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Promotion and Adoption of ISFM in Northern Ghana: The case of legume and cereal farmers

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Abstract
This study assesses the determinants of the adoption of various components of Integrated Soil Fertility Management (ISFM) using cross-sectional data from 288 farmers. Employing a descriptive and three-stage least-square regression, the sampled farmers predominately worked on family lands and had diverse ways of managing land. Slightly more than a tenth of farmers use neither organic nor inorganic fertilisers. Being a female and an increased contact with extension agents increase farmers' likelihood to adopt full ISFM. On the other hand, age, area of farmland and farming on family lands dissuade farmers from the full adoption of ISFM practices. Therefore, ISFM can be promoted through increased farmer contact with extension. Further, appropriate land reforms at the local and national level, which facilitate land acquisition and ownership particularly among women and the youth, should be instituted to encourage transition into sustainable land management.

Keywords: Integrated Soil Fertility Management, Adoption, Family land

Introduction
Crop productivity is generally low in Ghana and attributed to low soil fertility, poor land management and current variability and future climate change (MoFA, 2020). Current fertilizer application rate is 20 kg ha^{-1} and it is below the recommended 50 kg ha^{-1} as adopted by the African Fertilizer Summit in 2006 (Winnie et al. 2022*)*. To this end, extensive areas of the country's arable land, particularly the interior savannah zone (Northern, Upper East, Upper West and North East Regions) have suffered from severe soil erosion and land degradation in various forms and experience high levels of food deficit. To reverse the declining trend in land productivity (crop yield) and ensure food security, soil management is crucial. Integrated Soil Fertility Management, ISFM, which combines both organic and inorganic inputs has been identified as the ideal practice that maintains soil fertility in both the short and long term. (Wamalwa 2024). It has the potential to increase yield and subsequently food production in Ghana, but the practice has been met with mixed success. The Northern part of Ghana namely upper East, Upper West, North East and Northern region which specialises in the production of maize, rice, cowpea and peanut have

enjoyed relatively high successes in the implementation of the technology (Vanlauwe et al., 2015). Nonetheless, full adoption of the ISFM package is minimal (Martey and Kuwornu, 2021) with only 3% of sampled farmers in Tamale (northern region) on full adoption (Adolwa et al., 2019). Against this background, we set out to (1) identify the components of ISFM practiced by a systematically sampled smallholder farmers in the above listed crops and (2) identify the factors that determine the adoption of the various components of ISFM in the four Northern regions of Ghana namely Upper West, Upper East, North East and Northern regions given the reference cropping year.

Material and Methods

The study was carried out in four out of the five regions in Northern Ghana namely Upper East, Upper West, North East and Northern regions which are situated within two agroecological zones: Sudan and guinea savannah. The sampling frame for this study was smallholder cereal and legume producers. A multistage sampling procedure was used for this study. First three (3) districts were randomly selected from each of the regions under study. This was also followed by another random selection of three communities from each district of which 10 farmers were sampled randomly for the study. Given this approach, the intended sample size was 360 farmers but non- response of some selected farmers decreased the sample size to 288 farmers. A mixed method approach was employed in collecting data and both inferential and descriptive analysis was used employed in analysing the data.

Results and Discussion

3.1 Socioeconomic characteristics of farmers

Socioeconomic characteristics of respondents shows an almost equal proportions of male and female farmers. Crop farming is the main occupation and majority of farmers kept livestock as household assets. On average, the farmers held about 10 acres of farmlands. However, average cultivated farm size was about seven acres. The pooled data shows that one-third of the farmers grow crops on their own lands (Table 1). This suggests that family-owned farmlands[1] were the predominant land ownership system in Northern Ghana. In addition, access to extension services among the farmers is low considering their relevance in educating farmers on new and improved means of crop production.

Table 1: Variable description and socioeconomic characteristics of farmers

Variable	Description	Mean *(n=288)*	Standard deviation
Gender	1=male, 0=female	0.493	0.5001
Main occupation	1=farming, 0=otherwise	0.979	0.143
Age	Years	45.076	13.139
Total landholding	Acres	10.787	14.523
Farm size: pooled data	Acres	6.610	8.125
Land ownership: pooled data	1=self, 0=family/rented	0.330	0.503
Agricultural extension contacts	1=yes, 0=no	0.156	0.493

[1] Family owned farmland refers to a piece of land that is in the custody of the head of the family, in this case, the head of the extended family. Family members have access to the land through authorization by the head of the family. Personal or owned land is one acquired by an individual and does not need permission from any family member to work or till it.

3.2 Profiling of ISFM practices

Table 2 reveals the components of ISFM practices currently adopted by the farmers, slightly more than a tenth of the farmers did nothing as in apply both organic and inorganic fertilizers to improve the fertility of their farmlands. The adoption of ISFM practices varied slightly in rice, maize, peanut and cowpea farms.

Table 2: ISFM practices adopted by farmers

ISFM practice	**Percentage** (*n=288*)				
	Pooled data	*Rice farmer*	*Maize farmers*	*Peanut farmers*	*Cowpea farmers*
Non-application of fertilizer	11.37	9.75	9.40	12.02	6.94
Use of only organic fertilizer	7.97	8.58	8.03	8.57	7.89
Use of only inorganic fertilizer	15.51	13.22	16.44	15.32	9.46
Use of both inorganic and organic fertilizers	12.54	14.39	12.48	12.02	15.14
Non-application of fertilizer and hybrid seeds	10.31	8.82	9.40	10.71	7.26
Use of organic and hybrid seeds	11.58	12.76	11.87	11.37	16.40
Use of inorganic and hybrid seeds	4.68	5.80	5.32	4.78	6.31
Use of both organic, inorganic & hybrid seeds	12.22	13.22	12.61	11.53	15.77
Use of inorganic and hybrid seeds	13.82	13.46	14.46	13.67	14.83

3.3 Determinants of ISFM adoption

Table 3 shows estimate from 3SLS regression for the determinants of ISFM adoption. Sex negatively influence the full adoption of ISFM practices (organic, inorganic, and hybrid seeds). This implies that female farmers are more likely to adopt full ISFM practices than males. The model also shows that adoption of full ISFM package reduces with age. Younger farmers are highly motivated than older ones and possess the energy required to carry out ISFM practices. Again, the model shows that large scale farmers are more likely to adopt ISFM practices than smallholders. Moreover, the association between farmers land management practices and landownership implies that farmers producing crops on their own farmlands are more likely to apply both organic and inorganic fertilizers than those producing on family lands. Farmers producing crops on their personal farmlands consider such farms as their personal assets. Thus, they willingly adopt ISFM practices that sustain soil fertility and boost productivity. Further agricultural extension contact is statistically significant and positive for full ISFM adoption hence, having contacts with agricultural extension increases the adoption of ISFM practices. Agricultural extension officers educate farmers on new and improved methods of farming, which includes ISFM practices. This agrees with Tetteh et al. (2020); Abebe and Debebe (2019); Ali et al. (2018); Gelgo et al. (2017) who reported that extension visits boost adoption of organic fertilizer.

Table 3: Determinants of ISFM adoption

Independent variable	**Coefficient (standard error)**				
	None	Only organic	Only inorganic	Organic & inorganic	Organic, inorganic & hybrid seeds
Sex	-0.344 (0.304)	-0.852 (1.977)	-0.049 (0.510)	-0.869 (0.196)***	-1.299 (0.457)***
Age	-0.007 (0.008)	-0.006 (0.025)	-0.002 (0.012)	-0.024 (0.006)***	-0.029 (0.009)***
Education	–	0.586 (0.999)	0.009 (0.016)	-0.155 (0.143)	0.213 (0.196)
Farm size	0.036 (0.023)	-0.016 (0.057)	0.005 (0.039)	0.020 (0.014)	0.054 (0.025)**
Landownership	-0.503 (0.208)**	0.172 (0.656)	-0.645 (0.381)*	0.843 (0.169)***	–
Extension contacts	–	–	-0.613 (0.671)	1.231 (0.196)***	1.323 (0.268)***
None	–	0.088 (1.927)	-1.437 (0.984)	-1.121 (0.476)**	-0.976 (0.445)**
Only organic	0.487 (0.394)	–	1.672 (1.098)	–	–
Only inorganic	-0.700 (0.466)	1.785 (1.712)	–	–	–
Constant	0.945 (0.496)*	-0.087 (1.295)	0.801 (0.839)	1.073 (0.377)***	–

Parms	13	13	13	13	12
RMSE	0.293	0.602	0.345	0.222	0.293
R-squared	0.446	-1.330	0.512	0.802	0.636
Chi-squared	48.01***	9.84	20.97*	104.85***	54.58***

*, **, and *** represent statistical significance at 10%, 5%, and 1% respectively.

Note: other socioeconomic variables controlled for in the model

Conclusions and Recommendation

The study has shown that farmlands used by farmers in Northern Ghana is predominately family lands which is expected to give farmers more security and opportunity for longterm investment. Farmers have diverse ways of managing farmlands but exclusive use of organic fertilizers was generally minimal. Slightly more than a tenth did not apply fertilizer at all. Farm size, own or personal lands, as well as contact with extension officers were some of the factors that positively influence adoption of ISFM. On the other hand, age, farming on family lands among others dissuade farmers from the full adoption of ISFM practices. This brings to fore the dynamics in land management between own or personal lands and family lands which are often used interchangeably. This implies that ISFM adoption can be enhanced by facilitating land regimes that makes it easier to acquire and own farmlands for cultivation. This can be achieved through appropriate land reforms at the local and national level. Considering the fact that young farmers are more likely to adopt new farm practices including ISFM, there is the need to encourage the youth who show interest in farming by facilitating their land acquisition and ownership. Also, the adoption of ISFM can be promoted through increase contact with extension agents who can offer training to bridge the gap in limited knowledge in land management.

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