Do sustainable intensification practices reduce crop damage? Evidence from the maize-based cropping systems in eastern Uganda

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Introduction

- Feeding 9.7 billion people by 2050[1] in a sustainable manner is challenging under the increasingly difficult social, economic, environmental conditions [2,3,4] (Fig.1).
- Farmers suffer crop losses/damage due to pests and climatic hazards[5,6] (Fig. 2).

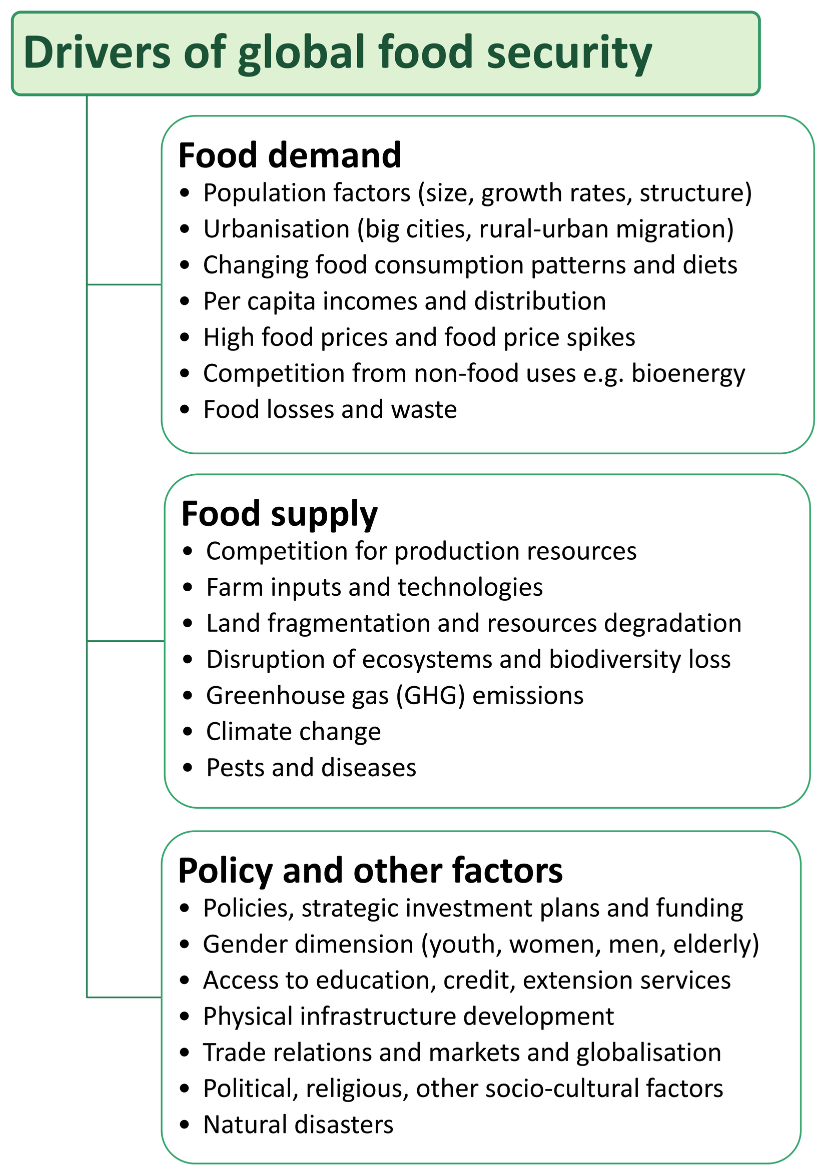

Figure 1: Factors influencing the global food system

Figure 2: Maize crop growing with six plants per stool, showing pest damage, and lack of some macronutrients (*photo by John Ilukor*)

- Sustainable intensification (SI) has emerged as a suitable approach for increasing yields on the same land area while minimising adverse environmental impacts[7,8].
- Several SI practices have been promoted including agroforestry, intercropping, crop rotation, integrated soil fertility management (ISFM), integrated pest management (IPM), and use of pest and disease and drought-tolerant varieties.
- However, studies that examine the effect of SI practices on crop damage are limited, largely attributed to methodological challenges and availability of data.
- Yet, the assessment of crop losses despite actual crop protection strategies are needed to develop and design future strategic actions to reduce crop losses.
- In this study, we examine whether the SI practices in the maize-based cropping systems in Eastern Uganda reduce crop damage or not, and to what extent.
- Specifically, we identify the major sources and magnitude of the crop damage.

Materials and Methods

- We use primary data collected in 2015 and 2016 from 440 households as part of the Methodological Experiment on Measuring Maize Productivity, Varieties and Soil Fertility (MAPS) in Iganga and Mayuge districts in Eastern Uganda.
- Data was collected by Uganda Bureau of Statistics (UBOS), with technical and financial assistance provided by inter-agency partnership led by the World Bank
- In each MAPS household, one maize plot, matching the household cultivation status, was selected at random, from all maize plots cultivated by the household, by World Bank Survey Solutions CAPI app for crop cutting and soil sampling.
- The fieldwork was organized around three visits to each household, namely post-planting, crop-cutting, and post-harvest.
- During the post-planting visit, each household was administered a farm survey tool that collected information on the plot, farm, and household characteristics.
- The enumerator visited the randomly selected maize plot; measured its area and saved its boundaries on a Garmin eTrex 30 handheld Global Positioning System (GPS) device; set-up one 4x4m and one 2x2m crop cut sub-plot, in accordance with the international best practices, for later harvesting and weighing.
- Data on crop damage (number damaged) was collected from each crop-cut plot.
- Data was analysed using Stata 15 to generate key descriptive statistics and fitting a multiple linear regression to estimate the factors that influence crop damage.

Results

- The results show that on average, 11 percent of the maize yield can be lost during the pre-harvest stage.
- Pests accounted for the largest share of pre-harvest crop damage (74 percent). Termites were major pest reported (24 percent), then crop diseases (15 percent).
- The results also reveal that the magnitude of crop damage is lower in the plots with high plant density, high nitrogen content, under maize-coffee intercropping, planted with hybrid maize seed, and managed by older people.

Table 1: Factors influencing crop damage in the maize-based cropping systems

Dependent variable = crop damage (%)	dy/dx	Std. Err.	z	p>z	Sig.
Multiple varieties planted (varietal mixing)	5.77	3.56	1.62	0.11	
Improved variety (correctly identified)	9.38	5.74	1.63	0.10	
Variety recyclability (correctly identified)	-19.79	5.06	-3.91	0.00	***
Recycled seed (self-reported)	-3.62	2.86	-1.26	0.21	
ln_seed planted (kg)	-1.30	1.45	-0.90	0.37	
ln_plant density	-15.77	2.01	-7.85	0.00	***
Crop rotation practiced	0.35	2.66	0.13	0.89	
Cover crops present	4.49	3.33	1.35	0.18	
Intercrop with legume	3.78	3.85	0.98	0.33	
Parcel with maize-coffee trees	-6.25	2.62	-2.38	0.02	**
Parcel with maize-fruit trees	1.88	3.03	0.62	0.53	
Intercrop*improved variety (interaction)	-8.12	6.12	-1.33	0.19	
Used pesticide (self-reported)	-5.08	8.24	-0.62	0.54	
No inorganic fertilizer used (self-reported)	-8.80	5.79	-1.52	0.13	
Slope (1=flat; 0=otherwise)	2.01	2.65	0.76	0.45	
Acidified nitrogen (soil analysis)	-456.68	173.67	-2.63	0.01	**
Acidified carbon (soil analysis)	26.66	11.08	2.41	0.02	**
Plot manager is head of household	5.64	3.18	1.77	0.08	*
Plot manager's education (years)	-0.39	0.31	-1.27	0.20	
Plot manager's age (years)	-0.22	0.09	-2.59	0.01	**

Conclusion

- The study concludes that promotion of maize-coffee intercropping, enhancement of nitrogen in the soil, and growing of hybrid seeds should be encouraged to reduce crop damage.
- The study recommends that the extension system in Uganda should develop a strategy for building the capacity of young farmers and plot managers to manage their plots and adopt sustainable intensification (SI) practices that reduce crop damage, and have the potential to increase yields and moderate climate change.

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Acknowledgement: This study and poster were made possible with support from the Uganda Bureau of Statistics (UBOS) and the World Bank (datasets), and the Makerere-Sweden (Mak-Sida) Bilateral Research Programme 2015-2020

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