

# Gender Roles Influencing Fall Armyworm Management Towards Environmental and Food Production Resilience in Bomet County, Kenya

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**Abstract:** *The emergence and rapid spread of the fall armyworm (FAW) *Spodoptera frugiperda* in Africa having spread from its Native American since 2016 seriously threatens the food crop production of millions of smallholder farmers. In December 2016, the Kenyan government started experiencing the invasion of FAW threatening the food crop production in the country. Smallholder farmers have different household setups with gender differentials towards managements of any new invasive crop pests including FAW. A household baseline survey and focus group discussions were done using a structured questionnaire and checklist with the aim of identifying gender roles in the management of the fall armyworm invasion in Bomet County. The study result showed that both male and female farmers were involved in decision making during pesticide spraying, local sorcery (seers), shifting of priority crop production, mixing hybrid maize seeds alongside local maize seed varieties, feeding livestock with infected plants, crop rotation, and inter-cropping and mono-cropping. Spiritual interventions and manual killing was done by female farmers only whereas, there was no role that was done by male farmers only. There should be awareness creations on farmers so that they don't spread fall armyworm through their management practices such as transporting infected plants to feed their animals. There should be training for both men and women farmers on fall armyworm management practices whereas, the training should take into consideration the different gender roles.*

**Keywords:** Gender; Fall Armyworm; Households, Food Production; Environmental Management

## 1. Introduction

There has been changes in the social system between many smallholder farmers' and their households' daily farming welfare. These changes have been occasioned from the impacts of the fall armyworm (FAW) (*Spodoptera frugiperda*). The FAW is an invasive pest from Latin America which appeared in Africa in 2016 and spread widely threatening the food and income security of millions of smallholder farmers (Day *et al.*, 2017; Kebede 2018; De Groote, 2020). FAW is known to feed on over 350 plant species with a preference for maize, a staple food for over 300 million Africans including Kenya's smallholder farm families (Midega *et al.*, 2018; FAO, 2018; MOA, 2018; Montezano *et al.*, 2018). Different study findings have shown that if FAW is left uncontrolled, it can cause up to 100% maize yield loss (Burtet *et al.*, 2017; Day *et al.*, 2017; Deole and Paul, 2018; De Groote, 2020).

There is an abundance of new pesticide users in agricultural production where invasive pests including FAW have recently invaded. The overuse of these pesticides is known to cause negative consequences to the environment (e. g. soil, food contamination, water and air) and ultimately human health (Chimweta, *et al.*, 2020). As the indiscriminate use of pesticide in farmlands increased over the past few years since the arrival of FAW, the likelihood of smallholder farmers' exposure to these chemicals increased considerably (Goergen *et al.*, 2016; Burtet *et al.*, 2017). On the other hand, the invasive pests significantly disrupted the environment's resilience to agricultural

production activities. Once a new invasive pest arrives on farmer crop, the change and shift is almost dramatic (Bottrell and Schoenly, 2018). Environmental systems have always been vulnerable to hazards like new invasive pests, which upset the smooth functioning of many interconnected components thereby interfering with the resilience of the environment (Castells – Quintana *et al.*, 2018). This study, used the resilience theory which is an integrative theory of social change that examines processes and drivers of change in complex adaptive environmental systems.

The outbreak of FAW was first reported in Kenya in 2016 (Davis, 2018). The pest spread rapidly to all major maize producing areas in the country including Bomet County causing heavy losses affecting food security and trade. Agriculture is the main economic activity in Bomet County with over 80 percent of the total population engaging in crop and livestock production (FAO, 2017). The main farming systems practiced in Bomet County are small - scale mixed crop - livestock systems and medium to large - scale mono - cropping systems (Cramer, 2021). Food crops in Bomet have been threatened by the outbreak of invasive pests especially FAW and maize lethal necrosis disease (MLND) (Niassy *et al.*, 2020; De Groote *et al.*, 2021). These challenges relate largely to poor crop husbandry, use of uncertified seeds, poor land management, and lack of information (Ansah *et al.*, 2021; Asare - Nuamah, 2021). Bomet County is unique since it has all year round crop production potential. This conditions greatly favours FAW, and hence the importance of knowing the management strategies. This study probed on identifying smallholder farmers' different gender roles in the

management of the fall armyworm invasion in Bomet County.

## 2. Materials and Methods

### 2.1 Description of the Study Area

Bomet County has a high altitude that has inclined the county into favourable climatic conditions that have allowed the area to remain green for most parts of the year, making the area favourable for FAW's survival throughout the year. Agriculture is the County's main economic activity with over 80% of the total population engaging in crop and livestock production (KNBS, 2010; Tole *et al.*, 2018). The study was carried out in five sub - counties (Konoin, Sotik, Bomet East, Bomet Central and Chepalungu) in Bomet County, Kenya (Figure 1). The county lies between latitude 0°29'S and 1°03'S and between longitudes 35°05' East and 35°35' East with an average elevation of 1, 962 meters above sea level (Wiesmann *et al.*, 2016).

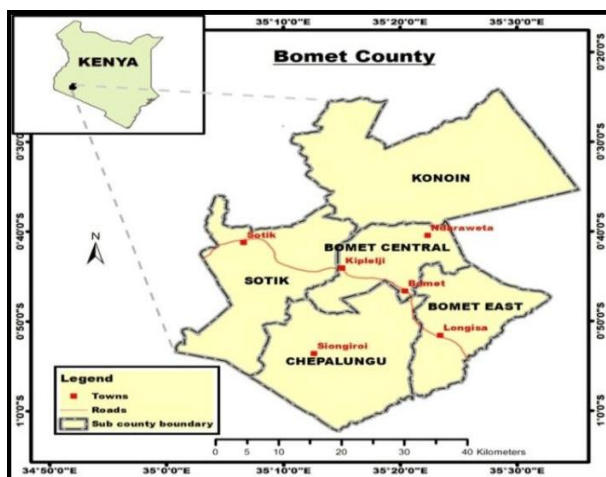


Figure 1: Map of Kenya showing the study sites (Source: KIEBC.2012)

### 3. Sampling Procedures and Data Collection

Data was collected from February 2020 to December 2020 within the five sub - counties of Bomet County where smallholder farmers who practice agriculture mainly maize production were randomly sampled. A cross sectional study design was used to select and sample individual households and farmers' focus groups (Chaokromthong and Sintao, 2021). A total of 384 respondents were randomly sampled with the help of the ministry of agriculture' extension officers. A structured questionnaire was used to collect information identifying gender roles in the management of the fall armyworm invasion and how this influenced environmental and food production resilience in Bomet County. Data was collected from different headed households whereas, the households' heads were interviewed, focus group discussions and key informants were done. Data collection from focus group discussions involved social interactions among the group members with recall on crop yields changes before and after FAW invasion while acquiring a deeper theoretical understanding and expanding empirical knowledge towards household food security and environmental sustainability (Bryman, 2008).

Where need be, the questionnaires were administered in the appropriate language and the responses transcribed into English.

### 3.1 Analytical Methods

Data collected by use of questionnaires and checklists were digitized into the Statistical Package for the Social Science (SPSS) and EXCEL where the data was coded, edited and double re - entered so as to ascertain the quality. The collected data was analyzed using both descriptive and inferential statistics from Statistical Package for the Social Scientists (SPSS) of version 19 windows (Sun, 2019) and EXCEL (Barreto, 2015).

## 4. Results and Discussions

### 4.1 Characteristics of Respondents

Of the survey respondents, 44.8% were male and 55.2% were female smallholder farmers with an average household composition of 8 family members (inclusive of parents and children). However, the average age of the respondents was 56 years with a gender mean age of 49 years for male and 52 years for female smallholder farmers indicating a significant age difference between different headed households. On education levels, 68% respondents had attained primary levels of education with 16.9% having secondary and tertiary education levels whereas 19.5% have no formal education. The segregation of gender by education levels of the smallholder farmers indicated 6% males and 10.8% females had secondary educational levels and above whereas 35% males and 29% females had primary levels with 5% males and 15% females' having non - formal education.

On income generation 49% respondents relied on crop farming whereas, 32.3% obtained their income from livestock production with 10% running own businesses (shop, vegetable vendors) and 9.1% were employed elsewhere with a monthly salary earning. On division of labour, 78.1% households relied on family labour (both parents and children) whereas, 19.8% utilized hired labour for pay with 1% leasing out their own land. The gender labour result indicated 23% male and 32% female used family labour during agricultural production. About self - labour, 12% female and 11% male used own labour during agricultural production without family labour or hiring labour whereas 10% male and female farmers used hired labour. Result on land ownership, 59% of the smallholder farmers owned below 2 ha (5 acres) of land with 41% owning above 2.1 ha (5.1 acres) of land.

### 4.2 Gender roles in FAW management

The study result showed that all the respondents had experienced fall armyworm invasion in their farm fields during agricultural production. The study findings had shown that agricultural production was the major source of livelihoods of the study smallholder farmers with 57% engaging on crop farming and 43% engaging in livestock production. The finding showed 14% male and 29% female were involved in livestock production whereas, 26% male and 31% female were involved in crop farming (Fig.1).

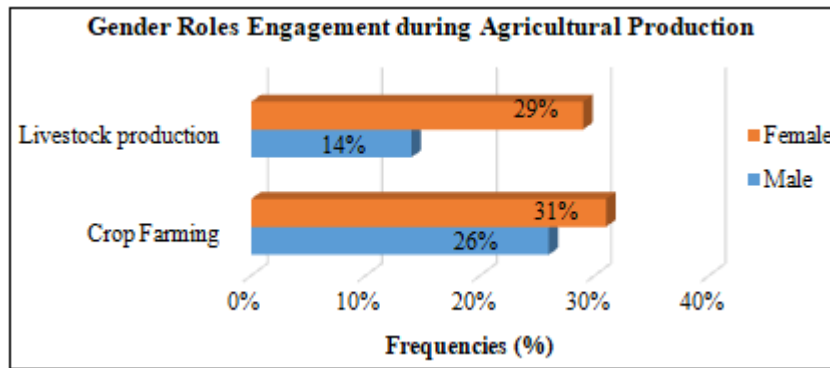


Figure 1: Gender Roles Engagement during Agricultural Production

The result on gender roles’ engagement during agricultural production (Figure 1), illustrates that different headed households’ major source of livelihoods is from agricultural production with different gender roles and prioritization of activities apportioned during food production. This finding is in agreement with studies by Quisumbing and Doss, (2021), Doss *et al.*, 2018) who stated that in the African households’ farming setup, they engaged gender roles based on the need and prioritization during agricultural production.

**4.3 Gendered decisions during FAW management**

The study finding showed 30% male and 34% female headed households’ made decisions on who sprayed the chemical towards control FAW invasion with 20% male and 26% female farmers deciding to shift their crop preferences. The

results further showed 14% male and 14% female decided to adopt crop rotation as a management strategy against FAW invasion with 9% male and 12% female farmers making decisions to plant hybrid maize seeds alongside local seed (Figure 2).

The study result on spiritual prayers showed 7% male and 10% female farmers used divine interventions as a fall armyworm management strategy whereas, 7% male and 8% female sought for local sorcery (seers). The decision to feed livestock with infected maize plants had 2% male and 3% female farmers with 1% male and 3% female farmers smallholder farmers using hand picking of fall armyworm caterpillar through manual killing as a management strategies against FAW invasion (Figure 2).

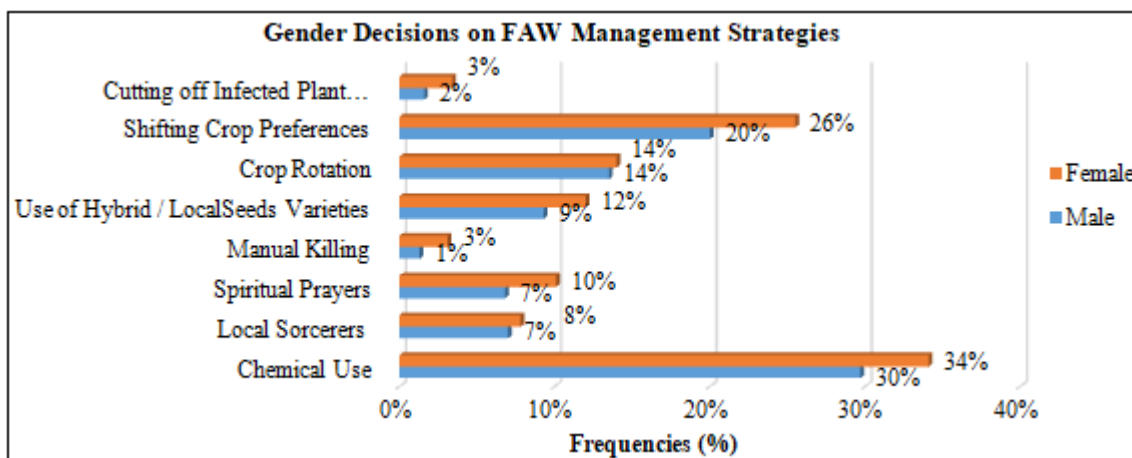


Figure 2: Decisions on Gender Roles during FAW Management

On decisions on gender roles during fall armyworm management (Figure 2), there were gender differentials between male and female headed households during decision making on pesticide acquisition with the sourcing of pesticides. This finding agreed with a study done on a global outlook by Botreau and Cohen, (2020) who stated that there is gender inequality during decision making and control of resources during agricultural production in developing countries.

**4.4 Gendered labour perspective during FAW management**

The study result on the labour used by gender towards the control of fall armyworm was to understand how different

gender provided labour during crop and livestock feed production. The findings showed 40% of the male and 60% female farmers provided the total labour required for FAW management during crop and livestock feed production (Fig.3).

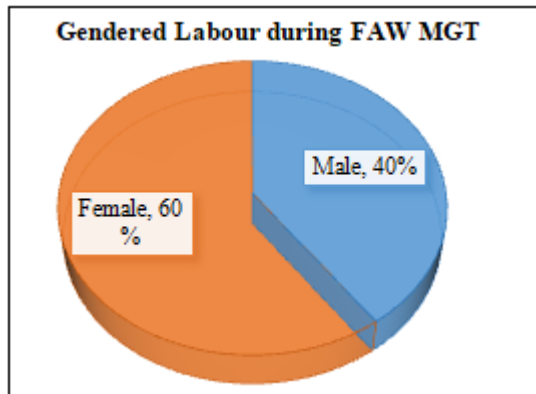


Figure 3: Gendered Labour inputs during FAW Management

The result demonstrated that the labour contribution varied within different headed households with female farmers making essential labour contributions to food crop and livestock production as compared to male farmers indicating that there were labour differences between female and male headed households during agricultural production. This finding is in agreement with a study done by Doss *et al.*, (2018) on women in agriculture and Quisumbing and Doss, (2021) on gender in agriculture and food systems stating that in the African farming communities, female farmers use between sixty to eighty percent of their labour in agricultural production with Rubin and Manfre, (2014) on promoting equitable gender in agriculture indicating that there are labour differences between female and male headed households during agricultural production. .

The result on the type of labour engaged by different headed households (Fig.4), 22% male and 28% female farmers engaged family labour to manage FAW invasion during crop and livestock farming. The finding further showed that there was hiring of extra labour during the high peak season of agricultural production with 10% male and 9% female hiring labour as substitution for the control of FAW invasion whereas, 8% male and 23% female used own labour without

any support to manage FAW invasion during crop and livestock feed production (Fig.4).

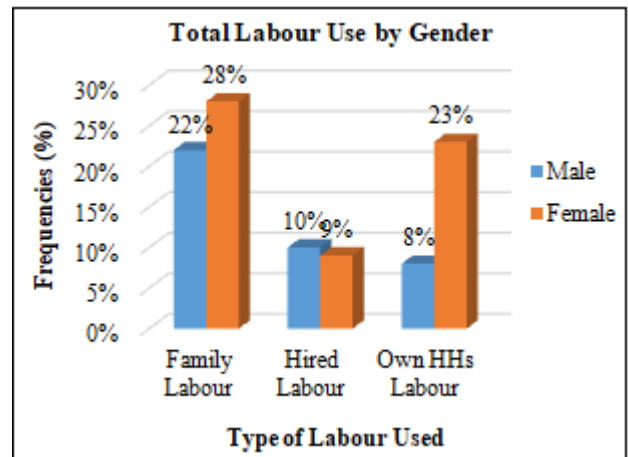


Figure 4: Total Labour Use by Gender during FAW Management

The result on Figure 4 showed agricultural production had gender - specific roles and responsibilities. This finding was in agreement with a study done by Palacios - Lopez *et al.*, (2017) who stated that labour was gendered within different headed households and was allocated according to type of activity required during crop and livestock production in developing countries.

The result on gender roles apportionment towards labour engagement during livestock feed production (Fig.5), 9% male and 12% female farmers used family labour whereas, 2% male and 4% female use hired labour with 3% male and 13% female household heads used their own labour. The result on crop farming's labour requirements showed 13% male and 16% female used family labour whereas, 8% male and 5% female used hired labour with 5% male and 10% female used household head's own labour during fall armyworm management (Fig.5).

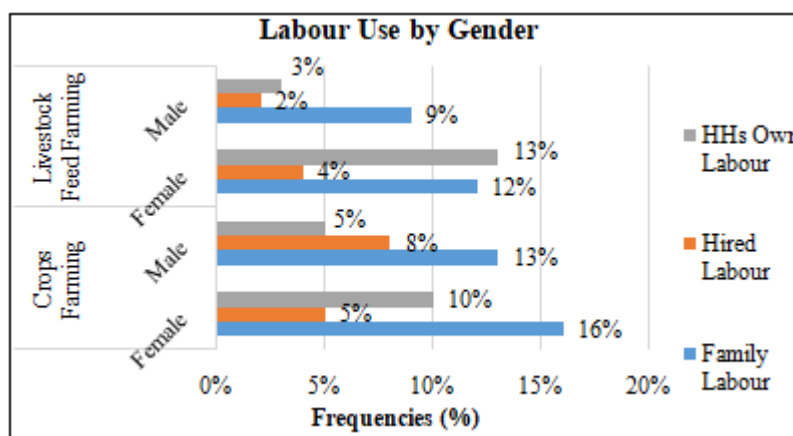


Figure 5: Labour use during FAW Management by gender

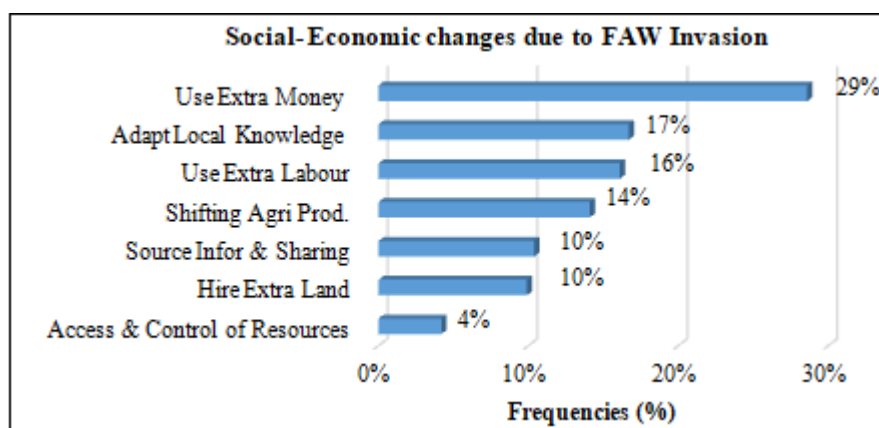
The result showed the exploitation of family labour was higher in crop and livestock feed production as compared to the use of hired labour and household head's own labour. Different headed household engaged different labour by gender depending on the agricultural activity needed which was an essential input during management of agricultural

shocks including fall armyworm invasion. This finding agreed with a study by Due, (2019) who stated that labour in an African household was one of the most demanded and important requirement with the smallholder farmers being dependent on manual labour sourced mainly from family and hired labour.

#### 4.5 Gendered social change during FAW Management

The result showed 28.6% of the households intimated to spending extra financial (money) towards management of fall (Fig.6). The results further showed 16.7% of the smallholder farmers adapted to using local knowledge of the known pest management strategies to control fall armyworm invasion in their crop fields whereas, 16.1% households hired extra labour due to the labour involved in the control of fall armyworm invasion.

The study finding indicated 14.1% of the household respondents shifted their preferred crop production to new resilient crops that were not susceptible to FAW invasion whereas, 10.4% households sourced for information about FAW management through joining new farmer groups and frequently attending communal social gatherings. The study result further showed 9.9% households leased in extra land so as to practice crop rotation as a management strategy against fall armyworm invasion with 4.2% household heads changing their access and control of resources (land) to making them accessible and available to other family members due to fall armyworm invasion (Fig.6).



**Figure 6:** Social - Economic changes due to FAW Invasion

The result in Figure 6 showed a change in social - economic status within different headed households due to fall armyworm invasion. This finding agrees with Abubakari *et al.*, (2018) who states that different households' farming communities encounter social - economic changes during agricultural shocks due to the transfers of resources from the intended use to another new use creating an imbalance in households' food securities and risks to the environment. The socio - economic inequalities in this study arose from agricultural shocks including the management of the new invasive pest (FAW) due to the transfers of resources from the intended use to another new use creating an imbalance in households' food securities and environmental risks.

The result on gender roles on social - economic changed due to fall armyworm invasion (Figure 7), 12% male and 16% female use extra finances (money) to control fall armyworm invasion with 9.3% male and 7.4% female household heads seeking to learn local knowledge strategies of the known

pest management to replicate it for the control fall armyworm invasion in their crop fields.

The results further showed 7.6% male and 8.6% female household heads hired extra labour during fall armyworm invasion (Fig.7). About 6.3% male and 7.8% female farmers shifted their usual pattern of agricultural production to new patterns of agricultural due to FAW invasion whereas, 4.9% male and 5.5% female headed households joined farmer groups and attended communal social gatherings towards getting information about FAW management. Another view, expressed by 4.9% male and 5% female headed household, held that leasing in extra land helped in practicing crop rotation as a fall armyworm invasion management strategy with 1.6% male and 2.6% female headed household allowing the access and control of resources to other household family members due to fall armyworm invasion during agricultural production.

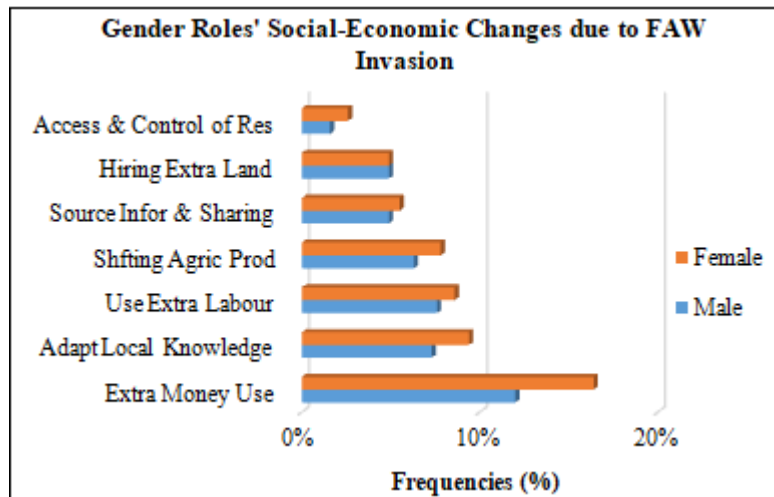


Figure 7: Gender Roles' Social - Economic Changes due to FAW Invasion

The result showed that there were differential social - economic changes within different headed households due to fall armyworm invasion. The result on the gender differences on social – economic change did not imply that female headed households were more affected by fall armyworm than the male headed households' rather the difference might have been the female respondents were not the main handlers of the technologies (pesticides) used in controlling fall armyworm.

## 5. Conclusions and Recommendations

### 5.1 Conclusions

This study concludes that the management of fall armyworm are gender specific with different gender roles and activities being used. Therefore, gender specific programs and different headed households should be approached differently during agricultural production using an effective network of extension and advisory which provides technical advice on management of new invasive pests towards food production and environmental resilience.

### 5.2 Recommendations

The findings of this study indicates that there is need of approaching male and female smallholder farmers differently during agricultural production. It is critical that agricultural production be gender neutral with gender analyses being carried out at the very beginning of any intervention since each agricultural production chain brings with it specific challenges and opportunities. This includes reaching out to both female and male farmers individually, and recognizing their different roles and priorities in relation to the environment use during food production.

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