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Horticultural innovation practice, challenges and impacts on livelihoods among farmers in Wareng sub-country, Kenya

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Abstract
This paper sought to establish horticultural innovations currently practiced by farmers in Wareng Sub- County, Kenya. This study adopted a descriptive survey method. The sampling frame for this study was 1480 households and 35 technical staff from Ministry of Agriculture in Wareng Sub- County. Systematic random sampling technique was used in selecting 182 household heads and purposive sampling technique was used in selecting 6 technical staff from Ministry of Agriculture Livestock and Fisheries. Both primary and secondary data was obtained for the study. Interviews schedules, questionnaires and observation were used for data collection. The study utilized descriptive analysis techniques. Quantitative data was analyzed by use of measures of frequency distribution such as frequencies, and percentages while qualitative data was summarized and interpreted in line with the research objectives and questions. Results of data analysis were presented in form of figures and tables. The study findings indicated that most of the horticultural farmers in Wareng Sub- County used chemical innovations 27.2%, integrated pest management 17.%63 and biological innovations (new seed varieties) 15.81% in order to increase productivity in their farms. It was recommended that the government should subsidize horticultural farm inputs, fertilizers, pesticides and seeds to enable the farmers afford them so that they increase horticultural farming and also to encourage more farmers to involve themselves in horticultural farming. This study recommends that trainings for the farmers should be farmer tailored. The government should see to it that policies addressing horticultural issues already in place are implemented.

Keywords: Horticulture, innovation, greenhouse, livelihood, adoption

1. Introduction
Most of the economies in Sub-Saharan Africa largely depend on agriculture for food and income provision. In this region, more than 50% of the population relies on agriculture for their livelihood and the sector contributes more than 30% of the Gross Domestic Product (Van Straaten, 2002) [7]. Productivity increase in agriculture can reduce poverty by increasing farmers' income, reducing food prices and thereby enhancing increments in consumption (Diagne *et al.*, 2009) [4].
Several research findings have pointed to the fact that the use of new agricultural technology, such as high yielding varieties that kick-started the Green Revolution in Asia, could lead to significant increase in agricultural productivity in Africa and stimulate the transition from low productivity subsistence agriculture to a high productivity agro-industrial economy (World Bank, 2008) [8]. This implies that agricultural productivity growth will not be possible without developing and disseminating cost effective yield-increasing technologies, since it is no longer possible to meet the needs of increasing numbers of people by expanding the area under cultivation or relying on irrigation (Datt and Ravallion, 1996) [2].
Horticulture is divided into three main sections; Pomology (that is fruit growing), market gardening (that is vegetables and herbs growing), and ornamental cultivation (floriculture). Innovations are new methods, customs, or devices used in horticultural farming to perform new tasks. Innovations have been categorized into classes which include mechanical innovations (tractors and combines), biological innovations (new seed varieties), chemical innovations (fertilizers and pesticides), agronomic innovations (new management practices), biotechnological innovations, and informational innovations that rely mainly on computer technologies (Ball *et al*., 1997) [1].
Many technologists believe that advantageous innovations will sell themselves, which the obvious benefits of the new idea was widely realized by potential adopters, and that the innovation will therefore diffuse rapidly, this is rarely the case. Most innovations, in fact, diffuse at a disappointingly slow rate (Rogers, 1995) [9].
The utilization and viability of agricultural technologies are influenced by political, social, economic and institutional constraints. Any decision to adopt technology would be based not only on profitability but also on potential tangible social and cultural benefits. According to Doss (2006) [6], farmers will adopt technologies if they do not seriously disrupt existing farming systems, jeopardize their subsistence, or introduce additional strains on already constrained and limited resources.

2. Methodology
This study was conducted in Wareng Sub- County of Uasin-Gishu County. The content scope is to establish horticultural innovations currently practiced by farmers. This study adopted a descriptive survey method. The sampling frame comprised of the targeted 1480 household heads drawn from 61866 households. The 35 agricultural staff in the sub-county was the sample frame to pick the staff.
Kesses Sub-County has 10 locations and Kapsaret sub-county has 4 locations. From each sub-county half of the locations were sampled by simple random technique. The locations

selected through simple random technique were Kapseret, Ngaria, Chagaiya, Kapkoi, Tarakwa, Oleinguse, and Kesses.
Six (6) Agricultural staff were purposively selected from 35 staff in the sub-county depending on subject matter specialist relevant to this study and the heads of both sub-county. The total sample size for this study was 182 household heads and 6 agricultural staff making a total of 188. From each location randomly selected 26 household heads were selected using systematic random sample design. The sample size was determined from the formula proposed by Yamane (1967) [10]. The tools used in collection of data relevant to this study were interview schedules, questionnaires. The study utilized descriptive analysis techniques. Quantitative data was analysed by use of measures of central tendencies such as frequencies and percentages.

3. Results

3.1 Horticultural innovations currently practiced by Farmers

There are several horticultural innovations which are being practiced by farmers in Wareng Sub- County. It was necessary to asked farmers whether they practiced horticulture in their farms or not. The study findings showed that all the targeted farmers practiced horticulture. The respondents were further asked to indicate the horticultural innovations they practiced to increase productivity in their farms. The results are presented in Table 1.

Table 1: Horticultural innovations currently practiced by farmers

Innovation	Frequency	Percentage
Entrepreneurship matters	84	12.77
Biological innovations (new seed varieties)	104	15.81
Economic collaboration	78	11.85
Integrated pest management	116	17.63
Zero tillage	66	10.03
Chemical Innovations	179	27.20
Agronomic Innovations	31	4.71
Total	658	100.00

3.2 Factors that influence adoption of horticultural innovations

Table 2: Factors that influence adoption of horticultural innovations in Wareng Sub-County

Factors	Frequency	Percentage
Age	54	5.3
Gender	120	11.9
Educational level	141	13.9
Training attended	165	16.3
Marital status	32	3.2
Yields Associated	144	14.2
Accessibility of horticultural markets	85	8.4
Accessibility of agricultural extensions Services	125	12.4
Land Size	145	14.3
Total	1011	100.00

Table 2 shows that 16.3% farmers cited that the training they had attended influenced their adoption of horticultural innovations, 14.3% farmers indicated that they were influenced by the land size they had, 14.2% farmers indicated that they were influenced by yields associated with the innovation. While 13.9% cited that the level of education influenced their adoption of horticultural innovations, 12.4% farmers cited that they were influenced by accessibility of agricultural extensions Services and 11.9% farmers indicated that their gender influenced farmers' adoption of horticultural innovations.

3.3 Impacts of Adopted Horticultural Innovations on Livelihoods

Table 3: Source of Livelihoods to farmers

Source of Income	Frequency	Percentage
Casual Work	54	16.5
Trade	93	28.6
Farming	179	54.9
Total	326	100.00

The results showed that 54.9% of the farmers depended on farming as a major source of income, 28.6% of the farmers engaged in trade for their livelihoods while 16.5% of the
Farmers also engaged in casual work in order for them to earn their livelihoods as shown in Table 3.
The results showed that 34.60% of the farmers earned over Kshs 80,000 per year from the horticultural produce, 27.40% farmers earned Kshs 60,000 – 80,000, 16.80% farmers earned Kshs 40,000 – 60,000 per year and 12.8% farmers earned Kshs 20,000 –40,000 per year while 8.40% earned less than Kshs 20,000 per year from horticulture.

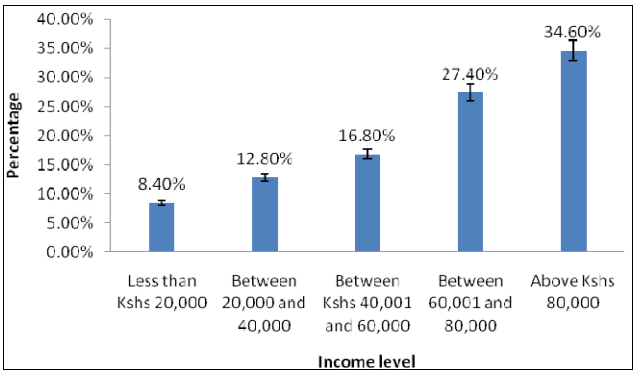

Fig 1: Average household income earned by farmers per year from horticultural produce

Figure 1. Shows that majority (61.0%) of the farmers earned over Kshs 60,000 per year from horticultural farming an implication that most of the farmers depended on horticultural produce for their livelihoods. The figure further shows that the adoption of horticultural innovations had an impact on household income enhancement. Most of the key informants interviewed further noted that farmers who had adopted horticultural innovations in the study area earned more than Kshs 40,000 per year making them self-sufficient on food. Further, these farmers' income had improved resulting to higher socio-economic status from the horticultural enterprises.
Further, the respondents were asked to indicate the amount of horticultural produce they consumed in their families per day. The results showed that 82.7% of the farmers consumed 2-4kgs of the produce per day while 17.3% farmers consumed less than 2kgs of the produce per day.

Similarly, the farmers were asked to indicate whether they harvested their horticultural produce throughout the year or not. The results showed that all the farmers did not harvest the horticultural produce throughout the year. The farmers did not harvest their horticultural produce throughout due to some challenges they encountered and this leads to shortage of sources of livelihood in some seasons of the year.

3.4 Challenges to adoption of horticultural innovation

Table 4: Challenges facing horticultural practices in Wareng Sub-County

Challenges	Frequency	Percentage
Lack of water for irrigation	148	38.1
Lack of adequate extension services	31	8.0
Lack of credit services	56	14.4
Lack of adequate land to practice horticulture	28	7.2
Lack of market for the horticultural produce	18	4.6
Inadequate labour	21	5.4
Inadequate skills	23	5.9
High cost of production involved	63	16.2
Total	388	100.00

Table 5 shows that among these challenges 38.1% of the farmers cited lack of water for irrigation, 16.2% of the farmers indicated high cost of production involved, 14.4% of the farmers cited lack of credit services and 8.0% of farmers indicated lack of adequate extension services. While 7.2% pointed out that lack of adequate land to practice horticulture was there challenge, 5.9% indicated inadequate skills, and 5.4% cited inadequate labour and 4.6% cited lack of market for the horticultural produce.

4. Discussions

4.1 Horticultural innovations currently practiced by Farmers

On interviewing the key informants it emerged that farmers had adopted the use of chemicals especially for providing nutrients to their crops, preventing and curing disease infections and pest infestation, and to control weeds in their horticultural farms. It was realized that all the horticultural farmers had invested heavily on chemicals to enhance their productivity. The farmers sprayed their horticultural crops at least once in a week especially during rainy season making their investments to be expensive ventures. However it further emerged that these adoptions have led to environmental degradation in that water quality lowered as these chemicals pollute the water bodies. The informants also pointed out that there are farmers who did not adopt the use of chemicals or who did not use them sufficiently due to the costs of these chemicals.

Similarly, it was also noted that all the farmers used new seed varieties for the various horticultural crops with an aim of increasing their production. However they pointed out that most of the new seed varieties are very expensive for example ANNA F1 10g costing about 3000/=, which makes the adoption of horticultural innovations an expensive exercise. The key informants indicated that generally there is an increase in crop productivity when the farmers adopt an innovation in turn translates to increased income.

4.2 Factors that influence adoption of horticultural innovations

Adoption of horticultural innovations is influenced by several factors. The measures of adoption may indicate both the timing and extent of new technology utilization by individuals to increase productivity. The second objective of this study was to determine the factors that influence adoption of horticultural innovations Wareng Sub- County. To achieve this, farmers were asked to indicate the factors that influence their adoption of horticultural innovations.

On interviewing the key informants (Agricultural extension officers) it emerged that farmers were mostly influenced by their level of education and trainings they have attended on horticultural enterprise management. These trainings were mostly in form of farmers' training forums like field days, demonstrations, agricultural shows and agricultural trade fares. Similarly, farmers were exposed to horticultural innovations through the media such as the newspapers, radio and television programmes which deal on agricultural production like the shamba shape up programme in citizen TV. This was supported by (Magomere, 2003) University of Nairobi, Kenya, observation) who undertook a study on factors influencing farmer participation in the adoption of horticultural innovations in Kakamega and Machakos districts of Kenya, the research found that farmer personal characteristics including age, marital status and educational level and accessibility to horticultural markets influenced farmer participation in horticultural improvement programmes.

Yields associated with innovations such as use of new seed varieties also encouraged farmer participation in horticultural innovations. It emerged that farmers who had adopted horticultural innovations motivated other farmers to adopt these innovations due to yields associated with adoption of these innovations. For example one of the agricultural extension officers noted that use of new seed varieties of potatoes like Kenya mpya, Tigoni in the area had resulted to high yields as compared to the ordinary seeds.

Diagne (2006) also assessed the impact of NERICA adoption on rice yield in Cote d'Ivoire. The results showed a positive and significant increase in yield particularly on the female farmers.

4.3 Impacts of Adopted Horticultural Innovations on Livelihoods

The third objective of this study was to assess impacts of adopted horticultural innovations on livelihoods and environment Wareng Sub- County. It was important for the researcher to understand the most important sources of income to farmers in Wareng Sub- County in order to know whether the adopted horticultural innovations had an impact on their livelihoods.

Most of the key informants interviewed noted that most of the inhabitants of the study area depended on farming for their livelihoods. This has encouraged the farmers to adopt horticultural innovations with an aim of increasing their productivity and hence high income and food security. According to Dontsop Nguezet, P. M. *1, Diagne A., Okoruwa, V. O., and Ojehomon, V. (2011) [5] in their study which examined the impact of New Rice for Africa varieties

(NERICAs) adoption on income and poverty among rice farming household in Nigeria. The results showed that while there is a significant difference between the gross incomes of adopters and non-adopters, there was no significant difference in the amount spent per head by both groups. The incidence of poverty was higher among non-NERICA adopters (50.2%) than NERICA adopters (45.5%). In addition, both the depth and severity of poverty were also higher (19.25% and 10.02%) among non-adopters than the adopters (15.28% and 7.76%). All three poverty measures indicate that poverty was more prevalent and severe among non-adopter compared to adopters.

4.4 Challenges to adoption of horticultural innovation

The key informants interviewed noted that most of the horticultural crops need adequate and reliable water supply especially if they are grown for export to fetch more income. However, it emerged that most farmers did not have adequate and reliable water sources as they depended mostly on rain water. In the study area, long rains are experienced during the months of April to September while short rains are experienced during the months of November to December. Sometimes this rainfall trends are never experienced making those farmers who depend on rain for agriculture to lose their crops and the investments they had invested. The key informants also noted that the cost of farm inputs was very high for example the new seed varieties and this had discouraged the farmers from participating in horticultural crop enterprises and hence innovations. The results agreed with (Warrington, I.J. (2010) observation) which according to him the most topical issue that is facing horticultural production in almost all areas of the world is the availability of water. Pressure on water resources for urban, industrial, recreational, conservation and other uses all appear to have higher priority within societies than the availability of water for horticultural crop production.

5. Conclusion

Most of the horticultural farmers in Wareng Sub- County used chemical innovations, integrated pest management and new seed varieties in order to increase productivity in their farms.

The most important factors that influenced adoption of horticultural innovations amongst the farmers included training attended by farmers, land size, accessibility to agricultural extension services and educational level of farmers.

The adoption of horticultural innovations had a positive impact on household income enhancement.

The study findings showed that among the challenges encountered by horticultural farmers included lack of water for irrigation, high cost of production involved, lack of credit services and lack of adequate extension services.

6. Recommendations

The following recommendations were made based on the study findings;

- The government should subsidize horticultural farm inputs, fertilizers, pesticides and seeds as done for maize, wheat and Irish potatoes through NAAIAP, the program aims at increasing the farmers' income, food security and demand for fertilizer and certified seeds. If horticultural farm inputs are subsidized it will enable the farmers afford them so that they increase horticultural farming and also to encourage more farmers to involve themselves in horticultural farming.
- Trainings for the farmers should be organized in such a way that most farmers can afford and should be at venues very convenient to most of the farmers. The agricultural private sectors should be supported or facilitated by the government to organize farmers training on horticultural farming so that more farmers receive these horticultural farming trainings. Agricultural shows of Kenya should organize shows specific for horticultural farming so that trainings on all the many horticultural crops can be done on all the stages that is from seed sowing and other propagation methods to harvesting stages. This will enable the farmers know management practices at all growth stages.

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