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## Extent of Adoption and Use of Agricultural Technologies in Moiben Sub County of Uasin Gishu County, Kenya

**Teresia Koskei**

Lecturer, School of Arts and Social Sciences, Moi University, Eldoret, Kenya

### **Abstract:**

*The significance of agriculture as a driver of economic growth cannot be gainsaid. It contributes to food security and generates employment, and it is closely integrated with other sectors of the national economy. Therefore, agriculture is an important element in poverty reduction initiatives. The agricultural sector in Uasin Gishu County, Kenya contributes approximately 25% to the country's GDP and, together with Trans Nzoia, are considered Kenya's bread basket. However, the sector has contributed far below the expectation to the economy. It is, therefore, important that adoption and use of agricultural technologies in agriculture and their potential in socio economic development should be investigated. To advance this investigation, the study was organized around two particular research questions, namely to describe modern agricultural technologies utilized in Moiben Sub County, and examine the extent of use and impact of agricultural technologies on agricultural development. Survey research design was employed. Households engaged in agriculture in Moiben Sub County, Uasin Gishu County constituted the study population. The study applied the voluntary purposive sampling method to select a sample of 120 respondents, consisting of 24 respondents from each of the five wards in Moiben Sub County. The data collection methods used was focus group discussions (FGDs) and in-depth interviews. The data was analyzed qualitatively. The study found out that: modern agricultural technology is applied by most of the agriculturalist in Moiben Sub County at their different levels of farming activities in order to curb food insecurity since they proved to be efficient in production. The finding further elaborately describes the types of modern agricultural/farming technologies that are in use in Moiben Sub-County such as; hybrid seeds, weed controls, artificial insemination, non-human labour harvesters, and milking machines. In determining the extent of adoption and use of modern technology by the farmers of Moiben Sub-County, the study outcomes revealed high extent of adoption of modern agricultural technology; it was revealed that there is need for farmers to willingly seek information and technology for the effectiveness of their business. The results obtained from this study will assist in establishing effective strategies for simulating potential growth of various sectors within the economy and will be useful in resolving the challenge of poverty facing Moiben in Uasin Gishu County, Kenya.*

**Keywords:** Department for International Development, Gross Domestic Product, Geographical Information Systems, Information and communication technology, International Fund for Agricultural Development, Millennium Development Goals and Sustainable Development Goals

### **1. Introduction**

The experience of the recent past has shown that agriculture is emerging as the mainstay of the global economy in many countries; and that agriculture is also a major source of income for majority of the world's population (Abdullah et al, 2005). Agriculture supports directly and indirectly the entire global population by providing food thus forming a most important base for general development and growth in most countries. Since the late 1970s to mid-1980s, many African countries put into practice macroeconomic, sectoral and institutional restructuring aimed at guaranteeing high and sustainable GDP growth, long term stability in food production, and minimization of poverty. Despite all these accelerations, the agricultural sector's growth has remained inadequate to sufficiently address poverty, achieve food security, and lead to sustained GDP growth on the continent. More perturbing is that the sector remains portrayed by little use of modern agricultural technology and low productivity and therefore unable to meet the increasing demand for food brought about by population growth. While there has been some evidence of new crop varieties in some countries in Africa, but adoption rates remain far below expectation some countries, casting doubts on the possibility of agricultural technology impact on socio economic development. Therefore, the adoption of modern agricultural technologies by farmers can increase farm productivity then subsequently increase household incomes, promote food security and provide more employment opportunities for the many unemployed citizens of various countries.

Technological innovation has been one of the greatest instigators of productivity, growth and development in agriculture, especially in developed countries. These benefits are beginning to be realized in developing countries as well. Technological change has led to improvements in outputs and incomes, and these have in turn contributed to policy developments in agriculture, education, research and development, as well as in trade, which have spurred further

technological change. Therefore, applying technology in agriculture can create a virtuous circle which contributes to development, not only in agriculture, but in other fields as well (UNDP, 2005).

According to Yudelman et al., (1971), technology is the operative knowledge of means of production of particular groups of goods or services. In this context, technological change is the sum of changes in production caused by the application of scientific knowledge. According to Morroni (1992), technological change is a difference in the mode of production or the quality of goods produced; pointing out that there is a significant difference between a change in production and a change in the quality of products, both types of change are intrinsically connected to each other, since a change in production creates change in the product, and the reverse is also true.

The process of adopting new technology is influenced by an array of cultural, institutional, personal and social factors, which are processed through five consecutive stages: 'awareness; further information and knowledge; evaluation; trial; and adoption' (Tisdell, 1998). Particular aspects of technology, such as its level of simplicity, the visibility of its outcomes, its effectiveness in fulfilling existing needs and the level of capital investment necessary to implement it, will either advance or hinder its eventual adoption, and should be taken into consideration when adopting any form of technology (Tisdell, 1998).

A significant hurdle to be overcome in the near future is how to develop technologies that will allow for continual agricultural growth to meet the ever-increasing need for human food, and for agricultural inputs, including animal feeds. To minimize poverty and hunger in rural areas, agricultural development has to be equitable, and to ensure that natural resources are conserved while pollution is controlled. According to Hazell and Lutz (1998), such agricultural development should also have wide public participation, and should be market oriented, based on agricultural technology that enhances factor productivity and maintains the natural resource base. For farming with minimal dependence on external inputs (such as chemical fertilizers, for instance) there is increasing emphasis on agro-ecological methods which maximize optimum growing conditions for plants and livestock within the wider ecosystem (Altieri, 1995). These methods include various forms of mixed farming, interspersed with forestry, biological pest control, soil conservation and maintaining soil fertility.

Technological change is also crucial in economic growth and development. Evidence from history shows that when agricultural technology increases, the productivity of factors of production (capital, labour, land and natural resources), then they cumulatively contribute to economic growth. Developed countries were the first to apply technological change to agriculture and industry, and it is increasingly apparent that developing countries are following this trend (Hayami and Ruttan, 1985).

It is increasingly acknowledged among scholars that technological change, economic growth, environmental standards, population growth and social change are closely connected (Tisdell, 1988; Clapham, 1980). Indeed, Tisdell (1988) demonstrated that the availability and implementation of new technology is essential to economic progress and in determining the shape and character of society, and that it contributes to qualitative changes in the environment. This builds upon the work of Dean (1955) who showed that the sustained economic growth in the United Kingdom in the 18th century was mostly due to the application of new inventions, rather than a high level of savings and capital accumulation. This is supported by Blum et al., (1967) and Denison (1962), who stated that qualitative factors, such as the adoption of new technologies, were a greater source of economic growth than quantitative elements like the amount of capital and savings that had been previously amassed.

Agricultural technologies available to small scale farmers have been one of the major resources for modern agricultural production; technological change has been identified as a major factor shaping agriculture in the last one century. Consistent with Ingold (2002), failure by small scale farmers to accept, apply and implement modern farming technologies on their farms so as to promote productivity in the major food production systems has led to very low agricultural productivity and consequently the escalating food insecurity and poverty problems in Africa. Langat et al (2014) noted that slow adoption rates of modern Agricultural technologies continue to hamper Africa's food insecurity reduction programmes, as well as the failure of other initiatives, by government agencies and NGOs, that sought to empower farmers economically.

Based on the above background, there is increasing needs of adopting new enhanced technologies in developing countries to accelerate diversification and intensification of agriculture. The need is induced by several factors of which growing population pressure is the most prominent (Norton et al., 2006). Implementing advanced agricultural technologies to grow crops is a principal means of raising smallholder productivity in the developing world, in so doing fostering economic growth and improving wellbeing for millions of poor households. Nevertheless, some of the developing countries are still lacking information about various agricultural technologies used by farmers making the formulation of policy on increasing productivity a difficult endeavour. There is a wide range of agricultural technologies which are being used successfully by farmers in developed countries. However, their adoption in Africa still poor. Experience from various researches revealed low adoption rate of new agricultural technologies in the perspective of smallholder farming (Perret and Stevens, 2003).

This shows that using technological change to facilitate agricultural development can have far reaching ramifications, not only for the agricultural sector, but also for the wider economy, in terms of employment, economic growth, and environmental management, among other factors. Deliberation on the extent of adoption and use of agricultural technologies in Moiben Sub County, UasinGishu County, Kenya and the critical role expected on the adoption of agricultural technologies make it imperative to study the sector and look at the policy implication for the achievement of socio-economic objectives of the nation.

## 2. Statement of Problem

Rogers (2003) defines the rate of adoption as the comparative speed at which technology is adopted by different members of a society. Nkonya et al., (1997), defines it as the proportion of farmers who have adopted a specific innovation. According to Van den Ban and Hawkins (1988), the rate and pattern of adoption of innovations vary according to the type of crop, the location and the specific innovation. Therefore, the rate of adoption of a new technology is then subject to its awareness and also the profitability and the degree of risk and uncertainty linked to it, and it is closely connected to capital requirements, agricultural policies, and the socio-economic attributes of farmers. A study conducted by Raintree (1983) stated that the rate of adoption of an innovation is greatly enhanced when the proposed technology holds potential to solve perceived problems in a particular location. Similarly, a study by Byerlee and Hesse de Polanco (1986) examining the relationship between rates (speed) of adoption of technologies and various economic factors showed that the adoption pattern of a particular technology is a function of some characteristics such as profitability, riskiness.

Norton (2004) states that agriculture has developed into a field in which implementation of cutting-edge technology is mandatory, due to ongoing innovation in crop genetics such as variety of seeds and, chemical fertilizers, pest and livestock management, and machinery. The bulk of the developing world trails behind the developed world in this regard, due to self-inflicted restrictions on the use of private agricultural technologies. Kimaro et al. (2010), demonstrate that in the developing world, growth in productivity, profits and sustainability depend on the willingness of farmers to embrace change, and to use new technologies, new management structures, organizations and resources. Indeed, Salasya et al. (2007) demonstrated that rejection of appropriate maize strains was the second most significant limiting factor for maize yields. The study by Akudugu et al. (2012) in Ghana indicated that low productivity of farmers in the country was due to low adoption of modern agricultural technologies.

Over the years, agricultural production in Moiben Sub County has been declining due to low adoption of modern agricultural technologies. This was occasioned by the utilization of old production techniques and dependence on rain water. Therefore, this study tries to fill the gap by revealing the extent of adoption and use of agricultural technologies in Moiben Sub County, UasinGishu County, Kenya

### 2.1. Purpose of the Study

The main objective of this research study was examined the extent of adoption and use of agricultural technologies in Moiben Sub County, UasinGishu County. Two specific research objectives were addressed;

- To describe modern agricultural technologies utilized in Moiben Sub County.
- To examine the level of adoption and use of agricultural technologies in Moiben Sub County.

## 3. Research Methodology

This study utilized a cross – sectional survey design based on a sample drawn among farming households and agricultural officers in Moiben Sub County, UasinGishu County, Kenya. The study population comprised a comprised farming households and agricultural officers in Moiben Sub County, UasinGishu County while sample size of 112 respondents was chosen from each of the two strata i.e., farmers and agricultural officers. This study used questionnaire to collect data. The content validity was decided by chain of evidence. The reliability of instrument was decided using the test-retest techniques.

## 4. Results and Discussion of Research Findings

To examined the extent of adoption and use of agricultural technologies in Moiben Sub County, UasinGishu County, Kenya. Two specific research objectives were addressed; the Statistical Package for Social Sciences (SPSS version 23) was used to obtain the descriptive statistics. The analysis and interpretation of the findings was in line with the study objectives of.

### 4.1. Adoption and Use of Modern Agricultural Technologies

A number of respondents had differing understanding by adoption of modern agricultural technology yet what seemed as their different views were very similar in many ways. Some proportion of interviewees viewed modern agricultural technology in use in terms of new methods, while others saw it as application of new technology, and still again some considered this to mean being creative in farming. There is a convergence in the diversity of thoughts and responses.

Many respondents seemed to know what modern agricultural technologies are since they gave an affirmative yes response overwhelmingly followed by a list that was obtained across board and summarized to list the examples of modern agricultural technologies. The list suggested the following as modern agricultural technologies;

- Improved storage of produce and good post-harvest techniques,
- Use of hybrid seeds,
- Application of weed control technologies,
- Using non-human labour harvesters,
- Irrigation technologies in farming,
- Greenhouse farming,
- Artificial for breeding animals,
- Fertigation for fertilizer application, and
- Use of milking machines.

While answering a structured question as to whether they use modern agricultural technologies or not, it became affirmative that the respondents do by 70 against 32 of those who don't. A few others were indifferent since their response ticked the option 'Not Sure'. This was presented in a pie-chart as below in figure 1.

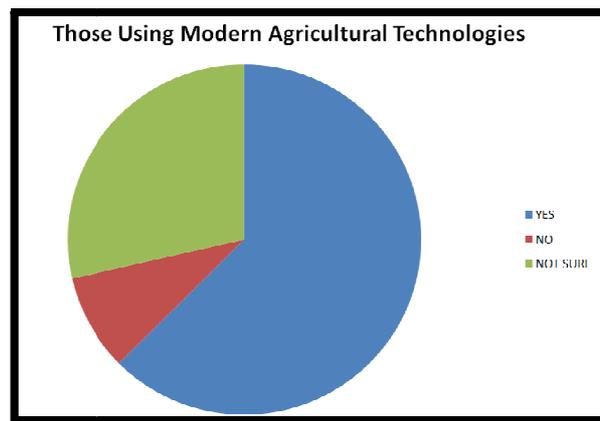


Figure 1: Pie Chart Showing Respondents Who Use Modern Agricultural Technologies in Moiben Sub-County (Farmers' Perspectives)  
Source: Author, 2021

On the specific question of the type of modern agricultural technologies the respondents use, a wide range of answers coming in form of continuous data were given based on a composite response combining both the Farmers and Agricultural Officers. The overall evaluation of the responses per each category revealed that they were highly used. In addition, the categories they picked of types of modern technologies used comprised; hybrid seeds, weed controls, artificial insemination, non-human labour harvesters, and milking machines. The continuous data presentation for these types would look as in the presentation in the table below;

S/No.	Type of Modern Agric. Technologies Used	No. of Responses	Cum. Responses
1	Hybrid Seeds	184	184
2	Weed Controls	180	264
3	Non-human labour harvesters	130	394
4	Artificial Insemination	80	474
5	Milking Machines	60	534

Table 1: Table Showing Type of Modern Agricultural Technologies Respondents Use  
Source: Researcher, 2021

The respondents were prompted by numerous reasons to use the above types of modern agricultural technologies that they chose. Some of the reasons included;

- Better yields,
- Efficiency,
- Speed of farming process,
- Cost effectiveness, and
- Easy control of hygiene

Among these reasons, the most popular reason prompting was better yields and speed of farming process. The field data further specifically pointed out that the benefits of adopting modern agricultural technologies to farmers comprise; experiencing high outputs, faster agro-processes, long-term cost saving, and making agriculture competitive.

#### 4.1.1. On Whether Agriculturalists Use Modern Technologies in Moiben Sub-County

The study sought to find out whether Agriculturalists use Modern Technologies in Moiben Sub-County. This was the first objective of the study. The results are tabulated in Figure 2 Pie Chart

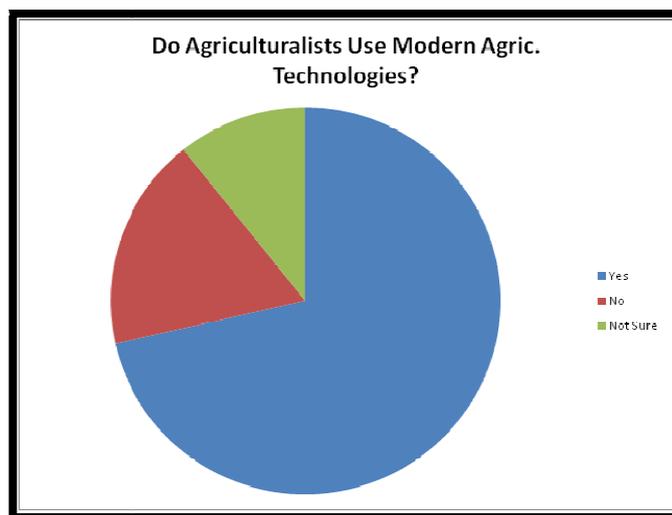


Figure 2: Pie Chart Showing Whether Agriculturalists Use Modern Technologies in Moiben Sub-County  
Source: Researcher, 2021

The Agricultural Officers’ Perspectives on the above question is succinctly addressed already in figure Figure 2 Pie Chart above which was a unanimous affirmation. Of course, this response type as already observed was parallel with what the farmers suggest summarily. The responses from the data revealed that majority of people in Moiben indeed use modern Agricultural technologies at different levels of their farming activities. Of the 112 respondents, 80 responded yes while 20 and 12 respectively took a No and Not Sure stance. The data further elaborately describes the types of modern agricultural/farming technologies that are in use in the table below.

S/No.	Modern Agric. Technologies Used in:	Types of Technologies
1	Land Preparation	Chisel Plough (Tractor pulled)
2	Planting	Planters
3		Fertigation
4	Weeding	Crop Sprayers
5		Fertigation
6	Harvesting	Combine Harvesters
7		Hay balers
8	Animal Husbandry	Artificial Insemination
9		Hand Sprays
10		Milking Machines

Table 2: Table Describing the Types of Modern Agricultural Technologies by Respondents  
Source: Researcher, 2021

The deviation from agricultural officers as to use of modern agricultural technologies is frequency of use and the fact that they are non-integral part of agricultural activities. Many farmers due to strains are quick to imply technology as expensive thus adding costs unnecessarily to farmers hence only used when conditions require quick fixing of farm problems. This attitude, the officers say is one area which they continue to destigmatize out of the farmers.

**4.1.2. The Extent of Adoption and Use of Agricultural Technologies in Moiben Sub-County**

In this section, the extent to which farmers have adopted the farming agricultural technologies recommended in Moiben Sub-County is discussed. Frequencies and percentages were used to establish the extent of adoption and use of agricultural technologies of the improved agricultural technologies practices that go with those farming. These statistical methods together were used to categorize the data as. The criteria for this categorization and the extent of adoption and use of agricultural technologies using these criteria are also discussed in this section. This question was subjected to Likert Scale as a rating methodology. The outcome of this response which the researcher herself was able to undertake revealed that there is a big extent of adoption and use of agricultural technologies in Moiben Sub-County. Having been divided into three measures; High extent, moderate extent, and low extent, the responses indicate there was high extent of adoption since the leaning towards moderate and high extent represented 100 respondents against 12 suggesting low extent. The researcher was able to assess this by posing the question to the farmers directly. This is represented in the table below;

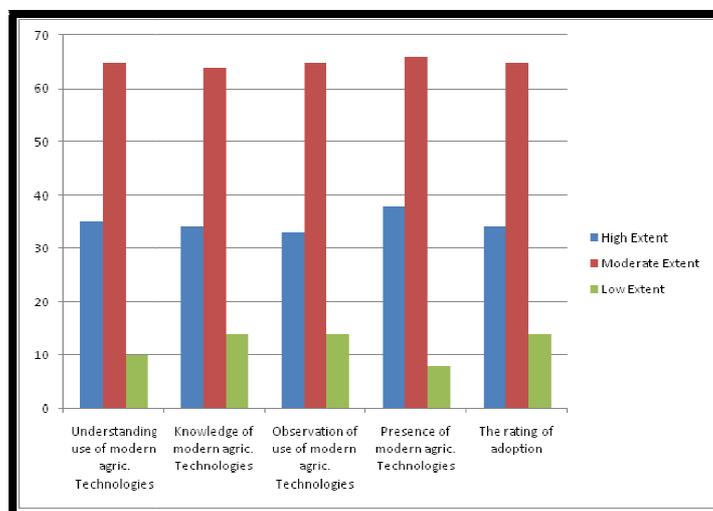
S/No.	Measure of Extent	High Extent Responses	Moderate Extent Responses	Low Extent Responses
1	Understanding use of modern tech.	35	65	10
2	Knowledge of Modern technologies	34	64	14
3	Observation of Use of technologies	33	65	14
4	Presence of modern technologies	38	66	8
5	Rating Adoption	34	65	14
	<b>Averages of Extent Levels</b>	<b>34.8</b>	<b>65</b>	<b>12</b>

*Table 3: Table Showing Extent of Adoption and Use of Agricultural Technologies in Moiben Sub-County (Farmers' Perspective)*  
Source: Researcher, 2021

S/No.	Measure of Extent	High Extent Responses	Moderate Extent Responses	Low Extent Responses
1	Understanding use of modern tech.	15	36	21
2	Knowledge of Modern technologies	22	30	20
3	Observation of Use of technologies	27	35	10
4	Presence of modern technologies	26	34	12
5	Rating Adoption	22	30	20
	<b>Averages of Extent Levels</b>	<b>22.4</b>	<b>33</b>	<b>16.6</b>

*Table 4: Table Showing Extent of Adoption and Use of Agricultural Technologies in Moiben Sub-County (Agricultural Officers' Perspective)*  
Source: Researcher, 2021

This question the extent of adoption and use of agricultural technologies in Moiben Sub-County was subjected to Likert Scale rating for Agricultural Officers also. The response outcome which the researcher herself was able to undertake revealed that there is high extent of adoption and use of agricultural technologies in Moiben Sub-County. The trend the answers obtained from the officers almost resembled those of the farmers. Outcomes revealed high extent of adoption by a look at the figures of responses linked to moderate and high extent respondents against the low extent ones. This is captured in Figure 3 above.



*Figure 3: Bar Chart Showing Extent of Adoption and Use of Agricultural Technologies in Moiben Sub-County (Farmers' Perspective)*  
Source: Researcher, 2021

Figure 3 indicates by the blue and red colours the extent of adoption and use of modern agricultural techniques. As in the table above for example, their understanding was rated as 35, 65, and 10 on the basis of high, moderate, and low extent respectively. Though other measures had different respondent's data on the same, the overall averages of the rated levels depicted this same trend as; 34.8, 65, and 12 to high, moderate, and low levels. In terms of which modern technologies the respondents lack, they expressed that in such situations they hire from large scale farmers who have them despite delays when need arises.

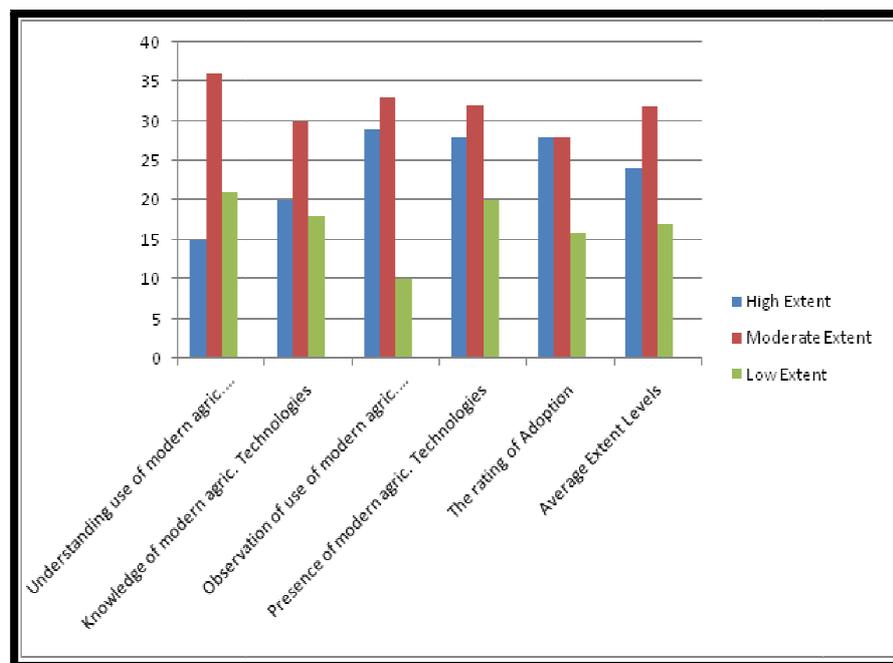


Figure 4: Bar Chart Showing Extent of Adoption and Use of Agricultural Technologies in Moiben Sub-County (Agricultural Officers' Perspective)

Figure 4 just like figure 3 indicates by the blue and red colours the extent of adoption and use of modern agricultural techniques. In this table, the understanding of farmers of use of modern agricultural technologies by farmers was rated as 15, 36, and 21 on the basis of high, moderate, and low extent respectively. The outcome of this response tends to point that there is low understanding, quite a marked difference from table 1. It is observed in the current table 2 that there is observation of use, presence of, and good rating of agricultural technologies. It is a confirmation from the experts that despite use, some farmers do not even know they use modern agricultural technologies. The averages as per agricultural officers as to use of modern agricultural technologies tend to high in contrast to farmers' response captured in table 1.

Respondents thought and expressed that they can improve adoption of modern agricultural technology among farmers through;

- Getting better training which they receive only occasionally,
- Government setting up demonstration farms in the Sub-County,
- Put incentives for those using such technologies to encourage change, and
- Giving financial credit in form of the technologies to be improved.

In addition to these sentiments, agricultural officers' response indicated that farmers need to be deliberately willing to seek for information and technologies that improves their business (agriculture). The tendency to wait for external push should not be the best drive since the beneficiary is them both in income and as recipients of farm outputs (food).

## 5. Conclusions

Based on the results of the study the following conclusions were drawn based on the objectives of the study in relation to modern agricultural technologies and the extent of adoption and use of agricultural technologies in Moiben Sub County, UasinGishu County, Kenya.

The findings of the study showed modern agricultural technologies utilized in Moiben Sub County to cope with insufficient food that that majority of the respondents agreed with. It included; improved storage of produce and good post-harvest techniques, use of hybrid seeds, application of weed control technologies, using non-human labour harvesters, irrigation technologies in farming, greenhouse farming, artificial for breeding animals, fertigation for fertilizer application, and use of milking machines. The overall evaluation of the responses per each category revealed that they were highly used. In addition, the categories they picked of types of modern technologies used comprised; hybrid seeds, weed controls, artificial insemination, non-human labour harvesters, and milking machines.

The conclusion made from the findings about the extent to which of adoption and use of agricultural technologies in Moiben Sub County was that most of the respondents in the study sample indicated to a very big extent of adoption and use of agricultural technologies in Moiben Sub-County This entailed that there was high extent of adoption since the leaning towards moderate and high extent represented 100 respondents against 12 suggesting low extent. The trend the answers obtained from the agricultural officers almost resembled those of the farmers. Therefore, the outcomes study revealed high extent of adoption against the low extent. The study concluded that farmers need to be deliberately willing to seek for information and agricultural technologies that improves their business (agriculture) and socio economic development.

## 6. Recommendations

The study was conducted on the the extent to which of adoption and use of agricultural technologies in Moiben Sub County, UasinGishu County, Kenya. Consequently, apparent of the findings, discussions and conclusions of this study, the following recommendations based on specific objectives were made:

- The study established information gap as one factor that impedes adoption and use of agricultural technology in MoibenUasin-Gishu County, Kenya. There is therefore need to strengthen contact between the technology promoters and the farmers. This can be done by raising the number of agricultural extension officers in the region and improving their access to the farmers by providing them with transport means and all the necessary materials required for dissemination of agricultural technologies.
- Though the types of modern agricultural technologies and usage level indicated an average response combined, focus should be placed on each individual type of modern agricultural technologies and its impact of agricultural development. This will make attribution and measurement easier. To tackle obstacles to modern agricultural technologies usage community participation is required to address perceived negative attitudes and behaviour towards modern agricultural technologies. This eliminates the idea of technologies being damped on users. Modern agricultural technologies initiatives should be people centred (farmers).
- To improve productivity, small-scale farmers require the availability of advanced innovations and best practices, and to adequate, up to date and detailed information on production, value addition and markets.
- Modern innovative agricultural technologies have had mixed impacts in addressing the productivity problems facing agriculture in many parts of the developing world, especially in sub-Saharan Africa. The mechanization era is now often associated with numerous machinery graveyards in failed mechanization schemes and to date, efforts to mechanize the small-scale farm remains elusive. The debate on the benefits and demerits of agricultural biotechnology still rages on, while the problems of declining agricultural productivity and increasing food insecurity persist in many regions. There is a need to instigate collaborative and farmer-oriented adaptive R&D on nano-agriculture for the transformation of traditional subsistence agriculture into contemporary market-oriented agriculture.
- The aforementioned summary of major findings provided a comprehensive picture on the multifaceted impacts of technological change in agriculture. However, synthesizing the nature of these multifaceted impacts of technological change on key economic variables and the environment would provide the basis for strategic agricultural development planning for years to come.
- There is need for farmers and extension officers to be educated on innovations that will raise yields, as well as technologies that will restore soil fertility, as well as conservation and other technologies that can positively contribute to high productivity among farmers. This will increase awareness on the availability and usefulness of the technologies.

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