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CONSTRAINTS TO FERTILISER USE IN UGANDA:
Insights from Uganda Census of Agriculture 2008/9

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ABSTRACT

Uganda's agriculture faces a myriad of challenges, which among others include low productivity, declining soil fertility and degradation of the natural resource base. To reverse and/or minimise the challenges, judicious use of fertilisers – both organic and inorganic is highly recommended. Yet, few agricultural households in Uganda use fertilisers and moreover, in quantities lower than the recommended. Using data from the Uganda Census of Agriculture 2008/9, this paper provides insights on key constraints to the use of fertilisers by agricultural households.

Results indicate a spatial dimension in agricultural household use of fertilisers, implying spatially targeted rather than blanket interventions will be pertinent in the campaign to promote fertiliser use in the country. While the majority of farmers in Uganda do not use fertiliser due to high cost, results also indicate that lack of information and technical advice related to use of fertiliser- due to the low level of extension services outreach in the country, greatly impacts on adoption of both organic and inorganic fertilisers. Results further suggest that access to production-support services and facilities such as credit, irrigation and storage as well as ease of access to input and output markets significantly impact on fertiliser adoption. Finally, physical assets and human capital are important in the decision of agricultural households to adopt fertiliser.

Key words:

Fertiliser use, Constraints, Uganda Census of Agriculture

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1. INTRODUCTION

Food security and nutrition in Uganda remain precarious despite a decade of government interventions - through the Plan for Modernization of Agriculture (PMA) to transform agricultural production from subsistence to modern farming. Ssewanyana and Kasirye (2010) indicate that over two-thirds of the country's population are food insecure, and the number at risk is likely to increase considering the fact that average agricultural production growth for the past five years remains low (about 1.2 percent per annum) compared to 5-year average population growth of about 3.2 percent per annum. The population of Uganda, estimated at 32.9 million in 2011, is projected to grow to 89 million in 2037 (Population Secretariat 2010). The rapid population growth in the country has led to unprecedented increase in the demand for land for cultivation, food and wood for energy. This has serious implications on agriculture as well as the environment. Henao and Baanante (2006) indicate that approximately 70 percent of deforestation in Africa is a result of land clearing for cultivation.

Low productivity, declining soil fertility coupled with low use of improved inputs such as fertiliser, among other factors are cited in the Development Strategy and Investment Plan (2010/11-2014/15) of the Ministry of Agriculture Animal Industry and Fisheries (MAAIF) as one of the key challenges to increasing agricultural output in Uganda (MAAIF, 2010). One way to address the twin problem of low agricultural productivity on one hand and environmental degradation on the other is fertiliser use –both organic and inorganic, especially in low income countries where fertiliser use is lowest (Smaling *et al.,* 2006). Inorganic fertiliser use in grain production, for example, can increase output by 40-60 percent (Roberts, 2009). Application of organic fertiliser from animal and/or plant residues on the other hand provide some nutrients besides playing a crucial role in improving soil moisture conservation, especially when combined with conservation tillage practices that protect soil structure, reduce erosion and runoff,and promote soil biological functions important for soil productivity (Agwe *et al*., 2007). Nonetheless, a combination of organic and inorganic fertilizer for integrated soil fertility management is the most ideal in increasing yield while maintaining long term soil fertility (Alley and Vanlauwe, 2009).

Indirectly, use of fertilisers lead to higher economic growth and poverty reduction through increased agricultural productivity and output (Dethier and Effenberger, 2011). This is particularly more evident in Sub-Saharan Africa (SSA) countries where agriculture is the primary sector and source of livelihood to the majority of the population (World Bank, 2007). Indeed recent empirical evidence from Uganda (such as Senoga and Matovu, 2010) has demonstrated that increasing agricultural output and productivity leads to higher growth of the gross domestic product and accelerates poverty reduction.

On the environmental front, agricultural intensification – where a farmer gets more output from the same piece of land by using high yielding inputs including fertiliser, reduces forest cover loss and promotes biodiversity (Smaling *et al.,* 2006). Nevertheless, if not well managed, long-term use of fertiliser –whether organic or inorganic, results in inefficiencies of input use, leading to soil degradation, lower productivity and potential damage to the environment (FAO, 1994; Ju *et al*., 2007).

Despite the benefits, use of fertilisers in crop production in Uganda remains low. Available facts indicate that, on average, a Ugandan farmer uses less than 1 kilogram per hectare per annum of inorganic fertiliser. This is despite the fact that Uganda is one of the countries in the world with the highest level of soil nutrient loss (Henao and Baanante, 2006) and a signatory to the Abuja declaration. Although Uganda is among countries in SSA that signed the Abuja declaration of increasing fertiliser use from the continent average of 8 kg per hectare to at least 50 kg per hectare per annum by 2015, (African Union, 2006), there is little or no indication of a policy push to increase fertiliser use in the country. According to Smaling et al. (2006), unless radical interventions occur, projected inorganic fertiliser consumption growth in SSA until 2030 will remain at 1.9 percent per annum.

A review of previous literature reveals few national-level studies on adoption of agricultural technologies in Uganda. Most of the studies (such as Bekunda and Woomer, 1996; Pender *et al*., 1997; Okello and Laker-Ojok, 2005; Sserunkuuma, 2005; Sserunkuuma, 2007) that have been conducted in the country were not national. One of the few studies that were national is Deininger and Okidi (2001) that used UNHS 1992/3 and 1999/2000 data to examine factors influencing demand for improved seed and fertiliser. The other study on technology adoption that was at national level –though biased towards the districts where NAADS was working, was by Benin et al. (2007). Limited access and/or unavailability of nationally representative agricultural related information in the past may have hampered undertaking such studies. Thus, using data from the Uganda Census of Agriculture (UCA)[1]2008/9 collected by the Uganda Bureau of Statistics (UBoS), this paper provides insights into factors that are likely to influence a household's decision to use fertilisers (organic and inorganic). The study contributes to the understanding of appropriate policy actions that will increase the use of fertilisers by agricultural households and ultimately increase productivity in the agricultural sector.

The rest of the paper is organised as follows: Review of literature relevant to this study is presented in the next section. The data and methods used in the study are presented in section 3. The results are presented and discussed in section 4 prior to conclusions and recommendations in section 5.

1 Whereas traditionally a census gathers data from each and every individual observation of interest, a sampling approach - gathering data from only a sub-set of the all possible individual observations, was used in gathering UCA 2008/09 data. Additional details on UCA methodology available at: www.ubos.org/onlinefiles/uploads/ubos/.../UCAMethodology.pdf

2. REVIEW OF LITERATURE

Although use of improved technologies including improved seed and fertiliser is essential in increasing agricultural productivity, food security and reducing poverty, not all farmers in agriculture-dependent countries in SSA in general and Uganda in particular, use these inputs. Factors that influence farmers' decisions to use improved agricultural input scan be broadly categorised into economic factors and non-economic factors. Economic factors mainly focus on price, costs and/or returns to factors of production while non-economic factors include social, cultural, institutional and political factors.

2.1 Economic factors that influence technology adoption

Economic factors that influence fertiliser use among others include the price of fertiliser, price of other inputs that complement (e.g. seed) or substitute fertiliser use, price of crop output, profit and opportunity costs associated with production and marketing risks. Empirical literature suggests that fertiliser use is sensitive to changes in its price as well as the price of crops to which it is applied (Griliches, 1958;, Roberts and Heady, 1982; Ariga and Jayne, 2010). In particular, demand for a particular type/brand of fertiliser (e.g. nitrogen) is derived demand, price elastic and influenced by the price of other types/brands of fertiliser (Acheampong and Dicks, 2012). The price and/or availability of other inputs that complement and enhance fertiliser productivity – for example, hybrid seed and irrigation, also play an important role in farmer's decision to use fertiliser. Similarly, the price and/or availability of other inputs that substitute a variety/brand of fertiliser as well influence its use (Acheampong and Dicks, 2012).

The wedge between the high price of fertiliser on the one hand and low price of crops on the other, especially for farmers in landlocked countries in SSA is one of the major factors that make them reluctant to use the input. Morris et al. (2007) observe that demand for fertilizer is often weak in Africa because incentives to use fertilizer are undermined by the low level and high variability of crop yields on the one hand and the high level of fertilizer prices relative to crop prices on the other. Smaling et al. (2006) indicate for example that farmers in Africa require 6 -11 kg of grain to purchase one kg of nitrogenous fertiliser compared with about 2- 3 kg of grain in Asia.

High fertilizer prices in SSA are mostly attributed to high transaction costs of fertilizer trade arising from high transportation costs, high interest rates and low volume of purchases (Gregory and Bumb, 2006). Lack of market information about the availability and cost of fertilizer and the inability of many farmers to raise the resources needed to purchase fertilizer in bulk is cited among other factors that make farmers pay more for fertiliser (Morris *et al.,* 2007). Low farm-gate prices for crops on the other hand is mainly influenced by poor road infrastructure and lack of storage facilities as well as lack of market information (Torero and Chowdhury, 2004; Morris *et al.,* 2007).

2.2 Non-economic factors that influence technology adoption

Lanyintuo and Mekuria (2005) categorize non-economic factors that influence farmers' decisions to use agricultural improved inputs as: farmer characteristics, institutional factors and characteristics of the input. Farmer characteristics among others include sex, age, education, and household size while institutional factors include farm size, membership to association, access to information, access to credit, and access to infrastructure such as roads or storage. Characteristics of the factor input relate to the subjective attributes of the input as perceived by the farmer (Adesina and Zinnah, 1993).

Sex plays an important role in farmer use of agricultural technologies. A recent study by Nayenga (2008) indicates that use of agricultural inputs -including inorganic fertiliser in Uganda, is more prevalent in male than female headed households. In Kenya, Karanja et al., (2010) also found differences in the proportion of men compared to women household heads in Nakuru urban area using fertiliser –though the result was not significant due to sample size. In Malawi where fertilisers are provided to farmers as subsidies irrespective of sex, no significant men/ women differences have been observed with regard to use (Chirwa *et al.,* 2011).

Lanyintuo and Mekuria (2005) argue for inclusion of sex in analysis of technology adoption by observing that extension services provision, which is important in use of improved inputs, is mainly conducted by men who are biased towards fellow men and yet women are the majority in African agriculture – in particular small-scale agriculture. Additionally, inclusion of sex as one of the explanatory variables is important in the case of Uganda because; women-headed households are relatively poor compared to male-headed households (UBoS, 2010); and yet 72 percent of all employed women and 90 percent of all rural women work in agriculture (IFAD, 2000).

Studies that have examined the relationship between age and use of improved technologies in production have reported mixed results. Adesina and Baido-Forson (1995) reported a positive relationship between age and adoption of new sorghum and rice varieties in Burkina Faso and Guinea respectively. On the contrary, Kassie et al. (2010) found a negative relationship between age and use of compost manure and stubble tillage in Ethiopia. In Nigeria, several authors (Akramov, 2009; Lawal and Oluyole, 2008; and Tabi *et al.,* 2010) also reported a negative relationship between age and improved inputs use. Explanations offered for the mixed results regarding age and improved inputs use are that on one hand, young farmers may have lower income and wealth, limited access to credit and extension services, and face labour constraints, all of which may make them less prepared to adopt and use improved agricultural technologies than older farmers, hence age having a positive relationship with adoption. On the other hand, young farmers are sometimes more open to change and hence eager to try out new ways of doing things, thus a negative relationship between age and improved inputs use (Lanyintuo and Mekuria, 2005).

The role of education in farmer use of improved inputs is widely discussed in literature. Educated farmers are believed to have higher ability to perceive, interpret and respond to new information about improved technologies than their counterparts with little or no education (Lanyintuo and Mekuria, 2005; Tabi *et al.,* 2010). Relatively more educated farmers are more likely to access information and advice from extension workers, which influence their adoption and use of improved inputs. Moreover, education and the economic status of the farmer, which affects ability to buy and use improved inputs, are to a great extent positively correlated especially in developing countries such as Uganda (UBoS, 2010).

The ability of the farmer to actually buy the input is perhaps the most important characteristic, which hitherto is not well captured in the literature. According to Morris et al. (2007), even if farmers believe that fertiliser is profitable, they may be unable to purchase it if they lack cash and/or cannot obtain credit. In agricultural households, the main sources of cash include earnings from salary/wage employment, sell of livestock, and trade. Besides, farm-household size and composition –which has close links with labour supply as well as the income status of the household head, has both positive and negative implications on adoption of inputs. In case of labour intensive inputs such as production and use of organic fertiliser, availability of labour with minimum knowledge can encourage its use even in poor households. On the other hand, if large households are disproportionately poor, then lower use of relatively expensive inputs such inorganic fertiliser is expected in households with large families. As such, the effect of family size and composition on agricultural technology adoption is not clear in adoption literature –as both positive and negative relationships have been reported (Oluoch-Kosura *et al.,* 2001).

The role of credit in financing farmer investments in improved technologies, particularly in developing countries where smallholder farmers are generally financially constrained cannot be overstated. Whereas most studies report a positive relationship between access to credit and use of improved technologies (Feder *et al.,* 1985), a recent report by UBoS observes that access to credit in Uganda is a challenge (UBoS, 2010). An earlier study by Deininger and Okidi (2001) reported that capital constraints were a major obstacle to fertilizer use in Uganda.

Extension agents are some of the most important sources of agricultural information in many countries. Farmers' access to information on agricultural technologies through increased government investment in extension services is crucial in revealing the opportunities of using such technologies, thereby reducing the subjective uncertainty on one hand and fostering increased adoption on the other (Strauss *et al.,* 1991; Lanyintuo and Mekuria, 2005). Indeed, a number of studies (Feder and Slade, 1984; Igodan *et al.,* 1988; Strauss *et al.,* 1991; Deininger and Okidi, 2001; and Akromov, 2009), report a positive relationship between extension services access and use of improved technologies in general and fertilizer in particular. Nonetheless, the provision of extension services in Uganda is dominated by men who have little or no gender-aware training (Opio, 2003).

Availability of and easy access to infrastructures such as roads, storage and irrigation facilities are critical in agricultural production processes. Roads, for example, ease access to inputs and outputs markets; while storage facilities help to maintain the quality of harvested crops and postpone immediate sale. A number of studies including Jansen et al. (1990) and Ransom et al. (2003) reported that availability of and access to such infrastructure increases the likelihood of use of improved technologies. In Bangladeshi, Ahmed and Hossain, (1990) found that improved rural infrastructure tremendously increased the intensity of use of modern agricultural technologies including fertiliser, high yielding varieties and irrigation, in villages with developed infrastructure than in underdeveloped villages.

According to Morris et al. (2007), factors that influence the intensity of fertiliser use depend on farmers' perceptions of the potential profitability of fertiliser use –which in turn depend on the characteristics of the input, including productivity of (crop response to) fertiliser as well as the perceptions that farmers may hold against fertiliser. Vanlauwe and Giller (2006), for example, catalogue several myths surrounding soil nutrient balances, and organic and inorganic fertilisers use in SSA, which the authors note that potentially limits soil fertility management if not adequately demystified.

From the foregoing literature, it is clear that both economic and non-economic factors influence farm-household decisions either positively or negatively with regard to use of fertiliser. The question pertinent to this study therefore is: which among these factors have a strong bearing on the likelihood of farmers in Uganda to use organic and inorganic fertilisers.

3. DATA AND METHODS

3.1 Data

The paper draws on UCA 2008/9 data to achieve the set objectives. The Census was conducted by UBoS from September 2008 to August 2009, in all the 80 districts that existed in the country in July 2007 –which was the planning time of the survey (UBoS, 2008). Data were collected on three modules, namely: (i) The Agricultural Household and Holding Characteristics Module; which was used to collect data on the demographic characteristics of household members as well as structural type of data on the agricultural holding; (ii) Crop area module captured information on holding parcel and crop plot areas; and (iii) Crop Production Module; which collected data on crop production. Households were visited twice during the survey period (UBoS, 2008).

According to the UCA 2008/9 technical report[2], data was collected through a sampling scheme of 3,606 Enumeration Areas (EAs) and 10 agricultural households in each selected EA. In total, 31,340 agricultural households were sampled. However, the analysis is restricted to 29,355 households that had non-missing information on whether they applied fertilisers or used improved seeds. A quick exploratory data analysis of the variables used in this study revealed some missing data. In survey data, missing data is a common problem because some respondents do not answer certain questions (Carson *et al.,* 1995). In the case of UCA, 2008/9 data, the proportion of respondents with missing data on the variables of interest in this study ranged from 1 - 21 percent non-response rate (see lower section of Appendix 1).

Missing data are a potential source of bias in the analysis, especially if the variable with missing data is essential in the results outcome (EMEA, 2001). Suggestions to deal with key data items missing in the analysis are provided in the literature. One suggestion is to drop respondents with missing in the analysis and adjust the weighting process, while the other is to impute or substitute a valid response for the missing value (Carson *et al.,* 1995). Engels and Diehr (2003) and Kalton (1995) provide thorough discussions of approaches for imputation of missing values in longitudinal data and cross-sectional survey data, respectively, including deterministic (e.g. mean, median or modal values) and stochastic (e.g. random regressions) approaches. Of all the approaches, none is a gold standard, though deterministic approaches are rather common. Given that missing data in some of the variables in this paper were fairly high, median values were calculated (see lower section of Appendix 1) and substituted for missing data.

[2] Further details regarding the technical report are available online at http://www.ubos.org/nada3/index.php/ddibrowser/22

3.2 Model specification

A farmer *i* can choose either to use or not to use fertilisers in crop production. This leads to a binary outcome, y_i, which can be written as in equation (1).

$$y_i = \begin{cases} 1 & if\ farmer\ uses\ fertiliser \\ 0 & otherwise \end{cases} \quad (1)$$

Choice -either or not to use fertiliser depends on both economic and non-economic factors (x). In econometrics, outcomes which are binary are analysed using Binary Choice Models (BCM) (Greene, 1993).

In BCM, interest is to estimate the conditional probability, $P(y_i=1|x_i)$, which in this paper case is the probability that farmer *i* uses fertiliser ($y_i = 1$) given x_i, the economic and non-economic factors under which the farmer operates. This can be stated as in equation (2).

$$P(y_i = 1|x_i) = F(x_i) \quad (2)$$

F(.) is the functional form –which can be linear (e.g. Linear Probability Model) or non-linear (e.g. Probit or Log it Models). Equation (2) can be expressed as regression model as in (3).

$$y_i = x_i'\beta + \varepsilon_i \quad (3)$$

The right-hand of Equation (3) has two parts: $x'\beta$, the part which is explained by observable explanatory variables, x_i, β being the unknown parameters to be estimated; and ε_i the stochastic error term that is unobservable in statistical analysis but affects the decisions of the farmer. Following the literature, we disaggregate the explanatory variable, *x*, into economic (x_{1i}) and non-economic factors (x_{2i}) as in equation (4).

$$y_i = \beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + \varepsilon_i \quad (4)$$

3.3. Description of variables

3.3.1 Dependent variable

The dependent variable is whether or not a household used fertilisers (organic and/or inorganic) during the last 12 months prior to interview. Summary statistics of these variables, provided in Appendix 1, indicate that about 26 percent of households reported using organic fertilisers while 8 percent reported using inorganic fertilisers. However, these variables could not be used to provide insights on intensity of usage. Lack of information on the quantity of fertilisers applied limit our ability to provide policy guidance on what government needs to do to increase application of fertilisers as per the recommended rates or the commitments made in Abuja declaration.

3.3.2 Explanatory variables

i) Economic factors (x_{1i})

Ideally, economic variables to be included in this study would comprise price, cost and quantities of inputs/outputs. Nonetheless, these were not captured in the UCA 2008/9. Instead, we include price-like factors including distance to local farm-input shops, distance to extension services, distance to local produce market, distance to district produce market, and distance to feeder and all-year gravel roads as proxies for cost of inputs and price/value of outputs. These factors can also be regarded as market access variables. Households who are more distant from these facilities are hypothesized to less likely use fertilisers. Descriptive statistics of these variables are also provided in Appendix 1.

ii) Non-economic factors (x_{2i})

Non-economic variables included in this paper are: household characteristics, production support services and location (regional) factors. Household characteristics include those of the head of the household in terms of age, sex, marital status, and education attainment and whether they are literate or not. Other variables included: household size and share of adult members in total household size, share of adults in the household and ownership of livestock/ poultry. Our hypothesis is that household heads that are literate, with more years of education, and/or own livestock/poultry are more likely to use fertilisers - both organic and inorganic.

Production support factors included are: access to extension services, access to credit, ownership of storage facility, ownership of irrigation facility. It is hypothesised that households who access/own of these services/facilities are more likely to apply fertilisers. Regional dummies are included to account for differences that might arise due to geography, soil types, crop patterns, culture, and socio-economic status. The units of measurement and summary statistics of these variables are presented in Appendix 1.

3.4 Model estimation

In this paper, the BCM used in the analysis is the probit model, which is estimated by the maximum likelihood method. The estimated coefficients of the regression can be reported either as odd ratios or marginal effects. Marginal effect values –which give the percentage change in the probability of fertiliser use for each unit change in the value of the corresponding explanatory variable, are reported.

Explanatory variables with continuous values were transformed into natural logarithms to make the data normally distributed and/or their variances homogenous (McDonald, 2009). In particular, values of the following variables: years of education, distance to farm inputs shop, distance to local produce market, distance to district produce market, distance to feeder road, distance all-year gravel road, and distance to extension service provider, were transformed into natural logarithms. The square of the household head age variable was included in the model as an additional variable to account for the likely effects of ageing on technology adoption –which according to the life-cycle hypothesis is that as people advance in age -from middle to old age, they spend more on consumption than investment in production (Feinstein and Thomas, 2004).

4. RESULTS AND DISCUSSIONS

This section presents and discusses results from the descriptive and econometrics analyses.

4.1 Descriptive statistics

It is evident from Table 1 that a greater share of agricultural households used improved seeds (32 percent) compared to organic and/or inorganic fertilisers. More notably, the share of agricultural households that used organic fertilisers are nearly three-fold those that used inorganic fertilisers. In other words, the agricultural households seem to rely more on organic than inorganic fertilisers. The proportion of those households that used all the three technologies stood at 3.4 percent; and those that used both organic and inorganic fertilisers at 4.6 percent.

The national pattern of technologies use mirrors itself spatially as illustrated in Table 1. The northern region emerges with the lowest percentage of households using either organic or inorganic fertilisers. The Eastern region leads with the highest percentage of households that used improved seeds. And there are significant differences within the sub-region – with the Eastern sub-region recording a higher share (47.6 percent) relative to their counterparts in Eastern Central region (42.4 percent). More households residing in the Central and Western region used organic fertilisers relative to their counterparts in other regions. In particular, households in the districts of Bushenyi, Kabale, Kisoro and Kanungu used organic fertiliser most (Appendix 2). As with improved seeds, there are significant variations within the region.

Table 1 : Agricultural households' incidence of technologies use, %

		Fertiliser	
	Improved seeds	Organic	Inorganic
Uganda	32.0	25.5	8.3
Central region	**32.0**	**34.2**	**11.7**
Kampala	32.3	23.0	5.5
Central 1	33.0	41.5	14.7
Central 2	31.0	27.6	9.2
Eastern region	**45.7**	**21.9**	**10.4**
East Central	42.4	15.4	5.2
Eastern	47.6	25.9	13.6
Northern region	**31.7**	**9.6**	**4.4**
Mid-North	32.9	6.7	3.6
North East	26.2	2.1	2.0
West Nile	31.4	16.0	6.2
Western region	**18.2**	**33.9**	**6.5**
Mid-West	19.0	15.9	5.9
South-Western	17.5	49.0	7.1

Source: Author's calculations based on UCA 2008/9.

Considering inorganic fertilisers, more households residing in the Central and Eastern region applied inorganic fertiliser compared to the national average. The reverse is observed for those households in Western or Northern region. The higher proportion of households using organic fertilisers in south west sub-region could be related to intensive livestock systems. Within the Eastern region, higher proportion of households using inorganic fertiliser is largely driven by the districts of Kapochorwa, Bukwo, Sironko and Bududa (Appendix 2), all situated in Mt. Elgon highlands.

Comparing the characteristics of those households that used with those that did not use improved technologies, it is evident from Table 2 that the former were headed by better educated and literate head; male heads and households with larger families. On the other hand, on average, those that did not use improved seeds were headed by an older household head. The reverse is observed for use of organic fertilisers. No major differences in age observed with regard to use of inorganic fertiliser. It is further noted that households that used inorganic fertiliser had a higher proportion of adults relative to their counterpart that did not use inorganic fertiliser. There are no observed differences with regard to use of either improved seeds or organic fertilisers.

Table 2: Household head characteristics (mean) by technology and status of use

	Improved seed		Organic fertilizer		Inorganic	
	Users	Non-users	Users	Non-users	Users	Non-users
Age (years)	44.2	45.2	45.8	44.6	44.7	44.9
Years of schooling	6.1	4.8	5.7	5.0	6.3	5.1
Literacy rate	75.5	64.7	75.3	65.7	77.6	67.2
Male headed	83.5	77.0	80.2	78.6	84.6	78.5
Household size	5.9	5.2	5.7	5.3	5.9	5.3
Share of adults in household (15-59 years)	46.5	46.1	46.1	46.3	48.5	46.1

Source: Author's calculations based on UCA 2008/9.

Table 3 reveals that, overall, 19 percent of farm households reported access to extension services. The corresponding estimate for access to credit was about 10 percent and only 1 percent had irrigation facilities. Furthermore, more than half of the households had storage facilities and about 69 percent reared livestock/poultry. With regard agricultural technology use and access to complementary services/facilities, it is clear in Table 3 that households that reported greater access to these complementary services/facilities were those that used agricultural technologies regardless of type.

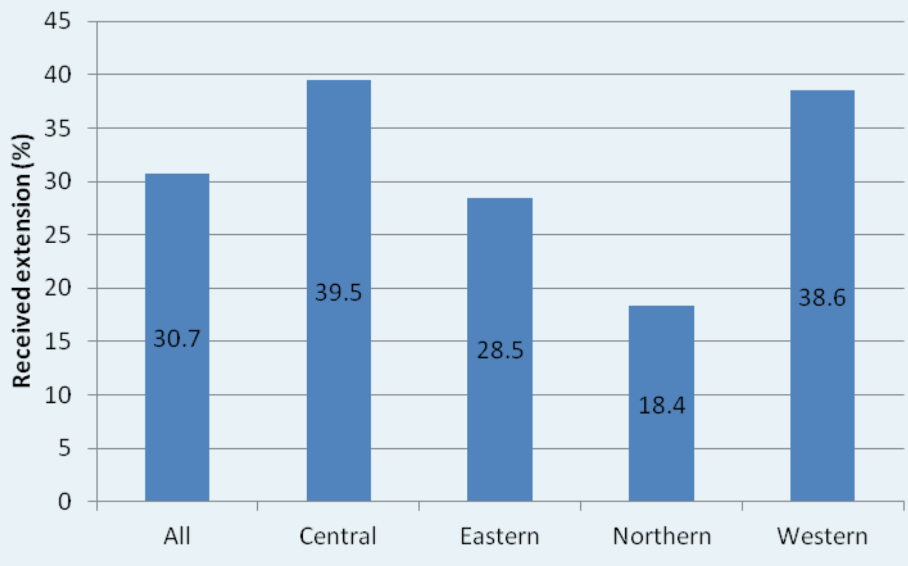
Table 3: Households access/use to other inputs by technology use, %

	Extension services access		Credit access		Has storage facilities		Has irrigation		Has Livestock/ poultry	
Technology	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Improved seed	27.4	15.1	13.7	8.7	64.6	52.3	1.8	0.6	79.4	64.9
Organic	26.4	16.5	15.8	8.4	60.7	54.7	1.9	0.6	77.8	66.7
Inorganic	28.3	18.2	18.8	9.5	60.7	55.8	3.6	0.7	80.9	68.5
All	19		10.3		56.3		1		69.5	

Source: Author's calculations based on UCA 2008/9.

Of the households that reported access to agricultural extension services, 30.7 percent received information on the use of organic/inorganic fertilisers. And this varies across regions (Figure 1). For instance, the share of households residing in Western and Central regions that received such information was higher than the national average. The reverse was observed for those households in Northern region (see Figure 1).

Figure 1: Share of households that received extension services on fertiliser use, %



Source: Author's calculations based on UCA 2008/9.

Taking sex into consideration, we found that there were more men than women using fertilisers (Table 4). Results in Table 4 also indicate remarkable differences - in favour of households that had access to extension services and/or credit, had irrigation facilities and/or storage, with regard to use of improved technologies. For example, the proportion of farmers who received credit and also used inorganic fertilisers (15.8 percent) was twice that of farmers who used inorganic fertiliser though did not access credit (7.7 percent). This suggests that credit eases the cash constraints and so enables farmers to afford fertilisers. Fertilisers were mostly used by farmers who owned livestock than those who do not own livestock. People who own livestock in Uganda are likely to be wealthier compared to those without (MoFPED, 2004). This is because livestock is an asset that can be used to generate income and thus aid farmers to purchase fertilisers. Also, livestock waste (dung and urine) is an important source of organic fertilisers. The incidence of fertiliser use among farmers with irrigation facilities (31 percent) was higher than the proportion of fertiliser users without access to irrigation facilities (8.3 percent).

Table 4: Agricultural households use of technologies by key characteristics, %

		Proportion (%) using technologies		
		Improved seed	organic	inorganic
Sex	Female	25.3	24.0	6.0
	Male	34.7	26.5	9.2
Access to extension services	No	29.4	23.6	7.6
	Yes	46.9	35.8	12.6
Access to credit	No	31.5	24.3	7.7
	Yes	43.5	40.1	15.8
Has storage facilities	No	26.5	23.3	7.7
	Yes	37.6	28.0	9.2
Has irrigation	No	32.5	25.7	8.3
	Yes	59.6	50.3	31.0
Has Livestock/poultry	No	22.5	19.0	5.4
	Yes	37.3	29.0	9.9

Source: Author's calculations based on UCA 2008/9

It is evident from Table 5 that the most important source of improved seeds was markets regardless of region. However, government and related associations as most important source are predominant in the northern region relative to other regions. This could be attributed to the fact that government has rolled out a number development programmes including the Northern Uganda Social Action Fund (NUSAF) and Peace Recovery and Development Plan (PRDP) for Northern Uganda, which among other things provide agriculture-related support to people in the war-ravaged Northern Uganda. Besides, there are about 500 Non-government organizations (NGOs) operating in the North[3] –all targeting people in the area with various

[3] Details of NGOs in Northern Uganda can obtained from the Office of the Prime Minister, or from http://www.crusadewatch.org; http://www.csopnu.net/

types of support including agricultural production inputs. While most households reportedly obtained organic fertiliser from their own sources, those who applied inorganic fertilisers depended largely on markets.

Table 5: Household response on most important source of agricultural technologies, %

	N	Central	Eastern	Northern	Western	All
Improved seeds	9405					
Own		3.7	5.9	2.8	6.1	4.9
Markets		76.0	79.8	61.6	72.9	74.3
Cooperatives		4.4	1.9	2.6	3.8	2.9
Government		7.2	3.9	12.1	4.8	6.3
Related associations		5.2	5.4	18.2	8.2	8.3
NGOs		3.5	3.2	2.7	4.2	3.3
Organic fertiliser	7207					
Own		83.8	75.1	72.2	88.5	82.6
Markets		11.9	19.3	10.1	6.5	11.6
Cooperatives		1.1	1.4	7.0	0.7	1.5
Government		1.1	1.5	2.7	0.5	1.1
Related associations		0.4	1.5	6.6	2.3	1.9
NGOs		1.7	1.1	1.5	1.5	1.5
Inorganic fertiliser	2528					
Own		42.0	27.9	35.2	29.8	33.0
Markets		47.8	55.2	28.6	31.0	44.6
Cooperatives		1.6	2.9	12.5	10.9	5.4
Government		3.5	5.3	3.8	2.1	3.9
Related associations		1.4	2.1	18.4	22.2	8.3
NGOs		3.8	6.7	1.4	3.9	4.7

Source: Author's calculations based on UCA 2008/9

Turning to reasons for non-use of agricultural technologies some observations do emerge. The most frequently (50 percent) cited reason for not using inorganic fertilisers was that they are too expensive. Other farmers were not using fertilisers because they lacked knowledge about them (25 percent); lacked access to fertilisers (14.1 percent); while others perceived fertilisers as being useless (9.5 percent). Similar patterns are observed for the non-use of improved seeds. Notably is the higher percentage of households that reported lack of information on organic fertiliser relative to inorganic fertilisers.

Table 6: Response on reasons for non-use of agricultural technologies, %

	Region					
	N	Central	Eastern	Northern	Western	All
Improved seeds	18440					
No knowledge		11.7	10.2	19.7	22.6	16.9
Too expensive		65.4	77.2	54.5	47.0	59.4
Not available		12.4	7.8	21.6	21.3	16.3
Cannot see usefulness		8.8	3.8	3.4	7.2	6.0
Others		1.7	0.9	0.9	2.0	1.5
Organic fertilisers	25118					
No knowledge		27.3	38.1	39.1	36.3	36.0
Too expensive		32.8	36.8	33.5	29.8	33.5
Not available		26.0	15.5	18.5	22.2	19.8
Cannot see usefulness		12.2	8.4	7.9	10.4	9.5
Others		1.6	1.1	1.1	1.3	1.2
Inorganic fertilisers	20525					
No knowledge		17.6	25.8	32.4	24.1	25.0
Too expensive		57.3	54.7	41.1	47.3	50.2
Not available		11.0	11.6	17.4	16.2	14.1
Cannot see usefulness		12.7	7.1	8.3	10.6	9.5
Others		1.4	0.8	0.8	1.8	1.2

Source: Author's calculations based on UCA 2008/9.

4.2 Econometric results

This section presents the results based on econometric analyses. It augments the descriptive analysis by providing more insights about the key binding constraints to fertiliser use in Uganda. Results of the probit regression models are presented in Table 7. The Wald Chi-square statistics suggest overall that the models were statistically significant at 1 percent level. Predicted probabilities for agricultural households using organic and inorganic fertilisers were 23.8 and 7.2 percent, respectively –which was close to that observed in the descriptive statistics in Appendix 1

Table 7: Probit model estimates of determinants of use of organic and inorganic fertilisers

	Organic fertiliser use		Inorganic fertiliser use	
Explanatory variables	marginal effect	(z)	marginal effect	(z)
Household/head characteristics				
Age	0.004***	(2.97)	0.000	(0.39)
Age squared	0.000**	(-2.06)	0.000	(0.15)
Sex (male=1)	-0.031***	(-2.52)	0.014**	(2.01)
Marital status (***ref: never married):***				
Married	0.046***	(2.58)	-0.004	(-0.39)
Separated/widow/divorced	0.015	(0.75)	-0.003	(-0.24)
Log years of education	0.014*	(1.82)	0.019***	(4.42)
Literate (=1)	0.038***	(2.98)	-0.002	(-0.26)
Share of adults in household	0.052***	(3.18)	0.055***	(6.15)
Household size	0.005***	(3.44)	0.004***	(4.55)
Institutional/market access factors				
Access extension services (=1)	0.092***	(6.62)	0.028***	(3.41)
Access credit (=1)	0.070***	(3.92)	0.046***	(5.57)
Has storage (=1)	0.042***	(3.6)	0.001	(0.21)
Has irrigation facility (=1)	0.186***	(4.15)	0.161***	(5.66)
Has livestock/poultry (=1)	0.081***	(7.2)	0.032***	(5.57)
Log. Distance :				
Local produce market	0.013	(1.34)	-0.006	(-1.11)
District produce market	-0.032***	(-3.2)	-0.003	(-0.57)
Local farm input shops	-0.014	(-1.44)	-0.002	(-0.5)
Extension services	0.000	(0.00)	-0.013***	-2.41
Feeder roads	-0.013	(-1.01)	0.006	(1.05)
All-year gravel road	-0.005	(-0.43)	-0.007	(-1.33)
Regional dummies (ref =Central)				
Eastern	-0.131***	(-6.66)	-0.017	(-1.48)
Northern	-0.229***	(-10.54)	-0.057***	(-5.37)
Western	-0.005	(-0.19)	-0.042***	(-4.41)
Number of observations (N)	28069		27995	
Wald chi square (23)	565.82***		396.63***	
Log pseudolikelihood	-14676.9		-7611.41	
Predicted probability	0.238		0.072	

Note:Log. implies natural logarithm of the variable. Z-statistics in parenthesis based on robust standard errors. ***, **, and * indicate statistical significance at 1, 5 and 10 percent level

Reference variables: never married, and Central Uganda

Source: Author's calculations based on UCA 2008/9.

Results in Table 7 generally mirror the descriptive statistics and confirm most of our hypotheses. While being literate is appears to be the necessary condition for farmers to adopt organic fertiliser, results suggest that the level of education matters most when it comes to adoption of inorganic fertiliser. Holding other factors constant, the likelihood for literate farmers to use organic fertilisers is 4 percent higher than for the illiterate while the prospects to use inorganic fertiliser are 2 percent higher for farmers with an additional year of education. The results are moreover statistically significant at 1 percent level. The likely reason for a higher proportion of more educated farmers using inorganic fertiliser is the fact that more educated people in Uganda have higher disposable income (UBoS, 2010), which makes it possible for them to purchase high-value inputs such as inorganic fertiliser. Besides, more educated farmers are more likely to use fertiliser due to their relatively advantaged position in terms of access to market information and technical advice on agricultural technologies (Langyintuo and Mekuria, 2005).Despite the importance of high education in adoption of inorganic fertiliser, the challenge though is that fewer farmers in Uganda –especially women (less than 30 percent) have attained at least secondary education (UBoS, 2010).

The most likely reason why being literate per se and not high education as such matters most in adoption of organic fertilisers, is the fact that on-farm production and use of organic manure -unlike inorganic fertiliser, requires just basic knowledge and not necessarily high level of education. Good to note though is that according to the UBoS (2010), literacy levels in Uganda (73 percent), particularly among rural women (69 percent) have improved remarkably over the past few years -since the introduction of Universal Primary Education (UPE) in 1997. Although household size is important in adoption of fertiliser, we note that the share of adults in the household –which is the source of labour, is critical. Taking other factors as constant, up-to 5 percent increase in the probability of farmer use of fertiliser both organic and inorganic can be attributed to a unit increase in the proportion of adults in the household. This finding supports literature (for example, Jehangir and Sampath, 1999; Palm et al*.,* 1997) that suggests the availability of labour as a precondition for adoption of bulky inputs such as fertiliser. This is true given the fact that fertiliser use, particularly organic manure production and application are labour intensive. Inorganic fertiliser application/placement at the base of plants rather than broadcasting/sowing, similarly, is labour-intensive.

Results indicate that age and age-squared have a significant influence on organic fertiliser use. That is, as farmers advance from youthful to middle age, they are more likely to adopt organic fertiliser, but with advanced age (age-squared), dis-adoption becomes likely. This may be due to the labour intensive requirement of organic fertiliser adoption – as most young and even much older farmers are generally disadvantaged - as they usually have a smaller share of adults in the household.

Turning to sex, the coefficient for inorganic fertiliser use is positive and significant ($p<0.05$), indicating that the likelihood of male farm household heads to use inorganic fertiliser is much higher compared to that of female farm household heads. This is expected as male farm household heads in Uganda have more access to extension services (Nayenga, 2008) -which are dominated by male extension workers (Opio, 2003).Beside, male household heads in Uganda on average have higher income than female household heads (UBoS, 2006; 2010). Results indicate that women have a significant ($p<0.01$) edge over men when it comes to organic fertiliser use – which is somewhat contrary to the descriptive result in Table 4. Nonetheless, it appears that the somewhat weaker position of women in Uganda in relation to financial resources and supportive extension services to use inorganic fertiliser might have led them to embrace organic fertiliser as the alternative.

Results reveal a strong relationship between access to extension services and/or credit and fertiliser use irrespective of type – which supports the descriptive statistics as well as various literatures (Feder and Slade, 1984; Igodan *et al.,* 1988; Strauss *et al.,* 1991; Akromov, 2009). A similar relationship is observed in relation to ownership of irrigation facility and/or livestock, and fertiliser use. Much as these complementary inputs in production are important in the decision of farmers to adopt fertiliser, the challenge is the availability of these inputs/services in the country. Extension services outreach in Uganda is low (19 percent) (see Appendix 1) and skewed to NAADS supported farmers. Credit on the other hand attracts high interest rates and hence mainly provided to non-agricultural enterprises that have a short gestation period, while use of irrigation in Uganda is in its infancy.

Although distance to factor input markets as well as output markets is observed to negatively influence fertiliser use, the long distances to access extension services –averaging 9km and district markets–averaging 20km, stand out as critical constraints. As with regions, a significantly lower use of organic fertiliser is noted in Eastern and Northern Uganda and lower use of inorganic fertiliser observed in Northern and Western Uganda, compared to Central Uganda, the reference region. Low population of livestock – a major source of manure, in Eastern and Northern Uganda compared to Central and Western regions may be a key constraint to intensive use of organic manures in those regions. Acceptability and practical application of organic manures on large-scale basis by local farmers in Uganda however remains a challenge – as many farmers practicing organic based systems take animal refuse to back-yard gardens as a means of disposal rather as a conscious method of soil nutrient management. Generally, farmers are reluctant to change from familiar methods of soil nutrient management to newer methods (Omotayo and Chukwuka, 2009).

5. CONCLUSIONS AND IMPLICATIONS FOR POLICY

Using the UCA 2008/9 data, this study investigated the factors that limit farmer use of organic and/or inorganic fertiliser in Uganda. Here we focus on the major findings. Results of the study indicate geographical differences in the proportion of farmers using fertilisers – in favour of Eastern Uganda (specifically Mt. Elgon highlands) for inorganic fertiliser and Western Uganda (specifically Kigezi highlands) for organic fertiliser. A relatively high proportion - compared to national average, of farmers using organic and/or inorganic fertiliser is observed in Central Uganda. The reverse is observed in Northern Uganda. Thus the on-going drafting of the National Fertiliser Policy and National Fertiliser Strategy should pay attention to this fact when designing strategies to promote the adoption of fertiliser in the country.

Lack of or inadequate access to extension services that provide technical advice is a major constraint to increased adoption of fertiliser in Uganda. Results show that less than one-third of agricultural households in the country received fertiliser-related extension advice and moreover the average distance to the nearest extension services provider was over 20 kilometres.

Owing to the fact that access to extension services increases not only the likelihood of fertiliser use but also the associated agricultural productivity, yet enormous resources are currently earmarked to the provision of free inputs to few beneficiaries under the NAADS program, we propose that these resources be reallocated to increase the coverage of extension services to as many farmers as possible country wide. Besides, the MAAIF should consider reviving and strengthening the original mandate of her extension services staff at the district.

The paper findings have demonstrated that there is a noticeable gender bias in fertiliser use. The households with female heads are less likely to use fertilisers relative to their male counterparts. The provision of extension services is dominated by male workers who focus their services mostly to fellow men as a result of lack of gender-sensitive training background. One way of addressing this challenge is to encourage agricultural training institutions to introduce/ integrate gender awareness training modules in the curriculum. Besides, government should deliberately target to train and deploy more female extension workers in the country.

Fertiliser use, access to credit and use of irrigation are closely linked – yet, farm-household access to these complementary services is low in Uganda. In Asia, Hazell (2009) observes that fertiliser, improved seed and irrigation supported with credit were the key components of the Green Revolution. Therefore, any successful intervention to promote fertiliser use in Uganda will have to be accompanied with complementary inputs and services – as a package.

While access to credit has a positive influence on fertiliser adoption, it is still expensive and inaccessible to most agricultural households. Government should reconsider and implement the President's 2011 election plan of providing these households with loans at low interest rates. In particular, government can spur fertiliser adoption by conditioning fertiliser purchase and use on access to affordable agricultural credit through Savings and Credit Co-operatives (SACCOS).

While few farmers in Uganda own/use irrigation facilities and yet fertiliser use is more effective with irrigation, for the past five years government has implemented water for production programme targeting mainly rehabilitation large-scale irrigation schemes at the expense of small-scale irrigation for smallholder farmers who produce most of the country's output and need farm-production water most. Thus we recommend that government should consider review the water for production programme with a view of putting more resources in low-cost small-scale irrigation systems and technical advice to smallholder farmers adopt irrigation farming on a sustainable basis.

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Appendix 1: Summary statistics of variables used in the analysis

Variables	Unit of measure	Mean	Std. Err.
Dependent variables			
Organic fertiliser use	Yes =1, No =0	0.26	0.01
Inorganic fertiliser use	Yes =1, No =0	0.08	0.00
Explanatory variables			
Household head age	Years	44.89	0.13
Sex of household head	Male=1, female=0	0.79	0.00
Marital status -Single	Yes =1, No =0	0.04	0.00
Marital status -married	Yes =1, No =0	0.74	0.00
Marital status –separated/divorced/widow	Yes =1, No =0	0.22	0.00
Household head years of education	Years	5.19	0.04
Household head literate	Yes =1, No =0	0.69	0.00
Share of adult in household	Ratio = adults(=>18 years)/ household size	0.47	0.00
House hold size	Number	5.41	0.03
Household keeps livestock/poultry	Yes =1, No =0	0.70	0.01
Household head access to extension services	Yes =1, No =0	0.19	0.01
Household head access to credit	Yes =1, No =0	0.10	0.00
Household has storage facility	Yes =1, No =0	0.56	0.01
Household has irrigation equipment	Yes =1, No =0	0.01	0.00
Distance to local produce market	Kilometres	5.21	0.16
Distance to district produce market	Kilometres	20.03	0.36
Distance to local farm input shops	Kilometres	7.84	0.23
Distance to extension services	Kilometres	8.80	0.23
Distance to feeder roads	Kilometres	2.55	0.08
Distance to All-year gravel road	Kilometres	4.19	0.16
Household in Central region	Yes =1, No =0	0.20	0.01
Household in Eastern region	Yes =1, No =0	0.30	0.01
Household in Northern region	Yes =1, No =0	0.20	0.01
Household in Western region	Yes =1, No =0	0.29	0.01
Missing value- variables (proportion observed and median value			
Variable	**Missing value**	**proportion**	**Median**
Household head age (years)	Yes =1, No =0	0.02	42.32
Marital status (either single, married, or separated/divorced/widow	Yes =1, No =0	0.06	0.5
Household head years of education (years)	Yes =1, No =0	0.01	6
Distance to local produce market (kilometres)	Yes =1, No =0	0.06	3
Distance to district produce market (kilometres)	Yes =1, No =0	0.17	15
Distance to local farm input shops (kilometres)	Yes =1, No =0	0.13	5
Distance to extension services (kilometres)	Yes =1, No =0	0.21	6
Distance to feeder roads (kilometres)	Yes =1, No =0	0.13	1
Distance to All-year gravel road (kilometres)	Yes =1, No =0	0.21	2

Source: Author's calculations based on UCA 2008/9

Appendix 2: Agricultural households' incidence of technologies use by district, %

Region	District	Improved seed		Organic fertiliser		Inorganic fertiliser	
		freq.	CV	freq.	CV	freq.	CV
Central	Kalangala	15.5	20.6	44.9	31.8	12.1	54.1
	Kampala	32.3	29.8	23.0	32.6	5.5	68.8
	Kiboga	27.3	15.6	13.5	22.7	4.3	39.7
	Luwero	45.7	7.0	28.3	13.9	6.9	35.0
	Masaka	31.4	11.9	43.9	11.3	18.7	20.6
	Mpigi	37.3	8.1	53.0	8.7	23.1	18.7
	Mubende	19.5	22.5	36.1	12.7	10.1	25.5
	Mukono	37.7	8.4	33.0	11.1	12.8	11.5
	Nakasangola	39.5	40.4	2.3	65.3	3.3	54.3
	Rakai	15.4	26.2	26.6	22.9	8.5	26.1
	Sembabule	44.7	13.4	45.0	16.6	20.2	25.7
	Kayunga	23.4	9.8	13.6	15.9	4.1	45.9
	Wakiso	42.2	11.8	41.6	12.9	7.5	28.1
	Lyantonde	20.9	25.3	21.9	12.5	3.9	31.1
	Mityana	29.7	12.6	36.4	12.7	10.2	25.7
	Nakaseke	34.8	14.5	28.4	20.1	16.1	27.2
Eastern	Bugiri	40.4	9.3	9.5	42.8	2.2	39.7
	Busia	39.2	9.1	22.2	8.9	11.0	28.4
	Iganga	49.3	6.4	17.1	5.7	5.1	31.0
	Jinja	42.7	7.2	22.9	15.0	17.8	37.6
	Kamuli	43.8	9.6	9.0	12.1	1.6	23.6
	Kapchorwa	80.1	4.1	60.3	7.1	47.1	12.1
	Katakwi	61.7	11.4	30.6	17.4	0.3	100.3
	Kumi	24.4	8.0	13.4	9.1	7.8	36.0
	Mbale	57.6	9.3	28.1	18.9	17.0	20.2
	Pallisa	26.0	11.9	7.9	5.9	5.2	19.0
	Soroti	50.4	13.8	22.4	27.4	2.2	46.5
	Tororo	47.6	8.8	16.9	33.4	4.5	39.6
	Kaberamaido	24.7	19.4	0.9	65.7	0.0	
	Mayuge	40.8	11.3	22.5	14.5	4.1	31.8
	Sironko	52.7	6.9	34.6	13.6	36.7	15.4
	Amuria	46.1	9.3	25.0	14.7	1.1	54.7
	Budaka	40.7	16.7	21.6	34.0	11.5	46.0
	Bududa	54.7	9.2	55.7	7.9	38.4	14.5
	Bukedea	19.7	11.0	20.6	12.1	0.7	36.9
	Bukwo	96.3	0.9	51.5	4.2	47.4	8.8
	Butaleja	39.3	14.8	22.2	34.9	7.2	25.8
	Kaliro	33.6	17.3	11.1	14.1	2.1	42.5
	Manafwa	75.1	2.0	51.0	11.4	28.0	12.0
	Namutumba	31.6	16.1	27.0	23.3	10.9	26.0

Region	District	Improved seed		Organic fertiliser		Inorganic fertiliser	
		freq.	CV	freq.	CV	freq.	CV
Northern	Adjumani	27.5	11.3	9.2	28.9	2.0	75.2
	Apac	30.1	7.9	15.7	31.5	4.2	30.5
	Arua	42.7	11.7	26.5	15.6	8.7	29.5
	Gulu	27.7	20.2	4.6	39.9	10.5	30.0
	Kitgum	19.6	21.5	0.8	75.9	0.3	102.3
	Kotido	44.9	41.4	0.0		0.0	
	Lira	36.9	10.8	2.0	27.5	4.9	63.4
	Moroto	6.9	45.0	0.0		0.0	
	Moyo	25.2	12.0	7.2	21.6	10.3	53.8
	Nebbi	30.9	16.3	8.3	21.5	5.7	30.7
	Nakapiripirit	14.3	28.7	1.2	73.1	1.2	73.1
	Pader	27.7	30.6	12.9	38.5	1.1	72.4
	Yumbe	24.6	22.9	16.5	21.8	1.6	36.3
	Abim	45.0	37.7	1.1	99.5	0.0	
	Amolatar	15.3	20.8	3.3	25.6	1.8	27.9
	Amuru	22.9	26.3	8.7	34.5	4.8	48.9
	Dokolo	58.6	7.9	12.3	25.6	0.3	86.5
	Kaabongo	43.1	22.3	17.1	43.2	18.1	38.2
	Koboko	36.0	17.2	17.7	65.6	10.6	68.8
	Maracha	23.4	15.2	24.2	21.8	6.5	25.3
	Oyam	44.5	10.0	4.4	39.3	1.1	72.0
Western	Bundibugyo	7.5	48.9	5.0	50.1	2.9	58.2
	Bushenyi	14.7	29.0	72.2	6.7	5.3	36.6
	Hoima	38.1	17.9	40.1	13.0	21.6	13.8
	Kabale	34.6	8.8	64.5	4.4	11.2	28.2
	Kabarole	20.7	18.4	13.2	27.9	7.7	42.2
	Kasese	11.7	19.8	16.8	30.1	2.5	51.1
	Kibaale	24.3	6.4	14.6	15.7	3.5	17.9
	Kisoro	19.5	12.8	68.5	3.9	16.1	29.4
	Masindi	29.3	14.2	7.5	19.6	7.1	24.2
	Mbarara	5.6	28.7	45.7	16.4	1.1	56.2
	Ntugamo	6.2	50.1	18.2	16.1	2.2	45.0
	Rukungiri	26.7	15.5	50.8	14.5	11.2	22.8
	Kamwenge	6.8	12.7	7.5	21.8	1.7	42.7
	Kanungu	32.3	5.4	57.3	12.1	7.8	26.2
	Kyenjojo	14.8	15.2	17.9	12.4	3.1	20.8
	Buliisa	4.2	34.0	2.8	55.8	1.1	102.5
	Ibanda	11.2	12.3	36.2	8.1	5.1	33.4
	Isingiro	9.9	41.7	21.6	18.8	6.9	40.4
	Kiruhura	7.5	40.5	18.5	18.4	1.8	97.3

Note: the coefficient of variation (CV) expressed in % is included to measure the relative size of the errors

Source: Author's calculations based on UCA 2008/9

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