Evidence Brief

Transforming African agriculture through sustainable intensification

November 2016

Sustainably intensifying at right densities in northern Ghana

small ruminant corralling density, plant density, and nitrogen rate effect on maize

Main picture: Maize plants in a field on which small ruminants were corralled, (inset) maize plants in a field where no small ruminant corralling was done. *Photo credit: Abdul Rahman Nurudeen/IITA*

Key messages

- Low resource endowed farmers with small ruminants may corral at recommended density without mineral fertilizer.
- Farmers with a low number of small ruminants with interest in both grain and stover yield may corral at recommended density with mineral fertilizer at 90kg/ha nitrogen.
- Farmers with a large number of small ruminants with more interest in grain yield may also corral at high density with mineral fertilizer at 60kg/ha nitrogen.
- A maize density 50% higher than the recommended density results in better grain and stover yield.

The issue

Smallscale mixed farming dominates in sub-Sahara Africa, especially in Ghana. Yet crops yields in this farming system are low due to weak integration of crop and livestock enterprises, and low soil fertility and plant density. The average yield of maize is about 1.7t/ha (MoFA, 2011) compared to a potential of 4 to 6t/ha under good agronomic practice.

The fragility of this ecosystem requires a new and innovative integrated crop-livestock system that improves soil fertility and crop yields. Corralling of livestock returns both manure and urine to soil; requires no labor for manure handling, storage, and spreading; reduces loss of nitrogen (N) in manure by 40 to 60% due to the urine; and also results in greater crop yields (Powell and Ikpe 1992; ILCA 1993a; Williams et al. 1995).

A study was conducted to determine the effect of corralling density of small ruminants combined with plant density and nitrogen rate on the yield of

maize in northern Ghana.

Findings

- Small ruminant coralling increased both grain and stover yield of maize. Stocking density at 70herd/ha combined with nitrogen fertilizer at 90kg/ha recorded better yield (Table 1). Stocking density at 70herd/ha obtained better stover yield (Table 2).
- Nitrogen application increased both maize grain and stover yield. An application rate of 90kg/ha recorded the highest stover yield (Table 2).
- Plant density affected both maize grain and stover yield. A maize density of 10,400plants/ha obtained a better grain and stover yield (Fig. 1).

Table 1: Maize grain yield (t/ha) as affected by corralling density and nitrogen fertilizer rate in northern savanna of Ghana

	N rate (kg/ha)		
Corralling density (herd/ha)	0	60	90
0 (Control)	0.8	1.4	1.5
70 (recommended)	1.6	2.2	2.7
140 (high)	1.7	2.7	2.8
standard error		0.08	
P-value		0.02	

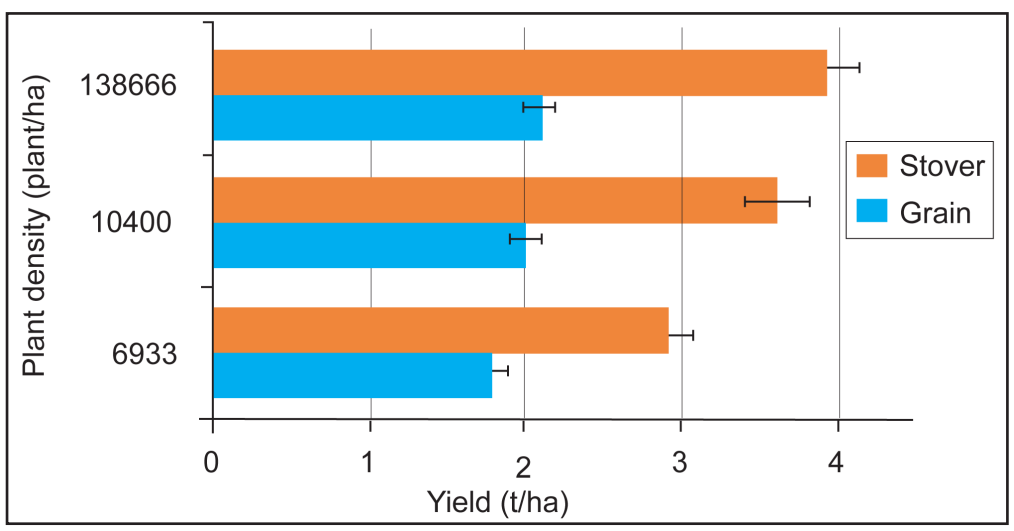

Figure 1: Plant density effect on grain and stover yield in Northern savanna of Ghana

Table 2: Maize stover yield (t/ha) as affected by the corralling density and nitrogen fertilizer rate in northern savanna of Ghana

	N rate (kg/ha)			
Corralling density (herd/ha)	0	60	90	**Mean**
0 (Control)	1.7	2.7	2.9	**2.4b**
70 (recommended)	3.2	4.0	4.3	**3.8a**
140 (high)	3.3	4.6	4.8	**4.2a**
standard error		0.11		
P-value		0.11		
Mean	**2.7c**	**3.8b**	**4.0a**	

Recommendations

- Maize grain yield can be sustainably intensified through crop-livestock integration.
- Corralling of small ruminants on arable land increases maize grain yields.
- Increasing plant density increases maize grain yield.
- Increasing N fertilizer intensifies maize grain yield.

Methodology

A split split plot design with 8 replications in two communities (Gia and Nyangua) was used. Main plots were small ruminant corralling densities on farmland overnight (0, 70 and 140 herd/ha), sub-plots were maize plant densities (6933; 10,400; and 138,666 plants/ha) and sub sub-plots were nitrogen fertilizer rates (0, 60, and 90kg of N/ha). Grain and stover yields were measured.

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.

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