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Farmers' Management Practices and, Perception on Fall Armyworm (Spodoptera Frugiperda Smith) in Fogera Districts, South Gondar, Ethiopia

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Abstract **– This study was conducted to investigate the farmers' pest management use practice on fall armyworm in irrigated maize production. A survey was carried out in fields of major irrigated maize-growing areas of Fogera districts of Ethiopia in 2020 cropping seasons. Farmers who grow maize were selected randomly for this interview. A semi-structured questionnaire was used. Almost all farmers depend on pesticide as fall armyworm control, they used 5 times and one-time pesticide applications for irrigated and rain-feed maize for fall armyworm control respectively. Most of the pesticide-sprayer farmers had poor pesticide use and handling practice. Government and nongovernment organization should focus on awareness creation for farmers on safely pesticide use practices, particularly on the use of personal protective devices, and sanitation practices during and after application of pesticides.**

Keywords **– Fall Armyworm, Miss Use of Pesticide, Irrigated Maize, Small Holder Farmers, Pest Management.**

I. INTRODUCTION

Maize, Zea mays L., is one of the important crops in many rural farm families in the world as well as in Africa. Maize is the most important staple crop in terms of calorie intake in Ethiopian rural families. Approximately 88% of maize produced in Ethiopia is used as food in green cobs and grain (Nigussie, Tanner, & Twumasi-Afriyie, 2002). Because of its multiple advantages rank second in the production area, next to teff, but first in its productivity among major cereal crops (Abate et al., 2015). Currently, maize is produced through irrigation in addition to rain feed production and Fogera is a common area through irrigated maize production. Current maize productivity is below its potential.

The maize stalk borer (Busseola fusca) and Spodoptera frugiperda (J.E. Smith) (Lepidoptera: Noctuidae) are now major insect pests causing substantial yield losses of maize in Ethiopia. The fall armyworm (FAW) is a polyphagous moth pest that can feed on more than 300 host plant species (Montezano et al., 2018) though has a preference for cultivated grasses, including maize, sorghum, and wheat (Silva et al., 2017). The FAW is native to the tropical and subtropical regions of the Americas (Early etal, 2018). FAW is a migratory insect pest known to cause serious damage to maize crops under warm and humid conditions in the Americas (Clark et al., 2007). It has now invaded Africa (Day et al., 2017) and is rapidly spreading throughout tropical and subtropical regions of the continent. Because of the globalization of trade (Fan et al., 2020) and FAW's strong dispersal ability, the impact of this pest has extended to other continents in recent years. The fall armyworm was intercepted on a few hectares of irrigated maize fields in southern Ethiopia in February 2017 and is now distributed over about 640.8 thousand hectares in major maize-growing regional states, namely Benishangul-Gumuz, Amhara, Tigray, Gambella, Oromia, and SNNPs. Since Irrigated maize production is a recent activity in Fogera districts, Ethiopia, there is no study has been done on farmers' perception of pest and pest management, so far in the irrigated maize production area of Ethiopia. Considering the necessity of farmers Knowledge level and

perception about fall armyworm and pest control for establishing an effective pest management approach, the study on farmers' perception of pests and current pest management is an indispensable precondition. Therefore the experiment was conducted with the objective of assessment irrigated maize growers' perceptions and pesticide use practice on fall armyworm in Fogera districts.

II. Material and Method

Fall armyworm management practice among smallholder irrigated maize farmers data were obtained from an experiment designed to assess Farmers' perception and knowledge on management of vegetable pests and pesticide use practice. A survey was conducted in the fields of major irrigated maize-growing areas of Ethiopia; in Fogera districts in 2020 cropping seasons. Smallholder maize growers' knowledge and perception concerning the fall armyworm and pest management were gathered through a semi-structured questionnaire which was prepared by entomologists. The questionnaire was first prepared and pretested to improve it and thereafter translated to local language for convenience communication between farmers and interviewers. The multi-stage sampling technique was used to select the respondents for the study. Within 3 selected district, three kebele were included for the interview and 6-13 households were randomly selected for individual interviews using the transect method. A total of 63 growers who have more than one year of production and pest management experience, were interviewed. The questionnaire contained 17 main questions. Open-ended questions were used to gather information about farmers' perceptions and knowledge of pests and pest management. The farmers were asked to rank the production constraints pests and fall armyworms in order of importance and then illustrate how they manage the fall armyworms, and different types of management options used.

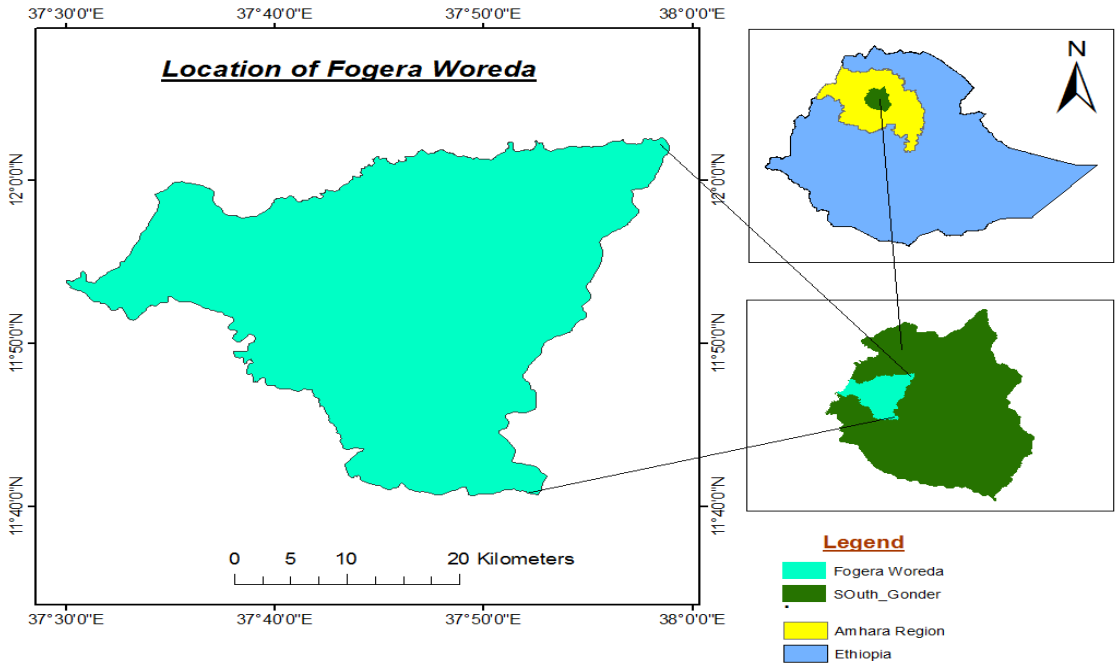

Fig. 1. Showed that Fogera district.

Statistical Analysis

Descriptive statistics (frequencies, percentages, means, and standard deviations) were calculated using the Excel and statistical Package for Social Sciences (IBM SPSS version 23.0).

III. Result and Discussion

Irrigated Maize Production System in South Gondar

According to farmers response maize production by irrigation in Fogera, Dera and Libo districts has increased significantly for the past 5 years and it has momentous contribution in annual households' income. Maize production by irrigation in the study area mostly for the purpose of green pod. The number of consecutive crops planted in the same area per year varied among the respondent farmers. Irrigated maize production practice within a year in Fogera is rice-vegetable-maize, rain feed- irrigation- irrigation respectively. Mostly maize sown by irrigation from February to April after vegetable. Irrigated farmers use water pumps to pump water from rivers or wells. According to 2019 report irrigated maize cover 52% from all cereal coverage in south Gondar Fig. 2. Regarding to the production 3000 quintal maize was produced by irrigation in 2019 in Fogera districts. However, this irrigated maize, and production is seriously affected by fall armyworms and disease in Fogera.

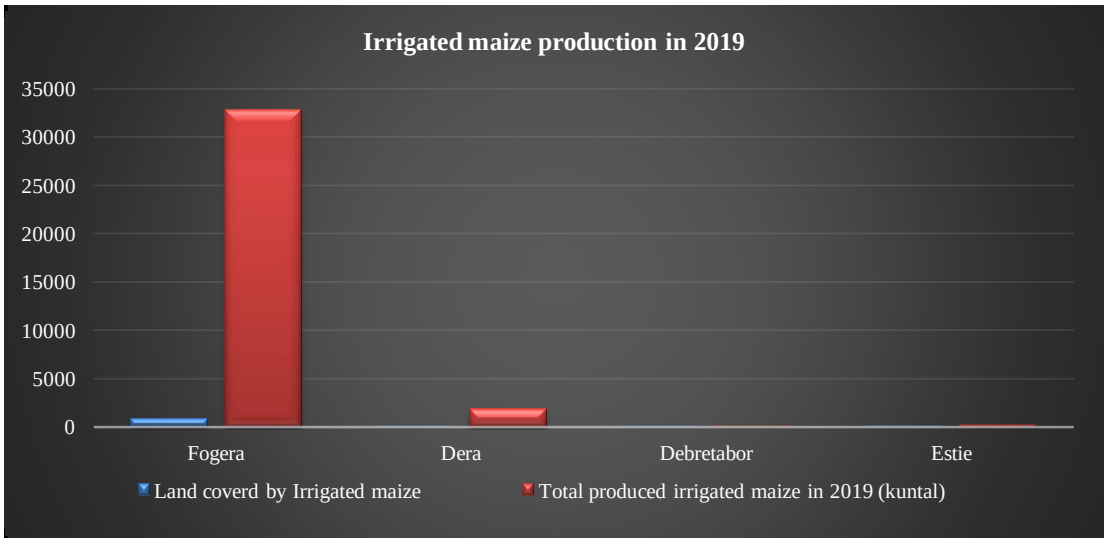

Fig. 2. Irrigated maize production in 2019.

Source: row data from South Gondar Agricultural office.

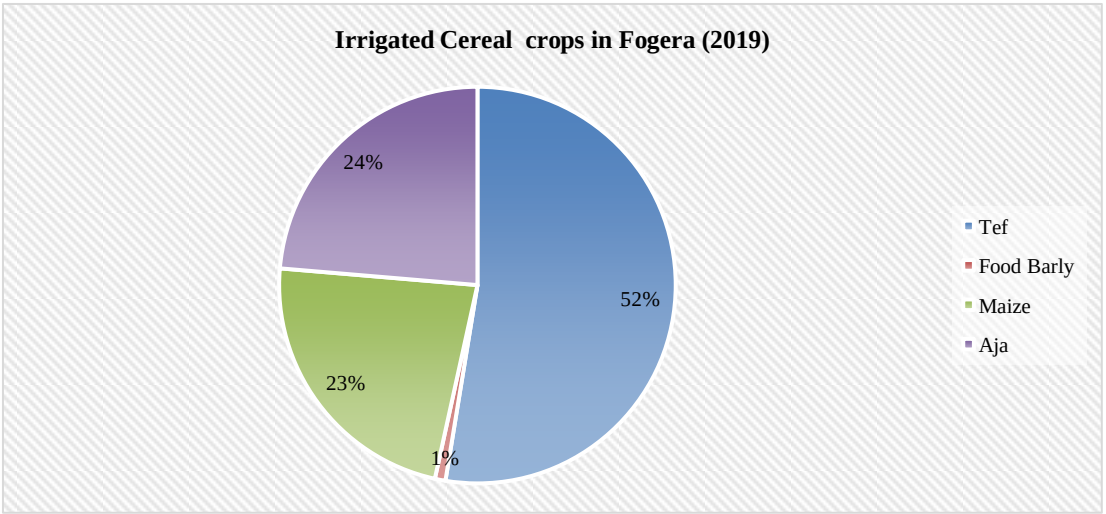

Fig. 3. Irrigated Cereal crops in Fogera (2019).

Source: row data from South Gondar Agricultural office.

A B

Photo 2 (A) Corn ear damaged by caterpillar of Spodoptera frugiperda (CABI, 2017a) and (B) Fifth instar larva of S. frugiperda (Benin, Calavi Akassato, 2.vi.2016, G. Goergen) Photo by GG. https://doi.org/10. 1371/journal.

Farmers Socio-Economic Profile

Table 1 represents the socio-economic profile of the smallholder maize growers.

More than half (58.44%) of the respondents had ages between 41-66 years, while 41.56 % fell within the 19-48 years age. Farmers who had more than 49 years of age only 9.32%. The majority of farmers 85.3% were male, whilst 14.7% were females. The current survey result showed that 54.55% of the respondents were didn't receive any formal education at all, whereas 37.66% of respondents had primary school education. Nearly ten percent of respondent were secondary school graduated, while only one respondent attained a college diploma. In each surveyed area more than 92% of the respondents hand mobile phones for communication (Table 1).

Table 1. Represents the farmers socio-economic profile.

Characteristics	**Respondents (%) (n = 63)**	
Sex		
Female	14.7	
Male	85.3	
Age (year/s)		
19-40	41.56	
41-66	58.44	
Level of education		
Illiterate (unable to read and write)	54.55	
Elementary (Grade 1-8)	37.66	
Secondary (Grade 9-12)	9.09	
College or University graduated	1.30	

Farmers' Fall Armyworm Management Practices

Majority of (77%) irrigated maize growers in our study understood the damage of fall armyworm and they overwhelmingly depend (100%) on pesticide to prevent fall armyworm activities and reduce maize losses during

growing seasons. Some of farmers (21%) used both hand pick practice for fall armyworm mitigation in addition to pesticides. None of the respondents used no control, biological and resistance variety as fall armyworm management option. Even though, integrated pest management (IPM) is an effective and environmentally friendly approach, none of the farmers used as pest management option and even had awareness about IPM concept.

In our current study, none of the maize growers obtained training from government and nongovernment organization regarding to specific pest and pesticide management training.

Table 2. Fall armyworm control option used by the smallholder farmers (multiple answers possible).

Variables	**Respondents (%)(N=63)**	
Know FAW		
77	Encountered FAW damage (Yes)	
Pest control method		
Chemical spray (yes)	100	
Both Chemical, Pick-off by hand	21	
Only Pick-off by hand	0	
No control	0	

Farmers' Frequency of Pesticide Application for Fall Armyworm

Regarding the frequency of pesticide application, most of the farmers applied pesticide in average 5 times for irrigated maize and 1 times application for rain feed maize throughout their growing season for fall armyworm control. In our study irrigated maize received more pesticide application frequency than rain feed maize in both Fogera Districts. If farmers manage pests in the best way, there is a certain set of knowledge and information they need to be aware of including conceptual and technical knowledge, as well as the ''know-how'' to carry out certain practices.

Figure 1 showed that number of pesticide spray by farmers for both irrigated and rain feed maize.

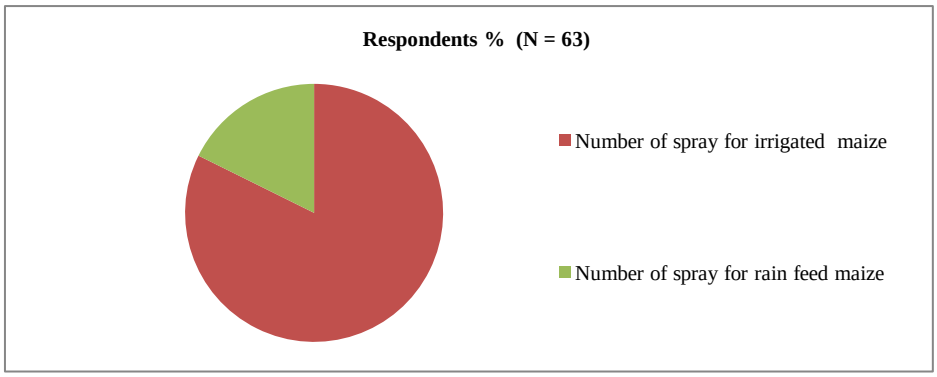

Fig. 2. Frequency of pesticide spray for fall armyworm.

Use of Personal Protective Equipment (PPE) for Farmers who Applied Insecticide on their Maize

In this regard most of, (94.81%) maize growers in our study area did not use personal protective equipment during insecticide application; they wear normal clothes (Table 3). Furthermore, the farmers in this survey

experienced insecticide spraying with bare feet were 29%. In the other aspect, only 15.58% of participants used hats at the time of insecticide application (Table 3). Using overalls (tuta) and boots are the other recommended PPE during insecticide application, but only 2.6% and 10.39% of our participants used overalls and boots respectively. Few farmers (12.99 %) farmers in our study wear a mask during insecticide application. Only one and two of the farmers wear eyeglass and closed boots, respectively.

Unavailability, inconvenience PPE wearing (e.g. mask affect breath properly), misperception about insecticide long term health effect and cost of personal protective types of equipment were major ground for different farmers as factors behind their insecticide usage without personal protective equipment.

A B C D

Photo 3. Pesticide spray practice without protective equipment to control fall armyworm (A and B) and fall armyworm damage (C and D) in Fogera districts; Photo by Geteneh Mitku.

Place of Mixing Insecticide

Our study revealed that half of the respondents (51.94%) mix the insecticide near the river and community water source, which are used by local residents for drinking, and other domestic purposes, while 44.06% of participants mix the insecticide on the farm. Small number of participants (4.1%) mixed the insecticide at home. This may because of health risks for each family and another domestic animal (Table 3). The most place where insecticide mixing tacks place by smallholder farmers are near to Gumara River which are the major water source of Lake Tana. Thus, the current result is the indicator of possibility of the Lake Tana fish species is endanger or under high pollution.

A B

Fig. 4. Showed that farmers pesticide mixing without protective equipment at Gumara river (A) and in small river (B); Photo by Geteneh Mitku.

Fate of Empty Insecticide Container

Table 3 represents the fate of empty pesticide containers in the study area. The study found that an approximately equal proportion of participants (44.78%) replayed that they throw the empty pesticide container into irrigation canal or on-farm, while 2.99% reuse the empty pesticide containers for drinking, and to store solids for pouring. The respondents who experienced collect and bury in the ground on-farm were 16.41%. Furthermore, 38.81% of farmers collect and sell empty insecticide containers for empty bottle collectors locally called 'Quralew'. These empty pesticide containers sell practice carried out by farmers' son or daughter who collect and store empty pesticide container in the house and then they sell those collected empty container for locally named as 'QURALEW'. Good practice (collect and burn) of empty pesticide container handling in the current study was implemented by only 7.99% of farmers. In general, the improper practice of empty pesticide container handling of the current study is inconsistent with the (Tebkew and Getachew, 2015) report, which conducted in central Rift valley, Ethiopia. This similarity may due to a lack of training on empty pesticide container handling in both previous and current study areas.

Fig. 5. Pesticide container disposals in Fogera districts, Photo, by Geteneh Mitku.

Table 3. Showing Protective equipment, places where mixing carried out and fate of empty insecticide container.

Variables	Respondents (%) (N = 63)
Protective equipment used bay farmers	
Wearing normal clothes	94.81
Hat	15.58
Boots	6.39
Face mask	12.99
Eye glass	1.3
Cotton overalls	2.60
Place of insecticide mixing	
Near the river	51.94
In the field (Farm)	44.06
At home	4.1
Fate of empty insecticide container	
Throw in to irrigation cannel or river	44.78
Keep for domestic use	2.99
Collect and burn	7.99
Collect and sell	38.81
Collect and bury in ground on farm	16.14

Source of information for farmers.

Pest and pest management advisory services for the farmers in the study area were from different sources (Table 4). Though, this is important precondition, farmers' pesticide selection in our study area relay on the basis of availability and accessibility. Thus, almost half of (44.16%) respondent's insecticide selection and decision influenced by pesticide dealer, while 14.29% farmers select the insecticide based on their neighbors information. The remaining, 25.97% them buy the insecticide based on their own experience whereas, 15.58 % were perceived necessary understanding from extension worker.

Table 4. Showed Source of information for smallholder farmers.

Variables	**Respondents (%) (N = 63)**
Source of information for buying insecticide	
Extension workers	15.58
Retailers	44.16
Own Experience	25.97
Neighbors	14.29

IV. CONCLUSION

Farmers perceived fall armyworms as important irrigated maize production constraints in the study area. Even though, fall armyworm was perceived by the farmers as both irrigated and rain feed maize production constraints in the study area. Only a few of the respondents used pesticides for rain feed maize control, whereas for irrigated maize farmers used an average of five times pesticides sprays over one growing season. Most of the farmers involved in the interview had wrong pesticide handling; they did not worry to save themselves and their family members from the risks of insecticide. We understood farmers in the study area showed that lack of sufficient knowledge and misperception on the effect of pesticides. Our study suggests that awareness creation on pesticide safety, particularly on the use of personal protective devices, sanitation practices during and after the application of pesticides. Further research is needed on developing low-cost and environmentally safe fall armyworm control measures, and the effect of natural enemy on-field fall armyworm. Additionally, it is recommended for researchers to identify the type of natural enemy on maize insect pests and educate farmers regarding pest management and insecticide effect on their health and the environment.

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