

Different Farm Business Modules for Small Holder Farmers' Access to Agricultural Services and Technologies; the Case of Upper East and West Regions of Ghana

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Abstract: *The study was conducted in selected communities in the Upper East and West Regions of Ghana with the objective of identifying a farmer business module that best supports small holder farmers with Agricultural Services and Technologies and the challenges small holder farmers faced in crop production. The farm business modules identified were the nucleus farmer, Aggregator and the Farmer based organization modules. Data was collected from 10 out grower farm business modules and 50 small holder farmers in the Upper East and West Regions. Services rendered to the small holder farmers included, tractor service fertilizer, field spraying and threshing services. Technologies adopted also included the use of certified and hybrid seeds, row planting, use of weedicides and pesticides among others; technologies these modules supported the small holder farmers with. The nucleus farmer module supported the small holder farmers with 75% of these services and technologies. The study also revealed that 80% of the services rendered by the nucleus farmer were normally paid in kind after harvest. Fifty percent (50%) of the small holder farmers got their income from crop production and animal rearing indicating that there was an all year round income generation.*

Keywords: *Aggregator, Inputs, in-kind, Services, Technology.*

I. Introduction

Agriculture is the strategic sector in the promotion of most low-income countries. Agriculture employs about 40 percent of the population in the world (World Bank, 2006). Most Africans depend on small-holder farming systems as the primary source of their livelihoods.

In sub-Saharan Africa, 60 percent of the population is dependent on agriculture (World Bank, 2006). Agriculture in Ghana is dominated by small-holder farmers (SHF) who are predominantly rural dwellers. Ninety percent of these SHFs cultivate less than 2 acres in land size (MoFA, 2011; Oppong-Sekyere *et al.*, 2015). The dominance in SHFs means that no agricultural policy to support the development of agriculture can undermine these farmers. In line with this, institutions such as MoFA and the World Bank have emphasized the reorientation of policies such as access to technology, services and markets as a means to improving the livelihood of SHFs.

In Ghana, the total land under cultivation as at 2010 stood at 7,846,551 hectares, representing 57.6 percent of the agricultural land (MoFA, 2011). Siziba *et al.*, (2011) stated that, agriculture in Africa needs to improve in order to reduce poverty and hunger by transforming low productivity subsistence farming to high level commercial production. Smallholder farmers have not been given the support they need to flourish. Donors and governments have neglected this group, both through their approach to agriculture, and the dramatic decline in public finance allocated to support agricultural livelihoods (Salifu *et al.*, 2010).

National and international policies have often not favoured the marginal SHFs as they either travel to work on 'more productive' farms elsewhere in the rural economy, or migrate to cities in search for the non-existent jobs. Equally, African governments often do not give agriculture a high priority and tend to view rural areas as sources of political and economic patronage rather than as a focus for development efforts (Salifu *et al.*, 2010).

Northern Ghana consisting of the Northern, Upper East and West Regions is poorly endowed with natural resources and the income per capita of its population falls below the national average (Marchatta, 2011)

Over the past years, most non-governmental organization (NGO) have come up with various interventions through various farm business entities to develop the capacity of the small holder farmers so that they become food secured. These farm business entities include the formation of farmer based organizations (FBOs), development of the capacity of nucleus/lead farmers and aggregators to support the small holder farmers who are mostly dependent on them for inputs, loans, tractor services and other improved technologies that will increase their yield.

In recent years, there has been renewed interest among both public and private organizations to establish farmer based organizations (FBOs) in Ghana. This interest is based on the premise that FBOs give farmers bargaining power in the market place, enable cost-effective delivery of extension services, and empower

FBO members to influence policies that affect their livelihoods (Salifu *et al.*, 2010). Northern Ghana has a number of different farm business entities engaged in farming activities with the aim of supporting SHFs crop production all with the aim of reducing poverty and enhancing food security. The purpose of this study was to; identify the kind of support these entities give to the small holder farmers and identify which farm business entity is more beneficial to them; more so, which of the services or technology do farmers require to be food secured.

II. Methodology

1.1 Source of Data

The data collected was purely primary data. This was gathered through a survey by the use of a semi-structured questionnaire aided by a face to face interaction of smallholder farmers and the various farm business models they were linked to. The semi-structured questionnaire was designed to collect a range of data on their demographics including age, gender, sex, marital status; yield, technologies used, services received, land size, types of crops cultivated.

1.2 Sample size and approach

The target population was out-grower farm business modules closely monitored by NGOs in the Upper East and West Regions of Ghana. Three (3) business modules were identified and considered for the research. They are the nucleus farmers (NF) farm business module, the Aggregator module and the FBO module.

For the purpose of this study, a nucleus farmer (NF) is an out grower Business model where the NF has land and farms his or her own land and invests in some or most of the out grower's own cultivation.

An aggregators is an out grower model where the aggregator does not farm land, and may not have any assets, and only buys commodity FBO is a business model where all members of the FBO are equal, except for leadership, and they support each other through land preparation, meetings, trainings, mutual use of FBO assets, commodity sales etc. these farm business modules were considered for their support to smallholder farmers in the two regions.

In all, ten (10) farm business modules were considered; six (6) in the Upper West Region and four (4) in the Upper East region. These were randomly selected from a group of 30 different farm business modules in operation in the Regions.

They were also selected from different districts in each region to ensure uniformity.

Five (5) smallholder farmers linked to each business module were also selected from different communities for the study. In all ten (10) farm business modules were identified with 50 smallholder farmers for the survey. The multi-stage sampling was the appropriate procedure adopted considering the nature of the study. The multi-stage procedure was in three stages; clustered, purposive and randomized sampling approach.

A focus group discussion was conducted with the SHFs in a randomly selected community for each of the ten (10) selected farm business module, this was purely to assess the constraints they faced with their farm business module and the kind of support they might need from the relationship with the Farm business module.

1.3 Data Analysis

The data obtained from the questionnaire was analyzed using statistical package for the social scientists (SPSS version 17.0) and Microsoft Excel, and summarized into percentages and frequencies.

III. Results and Discussion

Table 1: Sex Distribution of Respondents

REGION	SEX OF RESPONDENTS		TOTAL
	FEMALE	MALE	
UPPER EAST	7	13	20
	35.0%	65.0%	100.0%
UPPER WEST	9	21	30
	30%	70%	100.0%
TOTAL	16	34	50
	32%	68%	100.0%

"Table"1 above shows the sex distribution of small holder farmers interviewed in the Upper East and West Regions of Ghana. Results show that males representing 65.0% and 72.0% were the majority of the small holder farmers who were linked to business models in the two regions respectively. It also shows that 35.0% and 32% respectively were females. This goes to prove the fact that more men are involved in the ownership of family farm lands in the Upper East and West Regions than females. It also supports the fact the farming activities are spearheaded by males in the two regions.

Table 2: Education levels of small holder farmers

REGION	EDUCATIONAL LEVEL OF RESPONDENTS				TOTAL
	BASIC	NO FORMAL EDUCATION	SECONDARY	TERTIARY	
UPPER EAST	7	11	1	1	20
	35.0%	55.0%	5.0%	5.0%	100.0%
UPPER WEST	8	16	5	1	30
	26.7%	53.3%	16.7%	3.3%	100.0%
TOTAL	15	27	6	2	50
	30%	54%	12%	4%	100.0%

Results of the current study shows that more than half (55% and 54%) of the respondents in the two regions respectively had no formal education while 35% and 30% had basic education in the two regions respectively. This is as a result of the fact that, most rural farmers do not attend school but spend all their time to farm to feed themselves and their families. This results corroborates those of Oppong-Sekyere and other researchers (Oppong-Sekyere *et al.*, 2016).

Table 3: Sources of Income for Small Holder Farmers

REGION	MAIN SOURCE OF INCOME							TOTAL
	Crop farming	Crop farming, Animal farming	Crop farming, Animal farming, Other	Crop farming, Animal farming, Salary/employee	Crop farming, Animal farming, Trading	Crop farming, Salary/employee	Crop farming, Trading	
UPPER EAST	2	13	0	1	4	0	0	20
	10.0%	65.0%	0.0%	5.0%	20.0%	0.0%	0.0%	100.0%
UPPER WEST	6	12	1	3	2	1	5	30
	20%	40%	3.3%	10%	6.7%	3.3%	16.7%	100.0%
TOTAL	8	25	1	4	6	1	5	50
	16%	50%	2%	8%	12%	2%	10%	100.0%

Table 3 above shows various sources of income generation for the small holder farmers in the study area. It reveals that half (50%) of SHFs get their income from crop farming and animal rearing. This was revealed at various focus group discussion stating that they produce crops during the rainy season and rear animals during the dry season to ensure all year round income generation. Apart from this 16% of the SHFs also generate their income from producing multiple crops for home consumption and also sell for cash. This will enable them to pay their children school fees and attend to their health needs.

IV. Services Granted to Small Holder Farmers

Table 4: Multi-purpose Sheller Service/Technology

Service or Technology	Response	Frequency	Percentage
Use of multipurpose Sheller	No	15	30
	Yes	35	70
Application of service at the time needed	No	5	17.9
	Yes	23	82.1
Application of service during the previous season	No	7	20
	Yes	28	80
Mode of payment or service	Free	7	25
	No	1	3.6
	Yes in kind	19	67.9
	Yes in cash	1	3.6
Who provides the services	Aggregator	5	17.9
	Nucleus farmer	11	39.3
	Self	5	17.9
	Other	6	21.4

Results of the study as shown by Table 4 indicate that more than two-third majority (70%) of the respondents had access to the service as compared to 30 percent of others who did no. It also revealed that 82.1 percent of the respondents also got the service at the time they needed it which is an indication that the service is readily available for the small holder farmer and the service was also used in the previous season as confirmed by 80 percent of the respondents (Nyamah *et al.* 2014).

The Nucleus farmer carried the highest provider of the service as confirmed by 39.3 percent of the respondents.

The results further reveals that the mode of payment for the service was in kind as respondents confirmed the exchange (payment) of one bag for every ten bags shelled.

Table 5: Use of Tarpaulin

Service or Technology	Response	Frequency	Percentage
Use of tarpaulin	No	30	60
	Yes	20	40
Application of service at the time needed	No	2	11.1
	Yes	16	88.9
Application of service during the previous season	No	4	18.2
	Yes	18	81.8
Mode of payment or service	Free	13	61.9
	No	2	9.5
	Yes in kind	5	23.8
	Yes in cash	1	4.7
Who provides the services	Aggregator	3	16.7
	Nucleus farmer	6	33.3
	self	4	22.2
	other	4	22.2
	FBO	1	5.6

Results in Table 6 show the use of Tarpaulin service by small holder farmer in their farming business. The table shows that the nucleus farmers provided the service for the small holder farmers as 33.3 percent of the respondents confirmed. The tarpaulin service was also given for free as established by 61.7 percent of the respondents.

The results further revealed that a little above fifty percent (58.5%) of the respondents had no access to the use of tarpaulin as the service providers confirmed they did not see it a very important service as most of the small holder farmers cultivated very small acreages of land and thus harvested small quantities of produce. The few that had access to the service got it timely (Akpalu *et al.*, 2013).

Figure 1: Use of moisture meter

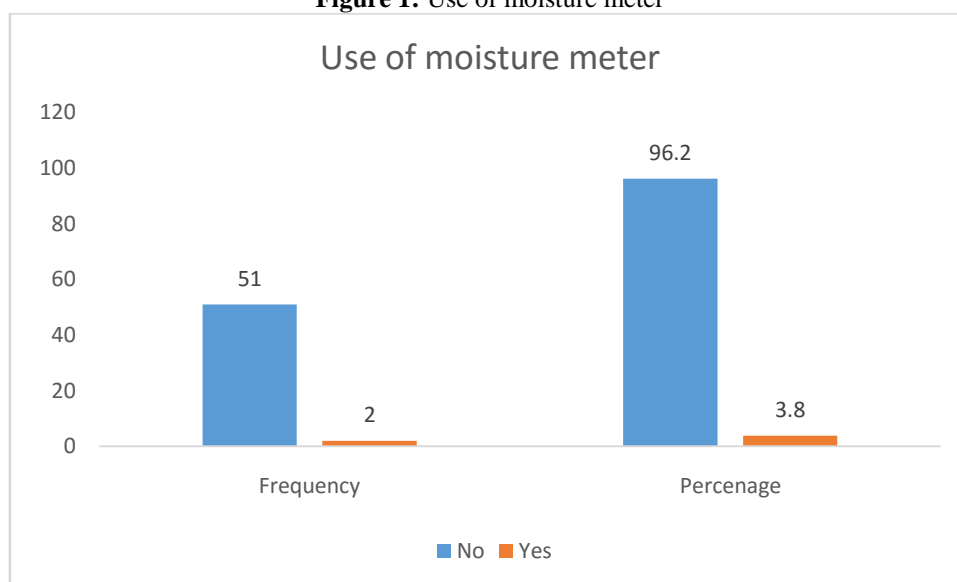


Figure 1- Use of moisture meter by small scale farmers

The use of moisture meter by respondents to test the moisture content of maize before storage is represented in “Fig” 1 the study revealed that a whopping 96.2 percent of the SHFs did not have access to the use of a moisture meter while a small 3.8 percent of the respondents did have access to its use. The assigned reason for this disparity was revealed by respondents during the focus group discussions session. Respondents attributed high temperatures allowing grains to dry to the maximum before they are stored. The study also revealed through a group discussion that, aggregators who bought from organizations like the WFP, Savanna farmers marketing company etc demanded quality grains, as such did test the moisture content before buying maize from them, and such organizations were few confirming the lower rate of the use of moisture meters(Akpalu *et al.*, 2013).

Table 6: Access to a warehouse

Service/technology	Response	Frequency	Percentage
Use of warehouse	No	30	60
	Yes	20	40
Mode of payment	Free	17	73.9
	Yes in cash	4	16.7
	Yes in kind	2	77.8
Service provider	Aggregator	1	5.6
	Nucleus farmer	3	16.7
	Self-owned	14	77.8

Access to the use of warehouse/store rooms for storing maize by SHFs is indicated in Table 6. The survey shows that majority of small holder farmers (60%) had no access to warehouses or storage rooms for their maize, whereas a smaller percentage of 40 percent of the SHFs however had access to the service. It was also revealed that over seventy percent (77.8%) small holder farmers owned store rooms where they normally stored their maize produce. This also goes to confirm the fact that most small holder farmers (73.9 percent) stored their maize for free as they owned the facilities. However, 73.9 percent of them stored for free as they did so in their own storage rooms. A postharvest study of groundnuts by Oppong-Sekyere and others (Oppong-Sekyere *et al.*, 2016) revealed similar trend.

Table 7: Access to hermetic/pics bag

Service	Response	Frequency	Percentage
Use of hermetic/pics Bag	No	20	40
	Yes	30	60
Use of service the previous season	No	1	3.3
	Yes	29	96.7
Mode of payment	Free	5	17.2
	Yes in kind	1	3.4
	Yes in cash	23	79.3
Service provider	Aggregator	1	5.6
	Nucleus farmer	3	16.7
	Others	2	11.1
	Self	12	66.7

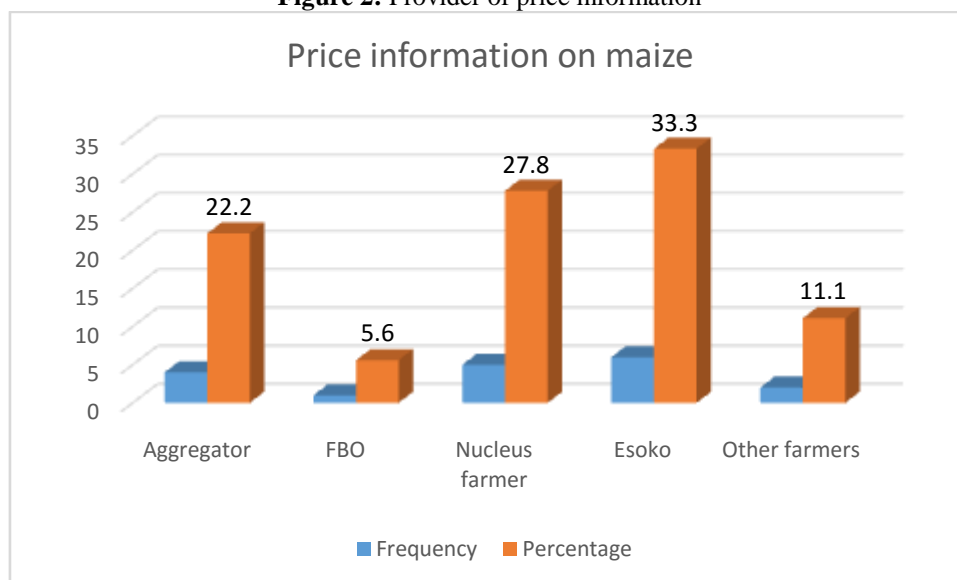
The results in Table 7 indicate that more than half (60 percent) of the respondents had access to the use of the bags for storing their maize. The results also show that most of them (96.7 percent) of SHFs used the technology in the previous season. SHFs bought the hermetic/pics bag themselves which shows from the service provider as 66.7 percent of the respondents buying them for use. These bags are bought in cash as 79.3 of the respondents purchased them in cash (Field Survey, 2016).

Table 8: Use of storage chemicals

Service/technology	Responds	Frequency	Percentage
Use of storage chemicals	No	22	44
	Yes	28	56
Use of technology in the previous year	No	3	10.7
	Yes	25	52.8
Mode of payment	Free	2	8.3
	Yes in cash	22	91.7
Service provider	Aggregator	1	6.7
	FBO	1	6.7
	Nucleus farmer	3	20
	Open market	11	73.3

SHFs used storage chemicals to store their maize as confirmed by 56 percent of the respondents. This was also confirmed at a focus group discussion with the SHFs as they used a common chemical Phostoxin for storing maize. Respondents also confirmed they bought the chemical with cash from the open market as a majority 91.7 and 73.3 percent of them indicated they bought with cash and from the open market respectively.

Figure 2: Provider of price information



The farmers also indicated that ‘Esoko’ is the major provider of prices of maize in the market. 33.3 percent of the respondents attested to that fact. Respondents also got the information through text messages on their phones. 27.8 percent also got price information from their nucleus farmer while 22.2 percent got from the aggregators of maize.

Figure 3: Price information

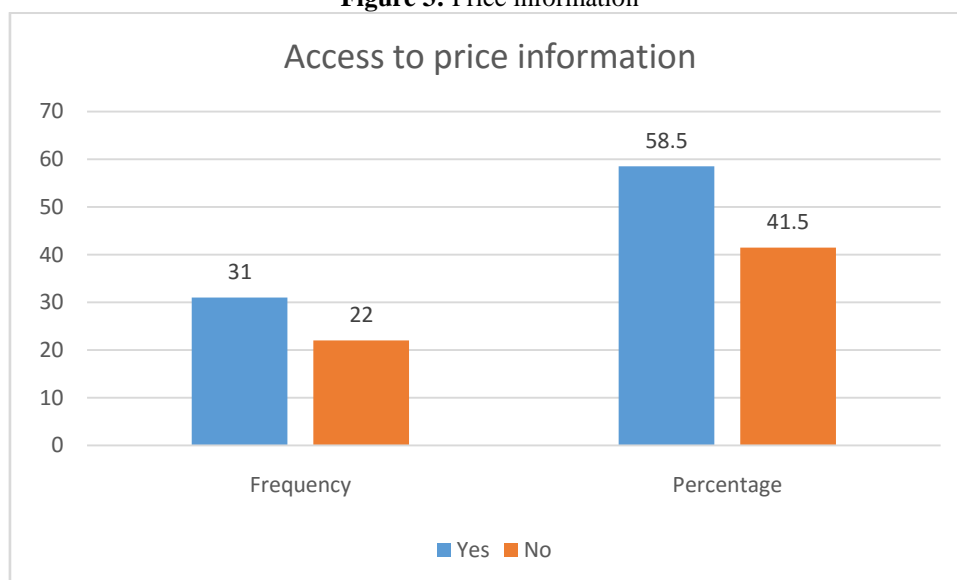


Figure 3 shows access to price information by SHFs in the Upper East and West Regions of Ghana. Majority of SHFs had access to price information as confirmed by 58.5 percent of the respondents. This was revealed as most of them got text messages from ESOKO for the prices of food and other serves just before harvest. They revealed receiving help to also price their produce. They also revealed through a focus group discussion that the messages on prices they got from ESOKO did not really influence their pricing as they were forced to give it at giveaway prices when there was a glut and no storage space to keep the excess(Nyamah *et al*, 2014).

V. Access to Technology

Table 10: Access to improved seed

Service/technology	Response	Frequency	Percentage
Access to improved seed	No	1	7.5
	Yes	49	98
Use improved seed in the previous year	No	1	2
	Yes	44	89.8
Application of service/technology at the time needed	No	2	4.5
	Yes	42	95.5
Mode of payment	Free	2	4.7
	Yes in cash	30	69.8
	Yes in kind	11	25.6
Service/technology provider	Aggregator	2	7.1
	FBO	1	3.6
	Nucleus farmer	12	42.9
	Open market	13	46.4

SHFs adoption of the use of improved seed is high among respondents in the Upper East and West Regions. The research revealed a huge majority (98 percent) of small holder farmers had access to improved seeds and used them in the previous season's planting. A contrary view was shared by Oppong-Sekyere *et al.* (2016) in a survey study carried out in groundnut in the three northern regions of Ghana.

The SHFs mentioned in a focus group discussion that NGOs had encouraged them to use the improved seed to increase their yield. However most of them bought the improved seed from the open markets near their communities as is shown in the results (46.4 percent). The study further revealed that SHFs bought the seed in cash from the input dealers. It was also revealed that the nucleus farmer provided improved seed to the SHFs but service provided by the NF was paid in kind.

Table 11: Access to fertilizer

Service /technology	Response	Frequency	Percentage
Use of fertilizer	No	4	8
	Yes	46	92
Use technology the previous year of	No	1	2.1
	Yes	46	97.9
Application of technology/service at time needed	No	12	26.1
	Yes	34	73.9
Mode of payment	Free	0	0.0
	Yes in kind	15	32.6
	Yes in cash	31	67.4
Service/technology provider	Aggregator	3	11.1
	FBO	2	7.5
	Nucleus farmer	9	33.3
	Open market	13	48.1

Poor yields of maize as a result of poor soils in the study area had necessitated the use of fertilizer by SHFs in the Upper East and West Regions. This was revealed in a focus group discussion and confirmed by a mammoth 92 percent majority of small holder farmers in separate interview sessions (Table 11). It was also stated by majority of the farmers (97.9 percent) that they used fertilizer in the previous year. The application of fertilizer was timely as revealed by 73.9 percent of them while 26.1 of them stated otherwise. Fertilizer was bought from the open market by majority of the SHFs (48.1 percent) while 33.3 percent of them got it from their nucleus farmers and paid back in kind. However, mode of payment was in cash as they bought from the open market (Table 11). Fertilizer use and its timely application is confirmed by MOFA, 2014

Table 12: Access to weedicide

Service/technology	Response	Frequency	Percentage
Use of weedicide	No	5	10
	Yes	45	90
Use of technology the previous year	No	2	4.4
	Yes	43	95.6
Application of technology/service at time needed	No	0	0
	Yes	43	100
Mode of payment	Free	1	2.3
	Yes in cash	34	79.1
	Yes in kind	8	18.6
Service/technology provider	Aggregator	4	16
	FBO	1	4
	Nucleus farmer	6	24
	Open market	14	56

The survey reveals that 90 percent of farmers used weedicide for weed control during the production of maize. It further revealed that 95.6 percent of them used the weedicide in the previous season. These weedicides were bought in cash from the open market. Twenty-four (24 percent) of the farmers also got the weedicides from the nucleus farmers and paid in kind after harvest (Table 12). This result is corroborated by studies conducted by the following researchers; Oppong-Sekyere *et al.* (2015); Oppong-Sekyere *et al.* (2016).

Table 13: Access to insecticide

Service/technology	Response	Frequency	Percentage
USE OF INSECTICIDE	No	30	60
	Yes	20	40
USE OF TECHNOLOGY THE PREVIOUS YEAR	No	4	20
	Yes	16	80
APPLICATION OF TECHNOLOGY/SERVICE AT TIME NEEDED	No	0	0.0
	Yes	16	100
MODE OF PAYMENT	Yes in cash	13	81.3
	Yes in kind	3	18.7
SERVICE/TECHNOLOGY PROVIDER	Aggregator	2	16.7
	FBO	1	8.3
	Nucleus farmer	2	16.7
	Open market	7	58.3

The use of insecticide was not very popular among small holder farmers who produced maize as only 37.7 percent of them confirmed the use of the chemical. 60 percent of the indicated they did not use insecticides for maize production. This was also confirmed in a focus group discussion with the SHFs as they said insecticides were used to spray their beans farms and not maize. 81.3 percent of SHFs also bought insecticides in cash and is normally available when they needed it (Table 13). These chemicals were normally bought from the open market (MoFA, 2014; Oppong-Sekyere *et al.*, 2015).

Table 14: Comparison of service provision between NFs and the other business models

services	business model	number	provision of service		percentage of service provided
			no	yes	
Tractor services	NFs	6	0	6	100%
	Other	4	4	0	0%
Fertilizer on credit	NFs	6	0	6	66.7%
	Other	4	1	3	33.3%
Seed on credit	NFs	6	0	6	75%
	Other	4	2	2	25%
Cash loans for agric and non-agric. activities	NFs	6	3	3	75%
	Other	4	3	1	25%
herbicides & weedicides on credit	NFs	6	3	3	42.9%
	Other	4	0	4	57.1%
Field spraying services	NFs	6	2	4	66.7%
	Other	4	2	2	33.3%
Threshing and shelling	NFs	6	0	6	75%
	Other	5	3	2	25%
Warehousing	NFs	6	0	6	75%
	Other	5	3	2	25%

According to the current study, the nucleus farmer (NF) business module was the best for supporting smallholder farmers in the upper east and west regions of Ghana. The result as shown in the table 14 indicates that NF provided most of the services that the SHFs needed for crop production. This means that small holder farmers stand a chance of benefitting from services from the NF than the aggregator and FBO farmer business modules. This has increased the small holder farmer's acres of production and increased yield making them food secured throughout the year as stated in a focus group discussion on the field.

VI. Challenges of NFs support to SHFs

The key challenges faced by NF and their SHFs business module gathered from a focus group discussion in this study are as follows;

- Sometimes the NF is unable to assist all members with improved seed, fertilizer, tractor services, among others.
- The SHFs productivity fluctuates in response to access to farming inputs; productivity has taken serious dips in years when the NF does not provide access to hybrid seed and fertilizer.
- The NF business does not offer access to markets connections to the SHFs and they do not buy or aggregate produce apart from collecting his repayment dues in kind from the SHFs.
- The NF business has marketing challenges, often selling and competing with SHFs to sell to prospective buyers.

Way forward to improve this business relationship include donor support to NF to ensure SHFs secure access to improved hybrid seeds, tractors, buyers of their produce and fertilizer every season. Alternatively, the SHFs asked for linkage between them and financial institutions that will provide the resources with the NF serving as collateral. The NF business also needs help with access to higher value markets.

VII. Conclusions and Recommendations

The research showed that the nucleus farmer business module best supports the small holder farmer's bid to increase crop production and also to be food secured throughout the year.

Nucleus farmers invest a lot of resources for the mutual benefit of both parties in the production activities; they develop real and long-term relationships with their SHF networks. However these business operators are not well resourced and need development partner and public assistance to strengthen and add capacity to their business operation as well as encourage new investors to enter the ranks of the nucleus farmers.

The FBO model is not an ideal standout model to deliver services and economic development to SHF. The case study revealed that FBOs that stand out performed very well but need to be classified as farmer based enterprise. FBOs serve an important role in creating unity of purpose in SHF groups.

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