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Understanding the Factors that Affect the Uptake of Subsidised Mineral Fertilisers in Northern Ghana: A Case Study of the Bunkpurugu-Yunyoo District

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Abstract

The mineral fertiliser subsidy programme in Ghana that kicked-off in 2008 went through peaks and valleys in ensuing years. But in 2017/8, it was apparently hauled up on the banner of 'planting for food and jobs'. This study sought to understand the factors that affect the uptake of subsidised mineral fertilisers under this supposed revitalised subsidy regime and the challenges associated with it. The study was conducted in the Bunkpurugu-Yunyoo district of the northern region of Ghana. A mixed method of inquiry was used covering one hundred and two households. Qualitative interviews were also carried out with retailers of fertilisers and agricultural extension officers.

The study reveals that some of the challenges of the previous years' relating to the penetration and/or availability of subsidised fertilisers significantly dwindled in 2018. This was found to be the result of the expansion of the fertiliser retail network and the high volumes of fertilisers that were supplied in the area. However, some farmers were still not able to access their preferred brands of fertilisers. Also, farmers who planted in the early part of the season partly used non-subsidised fertilisers because of the relatively late supply of the subsidised fertilisers. The direct issue of coupons to farmers by authorised field agents to access subsidised fertilisers under the programme did not also go as directed, as these agents and local political party leaders hoarded the coupons and later sold them to fertiliser retailers. By paying for these coupons, rather than receiving them for free, the profits retailers would have made for supplying fertilisers in the area were negatively affected.

A number of factors were found to have significant effects on the uptake of subsidised fertilisers. Uptake increased with the education levels of the heads of households and livestock owned by households, but decreased with off-farm work, the size and fertility levels of farmers' plots, including farmers' risk perception and the distance of their plots from their homesteads. It was also found that the gender and the age of the head of the household matter in the uptake of subsidised fertilisers, as male and younger heads used more fertilisers than their counterparts.

It is suggested in this study that further studies are needed to understand the following: how input subsidy programmes produce losers and winners in the distribution chain; why having an off-farm work is associated with diminishing involvement in farming activities; and measures of risk could be individually tested against the uptake of subsidised inputs.

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Contents

Chapter 1: Introduction

It is widely held that increased use of mineral fertilisers is imperative for farmers in Sub-Saharan Africa to maintain soil fertility, boost up output, and to make profits from farming (Druilhe & Barreiro-Hurlé, 2012, p. iv). Amongst the reasons commonly cited for the need for the region to intensify fertiliser use is the upsurge in population growth, with its concomitant high demand for food and pressures on natural resources (Berkhout, Malan & Kram 2017, p. 8). Increased fertiliser uptake is considered almost the 'silver bullet' to increased food production in developing countries, as most future raises in crop output are forecasted to be predicated on it (FAO, 2006). Also included are the expansion of arable land, protection of water reserves, and biodiversity amongst others (FAO, 2009).

Presently, the level of mineral fertilisers' use in Sub-Saharan Africa is very low, as it accounts for just 3% of global fertilizer consumption (Druilhe & Barreiro-Hurlé, 2012). Market imperfection is widely discussed as responsible in large measure for such low input uses in developing countries. This could, amongst other things, take the form of failing markets- this is where markets exist, but operate at prices that are not competitive; and market failure- here, markets exist and function at competitive prices, but "...welfare outcomes for some households are so low..." and interventions aimed at improving wellbeing may be invoked (Dillon & Barrett, 2017, p. 64). Subsidies on inputs are among the common interventions often invoked in cases of market imperfections. For example, after acknowledging that fertiliser use is low in Sub-Saharan Africa, the African Union Special Summit of the Heads of State and Government, in 2006, adopted the 'Abuja Declaration on Fertilizer for the African Green Revolution'. The resolution charged member countries to work towards increasing fertiliser use from 8.0 kg/ha to 50.0 kg/ha by 2015. Among the mechanisms member countries were to use was smart subsidies (The New Partnership for Africa's Development, NEPAD, 2011). In Ghana, beginning from 2008, fertiliser subsidies were consequently re-introduced; and it aimed at improving the food security situation of the country.

After years of successive implementation of the fertiliser subsidy programme in Ghana, studies have evolved. However, it is apparent that these studies seldom address the question of what influences farmers uptake of the subsidised mineral fertilisers, especially in the drier northern parts of Ghana. Also, since the subsidy programme was re-introduced in 2008, it has

gone through peaks and valleys, but in 2017/8, it was apparently hauled up on the banner of 'planting for food and jobs'. It is therefore important to explore this topic as it would shed lights on how the previous implementation challenges have been dealt with. Studies of this nature are highly recommended by the Food and Agricultural Organisation (FAO), which suggests research into "farmers' constraints and incentives related to fertilizer use under specific local conditions" (FAO 2012, p. vii). The purpose of this study is therefore to understand what influences farmers' uptake of the subsidised mineral fertilisers in the dry-land northern Ghana.

To achieve the purpose of this study, both quantitative and qualitative strategies of inquiry were used, with respondents/participants drawn from the Bunkpurugu-Yunyoo district of the northern region of Ghana. Based on the literature and concepts underpinning agricultural household behaviours, the following research questions were proposed:

1. What household social-related factors affect the uptake of subsidised fertilisers?
2. What household economic-related factors affect the uptake of subsidised fertilisers?
3. What plot-related factors affect the uptake of subsidised fertilisers?
4. How is the uptake of subsidised fertilisers affected by risks that agricultural households face?
5. How is the uptake of subsidised fertilisers affected by traditional farming practices that households engage in?
6. How satisfied are households with the subsidy programme?
7. What are the challenges associated with the fertiliser subsidy programme?

1.1. Organisation of the thesis

Chapter one gives a background to the study, where the purpose and significance of the study are stated and justified. The research questions guiding the study are also presented here. In chapter two, I discuss theoretical concepts and literature that serve as a framework to guide the study. In chapter three, I briefly outline the evolution of mineral fertiliser adoption and subsidies in Ghana; spell out the geographical context of the study, specifically the northern region and the study district. In chapter four, the methodology of the study is outlined. Chapter five is composed of the study's findings which are discussed in the light of literature

and theoretical concepts. Finally, in chapter six, the study's conclusion as well as recommendations for future studies and policy-making are presented.

Chapter 2: Review of literature and concepts

2.1. Introduction

In this chapter, literature on input subsidies, especially fertiliser is reviewed. It begins by rendering the state of fertiliser use in developing countries; justifies the introduction of input (fertiliser) subsidies; and, elucidates the factors that affect fertiliser uptake by households. The concepts of risk aversion and non-separability in agricultural households are also discussed.

2.2. Upscaling fertiliser use in developing countries

There is high population growth and food demand, putting pressures on natural resources, especially in Sub-Saharan Africa (SSA). The way out of this morass is agricultural intensification – "more production from the same acreage" (Berkhout et. al., 2017, p. 12). The use of chemical fertilisers is widely discussed as a major strategy to advance this process. However, of all the regions of the world, Sub-Saharan Africa lags behind when it comes to fertiliser usage (Druilhe & Barreiro-Hurlé, 2012). In the UK for example, in 2015/16, the amount of nitrogen, potash, and phosphate applied per hectare were respectively 113 kg, 25 kg, and 20 kg (National Statistics, 2017). The consumption rate in Ghana as of 2006 was about 4 kg of nutrients per hectare and it was considered low when compared with the application rate in SSA (FAO, 2006). However, following the re-introduction of the fertiliser subsidy programme in 2008, the consumption rate now hovers around 20.0 kg/ha (MoFA, 2014).

Market failures have been blamed as responsible for the low use of fertilisers in Africa. It is widely asserted to be more frequent in the agricultural sector than in any other part of the economy (Van Tongeren, 2008). This has been prominent in Africa's fertiliser use discourses. Among the obstacles to overcome and to correct market failures are increases in the purchasing powers of farmers and the deployment of large volumes of fertilisers in countries with low usage of fertilisers (World Bank, May 2006). A more practical approach has been subsidies. According to the 2008 World Development Report, market failures continue to plague the input markets (seeds and fertilisers, especially) in Sub-Saharan Africa, which is a consequence of high "transaction costs, risks and economies of scale." It goes on to highlight the corrective power of subsidies by pointing out that, "the renewed interest in

fertilizer subsidies needs to focus on sustainable solutions to market failures" (World Bank, 2007, pp. 12-13).

Dozens of fertiliser subsidy programmes have been carried out in many African countries since independence. Historically, these were usually universal in nature- blanket price subsidies were applied which did not discriminate among producers of different categories (Dorward, 2009). There has since been an upsurge in fertiliser subsidy in some African countries following the rise in global grain and fertiliser prices around 2008 (Dorward, 2009). The government of Ghana, for example, in 2008 "instituted a country-wide subsidy on 50Kg bags of four types of fertilizer in an effort to mitigate the effect of rising energy and food prices" (Banful, 2009, p. 1). This programme has since been continued, with varying degrees of reductions in fertiliser prices; and intermittent removal of such subsidies in 2014

The type of subsidy programme in Ghana and other countries has been described as a 'new generation of "smart subsidies". According to Dorwrad (2009), this approach is necessitated by the increasing interrogation by politicians, non-governmental organisation (NGOs) and policy analysts, of the effectiveness of liberal ideals of broad-based agricultural development. The approaches used under this include amongst others, targeted vouchers to farmers which allows them to increase their uptake of inputs and trigger demand in private market; and "matching grants to underwrite selected start-up costs of entry of private distributors to input markets" (World Bank, 2007, p. 13). Rationing and targeting are critical components of the this approach, and they help improve effectiveness of subsidies by reducing cost; and also allowing inputs to get to farmers whose use of such inputs were confined by market failures (Dorward, 2009, p. ii).

There are some conditions under which the greatest benefits could be derived under smart subsidies. It would have the greatest contribution to broad economic growth when it is targeted at farmers who engage in the production of staple grains. This allows for the promotion of the welfare of consumers and real incomes through lower food prices. The benefits would even be greatest when subsidies come with complementary investments and agricultural output market development policies which lowers the cost of farm produce (Dorward, 2009, p. ii; Jayne & Rashid, 2013). Policy-makers then often think in manner which parallels the analogy of Jayne and Rashid (2013): by subsidising 100,000 tons of fertiliser, fertiliser use intensity by farmers would equal 100,000 (p. 12). This has not been

the case, according to studies, and amongst others, it is partly because subsidies are "subject to major political economy and implementation challenges" (Dorward, 2009, p. ii).

Beyond policy (government) factors that may affect the uptake of subsidised fertiliser, some factors at the level of individual farmers have great impact on the intensity of subsidised fertiliser use. This is not surprising since they are the end users or beneficiaries of subsidised fertilisers. Given the heterogeneity of agricultural households, different responses to fertiliser use, is inevitable, notwithstanding the soundness of input policies. In the next section, I discuss some of these household factors that the literature indicates affect fertiliser use.

2.3. Determinants of fertiliser use

Because farmers are risk averse, they factor in the weather conditions before deciding on their uptake of fertilisers. It is for example, pointed out that, mineral fertiliser use and drought could put farmers in a quandary: they either have to postpone fertiliser application until conditions become better; or they may altogether suspend it for a planting season (Aune & Bationo, 2008, p. 123). This suggests that, irrespective of the inbuilt mechanisms to scale up fertiliser use among farmers, uptake could still be low under such conditions. The suggestion of complementary inputs is to correct this. In the case of drought, irrigation facilities could constitute complementary inputs and encourage fertiliser use among farmers.

The need for complementary inputs such as seeds and irrigation facilities to intensify fertiliser use brings another cost which famers would have to contend with. This would interact with other costs, such as those associated with labour and machinery, which are unavoidable, unless they are provided by members of the household. And where cost is concerned, households would undoubtedly respond and behave differently. This has been put succinctly by FAO (2012), that, additional investments such as in seeds to maximise the benefits of fertiliser use could increase the "cost of technically efficient fertilizer use thus increasing the role of risk factors (skill- or climate-related) and credit constraint (for risk-taking farmers) in the lack of adoption" (p. 7).

It can also be inferred from ample evidence that, irrespective of the subsidies imposed on agricultural inputs, famers may not necessarily intensify their use of such inputs. Aune and Bationo (2008) for example, use the analogy of 'climbing a ladder' and expatiate that, the processes of agricultural intensification in the Sahel are somewhat sequential, with some steps more difficult; and 'microdose' and higher rates of mineral fertiliser use in the

intensification processes are introduced gradually: either alongside with or after options that do not require financial outlay. This suggests, reasonably, that, fertiliser uptake could be dependent on the cultural practices that are observed by households, and participation in fertiliser subsidy programmes could vary across households because of their relative positions on the 'intensification ladder'.

Studies also suggest that fertiliser usage, and input adoption in general, is a product of the formal educational status of farmers. Fertiliser use is found to increase with increases in years of schooling attained by farmers and vice versa (Adesina, 1996; Akpan, Udoh & Nkanta, 2012; Deressa et. al., 2009). Because most of these studies are often quantitative, they tend not to add more information to delineate how education is related with the intensity of input adoption. At best, they speculate that such farmers tend to know the importance of fertiliser application, foreclosing the possibility of exploring other reasons for this observation.

Household sizes and the gender of the heads of households also play important roles in fertiliser uptake. The direction of the relationships has not been consistent. Many studies show that male headed households tend to use more fertilisers than their female counterparts, especially in SSA. The reasons for this partly rest on land tenure systems in developing countries and access to productive resources that are against women. Women tend to have limited information and rights; and may plant crops that require fertilisers as secondary crops (Adesina, 1996). With respect to household size, Akpan et. al. (2012) report an inverse relationship, while Adesina (1996) report positive relationship.

Distance and means of transportation have consistently featured as critical determinants of fertiliser uptake. Distance is often looked at in two ways: distance of the homestead to input markets; and distance of the plot that is cultivated relative to the homestead. Generally, the literature shows that the farther any of these two variables are away from the homestead, the lesser the uptake of fertilisers (Akpan, et. al., 2012; Adesina, 1996). This makes the ownership of means of transportation important in fertiliser uptake- it mitigates distances and the difficulty of transporting inputs.

What may be described as a logical determinant of fertiliser uptake is the fertility level of the soil itself. However, in this review, it is observed that this is seldom included in most studies. Part of the problem for its non-inclusion, it could be argued, is the difficulty of determining this, especially when many participants are involved. Even in developed countries like the

UK, it has been observed that in 2015/16, only about 23% of farmers used soil fertility determinants instruments to assess their plots before using fertilisers (National Statistics, 2017). In developing countries where this may not be done in the first place, letting farmers qualitatively rate the fertility levels of their plots should suffice.

Ownership of livestock, the size of plot, and having off-farm work are also associated with fertiliser uptake. The relationships that these variables have with fertiliser use intensity have not been consistent. Livestock and plot size are inversely related to fertiliser use intensity (Akpan, et al., 2012). For households with off-farm activities, the direction of their relationship with fertiliser use intensity is not a given. For example, Ellis (1998, p. 12), posits that, when the expected marginal returns of labour for engaging in farming activities is less than the likely returns for similar time expended on off-farm/non-farm activities, "then the household is better off switching that individual into off-farm or non-farm activities". Under this circumstances, the involvement of the households concerned in agricultural activities may be low, and hence, their fertiliser uptake.

3.4. Uncertainty/risk aversion

Uncertainty and risk are conventional physiognomy of agricultural production (Moschini & Hennessy, 2001); and farmers, especially in developing countries, show risk-aversion in their choices (Mendola, 2007; Roe & Graham-Tomasi, 1986). Risks are outcomes that can be objectively quantified (they can be expressed in terms of probabilities), and uncertainties are random decisions that lack these probabilistic expressions. However, given that probabilities are equally subjective in nature, the core attribute (numerical objective probability) that forms the boundary between these two is considered meaningless and they could be used interchangeably (Moschini & Hennessy, 2001).

About four types of risks/uncertainties have been classed by Moschini and Hennessy (2001). The first one, a broader one, is '*production uncertainty*'. According to them, before undertaking any productive activity in agriculture, the expected outputs from the given units of inputs to be deployed are not usually known with certainty. This is taken to be amongst others, a product of elements that are beyond the control of farmers, notably, the weather, which is rudimentary in agricultural productivity. The weather affects the biological processes that undergird the growth processes of plants and animals and when it is expected cause lags in production. Farmers therefore would try to avoid the worse by making strategic

decisions that could affect input use. It is for example posited in Aune and Bationo (2008), that, mineral fertiliser use and drought could put farmers in a quandary: they either have to postpone fertiliser application until conditions become better; or they may altogether suspend it for a planting season (p. 123). Pests and diseases cause loses in crops and livestock. They, therefore, also constitute production risk (Kahan, 2008).

Another is *price uncertainty*. It could be argued that, this type of uncertainty may be contemplated by, and more applicable to farmers who expect to sell part of their produce after harvest. Because of price volatilities associated with agricultural markets, the prices of farm products may not be known at the time the decision to farm is to be taken. Given that farmers are risk-averse (Mendola, 2007; Roe & Graham-Tomasi, 1986), it means that when farmers expect the prices of products to fluctuate or to be low, because of the volatility of markets, they may not want to invest their resources in some inputs such as fertilisers. This appears to be the case because, it has been found that, "where the use of fertilizers is not profitable, farmers, whatever their scale, will not use them" (FAO, 2006, xii). One of the conditions under which farmers may use more of inputs such as fertilisers even when the prices of output is low, studies has shown, is when the percentage reduction in the prices of fertilisers are larger than that of output prices (Singh, Squire & Strauss, 19986, 171).

Technological uncertainty: Though technological inputs help intensify production in agriculture, they still have to compete with local appropriate technologies or practices; they could still be viewed as alien innovations and there could be some laxity among farmers in their usage. Some farmers may not want to jettison their indigenous farming methods in favour of new methods which they are not certain of their outcomes. Others assert that, as more and more technological inputs are used in production, the level of risk and uncertainty increases and that affects the type of inputs farmers choose to deploy in production and consequently, the type of crop planted (Roe & Graham-Tomasi, 1986, p. 272).

Policy uncertainty: agricultural policies are constantly under change, especially in developing countries. And where policies concern inputs for example (subsidies), it creates uncertainties and affects the usage of such inputs. The uncertainties regarding fertiliser subsidies could manifest in forms such as: the unit price farmers may have to pay, the time that fertilisers would be deployed to depots, and the quantities that farmers may be legally allowed to acquire. The time that some of these are made available to farmers are extremely important because of the seasonality of their activities. With uncertainties, the type of crop and the size

of land made available for production could be affected, thereby affecting fertiliser use intensity.

3.5. Non-separability in agricultural households

It is asserted that, there is difficulty in determining beforehand, the effects of agricultural policies, especially in developing countries. Attempts at these are usually constrained by some behavioural dynamics typical of "semi-commercialised, rural economies" (Singh et al., 1986, p. 149). The reasons they point out, amongst others, include the fact that agricultural households engage in agricultural activities both for consumption and sale; some inputs such as fertilisers, are acquired from the market and others such as labour, could be provided by the family. Because of this, changes in agricultural policies affect both production and consumption and household decisions concerning these two can therefore, not be modelled separately (Singh et al., 1986, p. 149). This has been described as non-separability.

The concept articulates that, the decisions of households concerning production, such as the use of inputs (subsidised fertiliser, for example) are affected by their consumption characteristics (Singh et al., 1986; Yutopoulus & Lau, 1974; De Janvry & Sadoulet, 2006). That is, consumption and production have feedback on each other. This is because of low resource base and adverse contexts, which compels rural households to use balancing strategies to maximise benefits due to market imperfections (De Janvry & Sadoulet, 2006). This means that, though subsidies lower the unit cost of fertiliser, creating some spare income on the part of farmers on every unit of fertiliser they buy, it is not given that they would intensify their fertiliser use through increased purchases. In some cases, the subsidies would not increase the spare incomes of farmers significantly; which means, subsidies would not necessarily translate into intense use of fertilisers. It has been shown for example that, when the prices of fertilisers are reduced by 10%, the real incomes of farmers increase by less than 01% (Singh et al., 1986, p. 171). Farmers' consumption of other goods including fertilisers is not expected to be affected in any great extent under this circumstance. This is why the effective incentive to intensify fertiliser use through subsidies is when the subsidies are very large (Singh et al., 1986).

Because of the feedback effects that production and consumption has on each other, even when subsidies result in higher real incomes, any spare income that results could have feedback effects on the consumption of other goods: some of these could be agricultural

inputs such as hoes and cutlasses, and not fertiliser; others could be daily consumables and expenditures in education and health, for example.

3.6. Summary

In the literature reviewed, there were not many studies that address the purpose of this study in the Ghanaian context. It was observed that studies in Ghana have largely been concentrated on analysis of trends in annual agricultural output and budgetary allocations to subsidies (Fearon et al., 2015). The conclusions of studies after years also indicate little evidence of increased uptake of subsidised fertilisers (Houssou, Andam & Asante-Addo, 2017; Fearon et al., 2015). The question of what influences uptake is seldom addressed. Though the determinants of fertiliser use intensity are well documented, how the variables work to influence fertiliser uptake are not often accounted for. These are some of the gaps this study seeks to contribute in filling, by using both quantitative and qualitative strategies.

Chapter 3: Background to fertiliser subsidies in Ghana and the study district

3.1. Introduction

This chapter presents a background to both the fertiliser subsidy programme and the study area. It begins with a brief history concerning the adoption of chemical fertilisers in Ghana before discussing fully the recent subsidies. This is followed by a description of the study area which is presented within the context of the Northern Region of Ghana.

3.2. The origin of the adoption of chemical fertilisers and subsidies in Ghana

The beginning of mass chemical fertiliser adoption in Ghana can be traced to the introduction of mechanised agriculture in the immediate years preceding independence in 1957. The Gonja Development Company (GDC), the Agricultural Development Corporation (ADC), which was later replaced by the State Farms Corporation in 1962, were the pioneer intermediaries advancing the mechanisation efforts. They however had jurisdiction over state controlled farms- the farms were compulsorily acquired from local people by government. They received heavy financial backing from the government and the objectives were to, amongst other things, foster mass production for export and to feed the growing urban population. The promotion of chemical fertiliser use was a key component of these mechanisation efforts; and though they were socialist in nature, peasants who contributed the bulk of the nation's output were less integrated into them (Akoto, 1987; Amanor, 1999; Dzorgbo, 2017).

It was not until after 1966, and well into the 1970s, that private individuals were integrated into the agriculture mechanisation drive, with substantial state support. For example, in the 1970s, under the banner of Operation Feed Yourself (OFY)[1], the subsidies on fertilisers paid by the government was about 77% of the CIF (Cost, Insurance, and Freight) component of fertiliser prices, and 78% of these fertilisers went to the northern regions of Ghana (Akoto, 1987). However, following the structural adjustment programmes of the 1980s, the state gradually withdrew its support for the agricultural sector; and in some instances, taxes on chemical fertilisers were levered up. In 1992, agricultural inputs subsidies were completely

[1] This was launched in 1972. Its aim was to ensure that Ghana was self-sufficient in food production by raising output through expansion of land under cultivation by small-holder farmers; and large scale mechanised farms (Akoto, 1987).

abolished (Brooks, Croppenstedt & Aggrey-Fynn (2007). According to ISSER (as cited in Amanor, 1999, p. 39), the prices of NPK and Urea increased by 380% and 190% respectively from 1990 to 1994; in 1995, the price of Urea hiked up again by 416% . These hikes in prices beginning from the period of the structural adjustment inevitably resulted in reduced fertiliser use by farmers, consequently, "growth in the sector [agricultural] remained relatively sluggish throughout the 1980s and also in the first half of the 1990s" (Brooks et. al., 2007, p. 14).

3.3. The recent subsidies

The most important subsidies of the 2000s started in 2008. This was spurred by the desire to counter the effects of the hikes in energy and food prices- because of the increases in food prices, the subsidy programme was to encourage farmers to use more fertilisers so that food output in 2008 would not significantly go down below 2007 levels, which was partly influenced by higher fertiliser prices. This was a public-private partnership, and specifically, the following types of fertilisers were subsidised: NPK (15:15:15), NPK (23:10:05), urea, and sulphate of ammonia (Banful, 2009). The table below shows fertiliser prices and subsidies of some selected years, beginning from the first year the subsidies were re-introduced (2008). From the table, it could be seen that government have always absorbed up to 50% of the total market prices of fertilisers. With the exception of the first year (2008), the rates of subsidies are usually homogenous across all the regions.

Table 1: The Full costs of solid/granular fertilisers and subsidies of selected years (sources: MoFA, 2016, 2017; Banful, 2009; field data).

Year	Fertiliser type	Full cost **GH₵/50kg**	Subsidy paid by Government **GH₵/50kg**	Price at which Farmers buy Fertilizer **GH₵/50kg**	**Percentage (%)** of Subsidy
2008[2]	**NPK:15.15.15**	**51.20**		**33.10**	
	Ammonia	34.70		27.10	
	Urea	52.70		34.10	
2014	-	-	No subsidy	Full price	-
2016	**NPK:23.10.05**	**120.00**	**40.00**	**85.00**	**32**
	NPK:15.15.15	120.00	40.00	85.00	32
	Urea	100.00	20.00	80.00	20
	Ammonia	-	-	-	-
2017	**Compound**	**115.00**	**57.50**	**57.50**	**50**
	Urea	95.00	47.50	47.50	50
	Organic (ACARP)	30.00	15.00	15.00	50
	Organic (YAYRA GLOVER)	65.00	32.50	32.50	50
2018	**Compound**	**136.00**	**68.00**	**68.00**	**50**
	Urea	126.00	63.00	63.00	50
	Ammonia	80.00	40.00	40.00	50

The rate of subsidies after 2008 begun to swing- this was an exit strategy (MoFA, n.d) - and as seen in table 1, they were completely removed in 2014[3]. The removal of the subsidies in 2014 resulted in a fall in fertiliser imports from 458,241 metric tonnes in 2013 to 207,109 metric tonnes in 2014. Though this implicitly suggests a decline in fertiliser uptake in 2014, it is important to note that that period witnessed a sharp rise in the importation of liquid formulations of fertilisers from 264,649 litres in 2013 to 1,345,562 litres in 2014. According

[2] The prices varied across the ten regions of Ghana. The figures here are the averages for the Northern Region. In general, it is estimated that the government absorbed up to 50% of the market prices of fertilisers.

[3] The impact of the withdrawal of the subsidies on fertilisers was enormous: for example, the output of one of the major crops, maize, experienced a negative growth (-2%); about 70-80,000 metric tonnes of maize stored in 2013 was depleted in 2014; and about 300,000 metric tonnes of maize worth $95.1 million was imported (CSIR-STEPRI/MOFA/D03, n.d).

to the Ministry of Agriculture, farmers, especially vegetable farmers and those under irrigation schemes, switched to the liquid formulations because they saw it as more cost effective than the granular/solid formulations (the subsidies are usually on the solid forms of fertilisers) (MoFA, 2014, p. 38).

Beginning from 2017, the subsidy programme witnessed resurgence, under the banner of 'Planting for Food and Jobs'. According to the Ministry of Food and Agriculture (MoFA), the expectations behind the rejuvenation of the programme is the desire to modernise agriculture and bring about food security and food self-sufficiency; to generate surplus for export; and to ensure sufficient availability of raw materials for local firms (MoFA, 2017). Under this flagship programme, government still absorbs 50% of the market prices of fertilisers; however, there is improvement in the quantities of fertilisers imported: imports of fertilisers was121% higher than what was supplied in the previous years under the regular subsidy programme.

Also, there have been subsidies on other inputs (certified seeds), and technical support to farmers. Sulphate of Ammonia also attracted subsidies, which was not the case in 2016 (MoFA, 2017). In 2018, this continued, with a wider coverage- farmers with up to five hectares of plots were included- and subsidised fertilisers were to be available all year round. The expansion in coverage of the programme suggests that some of the challenges the policy encountered in the past years are probably being resolved. For example, it is reported that, in the early years of the subsidy programme, small-holder farmers had limited access to subsidised fertilisers, because much of the fertilisers were often appropriated by large- scale and wealthy farmers (Houssou, et. al., 2017).

3.4. Fertiliser uptake, yield, and profitability in Ghana

It is without doubt that the subsidy programme starting from 2008 has enhanced fertiliser use intensity in Ghana. It is estimated that fertiliser uptake in Ghana as of 2006 was 8 kg/ha, down from 21.9 kg/ha of the 1970s (Yawson, Armah, Afrifa & Dadzie, 2010). However, after the subsidy was introduced in 2008, fertiliser uptake moved from 8.0kg/ha to about 20.0kg/ha by 2014 (MoFA, 2014).

The increase in the uptake of fertilisers has resulted in an increase in the average yields of the main crops that are usually targeted by the programme (maize, millet, sorghum, and rice). When the average yields of these crops are compared with that of other countries within the

West African sub-region that have no subsidies, it has been observed that, yields in Ghana have been experiencing significant increments as a result of the subsidies (Druilhe & Barreiro-Hurlé, 2012). This is supported by other studies. For example, Hill (2014), reported positive and significant correlation between fertiliser use and maize yield within the context of the subsidised fertilisers in Ghana. The subsidy programme is also found to have increased farmers motivation to use fertilisers (Scheiterle & Birner, 2018). In terms of profitability, it is found that under the subsidy regime, fertiliser use is not sufficiently profitable for small-holder farmers to intensify application (Hill, 2014). But there are indications that large-scale farmers may find fertiliser use under the regime, profitable. For example, taken 1.5 Mt as a production threshold, and outputs above this as high production systems, Scheiterle and Birner (2018), found that fertiliser use for high output systems is profitable and contributes to economic growth.

3.5. Agriculture and livelihoods in the northern region of Ghana

The study was conducted in the Bunkpurugu-Yunyoo District (BYD), which is located in the Northern Region of Ghana. The region is fairly homogenous on almost all social, political, ecological, cultural, and educational indices amongst others. The vegetation is savannah and the soil is mainly poor- for many years, "low soil fertility status of soils has been ranked first among the constraints collated from all the districts of northern region at the regional planning sessions" (SARI, 2011). However, the livelihoods of majority of the populace are rooted in agriculture, though a negligible proportion of this entails cash crop production (Hesselberg, 2013). Just 01% of farmers consider cash crop production as important: production is for consumption, beyond this, they hardly generate surplus significant enough to accelerate long-term economic growth. Majority of farmers are smallholder farmers, with plots of lands under two hectares; they mostly grow maize- their main food crop- and do not engage in the cultivation of other crops even when they apparently command higher prices in the market; irrigation farming is almost absent; and rights to land is customary (Hesselberg, 2013).

The figure (1) below is the map of the Northern Region of Ghana, with the arrow showing where this study was conducted. In the ensuing paragraphs, I expound on some variables specific to the district and as they relate to this study.

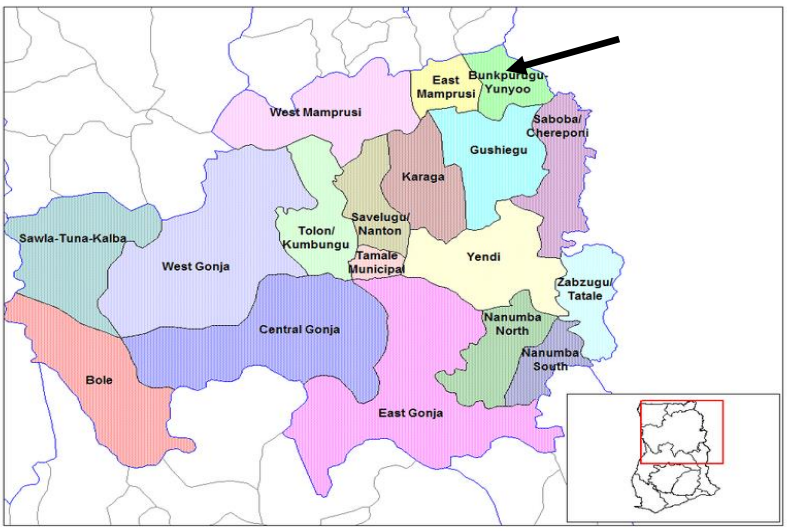

Figure 1: Map of the Northern Region of Ghana (arrow on Bunkpurugu-Yunyoo District). Source: Wikipedia (06/03/2019).

3.6. Bunkpurugu-Yunyoo District (BYD) - the study district

This study was conducted in the Bunkpurugu-Yunyoo District[4] (BYD). It is a rural district- about 85.9% of residents are in rural areas (by Ghana's classification). It is located at the north-eastern corner of the Northern Region of Ghana; and shares boundaries in the North with the Garu-Tempane, to the East with Togo, West with East Mamprusi and to the South with Gushiegu and Chereponi Districts.

According to statistics from the most recent census conducted in Ghana (2010), majority of households (about 94.1%) in the district are engaged in agriculture, with 97.9% of them involved in crop farming- this is homogeneous across urban and rural households. The next agricultural activity in the district is livestock rearing, but this appears not a significant activity. Few households keep cattle and sheep which have higher market value. Majority of households keep livestock which command lower prices in the market- fowls and goats (GSS, 2014). It has been labelled, together with other neighbouring districts, as "cereal-legume-livestock-zone", with the dominant livestock being "small ruminants and guinea fowl" (Dittoh, 2010, p. 33). These activities are dominated by males, as they maintain a share of 54% (GSS, 2014).

[4] The Bunkpurugu-Yunyoo District (BYD) is now divided into two (last year, 2018) with majority of the people being part of the Bunkpurugu-Nakpanduri area. This was not the case at time the proposal concerning this study was completed and approved. The information presented here therefore pertains to that of the former much larger district, BYD.

The area- and the whole of northern Ghana generally- has only one rainy season that lasts from around April to October, with mean annual rainfall of about 1155mm (MoFA, 2017). With respect to soil type, the area is composed of the Savannah Ochrosols- the entire district is nearly made of this- and ground water laterites. The former is a fairly well drained up land solids formed mainly on Voltain Sandstone; is loamy in texture and with good water retention; and supports the growth of a wide range of crops. Low soil fertility in the area is partly attributed to low vegetative cover which results in soil erosion in the rainy season; and low accumulation of organic matter resulting from persistent burning of crop residues, or the use of such residues as fuel, animal feed, and for building purposes (BNDA, 05/02/2019, Relevant Data).

3.6.1. Land tenure

Overall, land in the area is controlled by 'families'- it is common to hear people say 'our family land'. These families hold exclusive rights to their lands and decide how it could be used. For example, they could give out portions as 'gifts' to interested persons or other families. This in the past was usually brokered with few witnesses over local beverage and kola nuts. Under this 'gift' conditions, major economic trees on gifted plots of lands, such as shea trees, African locust bean (Parkia biglobosa)- commonly called *dawadawa*- still belonged to the original family that own the land. Their continual dependence on these trees after parting lands to other families is strategic: in the absence of contractual documents, irrespective of the years another family holds a parcel of land through 'gift', whether there were witnesses or not, it is easy to determine the original owner of a piece of land by examining how some economic trees on the land in question are exploited. This helps to reduce conflicts over land. The exception may be when these trees were planted by the second family that received it as a gift.

Another mode of maintaining ownership over a gifted land and minimising conflicts over land in the area is making the new owner committed to bringing some portions of their harvest to the original owner. This does not necessarily amount to paying for using the land, though that is also possible, especially in recent years and with smaller plots of lands. It is a form of allegiance, one that binds the two families involved, with beneficiary families acknowledging that lands under which they cultivate are not theirs, but the benefactors'.

The outright purchase of land for agricultural purposes in the area is rare. This partly explains why large-scale commercial agriculture is nearly absent. Lands are mostly sold for residential purposes and largely in the few urban areas in the district. Chiefs and the government barely have control over land. This is unlike in the other groups, such as the Mamprusis, Dagombas and the Gonjas, that compose the northern region. Government use of land may entail agreement with the family that owns the land: they may give out freely or ask for compensation from the government.

3.7. Summary

In this chapter, a background to the adoption of chemical fertilisers and subsidies were introduced-this was in the 1950s; and they were state-led initiatives implemented on state farms. From the 1970s to the 1990s, different subsidy regimes emerged, and the open market prices of fertilisers in years without subsidies fluctuated. But unlike in the 1950s and 1960s, this period saw small-holder farmers participating in the various fertiliser regimes. The recent subsidies initiated in 2008 have been relatively stable with wider coverage and target.

Chapter 4: Research Methodology

4.1. Introduction

This section shows how the study was designed and conducted. It thus consists of the research strategy, the design, sampling, analysis method, the challenges the researcher encountered on the field, methods of ascertaining validity and reliability, and ethical considerations.

4.2. Paradigms, research strategy and design

Known by different names including philosophical worldviews and standpoint, paradigms could be described as "the way we see the world and our position in relation to others and society" (Walter, 2013, p. 11). This then shapes the researcher's approach to their study- "plans and the procedures for research that span the steps from broad assumptions to detailed methods of data collection, analysis, and interpretation" (Creswell & Creswell, 2017, p. 3). The pragmatists' worldview underpins this study. This approach is not committed to specific philosophical assumptions and reality: it emphasises what works in a given situation, the research problem and any approach the researcher thinks is important in understanding the research problem- the researcher can use both quantitative and qualitative approaches if they think that would best address the research problem (Creswell & Creswell, 2017).

Guided by the assumptions of pragmatism, the research strategy adopted in this study is the mixed-methods, since "pragmatism opens the door to multiple methods, different worldviews, and different assumptions, as well as different forms of data collection and analysis" (Creswell & Creswell, 2017, p. 11). Quantitative and qualitative data were thus collected. However, the dominant of the two was the quantitative. The qualitative data was collected for the purposes of what Bryman (2012, p. 634) calls enhancement- augmenting the findings of one of the approaches (in this study, the dominant quantitative approach) by gathering data using the other approach (the qualitative approach). The qualitative data was to help generate enough background information pertaining to the study area, the fertiliser subsidy programme and agricultural practices. In terms of sequence, data from farmers for the two approaches was collected concurrently. It is data from fertiliser dealers and agric officers that was collected later.

The major design (quantitative) for the study was a survey design. It "provides a quantitative or numeric description of trends, attitudes, or opinions of a population by studying a sample of that population... [with] the intent of generalizing from a sample to a population" (Creswell & Creswell, 2017, p. 13). Specifically, it was a cross-sectional survey, with questionnaires composed of closed-ended questions. These were administered on farmers only. Unstructured interviews (qualitative) were also conducted with farmers at the time of administering the survey instrument; and fertiliser dealers and agric officers, after the major part of the study was completed.

4.3. Sampling procedure

Multi-stage cluster sampling method was used to select three study communities (clusters) in the Bunkpurugu-Yunyoo district of the northern region. With this procedure, "the sampling unit (the first stage of the sampling procedure) is not the units of the population to be sampled but groupings of those units" (Bryman, 2012, p. 193). This is similar to stratified sampling, where the study population is stratified based on some characteristics (village/town) and then sampling is done "using simple random sampling, from each stratum of the population" (Creswell, 2002, p. 628). This was necessary since the district is composed of several towns and villages. Probability sampling procedure was used to select the three communities (clusters). There are four major towns in the district and outlying villages depend on them for exchanges of goods and services, including the purchase of fertilisers and the sale of farm produce. These four towns were put in one cluster and one of them randomly selected. This was necessary to prevent the possibility of all of them being selected if the whole district was taken as a single cluster, and each town or village had equal chance of being selected. This was informed by the proposition that a researcher has to ensure that samples (clusters, in this study) differ on some attributes that are important to the research questions (Bryman, 2012, pp. 416-428). The remaining outlying communities[5] were put in one group and two of them randomly selected. The procedure is summarised in figure 2 below.

[5] It was not possible to know the total number of outlying communities in the district. Some of them are very small and hard to access; and studying them would have entailed some difficulties. With the assistance of fertiliser dealers, I was able to list 12 major communities that depend on the four major towns for exchanges. These 12 communities then constituted the second cluster from which I selected at random, 2 communities.

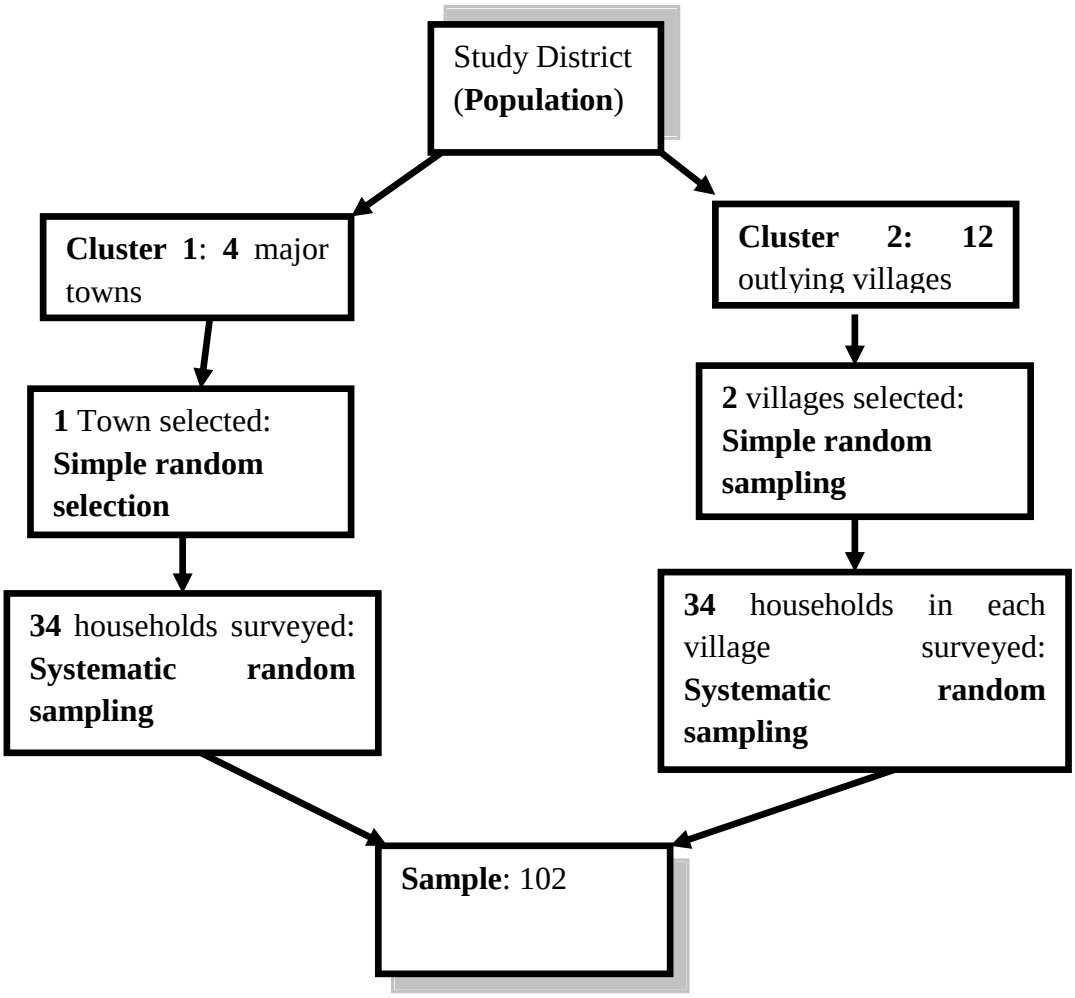

Figure 2: *A summary of the sampling procedure for the study- multi-stage cluster and systematic random sampling*.

The second stage in the sampling procedure involved the selection of respondents for the survey. Having gotten three clusters, I used systematic random sampling procedure to select respondents from each cluster. It was not possible to know how many households exist in the clusters. Data pertaining to this was hard to access; and given time-constraints, I could not enumerate my clusters of interest. Under these circumstances, what I did in the case of the outlying clusters was to administer questionnaire to every 3rd house. With the first cluster, I used this method and it resulted in thirty-four (34) being administered. This then informed the number of respondents (households) I should look for in each cluster. For the major town that was included, every 5th house was surveyed.

4.4. Reliability and validity

In evaluating a research output, Bryman (2012), points out three important criteria that should be used: reliability, validity, and replication. In this study, two of these measures were followed: reliability and validity. Replication, according to him, is similar to reliability, and because of this, it was deemed not necessary to be included in this study. In the next sections, I expound on how these two were ensured.

4.4.1. Reliability

> *Reliability means that individual scores from an instrument should be nearly the same or stable on repeated administrations of the instrument and that they should be free from sources of measurement error and consistent* (Creswell, 2002, p. 627).

In accordance with Creswell (2002) above, internal reliability test was conducted on the data that involved measurement- risk and satisfaction with the subsidy programme. They were likert scale questions and "when you have multiple-item measure in which each respondent's answers to each question are aggregated to form and overall score", this test is required to ascertain whether the indicators (items on the scale) measure the same thing (Bryman, 2012, p. 170). The two likert scale questions are described below:

1. Satisfaction with the subsidy programme: five likert items were used to determine farmers' satisfaction with the subsidy programme. It is argued that likert scale data could be treated as ordinal data and analysed using descriptive statistics; and that, when multiple responses are summated, they could as well be treated as interval data, however, all the items must use the same likert scale; measure the same latent variable; and can be analysed using parametric tests (Bertram, 2007). The five satisfaction items had five responses each, ranging from "very satisfied" (assigned 5) to "very unsatisfied" (assigned 1). The composite scores of respondents for every response on the five items were computed and treated as a continuous variable.

2. Risk associated with the use of fertilisers was also assessed using a likert scale. The items were drought, pest/disease attack, post-harvest prices, crop failure/poor yield, and credit. And they were processed in the same manner as the satisfaction items.

The Cronbach's alpha test was used to test the reliability of the scales above. The alpha (**α)** ranges from 0 to 1, and it is important that this is calculated for each concept (Tavakol & Dennick, 2011). A high **α** shows that the items on the questionnaire are reliable measures of the concepts, though this may not always be the case; and **α** 0.70 is considered strong (Tavakol & Dennick, 2011). The **α** for risk was 0.854 which shows that the items that composed it were reliable. The **α** for satisfaction was 0.673. This was relatively weak, but an **α** in the range of 0.67–0.87 is still reasonable (Taber, 2018). Appendixes 1 and 2 show the individual item-scores.

4.4.2. Validity

> *Validity is the development of sound evidence to demonstrate that the intended test interpretation (of the concept or construct that the test is assumed to measure) matches the proposed purpose of the test. This evidence is based on test content, responses processes, internal structure, relations to other variables, and the consequences of testing* (Creswell, 2002, p. 630).

Some measures were taken to satisfy the tenets of validity as pointed in the above quote. One of the measures was *face validity*. This could be achieved by "asking other people whether the measure seems to be getting at the concept that is the focus of attention...possibly those with experience or expertise in a field" (Bryman, 2012, p. 171). I ensured this by working closely with my supervisor in developing the survey instrument. I also had inputs from individuals who had knowledge of the district I was going to do my fieldwork. Another validity procedure was *construct validity*. According to Bryman (2012, p. 172) this could be ensured when the study is guided by theories. This was achieved by extensive review of theories and literature. The research questions and the consequent survey instrument were thus the result of this procedure.

External validity was also addressed. This concerns how the study's findings are "generalizable to other persons, settings, treatment variables, and measures" (Creswell, 2002, p. 303). How people are selected to take part in the research helps to ensure this (Bryman, 2012). Details of the sampling procedure are outlined under 'sampling'. Multi-stage cluster and systematic sampling techniques were used. And in each stage, random sampling method was applied. This was against the backdrop that the eventual sample could be relied on as representative.

Finally, *internal validity*. This has to do with how certain it is that an independent variable is responsible for the variations in the dependent variable (Bryman, 2012). The dependent variable in this study was quantity of subsidised fertiliser. Internal validity then means that how certain is the researcher that the independent variables of this study are responsible for the variations in the quantities of fertilisers used by farmers. A number of factors could affect a causal link between these variables and they were addressed in the study. One is respondent selection (Creswell, 2002). The use of random sampling was to ensure that the researcher does not choose people who are likely to respond to the questionnaires in a specific way. Another is ambiguities in the questions or scale. The researcher was able to conduct a pilot study before the actual survey was done. This helped to clarify the meanings of concepts and deal with the issue of ambiguities. The formulation of research questions based on existing literature and theories is also important in ensuring internal validity. The factors that affect fertiliser usage were obtained from the review; and they can be counted on as capable of influencing the quantities of fertilisers farmers use.

The above measures were taken to ensure reliability and validity. However, there might be other factors that could have affected them, and which the researcher did not anticipate, practically encountered, or could not have controlled. From the formulation of the study's questions to the conduct of the survey, the researcher was mindful of the need to account for these two which are critical in ensuring that the study's findings are acceptable.

4.5. Research experience and ethics

Measures were taken to ensure that the study did not intentionally violate ethical principles that govern research. They included but not limited to protecting privacy and informed consent. All respondents usually agreed to take part in the survey before I administered questionnaires to them. This was after I had explained the nature of the survey; and told them about their rights in it, including their right to withdraw from the survey at any stage. To ensure anonymity and confidentiality, I did not collect data in a manner that they can be traced to particular households, for example, residential addresses.

In the first community I visited, there was express disapproval from respondents concerning their community's name appearing in the research output. Realising that this was an ethical concern, I decided not to use the actual names of communities in the study, and used that point to ensure respondents how anonymous my study was going to be.

It was also obvious that most households had participated in a number of surveys over the years; and they were often told in these surveys that the data collected from them was to be used as the basis for the design and provision of basic services in their localities for their benefit. But they indicated that nothing happens after they take part in these surveys and the researchers are long gone. There is, therefore, some reluctance on the part of households to participate in surveys. This made my work somewhat difficult in the beginning, as I had to explain at length how my survey was different- I always had to inform them that I was carrying out an academic exercise, and there were no direct benefits to be derived by them as a result of the data I gather from them.

On countless occasions, I had to show my student identity card to household members who could read, to affirm that I was a student and that I was not collecting the data for any government agency or a non-governmental organisation that promise or provide assistance. In other instances, I pointed to respondents that any member of their households, who goes as high as I have done in education, would find themselves at one point in time, in one way or another, gathering some empirical data from people. These two approaches were effective in offsetting what was an apparent fatigue in responding to surveys by households; and once a few households grasped this, it immediately diffused to other households, and I hardly explained my purpose over time. However, I was mindful not to allow this approach interfere with the data households provided- knowing that I was a student could have influenced how they respond to the study. What I did, once they knew that I was a student, was to equally emphasise the importance of reliable and accurate data for my studies.

4.6. Analytical Model

Multi-linear regression was used for data analysis. This has been used extensively in other related studies (Dahal & Routray, 2011; Akpan, Udoh & Nkanta, 2012). This is used to predict the value of dependent variables from given set of independent variables; or to determine the linear relationship between predictor and response variables, which could be continuous, categorical or both (Wan, 2013). The tobit and probit models have been used in other studies, however, they are often with respect to the probabilities and intensities of fertiliser adoption (Adesina, 1996; Fufa & Hassan, 2006). But in this study, fertilisers have

been adopted and all households sampled have been using it. Multi-linear regression was thus appropriate based on the study's objective. The equation for the model was:

$$Y = \beta 0 + \beta 1X1 + \beta 2X2 + ... + \beta pXp + \varepsilon$$

Y= the dependent (response) variable;

X1 through Xp= independent (explanatory) variables;

β0 and β1 are parameters to be estimated: β0 = the intercept term and β1through βp= the slope; ε= error/disturbance

Before fitting the model, a number of assumptions were tested. It is important to do this because if such "assumptions are not met the results may not be trustworthy" (Osborne & Waters, 2002, p. 1).

4.6.1. Test of model assumptions

1. *Normality*: variables should have normal distributions so that relationships and significance tests are not biased; and this can be observed physically by looking at the P-P plot; and the data points are expected to be close to the line (Osborne & Waters, 2002). The P-P plot attached as appendix 3 shows that the dependent variable was fairly normally distributed.

2. *Linearity*: since multivariate regression measures linear relationships, variables must be linearly related to avoid under-estimating actual relationships; and scatterplots of residuals can determine this (Osborne & Waters, 2002). The data points are supposed to be random, and that has been met as seen in appendix 4.

3. *Multicolinearity:* The variables in the model should not be correlated with one another. Critical values higher than 0.75 would cause multicolinearity effects (Abdullah & Jubok, 2013, p. 111). A correlation coefficient of over 0.9 means multicolinearity is certain (Dohoo, et. al., 1997). The Pearson product-moment correlation was used to test multicolinearity. Inferring from Abdullah and Jubok, (2013), 0.75 was used as the cut-off point. A number of variables crossed this mark and some of them were consequently dropped- total plot was dropped for plot fertilisers were applied; and satisfaction dropped for risk.

4. *Homoscedasticity:* the null hypothesis is that the variance of the residuals is constant. A p– value not more than 0.05 means that this hypothesis is accepted- a rejection of

this hypothesis is the ideal. This was tested using Breusch-Pagan test, and the results was p = .06. The null hypothesis was thus rejected; however, this statistic is relatively weak.

4.7. Empirical Model

Table 2: *Description of independent variables used in the model*

Explanatory variable	**Description**
Off-farm work	**Dummy**: **1** if true, **0** otherwise
Distance of household to the fertiliser shop (km)	**Continuous**: distance from household to where fertiliser was bought
Distance to plot (km)	**Continuous**: distance from the household to plot
Education level	**Continuous**: years of schooling attained by the head of the household
Household size	**Continuous :** Number of people who constitute the household
Household debt (GH₵)	**Continuous:** Amount of money the household owed others.
Complementary input use	**Dummy**: **1** if inputs used, **0** otherwise
Livestock	**Continuous**: Sum of cattle, sheep, goats, and pigs. Poultry was excluded
Male	**Dummy**: **1** if male, **0** otherwise
Size of plot fertiliser applied (ha.)	**Continuous**
Risk in fertiliser use	**Continuous**: sum of scores on likert scale. The items were: post-harvest price, disease/pest attack, weather, credit, and crop failure
Soil fertility	**Continuous**: scale from 0 to 5
Traditional Farm methods	**Dummy**: **1** if yes, **0** otherwise
Means of transport	**Dummy: 1** if farmer has any of motorbike and car, **0** otherwise
Younger households	**Dummy: 1** household heads aged 16 to 45, **0** otherwise

The quantity of fertilisers was the dependent variable. Farmers used both subsidised and non-subsidised fertilisers (NPK, Ammonia and Urea). These compound and single fertilisers are bagged at 50 kg per bag. It is this standard measure (kilogram) that was used in this study, and not the kilogram of nutrients in each bag. The quantities of subsidised and non-subsidised fertilisers were determined separately as presented in table 3. It is the quantities of subsidised fertilisers, a continuous variable, which was used in the model. Where a famer used both subsidised single and compound fertilisers, they were added to obtain the total quantities of fertilisers used by that particular farmer. This was then divided by the size of plot that the farmer applied fertiliser to. Thus:

$$\text{Fertiliser per hectare (xha)} = \frac{\text{Xbags*50 kg}}{\text{Size of plot (hectare)}}$$

The variables that composed the explanatory variables for the model, including their descriptions, are contained in table 2. They were informed by the literature and theories on agriculture input use and adoption by farming households. These variables were grouped as: household social-related variables; household economic-related variables; farm (plot)-related variables; and risk. A number of variables were dropped for others because of multicolinearity- total plot owned by households, satisfaction with the subsidy programme, and the nature of dwelling places. Membership of farming cooperatives, access to extension services, the use of manure, irrigation farming, use of improved seeds and the source of resources invested in farming, were also dropped because respondents nearly gave the same responses for each case. How the final variables used for the estimation were predicted to influence subsidised fertiliser uptake are described below.

4.7.1 Household social-related variables

Gender of head of household was dummy coded (Male=1; and Female=0) and used in the model. The prediction is that male headed households would use more fertiliser than their female counterparts. This is informed by the fact that males compared with females command more resources; and should therefore purchase more fertiliser.

As pointed earlier, male headed households were more than their female counterparts by fifty. In addition, it is predicted that younger households (*youthful_age*) - 16 to 45 years age

bracket- would use more fertiliser than their older counterparts since they are likely to be more economically engaged and should command more resources to invest in farming.

The *distance of the household to input market* is predicted to be inversely related to fertiliser use: the closer the household to fertiliser market, the more fertiliser they are likely to use. This may be influenced by ease of transporting it to the household; and the access to information regarding fertiliser availability. This variable should also be understood as a proxy for locality, since households that sampled in the urban town bought their fertilisers within the town; and those sampled in outlying communities made their purchases in nearby urban places. Thus, while the distance for urban dwellers was basically zero, it differed for the outlying communities.

Household size is predicted to be inversely related with fertiliser use. The assumption is that, giving that the consumption and production functions of rural agricultural households are non-separable (Singh et al., 1986, p. 149), larger households may sacrifice investments in fertilisers to meet other obligations. They may therefore use more of their labour endowments. This assumption was in contrast with the thinking that larger households have higher land dependency ratio and therefore use more chemical fertilisers (Adesina, 1996).

Households that also have *means of transport*: Means of transport was dummy coded, with households owning any of car and motorbike compared with those without any of them. The prediction is that, households with means of transport would use more fertilisers because of the advantages they provide- they facilitate the transportation of farm inputs.

The educational status of the head of the household (education) is a continuous variable- farmers stated the years of schooling they have attained. This has been an important factor in similar studies (Adesina, 1996; Akpan, Udoh & Nkanta, 2012; Deressa et. al., 2009). They show that individuals with higher formal education tend to have higher adaption/adaptation propensities. The same prediction is assumed in this study.

4.7.2. Household economic-related factors

It is predicted that if the head of the household farms and at the same time engages in other *off-farm income* generating activities, they are more likely to use more fertiliser. The reason is that, having off-farm work suggests multiple streams of income; and such farmers should have good resource base to purchase fertilisers more than their counterparts. The same is

predicted for the size of *livestock* the household has. It is an indicator of wealth (Deressa et. al., 2009). This was a continuous variable and consisted of the aggregate of livestock, excluding chicken/fowls, owned by households.

The liabilities (household debt) of households at the start of the farming season should affect their input use. This is with respect to those not related with farming activities. They could be borrowed money spent on food, shelter, utility bills, and others not directly related to farm improvement. This should affect expenditure on fertiliser because any future income generated by the household would be split to offset the debt and to purchase farm inputs-based on non-separability in agricultural households, expenditure in one domain should affect the allocation of resources to the next domain. Higher liabilities should therefore be associated with lesser use of fertilisers.

4.7.3. Farm (plot)-related variables

A negative relationship between the *distance from the household to (farm)* and fertiliser uptake is also predicted. Farmers with plots close to their houses should use more fertilisers because of the ease of transporting it. There is also the proposition that distant farms are more likely to be subjected to land fallowing and therefore, farmers may use less fertilisers because such practice improves soil fertility; and that, the associated cost of cultivating distant farms as well the cost of transporting chemical fertilisers could also limit fertiliser use intensity among farmers with distant lands (Adesina, 1996).

The *use of traditional soil fertility management* practices is predicted to be associated with lower use of fertilisers. Practices such as shifting cultivation, land rotation, and intercropping among others, are assumed to be undertaken to get the best out of their plots, and in the process, such farmers should depend less on chemical fertilisers. Based on this assumption, households that reported being systematic with these practices were compared with those who do not. Related to this is *the fertility level of the plot*: logically, the quantities and types of fertilisers used by farmers should be informed by the nutrients levels of their soil, the pH, amongst others. These may be hard to scientifically determine by smallholder farmers such as those in this study. However, it is without doubt that they have some qualitative knowledge regarding how fertile their plots are; and higher perception of soil fertility should be associated with lower usage of fertilisers. Finally, the *use of complementary inputs* should be inversely related to fertiliser use. This is because, the amount of resources allocated to other

inputs like labour, seeds, and pesticides, should affect the resources devoted to the purchase of fertilisers, bearing in mind, non-separability in agricultural households, where resource use in one domain affects allocations in other domains.

4.7.4. Risk/Uncertainty

Risk takes different forms, and it informs input use. Moschini and Hennessy (2001), identified price, production, technology, and policy uncertainty, as affecting agricultural households' decision-making regarding input use. Other forms of risks are pests and diseases (Kahan, 2008). The relationship between each of this and input use is not always the same. Some of them are associated with lower input use. For example, fertiliser use and drought could put farmers in a quandary: they either postpone fertiliser application until conditions become better, or they may altogether suspend it for a planting season (Aune & Bationo, 2008p. 123), in which case, fertiliser use would have negative association with uncertainty regarding the weather. The prediction in this study is thus, higher risk concerning the use of fertilisers is associated with lower use of fertilisers.

4.8. Summary

In this chapter, the methodology that was adopted to guide the conduct of the study was outlined- the research paradigm, design, and sampling methods; the reliability and validity measures that were undertaken, as well as ethical considerations. The analytical model- multi-linear regression- was described and the empirical model specified.

Chapter 5: Results and discussion

5.1. Introduction

The purpose of this study was to understand the factors that affect the uptake of subsidised mineral fertiliser in the Bunkpurugu-Yunyoo district of the northern region of Ghana through the mixed method of inquiry. This chapter presents the findings of the study in that regard. The chapter begins with a description of how the programme operated; and embedded in this is the answer to one of the research questions- the implementation challenges. Descriptive statistics of some variables that were not used in the model estimation are presented next. The results of the qualitative interviews which were obtained to provide background information; and for enhancement- augmenting the findings of one of the approaches (the quantitative findings) (Bryman, 2012, p. 634), are used where it is deemed necessary. The results of the multiple regression analysis are presented last in this chapter.

5.2. The operation of the fertiliser subsidy programme in 2018

The coupon system was used in 2018 to market subsidised fertilisers. There were specific coupons for each of the fertilisers subsidised. A coupon was issued for every bag of fertiliser. The coupons had unique serial numbers, colours, and space for the details of farmers to be entered by an authorised agric officer before they were issued with fertilisers. On receipt of a valid coupon, a farmer could proceed to an authorised retailer of the fertilisers and deliver the coupon, including the part of the amount farmers were to pay to the retailers in exchange for the fertilisers they were entitled to. These retailers then transferred the coupons to the fertiliser marketing companies from whom they had their supplies, and it is these marketing companies that would tender the coupons to the government for payment, based on the value of the coupons. How this operated is similar to the voucher system piloted in 2008/9 in Nigeria by the International Fertilizer Development Center in collaboration with the National Programme for Food Security in Nigeria (Kiger & Adodo, 2010). Figure 3 below summarises how the policy was supposed to be implemented. The information used to do this is based on the narratives gathered from the field.

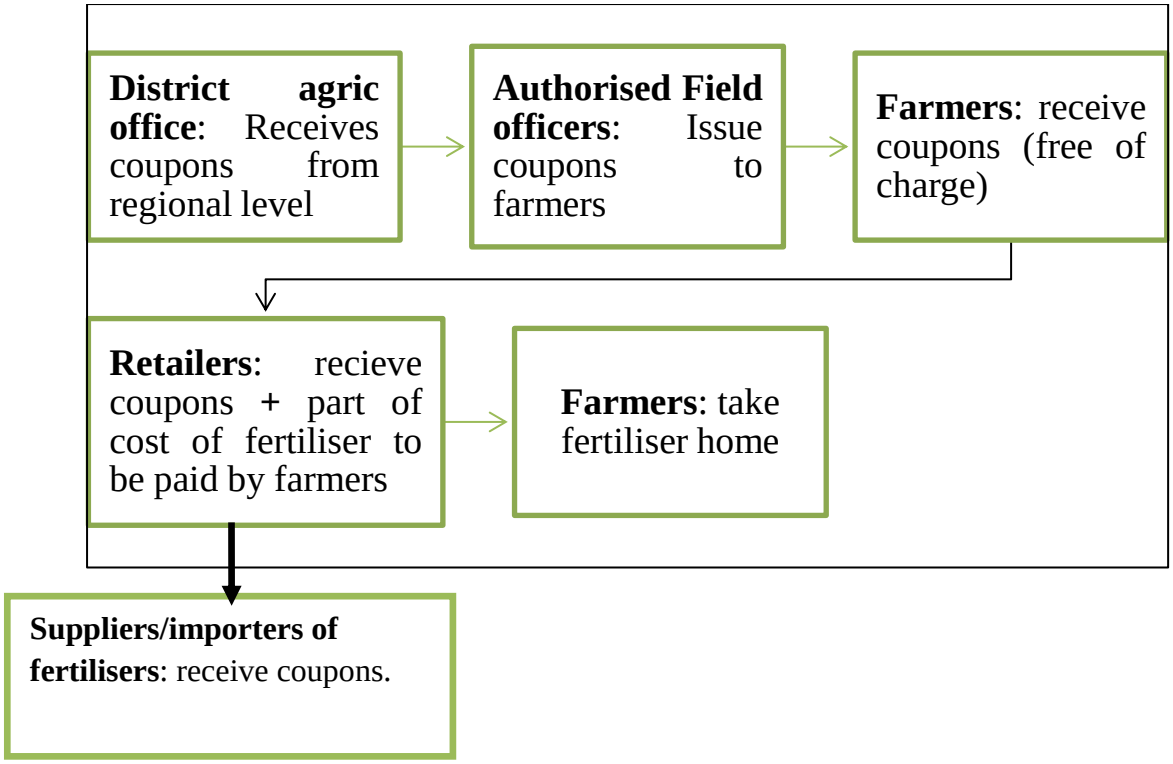

Figure 3: *Policy procedures for acquiring subsidised fertilisers in the study district in 2018* (Source: narratives from the field).

Each farmer could purchase a maximum of ten (10) bags (each bag is 50 kg) of NPK (15.15.15, 21.5.5, 25.10.10, 20.10.10) and five (5) bags of the single fertilisers (Urea and Sulphate of Ammonia). The NPK was sold at a subsidised price of GH¢68 and the single fertilisers went at GH¢ 63 (Urea) and GH¢ 40 (Sulphate of Ammonia). According to the retailers in the district, they had their supplies of these fertilisers from about eight different marketing companies, and these companies each had specific quota to distribute in 2018. They also indicated that they were informed of the subsidies for the year in May; however, they could not procure it for distribution to farmers until June. It appears there was, therefore, some improvement in the time of delivery of subsidised fertilisers. For example, in the first year of the programme (2008), the subsidies took effect on the 4th of July. This was too late to benefit many farmers (Baltzer & Hansen, 2011).

As it can be seen in figure 3 above, field officers (mostly extension officers) were supposed to issue the coupons to farmers who wanted fertilisers. They were assigned zones, and farmers within these zones were to approach them for coupons anytime they wanted to buy fertilisers. But as it would be expounded in some paragraphs later, the programme went on in the district, but farmers hardly received coupons from extension officers; and extension

officers hardly executed their mandate as prescribed. There was, therefore, a divergence between policy directives and actual implementation procedures.

There was no official statistics of the number of retail outlets in the district. However, extension officers indicated that they expected the number to be high, because many key retailers opened new outlets in areas that previously lacked one. This was confirmed by some retailers who pointed out that because of the great supplies they had, they occasionally conveyed fertilisers from their shops to sell in the major markets (only on market days) where they expected farmers from outlying villages to attend.

From the farmers, agricultural extension officers, and to the retailers of subsidised fertilisers, the market supply of subsidised fertilisers in the 2018 farming season in the northern region of Ghana was plentiful. What this study revealed thus contrasts greatly with studies that were conducted when the programme was introduced in 2008. For example, Mustapha, Abdulai & Ustarz (2011), found that, in the first years of the subsidy programme, access was very low, retail outlets were few, and access to fertilisers by farmers were heavily influenced by political affiliation. The role of party politics in who accessed or could not access fertilisers led to fewer farmers benefiting from the programme, consequently, many farmers reported being generally dissatisfied with the programme in the early years (Yawson et. al., 2010). This contrast is understandable since the government have since levered up efforts to overcome the challenges of the past years. However, two major challenges with the programme were observed; however, the greatest was the one that the retailers of subsidised fertilisers in the localities faced.

5.3. The commodification of coupons and the conditional sale of fertilisers

As indicated in one of the preceding paragraphs, policy procedures and actual implementation procedures varied. This divergence has been noted by Holden (2018) in a review of fertiliser subsidy programmes in Sub-Saharan Africa. Holden (2018), pointed out that, in some cases, the objectives and designs of subsidy programmes may be clear, but ‘implementation failures’ may persist. Among these ‘implementation failures’ are weak monitoring systems and late delivery of fertilisers (p. 16). Figure 4 below depicts how the policy was carried out in the study district in 2018. The information is based on the narratives gathered from the field. When figure 4 is compared with figure 3 above, one can state that

there was probable ineffective monitoring of the programme in the area, resulting in the divergence between policy design implementation.

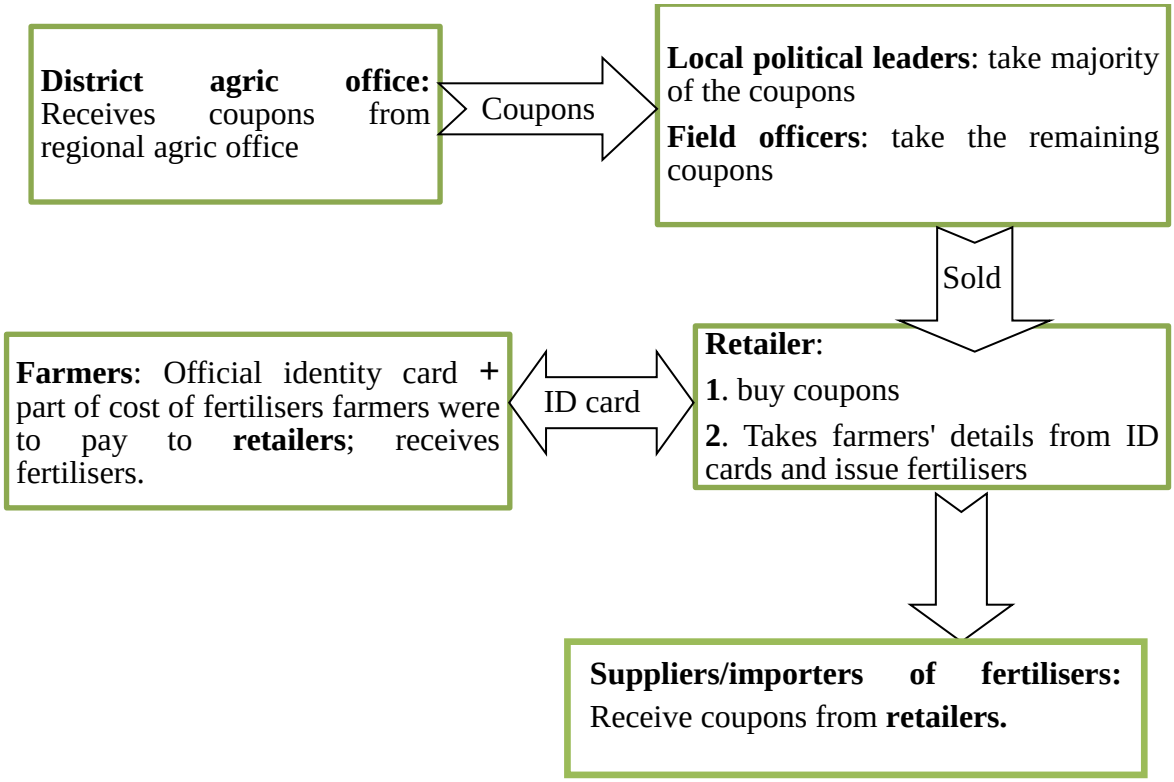

Figure 4: *Actual procedures for acquiring subsidised fertilisers in the study district in 2018* (Source: narratives from the field).

Figure 4 shows clearly that farmers did not receive coupons from extension officers. They rather went directly to the retailers with their official identity cards, mostly their voters' identity cards. Details on these cards were then recorded by the retailers and fertilisers were consequently issued to the farmers who presented such identity cards, plus the cost of the fertilisers that were to be paid by farmers. Retailers were asked to use this approach, while they waited for the coupons which were to be issued to them by field officers on later dates. The narrative of one of the retailers captures this:

> *Farmers were supposed to go to agric officers, register for coupons, and bring the coupons for fertiliser. That is how it was supposed to be. But the coupons were not there. They were scarce. So what we finally did was to use their voter identity cards to register them. We also took their mobile phone numbers. We did this, hoping that later on we would be issued with the coupons, and we would then fill out the farmers' details.*

Things did not turn out well as the retailers were told. As it can be seen in figure 4 above, majority of the coupons were immediately taken by local political party leaders, leaving a few for the authorised field officers. These coupons were then sold to the retailers who needed them to handover to their suppliers in other to avoid paying the component of fertiliser prices the government absorbed. This observation fitted well with the concerns raised by Druilhe and Barreiro-Hurlé (2012) in their review of fertiliser subsidy programmes in Sub-Saharan Africa. According to them, the subsidies are politicised and need effective monitoring to "...track implementation performance, efficiency and sustainability" (p. iv). The narrative of one of the retailers of subsidised fertilisers demonstrates the form of the political interference that was witnessed in the area. According to him:

> *The agric officers didn't have control over the coupons. Anytime the district director of agric received coupons from Tamale* [northern regional capital], *the local political party leaders would come for them, leaving a few for the agric officers. They had people they gave these coupons to; and these people would then sell them to us. The party leaders really made a lot of money from the sale of these coupons to us.*

The prices at which retailers bought these coupons at were also high, and in some cases, the price of a coupon outstripped the profit retailers were supposed to make on a bag of fertiliser. Thus, retailers had their expected profits greatly affected in 2018. One of the retailers, for example, expressed that:

> *We sold the fertilisers as they directed us, but in the end, we couldn't get the coupons. I was supposed to be given close to 7000 coupons for free, but they gave me a little over 1000 coupons. I had to buy the remaining coupons and give it to my suppliers, which was bad. I had to use part of my profits to buy the coupons. I paid GH¢ 0.50 for each of the first 1000 coupons I bought. Later on, I was paying as high as GH¢ 3 and GH¢ 4 for coupons. This is money I could have used to develop myself.*

Retailers were ready to pay this much for a coupon because failure to handover these coupons to the marketing companies meant that, it would have been considered that, they bought the fertilisers at the open market price, and hence, should pay the remaining balance. To illustrate: the value of a coupon- the amount government absorbed- for a 50 kg of compound fertiliser was GH₵68.00. Failure to return a coupon in place of a 50 kg of compound fertiliser would have resulted in the retailer paying this amount to the distributor. Party officials and the agric officers who sold the coupons, therefore, knew that, retailers would pay any amount

for a coupon to avoid paying the market prices of fertilisers to their suppliers. This explains why they rather sold than give it out for free to the retailers.

According to the retailers, the coupons that were in circulation were actually enough for every farmer to get any quantities of fertilisers they wanted. There was therefore no room for party officials and agric officers to inappropriately direct the programme to the disadvantage of any farmer, or to extort some benefits from them. The chances of officials using their discretion to take bribes from farmers; or to divert subsidised inputs from the intended beneficiaries to others who are not entitled to, as indicated in Wiggins and Brooks (2010), is therefore possible only in cases where the subsidised inputs are limited in supply.

Given that the sale of coupons was blatant, retailers were asked what the response of authorities at the regional and national levels was. They indicated that a different regime, one that has been used before, would be used in 2019. According to them, that regime is the best, as it is less stressful. With that system, retailers would only use the documents covering the fertilisers they received from suppliers and fill out a form called 'Form A'. It is this form that suppliers would subsequently tender to the government for payment.

It was also observed that farmers did not get some of their preferred fertilisers. Most of them preferred the 'Yara' brand of fertilisers. According to the retailers, farmers who are not educated and who constitute the bulk of the agricultural workforce knew the different brands of fertilisers and their effectiveness with respect to crop yield. They could tell this by the symbols on the fertiliser sacks; and they knew that 'Yara' fertilisers (NPK) had the most nutrients. Unfortunately, according to the retailers, they were informed by the company that the quota given to them to supply to farmers was very limited in 2018. According to the retailers, the company (Yara) then resorted to conditional sales so that it could dispose off its 2018 stock as well as that of the previous year's. Any retailer who wanted their subsidised fertilisers needed to also buy similar quantities of their non-subsidised fertilisers. This became a challenge to retailers because they lacked resources to engage in conditional purchases of fertilisers.

The retailers pointed that, in the early part of the farming season (in May and early June), when the subsidised fertilisers were not yet distributed, those farmers who bought fertilisers at the open market prices bought the 'Yara' brand of fertilisers. Also in some occasions where farmers urgently needed fertilisers, for example, when there was an unexpected rain,

and there was no subsidised fertilisers in the area, farmers buying fertilisers preferred this brand. These two scenarios relating to the use of non-subsidised fertilisers contributed greatly to the overall quantities of non-subsidised fertilisers used by farmers. Table 3 and figure 5 below Illustrate this.

Table 3: Quantities of subsidised and non-subsidised fertilisers purchased by the sampled farmers

Subsidised fertiliser(Kg)		**Non-subsidised(Kg)**	
NPK	**42150**	NPK	**8150**
Ammonia	**2800**	Ammonia	**4050**
Urea	**700**	Urea	**3450**
TOTAL:	**45650**	**TOTAL**:	**15650**
% of total fertiliser	**74.47**	**%** of total fertiliser	**25.53**

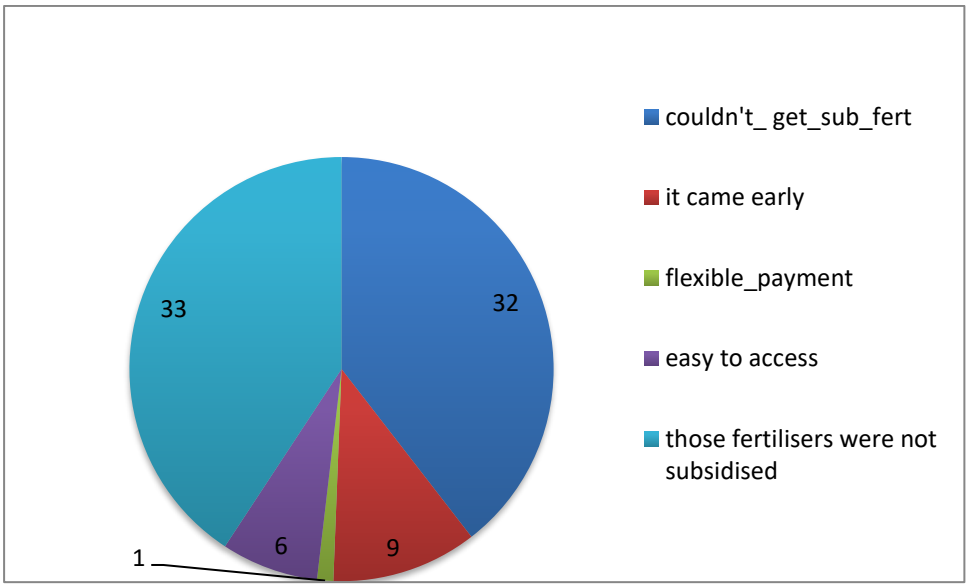

Figure 5: Reasons why households use non-subsidised fertilisers (source: field data, based on frequencies).

From table 3, it could be seen that non-subsidised fertilisers constituted 25.5% of total fertilisers used by farmers. The table also reveals that much of the single fertilisers used by farmers were non-subsidised. As to why farmers used non-fertilisers, figure 5 shows that two reasons stood out: the brand of fertilisers were either not subsidised or they could not get the subsidised fertilisers at the time of application, and thus resorted to non-subsidised ones.

5.4. Descriptive statistics for household and farm variables

Table 4: Frequencies, means (M), standard deviations (SD), and the upper limits of household variables, plots, yield, and fertiliser consumption.

Variable	Freq.	Mean	SD	Maximum
Households surveyed	102			
Household- female headed	26			
Household- male headed	76			
Households with means of transport	28			
Households with off-farm work	34			
Unit of fertiliser (kg)[6]		416	355	2500
Total plot per household (ha.)		1.52	1.13	8.10
Fertiliser per hectare (kg)		275	122	617
Maize yield per hectare (kg)		1937	708	4077
Satisfaction- aggregate of likert scale score		8.85	5.29	20
Dwelling places:				
Block	8			
Bricks	41			
Mud	53			

It could be seen in table 4 that the number of male headed households that were surveyed was 50 more than that of female headed households. It is important to point that the data obtained are not specific to the head of the household, especially in the case of the male headed households. People hardly represented themselves when they are in the same household with their father, even if the responses, for example, fertiliser used and plot ploughed, belonged to them- they provide such data in the name of their father. But for the female headed households, it was observed that the data collected were those related directly to the women.

[6] Where a farmer used both compound and single fertilisers, these were added together. In Ghana, these fertilisers are bagged the same: 50 kg per bag. It is this standard measure (kg) that was used in this study, and not the kilogram (kg) of nutrients in each bag.

Women also identified their households as ‘female headed’ only when they did not have grown-up male children, otherwise, matured male children took the place of head of households. In sum, the difference in household should be taken with caution; and the involvement of women in productive activities could be masked behind such statistics.

One of the indicators of economic status, the nature of dwelling place, though was part of the survey instrument prior to the field work, was affirmed in all the communities surveyed as the most important indicator of wealth. But few of them owned block houses: majority lived in thatched houses, and I was often told that, “you cannot be rich and still stay under a roof like this”. A few of them were engaged in off-farm work, though some households had members engaged in other forms of employment.

From table 4, it is clear that there is greater variability in the quantities of fertilisers (in kg) that households purchased in the 2018 farming season (M=416, SD=355). But this does not take into account the size of plots. When the size of plots are taken into consideration, the same variability still exists (M=274, SD=122). Plot sizes were also small. This is not surprising since about 90% of farm holdings in Ghana are less than two hectares (MoFA, 2010). The yield per hectare for maize (M=1937, SD=708) was similar to what has been observed in demonstration farms in the same district. For example, the Council for Scientific and Industrial Research (CSIR- Ghana) in 2011 recorded 1852 kg/ha (SARI, 2011, p. 138).

A number of traditional farm management practices were also observed. The dominant practices were inter-cropping and crop-rotation. For crop rotation, farmers explained that, after cultivating maize on a plot for a few years (two years in most cases), they plant groundnuts and sorghum on that plot in the third year. In this way, they are able to get good yield of groundnuts and sorghum, because, they believe that, their plots would have retained some nutrients from the fertilisers they had applied on the maize farms in the previous years.

Farmers also pointed out that the risk involved in diversifying crops is very high. This reflected the exposition that farmers know the differences in the yield of different crops under various soil types, including other factors on the farm that affect yields. Because of this, farmers “often prefer to continue with familiar crops and production activities with low risk” (Kahan, 2008, p. 34). Many of the farmers, therefore, were found to stick to the cultivation of maize, groundnuts, sorghum and millet. In figure 6 below, farmers were asked to list their

most important food crops; and all but one respondent said maize was their first primary crop. The other crops are secondary staples with sorghum and groundnuts often inter-cropped.

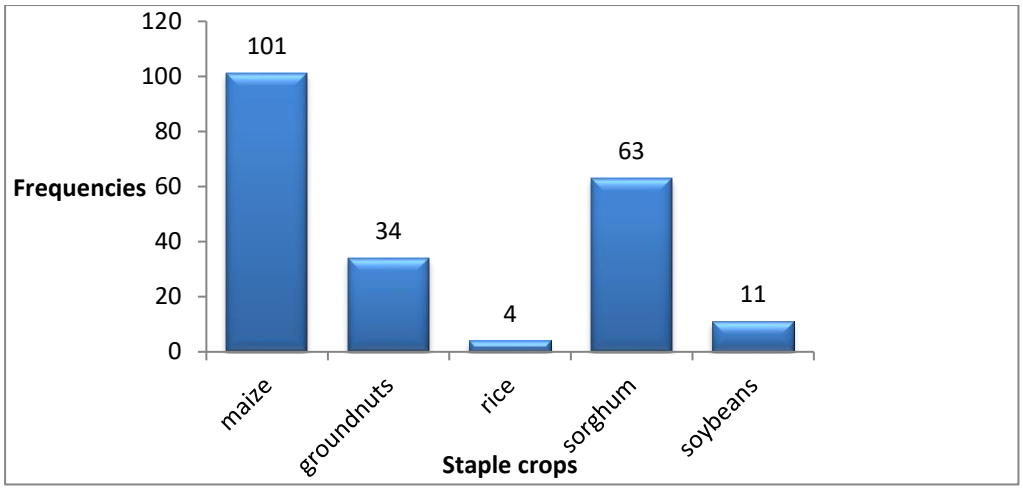

Figure 6: *Staple crops grown by respondents* (source: field data, based on frequencies).

5.5. Descriptive statistics and Multivariate regression results of factors that affect the uptake of subsidised fertilisers

A standard multiple linear regression analysis was conducted to determine the factors that predicted households' uptake of subsidised mineral fertiliser in the Bunkpurugu-Yunyoo district of the northern Ghana. Preliminary analyses were performed to ensure that the assumptions of multicolinearity, normality, linearity, and homoscedascity, were not violated. An alpha level of .05 was used for all statistical tests. A collective significant relationship between the independent variables and the dependent variable was found, ($p < 2.2e\text{-}16$), with an R^2 of 0.7789. The estimated coefficients of the model, including statistical significance levels are presented in table 6 below, and the statistical output of it attached as appendix 5. The interpretations and discussion of the estimates follows shortly after the table. The means and standard deviations of the variables used in the model estimation are first presented in table 5. They are not explained in full. However, they are referred to when discussing the model results.

Table 5: Means (M) and Standard Deviations (SD) of variables used in the model estimation.

Explanatory variable	Mean	S.D.
Off-farm work	0.3333333	0.4737325
Distance to fertiliser shop (km)	2.6372549	2.5632174
Distance to plot (km)	4.1643564	2.7301496
Education level	6.0980392	5.5087865
Household size	8.5490196	3.5505611
Household debt (GH¢)	138.8235294	178.9036696
Complementary input use	0.1764706	0.3831026
Livestock	9.2843137	9.2515746
Male	0.7450980	0.4379582
Size of plot fertiliser applied (ha.)	1.5235556	1.1252556
Risk in fertiliser use	12.8333333	6.3978390
Soil fertility	2.3137255	1.2972201
Traditional Farm methods	0.5882353	0.4945834
Means of transport	0.2745098	0.4484707
Younger households	0.6633663	0.4749153

Table 6: *Summary of Multiple Regression Analyses for Variables Affecting the Uptake of Subsidised Mineral Fertilisers* (N=102).

	Estimate	Std. Error	t value	P - value
Intercept	378.02310	45.97112	8.223	2.17e-12 ***
Explanatory variables:				
Off-farm work	-45.17304	18.30588	-2.468	0.01563 *
Distance to fertiliser shop (km)	1.03156	2.86271	0.360	0.71949
Distance to plot[7] (km)	-5.75616	2.93905	-1.959	0.05349 .
Education level	8.90771	1.76011	5.061	2.42e-06 ***
Household size	1.79567	2.50252	0.718	0.47503
Household debt (GH¢)	0.06676	0.04172	1.600	0.11334
Complementary input use	26.36301	19.22797	1.371	0.17400
Livestock	3.16646	1.25125	2.531	0.01325 *
Male	18.49965	18.79884	0.984	0.32790
Size of plot fertiliser applied (hectare)	-35.82996	11.07403	-3.235	0.00174 **
Risk in fertiliser use	-6.01181	1.98854	-3.023	0.00332 **
Soil fertility	-31.28316	6.82618	-4.583	1.58e-05 ***
Traditional Farm methods	13.45802	14.30485	0.941	0.34950
Means of transport	-2.46291	24.82173	-0.099	0.92120
Younger households	4.47146	15.32961	0.292	0.77124
Missing observations deleted	2			
Multiple R-squared	0.7837			
Adjusted R-squared	0.7451			

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Education was positively and significantly related with fertiliser usage. An increase in educational status by one year was found to result in increase in fertiliser use by 9 kg. It was observed that the few farmers who had completed college and were formally employed

[7] Plot: this refers to the cultivated land/farm that farmers applied fertilisers to.

invested the more in fertilisers. Their usage of fertilisers was informed both by the economic advantages- salaries- that came with higher education and formal employment, which was as anticipated; and also, by their knowing the appropriate rates and timing of application. Similar findings have been reported in Nasrin and Bauer (2016); and (Bacha, Aboma, Gemeda & Groote, 2001)

Off-farm work was significantly associated with fertiliser uptake. However, this was negative, as farmers who do not have alternative sources of livelihoods in addition to farming were found to use 45 kg of fertiliser more than their counterparts. This means that having multiple streams of income does not necessarily translate into more investment in farming- a proposition that was made at the outset. The reasons for this were not explored in this study; however, one can safely speculate that for such people, farming is subordinate to the alternative job- probably done to meet the food requirements of the family. This finds meaning in an exposition in Ellis (1998): when the expected marginal returns of labour for engaging in farming activities is less than the likely returns for similar time expended on off-farm/non-farm activities, "then the household is better off switching that individual into off-farm or non-farm activities", partly stemming from latent social rules that engender the inclusion/exclusion of individuals in some income generation activities (p. 12). However, other studies show that alternative source of livelihood is positively related to fertiliser use (Asesina, 1996; Nasrin & Bauer, 2016).

Livestock was also significantly and positively related with fertiliser uptake. However, a negative relationship between livestock and fertiliser use has been reported in other studies (Akpan et. al., 2012). A unit increase in livestock is observed to be associated with 3.2 kg of fertiliser use. In explaining why they kept pigs[8] for example, most women gave two major reasons: to sell and invest on their farms; and to pay children's school feels. It was clearly evident that livestock plays important role in women's lives in particular. While cattle, sheep, and goats rearing from their narratives, appeared to be diminishing- because of theft and other reasons- that of piggery which was within the domain of women was reported to be relatively stable. However, fewer households reported keeping more than five pigs.

[8] Women mostly kept pigs, and this was on free range. Cattle, sheep, etc. are reared by men. For women, it was amongst other things, less expensive to raise pigs, as they only fed them with food residues which they have control over within the household.

The narratives of women show that the sale of pigs usually coincided with the start of the farming season. They usually sell them at this time of the year to pay for the ploughing of their plots. By doing this, they free resources from other sources- sale of farm produce, for example, - that are then used to purchase fertilisers later in the farming season. In this way, it could be stated that, money from the sale of livestock (the case of women as observed in this study) affects the purchase of fertilisers indirectly.

The distance of household to plot: Most farmers lived at least 4.2 km (*SD*=2.7) away from their plots. The relationship between *the distance of household to plot* and fertiliser usage was significant. However, this was observed to be negative. The prediction that the farther the plot is to the household, the lesser the use of fertiliser is thus supported. However, aside the assumptions that informed this prediction, the narratives of farmers revealed other reasons why this was the case. Working on distant plots, according to them, was frustrating. They complained of unpaved pathways and insects (mosquitoes, especially) amongst others, that make it difficult for them to attract farmhands. Farmers with distant plots were therefore more likely to grow more of other crops- pearl millet in particular- and they do not apply fertilisers to this crop[9]. Distant plots are the last to be harvested (November/December) – this is when they could get farmhands, including voluntary help from neighbours. Having maize which is the crop they mostly apply fertilisers to, on distant plots, was thus less attractive, because, in the words of one of the farmers, "you have to harvest it [maize] when everyone in the village is harvesting theirs. So how do you get help?"

Size of plot fertiliser was applied (the cultivated area per farm): The relationship between this and fertiliser uptake was significant, but inverse. The results show that a unit decrease in plot size results in increase in fertiliser uptake by 36 kg. This observation shows that farmers with smaller lands seek to increase output through intense fertiliser use. This finding parallels with that of Nasrin and Bauer (2016)**.** In their study in Bangladesh, among farmers surveyed, it was farmers with the least land holdings (marginal farmers) who used fertilisers the most. Also, Seck (2017, p. 10), observed the same in Senegal, and concluded that this was in line with the "peasant mode production" hypothesis which stipulates that small-holder farmers are inclined to use more input per hectare compared with farmers with relatively large farm holdings. However, Bacha et. al. (2001), observed in Ethiopia that the probability of using fertiliser increases by about 82% for every extra hectare of maize cultivated.

[9] They often expressed that 'every crop must have its fertilisers', but they have never bothered to know what is appropriate for this crop, let alone attempt to apply fertilisers to it.

Fertility level of plot was also significantly related to fertiliser uptake. Fertility was more qualitatively determined, since it was based on farmers' perceptions of their plots. However, giving that households are resource constrained and would most likely allocate resources rationally; it would not be surprising if farmers' perceptions of the quality of their plots inform their fertiliser usage decisions. Hence, this finding that a unit increase in perceived soil fertility results in decrease in fertiliser applied to plot by 31 kg, could be trusted. A similar finding is reported in Zhou, Yang, Mosler and Abbaspour (2010)**.** But on the contrary, Adesina (1996); and Nasrin and Bauer (2016) reported that higher perception of soil fertility is associated with more fertiliser use.

Risk: A likert scale was used to determine risk. The scale had five items with a maximum score of five for each item. The composite scores of respondents on the five items were computed and summed up. The reliability of the items as a measure of risk was high (**α** = .854). The relationship between risk and fertiliser uptake was very strong (p = .0033). The hypothesis at the outset is thus confirmed. A unit increase in risk is associated with reduced fertiliser uptake by 6 kg. As it can be seen in figure 7 below, three of the items with the highest ratings- post-harvest prices, crop failure, and credit- were rated similarly by households. Drought was the least rated, and it meant that, it represents the least risk farmers contemplate over before using fertilisers. But there are indications that drought could be ranked very high as a risk by farmers. For example, it is reported that drought could put farmers in a quandary, vis-à-vis fertiliser use: they either have to postpone fertiliser application until conditions become better; or they may altogether suspend it for a planting season.

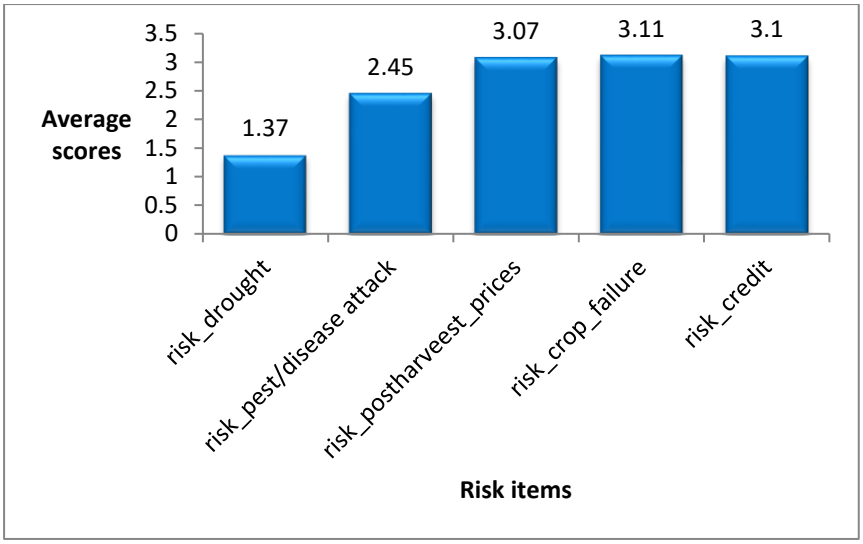

Figure 7: Farmers' risk perception on 5 items that affect their uptake of subsidised fertilisers (source: Field data, average scores of items).

With regards to credit in particular, farmers' narratives show that their ratings were informed by events of the previous years (2016 farming season in particular).Some farmers, especially women, received an average of five bags (250 kg) of fertilisers from a not-for-profit organisation in the 2016 farming season. They were to pay with their harvest at the end of the farming season. But it appears there was a miscommunication in the quantities of maize they were to pay back. For each bag (50 kg) of fertiliser and associated complementary inputs received, beneficiaries understood they were to pay back 150 kg of maize after harvest. But at the time of harvest, it became clear to them that they were rather to pay more than that. According to them, this caused mass default; and consequently, the organisation involved the police, leading to the arrest of several defaulters. This incident was widely recounted in all the communities surveyed, though none of those sampled reported being a beneficiary of the programme or a victim of the police arrests. However, there was manifest circumspection regarding what they often said, "take and pay later" (credit). In explaining why he is scared of credit or any of its forms, an elderly man interviewed expressed that:

> *My wife did not get the fertilisers. She was told that her name was not in the list they had; hence, they could not give her any fertilisers. But many women received it, especially widows. But as I am telling you, for those who received it, when it was time for them to pay back with their harvest, for the cost of the fertilisers, it became a tug of war* [the resistance and subsequent arrest of defaulters by the police was described as war].

From the narratives of farmers, it was also observed that some women did register for more fertilisers than they needed. In this way, the passed the excess bags of fertilisers to other women who were not registered. Others also sold the fertilisers and used the money for other purposes. What caused this was that, some beneficiaries thought that, since 2016 was an election year, it was possible the incumbent government was using this as a ploy to buy votes in the area; hence, if they did not repay after harvest, the government, very interested in their votes, would not be interested in pursuing defaulters. This narrative shows the dilemmas of giving or receiving credit. It indicates the need for clarity in credit policies; the need for more conflict-free credit recovery mechanisms; and above all, the depoliticisation of interventions.

The relationship between *household debt/liabilities* and fertiliser uptake was not significant at 0.05. But it could be observed that it is fairly significant (p = .1) with a negligible marginal effect: a unit increase in debt only decrease fertiliser uptake by less than 1 kg. There was great variability in debt among households- mean debt was GH¢139 (*SD*=179) per household[10].The debts most households reported were less related to food purchases- an indication that previous harvests have been enough for most households to depend on; and they were also less related to health and education bills- partly because of the national health insurance scheme that is place and the recent free secondary education programme respectively. In the most urbanised town that was included in the study, debts reported were mostly with respect to electricity bills; and in the two outlying villages, it was basic household maintenances and funeral performances amongst others.

Household size: The mean household size was 6 (*SD* = 4). It was hypothesised that an inverse relationship exist between household size and fertiliser use, such that, the usage of fertiliser decreases with increases in household size. The result suggests clearly that no such relationship exist: a unit increase in household size rather increase fertiliser uptake by 2 kg. Though this was positive, it was still extremely weak (p = .48). But in a separate analysis, where household size was regressed as the only independent variable against the dependent variable, a significant relationship was observed (p = .0041). The relationship between these two variables is thus attenuated by the addition of some variables in the model.

Distance of household to inputs market: Most farmers lived at least 2.64 km (*SD*=2.56) away from the nearest markets from which fertilisers are sold. It was found that this variable was not important as far as the uptake of subsidised fertiliser was concerned (p = .72). An increase

[10] The equivalent of the mean household liabilities is $25 (XE Currency Converter, 13/03/19).

in distance by a kilometre would result in increase in fertiliser use by just 1 kg. This suggests that location- urban or rural- is not important in fertiliser usage. Farmers expressed that, with the proliferation of "motor kings", a type of tricycle that was ubiquitous everywhere I went, getting fertilisers to the homestead was not an issue for them. This view was contrary to the assumption that informed my prediction concerning fertiliser uptake and location prior to the survey. Even in a separate analysis, where this variable was regressed as the only variable against the dependent variable, the hypothesis was still rejected at a similar statistic ($p = .79$).

By dividing the sample into *male and female headed households,* with the latter being the reference category, it is observed that the mean difference in subsidised fertiliser uptake between the two groups is 18.50 k***g.*** This supports the prediction of the study initially stated; and similar findings have also been reported (Akpan et. al., 2012). However, considering that male headed households were overly represented (50 more than females), it is important that this particular finding is taken with caution, as a more balanced representation of both gender can bend this observation in any direction. When the sample was also divided into households with *youthful and older* heads, with the later being the reference category, the mean difference in fertiliser uptake between the two is 4.50 kg. This also supports the study's prediction. However, some studies show that fertiliser usage increases with age (National Statistics, 2017; Akpan et. al., 2012).

Ownership of means transport: Twenty-eight (28) households reported owning motorbikes (no household had a car). They ownership of these motorbikes was not related to fertiliser use and this was contrary to the prediction at the outset. In fact, those without means of transport rather used 2.5 kg of fertiliser more than their counterparts. This gives meaning to the assertion of farmers previously stated- the fact that with the presence of "motor kings", transporting fertilisers to the homestead and to farms was not a significant issue to households. The sale of fertilisers on strategic market days, could have also partly brought fertilisers closer to farmers leaving far from fertiliser retail shops, and probably made 'means of transport' not particularly significant in fertiliser uptake.

The use of complementary inputs on plot: Farmers who used complementary inputs, such as weedicides and pesticides, were found to have used 26 kg of subsidised fertilisers more than those farmers who did not use any of these inputs. However, larger plots were associated with more input use. This appears logical, inasmuch as weed control is largely done manually in

the area- with the use of hoes- and it may not be feasible or effective as the plot size increases.

Traditional farming practices: Part of this has been addressed in the beginning of this chapter. Households with traditional farm management practices used 13.50 kg more than their counterparts who reported not applying any cultural practices on their plots. As indicated earlier, crop-rotation and intercropping are the two important cultural practices in the study area. Because farmers with smaller plots were found to use more fertilisers than their counterparts, a separate analysis was also done to see the relationship between employing cultural practices on farm and farm size. The results indicated that households that employed traditional practices owned 0.2 hectares of plots less than their counterparts- an indication that, large plot owners rely less on traditional farm management practices.

Satisfaction of farmers with the 2018 subsidy programme: This was ascertained using a likert scale with five items and a maximum score of five for each item. The composite scores of respondents on the five items were computed. The number of complete observations was 100. The reliability of the items as a measure of satisfaction was relatively weak (α = 0.673). There was no single statistic (inferential) stating farmers' satisfaction and how that is related to fertiliser uptake, since this was dropped because it strongly correlated with another explanatory variable, risk. It would therefore be appropriate to interpret this observation by looking at the aspects of the subsidy programme that farmers were satisfied with. As it can be seen in figure 8 below, the average scores of all the items were each below this maximum expected score of five (5).

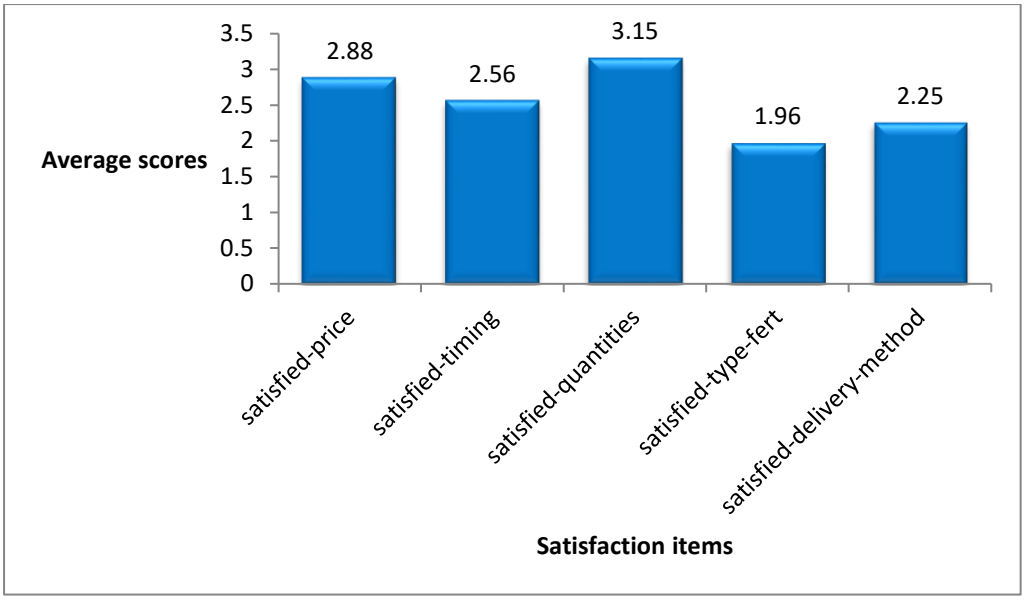

Figure 8: Farmers' satisfaction levels with 5 items related to the fertiliser subsidy programme (source: Field data, average scores of items).

The aspect of the subsidies that farmers were most satisfied with is the quantities of fertilisers they were permitted to buy- the subsidy covered famers with up to five hectares of land; this was therefore not surprising, since most of the households farmed less than two hectares. Aside this, satisfaction levels with the other items did not differ significantly from each other. However, average satisfaction scores with the prices that subsidised fertilisers were sold, and the time farmers got to know about the prices, including the time they were available in the locality, were each more than half the possible score of five. The average satisfaction scores with the type (brand) of fertilisers subsidised and that of the accessibility method (delivery method), were each less than the half the possible score of five. The delivery method in large measure was responsible for the relatively higher quantities of non-subsidised fertilisers used by farmers.

Also for the delivery method, there was a particular development in the farming season, which many farmers complained bitterly about how it nearly caused chaos in their farming activities. The initial condition, from the Ministry of agriculture, which accompanied the subsidy programme, was that, farmers were required to buy improved seeds before they could access subsidised fertilisers. This development is summed in the words of a Technical Adviser at the Ministry of Food and Agriculture to distribution agents in one of their training workshops:

> *For this year's planting for food and jobs programme, farmers can get seeds at only the District Agric offices, but that of the fertilizer can be gotten at both the district offices and fertilizer distribution agents. Any farmer who wants to buy fertilizer at subsidized rates must first go to the district Agric offices to buy seeds at a subsidized rate before you can get coupons to purchase the subsidized fertilizer. If a farmer does not buy seeds he or she will not get a coupon. If you don't get a coupon, you don't get fertilizer. In short, no seed, no coupon and no coupon, no fertilizer*. (Awuni, 2018, April 26).

This complementary initiative was in line with the suggestion that if "...fertiliser subsidy programmes are to help farmers improve their use of fertiliser then this requires subsidised provision of...crop varieties" (Dorward, 2009, p. 13). Though this directive was later marked down, it did caused dissatisfaction among farmers regarding the subsidy programme. Almost every farmer had selected their seeds for planting in the previous year. This is the practice. The purchase of seeds was seen as an extra cost on farming. Others expressed uncertainty about the potential yield, suitability to their plots, and the maturity period. There were yet others who had already planted before they heard the directive. The disorder that then ensued fed into farmers' satisfaction with the subsidy programme in 2018.

Chapter 6: Conclusion and recommendations

The purpose of this study was to understand the factors that affect the uptake of subsidised mineral fertiliser in the Bunkpurugu-Yunyoo district of the northern region of Ghana through the mixed method of inquiry. The subsidy programme was re-introduced in 2008 and went through peaks and valleys in the ensuing years. But in 2017/8, it was apparently hauled up on the banner of 'planting for food and jobs'. This study, therefore, sought to understand the factors that affect the uptake of subsidised mineral fertilisers under this supposed revitalised subsidy regime and the challenges associated with it. The addition of qualitative aspect which studies addressing this topic seldom included was equally important for sharing lights on some quantitative observations.

In the early years of the fertiliser subsidy programme, the major challenges of limited retailers; and limited supplies leading to field officers using discretionary measures to discriminate against some farmers by giving coupons only to their favourites- in most cases, political party loyalists (Mustapha et al., 2011; Banful, 2009)- appears in large measure to have dwindled. The apparent diminished discrimination in particular was the result of the large quantities of the subsidised fertilisers disbursed in 2018. This suggests that, for small-holder farmers to optimally access subsidised inputs, the inputs in question need to be supplied as much as possible, abundantly. This could make discrimination often associated with input subsides, difficult.

However, it was observed that some of the previous challenges associated with the subsidy programme have taken different forms, though they did not affect farmers' access to the right quantities of fertilisers. There was a divergence between the fertiliser subsidy official implementation procedures and actual implementation procedures. The official system for accessing subsidised fertilisers was the use of coupons, however, this was ignored in favour of a procedure where farmers were verified through official identity documents (voter's ID cards, etc.) and fertilisers issued to them after they had also paid the component of the fertiliser prices that farmers were supposed pay.

Coupons were seldom issued to farmers. They were reported to have been turned into commodities for sale to fertiliser retailers in the district by local political party leaders and some agric officers. This act was and/or is a blatant illegality- the coupons were to be issued free of any charges and by only authorised field agents. For every bag of fertiliser a retailer

received from a distributor, they were expected to return a coupon to the distributor. Where a retailer could not fulfil this, they were expected to pay an amount equal to the face value of the coupon to the distributor. Because retailers wanted to avoid this, they yielded to the purchase of the coupons. In the process, retailers appeared to have been the main losers in the 2018 fertiliser subsidy programme, since in some instances, the price at which retailers bought a coupon exceeded their expected profit on a bag of fertiliser. The sale of coupons, if continued, has the potential to undermine the subsidy programme. For example, if retailers continue to buy the coupons, they could decide to inflate the cost of fertilisers sold to farmers which could negatively affect their uptake of fertilisers. Also, it could discourage new retailers from entering the fertiliser distribution market; and retailers currently in the market could be discouraged from investing more in the distribution of fertilisers.

The challenge with the coupons, as indicated above, though undesirable, rather helped the farmers: farmers simply used their voter identity cards to access fertilisers, which to them, was more convenient compared to the tussle involved in securing coupons from unstationary extension officers. Some farmers, nonetheless, did not get the specific brand of fertilisers they wanted. This was because of the unequal quota given to the fertiliser marketing companies. This uneven quota resulted in the use of conditional sales to supply subsidised fertilisers to retailers. It equally resulted in some farmers using non-subsidised fertilisers, obviously raising their cost of production. The unequal quota, it can also be stated, produced winners and losers among the major distribution companies.

A number of factors were found to have strong significant relationship with fertiliser uptake. Among these, it was only education and the ownership of livestock whose relationships with fertiliser uptake were positive. The same has been reported in other studies (Akpan et. al., 2012; Nasrin & Bauer, 2016). These two variables are strong indicators of socio-economic status: livestock directly convertible into cash (wealth); and education, indirectly through employment, affects household income (wealth), the basis of how much of agricultural inputs households can command. The direct effect of education on input use and adoptions of various forms is also often discussed with respect to the role of knowledge, where the more educated people are, the more they understand systems and how to use inputs, leading to better adoption (Deressa et. al., 2009; Akpan et. al., 2012)

The other significant factors had negative relationship with fertiliser uptake. The finding relating to off-farm work which was one of them contrasted with what is reported in other

studies such as Asesina (1996) and Nasrin and Bauer (2016). It may be that when people have alternative sources of income, they may invest less in farming- they may farm just enough to provide for their household staple requirement. This is likely the case since it is very common to find people who prefer not to farm at all, and only buy staples for their households after harvest. Those who are more likely to do this are found among the working class. It also means that farming is considered as an occupation for individuals without other forms of livelihoods, such that, as individuals find alternative jobs, they begin to disengage from farming, leading to less and less use of inputs.

Two other factors with significant but negative relationship with fertiliser uptake directly related to farmers' plot characteristics. They were the fertility level of plots and the size of the plots fertilisers were applied to. The negative association between the sizes of the plots fertilisers were applied to and the units of fertilisers used, mirrored 'peasant mode production' well articulated in Harrison (1977) and Carter (1984). Under this mode of production, input use per hectare tend to decrease as farm size increases, and vice versa. This proposition is near universal that they have been reported in many studies, for example, Seck (2017) and Nasrin and Bauer (2016). For soil fertility and fertiliser uptake, the relationship was instructive, since fertilisers improve soil fertility; and farmers should be expected to use it in accordance with the fertility level of their plots.

The last two factors with significant but negative relationship with fertiliser uptake were risk and the distance of plot to the homestead. The most common explanation relating to distance of farm to the home and fertiliser use intensity has always been the difficulty of transporting fertilisers, due to their relatively heavy nature. In poorer societies, with bad or no access roads leading to farms, as it was the case in this study, the finding here should be little surprising. But what was observed aside this, was that, engagement with farms in general decreases as the distance between it and the home increases. The difficulty of mobilising farm-hands to work on distant plots, it was noticed, was another limiting factor for the under-exploitation of distant farms, accounting for low investment in inputs, including fertilisers.

The finding that higher risk is associated with lower use of fertilisers need to be taken cautiously, especially when the five risk items used here were not tested individually to determine their relationship with fertiliser use. It is for instance, posited that, farmers who are net sellers- those who sell more than they buy- tend to lose if input subsidies result in lower food prices after harvest (Dorward, 2009). Taken one of the risk items, post-harvest prices,

for example, it means that those farmers who are net sellers and those who are net buyers may identify differently with this: for net sellers, an anticipated fall in post-harvest prices could be considered a higher risk to invest resources in farming, hence, probable use of less subsidised fertilisers; for net buyers, expected higher prices may be considered a high risk, in this case, it may be considered prudent to produce more for the household to avoid buying staples at higher prices after harvest, hence, probable use of more subsidised fertilisers.

There was virtually no relationship between the distance of the household to the fertiliser shop and the quantities of subsidised fertilisers farmers purchased. The expansion of the retail network for subsidised fertilisers; the sale of subsidised fertilisers on the market days of strategic communities; and the proliferation of tricycles (called 'motor-king') with minimal charges for carting goods, breached the distance between the farmer and fertiliser selling points.

The uptake of fertilisers was highest in male headed households. This has been reported in numerous studies; and given the dominance of the male gender in many social domains in the area, the result was as one would have speculated. A parallel to this was the age bracket of the heads of households, and those considered as 'younger heads' relatively used more fertilisers than their counterparts. Based on non-separability in agricultural households, one would have expected a strong relationship between the debts households owed others and the quantities of fertilisers they purchased- the same household income is assumed to be used to settle debts owed others and to purchase fertilisers, hence, as debts increases, the capacity of households to purchase fertilisers should reduce. But this relationship, though existed, was weak.

The uses of complementary inputs and cultural practices on farms were found to be positively associated with fertiliser uptake. But these relationships were very weak. Of all the variables that recorded such weak relationships with fertiliser uptake, it was 'ownership of means of transport' that recorded the weakest relationship. A number of reasons may account for this. As indicated, some factors breached the gap between farmers and fertiliser selling points, weakening 'means of transport' as a challenge to accessing fertilisers. Also, means of transport would have played significant role under the cultivation of distant farms. But farmers tended to under-cultivate such farms, citing difficulty of attracting farm-hands.

6.1. Recommendations- further studies

A number of issues were identified as needing further investigation to add more knowledge to this topic. They include the following:

1. How fertiliser subsidy programmes produce losers and winners in the distribution chain.
2. Measures of risk associated with subsidised input use could be tested or investigated individually.
3. Having an alternative job appears to be related to reduced engagement in farming. This could be investigated further: why is it so? At what point does this set in?

6.2. Recommendations- policy

1. The bottlenecks within the fertiliser distribution chain- the unethical sale of coupons to retailers and the unequal quotas given to distributors- need addressing to encourage more players to participate in the supply and distribution of fertilisers.

2. The timely disbursement of subsidised fertilisers is needed to reduce the amount of non-subsidised fertilisers farmers use in addition to the subsidised fertilisers.

3. It appears there is too much political involvement in the administration of the fertiliser subsidy programme. This could undermine the authority of authorised agents, especially administrators and agricultural extension officers. The resolution of this is important not only for the effective running of the programme, but also, for the effectiveness of these agents in the provision of other agricultural services in the district. More efforts are therefore needed to reduce the level of political interference and to allow agricultural officers to freely execute their mandate.

4. Education on the use of complementary inputs, especially improved seeds: farmers rejected the purchase of improved varieties of seeds as a pre-condition for the purchase of subsidised fertilisers because this appears to have been forced upon them without prior education on the significance of using such seeds. In addition, such complementary inputs need to be available before the start of planting. It is important that this is ensured because studies already suggest that, in the Northern part of

Ghana, “Plots with improved seeds ... [have] a 22% higher likelihood to yield above average” (Schieterle & Birner, 2018, p. 8). The complementary inputs (seeds) should therefore be allowed to continue and be promoted, because it holds the potential to increased output and food self-sufficiency in the region.

6.3. Limitations of the study

The study did not collect household data concerning farming activities in the previous year. Such data would have help to understand a number of trends in their response to the subsidy programme. For example, changes in the uptake of fertilisers and yields. Data from at least two different farming seasons would have placed the findings reported here in perspectives, for example, how farmers’ motivations to use subsidised fertilisers vary with changes in some underlying variables. But it is important to point out that, it was initially anticipated that, collecting such data would be constrained because most farmers do not keep records in written formats- because most of them are not educated. This was validated on the field, as it took most respondents some time to provide information pertaining to the current year.

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Appendix 1

Item-Total Statistics (Risk)

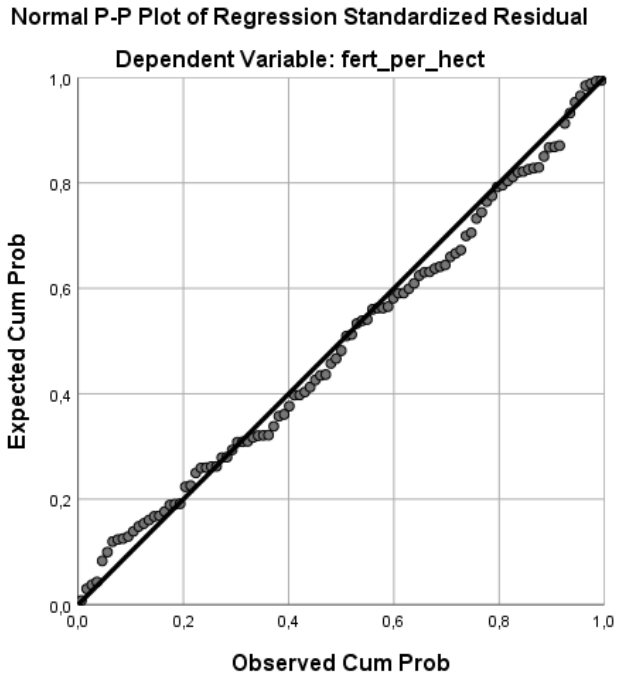
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
risk_drought	11,50	31,441	,397	,888
risk_pest/disease_attack	10,44	26,843	,772	,799
risk_postharvest_price	9,83	24,794	,753	,800
risk_crop_failure	9,79	26,066	,735	,805
risk_credit	9,80	26,337	,706	,813

Appendix 2

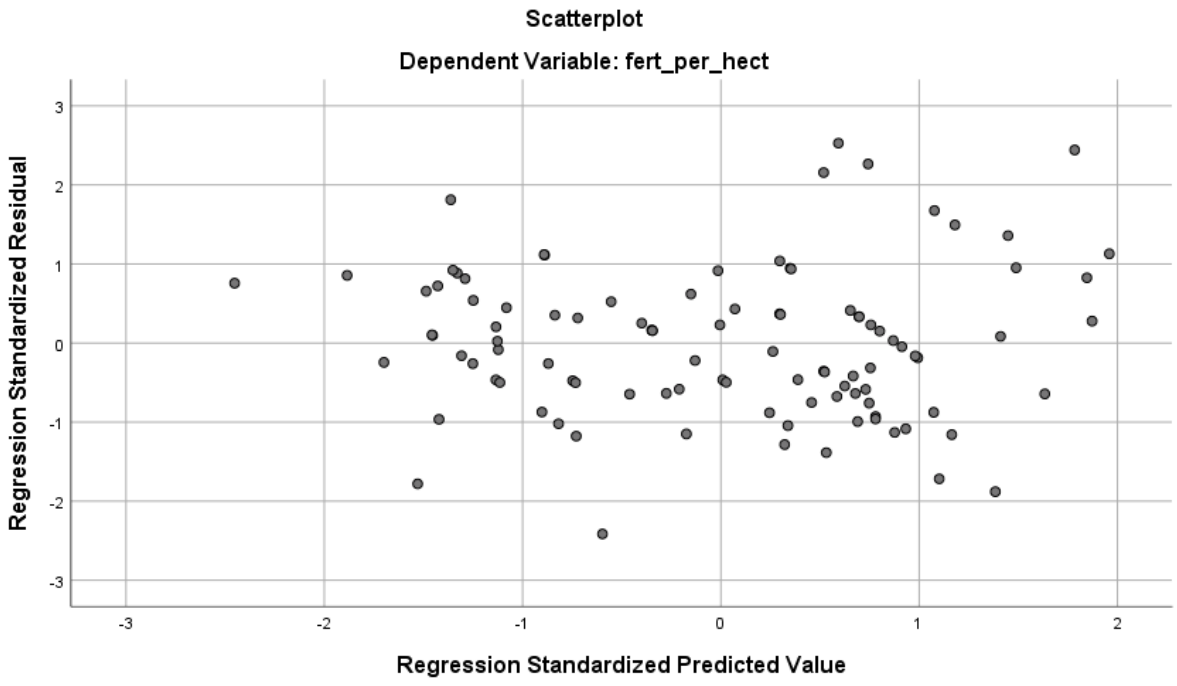
Item-Total Statistics (satisfaction)

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
satis_price	9,84	13,530	,427	,621
satis_time	10,16	12,984	,468	,602
satis_quantities	9,54	12,029	,600	,535
satis_types of fert	10,77	17,027	,211	,698
satis_methods	10,45	13,785	,425	,622

Appendix 3



Appendix 4



Appendix 5

```
> summary(RegModel.3)
Call:
lm(formula = fert_per_hect ~ altternativeLivelihood + dist_to_fertshop + dist_to_plot + education + houseSize + indebtedness + inputs_used + livestock + male + plot_fert_applied + risk + soilfertility + trad_farm_method + transport_has + youthful_age, data = corrected)
Residuals:
     Min       1Q   Median       3Q      Max
-158.206  -36.526   -2.167   35.929  152.863
Coefficients:
                       Estimate Std. Error t value Pr(>|t|)
(Intercept)            378.02310   45.97112   8.223 2.17e-12 ***
altternativeLivelihood -45.17304   18.30588  -2.468  0.01563 *
dist_to_fertshop         1.03156    2.86271   0.360  0.71949
dist_to_plot            -5.75616    2.93905  -1.959  0.05349 .
education                8.90771    1.76011   5.061 2.42e-06 ***
houseSize                1.79567    2.50252   0.718  0.47503
indebtedness             0.06676    0.04172   1.600  0.11334
inputs_used             26.36301   19.22797   1.371  0.17400
livestock                3.16646    1.25125   2.531  0.01325 *
male                    18.49965   18.79884   0.984  0.32790
plot_fert_applied      -35.82996   11.07403  -3.235  0.00174 **
risk                    -6.01181    1.98854  -3.023  0.00332 **
soilfertility          -31.28316    6.82618  -4.583 1.58e-05 ***
trad_farm_method        13.45802   14.30485   0.941  0.34950
transport_has           -2.46291   24.82173  -0.099  0.92120
youthful_age             4.47146   15.32961   0.292  0.77124
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Residual standard error: 62.24 on 84 degrees of freedom
```

```
  (2 observations deleted due to missingness)
Multiple R-squared:  0.7837,     Adjusted R-squared:  0.7451
F-statistic: 20.29 on 15 and 84 DF,  p-value: < 2.2e-16
```

Appendix 6

Survey instrument

1. Gender [0] Female [1] Male
2. Age [**1**]16-24 **[2]** 25-30 **[3]** 31-39 [**4]** 40-49 [**5**] 50-60 [**6**] 61+
3. Years of schooling [ ]
4. Total **number of people in household** [ ]
5. Household members aged 15 and above [ ]
6. Number of **children in secondary school** and above [ ]
7. **Ownership of plot(farm)** (**1**) It is my family land (**2**) Rented land (**3**) Gift
8. **Major occupation** in addition to farming [**SKIP if faming is the only occupation**].....
9. Money owed others before the start of the farming season [**use and enter quantities of fertilisers the family could have bought at that time to estimate this**] [ ]
10. Do you belong to a farming cooperative from which you obtained farming inputs? **(0)**Yes **(1)**No

11. In the table below, select those that to apply to you. State name and number of **livestock**.

Livestock		**Transport means**	**Sources of resources invested in farming**	**Nature of Hse.**
1	[ ]	1. Car/tricycle	1. bank	1. block
2	[ ]	2. motorbike	2. Friends	2. bricks
3	[ ]	3. bicycle	3. cooperative	3. mud
4 None		4. none	4. sale of farm produce	
			5. salary	
			6. own/family savings	

12. Farm information- for **Distance(km)**, the reference point is the farmer's house

Acres cultivated	**Distance to plot**	**Distance to fert. shop**	**distance-food mket**

13. **Subsidised** fertiliser used **NPK**[ ] **Ammonia**[ ] **Urea**[ ] **Tota**l [ ]
14. **Non-subsidised** fertiliser used (**if any**).....[ ].....[ ].....[ ] **Total**[ ]
15. What type of fertilisers do you wish the government had subsidised?.....
16. [**For those who used non-subsidised fert.**] what were your main reasons for this? **(1)**could not get subsidised fert. **(2)**good timing **(3)**flexible payment **(4)**ease of access (**5**) those fertilisers were not subsidised

17. On a scale of **1** to **5**, with **5** being the highest, rate your **satisfaction** with the following:

Price of the subsidised fertilisers**[ ]** The **time** you obtained them**[ ]** The **quantities** you were permitted to buy**[ ]** The **types** of fertilisers subsidised**[ ]** The **methods** used to distribute**[ ]**

18. On a scale of **1 to 5**, grade the **fertility** of your plot [**5 as most fertile soil**] [ ]

19. Farming method**[if this is deliberate and part of soil fertility management**]

(1) Mixed farming **(2)** Intercropping **(3)** Shifting cultivation **(4)** Crop rotation **(5)** Land rotation (6)None

20. Use of **manure [if this applies to a substantial portion of the plot**] **(0)**Yes **(1)**No

21. Types of **crops planted** [**maximum 3**] Maize **[1]** millet **[2]** Groundnuts **[3]** soybeans **[4]** Rice **[5]** beans**[6]** Vegetables **[7]** other**.....[ ]**

22. For the above crops, state those you applied fertilisers to, and the quantifies you harvested (in bags).....[ ].....[ ].....[ ]

23. Size of plot **in acres** allocated to the above crop(s).....[ ].....[ ].....[ ]

24. Did you **expand** your plot size in **[Q23]** the just ended farming season? **(0)**Yes **(1)**No

25. **Tillage** method (**1**)own oxen/bullocks **(2)**family labour **(3)**hired labour/bullocks **(4)**hired tractor

26. Complementary inputs used **(1)**pesticides **(2)**herbicides **(3)**seeds **(4)** None

27. **Risk** factors that influenced the quantities of fertilisers used[**rank them from 0 to 5, 0 means not a risk; 5 is high risk**] drought**[ ]** pest/disease attack**[ ]** post-harvest prices**[ ]** crop failure/poor yield**[ ]** credit**[ ]**

28. How did you perceive **post-harvest prices** of major crops before using fertiliser? **[this question applies to those who entered more than "0" for "post-harvest prices"**] **(0)** Lower, relative to prices of fertilisers **(1)** higher, relative to the prices of fertilisers

29. Rate how the following, concerning alternative crops that **do not require/require less** fertiliser influenced the land you allocated for the crops that require more fertilisers? [Rate this from **0 to 5**, "**0" means not important at all, 5 is very important**] price**[ ]** yield**[ ]**

30. How important was **membership of a political party** to the chances of getting the desired quantities of the subsidised fertilisers? **(0)**it was not important **(1)**it was somehow important **(2)** it was very important

Thanks for your participation