at 1%. The implication is that the longer the time since attachment, the more effective a student is likely to perceive FAP. This could allude to the exposure to the job or demands of the job market. As an effect, they realize the relevance of the programme to their careers. Students who have been exposed to the job market could have realized that the experiences or environment in the job market is similar to the conditions they were exposed to at the farm level during attachment. Moreover, they could have realized that the skills, knowledge and technical advisory services they gained during their interaction with farmers were relevant and in line with the industry and or real-world expectations. This could be pertinent to reducing reality shocks in the job environment. Furthermore, with the explorative nature of students to check through the market requirements as they plan for their careers, students could have realized that certain positions within their line of professional training could have demanded experience of working with smallholder/medium farmers thus, influencing their perception towards the programme with the reaffirmation of the importance of the programme.

Students' involvement in agricultural activities outside the university indicated a negative and significant relationship with perception at 10%. This suggested that the students who had prior participation or involvement in agricultural activities outside the university were less likely to perceive the programme effective relative to their counterparts who had not participated. A plausible explanation for this could be that the programme may have presented similar experiences as those they had preliminarily been exposed to during their involvement in other agricultural activities. With the objective of every student headed for attachment to gain new skills, knowledge, and exposure to new opportunities, students with prior exposure are likely to feel the FAP has not presented them with an adequate platform to learn new things or chance to superiorly match the demands of the real world. Diametrically, their counterparts are more likely to appreciate the new experiences and opportunities that the programme presented to them, thereby increasing their probability of perceiving the programme effective. On the same note, these students are more likely to learn new things and appreciate the programme for according them a platform to practice and transmit the theoretical and practical knowledge they have gained in their academics at the farm level in their quest to address farm challenges.

In conformity to prior expectations, the perception on how the University had prepared them had a positive correlation with the perceptions held by the students towards the programme at 5%. University preparation is a perception aspect regarding the adequacy of the training

students had received with regard to their technical know-how and foundation in the field agriculture. In light of the results, the adequacy of the training could have had a substantial impact on how the students in the programme were able to impart the knowledge they had acquired in the classroom set-up to real-farm situations. As a result, the ease with which students managed to address the contemporary issues faced on the farm made them have a feeling that the curriculum was very useful and the University had adequately equipped them both theoretically and technically to respond to the challenges that arose at the farm-level. This could further be ascribed to the fact that students may have referred to their academic material and or content to seek guidance in addressing a myriad of issues as they arose on their farm or to curb the pre-existing shortfalls on the farms for efficiency.

Moreover, the number of times students had contact with extension agents had a positive and significant in influencing the perception they had towards the programme at 1% level of significance. This infers that students who were exposed to more contacts with extension agents were more likely to perceive the programme as more effective compared to students who had less or no contacts. This is because extension agents are likely to accord students support that could in turn enhance; the technical advisory ability of students making them effective in imparting their knowledge and recommendations to the farmers, thus effectively addressing the challenges faced by farmers. Secondly, contact with extension agents could support the technical know-how of the students by helping them to effectively integrate theory and practice at the farm level based on the past experience of the extension agents. As a result, contact with extension agents is likely to enhance capacity building through intrinsic motivation making students to value their academics and therefore, refocus on their careers independently. In the process, students understand the responsibilities and demands within their line of specialization as opposed to their initial ideal career plans. As an effect, this softens the reality shock of transitioning from the world of academics to a working set-up. Consequently, this is likely to refine the perceptions of the students towards the programme.

Similarly, farmers' knowledge on agriculture had a positive and significant effect on student perception at 1%. This means that the more knowledgeable a farmer was on agricultural issues, the more likely he or she was to make student(s) attached to them perceive the programme as more effective and vice versa, ceteris paribus. This could allude that knowledgeable farmers are less conservative and less risk-averse, making it easier for a student to pass across the interventions they feel are beneficial and effective in addressing the challenges faced on the farm. Moreover, these farmers are easier to deal with, limiting the

time spend in passing out the content for making the necessary changes on the farm as they are capable of evaluating solutions proposed in different circumstances. Furthermore, such farmers relative to their counterparts are more likely to be aware of technologies or interventions that the student(s) is not aware of, therefore, propagating a mutual relationship by equally equipping the student with new skills and technologies. Therefore, enhancing the classroom learning processes by contributing positively towards their knowledge base through hands-on experience (Bukaliya, 2012).

Career expectation refers to the expected benefits that the students anticipated to gain from farm attachment. The expectation they had from the programme had a positive and significant relationship with perception towards FAP at 1%. This inferred that the more enriching the programme was to the career of the student through new skills and experiences, the more likely they were to perceive the programme better. This is because the programme could have exposed the students to experiences and skills that were in line with their career plans. With the students interacting primarily with the farmers and extension agents, they are more likely to get enriching insights into their career growth and development. The programme is likely to provide the students with an in-depth comprehension of the actual agricultural practice allowing them an opportunity to acclimatize themselves with the job requirements, test their career choices and in the process develop imperative hands-on work skills. As a result, students are likely to develop a more accurate self-concept and test the fitness between demands of the work environment with their individual characteristics, thereby creating a realistic set of expectations for work in the agricultural sector. To this end, the programme is more likely to enhance the employability skills of the students by equipping them with the requisite skills, knowledge and practical experience required in the job market.

4.4 Effectiveness of Farm Attachment Programme

Overall, the study found out that students on farm attachment had introduced twenty-three common agricultural practices to farmers. During the attachment period, a student proposed a number of agricultural practices in response to farm challenges. As a result, farmers depending on an array of factors ranging from farm characteristics, socio-economic, institutional, and student characteristics, adopted either all or a proportion of the total practices introduced. The proportion of the practices adopted by a farmer was used as a measure of the effectiveness of the programme to the farmers. Therefore, the practices introduced and the intensity of adoption is presented in Table 18.

Table 18: Intensity of technology adoption by farmers in FAP

Agricultural Practice	Proposed	Adopted	Intensity
Green manure	48	44	0.917
Crop rotation	41	38	0.927
Intercropping	62	49	0.790
Relay cropping	63	42	0.667
Tillage management	64	27	0.422
Chemical innovations	56	12	0.214
Strip growing	35	9	0.257
Certified/improved seeds	42	13	0.310
Soil &Water Conservation	38	7	0.184
New agronomic practices	55	12	0.218
Manure application	47	4	0.085
Pest & disease control	52	3	0.058
New crop varieties	46	7	0.152
Green house farming	28	5	0.179
Record keeping	31	20	0.645
Irrigation	15	13	0.867
Value addition	42	10	0.238
Artificial Insemination	37	18	0.486
Silage management	41	27	0.659
New livestock breeds	38	26	0.684
New animatics	52	11	0.212
Paddocking	3	2	0.667
Improved livestock structure	5	1	0.200
Zero grazing	3	1	0.333

As presented in Table 18, majority of farmers, 64% (n=64) were introduced to tillage management practice followed by relay cropping and intercropping respectively. However, only 3% of the farmers in the programme were introduced to new animatics and zero grazing. Regarding adoption, the findings indicate that majority of farmers, 92.7% adopted crop rotation followed by 91.7% adopting green manure and residue retention. More than half of the farmers (52%) were introduced to pest and disease control practices but only 0.058% of the farmers introduced adopted. This could be ascribed to the reduced effectiveness of this practice and its associated harmful effect on the environment.

The study established that the overall technology adoption rate of improved agricultural practices introduced to the farmers was 43.21%. Relative to the adoption rates resulting from agricultural extension agents from the ministry of agriculture and other stakeholders, adoption rates of the common agricultural practices ranges between 10% to 12% (Ogada *et*

al., 2014). This indicates that the programme was effective as compared to other technical advisory service providers. This could be attributed to the close interaction and joint appraisal of the farm challenges between students on attachment and the farmers. As a result, farmers are more likely to understand the technological solutions better hand therefore, own the interventions of the programme as compared to those introduced by other extensional approaches.

4.4.1 Determinants of the intensity of technology adoption among small-scale farmers

The maximum likelihood results of the Tobit regression model on the factors influencing the adoption behaviour of farmers in the programme are presented in Table 19. Model diagnostics including VIF, pair-wise correlation (pwcorr) and white test were performed to check for model specification errors. Premised on the tests, the model was free from multi-collinearity and heteroscedasticity with VIF values of less than 5 and pair wise correlation coefficient values of less than 0.7 as asserted by the rule of thumb (Faggion *et al*., 2014; Kavzoglu *et al*., 2014; Akinwande *et al*., 2015; Vu *et al*., 2015; Heit *et al*., 2017). The log likelihood of the fitted Tobit model was 82.940155 indicating that the model converged with the predictor variables used in the model statistically different from zero. The likelihood ratio (LR $Chi^2(18)$) was 104.73 with a corresponding p-value of 0.000 indicating that variables used in the model were jointly significant at 1% further confirming that the model had a good fit, hence the most appropriate model for the data (Zulfiqar and Thapa, 2018).

As shown in Table 19, the results depict that among the 16 hypothesized predictor variables included in the model, nine were found to have a significant influence on the intensity of technology adoption. Of these variables, only the age of the household head exhibited a negative correlation with the intensity of technology adoption. The rest revealed a positive relationship. Farming experience, security of tenure, student's responsiveness, and access to finance and product markets were positively significant at 1%. Education of the household head and access to agricultural training were significant at 5%. However, the slope of the land and the number of times a farmer had hosted student(s) on attachment had a positive correlation with the intensity of technology adoption at 10%.

Table 19: Determinants of the intensity of technology adoption among small-scale farmers

Variable	Coefficient	Standard error	P>|t|
Household characteristics			
Age of the household head	-0.0031**	0.0012	0.013
Gender of the H/H	-0.0280	0.0259	0.282
Education of the H/H	0.0073**	0.0036	0.049
Farming experience	0.0035***	0.0012	0.004
Household size	-0.0036	0.0032	0.266
Primary occupation	-0.0102	0.0118	0.392
Plot characteristics			
Slope	-0.0248	0.0223	0.270
Soil fertility	0.0055	0.0163	0.736
Security of tenure	0.1090***	0.0307	0.001
Land size	0.0030*	0.0016	0.064
Institutional characteristics			
Access to Credit	0.0691***	0.0243	0.006
Group membership	0.0089	0.0399	0.824
Access to agricultural Training	0.0684**	0.0272	0.014
Student characteristics			
Student's responsiveness	0.0830***	0.0294	0.004
Content delivered	0.0124	0.0188	0.513
Student's advisory ability	-0.0138	0.0183	0.453
Number of hosts	0.0145*	0.0087	0.099
Tobit regression		Observations	100
		LR Chi^2 (18)	104.730
		Prob > Chi^2	0.000
Log likelihood	82.940	Pseudo R^2	0.713

Note: ***, **, * significant at 1%, 5% and 10% probability respectively

Age of the household head negatively influenced the intensity of use of agricultural technology introduced to farmers by the students at 5%. This implies that as the age of the farmer increases, farmers are likely to invest in particular practices thereby, acquiring sufficient knowledge through time to enable them deal with production risks without necessarily risking alien techniques and practices. Due to the risk-taking nature and innovativeness of younger household heads, they are more likely to be interested in trying out new agricultural technologies as compared to the older household heads who are conservative and risk-averse due to their cultural practices. Furthermore, older farmers tend to have little interest in investing in long-term farming technologies compared to their counterparts. These results tally with those of Thuo *et al.* (2014) on the adoption of organic agriculture techniques, and Zulfiqar and Thapa (2018) on adoption of "better cotton" in Thailand who

argued that an increase in the age of the farmer confines the time frame through which a farmer can benefit from adoption resulting into risk-evasiveness. However, Ng'ombe *et al*. (2014) indicated a positive correlation between age of the household head and intensity of adoption of conservation farming practices in Zambia. In addition, Lavison (2013) argued that older farmers are more experienced and premised on their past experiences they are more likely to understand the benefits associated with new agricultural techniques as compared to their counterparts.

Years of schooling of the household head was statistically significant at 5% and positively influenced the intensity of adoption of agricultural technologies. This implies that more years of schooling enhances the farmers' capability to acquire, process and respond to new information germane to adoption of a new agricultural technology. Furthermore, more years of schooling influences the farmers' thoughts and attitudes making them to be rational and capable of analyzing the benefits associated with new technologies. As a result, introduction of new techniques to such farmers becomes easy ultimately affecting the adoption process. Probably, farmers with more years of schooling are likely to be more competent and therefore, capable of accessing and assimilating information on different agricultural technologies. As a result, these farmers can easily evaluate the benefits associated with a given technology thus, reducing doubts about the performance of the technologies introduced. These results are consistent with the findings of Kadafur *et al*. (2017) on adoption intensity of improved maize. In addition, Ghimire *et al*. (2015); Paltasingh *et al.* (2017) argued that years of schooling creates a conducive environment for adoption of new technology. However, these results do not conform to the findings of Furruh *et al*. (2007) who established a negative correlation between education and adoption of organic agriculture.

Slope of the main agricultural plot was found to positively influence the intensity of technology adoption at 10%. This infers that the steeper the slope of the main plot, likely a farmer is to adopt and use soil and water conservation measures. This mirrors the fact that plots with steeper slopes are increasingly prone to soil erosion and leaching thereby, necessitating the adoption of appropriate techniques for mitigating the effects of erosion and nutrient loss like terraces, mulching, conservation tillage and other sustainable agricultural practices. As a result, the likelihood of farmers in the programme intensifying the use of conservation agriculture increased with the perceived slope of the main plot. These results are consistent with those of Kassie *et al*. (2009); Masara and Dube (2018) who argued that so as

to facilitate adoption and the type of technology to be adopted, sustainable agricultural practices should be able to address site-specific characteristics, indicating that the nature of the slope influences the decision to adopt and use a myriad of conservation practices.

As expected the effect of land size was positive and significant at 10%. Larger sizes of land increase the willingness of farmers to accept and adopt the agricultural technologies introduced to them. The plausible explanation for this could be that farmers with larger parcels of land are more flexible in devoting part of their land for new practices on trial basis without risking their whole farm investment as compared to their counterparts with relatively smaller parcels. In addition, larger farm size gives farmers the liberty to risk as they have scale economies, thereby, able to bear costs of learning and acquiring information. Likewise, Zulfiqar and Thapa (2017); Kadafur *et al*. (2017) recorded a positive and significant association between fam size and intensity of adoption of "better cotton" in Thailand and adoption intensity of improved maize varieties in Nigeria respectively. Conversely, Holden (2014) found that land scarcity among farmers in Malawi induced agricultural intensification through SIPs adoption. Kassie *et al*. (2014) Also observed an inverse association between plot size and adoption of SIPs in Kenya, Tanzania, Malawi and Ethiopia.

Security of tenure is the legal regime through which a piece of land is owned. The results of the Tobit model indicate that security of tenure positively and significantly influenced adoption and the level of use of agricultural technologies proposed by the students at 1%. This could be attributed to the benefits of having full rights of owning and using land that in return creates an incentive for farmers in the programme to try out and adopt new and technologies. According to Gido *et al*. (2014), security of tenure guarantees farmers credit access and motivates them in undertaking long-term and riskier investment decisions. As a consequent, farmers with full land ownership are more likely to adopt and intensify the use agricultural technologies introduced by students as compared to farmers using land without full ownership. On the other hand, absence of full rights to use a piece of land limits the farmer's ability to invest in new and long-term innovative technologies, thereby reducing the likelihood of intensifying technology on that particular piece of land. This result reinforces the earlier findings of Kassie *et al*. (2014) who found that security of tenure influenced the adoption of different Sustainable Intensification Practices (SIPs) in Kenya, Malawi, Ethiopia and Tanzania positively.

The effect of access to credit was statistically significant at 1% with a positive effect on the intensity of technology adoption. This implies that farmers who had access to finance and product markets were more likely to adopt and use more agricultural technologies introduced by the students. This could allude that most of the agricultural technologies are capital and labour intensive and therefore, access to credit facilitates purchasing of the needed farm inputs and equipment and hiring of labour, thus stimulating technology adoption. Access to finance and product according to Mwangi and Kaiuki (2015) promotes the adoption of risky agricultural technologies by addressing liquidity constraints faced by farmers and boosting their risk-bearing ability. The result conforms to the findings of Masara and Dube (2018); Paltasingh *et al*. (2017) who found a positive relationship between credit and adoption of improved maize varieties. However, it contradicts the findings of Zulfiqar and Thapa (2018) reported a negative correlation between access to credit and the intensity of adoption of "better cotton" which they attributed to channelling of agricultural credit to other non-agricultural purposes.

On access to agricultural training by the farmers in the programme, a positive and significant relationship was found at 5% level of significance. Training exposes farmers to an array of technologies they could use to improve their agricultural productivity. This finding indicates that farmers who are exposed to agricultural training and information have a higher probability of increasing their intensity of technology adoption relative to those with no exposure. This could probably imply that training equips farmers with appropriate information enabling them to practically observe the technologies introduced to them by the students and weigh the advantages and disadvantages associated before committing substantial resources. As a result, training complements the solutions proposed by the students. This enhances their chances of adoption as they can also utilize the information attained from training to implement the introduced technologies properly. Mentire and Gecho (2017), while studying the adoption of wheat row planting technology in Southern Ethiopia also found a positive and significant relationship.

Farmers' perception on responsiveness of students to farm challenges had a positive and significant effect on the intensity of adoption at 1%. This implies that farmers' likelihood to increase the intensity of adoption increased with the responsiveness that students had in addressing the challenges that arose on the farm. A plausible explanation could be that farmers are more likely to note the first interventions undertaken by students in an attempt to

address challenges as they arise on the farm as compared to the interventions that are initiated at a pronounced phase of a farm challenge or problem. This is in line with priori expectation as it forms a ground on which a farmer could be responding to similar problems whenever they arise on the farm in future.

Similarly, the number of times a farmer has hosted a student(s) on attachment had a positive and significant influence on the intensity of adoption of agricultural technologies at 10% level of significance. This implies that farmers who have hosted students more times on their farms are more likely to increase the intensity of adoption as compared to those with few. This could be attributed to the technical nature of agricultural technologies thereby, requiring more time and help for farmers to fully implement the proposed solutions. In addition, the period allocated for attachment is relatively short and therefore, not sufficient for some technologies to be introduced and implemented to completion. Furthermore, interacting with different students in different cohorts enhances follow-up and reinforcement of the work of the previous student(s). As a result, a farmer is likely to adopt a technology that could either complement or substitute the previously introduced ones. In case of technology failure, with the involvement of the farmer, subsequent cohorts of students are likely to identify the cause and therefore, make the necessary adjustments.

CHAPTER FIVE
CONCLUSION AND RECOMMENDATIONS

5.1 Conclusions

From the analysis;

1. It was explicit that the programme increased technology awareness and access among farmers. However, the programme was limited by short attachment duration. Each attachment cohort was designed to take 8 weeks which majority of the farmers indicated was insufficient for implementation of some interventions. In addition, majority of the farmers believed that the programme was likely to increase farmer linkages within the Counties. Furthermore, high cost of student accommodation was a threat to the sustainability of programme.

2. Majority of the farmers (65%) perceived the programme as effective in enhancing agricultural productivity. This according to the ordered logit model was majorly influenced by security of tenure.

3. Majority of students (77.63%) perceived the programme as effective in enhancing their hands-on experience and their future career. This was primarily influenced by the number of contacts that the students had with extension agents.

4. The overall adoption rate of improved agricultural practices by the farmers in FAP was 43.21%. This rate is approximately four times higher than the adoption rate ascribed to the conventional extension agents from the ministry of agriculture.

5.2 Recommendations for Policy

Attachment duration should be reviewed to at least twelve or more weeks to ensure successful implementation of the interventions introduced by the students.

The national government in collaboration with the county governments should implement land land reforms to facilitate farmers' acquisition of title deeds with ease. This would motivate farmers to undertake long-term investments and technologies due to reduced uncertainty associated with insecure land tenure systems. Furthermore, this will cushion farmers as collateral in the acquisition of agricultural credit from financial institutions, as a result, motivate them to adopt improved farming techniques.

The programme implementors should incorporate extension agents in the FAP to increase the interaction between students on attachment and the extension agents to backstop students in integrating the theory learned in a classroom set-up to real-farm situations. This would enhance the students' hands-on experience and equip them with the necessary technical skills.

Premised on the intensity of technology adoption among farmers in the pilot Counties, the programme should be expanded to other counties within the country.

5.3 Recommendation for further research

Further research should be done to evaluate the impact of the programme on farmers' livelihood in terms of change in output and income. Since this study evaluated agricultural practices (solutions) introduced to farmers and their level of adoption, there is need to determine the effect of the introduced and adopted technologies on agricultural productivity and change in livelihood among farmers in Nakuru and Baringo Counties.

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APPENDICES

FARMER QUESTIONNAIRE

Egerton University Farm Attachment Programme Survey 2017

INTRODUCTION

HALLO, my name is _____and I am part of a team from Egerton University, who are evaluating the impact of farm attachment programme through student based solutions on small-scale farmers in Kenya. Your participation in answering these questions is highly appreciated. Your responses will be **COMPLETELY CONFIDENTIAL** and used solely for research purposes together with 99 other farmers. If you indicate your voluntary consent by participating in this interview, may we begin? If you have any questions or comments about this survey, you may contact the Principal investigator through **Prof. Nancy Mungai, Director, Board of Undergraduate Studies Egerton University, P.O. Box 536, Egerton.** Email address: **nmungai@egerton.ac.ke.**

Household ID: _____

Enumerator code **enumcode: _____**

SECTION1A: LOCATION DETAILS

County of the farmer 1=Nakuru 2=Baringo **County:_____**

SECTION 1B: GENERAL INFORMATION

Date of the interview **Date: _____**

Name of Respondent (optional) Respname **Nameid: _____**

Respondent's gender 1=male 0=female **Gend: _____**

Relationship to the household head 1=Household head, 2=Spouse, 3=Farm manager

99= other(specify)_____ **Relation _____**

Household identification	**Gender** 1=male 0=female	**Age** (in years)	**Education (schooling years completed)**	**Primary occupation codes below**	**Secondary occupation** codes below	**Farmer experience** (in years)	**Adult size**
HHID	Gend	Age	Educ	Poccu	Offmact	Fexp	Adlsz
Hh head _____							

Spouse _____							

Codes:

1=Farming, 2=Salaried Employment, 3=Casual on-farm, 4=Casual off-farm 5=Self-employed, 7=Student, 99=Other (specify) _____

Details of the household and family

SECTION 2: FARM CHARACTERISTICS

2.1 Details of the total agricultural land (in acres) owned by the household

Current total agricultural land	Land under production before programme intervention	Land under production after programme intervention
Totland	**BefProducland**	**aftProducland**

2.2 What is the tenure system of your main plot? (**Main plot**: plot with the farmers' main crop) 1=Owned w/deed, 2= Owned w/o deed, 3=Rented, 5=Government/Communal **tenure_____**

2.3 What is the slope of the main plot? 1=gentle/flat 2=medium 3=steep **Slope _____**

2.4 How do you perceive the soil fertility of your main plot? 1=low, 2=medium, 3=high **Sfert _____**

SECTION 3: AGRICULTURAL ASSETS

3.1 Indicate assets currently owned by the household intervention including their average values

aNo.	**Asset Type**	Current number	Current average value	Total Value currently
	Atype	**Cnum**	**Untval**	**Totval**
1	Irrigation equipment/facilities			
2	Hoe			
3	Shovel/spade			
4	Sickle			
5	Sprayer pump			
6	Wheelbarrow			
7	Livestock structure			
8	Milking cans/buckets			
9	Storage facility			
10	Feed troughs			
11	Feed mixer			
12	Cutter/feed chopper			
13	Generator			
14	Tractor			
15	Tractor trailer			
16	Plough			
17	Cart(for transporting farm produce)			
18	Others (specify)			
	Total Asset Value			

3.2 From the assets above, which ones have you purchased since you started hosting students? ***Assets*****_____**

SECTION 4: FARM ATTACHMENT PROGRAMME

4.1When did you start hosting students? **Year _____** **Month _____**

4.2 How many times have you hosted student on farm attachment? **numhost**_____

4.2b Have you hosted students consistently? 1=Yes 0=No **consisthost _____**

4.2c ***If no,*** why? 1=Was not allocated, 2=farmer not available, 3=Poor performance by previous student, 4=High cost of hosting students, 5=Lack of feedback, 6=Mismatch of skills required, 7=Inappropriate behaviour by students, 8=Poor attitude by students, 99=others (specify) _____ (***Provide multiple responses based on rank***) **rInconsistency _____**

4.3 How many students have you hosted since your first engagement with in the programme **nstudents_**

4.4 Who interacted with the student(s) most of the time? 1=Household head, 2=Spouse, 3=Farm Manager, 99=others specify _____ **Interractor _____**

4.5 How do you rate the relevance of the information delivered to you by the student(s)

1= Not relevant, 2=Slightly relevant,3= Relevant, 4= Very relevant **relevance _____**

4.6 How do you rate the responsiveness of students to farm challenges? 1= Not responsive, 2=Slightly responsive, 3= Responsive, 4=Very responsive **respons ____**

4.7 In general, how knowledgeable was/were the student (s) 1=0-20, 2=21-40, 3=41-60, 4=61-50, 5=81-100 **sKnowledgeability _____**

4.8 Did you have the motivation to incorporate the interventions of the programme? 1=Yes, 0=No

4.9 ***If yes***, what motivated you? 1=Students were knowledgeable, 2= Inefficiencies in farm production, 3=Responsiveness of students, 4=Recommendations were in line with farmer expectation, 5=Involvement of farm appraisal, 99=other(specify)_____ (***Provide multiple response if possible***) **Motiv _____**

4.10 How do you rate the students' technical advisory ability? 1=Not effective, 2=Slightly effective 3=Effective,4= Very effective **adability** _____

Details regarding technology (**Do not read the options for the farmer**)

Crop Production				**Livestock Production**		
Technologies Proposed **Codes below**	Technology adopted	Technologies in use currently		Technologies Proposed **Codes below**	Technology adopted	Technologies in use currently
Techsprop	**Adoptechs**	**Ctechs**		**Techsprop**	**Adoptechs**	**Ctechs**
New Agronomic practices(***name***)_____ 1=Manure application, 2=Relay cropping/intercropping, 3=Crop rotation,4=Fertiliser application				New Animatics (***name***)_____ 1=Dehorning, 2=Docking, 3=Teat clipping, 4=Debeaking, 5=Shearing,		
New pest and disease control (***name***) _____ 1=Spraying, 2=Insect trap, 3=Rogueing				New pest and disease control (***name***) _____ 1= Drenching, 2=Spraying, 3=Mastitis control		
Value addition (***specify***) _____ 1=Packing, 2=Cooking, 3=Market delivery				Value addition (***specify***) _____ 1=Yoghurt making, 2=Ghee making, 3= Packaging of animal products		
1=Green manure and residue retention, 2=Crop rotation, 3=Intercropping, 4=Relay cropping, 5=Tillage management, 6=Chemical innovations, 7=Strip growing, 8=Improved seeds, 9=Soil & water conservation, 10=,New agronomic practices 11=Artificial insemination, 12=Silage management, 13=manure as fertiliser, 14=New pest and disease control ,15=New Crop Varieties,16= New Livestock breeds,17=Greenhouse farming, 18=New Animatics, 19=Value addition 99=Other (specify)_____						

4.12 What was the effect of technology on the farm? (***Provide multiple responses***) 1=Increased acreage under production, 2=Increased output, 3=Change in farm labour costs, 4=Change in occupation, 5=Changes in food security status, 6=Reduction in post-harvest losses, 7=Change in resource utilization, 8=Change in input costs, 99=others (specify) _____ **techeffect** _____

4.13 Do you think the change in productivity is significant to make you different from farmers that are not in the programme? (1=Yes, 0=No) **signchang _____**

4.14 What was the direction of the change? 1=positive, 0=negative **Changedirec** _____

4.15 What are the strengths/ positives of the programme? 1=Increased technology awareness, 2=Improved agronomic practices, 3=Relevance of the technologies proposed, 4=High responsiveness, 5=Accessibility of information, 6=Timeliness, 99=others (specify) _____

(***Provide multiple responses based on rank***) **Strengths _____**

4.16 What are the weaknesses of the programme? 1=Short duration, 2=High costs of hosting the students, 3=Interpersonal relationship, 4=Mismatch of skills, 5=Culture shock, 6=Follow-up for implementation of ideas, 99=others (specify) _____

(***Provide multiple responses based on rank***) **Weakness** _____

4.17 What are the opportunities that can be realised from the programme? 1=Increased exchange of ideas

among farmers, 2=Increased technology access, 3=Increase in farm yields, 4=Increased farm efficienc y, 5=Culture diversity, 6=Food security, 7= Demand for the programme, 8=Value addition, 9=Increased farmer linkage, 99=others (specify)___(***Provide multiple responses based on rank***) **Opportunities _____**

4.18 What threats do you think can result from the programme? 1=Enterprise incompatibility, 2=Culture differences, 3=Student accommodation on the farm, 4=Conflicting objectives from different extension service providers, 99 = others (specify)__ (***Provide multiple responses based on rank***) **Threats _____**

4.19 In future, are you willing to host other students on attachment? (1=Yes, 0=No) **hostagain_____**

4.19b ***If no***, briefly state the reason, 1=Poor performance by previous student, 2=High cost of hosting students, 3=Lack of feedback, 4=Mismatch of skills required, 5=Inappropriate behaviour by students, 6=Poor attitude by students, 99=others(specify) _____ **Reason** _____

SECTION 5: EXTENSION, TRAINING, CREDIT ACCESS AND GROUP MEMBERSHIP

5.1 Did your household receive agricultural extension contact in the last year before hosting the student(s)? 1=Yes, 2=N0 **exten** _____ ***If yes***, specify the number of contacts **nexten** ___

5.2 Did your household receive agricultural extension contact in the last one year? 1=Yes, 2=N0

exten _____ ***If yes***, specify the number of contacts: **nexten** _____

5.3 Did anyone in the household attend farmer training after the programme intervention? 1=Yes 0=No **train**_____ *If yes*, how many times: **ntrain**_____

5.4 Did you require credit after the programme intervention? 1=Yes 0=No **credit**_____

if yes, did you receive (1=Yes 0=No) **reciev**___ ***if yes***, state the amount _____

5.5 How much was used for agricultural purposes? _____

5.6 Are you or anybody in your household a member of any agricultural group or association? (1=Yes 0=No) **groupmemb** _____ ***if yes***, specify the group **grouptyp**_____

1=self help group, 2=welfare group, 3=cooperative society/sacco, 4=producer group,

5=marketing group, 6=water user group, 7=credit associations/table banking, 99=other (specify) ____

STUDENTS QUESTIONNAIRE

Egerton University Farm Attachment Programme Survey 2017

INTRODUCTION

HALLO, my name is _____and I am part of a team from Egerton University, who are evaluating the impact of farm attachment programme through student based solutions on small-scale farmers in Kenya. Your participation in answering these questions is highly appreciated. Your responses will be **COMPLETELY CONFIDENTIAL** and used solely for research purposes together with 163 other students. If you indicate your voluntary consent by participating in this interview, may we begin? If you have any questions or comments about this survey, you may contact the Principal investigator through the following address: **Prof. Nancy Mungai Director, Board of Undergraduate Studies, Egerton University, P.O. Box 536, Egerton.** Email address: nmungai@egerton.ac.ke.

Date: _____ Code of the Enumerator: **enumcode** _____

SECTION1: STUDENT DETAILS

Name(optional) **firstnam**_____

Department 1=AGEC/AGBM, 2=CHS, 3=ANSC, 4=AGED, 5. ACDS, 6. Other _____

dpt1___dpt2___dpt3___dpt4___dpt5 ____

Programme enrolled 1=Degree, 0=Diploma **prog** _____

Age in years **age _____**

Gender 1=male, 0=female **gend** _____

County attached 1=Nakuru, 2=Baringo 3. Other _____ **County** _____

Sub-County **subcount**_____

Location **loc_____**

Name of the famer attached to: **fmnam** _____

SECTION 2: **FARMING BACKGROUND**

Home of origin? 1=urban 0=rural **Homeorig** _____

Back at home, what is your main household occupation? _____ 1=Farming, 2=Salaried Employment, 3=Casual on-farm, 4=Casual off-farm 5=Self-employed 6=Domestic worker, 7=Student, 8=Retired, 99=other (specify) _____

mocc1___mocc2___mocc3___mocc4___mocc5___mocc6___mocc7___mocc8___

Have you participated in any agricultural activity before joining the University? 1=yes, 0=No

agractpart _____ ***If yes***, specify _____

SECTION 3: FARM ATTACHMENT PROGRAMME

3.1 Do you believe the institution prepared you well for the farm attachment in terms of classwork and practically? 1=yes, 0=No **instiperep** _____

3.2 How many technologies did you introduce to the farmer? **ntechs** _____

3.3 Which were the main technologies that you introduced to the farmer? (Rank from the main ones) 1=Green manure and residue retention, 2=Crop rotation, 3=Intercropping,4=Relay cropping, 5= Tillage management, 6=Chemical innovations, 7=Strip growing, 8=Improved seeds, 9=Soil & water c onservation, 10=Agronomic innovation (New management practices), 11=Artificial insemination, 12= Silage management, 13=Greenhouse technology, 14=Process innovations (how to plant, milk, vaccina te, deworm) **techrank _____**

3.4 What motivated you to introduce these technologies? 1=Farmer's technological needs, 2=Your conversance with the introduce technologies, 3=Influence of the ministry, 4=inquiry and advi ce from other parties, 5=others (specify)_____**motiv1___motiv2___motiv3___motiv4__**

3.5 Do you think you were able to meet the farmers' technological demands? (1=Yes 0=No)

ftechdemand _____

3.6 Are you still in touch with the farmer you were attached to? (1=Yes 0=No) **hostcontact** _____

If yes, are you still consulting each other? (1=Yes 0=No) **consult** _____

3.7 Are you aware whether the farmer is still practicing the technologies you introduced?

(1=Yes 0=No) **adoptedtechs ____**

3.8 What do you think should be done to efficiently prepare students for farm attachment in future?

_____

_____

3.9 Did you receive any support during your attachment period? (1=yes, 0=No) **suprt** _____

3.10b ***If yes***, from who? 1=University, 2=farmer, 3=self, 99 = Other (specify) _____ **suprtfro** __

3.11 Which support? 1=financial, 2=accommodation, 3=information, 4=technical

suprt1___suprt2___suprt3___suprt4____

3.12Which support do you think the University should provide to students during farm attachment?

_____

_____

3.13 How do you rate the agricultural knowledge of the farmer?1=Very knowledgeable, 2=Knowledgeable, 3=Somewhat knowledgeable, 4=Not knowledgeable

Know1___Know2___Know3___Know4_____

3.14 How has Farm attachment programme enhanced your technical advisory ability? 1=very strongly, 2=Strongly, 3=Moderately, 4=Not much **fapr1 ___fapr2___fapr3 ___fap**

3.15 On a scale of 100, how do you rate the farm attachment programme regarding its importance to your career? 1=0-19, 2=20-39, 3=40-59, 4=60-79, 5=80-99

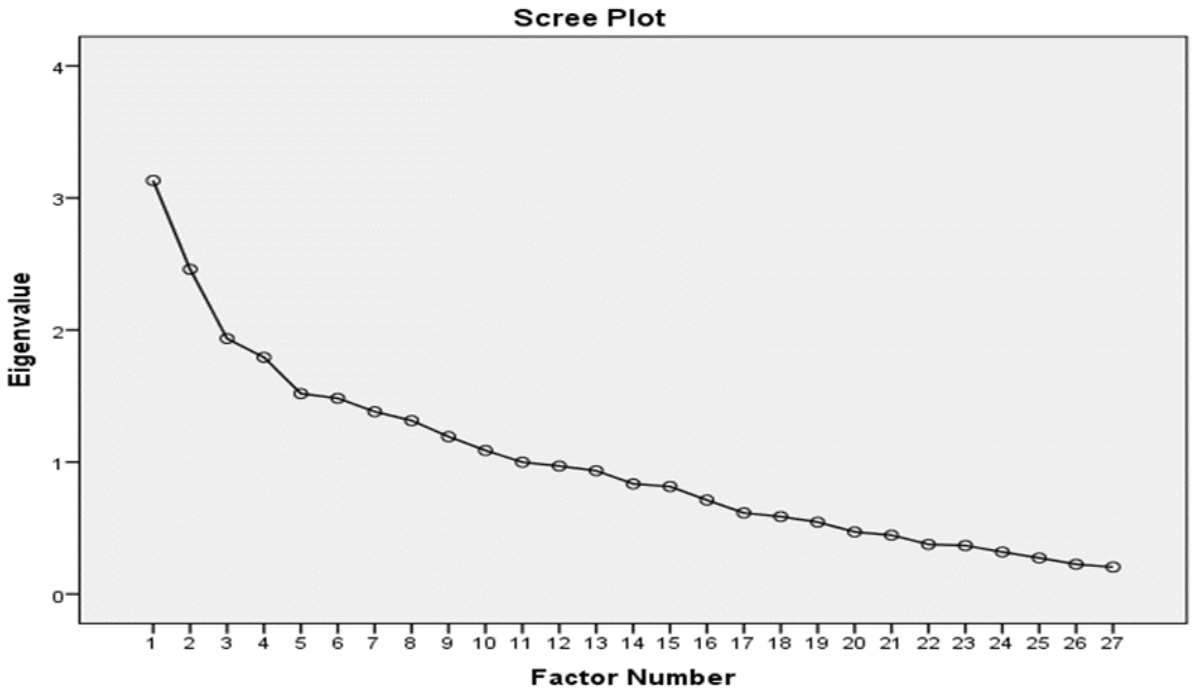
Scale1 __scale2__scale3___scale4_____

3.16 How effective was the programme to your career? 1 =Not effective, 2= Somewhat effective, 3 =Neutral, 4=Effective, 5=Very effective **effectiveness** ____

RAW RESULTS

8.1 SWOT Analysis

8.1.1 Scree Plot



8.1.2 Test for Sample adequacy

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.619
Bartlett's Test of Sphericity	Approx. Chi-Square	265.504
	df	136
	Sig.	.000

8.1.3 Reliability tests

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.705	.700	8

8.1.4 Communalities

Communalities

	Initial	Extraction
Increased technology awareness	1.000	.765
Timley Feedback by the students	1.000	.580
The attachment duration was short	1.000	.734
High costs of student accommodation	1.000	.753
Interpersonal relationship challenges	1.000	.688
Mismatch of student skills	1.000	.803
Drastic climate variability and drought	1.000	.711
Limited resources by farmers to implement the interventions	1.000	.729
Increased technology access	1.000	.645
Increas in farm yields	1.000	.665
Increase in farm efficiency	1.000	.557
Increase in food security	1.000	.673
Culture diversity	1.000	.772
Increased farmer Linkage	1.000	.716
Enterpsrise incompability	1.000	.644
Higher responsiveness by students to farm challenges	1.000	.682

Extraction Method: Principal Component Analysis.

8.2 Farmers' perception towards the programme

Eefectiveness of the program	Freq.	Percent	Cum.
Not effective	6	3.95	3.95
Somewhat effective	7	4.61	8.55
Neutral	21	13.82	22.37
Effective	62	40.79	63.16
Very effective	56	36.84	100.00
Total	152	100.00	

8.2.1 VIF

Variable	VIF	1/VIF
age_1	2.02	0.494228
fexp_1	1.80	0.555610
assetvalue	1.57	0.635891
educ_1	1.49	0.669027
totland	1.49	0.669320
exten	1.44	0.693071
ntrain	1.41	0.707303
dmmkt	1.39	0.719950
amount	1.26	0.795460
adlsz_1	1.22	0.821192
Mean VIF	1.51	

8.2.2 Pair-wise correlation for categorical factors

	gender	offmac~1	numhost	groupm~b	exten	sfert	tenure
Gender	1.0000						
offmact_1	0.1287	1.0000					
numhost	-0.2238	0.2396	1.0000				
groupmemb	-0.0793	0.0936	-0.1826	1.0000			
exten	-0.0375	0.1874	0.2231	-0.0385	1.0000		
sfert	-0.0188	-0.1974	-0.0324	0.0427	0.0082	1.0000	
tenure	0.1106	-0.0948	-0.0400	0.1174	0.1555	0.0433	1.0000
slope	-0.1813	-0.0357	0.2711	-0.1230	-0.0955	-0.0288	-0.5288 1.0000

8.2.3 White test for heteroscedasticity

Cameron & Trivedi's decomposition of IM-test

Source	chi2	df	p
Heteroskedasticity	32.00	31	0.4167
Skewness	22.87	10	0.0112
Kurtosis	1.26	1	0.2623
Total	56.13	42	0.0712

8.2.4 Factor analysis

Factor analysis/correlation — Number of obs = 100

Method: principal-component factors — Retained factors = 1

Rotation: (unrotated) — Number of params = 4

Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor1	2.03282	1.05922	0.5082	0.5082
Factor2	0.97360	0.37875	0.2434	0.7516
Factor3	0.59486	0.19613	0.1487	0.9003
Factor4	0.39872		0.0997	1.0000

8.2. 5 Factor loadings (pattern matrix) and unique variances

Variable	Factor1	Uniqueness
Responsiveness	0.3651	0.8667
stud_know	0.7117	0.4934
adability	0.8198	0.3279
relevance	0.8490	0.2791

Variable	Obs	Mean	Std. Dev.	Min	Max
fpercep_index	100	3.067743	.521594	1	3.740785

Test scale = mean(unstandardized items)

Average interitem covariance: .1591246

Number of items in the scale: 4

Scale reliability coefficient: 0.6221

. factortest responsiveness stud_know adability relevance

Determinant of the correlation matrix Det = 0.469

Bartlett test of sphericity

Chi-square = 73.231

Degrees of freedom = 6

p-value = 0.000

H0: variables are not intercorrelated

Kaiser-Meyer-Olkin Measure of Sampling Adequacy KMO = 0.657

8.2.6 Empirical results for Ordered logit model

Ordered logistic regression — Number of obs = 100
LR chi2(21) = 94.26
Prob > chi2 = 0.0000
Log likelihood = -96.863994 — Pseudo R2 = 0.3273

f_Perception	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Gender	.0898556	.496021	0.18	0.856	-.8823276	1.062039
age_1	-.0112048	.043695	-0.26	0.798	-.0968454	.0744358
age_2	.1384154	.0538639	2.57	0.010	.0328441	.2439868
educ_1	-.0111738	.0803696	-0.14	0.889	-.1686953	.1463478
poccu_1	-.4759686	.236894	-2.01	0.045	-.9402724	-.0116648
adlsz_1	.120559	.0661335	1.82	0.068	-.0090602	.2501782
tenure	-1.75378	.6345558	-2.76	0.006	-2.997487	-.5100735
sfert						
medium	-1.437897	.5510076	-2.61	0.009	-2.517852	-.3579418
h*igh*	-2.605462	.7232455	-3.60	0.000	-4.022997	-1.187927
slope						
medium	1.228641	.6775669	1.81	0.070	-.0993654	2.556648
steep	2.012709	.9346558	2.15	0.031	.1808175	3.844601
totland	.0297247	.0337309	0.88	0.378	-.0363867	.095836
nexten	.0282369	.0206695	1.37	0.172	-.0122746	.0687483
ntrain	-.1315715	.0683912	-1.92	0.054	-.2656158	.0024729
credit	-.8820889	.5337816	-1.65	0.098	-1.928282	.1641038
groupmemb	-.5411242	.9094442	-0.60	0.552	-2.323602	1.241354
numhost	-.0632875	.2145137	-0.30	0.768	-.4837266	.3571516
nstudents	-.0381667	.1088282	-0.35	0.726	-.251466	.1751327
responsiveness	-.7786116	.5452905	-1.43	0.153	-1.847361	.2901382
sknowledgeability	.6161041	.3434971	1.79	0.073	-.0571379	1.289346
adability	-.4892218	.3927429	-1.25	0.213	-1.258984	.2805401
/cut1	-3.754766	3.167834			-9.963607	2.454076
/cut2	-2.242154	3.144371			-8.405008	3.9207
/cut3	.1015362	3.17137			-6.114235	6.317308
/cut4	2.402963	3.175194			-3.820302	8.626229

8.3 Students' perception towards the programme

Eefectiveness of the program	Freq.	Percent	Cum.
Not effective	6	3.95	3.95
Somewhat effective	7	4.61	8.55
Neutral	21	13.82	22.37
Effective	62	40.79	63.16
Very effective	56	36.84	100.00
Total	152	100.00	

8.3.1 VIF

Variable	VIF	1/VIF
Att_Year	1.19	0.839010
Age	1.17	0.854047
Nexten	1.05	0.955239
Mean VIF	1.14	

8.3.2 White test for heteroscedasticity

Cameron & Trivedi's decomposition of IM-test

Source	chi2	df	p
Heteroskedasticity	16.95	9	0.0495
Skewness	4.95	3	0.1756
Kurtosis	14.47	1	0.0001
Total	36.37	13	0.0005

8.3.3 Ordered logit results for factors affecting students' perception towards the programme

Ordered logistic regression — Number of obs = 151; LR chi2(13) = 119.41; Prob > chi2 = 0.0000

Log likelihood = -133.41215 — Pseudo R2 = 0.3092

Effectiveness	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Programme	1.304161	.5875557	2.22	0.026	.1525729	2.455749
Att_Year	.4267487	.1184704	3.60	0.000	.194551	.6589464
Age	-.1852147	.099751	-1.86	0.063	-.380723	.0102937
Gend	.2203241	.379526	0.58	0.562	-.5235331	.9641814
Faculty	.63586	.369403	1.72	0.085	-.088156	1.359876
Nexten	.2498092	.0680071	3.67	0.000	.1165177	.3831007
H_Origin	.6506677	.4993582	1.30	0.193	-.3280563	1.629392
Agricpart	-1.973776	1.054513	-1.87	0.061	-4.040584	.0930328
Uni_Prep	.485566	.1921886	2.53	0.012	.1088832	.8622488
Support	-.3954874	.4646412	-0.85	0.395	-1.306167	.5151926
FKnowledge	.3935669	.1517189	2.59	0.009	.0962033	.6909304
Progeffect	.3053597	.2027599	1.51	0.132	-.0920423	.7027617
Careerexpctn	1.404342	.2535261	5.54	0.000	.9074401	1.901244
/cut1	1.628715	2.757613			-3.776106	7.033537
/cut2	2.844804	2.76343			-2.571419	8.261028
/cut3	4.938696	2.786842			-.5234141	10.40081
/cut4	8.17861	2.836729			2.618724	13.7385

8.4. Determinants of the effectiveness of the programme

8.4.1 VIF

Variable	VIF	1/VIF
Assetvalue	1.52	0.658974
fexp_1	1.49	0.671188
age_1	1.40	0.712504
nstudents	1.29	0.775622
ntrain	1.23	0.814559
amount	1.16	0.863145
adlsz_1	1.13	0.885877
nexten	1.10	0.905732
Mean VIF	1.29	

8.4.2 Pair-wise correlation for categorical factors

	exten	relevance	adability	offmact	poccu_1	gender	numhost	credit	slope	sfert	tenure	train
Exten	1.0000											
relevance	-0.0778	1.0000										
adability	-0.0156	0.5811	1.0000									
offmact	0.1874	0.0307	0.0320	1.0000								
poccu_1	-0.1416	-0.0992	-0.0312	-0.3249	1.0000							
gender	-0.0375	-0.0787	0.0158	0.1287	0.0094	1.0000						
numhost	0.2231	0.1983	0.1352	0.2396	-0.1376	-0.2238	1.0000					
credit	0.0465	0.0054	-0.0011	-0.0362	-0.0752	-0.0714	-0.2300	1.0000				
slope	-0.0955	0.2865	0.2459	-0.0357	-0.0271	-0.1813	0.2711	0.1753	1.0000			
sfert	0.0082	-0.1094	-0.0667	-0.1974	0.0196	-0.0188	-0.0324	0.0390	-0.0288	1.0000		
tenure	0.1555	-0.1983	-0.1005	-0.0948	0.1871	0.1106	-0.0400	-0.1552	-0.5288	0.0433	1.0000	
train	0.1291	0.0356	-0.0292	-0.0611	-0.2098	-0.0312	-0.1577	0.2032	0.2460	0.1530	-0.2876	1.0000

8.4.3 Tobit results

Tobit regression — Number of obs = 100
LR chi2(19) = 104.75
Prob > chi2 = 0.0000
Log likelihood = 82.95255 — Pseudo R2 = 0.7130

AB	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Slope	-.0239058	.0229893	-1.04	0.301	-.0696472	.0218357
numhost	.0143048	.008722	1.64	0.105	-.0030493	.0316588
tenure	-.1085713	.0307711	-3.53	0.001	-.1697961	-.0473465
sfert	.005578	.0162649	0.34	0.733	-.026784	.03794
gender	-.0276203	.0260155	-1.06	0.292	-.079383	.0241425
age_1	-.0031381	.0012354	-2.54	0.013	-.0055962	-.00068
educ_1	.0072062	.0036075	2.00	0.049	.0000284	.0143839
poccu_1	-.0102117	.0118372	-0.86	0.391	-.033764	.0133406
fpercep_index	-.0108009	.0685913	-0.16	0.875	-.147276	.1256741
offmact_1	-.0003143	.0003606	-0.87	0.386	-.0010319	.0004032
exp_1	.0034289	.0011672	2.94	0.004	.0011065	.0057513
adlsz_1	-.0036402	.0032338	-1.13	0.264	-.0100744	.002794
totland	.0030019	.0015985	1.88	0.064	-.0001786	.0061823
relevance	.0168432	.0340817	0.49	0.623	-.0509687	.084655
responsiveness	.089803	.0309099	2.91	0.005	.028302	.1513041
adability	-.0098338	.0310143	-0.32	0.752	-.0715425	.0518748
train	.0676078	.0276534	2.44	0.017	.0125863	.1226293
credit	.0692187	.0242978	2.85	0.006	.0208738	.1175636
groupmemb	.0097233	.0402733	0.24	0.810	-.0704081	.0898546
_cons	.5494982	.1465413	3.75	0.000	.2579271	.8410694
/sigma	.1055612	.0074635			.0907112	.1204113