

Farmer innovations in financing smallholder maize production in Northern Ghana

Farmer
innovations

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Abstract

Purpose – The purpose of this paper is to explore smallholder agricultural financing in Ghana's Northern region by identifying farmers' preferred traditional and innovative financing methods and estimating the determinants of use of innovative financing methods.

Design/methodology/approach – This paper presented a list of documented traditional financing methods to farmers during in-depth interviews and employed descriptive statistics to summarize choice and amounts sourced from traditional methods. Two questions from the survey revealed a felt need for extra financing sources for credit-rationed farmers. Farmers with positive responses to either or both questions were classified as "users of innovative financing". The authors then used a probit model to examine factors that influence decisions to use innovative financing method.

Findings – Farmers' own savings, reinvesting past season's profits and financing maize production with income from other commercial crops were the most popular traditional methods. The authors found complementary relations between formal and informal lending systems in the rural financial market. Smallholders also took farm and non-farm "by-day" jobs to raise income for farm investment and/or joined Village Savings and Loans Associations (VSLAs) specifically to take advantage of possible credit opportunities. These two latter methods were operationalized in this study as innovative agricultural financing. The results show that access to credit, social capital and market participation increased the likelihood of using innovative financing methods. Alternatively, farmer group membership, diversity in crop production and being a household head diminished the likelihood of innovative financing use.

Practical implications – The activities of VSLAs can be regulated and expanded to spread its benefits to more farmers. Also, creating avenues for dry season labour market participation in the region could enable farmers raise capital for farm investment.

Originality/value – This study explores existing practices and farmer innovations to agricultural financing and, by so doing, deviates from the vast literature focussing mainly on microcredit provisioning as the main model of smallholder agricultural financing in Africa.

Keywords Probit model, Northern Ghana, Agricultural finance, Smallholder farmers, Farmer innovations

Paper type Research paper

1. Introduction

Finance is the key driver of all activities in the agricultural value chain. Access to financial services guarantees production success by increasing access to productivity-enhancing inputs like fertilizer, improved seeds and pesticides. Adequate and timely access to farm finance removes barriers to market participation and contributes to poverty alleviation. Maize is Ghana's most important food security crop, constituting more than 50 per cent of total cereal production (Angelucci, 2013). Majority of maize output is meant for human consumption although there is growing derived demand from the livestock sector. Ragasa *et al.* (2014) assert that the poultry industry's demand for maize grew by 10 per cent annually between 2000 and 2009. Despite this importance, statistics from MoFA (2017) show that maize productivity is some 65 per cent below the achievable yields. This shortfall has been attributed to challenges like poor soil quality, disease and pest infestation, poor agronomic practices, low market integration and defective production and pricing policies that lead to gluts during harvest



seasons and shortages for most part of the year, and inadequate technology transfer and adoption (Wolter, 2009; Grewer *et al.*, 2016). Smallholder farmers can address these production challenges by adopting improved technologies in production, storage and general postharvest handling – this will require significant levels of farm investment.

In reality, farm investment funds are often not readily available to poor Ghanaian rural farmers due to missing or underdeveloped formal agricultural credit markets. Formal banks are usually concentrated in urban locations with minimal mobile or agency banking services for rural farmers. This increases farmers' transaction costs of formal credit market participation. For farmers, behaviours like risk aversion, fear of collateral loss and credit diversion (*ex ante* moral hazard) may influence credit supply and demand decisions (Turvey, 2017; Madestam, 2014). These barriers, along with exploitative interest rates, ration poor farmers from participating in informal lending markets. Therefore, these farmers would have to manage their own sources of finances in order to meet their numerous household needs while setting aside funds for farm investment in the production season. One way in which Northern Ghana farmers manage their funding sources is through cooperative credit thrift societies dubbed Village Savings and Loans Associations (VSLAs). VSLAs are essentially susu groups where like-minded people contribute monies at regular intervals (daily, weekly or monthly). These accumulated funds are administered in two ways; the money is given to society members on rotational basis at the end of every week or month. In the second scenario, pooled funds are given to requesting members at a defined interest rate (Afolabi, 2010; Fadeyi, 2018).

The Ghanaian agricultural financing literature has tended to focus on formal credit provision which established that the provision of timely and affordable credit could mitigate financial constraints on production, marketing and consumption and increase farm productivity (Kedir, 2003; Steiner *et al.*, 2009; Anang *et al.*, 2015; Akudugu, 2016; Asante-Addo *et al.*, 2017). While the formal credit system has been attributed with success stories of empowerment and progress (Dittoh, 2006; Martey *et al.*, 2015), the aforementioned challenges show other sources of farm investment capital may be needed. Some of these alternative sources identified in the literature include own income, credit and/or grants from donor agencies and development partners, and remittances (Abdul-Jalil, 2015; Wenner, 2010).

In principle, the commonest and most readily available source of capital for agricultural financing is the farm households' own income (either from farming activities or non-farm economic activities). Operationally, the study adopts IFAD's (2010) definition of agricultural finance as "financial services used throughout the agricultural sector for farming and farm-related activities including input supply, processing, wholesaling, and marketing". In this study, we define innovative agricultural financing as measures and methods initiated and pursued by rural farm households to generate revenue specifically for farm investment. These innovative enterprises are aimed at improving farmers' access to and control over farm resources such as land, labour, inputs and market channels. In other words, they are aimed at supplementing the traditional sources of financing farm activities.

With the obvious constraints that smallholder farmers face in accessing loans from formal institutions, there is a need to shift the focus of research to understanding farmers' indigenous knowledge and practices in farm financing. This would help to tailor solutions that are actually available and achievable to farmers' needs. Unfortunately, not enough research has considered the innovative ways in which credit-constrained farm households finance their agricultural activities, with specific interest in maize farming. By identifying the traditional and innovative methods that farmers use in financing their maize production, this study collates and circularizes indigenous practices and knowledge that has not been overtly covered in the literature.

In a credit-constrained environment, farmers are compelled to be creative in their quest for alternatives. In this study, a financing method is considered innovative when the decision to

use it stems from the farmer's felt need and consciousness and would ordinarily not have been pursued by the farmer if she/he had access to credit or adequate financing from other sources. Thus, use of innovative financing is an adaptation strategy that smart managers employ to perpetuate the success of their undertaking. To this end, it is important to identify the institutional and socioeconomic factors that influence the decision to use innovative financing. This will serve as entry points for policy formulation in the area of agricultural financing. As a justification, the findings on the main sources of finance for smallholder agriculture will help highlight and address challenges that may exist in their use to boost maize production and productivity. Furthermore, this study remains essential because it approaches solving the financing needs of farm households quite differently; by identifying farmers' own existing practices in order to apply them in designing financing packages for adoption in other areas. This will provide an added dimension to the agricultural financing literature.

2. Data and empirical approach

2.1 Study area, data types and sample size

The research focusses on maize farmers in the Northern region[1] of Ghana. Located between latitudes 8°N and 11°N, the Northern region is Ghana's largest and covers almost a third (70,384 km²) of the nation's total land area. It is bordered to the east and west by Ghana's international neighbours, Togo and la Cote d'Ivoire, respectively (GSS, 2013; Azumah *et al.*, 2017). The region makes substantial contributions to national food crop (especially cereals) production despite having only one rainfall peak season.

The region has been the target of many projects and programmes aimed at resolving the productivity challenges of local staples as well as "cash crops" like soybean. Notwithstanding the harsh local climate conditions, Northern region is the leading producer of cereals like millet and sorghum and also ranked fifth in maize and second in rice production (MoFA, 2016). These significant contributions to the food crop sector have led to the widespread regard of the Northern region as the bread basket of the nation.

The study used a cross-sectional primary data obtained from a survey conducted between February and April 2018. Principally, the questionnaire solicited information on credit access in a comprehensive way, including the innovative ways by which farmers finance their activities. Also, data on the per-unit costs (market prices) and quantities used of production inputs were collected. Further, demographic and institutional factors that may influence the use of innovative financing among maize farmers such as farmers' gender, access to credit and extension services and membership of farmer cooperatives were collected.

Six maize producing districts in the region were purposively selected for the survey, taking into account their maize performance and geospatial location in the region. A total of 360 maize farmers were sampled from the six districts. The ideal respondent is a maize farmer with more than one season's experience in maize farming, producing on a relatively small landholding with production technologies and inputs representative of the target population. Integration in a household setting with some level of commercial focus (participation in the maize crop market) and being a female producer were extras. A multi-stage sampling technique was employed to select respondents for the survey. In the first stage, two communities from each district were selected usually on the advice of local agricultural sector players who had had implementation collaborations with USAID's Feed the Future Ghana Agriculture Technology Transfer Project. To determine the appropriate sample size, we used the GSS (2013) report on the total population of the sampled districts and the region. The population of Northern region was reported to be 2,479,461 and the total for the six districts was 625,072.

This means about 25.21 per cent of the population could be used in calculating the sample size with a *z*-value of 1.96 at a margin of error of 0.05. Cochran's (1977) sample size

determination formula was used as follows:

$$n = \frac{z^2 \times p(1-p)}{d^2}, \quad (1)$$

where n is the initial sample; p the proportion of population under study (0.2521); z the value of z at 5 per cent sig. level (1.96); d the margin of error (0.05):

$$\begin{aligned} n &= \frac{1.96^2 \times (0.2521)(1-0.2521)}{0.05^2} \\ &= \frac{3.8416 \times 0.1885}{0.0025} = 289.66 \approx 290. \end{aligned}$$

Considering that these figures were taken in 2010 and that the population of the Region increased by 36.1 per cent between 2000 and 2010, the study added an extra 70 respondents to the estimated sample size to correct for population growth as at the 2018 survey year. This yielded a total sample size of 360 respondents.

The selection of households in the communities was done quasi-systematically; an absent household or the absence of a suitable respondent for interview led to the replacement of such household with one within close proximity from which a respondent had not been previously selected. In total, 11 communities were selected for the survey (only one community was selected in the Sawla-Tuna-Kalba District due to certain circumstances). Data from the survey was collected using a semi-structured questionnaire as the key instrument through personal interviews.

2.2 Identifying traditional and innovative sources of finance and per source fund magnitudes

We employ two main approaches in identifying the traditional methods of agricultural financing and the amount of funds generated from each method. First, we reviewed the extant literature on agricultural financing in Ghana. This review showed that past studies on agricultural financing focus on formal credit provision and access as the means of financing Ghanaian agriculture. Second, through key informant interviews with model farmers and agricultural sector players in the study area, other common forms of financing options were identified. In all, the study distinguished 16 sources of finance in maize production prior to the main data collection. These sources were presented to farmers during the survey process for verification.

From each financing option, we collected data on the magnitude of funds generated from each source. The outcomes give an idea of the extent of patronage of any financing method, which further reflects its popularity among farmers. A popular financing option may mean that farmers tend to derive higher utility from that option. Therefore, the random utility model is employed as the theoretical framework to examine factors influencing farmers' decisions to use innovative financing.

A smallholder maize farmer's decision to use innovative financing is driven by the need to generate income due to limited financial resources. This decision is initiated by the farmer and is one that creates a certain amount of utility for the farmer. The originality of the stimuli for that decision is what makes the choice "farmers' own innovation" as opposed to participation in a formalized agricultural intervention or programme. Thus, the farmer is faced with a discrete choice on which action, with regard to innovative agricultural financing, is likely to produce the greatest satisfaction (satisfaction could be in terms of achieving minimum total production cost or maximum total productivity).

Armed with knowledge on the constraints farmers face in accessing finance for farm investment, the questionnaire specifically elicited information on what farmers do when faced with limited resources. Specifically, the survey asked farmers the following questions to determine their use or non-use of innovative financing: Did you join any credit and loans group specifically to acquire credit for maize production?, and Did you take a “by-day” job specifically to raise money for maize production? The answers to each of these questions are either “yes or no”. The “yes” option to these questions yielded two key responses as follows:

- (1) I join a VSLA group specifically to take advantage of the possibility of accessing credit at short notice, at a relatively cheap cost, and with minimal processing requirements.
- (2) I take non-farm and off-farm jobs during the dry season (off-season) in order to raise funds for procuring farm inputs when the production season begins.

2.3 Determinants of innovative financing use

The decision to use innovative financing is modelled as a binary variable within the regression framework. To examine the factors influencing farmers’ decision to use innovative financing, we used the probit model. The farmer is assumed to be rational. According to Cascetta (2009), the general assumption is that farmers have a preference among the available choice alternatives that allows them to state which option they prefer. These preferences are assumed to be complete (the person can always say which of two alternatives they consider preferable or that neither is preferred to the other) and transitive (if option A is preferred to option B, and option B is preferred to option C, then A is preferred to C). The farmer is assumed to take account of available information, probabilities of events, and potential costs and benefits in determining preferences, and to act consistently in choosing the self-determined best course of action. Further, the above assumptions require that it is usually not possible to predict with certainty the alternative that the farmer will select. However, we can express the probability that the perceived utility of choosing innovative financing is greater than all other alternatives conditional on the farmer’s choice set I. This is expressed as:

$$p_i(j|I) = \Pr[U_{ij} > U_{ik} \forall k \neq j, k \in I]. \quad (2)$$

A farmer chooses innovative financing to achieve the maximum level of maize output at the minimum cost. This motivation holds true for all farmers irrespective of their socioeconomic and demographic characteristics like age, sex and market participation. Achieving this aim brings the farmer some level of utility that increases with higher maize yields and lower production costs. A maize farmer is said have maximized her utility when the decision to use innovative financing leads to increased productivity and lowered costs.

Thus, a maize farmer with limited financing options is faced with a 0/1 decision and we can model the decision to use innovative agricultural financing as a function of the characteristics discussed above. Other factors that influence this decision may be generally applicable to the entire (or homogenous subsets of) population. Examples of these are climatic and location variables. A final category of variables that affect use of innovative agricultural financing may be idiosyncratic, specific to individual farmers. Examples of these include farmers’ access to agricultural extension services and level of social integration (measured as a count of the number of membership of social groups). The binary nature of the decision means the parameter estimates can be converted and interpreted as the probability for a farmer to choose innovative agricultural finance (Ansah *et al.*, 2013).

The probit model specified as:

$$p(L_i^* = 1|Z_i) = \gamma Z_i + w_i, \quad (3)$$

$$L_i = \left\{ \begin{array}{l} 1 \text{ if } L_i^* > 0; \text{ farmer uses innovative financing} \\ 0 \text{ if } L_i^* \leq 0; \text{ farmer does not use innovative financing} \end{array} \right\},$$

where Z_i is a vector of observed characteristics; w_i is the error term of the binary estimator. Empirically, the model is specified as:

$$p(L_i = 1|Z_i) = \gamma_0 + \sum_{i=1}^{22} \gamma_i Z_i, \quad (4)$$

where Z_i is as defined in 3.2; γ_i is the coefficient of the independent characteristic to be estimated.

The explanatory variables, their units of measurement and *a priori* expectations are summarized in Table I. The estimate of L_i from Equation (4) is actually a latent variable that can only be observed by examining the probability that the event of interest occurs – a farmer uses innovative agricultural financing.

3. Results and discussions

3.1 Characteristics of sampled smallholder maize farmers

Previous studies (e.g. Wongnaa *et al.*, 2018) find that maize production in Northern Ghana is male-dominated. Our results in Table II tend to confirm this, as the majority of the sampled respondents (about 67 per cent) is male. The average age of farmers is about 42 years with a sample age range of 19–80 years. These figures show an aging farmer population. In terms

Var.	Description	Measurement	-/+
Z_1	Access to formal credit	Dummy; 1 if farmer has access to credit	-
Z_2	Farming as main occupation	Dummy; 1 if main occupation is farming	+
Z_3	Extension access	Dummy; 1 if farmer had contact with AEA	+
Z_5	FBO membership	Dummy; 1 if farmer is a member of a FBO	-
Z_6	Assets ownership	Count of assets owned by the farmer	-
Z_7	Household size	Count of farmer's household members	+
Z_8	Formal education status	Dummy; 1 if farmer is formally educated	-
Z_9	Maize as main crop	Dummy; 1 if maize is the farmer's main crop	+
Z_{10}	Social capital	Number of social groups farmer belongs to	+
Z_{11}	Household position	Dummy; 1 if farmer is the household head	-
Z_{12}	Level of crop diversification	Number of food crops cultivated by farmer	+
Z_{13}	Personal tragedy	Dummy; 1 if farmer faced a tragic incident	+
Z_{14}	Manure use	Dummy; 1 if farmer uses farmyard manure	-
Z_{D1}	Karaga District	Dummy; 1 if farmer is from Karaga District	+/-
Z_{D2}	Gushegu District	Dummy; 1 if farmer is from Gushegu District	+/-
Z_{D3}	Kumbungu District	Dummy; 1 if farmer is from Nanton District	+/-
Z_{D5}	West Gonja District	Dummy; 1 if farmer is from West Gonja	+/-
Z_{D6}	STK ^a District	Dummy; 1 if farmer is from STK ^a District	+/-
Z_{MP2}	Only commercial	1 if farmer is solely commercial	+
Z_{MP3}	Largely Subsistence	1 if farmer is largely subsistence	+
Z_{MP4}	Largely commercial	1 if farmer is largely commercial	+
Z_{MP5}	Both equally	1 if equally commercial and subsistence	+
Note: ^a STK, Sawla-Tuna-Kalba			

Table I. Description of variables in the probit model and their *a priori* expectations

Variable	Obs.	Mean	SD	Min.	Max.
Sex	347	0.6657	0.4724	0	1
Age	347	42.0338	11.4057	19	80
Formal education	347	0.2738	0.4465	0	1
Years in education	95	7.5368	4.3217	1	19
Marital status	347	0.9049	0.2938	0	1
Household size	347	15.2565	9.7370	1	60
Maize as primary crop	347	0.7406	0.4389	0	1
Farming as primary occupation	347	0.9135	0.2814	0	1
Level of social integration	347	0.9452	0.7937	0	5
Extension contact	347	0.4121	0.4929	0	1
Farm size	347	1.5248	0.9404	0.57	8.63
Farm experience	347	3.7877	4.8022	1.75	27
FBO membership	347	0.3458	0.4763	0	1
Credit access	347	0.2882	0.4536	0	1
Level of crop diversification	347	2.3977	0.8654	1	5
Off-farm employment	347	0.3285	0.4704	0	1
<i>Location variables</i>					
Karaga District	347	0.2190	0.4142	0	1
Gushiegu District	347	0.1873	0.3907	0	1
Kumbungu District	347	0.1499	0.3574	0	1
Savelugu-Nanton District	347	0.1902	0.3930	0	1
West Gonja District	347	0.1614	0.3684	0	1
Sawla-Tuna-Kalba District	347	0.0922	0.2898	0	1

Table II.
Details of selected
farmer characteristics
in the study area

of formal education, the result shows that a significant proportion of farmers are unschooled, with only 27 per cent having attained some level of formal schooling. Even for these, the average years of schooling is a little above 7. With the definition of basic education expanded to include secondary education, these statistics present a worrying state of affairs. On average, a farmer's household has 15 members with some farm households having as many as 60 persons. GSS (2013) notes that households in Northern Ghana are usually larger than national averages, attributing the gap to polygamy, high fertility and prevalence of extended family systems in the region. The size of a household may be a source of farm labour but could also create pressure on household resources especially when members are in a typically dependent age group. The average farm size of 1.5 acres shows that the sampled respondents are smallholder farmers, with some of them producing maize on landholdings as small as 0.57 acres.

Farmers were found to engage in multiple crop production, some producing as many as five different crops. On average, farmers produced at least one other crop in addition to maize. For about 26 per cent of respondents, these other crops were their primary crop with maize playing a supporting role. As discussed, the Northern region experiences a unimodal rainfall pattern and this necessitates engagement in off-farm businesses to complement farm returns. The results reveal about 33 per cent of respondents were involved in off-farm engagements. Concerning the spread of respondents in the survey, the Karaga district contributed the highest percentage with about 22 per cent of respondents, the Nanton district follows in a close second, while the Sawla-Tuna-Kalba district rounded it off with about 9 per cent of the respondents.

3.2 Traditional sources and magnitudes of funds for farm financing

In line with findings from recent studies in the study context (Anang *et al.*, 2015; Abdulai *et al.*, 2018), the results reveal that less than 50 per cent of respondents had access to formal credit. Our study finds that about 29 per cent of farmers had access to credit from both

formal and informal sources. The study found that the most popular sources of financing among maize farmers are their personal savings and ploughing back profits from the previous crop season. The highest percentage of farmers (62.82 per cent) finance their maize production from their personal savings, followed by ploughing back profits from the previous season's maize crop (59.37 per cent) and using income from sale of other crops (52.16 per cent). The latter source of farm financing is especially popular among maize farmers who produce largely for subsistence purposes, i.e., produce from the maize farm is usually reserved for household consumption with crops such as soybean, groundnut and/or cassava grown largely for commercial reasons to raise income for financing the production of maize in the next season, among other needs.

Besides these three dominant sources, income from livestock sale and off-farm economic activities are the next popular sources of finance among maize farmers in the Northern region. As one farmer in Kumbungu District asserted, it is easier to plan for purchasing agro-inputs such as fertilizer and herbicides if one raises livestock as part of their farming:

[...] all I have to do is to sell one goat and I can afford to buy fertilizer for 1 acre of maize farm, that is why I take my goat farming seriously. (Respondent Number 217, Cheyohi)

With 29.11 per cent of farmers admitting that they use income from their off-farm enterprises to finance their maize farming, it is easy to establish the importance of having diverse sources of income for production.

The most popular sources of farm finance, according to the scope of coverage in the literature, fall into a class of external loans sourced from formal institutions such as banks, microfinance institutions, non-governmental organisations (NGOs). Input credit through arrangements such as contract farming and government agricultural sector support policies such as the Fertilizer Subsidy Programme and the recent Planting for Food and Jobs Programme are also quite popular. This popularity in the literature did not reflect among sampled farmers as shown by the relatively low responses in farmer use. For example, only 1.73 per cent each of respondents reported taking loans from banks or accessing input credit while a paltry 0.29 per cent used loans from NGOs to finance their maize farming in the production season in the Northern region.

In the face of limited access to formal credit sources, farmers often have to rely on other options to generate income for farm investment. For example, some farmers may have to rely on informal credit sources from social network, familial lending and reciprocity. Jones *et al.* (2000) outlines family/relatives, friends, moneylenders and susu groups as key players in the informal financial space in Ghana. Despite the important roles informal financing, not much work has been done in that respect. In this study, we find that farmers depend on familial lending and social networks to obtain farm investment credit. For instance, 14.12 per cent of farmers acquired loans from friends; 9.15 per cent used loans from family members; 12.10 per cent used loans from moneylenders and 14.41 per cent used loans from their local Savings and Loans Associations. Another evidence of the importance of a strong social support structure to the Ghanaian rural farmer is the finding that 10.66 and 5.19 per cent of respondents, respectively, used remittances (gifts) from family members and friends for financing their maize farming. Other external non-loan sources of finance used by farmers include grants from NGOs (3.17 per cent) and income from lottery (0.58 per cent). These findings suggest that social networks have a greater impact on agricultural finance than has been previously considered although further research is required to establish causal links.

The average amounts obtained for each finance source is reported in Table III, with personal savings posting the highest mean amount of GH 759.24 with more than 10 per cent usage. The next highest amount is reported for loans from friends with GH 389.51 and GH 375.50 for ploughing back profits. The sources of finance were grouped into three classes to aid the description: internally generated fund financing – if a respondent uses personal

Source	Use per cent	Mean (GH¢) ^a	SD	Min.	Max.
Gifts from family members	10.66	181.4545	161.9432	2	600
Gifts from friends	5.19	146	114.3805	2	440
Loans from family members	9.15	396.6667	399.9746	20	1,800
Loans from friends	14.12	389.5106	438.2783	1	2,000
Personal savings	62.82	759.24	854.2224	1	5,000
Ploughing back profit	59.37	375.5	399.4516	50	2,500
Income from sale of others crops	52.16	279.4737	327.3488	30	3,000
Income from off-farm activities	29.11	360.8333	370.6627	40	2,000
Income from livestock sale	25.94	279.3721	281.2998	15	1,500
Income from lottery	0.58	800	–	800	800
Input credit	1.73	210	212.132	60	360
Grants from NGO	3.17	134	65.42171	50	200
Loans from moneylenders	12.10	215.6667	185.3469	2	1,000
VSLA loan	14.41	400	374.1657	100	1,000
Loans from banks	1.73	275	154.1104	100	500
Loans from NGOs	0.29	100	–	100	100

Note: ^a\$1 = GH¢4.3 as at February 2018

Table III.
Sources and
magnitudes of
agricultural financing
in maize production

savings, income from sale of other crops or reinvest profits; external non-loan financing – this encompasses gifts from family or friends, production grant, income from off-farm activities, lottery or sold livestock; and external loan financing – if respondent used loans from friends or family, input credit, loans from moneylenders, VSLA, Banks and NGOs.

To assess respondents' choice among the individual financing sources and the level of overlap in use, we cross tabulated the sources against each other. The results indicate that the combinations of personal savings and ploughing back profits (36.60 per cent), personal savings and income from sale of other crops (36.02 per cent), and ploughing back profits and income from sale of other crops (34.58 per cent) were the highest. Thus, combinations among the internally generated fund financing sources are the most popular among respondents.

Among the sources classified under external non-loan financing, income from off-farm economic activities was the most utilized financing source, recording 19.60, 17.29 and 15.85 per cent, respectively, in its combinations with personal savings, and ploughing back profits and income from sale of other crops. Income from livestock sale and ploughing back profits also shows some interesting results, with 17.58 per cent of respondents using this combination. Loans from VSLA, from friends and from moneylenders also recorded some relatively high figures when paired against the three sources under internally generated financing. The details are outlined in Table IV.

3.3 Innovative financing in maize farming

The present study defined innovative agricultural financing as measures and methods initiated and pursued by rural farm households to generate revenue for farm investment when the traditional ways are inadequate. This definition implies that this form of financing is different from those identified in Section 3.2 (those are classified as traditional forms of farm financing).

Thus, innovative financing is a coping/risk-mitigating technique that the farmer uses in the face of limited access to formal finance. In sum, innovative financing methods are external to farmers' household incomes and offer opportunities to increase the amounts of funds available for meeting the farmers' needs. Though external to the farm household, the decision to access innovative financing is not externally driven; it is neither advertised nor presented to the farmer by an agency or institution in the same way that loans from financial institutions or NGOs are done.

	PerSav	Profit	Cropsale	OffFarm	LiveSale	FamGif	FamLoan	FrnGif
Persav								
Plough back profit	127							
Crop sale	125	120						
Off-farm	68	60	55					
Livesale	46	61	52	31				
Famgif	30	20	21	15	13			
Famloan	16	17	17	8	9	3		
Frngif	12	13	12	7	8	6	1	
Frnloan	27	27	27	14	13	3	3	4
Lotto	2	1	1	1	1	1	1	0
Inpred	3	3	2	2	2	0	2	0
Grant	4	4	3	2	3	2	0	0
Lendloan	20	19	17	15	8	3	4	1
Vslloan	22	32	17	13	20	2	6	3
Bankloan	5	2	2	4	1	1	1	0
NGO	0	0	1	0	0	0	0	0
	FrnLoan	Lotto	InpCred	Grant	Lendloan	VSLA Loan	Bank Loan	NGO
Persav								
Plough back profit								
Crop sale								
Off-farm								
Livesale								
Famgif								
Famloan								
Frngif								
Frnloan								
Lotto	1							
Inpred	0	0						
Grant	2	0	0					
Lendloan	6	0	0	5				
Vslloan	4	0	1	6	6			
Bankloan	0	0	1	2	0	1		
NGO	0	0	0	0	0	0	0	

Table IV.
Cross tabulations of
sources of financing in
maize production

Notes: Persav, personal savings; Profit, ploughing back profit from maize farming; Cropsale, income from sale of other crops; OffFarm, income from off-farm employment; Livesale, sale of livestock; Famgif, gifts from family members; Famloan, loan from family member; Frngif, gifts from friends; Frnloan, loans from friends; Lotto, income from Lotto; Inpred, input credit; Grant, grants from NGOs; Lendloan, loans from money-lenders; Vslloan, loans from VSL Associations; Bankloan, loans from banks; NGO, loans from NGOs

Considering the methods of agricultural financing that this study identified, two methods stand out in that they meet all the criteria for innovative financing. These are joining a savings and loans group with the sole aim of accessing credit for maize farming when the need arises and taking menial (by-day) jobs in order to raise funds for maize farming.

The former method is similar to (and yet different from) the traditional financing method of taking VSLA loans; in both cases. The difference lies in the initial motivation for joining the group and the intention behind taking a loan from the VSLA group – joining a VSLA in order to save parts of one's income or taking a loan from the VSLA to meet household needs like food, shelter or healthcare is dissimilar to taking a loan to rent a tractor for land preparation. Similarly, while it is not uncommon to find farmers engage in other economic activities (usually off-farm), taking menial jobs to raise funds for farm investment differs in that these jobs may also be on-farm (taking a “caretaker” job on southern cocoa/cashew farms during the northern off-season). A farmer who uses either or both of

these methods is said to be using innovative financing in maize farming. The distribution of users in the sampled districts is presented in Table V.

Table V reveals that Savelugu-Nanton district has the highest population of users of innovative financing (about 65 per cent of its sampled respondents). Sawla-Tuna-Kalba and Kumbungu districts are the second and third, respectively, in terms of population of users. The West Gonja district has the least percentage of its respondents using innovative agricultural financing.

3.4 Determinants of innovative financing use

Table VI presents the results from the probit model estimation. The model diagnostics are presented in the final row. The Wald χ^2 in the probit model is asymptotically equivalent to the F -test in the OLS regression model. It can be used to check if a relationship exists between the dependent variable and independent variables – it tests that at least one of the predictors' regression coefficients is not equal to zero in the model.

The Wald χ^2 value of 99.68, statistically significant at 1 per cent level, shows that innovative financing use is determined by at least one of the variables included in the model. The pseudo- R^2 value of 0.2727 mean the selected sociodemographic and economic variables contribute to explaining about 27 per cent of variations in the use of innovative financing. Though this value is low, it reflects a characteristic of binary dependent variable models (these models are infamous for their tendency to report low R^2 values). In order to accurately measure the goodness-of-fit of the estimated model, we use the Count R^2 instead. The result of the Count R^2 estimation is presented in Table VII.

The Count R^2 yielded a value of 77.52 per cent; this shows the true predictive power of the models in explaining variations in farmer's decision to use innovative financing. This estimation is about 50 percentage points higher than the result from the Pseudo- R^2 and also presents a truer picture of the goodness-of-fit of the model.

For the two categorical variables in the estimations, we set for location, the Savelugu-Nanton district as the benchmark, while the category for farmers who produce for subsistence purposes only is set as the benchmark for the market participation variable. The coefficients and marginal effects of the variables are reported in Table VI. The marginal effects reflect the level of change in the probability of a respondent using innovative financing with a unit change in the independent variable.

From the results, a farmer with access to formal credit, a high level of integration into society, and who uses farmyard manure as a soil fertility-enhancing measure is more likely to use innovative financing than their radial opposite counterparts. The coefficients are statistically significant at 1 and 5 per cent levels. Also, farmers who had experienced a personal tragedy prior to or in the early parts of the season and those for whom maize is a main crop of cultivation were more likely to use innovative financing than those who did not. Another positive determinant of innovative financing use is the extent of a farmer's

District of survey	Innovative financing in maize farming		Total (%)
	Non-users (%)	Users (%)	
Karaga	51 (67.11)	25 (32.89)	76 (100)
Gushiegu	42 (64.62)	23 (35.38)	65 (100)
Kumbungu	31 (59.62)	21 (40.38)	52 (100)
Savelugu-Nanton	23 (34.85)	43 (65.15)	66 (100)
West Gonja	47 (83.93)	9 (16.07)	56 (100)
Sawla-Tuna-Kalba	16 (50.00)	16 (50.00)	32 (100)
Total	210 (60.52)	137 (39.48)	347 (100)

Table V.
Distribution of use of
innovative financing
in maize farming

AFR

Variable	Coefficients	Robust SE	Marginal effects
Access to formal credit	0.9231***	0.2993	0.3445***
Farming as main occupation	-0.2826	0.1892	-0.1055
Extension access	0.2795	0.2070	-0.1043
FBO membership	-0.4447**	0.0364	-0.1660**
Assets owned	0.0283	0.0093	0.0106
Household size	-0.0202**	0.1907	-0.0076**
Educational status	-0.1090	0.1907	-0.0403
Maize as main crop	0.3925*	0.2010	0.1465**
Social capital	0.3463***	0.1110	0.1292***
Household position	-0.4024**	0.1671	-0.1502**
Level of crop diversification	-0.3842***	0.1045	-0.1434***
Personal tragedy	0.5247**	0.2055	0.1958**
Manure use	0.9662***	0.2195	0.3606***
<i>Location variables</i>			
Karaga District	-1.0166***	0.2679	-0.3794***
Gushegu District	-1.1549***	0.2883	-0.4310***
Kumbungu District	-1.0863***	0.3035	-0.4054***
West Gonja District	-1.9829***	0.3690	-0.7401***
Sawla-Tuna-Kalba District	-0.9049**	0.3279	-0.3377**
<i>Extent of market participation</i>			
Only commercial	-0.2648	0.3103	-0.0988
Largely subsistence	-0.1934	0.2830	-0.0722
Largely commercial	0.1794	0.1860	0.0670
Both equally	0.6139**	0.4065	0.2291**
Constant	1.14868***	0.4621	

Notes: $n = 347$. Wald $\chi^2(22) = 99.68$ ***, Pseudo- $R^2 = 0.2727$, Log-Pseudo = -169.307. *, **, ***Significant at 10, 5 and 1 per cent levels, respectively

Table VI.
Determinants of innovative financing use – unmatched and matched models

Classified	D	True $\sim D$	Total
+	94	35	129
-	43	175	218
Total	137	210	347

Table VII.
Classification table for correct predictions by the model

market participation. Farmers who produce for subsistence and commercial purposes equally were more likely to access innovative financing than subsistence only farmers.

The results also show that farmers with more diversified production portfolio; who have larger household sizes; and who were members of FBOs were less likely to use innovative financing than those who had the opposites of these characteristics.

Based on the reported marginal effects, a farmer with access to formal credit is about 30 per cent more likely to use innovative financing than those without access. Farmers who apply for credit make explicit their keen interest in investing in their maize farms. When the formal sources fail to provide adequate amounts, they tend to use innovative financing sources to complement the funds they receive from the formal institutions.

Social capital represents the number of social groups that a farmer belongs. In line with the *a priori* expectation, the result shows that farmers with greater integration into society are more likely to use innovative financing than those with a limited social circle.

The reported marginal effect of 0.1196 means that with an additional group in which a farmer is involved, the likelihood of using innovative financing increases by about 12 percentage points, *ceteris paribus*.

It is an open secret that application of organic manure to maize fields helps in increasing yields and enhancing the structure of the soil. Despite this knowledge, there exist a fair number of farmers who still do not use this seemingly beneficial technology. From the field observations, the reason advanced by a number of farmers for abstaining from or “dis-adopting” manure use on their farms is its unavailability and the high cost of external acquisition. Thus, farmers who are determined to apply organic manure on their fields must have them available from their own livestock or raise the capital required to purchase it from elsewhere. This capital requirement is expected to boost a farmer’s inventiveness and cause them to be more likely to use innovative financing than those who do not apply manure. The marginal effect of 0.3200 says that a farmer who applies manure is about 32 per cent more probable to use innovative financing than those who do not apply manure.

A farmer who had experienced a personal tragedy before the start of the season or during the season prior to harvesting may suddenly have to divert farm funds to address this unforeseen contingency. Therefore, to meet farm investment requirements, the farmer becomes predisposed towards use of innovative financing. The results indicate that a farmer who has experienced personal tragedy is about 17 per cent more likely to use innovative financing for maize production than those who have not.

The probability of a farmer using innovative financing is higher for farmers whose major/first crop of interest is maize. Such farmers are about 12 per cent more likely to seek extra financial sources than those mainly engaged in other crops. Farmers for whom maize is the main crop of cultivation tend to give a lot more attention to the production process and make most of the investments required to attain good yields (examples include purchasing and applying the recommended quantities of pesticides and fertilizer in a timely manner). These activities require significant amounts of funds that may not always be available to farmers; necessitating the use of innovative financing methods to raise this extra capital.

In assessing the effect of a farmer’s maize market participation level on the likelihood of using innovative financing, pure subsistent farmers (farmers that produce solely to feed their families) was set as the benchmark for comparisons. The results indicate that there is no significant difference in the probability of using innovative financing for the base category and all other categories describing a particular level of market participation. However, farmers who aim at producing enough to feed their families and the market equally were found to be about 23 per cent more likely to use innovative agricultural financing than those who produce solely for subsistence purposes.

For the factors that reduce a farmer’s probability of using innovative financing, the results show that members of FBOs are less likely to use innovative financing than non-members. This result is in line with the *a priori* expectation. One key mission of modern FBOs is to mobilize access to certain services that may not otherwise be available to member farmers. An example of such services is access to production inputs on credit. Since FBOs apply for input credit as a group, they serve as collaterals (sureties) for each other and this facilitates access to desired input quantities (Martey *et al.*, 2015). This phenomenon may explain the inverse relationship between FBO membership and use of innovative financing.

The result also reveals that farmers with larger households are less likely to use innovative financing than those with smaller households. This may be attributed to the substitution of family labour for hired labour and the need to increase production. Maize production at medium to small scale requires a lot of physical labour due to use of manual implements and the limited level of mechanization in production. This labour requirement presents a significant cost burden for farmers and may influence their use of innovative financing methods positively. However, for large farm households, the presence of able-bodied members signifies a

source of cheap labour which substitutes the cost of hiring labour. In the absence of the need to raise funds to hire labourers for farm operations, farmers' perceptions of the expected utility of using innovative financing diminishes. The result shows that an additional employable family labour reduces the probability of using innovative financing by 0.69 per cent.

Another household-related characteristic that reduces the tendency of a farmer to use innovative financing is the farmer's position in the household. The result indicates that household heads are about 12 per cent less likely to use innovative financing. This may be as a result of household head's innate disposition to have more control over the financing options of the household than other members. Since other household members are usually more resource-constrained than the household head, they have greater expected utility from diversifying their income streams.

Similarly, farmers with diversified crop portfolios are about 12 per cent less likely than specialized maize farmers to use innovative financing. Diversification buffers the risk of crop failure via more income streams. This reduces a farmer's probability of being input-constrained and diminishes the incentive to seek external financial options.

With regard to the effect of a farmer's location on his/her probability to use innovative financing, the Savelugu-Nanton district was set as the benchmark because it is the district with the modal population of users. The model therefore helps to establish the veracity of this finding by testing for the difference in probabilities of using innovative financing. As expected, farmers in all other districts were found to have lower probabilities of being assigned the treatment than those in the base district. The magnitudes of the marginal effects from this estimation follow the same pattern as the percentage of users in the various districts with farmers in the West Gonja district (with a little over 16 per cent of users) found to be about 41 per cent less likely than farmers in the Savelugu-Nanton district.

4. Conclusions

After the rigorous processes employed in analyzing the cross-sectional data collected on 347 maize farmers in the Northern region, the study found farmer's own savings, ploughing back profits from the previous season and taking loans from relatives, among others, to be the dominant traditional methods of farm financing in the Northern region of Ghana. When faced with farm liquidity constraints, about 40 per cent of farmers reported taking "by-day" jobs and/or joining VSLA groups specifically to meet their farm financing needs. These two methods were thus identified as farmer innovations in farm financing.

Farmers' own savings (62.82 per cent), ploughing back profits (59.37 per cent) and using income from sale of other crops (52.16 per cent) were the most popular traditional methods of financing maize production among farmers in the study area. With regard to the amounts generated from these sources, farmers reported an average of GH 759.24 from own savings while reinvesting an average of GH 375.5 of their profits in production. About GH 279.47 of proceeds from other crops than maize was allocated to investment in maize production.

Farmers whose primary crop is maize were found to be more likely to use innovative financing. Also, access to formal credit, greater social integration and organic manure use were some other factors that increase farmer's likelihood of using innovative financing. Conversely, membership of FBOs, larger family size and greater diversification in crops produced negatively influenced farmers' likelihood of using innovative financing.

In line with the finding that majority of maize farmers in the Northern region depend on own financing methods, the study recommends that farmers be encouraged to continue and develop the existing culture of saving. The formal financial sector can influence this process through the provision of incentives like qualification for loan advances and personal and farm insurance cover. Since a large portion of farmers' income is from sale of farm produce, greater efforts should be made to empower farmers to reap more rewards from market participation.

The activities of VSLAs should be given more attention since they have the potential to serve as a conduit for mitigating risks involved in formal credit provision and can link farmers directly to inputs; reducing the need for cash loans. In its current state, VSLAs tend to target only female farmers. However, maize production in the study area tends to be male-dominated and this creates the need to get more males to participate in these associations. Since large portions of the household income is generated and controlled by the male head, inclusion of males in the VSLAs can increase the association's capital stock and boost its attractiveness to input suppliers.

A significant proportion of users of innovative financing are farmers who generate funds by taking off-farm jobs. This study recommends that government at the local levels increase their efforts of creating (sustainable) employment opportunities that absorb farmers in the off-season so that participating farmers can make some savings towards farm investment in the upcoming farming season. These off-season jobs can be in diverse areas of the economy (e.g. agro-processing, services and manufacturing) with capital sourced from the Government's 1-District 1-Factory Project to boost the local economies.

Note

1. In February 2019, the Northern region was split following a plebiscite. Details on the study area are accurate for the former state and maintained here to reflect the survey environment in 2018.

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