Intensifying maize production in integrated crop-livestock farming systems in northern Ghana

Introduction

Total productivity of the small-scale mixed farming systems in northern Ghana is low due to weak integration of the crop and livestock enterprises. Farmers tether sheep and goats on fallow land to recycle manure and urine for crops, but data on the effect of sheep and goat stocking density (SSD) on grain yield and soil properties in such systems is limited. The effect of SSD, maize planting density (MPD) and nitrogen (N) fertilizer level on grain yield was evaluated.

Photo 1: Maize stand on plots with no nitrogen fertilizer, no sheep and goats

Photo 2: Maize stand on plots with no nitrogen fertilizer where sheep and goat kept over night

Methods

A split-split plot design with 9 replications in 3 communities (Gia, Nyangua and Samboligo) was used. Main-plots were SSD (0, 400 and 200 head ha^{-1}) on farmland overnight, sub-plots MPD (6.93, 10.40 and 138.67 plants ha^{-1}) and sub sub-plots were N fertilizer rate (0, 60, 90kg ha^{-1}N). Grain and stover yield were measured. Agronomic efficiency (AE) and Partial Factor Productivity (PFP) indices were estimated according to Dobermann (2007) as:

$AE = \frac{Y - Y_0}{F}$ and $PFP = \left(\frac{Y_0}{F}\right) + AE$ where F = amount of fertilizer applied in kg ha^{-1}; crop yield with applied nutrient and Y_0 = crop yield with no applied nutrient.

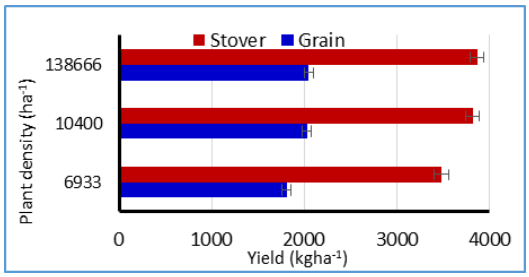

Figure 1: Planting density effects on maize grain and stover yields.

Results summary

Grain yield was affected by SSD and N fertilizer rate (Table 1). Grain and stover yields were affected by MPD (Figure 1) and N fertilizer rate (Table 2).

Table 1: Stocking density and nitrogen effects on maize grain yield

	Nitrogen rate (kgha-1) Grain yield (t/ha)		
SSD (head ha^{-1})	0	60	90
0	1.13	1.56	1.65
200	1.67	2.15	2.48
400	1.78	2.7	2.54
s.e.		0.088	

Conclusions

SSD of 400 with 60kg ha^{-1} N resulted in highest grain yield and best N use efficiency. Crop-livestock farmers can stock at SSD 400 with MPD of 10.40 x 10^3 plants for improved grain and stover yield.

References

Dobermann, A. 2007. Nutrient use efficiency – measurement and management: In proceedings of IFA International Workshop on Fertilizer Best Management Practices, Brussels, Belgium.

Table 2: Stocking density effects on nitrogen use efficiency

	Nitrogen rate (kgha-1)			
	Agronomic efficiency		Partial factor productivity	
SSD (head ha^{-1})	60	90	60	90
0	7.2	5.8	26	1.84
200	8.1	9.1	35.8	27.6
400	15.5	8.5	45.1	28.2

SSD: Sheep and goat stocking density

Table 3: Nitrogen fertilizer rate on maize and grain yield

Nitrogen	Grain yield (t/ha			Stover yield (t/ha		
(ha^{-1})	Gia	Nyangua	Samboligo	Gia	Nyangua	Samboligo
0	1.14	1.14	2.06	2.92	1.83	4.39
60	2.06	1.83	2.4	4.19	2.93	4.76
90	2.49	1.95	2.57	4.21	3.11	5.17
s.e (mean)		0.088			0.135	
P-value		<.0001			0.0139	

The Africa Research In Sustainable Intensification for the Next Generation (Africa RISING) program comprises three research-for-development projects supported by the United States Agency for International Development as part of the U.S. government's Feed the Future initiative.

Through action research and development partnerships, Africa RISING will create opportunities for smallholder farm households to move out of hunger and poverty through sustainably intensified farming systems that improve food, nutrition, and income security, particularly for women and children, and conserve or enhance the natural resource base.

The three projects are led by the International Institute of Tropical Agriculture (in West Africa and East and Southern Africa) and the International Livestock Research Institute (in the Ethiopian Highlands). The International Food Policy Research Institute leads an associated project on monitoring, evaluation and impact assessment.

Prepared by: Abdul Nurudeen (a.nurudeen@cgiar.org), Asamoah Larbi (a.larbi@cgiar.org) and Irmgard Hoeschle-Zeledon (i.hoeschle-zeledon@cgiar.org)

africa-rising.net