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# Effectiveness of Agricultural Extension Human Wildlife Conflict Mitigation Strategies among Small-scale Maize (*Zea mays*) Farmers in Laikipia West Sub County, Kenya

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## Abstract

Agriculture is critical in the achievement of food security, creation of employment opportunities, steering economic growth, and also a source of raw materials for agricultural industries in many Sub-Saharan countries. However, the small-scale farmers face various challenges which negatively affect farm productivity and production. Human-wildlife conflict is one of the most pressing challenges that small-scale maize farmers experience in some parts of Kenya. It arises from either people's encroachment on wildlife habitats or the movement of wildlife from their natural habitat into the neighbouring farmland. The small-scale farmers use various agricultural extension strategies to mitigate the conflict. However, the effectiveness of the agricultural extension human wildlife conflict mitigation strategies adopted by small-scale maize farmers in Laikipia West Sub-County had not been investigated and information on the same was inadequate and poorly documented. This study therefore, sought to determine the effectiveness of the agricultural extension human wildlife conflict mitigation strategies adopted by small-scale maize farmers in Laikipia West Sub-County. Whereas a document review guide was used to collect secondary data, semi-structured questionnaires were used to collect primary data from maize farmers and extension agents. Descriptive statistics were used to analyze primary data. It was established that crop damage was very severe, of up to 70% or even more per cropping season although farmers used various mitigation strategies such growing of unpalatable crops, live fences, grow resistant crop varieties and digging of trenches. This study concluded that the Agricultural Extension Human Wildlife Conflict Mitigation Strategies used were not effective. It was recommended that concerted efforts between stakeholders be used in dealing with the conflict to realize the benefits of synergies so as to stop crop damage and give small-scale farmers a chance to be food secure.

*Keywords:* human-wildlife conflict, mitigation strategies, small-scale farmers; Sub-county

## Introduction

Agriculture is important for achievement of food security, is a source of employment, contributes to the world's Gross Domestic Product (GDP) and economic growth (Alliance for a Green Revolution in Africa, (AGRA), 2013; Hanson, 2013). The agriculture sector also employs more than 65% of the total workforce in Africa (Huho and Kosonei, 2013). In the developing countries, when the agriculture sector grows, it increases income generation and reduces poverty levels (World Bank, 2012). Consequently, the agriculture sector is considered vital in the achievement of both Sustainable Development Goals 1 and 2, of ensuring that there is no poverty and no hunger, respectively (United Nations, 2015). In the developing countries, and in Kenya in particular, the agriculture sector is a source of food, income and employment (Biwott and Muriu, 2013). Despite the agriculture sector being crucial in achieving food security, creating employment and promoting economic growth, the small-scale farmers located in different parts of the world are confronted by numerous challenges. The small-scale farmers in Africa suffer from the effects of wildlife menace (Lamarque et al. 2009). The small-scale farmers in Kenya, particularly those in Laikipia West Sub County experience the problem of human-wildlife conflict (GoK, 2010; 2012; Ministry of Forestry & Wildlife, 2012). Human wildlife conflict is a phenomenon experienced in various parts of the world, especially where people and wildlife compete for scarce resources, besides sharing boundaries (Eniang et al. 2012; Musimbi, 2013). When human-wildlife conflict occurs, it leads to injury or death of livestock or even people, loss of crops, disease transmission or damage to various infrastructures. To mitigate human-wildlife conflict, small-scale farmers use various agricultural extension human-wildlife conflict mitigation strategies (AEHWCMS) after being trained by extension agents. The AEHWCMS include growing crops that are unpalatable to wildlife such as chilli, growing of resistant crop varieties, digging trenches to form a barrier to wildlife and also growing live fences such as Mauritius thorn, sisal or kai apple to form a barrier against wildlife entry. Although farmers use these mitigation strategies against wildlife, their effectiveness among small-scale maize farmers in Laikipia West Sub County had not been studied and information about the same was inadequate and poorly documented.

## Statement of the problem

In Kenya, the agriculture sector is important for the achievement of food security, generating employment and income, and providing raw materials for agro-based industries. However, the sector is affected by various challenges, one of the major one being the human-wildlife conflict. This results from either human encroachment on wildlife habitats and or movement of wildlife out of their unprotected areas into the areas neighbouring farms. When wildlife move out of their habitats into the farms, they damage crops, injure or kill livestock or even people. Available information on how much effective agricultural extension human wildlife conflict mitigation strategies used by small-scale maize farmers are was inadequate and poorly documented. This could mean that farmers will continue using mitigation strategies that are not effective and remain vulnerable to the conflict. This study sought to provide information to policy makers and agricultural extension service providers for them to plan better on how to reduce human wildlife conflict among small-scale farmers and help them to be food secure.

## Purpose and Objectives of the Study

This study sought to establish the effectiveness of agricultural extension human-wildlife conflict mitigation strategies (AEHCMS) used by small-scale maize farmers in Laikipia West Sub County. This information will be made available to extension service providers and policy makers who will use it to plan better on how to mitigate the conflict. The following objectives guided the study;

- i. To determine the AEHCMS adopted by small-scale maize farmers
- ii. To determine the extent of crop damage among small-scale maize farmers
- iii. To establish the effectiveness of the AEHCMS used by small-scale maize farmers

## Methods and Study Site

This study was done in Laikipia West Sub County. Laikipia West Sub County is one of the five Sub Counties in Laikipia County and it constitutes the Arid and Semi Arid parts. It covers an area of 3,188.8 km<sup>2</sup>. more than 70% of the communities in the sub county derive their livelihood from agricultural activities, with the main crops being maize and beans (GoK, 2013). The sub county has a total population of 129,263, with a total of 33,025 households (GoK, 2019). The sub county has a poverty index of 43.5%, with the poverty level being attributed to human-wildlife conflict and insecurity. During the study, a descriptive cross-sectional survey research design was used among small-scale maize farmers in Laikipia West Sub County. Small-scale farmers are the majority of farmers in Laikipia West Sub County. Public extension agents were involved because they teach farmers about various human-wildlife conflict mitigation strategies. A farmers' questionnaire was administered on 203 farmers who were selected using Simple Random Sampling (SRS) while extension agents' questionnaire was administered on 10 agents who were purposively selected. The semi-structured questionnaires were used to collect primary data, both from farmers and extension agents. The questionnaires collected both qualitative and quantitative data on the extent of crop damage, and the effectiveness of the mitigation strategies adopted so as to address the study objectives. A document review guide was used for collecting secondary data. The questionnaires and document review guide were developed by the researcher and validated by 5 agricultural extension experts of Egerton University. Primary data were collected for the years 2012 to 2015, with 2012 serving as a baseline. Data were analysed using the mean, mode and frequencies using the SPSS.

## Results

### Agricultural Extension Human-wildlife Conflict Mitigation Strategies (AEHCMS)

In Laikipia West Sub County, maize crop is attacked mainly by monkeys, elephants, buffalo, porcupine, birds, squirrel and hippopotamus. The small-scale maize farmers use combination of various AEHCMS against wildlife attack, especially establishing of a live fence, growing of unpalatable crops and digging of trenches being commonly used strategies, as shown in Table 1.

Table 1

AEHWCMS Adopted (n=203)

Strategy	Wildlife involved	Adopting Farmers (%)
Growing resistant crop varieties	birds	9.5 (n=19)
Digging trenches	Elephant, hippo	21.7 (n=44)
Growing a live fence	Monkey, elephant, buffalo, zebra	45.3 (n=92)
Growing unpalatable crops	Monkey, elephant, zebra	38.7 (n=79)

### Extent of Crop Damage

This study revealed that small-scale maize farmers in Laikipia West Sub County experience a severe crop damage, which occurs up to or even more than 70% per acre per cropping season, as shown in Table 2.

Table 2

Extent of Crop Damage per Acre (n=203)

Year	Extent of damage
2012	68 (n=167)
2013	69 (n=174)
2014	70 (n=187)
2015	69 (n=182)

### Effectiveness of Agricultural Extension Human-wildlife Conflict Mitigation Strategies

In this study, the term 'effectiveness' was used to mean the degree to which an AEHWCMS could reduce crop damage by at least 10%. This was based on a rating of the AEHWCMS by sampled farmers and extension agents on a five-point Likert scale. Farmers rated the effectiveness of each strategy they used on their farms. Further, extension agents who had trained the farmers on extension mitigation strategies and also observed their adoption by farmers rated the strategies on the degree of effectiveness. The sum of values of the rates by both farmers and extension workers were used to estimate the rate of the AEHWCMS. This study found that the small-scale maize farmers in Laikipia West Sub County use AEHWCMS that have low rates of effectiveness, as shown in Table 3.

Table 3

Degree of Effectiveness of AEHWCMS (n=203)

Strategy	Targeted wildlife	Rate of effectiveness
Growing unpalatable crops	Elephant	25.0 (n=53)
	Monkey	30.0 (n=64)
	Zebra	31.6 (n=68)
Growing a live fence	Elephant & buffalo	25.0 (n=53)
	Zebra	27.3 (n=58)
	Antelope, gazelle/ impala	26.1 (n=55)
Digging trenches	Elephant/gazelle/impala	33.3 (n=70)
	Hipopotamus	28.6 (n=62)
Growing resistant crop varieties	Weaver bird	33.3 (n=70)

## **Discussion [Conclusions/Implications]**

Growing maize varieties that have tightly covered husks and cobs reduce attack by birds. Digging trenches measuring six feet wide and six feet deep around the farm can form a barrier against elephant and hippopotamus. Mauritius thorn, sisal or kai apple can be grown as a barrier against monkeys, elephant, buffalo, and zebra. Crops that are unpalatable to monkeys such as sunflower and pyrethrum can be integrated into a crop rotation cycle. About two to three lines of chilli can be grown around the main crop to act as a repellent to oncoming wildlife. Chilli, tobacco, pyrethrum and sunflower can be grown around the main crop to act as a repellent to elephants. Further, crops that are unpalatable to zebra such as sunflower and pyrethrum can be grown around the main crop to repel the wildlife. These findings match with those of other studies which showed that small-scale farmers in African countries grow unpalatable crops such as chilli to mitigate elephant attack (Hockings and Humle, 2009; King et al. 2011). Chilli is also used in the Queen Eliabeth Park Area) in Uganda (Babaasa et al. 2013). Live fences are also used in Kibale and Bwindi Areas of Uganda against gorilla, baboon and elephant while trenches are used against elephant and buffalo in the Kibale and QEPA regions.

Findings of this study also showed that crop damage among small-scale maize farmers in Laikipia West Sub County is very high. These findings concur with those of a study done in Nigeria which showed that crop damage by wildlife in some cases is as high as 98% per acre per year (Eniang et al. 2011) and about 65% of maize crop per year in Tomboro area of Cameroon (Eyebe et al. 2012). These high crop damage values could mean that the AEHCMS used by the small-scale farmers are not effective. Results of this study further showed that the AEHCMS used by the small-scale maize farmers in Laikipia West Sub County have low rates of effectiveness, as low as 25%. The average rate of effectiveness of all the AEHCMS was just about 33%. The low rate of effectiveness means that the AEHCMS used by the small-scale farmers are not effective. This could be attributed to the farmers not using the mitigation strategies as recommended. This was shown by a large proportion (87.5%) of farmers who had a negative attitude towards the mitigation strategies promoted by extension workers. This results from their failure to accept the mitigation strategies, for instance, the use of chilli and pyrethrum. Further, the small-scale land holdings that is common among most farmers (50%) hinders adoption of some strategies, especially digging trenches and planting of live fences such as Mauritius thorn and sisal. Such plants take long to grow fully to establish effective bush so as to serve as a mitigation strategy. Additionally, most (75%) farmers had inadequate knowledge and skill on the available AEHCMS and their use. A study done along the Greater Virunga Landscape (GVL) showed that live fences, especially mauritius thorn are effective against baboons, gorilla and bushpigs (Andama, 2009; Babaasa et al. 2013). This is possible especially when it is planted and maintained as recommended, particularly if planted in three rows, 30cm apart, when branches are layered and intertwined to form an animal-proof barrier. Effective AEHCMS will restrict wildlife from accessing farms and people prevented from encroaching wildlife habitats, and the probability of an outbreak of human wildlife conflict will be minimised significantly, and the degree of severity of crop damage will be very low.

## **Conclusion, implication and recommendations**

Wildlife is conserved in Laikipia West Sub County although it has no wildlife habitat protected or gazetted area. Furthermore, people are settled adjacent the wildlife habitat and are allowed to undertake farming activities in the areas neighbouring the unprotected wildlife habitat. Wildlife freely move out of their unprotected habitat into the farmland, thereby causing damage to crops and even injuring livestock and even killing people. This study established that small-scale maize farmers use various AEHCMS in combination such as growing of crops that are unpalatable (38.7%) to wildlife such as chilli, sunflower and pyrethrum. About 45.5% of farmers dig trenches around the farm to form a barrier against wildlife entry. The low proportion of farmers using the AEHCMS could be attributed to their lack of adequate knowledge about the mitigation strategies or they might have realised that they are not effective and abandoned them. This could mean that the farmers will continue experiencing significant crop losses which could affect their productivity, production and household food security. The study further established that small-scale farmers experience heavy crop losses of up to 70% or even more due to wildlife attack even if they were using the AEHCMS. This study also found that the adopted AEHCMS were of low degree of effectiveness. For example, unpalatable crops were 30% effective, live fences 27%, trenches 33% and growing of resistant crops 33% effective. The low rate of effectiveness of the AEHCMS implied that the mitigation strategies promoted by extension services are not effective. Consequently, the small-scale farmers will continue to experience heavy crop losses. It was therefore concluded that the AEHCMS used by the small-scale maize farmers in Laikipia West Sub County are not effective and that they will continue to suffer from the effects of human-wildlife conflict. It was recommended that concerted efforts between stakeholders be used in

dealing with the conflict to realize the benefits of synergies so as to stop crop damage and give small-scale farmers a chance to be food secure.

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