Economic Analyses

The economic analyses revealed that the high cost of the commercial organic fertilizer makes its application unprofitable at all sites. Traditionally organic fertilizers are usually acquired from household kraals and animal pens which is usually not paid for or valued. The impact of the organic fertilizer on soil fertility has a long term implication which has not been assessed. Though the organic treatments have the least B/C ratios they may still be economically feasible and probably the most profitable in the long term.

Table 2: Benefit Cost Ratios

Location	Treatments			
	Control	Organic	Inorganic	Organic + inorganicv
Gbullahigu	3.18	1.27	2.73	1.38
Kpalsogu	2.03	0.94	2.60	1.12
Silbelle	1.56	0.51	2.77	1.22

Conclusion and Recommendations

Results obtained indicated that the closing of maize yield gaps at farm scale depends on the critical role of good agronomy and integrated soil fertility management to manage deficiencies of plant available nutrients especially nitrogen and phosphorus.

Thus fertilizer additions are required to optimize maize grain yields in northern Ghana. The use of either inorganic or combined organic/inorganic fertilizer sources produce better maize yields to those obtained where organic amendment sources are used alone. However, the organic materials may not be available in large amounts that are required for sole application. One objective of this study was to evaluate the economic profitability of the various soil nutrient replenishment inputs. Treatments with sole inorganic fertilizers had the highest B/C ratios at two out of three sites, followed closely by the control treatment. More so, the application of recommended rate of mineral fertilizer resulted in higher net benefit than the application of sole organic fertilizer or integration of organic and inorganic fertilizer sources. In order to reduce cost of the inorganic fertilizers farmers should be encouraged to use organic sources of nutrients. Despite the low B/C ratios associated with integrated use of organic and inorganic nutrient sources, farmers should be encouraged to adopt the combination of organic and mineral fertilizers to improve soil chemical properties and enhance maize productivity in low N soils in the long term.

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Info Note

ORGANIC AND INORGANIC FERTILIZER EFFECTS ON MAIZE PRODUCTION ON SMALLHOLDER FARMS OF NORTHERN GHANA

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KEY MESSAGES

- Maize (*Zea mays L.*) is an important cereal crop in Ghana
- Soils at the study sites are generally poor and adversely affect crop performance
- Various combinations of different fertilizer materials were tested at three sites in Ghana
- Combined organic/inorganic fertilizer sources produce better maize yields than those of sole organic treatment, however their BCRs were low
- Farmers are encouraged to adopt the combination of organic and mineral fertilizers to improve soil chemical properties and enhance maize productivity in low N soils in the long term

Introduction

Maize (*Zea mays L.*) is an important cereal crop in Ghana, especially in the northern part where it is replacing sorghum and millet. Low soil fertility is a major constraint to maize production in the small holder farms of northern Ghana. This is mainly attributed to the mining of nutrients due to cropping without addition of adequate external nutrients coupled with poor nutrient conservation practices. The situation is further accentuated by mounting population growth and land scarcity.

The results of this loss in soil productivity has been a continuous decline of maize yields on farmers' fields to less than 2.0 t/ha though the maize cultivars grown have a potential of greater than 6.0 t/ha. The use of mineral fertilizers on staple food crops such as maize has generally been restricted to only a few farmers endowed with resources. Mineral fertilizers are expensive hence unaffordable by most smallholder farmers. The majority of the smallholder farmers lack the financial resources to purchase sufficient mineral fertilizers to replace the soil nutrients exported with harvested crop products, which results in low yield. The use of organic nutrient sources to increase and maintain soil fertility is being considered as a solution to help the low- income smallholder farmers. Under such condition, integrated use of mineral and organic nutrient sources can play an important role to sustain soil fertility and crop yield (Tandon, 1998; Lampe, 2000).

The application of Farm yard manure and inorganic fertilizers separately and in combination to maize, showed a significant high fodder yield in the combined treatments over the organic or inorganic fertilizers alone (Oad et al., 2004). A judicious combination of organic and inorganic sources of nutrients may therefore be envisaged as it addresses both the problem of insufficient fertilizer supply and the large amounts of organic material required for nutrients supply.

The project on "Enhancing resilience and Adaptive Capacity to Climate Change through integrated Land, Water and Nutrient Manage-ment in Semi-arid West Africa" (ENRACCA-WA) adopted the farms of the future concept (FotF) to enhance the resilience of smallholder maize producers at Gbullahigu and Kpalsogu in the Northern region of Ghana which is situated in the Guinea savanna zone.
A study was conducted in northern Ghana with the main objective of determining the levels of complementarities between organic and inorganic soil amendments on their influence on maize grain yields.

Methods

A study was conducted on farmers' fields at Gbullahigu and Kpalsogu in the northern region of Ghana to determine responses of drought tolerant medium (100-110 days) maturing maize varieties (Obatanpa and Ewul-boyu) to organic and/or inorganic fertilizers. At each site, four treatments were evaluated on a farmer's field which also served as learning centers. These learning centers are good sites for research, training and demonstration as well as good interactions between researchers, extension staff and farmers. The soil amendment treatments were (i) Control – no soil amendment; (ii) 4t/ha of organic fertilizer, (iii) recommended rate of inorganic fertilizer – 64-38-38 kg/ha as N, P2O5 and K2O respectively and (iv) combined use of full rate of organic and half rate of inorganic fertilizers. The yields of maize from the fertilizer treatments were compared with the response obtained from control with no soil amendment which represented the farmers' normal practice.
Economic analysis was carried out to compare the profitability of producing maize using different combinations of organic and inorganic fertilizers.

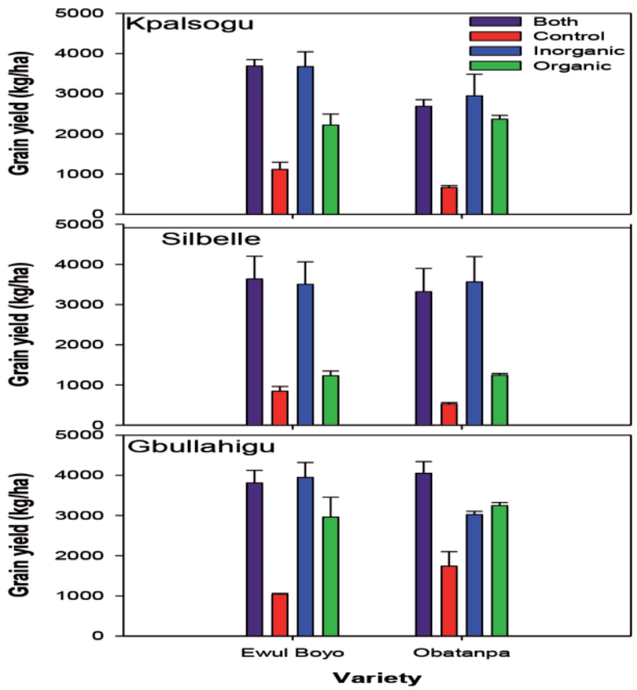

Figure 1: Grain yield across locations

Results summary

Grain yield

Mean grain yield range for treatments was 684 to 3533 kg/ha at Silbelle. The mean grain yield of 2977 kg/ha at Gbullahigu was the highest among the three sites, and was 23% and 32% greater than those at Kpalsogu and Silbelle, respectively. A combination of the above factors and a dry spell in July probably reduced maize plant growth and development as well as ultimate grain yield at Kpalsogu.
There was no significant difference between the two maize varieties at both Gbullahigu and Silbelle. Mean grain yield was influenced by soil amendment at all sites. At each location, grain yield of each maize variety was higher in treatments that received sole organic fertilizer, sole inorganic fertilizer and a combination of organic and inorganic fertilizer sources (Figure 1) and the least grain yields were obtained with no soil amendment. Yield increases with sole organic fertilizer rate of 4t/ha, recommended inorganic fertilizer rate and a combination of organic and inorganic fertilizer sources were 123, 151 and 182% at Gbullahigu. At Kpalsogu the yield increases for the respective rates were 159, 273 and 259%, while at Silbelle, the yield increases for the respective rates were 180, 417 and 408% over the control. At Kpalsogu and Silbelle, the highest maize grain yields of 3309 kg/ha and 3477 kg/ha respectively were realized from sole application of inorganic fertilizer. A combination of organic and inorganic fertilizer sources at Gbullahigu gave the highest yield of 3929 kg/ha.

In general, sustainable crop productivity can be achieved by optimizing benefits from inorganic and organic sources of plant nutrients. In addition to plant nutrient supply, organic nitrogen (N) sources improve soil humus content, water holding capacity, cation exchange capacity, water infiltration rate, aeration and porosity of the soil (Johnston and Syers, 1998; Saleem, 1999).
Generally maize grain yields tended to be lower in treatments with organic fertilizer alone compared to the treatments with inorganic fertilizers at all sites. The application of sole inorganic fertilizer at Gbullahigu, Kpalsogu and Silbelle, respectively increased grain yields by about 24, 27 and 63% when compared with the application of organic fertilizer.

Table 1: Grain and Biomas Yield (Kg/Ha)

Grain Yield (kg/ha)					
Location	**Treatment**				
	Control	Organic	Inorganic	Both	Lsd (0.05)
Gbullahigu	1390	3104	3486	3929	630
Kpalsogu	887	2292	3309	3186	605
Silbelle	684	1236	3533	3477	801
	Above ground biomass yield (kg/ha)				
Ewul-boyu	1267	2213	4227	3760	971.5
Obatanpa	1267	3000	6227	4133	971.5
	Above ground biomass yield (kg/ha)				
Gbullahigu	2367	5093	5373	6173	1338
Kpalsogu	2607	3818	6047	5493	1436

Maize crop under no Fertilizer

Maize Crop under Inorganic Fertilizer only

Maize crop under Organic Fertilizer Only

Maize crop under combined fertilizers