Blending science with indigenous knowledge: An Assessment of rice farmers' views on soil improvement technologies in Northern Ghana

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INTRODUCTION

Rice is a staple food for more than half of the world's population (Amissah *et al*., 2003). Since 2009, rice has achieved the status of the second most important staple crop after maize in Ghana (Ministry of Food and Agriculture, 2009). This indicates the important role of rice in ensuring household food security in the country. One major constraint that affects Ghana's domestic rice production is the declining soil fertility which results in very low yields. Despite the poor soil fertility conditions which negatively affect food crop production(Rhodes 1995), most subsistence farmers in northern Ghana cannot afford chemical fertilizers owing to their high price (Yiridoe, *et al*., 2006). Consequently there is an imbalance in the demand and domestic supply of rice, forcing reliance on huge imports of rice to fill the gap. Agricultural soil management performed using adapted local resources and knowledge systems are known to have a potential for improving production for subsistence farmers (Yiridoe, *et al*. 2006). The present study assessed farmers' accessibility, acceptability, and the affordability of local resources for soil fertility improvement in the savanna lowlands of northern Ghana. The benefits derived from the use of local resources for improving soil fertility were estimated. Our findings could contribute to a better understanding of the resources available to mitigate the production constraints of subsistence rice farmers in Ghana.

MATERIALS AND METHODS

Participatory rural appraisal

This study used both socio-economic and agronomic data collected from sampled rice farmers in northern Ghana. The socio-economic data was collected through the application of participatory rural appraisal techniques as well as in-depth interviews using a checklist and questionnaires. Participatory methodologies have become popular for assessing development and technological interventions (Dietz *et al*. 2009). The agronomic data was generated from on-farm rice production trials conducted by the UDS in collaboration with JIRCAS at sites located in the northern region of Ghana.

Profitability analysis

The socio-economic data was analyzed descriptively by using statistical measures such as means and percentage distribution. The profitability of soil improving technologies was determined by partial budgeting. The main cost components included those for land preparation, planting, weeding, harvesting and threshing, rice seed and fertilization (eight technologies), and transportation. Farmers' conditions were determined using prevailing market prices for inputs and outputs. A similar approach was adopted by Langyintuo and Dogbe (2005). Benefits to farmers were estimated using the benefit–cost analytical technique (Gittinger, 1984). Generally, the profit equation is given as follows:

Gross margin (profit) = PQ - TC

Where PQ = Gross income and TC = Total variable cost.

The types of soil improvement technologies (Fertilizers) are defined in Table 1.

Table1 Soil improvement technologie

Treatment Type	**Definition**
Zero	No treatment
NK	Nitrogen/Potassium (Non-Phosphorus)
NK + PR	Nitrogen/Potassium + Phosphate Rock (PR)
CD/RS + NK + PR	Cow dung/Rice straw compost + Nitrogen/Potassium + PR
HE/RS + NK + PR	Human excreta/Rice straw compost + PR
TSP + NK	Triple superphosphate + Nitrogen/Potassium
RS	Rice Straw Only
RS + NK	Rice Straw + Nitrogen/Potassium

RESULTS AND DISCUSSION

According to the farmers, cow dung (dropping from cattle), compost, ashes (prepared from rice straw), and charred rice straw were readily available in their communities. However, the farmers were concerned about how to obtain the recommended quantities of these materials for their rice fields (Figure 1). A majority of respondents (73.3 %) believed that using human excreta for agriculture purposes is inappropriate. Some respondents indicated that they might not consume food produced using human excreta as fertilizer. Religious, cultural, and social believes other than health reasons are the cause of the strong objections to the use of human excreta for soil improvements in the area. Charred rice straw (Kun-tan) is the most promising technology since it completely meets the triplicate criteria of accessibility (Figure 1), acceptability (Figure 2) and affordability (Figure 3). Compost, which is produced mainly from animal droppings and crop residues is accessible in the communities but the farmers feel that it is not a suitable soil improvement technology (fertilizer) for rice fields. The farmers opined that they would rather use compost for their upland maize farms, instead of the rice fields.

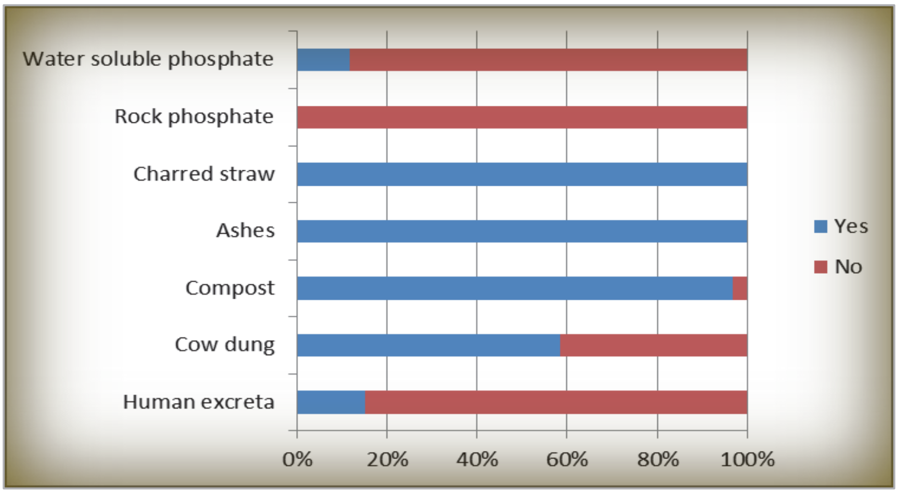

Figure 1 Accessibility in percentage of respondents

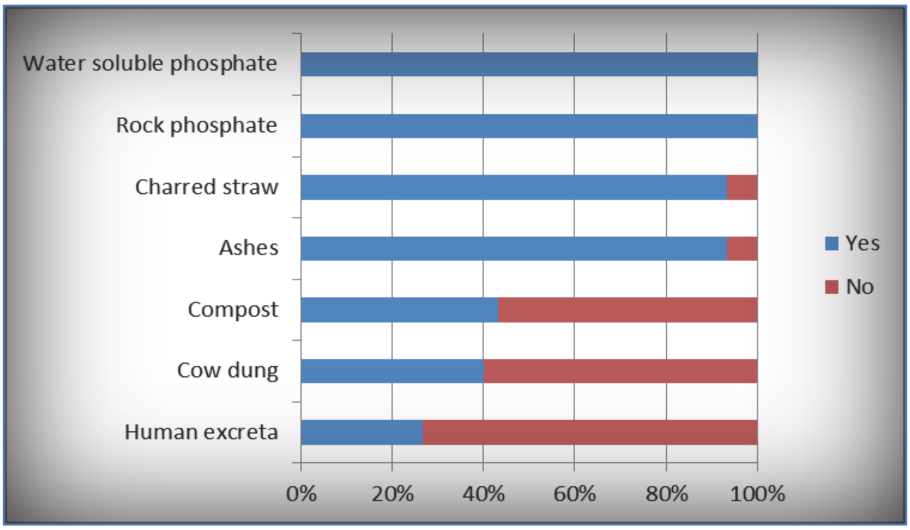

Figure 2 Acceptability in percentage of respondents

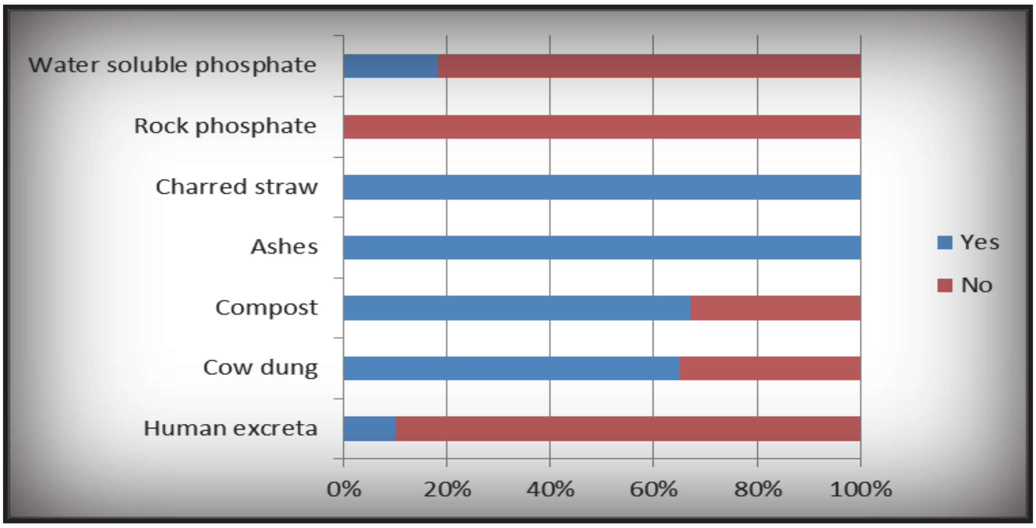

Figure 3 Affordability in percentage of respondents

Results of Profitability Analysis

The HE/RS + NK + PR treatment yielded the highest gross margin of GHS 1,681.28, followed by NK + TSP and CD/RS + NK + PR (compost) with gross margins of GHS 1582.88 and 1528.62, respectively (Table 2). Zero treatment and RS produced the lowest and second lowest gross margins of GHS 815.84 and GHS 1,008.89 respectively. However, in terms cost of production, the HE/RS + NK + PR treatment posted the highest cost of GHS 530.8/hectare. With the second and third highest cost of production going to the RS +NK and CD/RS + NK + PR (compost) respectively. The lowest and second lowest cost of production was realized from the zero treatment (GHS 290.2) and RS (GHS 345.3). In terms of yield, the HE/RS + NK + PR treatment produced he highest paddy of 3.12 tons/ha, followed by NK + TSP and CD/RS + NK + PR (compost) with average yields of 2.92 tons/ha and 2.88 tons/ha respectively (Table 2). Zero treatment and RS produced the lowest and second lowest paddy yield of 1.56 tons/ha and 1.91 tons/ha respectively. Such results, clearly indicates that farmers in the area need to add fertilizes in order to obtain higher yields.

Table 2: Results of profitability analysis of soil improving technologies

Treatment Type	number of samples	Rice Yield ton/ha	price per/ton GHS)	Gross income (GHS)	Total variable cost* (GHS)	Gross margin (GHS)
Zero	7	1.56	709	1,106.04	290.2	815.84
NK	7	2.42	709	1,715.78	453.6	1,262.18
NK+PR	7	2.56	709	1,815.04	493.5	1,321.54
CD/RS+NK+PR	7	2.88	709	2,041.92	513.3	1,528.62
HE/RS+NK+PR	7	3.12	709	2,212.08	530.8	1,681.28
NK+TSP	7	2.92	709	2,070.28	487.4	1,582.88
RS	7	1.91	709	1,354.19	345.3	1,008.89
RS+NK	7	2.30	709	1,630.7	519.1	1,111.6

* excluding cost of family labor (opportunity cost of family labor assumed to be zero)

CONCLUSIONS

Failure to apply any form of fertilization results in very poor economic returns to rice farmers in the area, but chemical fertilizers are relatively expensive, as a result most farmers cannot afford them. There are some local resources that have the potential for improving soil fertility at a lower cost. These resources need to be developed and used to improve production.

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