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Indigenous knowledge practices on management of key crop pests in Kitui West Subcounty, Kenya

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Abstract

Sub-Saharan Africa's subsistence agriculture is characterized by food deficits, recurrent famines, and poverty caused by irregular rainfall, deteriorating soil fertility, pests, and illnesses. Pests have not spared Kitui County's small-scale farmers. They've resorted to unjustified and unregulated pesticide use. In addition to chemical exposure, there is a risk of degradation and loss of valuable Indigenous Knowledge. The current study gathered information on traditional pest management approaches in Kitui West sub-county, Kitui County, Kenya with an aim of documenting it. It included a field study using a questionnaire and a desk evaluation of current information in Kitui west. Results of the current study indicated that farmers adopt various AIK methods to manage field and storage pests. Older farmers (46.10%) are more likely to adopt indigenous pest management practices than younger farmers (0.7%). More educated farmers favored chemical pest control over less educated farmers. The current study provides valuable information which can be used by farmers and policy makers in making pest management decisions.

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Introduction

Sub-Saharan Africa's subsistence agriculture is characterized by food deficits, cyclic famines, and poverty caused by erratic rainfall patterns, declining soil fertility, and crop pests and diseases (Ogendo *et al.*, 2013; Mihale *et al.*, 2009). Pests and illnesses cause 15–100% and 10–60% of pre-and post-harvest food grain losses, respectively (Saxena *et al.*, 1990; Wanjekeche, 1997). Kaminski and Christiansen (2014) estimate pest-related maize crop losses in Uganda, Malawi, and Tanzania between 1.4% to 5.9%. Insects jeopardize food security. Farmers fight pests using synthetic insecticides. Most subsistence farmers don't know how to safely apply synthetic pesticides, contaminating farm produce with pesticide residues. Synthetic pesticides cause ecological and medical difficulties, yet they don't minimize pest losses (Blackman and Eastop, 1999). Kumar (2010) noted that rapid environmental, social, economic, and political changes in indigenous communities pose a threat to their indigenous knowledge. According to WHO (2016), pesticide residue in food is a leading cause of diseases like cancer. Pesticide use has hurt pollinators, reducing agricultural output (Thompsons and Hunt, 1999). Grain pests threaten subsistence grain production, storage, and handling (Ogendo *et al.*, 2013). Damage from field insects varies by season, crop, growth stage, and agronomic practices (John *et al.*, 2015). Approximately 1.3 billion tons (One-third) of the food produced globally is lost anually during postharvest operations (Gustavsson *et al.*, 2011). Insect pests cause most storage losses (Kumar and Kalita, 2017). Food supply chain losses are highest during storage, according to several studies (Kumar and Kalita, 2017). Types of storage structures contribute to food losses. After 90 days in granaries and polypropylene bags, Costa (2014) estimated maize grain losses of 59.48%.

Kenya has promoted synthetic pesticides for over 50 years (Ogendo *et al.*, 2013). Despite high pesticide costs, pollution, and water contamination, this has continued. Pesticides contaminate soil, water, turf, and vegetation and are toxic to birds, fish, beneficial insects, and other non-target organisms. Runoff from pesticide-treated areas contaminate surface water with pesticide residues causing harm to aquatic ecosystems. According to USGS (1999), pesticides from every major chemical class pollute groundwater globally. Once groundwater is contaminated, it may take years to dilute and clean up the chemicals, and the process may be costly and complex (Aktar *et al.*, 2009).

Before modern pesticides, farmers effectively used indigenous knowledge (IK) to manage field and storage pests on farms (Kiplang'at and Rotich, 2008), so they were less exposed to chemicals, and pollinators were unaffected. Studies suggest combining scientific knowledge with AIK improves pest management (Ogendo *et al.*, 2013). AIK is a key source of knowledge for sustainable development (Anyira 2010; Claxton, 2010) and offers great prospects for enhanced agricultural production and food security (Zaid and Egberongbe, 2011). With the present trends in pesticide use and the fact that much IK is unrecorded, there is a rising risk that this IK may erode with shifting generations, hence the need to identify and document IK methods employed in Kitui West Sub County

Materials and method

The study was carried out in Kitui west Sub County, Kitui County. Kitui County is one of Kenya's 47 counties, located 160km east of Nairobi. It's the sixth-largest county, covering 30,496.4km^2. There are 8 subcounties in Kitui County namely; Kitui West, Kitui Central, Kitui Rural, Kitui South, Kitui East, Mwingi North, Mwingi West and Mwingi Central. Kitui West is an administrative unit covering three divisions namely; Kauwi, Mutonguni and Usiani. Kitui West Sub County's population according to the national census in 2019 was 70,871. Kauwi and Mutonguni divisions were chosen purposively for the study due to their distinct cultural identities and AIK knowledge. Kitui West Sub County receives meager and unpredictable rainfall and is arid and semi-arid (ASAL). Maize and beans are the principal crops grown. Green grams, cassava, millet, sorghum, cowpeas, and pigeon peas are also grown.

One hundred and eighty four (184) respondents were randomly selected from a target population of 500 farmers in Kauwi and mutonguni divisions of Kitui West Subcounty.

Both primary and secondary data was collected during this study. The collection of primary data involved field observation, note-taking and interviews. A structured questionnaire which comprised closed and open-ended questions was used for the survey. Before the survey, the questionnaire was pilot-tested. According to Orodho (2005), 10% of the sampled population is enough for a pilot study; hence 18 respondents were covered. Review of relevant books, articles, scientific journals, discussion papers, theses, institutional reports, and working papers provided secondary data.

Determining the effectiveness of ash in controlling cowpea bruchids (Callosobruchus maculatus)

According to Kitheka (unpublished data), 41.1% of farmers use ash to control storage pests. 21.7% of farmers said cowpea is the most pest-prone crop during storage. Ash and cowpea were chosen for validation. The investigation was conducted at SEKU's agriculture lab. During the studies, 10kg of newly harvested cowpeas were used. Two kilograms of ash from a farmer's property were sieved with a 2mm sieve. One hundred (100) cowpea seeds were randomly selected from 10kgs and counted for infestation. 100 seeds were placed in a 4-by-8-inch khaki paper packet. This was repeated 120 times to generate 100-seed samples. 120 samples (each with 100 seeds) were randomly separated into four groups (each with 30 samples) and maintained at room temperature at SEKU. 30 samples were kept untreated as a control group. In categories 2–4, 30 samples were treated with ashes. Each second-category sample received 5 grams of ashes. In groups 3 and 4, each sample received 10 and 15 grams. After one week, the number of contaminated seeds in each sample was reported. Five weeks passed.

Data Analysis

Data was examined qualitatively and quantitatively. Respondents' gender, age, education level, and land size were measured for central tendency and chi-square independence. Chi-square tests were used to compare Kitui West Sub-county's divisions' productivity, land size, and AIK application. Using content analysis, qualitative data was sorted into themes, categories, and patterns to detect trends and patterns. Correlation analysis was used to explore the association between gender and education level in the utilization of African indigenous knowledge.

Results

The main challenges that affect crop production in the study area include unreliable and poorly distributed rainfall (36.6%), pests and diseases (26.0%), inadequate farm inputs (22.9%) and inadequate knowledge and skills (10.5%), and unreliable markets and inadequate land (4.0%). According to the study, farmers know about various crop-damaging pests in the area. Majority of respondents (97%) said stalk-borers, aphids, beetles, weevils, larger grain borers, rodents, and birds are their main field pests. A variety of AIK techniques have been used to manage field and storage pests with varying degrees of success in the study area. Results of the current study indicate that ash was the most effective AIK method for the control of field pests, followed by the use of cow dung, donkey waste, pepper, and honey wax (Fig. 1).

Table 1. Major crops that are grown in Kitui West Sub-county.

Crop (Common and Scientific name)	Family	Percent
Maize (*Zea mays)*	Gramineae	17.1%
Greengrams *(Vigna radiata)*	Fabaceae	16.1%
Beans (*Phaseolus vulgaris)*	Fabaceae	15.3%
Cowpeas *(Vigna unguiculata)*	Fabaceae	15.3%
Pigeon peas *Cajanus cajan)*	Fabaceae	14.1%
Dolichos *(Lablab purpureus)*	Fabaceae	12.3%
Sorghum (*Sorghum bicolor)*	Poaceae	4.7%
Millet *(Pennisetum glaucum)*	Poaceae	2.8%
Bananas (*Musa acuminate)*	Musaceae	0.1%
Others: Sunflower (*Helianthus annuus)* Asteraceae)		

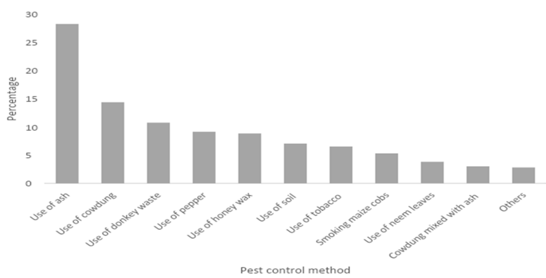

Fig. 1. Popularity of different AIK methods for the management of field pests in Kitui West.

Other field pest control methods mentioned include uprooting and burying affected plants, spraying a mixture of wood ash and cow urine on plants, spraying Aloe vera and detergent soap on plants, spraying green leaves maize soup and the filtrate on plants, scaring birds away with scarecrows, poisoned bait to catch rodents, uprooting and burying affected plants, and using coriander (*Coriandrum sativum*) seeds the physical killing of the pests and use of *Aloe vera* and neem (*Azadirachta indica)*.

Effect of age and education on the use of AIK

The age and educational levels of the two divisions of Kitui West Sub-county did not show major variations. In addition, there were no notable differences in the use of AIK between the two divisions. The responders were 50 years old on average. Most respondents (78.1%) were above the age of 40, while the minority (21.9%) were between the ages of eighteen and thirty-nine. Male-headed households accounted for only thirty-five percent (35%) of all households, with female-headed households accounting for the majority (65%). The majority of farmers over the age of 50 (46.10 percent) used AIK to manage field and storage pests. The use of AIK was influenced by age. It found that as one's age increased, so did the use of AIK in pest management. Older farmers had more expertise with AIK procedures and were more confident in implementing AIK practices. (Fig. 2)

Table 2. Effect of different concentrations of ash on infestation rates of Bruchids (*Callosobrochus masculatus)* on cowpea exposed for different lengths of time.

Concentration of ash (grams per 100 seeds)	Mean (±SE) number of infested seeds (n=30)				
	After 7 days	After 14 days	After 21 days	After 28 days	*P-value*
0g	5.33±0.308Aa	3.97±0.337Abc	3.53±0.261Abc	4.03±0.36Abc	<0.05
25g	4.03±0.481Ba	2.87±0.302Bac	2.57±0.355Bcd	2.33±0.211Bcd	<0.05
50g	1.00±0.144Ca	1.00±0.136Ca	0.53±0.124Cbc	0.63±0.112Cac	<0.05
75g	1.13±0.150Ca	0.83±0.167Cab	0.57±0.114Cbc	0.33±0.100Cc	<0.05
P-value	<0.001	<0.001	<0.001	<0.001	

Means within a column followed by same upper-case letters are not significantly different and means within a row followed by same lower-case letters are not significantly different (Tukey test, P≤0.05).

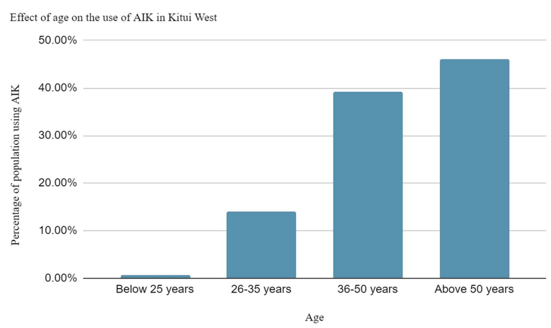

Fig. 2. Effect of age on the use of AIK in Kitui West.

Majority of AIK users had primary education (53.5%), followed by no formal education (25.7%), followed by 14.1% AIK practitioners have a secondary education, and 4.2% have a university degree. Males (2.5%) had more secondary and tertiary education than females. 30% of farmers have no pesticide training.

The results also indicate that the use of AIK did not depend upon the level of education (p-value of 0.001).

Effectiveness of wood ash in managing cowpea bruchids (Callosobruchus maculatus) under storage conditions

All ash concentrations employed in the study affected bruchid infestation rates (*Callosobruchus maculatus*). Different ash concentrations affected bruchid infestation rates. 5g of ash treated 100 seeds showed a greater infection rate. Fewer with 10g and 15g wood ash. The infestation rate by bruchids was not significantly different between 10g and 15g ash in 100 cowpea grains at 7-day intervals. 14-day, 21-day, and 28-day intervals showed a similar tendency.

Discussion

Scientists and agriculture stakeholders agree on the usefulness of AIK in pest management, and its earned a global reputation (Muthee *et al.*, 2019). This is because the chemical technique causes more harm than good to consumers, and AIK relies only on natural goods. Using AIK for pest management also helps ensure the planet's sustainability. Insect pests, rats, and birds have been shown to be a big problem for most farmers (Deng *et al.*, 2009; Laizer *et al.*, 2019). This is corroborated by the findings of the current study in Kitui West subcounty. . Results of the current study have shown that farmers apply various AIK methods in management of field and storage pests. This concurs with the findings by Theresa *et al.* (2014) in Nigeria where a wide variety of natural products was found to be useful for pest management. In another study in the Rift Valley Province, Kenya, Kiplang'at and Rotich (2008) found that tobacco juice was used to control weevils on maize and beans. Elwell and Maas (1995) woring on the natural ways of pest control in Zimbabwe showed that spraying crops with fragrant plants like lantana and khaki weed emits a strong, unpleasant fragrance that repels crop pests. According to Dethier *et al.* (1960), ash and various plant extracts repel or kill pests.. According to the results of the current study, ash was the most extensively used and effective indigenous pest control strategy for management of both field and storage pests. This supports findings by Kiplang'at and Rotich (2008) who found that ash was commonly used by farmers in Kenya's rift valley province to manage pests and diseases in vegetable crops.

Abate (2000) found that sub-Saharan Africa uses fewer pesticides than Europe or Asia. The survey found that most farmers in Kitui West Sub County chose AIK over agrochemicals since AIK is cheaper and more readily available (Ministry of Agriculture, 2010). Deng *et al.* (2009) observed that educated African youth generally discard traditional knowledge and that the average age of AIK users was 55 years. Laizer *et al.* (2019) found that farmers in Northern Tanzania who used indigenous pest control expertise were 50 years old. This agrees with the findings of the current study that older generations of farmers have more traditional knowledge, whereas younger generations prefer agrochemicals.

Results of the current study showed no relationship between AIK and formal education. According to Muthee *et al.* (2019) AIK is best gained by ecological and climatic knowledge without modern technologies, extension services, or inputs. This may explain why formal education and indigenous knowledge are unrelated. Kiplang'at and Rotich (2008) found that people with good AIK lacked formal education. Abdulsalam-Saghir and Banmeke (2015) observed a similar link in Ogun, Nigeria, suggesting that education hurts AIK. This may be because young farmers have less time to interact with elderly farmers due to their hectic school schedules (Tijani *et al.*, 2007; Deng *et al.*, 2009; Abdulsalam-Saghir and Banmeke, 2015).

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